Narodowe Centrum Badań Jądrowych
National Centre for Nuclear Research
Świerk

Annual Report 2014

NARODOWE CENTRUM BADAŃ JĄDROWYCH

NATIONAL CENTRE FOR NUCLEAR RESEARCH

ANNUAL REPORT
2014

PL-05-400 Otwock-Świerk, POLAND
tel.: 048 22 273 10 01
fax: 048 22 779 34 81
e-mail: ncbj@ncbj.gov.pl
http://www.ncbj.gov.pl

Editors:

N. Keeley
K. Kurek

Cover design:
S. Mirski

Secretarial work and layout:
G. Swiboda

ISSN 2299-2960

CONTENTS

FOREWORD

During 2014 NCBJ was stable with regard to its size and income, while effort was devoted to improving the quality of our research. The number of papers published in refereed journals increased to 541 and the number of citations reached 8000 this year. The corresponding Hirsch index increased to 115, giving NCBJ the 5th position in Poland among all institutes and universities.

The number of habilitations awarded by the NCBJ Research Council hit the record number of 7, including 5 NCBJ employees. We gained one more professor - Zygmunt Patyk who received the title from the President of Poland. On the other hand, three completed PhD theses is not an impressive number, but in addition to new hires from universities it is enough to renew the scientific staff of the institute.

The youngest part of the institute is the newly built Computing Centre Świerk (Polish acronym CIŚ). Calculation on this largest supercomputer in Poland was officially started by prof. Lena Kolarska-Bobińska, Minister of Science and Higher Education, on 13.11.2014. The machine is currently used mainly for basic research in particle physics, analyzing petabytes of data from the Large Hadron Collider at CERN. The main purpose of the creation of the Centre was to prepare NCBJ for the role of Technical Support Organization for the Polish nuclear power programme.

Young specialists from CIŚ and the Department of Nuclear Energy represented NCBJ at the World Nuclear Exhibition in Paris. Our institute was the only exhibitor from Poland at this global event, attracting many visitors curious about Polish plans for nuclear power. One of our important contributions to this programme is the International School on Nuclear Power. Every year a number of nuclear experts from all over the world give lectures and conduct practical exercises at the NCBJ main site and at the nuclear waste repository in Różan.

Last year NCBJ organized several important international conferences and workshops. In the field of nuclear power we hosted the 7th International Symposium on Materials Testing for Reactors and the EURADOS Working Group 7 “Internal dosimetry” meeting. In basic research the most important event was DIS2014 – the XXII International Workshop on Deep-Inelastic Scattering and Related Subjects, organized jointly with the Warsaw University Faculty of Physics. Another joint event – Theory Meeting Experiment, this year devoted to Neutrinos and the Cosmos, firmly established its position among the most important European events in this field. The 12th International School and Symposium on Synchrotron Radiation in Natural Science also brought worldwide specialists in free-electron lasers – the most advanced research devices of today’s science.

NCBJ continued its contribution to the largest free-electron laser in Europe – the 3.5 km long XFEL in Hamburg. Higher-Order-Mode-Absorbers and components of Low-Level-Radio-Frequency systems are now being installed in the XFEL tunnel. In 2014 we finished installation of several components of the W7-X stellarator in Greifswald – the largest nuclear fusion device before the launch of the famous ITER. We also continued production of PIMS – Pi-Mode accelerating structures – to inject protons into the CERN LHC. Last, but not least, our specialists participated in the assembly of SOLARIS, the first Polish synchrotron, in Cracow.

Participation in the construction of the largest and most advanced research devices is not only a scientific investment, but also a very effective means of technology transfer. The most modern technologies, often developed especially to meet the extreme challenges of frontier scientific experiments, are later implemented in commercial products by NCBJ and Polish companies cooperating with our institute. This was recently recognized by several prestigious awards given to NCBJ. The “Perl of Innovation” was awarded during a ceremony in the Royal Castle of Warsaw, while the “Polish Innovation Award” was given at the Congress of Polish Commerce in Katowice.

The “Polish Product of the Future” is another award granted to the NCBJ Radioisotope Centre POLATOM for their innovative products Itrapol and Lutapol. These are precursors for radiopharmaceuticals based on yttrium ^{90}Y and lutetium ^{177}Lu isotopes. Lutapol was the first ^{177}Lu based product in the world registered for medical use. The very strong market position and presence in 80 countries of NCBJ POLATOM has been gained thanks to continuous investment in research. In 2014 a new laboratory was launched for preclinical tests of radioisotope treatments on small animals. New ambitious project are being prepared and we hope to launch them in 2015.

Radioisotope production at NCBJ is possible thanks to the MARIA nuclear reactor. It is the 4th most powerful reactor in Europe, and it produces radioisotopes for two million patients a year. Many distinguished guests attended the 40th anniversary of MARIA. They underlined the role of the reactor for research and medical applications. Indeed, we have new ambitious plans for experiments using MARIA. Both vertical and horizontal channels are full of neutrons, which we plan to use for reactor experiments, materials research and medical studies. Therefore, the 40-years old MARIA is more and more attractive. Happy birthday MARIA!

Professor Grzegorz Wrochna
Director
National Centre for Nuclear Research

[1]SCImago Institutions Rankings – http://www.scimagoir.com/index.php

GENERAL INFORMATION

1. LOCATIONS

Main site:	Warsaw site:	Łódź site:
30 km SE from Warsaw	(divisions BP1, BP2, BP3)	(division BP4)
Świerk,	69 Hoża street	5 Uniwersytecka street
05-400 Otwock	00-681 Warsaw	90-950 Łódź

2. MANAGEMENT OF THE INSTITUTE

Director	Professor Grzegorz WROCHNA phone: +48 22 2731001, +48 22 2731583 +48 22 5532254 e-mail: Grzegorz.Wrochna@ncbj.gov.pl
Deputy Director, Science	Professor Ewa RONDIO phone: +48 22 2731585, +48 22 5532375 e-mail: Ewa.Rondio@ncbj.gov.pl
Deputy Director, Research Infrastructure	Professor Krzysztof WIETESKA phone: +48 22 2731474 e-mail: Krzysztof.Wieteska@ncbj.gov.pl
Deputy Director for Economy and Development	Zbigniew GOŁĘBIEWSKI, MSc Eng phone: +48 22 2731582 e-mail: Zbigniew.Golebiewski@ncbj.gov.pl
Deputy Director for Administrative and Technical Affairs	Marek JUSZCZYK, MSc phone: +48 22 2731614 e-mail: Marek.Juszczyk@ncbj.gov.pl
Deputy Director For Nuclear Safety and Radiation Protection	Jerzy KOZIEŁ, MSc Eng (till 30.06.2014) Adam HRYCZUK, MSc Eng (from 1.07.2014) phone: +48 22 2731333, +48 22 2731045 e-mail: adam.hryczuk@ncbj.gov.pl
Scientific Secretary	Assoc. Prof. Krzysztof KUREK phone: +48 22 5532239, +48 22 2731581 e-mail: Krzysztof.Kurek@ncbj.gov.pl
Spokesman	Marek SIECZKOWSKI, MSc Eng phone: 512 583 695 e-mail: marek.sieczkowski@ncbj.gov.pl

3. SCIENTIFIC COUNCIL

The Scientific Council was elected on 1 July 2011 by the scientific, technical and administrative staff of the Institute. As a result of merging The Andrzej Sołtan Institute for Nuclear Studies and The Institute of Atomic Energy a supplementary election was conducted on 23 September 2011.

The Council has the right to confer PhD and *habilitation* degrees in physics (DSc).

Representatives of scientific staff:

Helena Białkowska, Professor, *Deputy Chairperson*
Ludwik Dobrzyński, Professor
Zbigniew Guzik, Assoc. Prof.
Edward Iller, Assoc. Prof.
Anna Wysocka-Rabin, Assoc. Prof.
Agnieszka Syntfeld-Każuch, Dr.
Bogumiła Mysłek-Laurikainen, Dr.
Mieczysław Mielcarski, Assoc. Prof., *Deputy Chairman*
Marek Moszyński, Professor
Marek Rabiński, Dr.
Stanisław Rohoziński, Professor
Krzysztof Rusek, Professor
Marek Sadowski, Professor
Janusz Skalski, Assoc. Prof.
Adam Sobiczewski, Professor
Dariusz Socha, Dr.
Ryszard Sosnowski, Professor, *Chairman*
Andrzej Strupczewski, Dr.
Zbigniew Werner, Assoc. Prof.
Grzegorz Wilk, Professor
Wojciech Wiślicki, Professor
Sławomir Wronka, Dr. *Deputy Chairman*

Representatives of Management:

Ewa Rondio, Professor
Krzysztof Wieteska, Professor
Grzegorz Wrochna, Professor

Representatives of technical personnel:

Alina Markiewicz, MSc
Jacek Pracz, MSc
Jerzy Wysokiński, M.Eng.

External members:

Krystyna Jabłońska, Professor	- Institute of Physics, Polish Academy of Sciences, Warsaw
Danuta Kisielewska, Professor	- AGH University of Science and Technology, Cracow
Paweł Kukołowicz, Professor	- Holy Cross Cancer Center, Kielce
Piotr Malecki, Professor	- The Henryk Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences, Cracow
Tomasz Matulewicz, Professor	- Institute of Experimental Physics, Faculty of Physics, University of Warsaw
Janusz Mika, Professor, Professor	former Institute of Atomic Energy
Marek Pajek, Professor	- Institute of Physics, The Jan Kochanowski University, of Humanities and Sciences, Kielce
Bogdan Pałosz, Professor	- Institute of High Pressure Physics, Polish Academy of Sciences, Warsaw
Andrzej Patrycy, M.Eng.	- Energoprojekt Warszawa S.A
Stanisław G. Rohoziński, Professor	Institute for Theoretical Physics, University of Warsaw
Michał Waligórski, Professor	- The Henryk Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences, Cracow
Andrzej Ziębik, Professor	- Silesian University of Technology
Janusz Ziółkowski, Professor	- The N. Copernicus Astronomical Centre, Warsaw

DEPARTMENTS AND DIVISIONS OF THE INSTITUTE

DEPARTMENT OF NUCLEAR ENERGY
Director of the Department – Grzegorz KRZYSZTOSZEK, MSc Eng

- NUCLEAR ENERGY DIVISION (EJ1)
  Head of Divison – Tomasz JACKOWSKI, MSc

- MARIA REACTOR OPERATION DIVISION (EJ2)
  Head of Reactor – Andrzej GOŁĄB, MSc Eng

- RESEARCH REACTOR TECHNOLOGY DIVISION (EJ3)
  Head of Division – Janusz PIĄSTKA, MSc Eng

- RADIATION PROTECTION MEASUREMENT LABORATORY (LPD)
  Head of Laboratory –Zbigniew HARATYM, PhD

DEPARTMENT OF MATERIALS PHYSICS
Director of the Department – Professor Jacek JAGIELSKI

- MATERIALS RESEARCH LABORATORY (LBM)
  Head of Laboratory –Ewa HAJEWSKA, PhD

- NUCLEAR METHODS IN SOLID STATE PHYSICS DIVISION (FM1)
  Head of Divison –Jacek J. MILCZAREK, PhD

- PLASMA/ION BEAM TECHNOLOGY DIVISION (FM2)
  Head of Divison –Cezary POCHRYBNIAK, PhD

DEPARTMENT OF FUNDAMENTAL RESEARCH
Director of the Department – Professor Grzegorz WILK

- NUCLEAR PHYSICS DIVISION (BP1)
  Head of Divison –Bohdan MARIAŃSKI, PhD

- THEORETICAL PHYSICS DIVISION (BP2)
  Head of Divison –Michał KOWAL, PhD

- HIGH ENERGY PHYSICS DIVISION (BP3)
  Head of Divison –Maciej GÓRSKI, PhD

- ASTROPHYSICS DIVISION (BP4)
  Head of Divison – Jacek SZABELSKI, PhD, (till 30.06.2014)
  Agnieszka POLLO, PhD, DSc (from 01.07.2014)

DEPARTMENT OF NUCLEAR TECHNIQUES & EQUIPMENT
Director of the Department – Agnieszka SYNTFELD-KAŻUCH, PhD (till 30.09.2014)
Jacek RZADKIEWICZ, PhD, (from 01.10.2014)

- PARTICLE ACCELERATION PHYSICS & TECHNOLOGY DIVISION (TJ1)
  Head of Division –Sławomir WRONKA, PhD

- INTERDISCIPLINARY APPLICATIONS OF PHYSICS DIVISION (TJ2)
  Head of Division –Jan SERNICKI, PhD

- RADIATION DETECTORS DIVISION (TJ3)
  Head of Division –Łukasz ŚWIDERSKI, PhD, (till 10.09.2014)
  Tomasz SZCZĘŚNIAK, PhD, (from 11.09.2014

- ELECTRONICS AND DETECTION SYSTEMS DIVISION (TJ4)
  Head of Division –Michał GIERLIK, PhD

- PLASMA STUDIES DIVISION (TJ5)
  Head of Divison –Jarosław ŻEBROWSKI, PhD

- NUCLEAR EQUIPMENT DIVISION- HITEC (ZdAJ)
  Director of Division - Paweł KRAWCZYK, PhD

EDUCATION AND TRAINING DIVISION
Head of the Division– Professor Ludwik DOBRZYŃSKI

AND

RADIOISOTOPE CENTRE POLATOM (OR)
Director of Centre – Dr. Eng. Dariusz SOCHA

TRANSPORT DIVISION (ZTS)
Director, Bogdan GAS, Eng.

4. MAIN RESEARCH ACTIVITIES

I. Elementary particle physics, astro- & cosmic ray physics and cosmology

1. High-energy hadron-hadron interactions.
2. Elastic and inelastic μ and e interactions. Nucleon structure.
3. Rare decays.
4. Baryon resonances and near threshold meson production.
5. Neutrino physics.
6. Astrophysics: optical detection of short bursts, large-scale structure, dark matter.
7. Cosmic ray physics.
8. Cosmology.
9. Theory of lepton and hadron interactions.

II. Nuclear physics

1. Relativistic ion collisions.
2. Nuclear reactions.
3. Nuclear structure.
4. Properties of heavy and superheavy nuclei (theory).
5. Theory of nuclear matter, hypernuclei & nuclear structure and dynamics.
6. High-energy atomic physics.
7. Exotic atoms.

III. Plasma physics and technology

1. Development of methods and tools for plasma diagnostics.
2. Studies of light emitted from hot plasma jet and jets interaction with solid targets.
3. Thin Nb and Pb film coating by means of arc discharges under ultra-high vacuum conditions.
4. Nonlinear effects in extended media & Bose-Einstein condensates (theory).

IV. Detectors, accelerators, physics of materials & applications

1. Modification of surface properties of solid materials by means of continuous or pulsed ion and plasma beams.
2. R&D of linear accelerators for high-energy electrons.
3. Accelerators for hadron therapy.
4. Small electron accelerators for X-ray therapy.
5. Optimization of TiN coating processes for accelerating structures.
6. New detection methods and their application in physics experiments, nuclear medicine and homeland security.
7. Electronics for large-scale experiments in high-energy physics.
8. Systems for nuclear radiation spectroscopy.
9. R&D of special silicon detectors for physics experiments and environmental protection.

V. Solid state physics

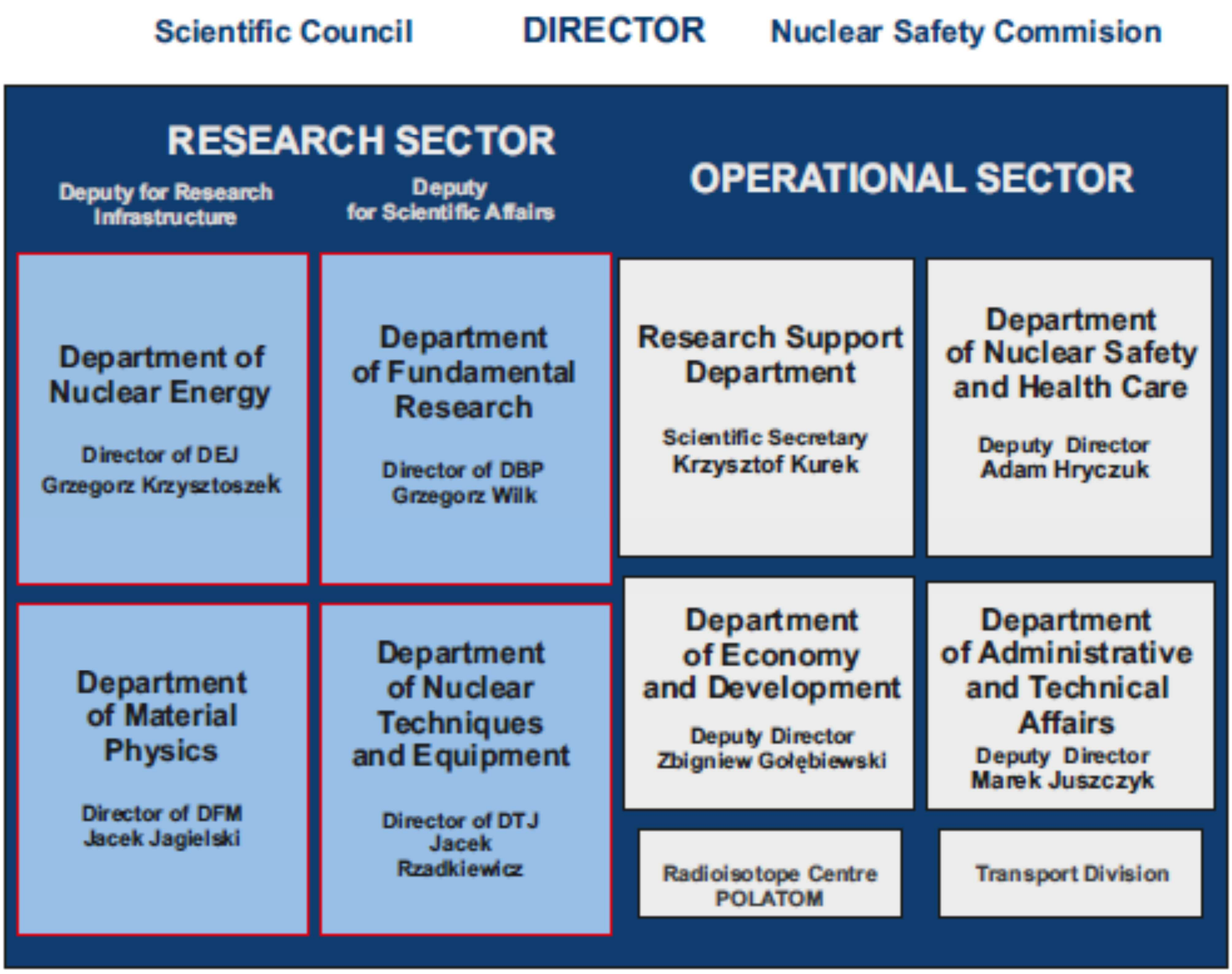
1. Materials structure studies by nuclear methods.
2. Technology of modifying surfaces of industrially used materials.

VI. Nuclear technology in energy generation

1. Physics and technology of nuclear reactors.
2. Nuclear power energy generation.
3. Management of spent nuclear fuel and radioactive waste. Nucelar transmutation.

VII. Nuclear technology in health and enviromental protection, management of hazards

1. Development of new radiopharmaceuticals for diagnostics and radionuclide therapy.
2. Dosimetry and nano-dosimetry.
3. Computer modelling of radiation sources, transport of radiation through matter and radiation dose calculations.
4. X-ray sources for medicine and industry.
5. New methods for obtaining radioactive isotopes.
6. Methods of assessment and forecasting of environmental threats from nuclear and industrial facilities.



5. SCIENTIFIC STAFF OF THE INSTITUTE

PROFESSORS

1. BIAŁKOWSKA Helena
2. BŁOCKI Jan(**)
3. CHWASZCZEWSKI Stefan(**)
4. CZACHOR Andrzej(**)
5. DĄBROWSKI Janusz (**)
6. DĄBROWSKI Ludwik
7. DOBRZYŃSKI Ludwik
8. INFELD Eryk (**)
9. JAGIELSKI Jacek (**)
10. JASKÓŁA Marian (**)
11. KRÓLAK Andrzej (**)
12. MĄCZKA Dariusz (**)
13. MOSZYŃSKI Marek
14. MRÓWCZYŃSKI Stanisław (**)
15. PARUS Józef
16. PATYK Zygmunt
17. PIASECKI Ernest (**)
18. PIECHOCKI Włodzimierz
19. RONDIO Ewa
20. RUSEK Krzysztof (*)
21. ROSZKOWSKI Leszek
22. SADOWSKI Marek
23. SANDACZ Andrzej
24. SIEMIARCZUK Teodor(**)
25. SŁOWIŃSKI Bronisław(**)
26. SOBICZEWSKI Adam
27. SOSNOWSKI Ryszard
28. STEPANIAK Joanna(**)
29. SZEPTYCKA Maria (**)
30. TUROS Andrzej (**)
31. TYMIENIECKA Teresa(**)
32. WIBIG Tadeusz(**)
33. WIETESKA Krzysztof
34. WILCZYŃSKI Janusz(**)
35. WILK Grzegorz
36. WIŚLICKI Wojciech
37. WIŚNIEWSKI Roland
38. WROCHNA Grzegorz
39. WYCECH Sławomir (**)
40. ZABIEROWSKI Janusz
41. ZDUNEK Krzysztof(**)
42. ZWĘGLIŃSKI Bogusław(**)

ASSOCIATE PROFESSORS

1 DELOFF Andrzej (**)
2 GARNUSZEK Piotr
3 GUZIK Zbigniew
4 ILLER Edward
5 KEELEY Nicholas
6 KOWAL Michal
7 KUREK Krzysztof
8 MIELCARSKI Mieczysław
9 MIKOŁAJCZAK Renata
10 POLLO Agnieszka
11 SKALSKI Janusz
12 SPALIŃSKI Michał
13 SZCZEKOWSKI Marek
14 SZUTA Marcin
15 SZYDŁOWSKI Adam
16 SZYMANOWSKI Lech
17 SZYMAŃSKI Piotr (*)
18 WERNER Zbigniew
19 WYSOCKA-RABIN Anna
20 ZALEWSKI Piotr
21 ŻUPRAŃSKI Paweł (**)
22 ZYCHOR Izabella

RESEARCH STAFF

1. ADAMUS Marek
2. ADRICH Przemysław
3. ANDRZEJEWSKI Krzysztof
4. AUGUSTYNIAK Witold(**)
5. BANTSAR Aliaksandr
6. BARLAK Marek
7. BATSCH Tadeusz
8. BERŁOWSKI Marcin
9. BIELEWICZ Marcin
10. BIEŃKOWSKI Andrzej (**)
11. BIŁOUS Waldemar (**)
12. BIRNBAUM Grażyna
13. BLACHNIK Marcin
14. BLUJ Michał
15. BOETTCHER Agnieszka
16. BOIMSKA Bożena
17. BOMARK Nils Erik
18. BOREK –KRUSZEWSKA Elżbieta
19. BORYSIEWICZ Meczysław
20. BRODA Ryszard
21. BUDZIANOWSKI Armand
22. BURAKOWSKA Agnieszka
23. BYSZEWSKA-SZPOCIŃSKA Ewa
24. CHMIELOWSKI Władysław (*)
25. CIEŚLIK Iwona
26. CIESZYKOWSKA Izabela
27. CZARNACKI Wiesław(**)
28. CZUCHRY Ewa

29. DOROSH Orest
30. DOROSZ Michał
31. DZIEWIECKI Michał(**)
32. FIJAŁ-KIREJCZYK Izabela
33. FILIKS Anna
34. FISZER Marzena
35. FRUBOES Tomasz
36. GAJEWSKI Jacek
37. GIERLIK Michał
38. GÓJSKA Aneta
39. GOLDSTEIN Piotr
40. GÓRSKI Ludwik(**)
41. GÓRSKI Maciej
42. GRODZICKA-KOBYŁKA Martyna
43. GRYZIŃSKI Michał
44. HAJEWSKA Ewa(**)
45. HARATYM Zbigniew(**)
46. HELLER Michał(*)
47. HOFFMAN Julia (*)
48. HRYCYNA Orest
49. JAKUBOWSKI Lech (**)
50. JANIAK Tomasz
51. JANKOWSKA-KISIELIŃSKA Joanna(**)
52. JANOTA Barbara
53. JAROŃ Antoni
54. JAWORSKI Wojciech
55. JĘDRZEJCZAK Karol(*)
56. JĘDRZEJEC Henryk(**)
57. KAPUSTA Maciej (*)
58. KARCZMARCZYK Urszula
59. KAZANA Małgorzata
60. KIREJCZYK Marek
61. KLIMASZEWSKI Konrad
62. KŁUDKIEWICZ Dominik Daniel
63. KONIOR Marcin
64. KORMAN Andrzej
65. KORSAK Agnieszka
66. KORYTKOWSKI Michał
67. KOWALIK Katarzyna
68. KOWALSKA Kamila
69. KRAWCZYK Paweł
70. KRZEMIEŃ Wojciech
71. KUPRASKA Łukasz
72. KUPŚĆ Andrzej (*)
73. KURASHVILI Podist
74. ŁAGODA Justyna
75. LICKI Janusz(**)
76. LIPKA Robert
77. LISTKOWSKA Anna
78. LORKIEWICZ Jerzy
79. ŁUCZAK Paweł
80. ŁUSZCZ Mariusz(**)
81. MĄDRY MAGDALENA (*)
82. MAJCZYNA Agnieszka
83. MAŁEK Katarzyna
84. MAŁETKA Krzysztof
85. MALINOWSKA Aneta
86. MALINOWSKI Karol
87. MAŁKIEWICZ Przemysław
88. MARCINKOWSKA Zuzanna
89. MARIAŃSKI Bohdan
90. MARKIEWICZ Alina
91. MAURIN Jan(**)
92. MAURIN Michał
93. MELNYCHUK Dmytro
94. MIELCZAREK Jakub(**)
95. MIESZCZYŃSKI Cyprian
96. MIJAKOWSKI Piotr
97. MILCZAREK Jacek
98. MYSŁEK-LAURIKAINEN Bogumiła
99. NAWROCKI Krzysztof
100. NAWROT Adam (**)
101. NIETUBYĆ Robert
102. NOWAKOWSKA-LANGIER Katarzyna
103. NOWICKI Lech (**)
104. OLSZACKI Michał
105. OŚKO Jakub
106. PADEE Adam
107. PAWLAK Dariusz
108. PAWŁOWSKI Marek
109. PIJAROWSKA-KRUSZYNA Justyna
110. PŁAWSKI Eugeniusz
111. PLEWA Grzegorz
112. PLUCIŃSKI Paweł (*)
113. POCHRYBNIAK Cezary
114. POLAŃSKI Aleksander
115. POTEMPSKI Sławomir
116. PROKOPOWICZ Rafał
117. PRZEWŁOCKI Paweł
118. PSZONA Stanisław(**)
119. PYLAK Maciej
120. PYTEL Krzysztof
121. RABIŃSKI Marek
122. RAJEWSKA Aldona (*)
123. RATAJCZAK Renata
124. ROŻYNEK Jacek
125. RUCHOWSKA Ewa
126. RZADKIEWICZ Jacek
127. RZEMEK Katarzyna
128. SASINOWSKA Iwona
129. SAWICKA Agnieszka
130. SENDAL Jagoda
131. SERNICKI Jan
132. SESSOLO Enrico Maria
133. SKŁADNIK-SADOWSKA Elżbieta (**)
134. SKORUPSKI Andrzej (**)
135. SŁAPA Mieczysław (**)
136. SMOLAŃCZUK Robert
137. SOBKOWICZ Paweł
138. SOKOŁOWSKI Marcin(*)
139. SOWIŃSKI Mieczysław (**)
140. STANISZEWSKA Joanna
141. STONERT Anna
142. STRUGALSKA-GOLA Elżbieta
143. STRUPCZEWSKI Andrzej
144. SULEJ Robert
145. ŚWIDERSKA Karolina
146. ŚWIDERSKI Łukasz
147. SYNTFELD-KAŻUCH Agnieszka
148. SZABELSKA Barbara

149. SZABELSKI Jacek
150. SZCZĘŚNIAK Tomasz
151. SZEWIŃSKI Jarosław
152. SZLEPER Michał
153. SZYMCZYK Władysław(**)
154. SZYSZKO vel Chorąży Tomasz
155. TARCHALSKI Mikołaj
156. TRACZYK Piotr (*)
157. TRZCIŃSKI Andrzej
158. TULIK Piotr(**)
159. TYMIŃSKA Katarzyna
160. TYMIŃSKI Zbigniew
161. UKLEJA Artur
162. WAGNER Jakub
163. WASIAK Jan
164. WASILEWSKI Adam
165. WAWRZYŃCZAK-SZABAN Anna
166. WAWRZYNIAK Karol
167. WIELGOSZ Monika
168. WILLIAMS Andrew
169. WOJCIECHOWSKI Andrzej(*)
170. WOJDOWSKA Wioletta
171. WOJTKOWSKA Jolanta (**)
172. WRONKA Sławomir
173. ZALIPSKA Joanna
174. ZARĘBA Barbara
175. ŻEBROWSKI Jarosław
176. ZIŃ Paweł
177. ŻOŁĄDEK-NOWAK Joanna
178. ŻÓŁTOWSKA Małgorzata

(*) on leave of absence
(**) part-time employee

6. VISITING SCIENTISTS

1.	Lansberg J.P.	Institute of Nuclear Physics, Orsay, France	20-26.01.	BP2
2.	Boussarie R.	Institute of Nuclear Physics, Orsay, France	16-23.02.	BP2
3.	Grabovsky A.	Budker Institute, Moskow, Russia	06-23.02.	BP2
4.	Gillibert A.	CEA, Orsay, France	17-20.02.	BP1
5.	Bllythin A.	Micro Materials Laboratory, UK	18-20.02	LBM
6.	Harris A.J.	Micro Materials Laboratory,, UK	18-21.03.	LBM
7.	Capdevielle N.P.	University of Paris, France	28.03-15.04.	BP4
8.	Lansberg J.P.	Institute of Nuclear Physics,Orsay, France	26.04-03.05.	BP2
9.	Wallon S.	Institute od Nucleare Physics Orsay, France	27.04- 02.05.	BP2
10.	Lorce C.	Institute of Nucleare Physics Orsay, France	27-30.04.	BP2
11.	Ducloue B.	Institute of Nuclear Physics,Orsay, France	27.04-03.05.	BP2
12.	Choi Ki Young	Korea Astronomy and Space Science Institute, Daejon	27.04-03.05.	BP2
13.	Carrington M.	Brandon University, Canada	28.04-11.07.	BP3
14.	Garrido	CSNSM, Orsay, France	01-10.05	BP1
15.	Oleksandrovich V.P.	University Complutense, Madrid, Spain	01.05- 31.07.	BP1
16.	Magner A.	Institute for Nuclear Researche, Kiev, Ukraine	05-18.05.	BP2
17.	Gazeau J.P.	University of Paris, France	08-10.05.	BP2
18.	Bergeron H.	University of Paris, France	18-24.05.	BP2
19.	Semina V.	Joint Institute for Nuclear Researche, Dubna, Russia	25-27.06.	LBM
20.	Heiny D.	SimScale GmbH, Germany	26.06.	EJ1
21.	Carr J.	Aix-Marseille University, France	01-04.07.	BP2
22.	Bergeron H.	University of Paris, France	06-12.07.	BP2
23.	Alamanos N.	CEA,Saclay, France	10-11.07.	BP1
24.	Shams A.	NRG, Petten, Niderland	14-18.07.	EJ1
25.	Fraile L.M.	University Complutense, Madrid,Spain	14-16.07.	BP1
26.	Gazeau J.P.	University of Paris, France	20.07.	BP2
27.	Gazeau J.P.	University of Paris, France	30.07.	BP2
28.	Harris A.J.	Micro Materials Laboratory, UK	26-29.08.	LBM
29.	Rauh G.	Lot Quantum Design GmbH, Germany	26-29.08.	LBM
30.	Harris A.	Micro Materials Laboratory, UK	10-12.09.	LBM
31.	Rowland G.	Warwik University,UK	16-26.08.	BP2
32.	Tsallis C.	CBPF, Rio de Janeiro, Brasil	18-22.09.	BP2
33.	Magner A.	Institute for Nuclear Researche, Kiev, Ukraine	20.09-05.10.	BP2
34.	Tsallis C.	CBPF,Rio de janeiro, Brasil	28-29.09.	BP2
35.	Didyk A.J.	Joint Institute for Nuclear Research, Dubna, Russia	29.09-03.10.	LBM
36.	Antinoluk T.	University of Santiago de Compostela,Spain	01-08.10.	BP
37.	Boussarie R.	Institute of Nuclear Physics Orsay,France	01-11.10.	BP2
38.	Capdevielle N.P.	University of Paris, France	17-31.10.	BP4
39.	Ducloue B.	Institute of Nuclear Physics,Orsay, France	02-06.11.	BP2
40.	Pierrard P.	CEA,Saclay, France	06.11.14	EJ1
41.	Gazeau J.P.	University of Paris, France	12.11.14	BP2

42.	Montbarbon E.	CEA, Saclay, France	30.11-05.12.	TJ3
43	lain G.,	CEA, Saclay, France,	17–20.02.	BP1
44.	Oleksandrovich V.P.	University Complutense, Madrid, Spain,	01.05-31.07.	BP1
45.	Alamanos N.	CEA, Saclay, France,	10-11.07.	BP1
46.	Fraile L.M.	University Complutense, Madrid, Spain,	14-16.07.	BP1
47.	Pierrard P.	CEA	22-23.04.	EJ1
48.	Cognet G.	CEA	22-23.04 .	EJ1
49.	Wahide C.	CEA	22-23.04.	EJ1
50.	Ochem D.	CEA	22-23.04.	EJ1
51.	Behar Ch.	CEA	22-23.04	EJ1
52.	Zaetta A.	CEA;	22-23.04	EJ1
53.	Kalivodowa J.	ÚJV ŘEŽ	22-23.04	EJ1
54.	Gregor K.	ÚJV ŘEŽ	22-23.04	EJ1
55.	Bělowský L.	ÚJV ŘEŽ	22- 3.04	EJ1
56.	Duspiva J.	ÚJV ŘEŽ	22-23.04	EJ1
57.	Žežula L.	ÚJV ŘEŽ;	22-23.04	EJ1
58.	Horvath A.	MTA Hungarian	22-23.04	EJ1
59.	Gado J.	MTA Hungarian	22-23.04	EJ1
60.	Mayer G.	MTA Hungarian;	22-23.04	EJ1
61.	Dařilek P.	VUJE, Trnava;	22-23.04	EJ1
62.	Liška P.	VUJE, Trnava;	22-23.04	EJ1
63.	Zajac R.	VUJE, Trnava	22-23.04	EJ1
64.	Hatala B.	VUJE, Trnava;	22-23.04	EJ1
65.	Van Geothem G.	EUROATOM;	22-23.04	EJ1
66.	Nabbi R.	Aachen University of Technology, Germany	22-23.04	EJ1
67.	Barbosa J. A.	Areva	15.05.	EJ1
68.	Tucholka K.	Areva	15.05.	EJ1
69.	Heiny D.	SimScale GmbH Germany	26.06.	EJ1
70.	Shams A.	NRG, Petten	14-18.07.	EJ1
71.	Vasile A.	CEA	6.11.	EJ1
72.	Pierrard P.	CEA	6.11.	EJ1
73.	Blythin A.	Micro Materials Laboratory, Anglia	18-20.02.	LBM
74.	Harris A. J.	Micro Materials Laboratory, Anglia	18-21.0	LBM
75.	Semina V.	Joint Institute for Nuclear Research - Dubna, Rosja	25-27.06.	LBM
76.	Harris A. J.	Micro Materials Laboratory, Anglia	26-29.08.	LBM
77.	Rauh G.	Lot Quantum Design GmbH, Niemcy	26-29.08.	LBM
78.	Harris A. J.	Micro Materials Laboratory, Anglia	10-12.09.	LBM
79.	Didyk, A. Ju.	Joint Institute for Nuclear Research – Dubna, Rosja	29.09-03.10.	LBM
80.	Garrido F.	Centre de Science Nucléaires et de Sciences		
		de la Matière, Orsay, France Visit in Warsaw:	01-11.05	FM2
81.	Capdevielle J.Noël.	Laboratoire AstroParticule et Cosmologie		
		- APC, Université Paris Diderot	28.03-15. 04	BP4
			17.10-31. 10	
82.	Delabrouille J.	Laboratoire AstroParticule et Cosmologie		
		APC, Université Paris Diderot	15.10-19.10.	
			25.11-26.11.	BP4
83.	Durkalec A.	Laboratoire d'Astrophysique de Marseille, France 1	06.12.14–05.01.15	BP4
84.	Takeuchi T. T.	Nagoya University, Japan	13.03-20.03.	BP4
			30.07-4.08.	
			31.08-8.09.	
			05.10-05.10.	
			08.11-11.11.	BP4
85.	Asano R.	Nagoya University, Japan	08-11.03.	BP4
86.	Solarz A.	Nagoya University, Japan	07.05-21.07.	
		częściowo w NCBJ, częściowo na UJ		BP4
			24.09.14-14.01.15	BP4
87.	Małek K.	Nagoya University, Japan	03-07.03.	BP4
88.	Bilicki M.	University of Cape Town, Republic of *South Africa*	20.06-22.06.	BP4
89.	Doug S.	Canada-French Hawaii Telescope, USA	29.05-31.05.	BP4
90.	Devost D.	Canada-French Hawaii Telescope, USA	29.05-31.05.	BP4
91.	Jaresch R.	Communications&Power Industries International Inc.	23.05.	TJ1
92.	Tschunke W.	Communications&Power Industries International Inc.	23.05.	TJ1
93.	Carrington M.E.	Brandon University, Canada		BP3

94.	Montbarbon E.	Francja, CEA SACLEY 0	01.12-05.12.	TJ3
95.	Leclerq R.	USA, ADIT Electron Tubes	10.10.	TJ3
96.	West A.	USA, ADIT Electron Tubes	10.10.	TJ3
97.	Tardocchi M.	Włochy, Instituto di Fisica del Plasma "Piero Caldirola" CNR	16.09-17.09.	TJ3
98.	Nocente M.	Włochy, Instituto di Fisica del Plasma "Piero Caldirola" CNR	16.09-17.09.	TJ3
99.	Alaribe L.	Niemcy, Freiburger Materials Research Centre	06.08.	TJ3
100.	Klamra Wł.	Szwecja, Department of Physics Rogal Institut of Technology AlbaNova	02.06-12.06.	TJ3
			24.11-04.12.	TJ3
101.	de Felice P.	Włochy, Uniwersytet w Padwie	06.03.	TJ3
102.	Pastore P.	Włochy, Uniwersytet w Padwie	06.03.	TJ3
103.	Moretto S.	Włochy, Uniwersytet w Padwie	06.03.	TJ3
104.	Lunardon M.	Włochy, Uniwersytet w Padwie	06.03.	TJ3
105.	Donatti M.	Włochy, ENEA	06.03.	TJ3
106.	Viesti G.	Włochy, Uniwersytet w Padwie	06.03.	TJ3
107.	Perucci S.	Włochy, Firma CAEN	06.03.	TJ3
108.	Iovene A.	Włochy, Firma CAEN	06.03.	TJ3
109.	Bodewist E.	Holandia, firma Scionix	06.03.	TJ3
110.	Schotanus P.	Holandia, firma Scionix	06.03.	TJ3
111.	Spanswick K. A.	Ariane Medica System	24.02.	TJ3
112.	Cester D.	Włochy, Universita di Padova	04.-07.02.	TJ3
113.	Santoro R.	Włochy, Universita d'Insubaria	04.-07.02.	TJ3
114.	Iovene A.	Włochy, CAEN	04.-07.02	TJ3
115.	Hannes F.	Szwajcaria, ARKTIS	04.-07.02.	TJ3

PROJECTS

RESEARCH PROJECTS IMPLEMENTED WITH THE FUNDS FOR SCIENCE

National Science Centre

1. Microdosimetric recombination detector for dosimetric analysis of reactor radiation
   Principal Investigator: P. Tulik, PhD
   No. N N518 4261 36
2. Investigation on decoherence and CPT symmetry in systems of K mesons at the KLOE-2 experiment
   Principal Investigator: Prof. W. Wiślicki
   No. N N202 0469 37
3. Influence of the nanostructure on the magnetic properties of metallic layers produced by the plasma surface engineering methods
   Principal Investigator: K. Nowakowska-Langier, PhD
   No. N N507 4743 37
4. Studies on the evolution of galaxies and the large scale structure of the Universe
   Principal Investigator: A. Pollo, PhD, DSc
   No. N N203 5129 38
5. Properties of heavy and superheavy atomic nuclei
   Principal Investigator: Prof. A. Sobiczewski
   No. N N202 2049 38
6. Recombination dose meter of new generation for exposure assessment on workplaces in radiation fields of reactors and accelerators
   Principal Investigator: M. Gryziński, PhD
   No. N N404 1350 39
7. Experimental study of leptonic decays of eta meson with WASA detector
   Principal Investigator: Prof. J. Stepaniak
   No. N N202 4843 39

8. Structure of ^{20}Ne and the Coulomb barrier distribution for ^{20}Ne+^{208}Pb
   Principal Investigation: Prof. K. Rusek
   No. N N202 0520 40
9. A search for supersymmetry using the CMS detector ate the LHC with an emphasis on heavy semi-stable charged particle signature
   Principal Investigator: P. Zalewski, PhD
   No. N N202 1674 40
10. Analytic structure of the scattering amplitudes of hard exclusive processes in QCD
    Principal Investigator: J. Wagner, PhD
    No. 2011/01/D/ST2/02069
11. Exotic nuclear states - predictions for experiments and tests for nuclear models
    Principal Investigator: Assoc. Prof. J. Skalski
    No. 2011/01/B/ST2/05131
12. Nuclear states of antiprotons and strange mesons
    Principal Investigator: Prof. S. Wycech
    No. 2011/03/B/ST2/00270
13. Non-equilibrium quark-gluon plasma
    Principal Investigator: Prof. St. Mrówczyński
    No. 2011/03/B/ST2/00110
14. In vitro and in vivo inestigations of the radiometals influence on the ability of CCK2R receptors imaging by the radiolabelled gastrin analogs
    Principal Investigator: Assoc. Prof. R. Mikołajczak
    No. 2011/03/B/ST5/02734
15. Isotropization of cosmological models
    Principal Investigator: O. Hrycyna, PhD
    No. 2012/04/S/ST9/00020
16. Cosmological models testing with deep galaxy surveys
    Principal Investigator: Assoc Prof. Agnieszka Pollo
    No. 2012/07/B/ST9/04425
17. Application of holographic metheods to the study of stronly coupled Yang-Mills plasma
    Principal Investigator: Assoc Prof. M. Spaliński
    No. 2012/07/B/ST2/03794
18. Investigation of the CP and CPT symmetries and the structure and decays of mesons at low energies in experiments KLOE/KLOE-2
    Principal Investigator: Prof. W. Wiślicki
    No. 2013/08/M/ST2/00323
19. Critical phenomena in the nuclear nonextensive systems
    Principal Investigator: J. Rożynek, PhD
    No. 2013/09/B/ST2/029897
20. Participation of the POLGRAW group in VIRGO gravitational wave observatory
    Principal Investigator: Prof. A. Królak
    No. DPN/N176.VIRGO/2009
21. Study of elementary and nuclear collisions in the LHC ALICE experiment at CERN
    Principal Investigator: Prof. T. Siemiarczuk
    No. DPN/N97/CERN/2009
22. Hadron production in nuclear interactions at CERN SPS
    Principal Investigator: Prof. J. Stepaniak
    No. DWM/N102/CERN/2009
23. Study of nucleon spin structure and production of vector mesons in deep inelastic scattering of polarized leptons of 27.5 GeV energy
    Principal Investigator: B. Mariański, PhD
    No. DPN/N60/DESY/2010

24. Construction of elements of Neutral Beam Injectors to be used in W7-X stellarator
    Principal Investigator: Prof. J. Jagielski
    No. DPN/N129/W7X/2010
25. LHCb experiment - Detector maintenance and participation in physics research program
    Principal Investigator: Assoc. Prof. M. Szczekowski
    No. DPN/N201/CERN/2009
26. COMPASS experiment- study of the structure of the nucleon
    Principal Investigator: Prof. A. Sandacz
    No. 2011/01/M/ST2/02350
27. T2K – the second generation neutrino experiment
    Principal Investigator: Prof. E. Rondio
    No. 2011/01/M/ST/02578
28. Studies on neutrino properties and proton decay with a large liquid argon detector ICARUS T600
    Principal Investigator: J. Łagoda, PhD
    No. 2012/04/M/ST2/00775
29. Studies of proton-proton, hadron-nucleus and nucleus-nucleus collision at relativistic energies in NA61/SHINE experiment at CERN SPS
    Principal Investigator: Prof. J. Stepaniak
    No. 2012/04/M/ST2/00816
30. The study of fundamental properties of nuclear matter in the ALICE experiment at the CERN Large Hadron Collider
    Principal Investigator: Prof. T. Siemiarczuk
    No. 2013/08/M/ST2/00598
31. Study of CP symmetry breaking and search for New Physics in LHCb experiment
    Principal Investigator: Prof. W. Wiślicki
    No. 2013/10/M/ST2/00629
32. Multiple choice problem in quantum cosmology
    Principal Investigator: P. Małkiewicz, PhD
    No. 2013/09/D/ST2/03714
33. Classification if z~1
    Principal Investigator: K. Małek, PhD
    2013/09/D/ST9/04030
34. Studies of CPT symmetry violation
    Principal Investigator: W. Krzemień, PhD
    2014/12/S/ST2/00459

Ministry of Science and Higher Education

1. Higher order correlation functions in ultracold atom systems
   Principal Investigator: P. Ziń, PhD
   No. DPN/MOB259/1/2011
2. Observation of astrophysical processes in strong gravitional fields wiith high time resolution in different ranges of spectrum and polarization
   Principal Investigator: Assoc. Prof. L. Mankiewicz
   No. ID2010000160
3. Experimental research on the behavior of gas an highly condensed matter (10-30 kbar) in low temperature anf high magnetic field enviroment
   Principal Investigator: Prof. R. Wiśniewski
   No. W88/ZIBJ Dubna/2011
4. Participation in calculations and design of the proton linac in ESS project
   Principal Investigator: S. Wronka, PhD
   No. W221/ESS/2012

5. Participation in calculations and design of the positron source for GBAR experiment
Principal Investigator: S. Wronka, PhD
No. W72/GBAR/2012

6. Development and qualification of a deterministic scheme for the evaluation of gamma heating in experimental reactors with expoitation as example MARIA reactor and Jules Horowitz Reactor
Principal Investigator: M. Tarchalski, PhD
No. W226/JHR CEA/2012

7. Investigation of public and industrial research using ion beam technology
Principal Investigator: A. Stonert, PhD
No. W127/SPIRIT/2013

8. cPIXE and cRBS study of Transition Metals location in implanted and Plasma Pulse Annealed Compound Semiconductors
Principal Investigator: R. Ratajczak, PhD
No. W55/SPIRIT/2013

9. Low Level RF development for X-ray Free Electron Laser - implementation of the MTCA electronics
Principal Investigator: J. Szewiński, PhD
No. W/158/DESY/2013

10. Study of Mueller-Navelet jets in the CMS
Principal Investigator; T. Fruboes, PhD
DPN/MOB131/III/2013

11. Search for cosmological singularity resolutions by means of coherent states and with special emphasis on the ambiguity in the choice of internal clock
Principal Investigator: P. Małkiewicz, PhD
No. DPN/MOB132/III/2013

12. Location of manganese atoms in semiconductor lattice after ion implantation and pulse plasma treatment
Principal Investigator: Assoc. Prof. Z. Werner
No. W7/ELETTRA/2014

13. Modernization of the CERN SPS magnets cooling system
Principal Investigator: S. Wronka, PhD
No. W11/CERN/2014

National Centre for Research and Development

1. Device for fast localization of the radioactive isotopes, dedicated for border guard
Principal Investigator: S. Wronka, PhD
No. PMPP/W/01-09.11

2. Research and development of technology for controlled thermonuclear fusion (consortium leader – Henryk Niewodniczański Institute of Nuclear Physis, Polish Academy of Sciences)
Principal Investigator: J. Żebrowski, PhD, M. Rabiński, PhD
Strategic Program “Technologies Supporting Development of Safe Nuclear Power Engineering”
No: SP/J/2/143234/11

3. Study of possibilities and criteria for participation of the Polish industry in the worldwide expansion of nuclear power engineering (research network leader – Warsaw University of Technology)
Strategic Program “Technologies Supporting Development of Safe Nuclear Power Engineering”
Principal Investigator: E. Hajewska, PhD
No: SP/J/5/143682/11

4. Development of nuclear safety and radiological protection methods for the nuclear power engineering's current and future needs (research network leader – Central Laboratory for Radiological Protection)
Strategic Program “Technologies Supporting Development of Safe Nuclear Power Engineering”
Principal Investigator: M. Gryziński, PhD
No. SP/J/6/143339/11

5. The development of high- temperature reactors for industrial applications (research network leader – AGH Univeristy of Science and Technology Cracow)
   Strategic Program “Technologies Supporting Development of Safe Nuclear Power Engineering”
   Principal Investigator: K. Różycki, MSc
   No. SP/J/1/166183/12
6. Alternative methods of technetium-99m production
   Applied Research Programme – programme path A
   Principal Investigator: R.Mikołajczak, PhD
   No PBS1/A9/2/2012
7. Passive, wireless MEMS dosimeter for the high radiation dose monitoring
   MNT ERA-NET
   Principal Investigator: M. Olszacki, PhD
   No MNT/DOSIMEMS/2012
8. ISOTope Trace Analysis (network leader - University of Silesia in Katowice)
   ERA-NET ASPERA-2
   Principal Investigator: J.Szabelski, PhD
   No ERA-NET-ASPERA/03/11
9. Light emitting photonic structures based on ZnO implanted with rare earth elements (research network leader – Institute of Physics Polish Academy of Sciences)
   Applied Research Programme – programme path A
   Principal Investigator: R. Ratajczak, PhD
   No PBS2/A5/34/2013
10. Phase I clinical trial using a novel CCK-2/gastrin receptor-localizing radiolabelled peptide probe for personalized diagnosis and therapy of patiens with prograssive or metastatic medullary thyroid carcinoma
    ERA NET TRANSCAN
    Principal Investigator: R. Mikołajczak, PhD
    No ERA-NET-TRANSCAN/01/2013
11. Trwałość i skuteczność betonowych osłon przed promieniowaniem jonizującym w obiektach energetyki jądrowej (leader - Institute of Fundamental Technological Research Polish Academy of Sciences)
    Applied Research Programme – programme path A
    Principal Investigator: M. Gryziński, PhD
    No PBS2/A2/15/2014
12. Kompleksowy System do Radioterapii Śródoperacyjnej (leader – National Centre for Nuclear Research)
    Applied Research Programme – programme path B
    Principal Investigator: A. Syntfeld-Każuch, PhD
    No PBS2/B9/26/2014
13. System kontrolujący skład chemiczny surowców do produkcji cementu, pracujacy w trybie ciągłym (online), oparty o neutronową analizę aktywacyjną i generator neutronów (leader – National Centre for Nuclear Research)
    Applied Research Programme – programme path B
    Principal Investigator: T. Szczęśniak, PhD
    No PBS2/B2/11/2013
14. Opracowanie pikselowego detektora radiograficznego w oparciu o technologię Multi-Pore-Optics (leader – Imagine RT Sp. z o.o.)
    Programme INNOTECH programme path IN-TECH
    Principal Investigator: M. Matusiak, MSc
    No INNOTECH-K3/IN3/6/225974/NCBR/14

RESEARCH PROJECTS GRANTED BY FOREIGN INSTITUTIONS

1. DESY - Low level RF development for X-ray Free Electron Laser
   Principal Investigator: J. Szewiński, PhD
   Cooperation Agreement
2. ESS - The European Spallation Source and the Superconducting Proton Linac
   Principal Investigator: S. Wronka, PhD
   Agreement No. 01/IPJ/2009
3. CERN – Design and construction of the Linac4 accelerator
   Principal Investigator: S. Wronka, PhD
   No. K1562/LINAC4
4. IAEA - Development of ^{68}Ga based PET-Radiopharmaceuticals for Management of Cancer and other Chronic Diseases
   Principal Investigator: D. Pawlak, MSc.
   No. 16476
5. IAEA - Therapeutic radiopharmaceuticals based on ^{177}Lu- and ^{90}Y- labelled monoclonal antibodies and peptides: development and preclinical evaluations
   Principal Investigator: W. Wojdowska, PhD
   No. 16639
6. IAEA - Accelerator-based alternatives to non-HEU production of Mo-99/Tc-99m
   No. 17419
7. COST TD1004 – Theragnostics Imaging and Therapy: An Action to Develop Novel Nanosized Systems for Imaging-Guided Drug Delivery
   Principal Investigator: Assoc. Prof. R. Mikołajczak
8. COST CM1105 - Functional metal complexes that bindto biomolecules
9. EURAMET - Ionizing radiation metrology for the metallurgical industry
   Principal Investigator : Z. Tymiński, MSc
   MetroMetal JRP IND04
10. EURAMET - Metrology for radioactive waste management
    Principal Investigator: Z. Tymiński, MSc
    MetroRWM JRP ENV09
11. CEA – Development and qualification of a deterministic scheme for the evaluation of gamma heating in experimental reactors with exploitation as example MARIA reactor and Jules Horowitz Reactor
    Principal Investigator : M. Tarchalski, MSc
    Commisariat a l'energie Atomique et aux Energie Alternatives No 13PPLA000012
12. EURAMET – Biologically Weighted Quantities in Radiotherapy
    Principal Investigator: S. Pszona, PhD
    BioQuaRT JRP No SIB06

RESEARCH PROJECTS CO-FINANCED BY 7TH FRAMEWORK PROGRAMME

1. HadronPhysics3 - Study of strongly interacting matter
   Principal Investigator: Prof. A. Sandacz
   Contract No. 283286 (2012-2014)
2. LAGUNA-LBNO - Design of a pan-European Infrastructure for Large Apparatus Studying Grand Unifictaion, Neutrino Astrophysics and Long Baseline Neutrino Oscillation
   Principal Investigator: Prof. E. Rondio
   Contract No. 284518 (2011 - 2014)
3. NURESAFE - Nuclear Reactor Safety Simulation Platform
   Principal Investigator: M. Spirzewski, MSc
   Contract No. 323263 (2013-2015)

4. ALLIANCE - Preparation of ALLegro – Implementing Advanced Nuclear Fuel Cycle in Central Europe
   Principal Investigator: K. Różycki, MSc
   Contract No. 323295 (2013-2015)
5. MODES_SNM - Modular Detection System for Special Nuclear Materials
   Principal Investigator: Prof. M. Moszyński
   Contract No. 284842 (2012-2014)
6. NC2I-R - Nuclear Cogeneration Industrial Initiative - Research and Development Coordination
   Principal Investigator: K. Różycki, MSc
   Contract No. 605167 (2013-2015)
7. ASAMPSA_E - Advanced Safety Assessment: Extended PSA
   Principal Investigator: M. Borysiewicz, PhD
   Contract No. 605001 (2013-2016)
8. ARCADIA - Assessment of Regional CApabilities for new reactors Development through an Integrated Approach
   Principal Investigator: B. Mysłek-Laurikainen, PhD
   Contract No. 605116 (2013-2016)
9. EuCARD-2 - Enhanced European Coordination for Accelerator Research & Development
   Principal Investigator: R. Nietubyć, PhD
   Contract No. 312453 (2013-2017)
10. TAWARA_RTM
    TAP WATER RADIOACTIVITY REAL TIME MONITOR
    Principal Investigator: Prof. M. Moszyński
    Contract No. 312713 (2013-2016)
11. ESNII plus - Preparing ESNII for HORIZON 2020
    Principal Investigator: K. Różycki, MSc
    Contract No. 605172 (2013-2017)

PROJECTS CO-FINANCED BY THE EUROPEAN UNION UNDER THE EUROPEAN REGIONAL DEVELOPMENT FUND (ERDF), SWISS CONTRIBUTION

1. Development of dedicated systems based on accelerators and detectors of ionizing radiation for medical therapy and in detection of hazardous materials and toxic wastes
   Jacek Rzadkiewicz, PhD
   Implementation period: 01.01.2008–31.05.2014
   Project value: 85 584 643,00 PLN
   ERDF: 67 507 000,00 PLN
   Agreement No.: POIG.01.01.02.-14-012/08-00

2. Computing Centre in Swierk: infrastructure and services for power industry
   Prof. Wojciech Wiślicki
   Implementation period: 05.01.2009–31.10.2015
   Project value: 97 708 010,00 PLN
   ERDF: 83 051 808,80 PLN
   Agreement No.: POIG.02.03.00-00-013/09

3. Strenghtening of the innovation potential of the institute in Świerk for development of technologies based on ionising radiation
   Cezary Pochrybniak, PhD
   Implementation period: 01.01.2010-30.06.2015
   Project value: 39 675 524,67 PLN
   ERDF: 33 675 466,00 PLN
   Agreement No.: RPMA.01.01.00-14-030/10-00

4. Construction of the Science and Technology Park along with the modernization of accompanying infrastructure of the Centre in Świerk
   Paweł Sobkowicz, PhD
   Implementation period: 01.01.2010-30.09.2015
   Project value: 50 0000 000,00 PLN
   ERDF: 42 499 337,00 PLN
   Agreement No.: RPMA.01.04.00-14-008/10-00

5. Bayesian approach to multi-parameter problems in physics and beyond involving parallel computing and large data-sets
   Prof. Leszek Roszkowski
   Implementation period: 01.01.2011-31.12.2015
   Project value: 5 360 480,00 PLN
   ERDF: 4 556 408,00 PLN
   Agreement No.: WELCOME/2010-3/1

6. Information Technologies for Astrophysical Observations in wide range of energy
   Tadeusz Batsch, PhD
   Implementation period: 01.10.2011–30.09.2014
   Project values: 1 370 444.34 CHF/3 676 354,00 PLN
   SWISS Contribution: 85%
   Agreement No: 3/2011

7. Mechanical properties of zirconium/zirconia system at high temperatures - the role of internal and interfacial stresses
   Łukasz Kurpaska, PhD
   Implementation period: 01.02.2014—31.12.2015
   Project values: 287 000,00 PLN
   ERDF: 243 950,00 PLN
   Agrement No.: HOMING PLUS/2013-8/7

8. School of the future
   Marcin Sadowski, MSc
   Implementation period: 16.04.2012-31.12.2014
   Project value: 921 642,00 PLN
   ESF: 783 395,70 PLN
   Agreement No.: UDA-POKL.09.02.00-14-058/11

9. PWP. Utworzenie i realizacja interdyscyplinarnych, anglojęzycznych, międzynarodowych, stacjonarnych studiów doktoranckich Innovative Nuclear and Sustainable Power Engineering
   Assoc. Prof. Krzysztof Kurek
   Implementation period: 01.01.2014 – 30.06.2015
   Project value: 3 134 342,00 PLN
   ESF: 2 664 190,70 PLN
   Agreement No.: UDA-POKL.04.01.01-00-038/13-00

7. PARTICIPATION IN NATIONAL CONSORTIA AND SCIENTIFIC NETWORKS

	NATIONAL CONSORTIA:	Institute representative:
1.*	Nuclear Science Center	G. Wrochna
2.*	National Consortium 'XFEL-POLAND' for collaboration with the European X-ray Free Electron Laser - Project XFEL	G. Wrochna/Z. Gołębiewski
3.	National Consortium 'High Temperature Nuclear Reactor in Poland'	G. Wrochna/M. Pawłowski
4.	National Consortium 'FEMTOFIZYKA' for collaboration with the FAIR project in GSI Darmstadt	B. Zwięgliński
5.	National Consortium 'COPIN' for scientific collaboration with France (IN2P3 Institute)	L. Szymanowski
6.	National Consortium for Hadron Radiotherapy (NCRH)	G. Wrochna/A. Wysocka-Rabin
7.	National Consortium of scientific Network 'Polish calculation system for experiments at LHC-POLTIER'	W. Wiślicki
8	Warsaw Science Consortium	G. Wrochna/M. Juszczyk
9	Polish Synchrotron Consortium	R. Nietubyć
10.	Consotrium EAGLE	J. Skalski
11	National Consortium 'PL-TIARA'	S. Wronka
12*	National Consortium 'COMPASS-PL'	A. Sandacz
13.*	National Consortium 'NEUTRINA-T2K'	E. Rondio
14.	National Consortium 'HADRONY-NA61/SHINE'	J. Stepaniak
15.	Polis Consortium VIRGO	A. Królak
16.	Consortium "Polish Particle Physics"	E. Rondio
17.	Polish Consortium ALICE-PL	T. Siemiarczuk
18.	Consortium ISOTTA	J. Szabelski
19.	Consortium NEUTRINA – ICARUS T600	E. Rondio
20.	Consortium ELA-MAT Polska	G. Wrochna
21.	Consortium CMS-Polska	P. Zalewski
22.	Consortium Polska@ISOLDE	Z. Patyk

	SCIENTIFIC NETWORKS:	Institute representative:
1.*	Polish Astroparticle Physics Network	G. Wrochna
2.*	Polish Neutrino Physics Network	E. Rondio
3.	Polish Nuclear Physics Network	G. Wrochna
4.	Polish Network of Physics of Relativistic Ion Collisions	St. Mrówczyński
5.	Polish Network of Neutrons-Emission-Detection	J. Szydłowski
6.	Polish Network of Neutron Scatterers (NeutroNET)	L. Dobrzyński
7.	Polish Network of Radiation Protection and Nuclear Safety	L. Dobrzyński

* Coordinator: NCBJ

8. DEGREES

Professor title

1. Zygmunt Patyk (National Centre for Nuclear Research)

2. Tadeusz Pisarczyk (Institute of Plasma Physics and Laser Microfusion)

3. Jerzy Wołowski (Institute of Plasma Physics and Laser Microfusion)

Habilitation

1. *Stefan Rościsław Borodziuk* (Institute of Plasma Physics and Laser Microfusion)
„Laserowa akceleracja materii – poszukiwanie wysokowydajnych metod wytwarzania superszybkich makrocząstek i strumieni zimnej plazmy."

2. *Janusz Mirosław Chrzanowski* (Maritime Academy in Szczecin)
„Opracowanie nowych metod w diagnostyce termonuklearnej plazmy i kwantowej teorii metali."

3. *Michał Kowal* (National Centre for Nuclear Research)
„Egzotyczne konfiguracje w najcięższych układach jądrowych"

4. *Adam Szydłowski* (National Centre for Nuclear Research)
„Badanie właściwości dielektrycznych detektorów śladowych i zastosowanie tych detektorów w korpuskularnych diagnostykach plazmy"

5. *Anna Wysocka – Rabin* (National Centre for Nuclear Research)
"Advances in Conformal Radiotherapy using Monte Carlo Code to design new IMRT and IORT accelerators and interpret CT numbers"

6. *Piotr Zalewski* (National Centre for Nuclear Research)
"Wybrane aspekty poszukiwania nowych cząstek w eksperymencie DELPHI przy LEP oraz eksperymencie CMS przy LHC"

7. *Izabella Zychor* (National Centre for Nuclear Research)
„Produkcja cząstek dziwnych w zderzeniach proton-proton przy energiach pośrednich"

PhD theses

1. *Martyna Daria Grodzicka - Kobyłka* (National Centre for Nuclear Research)
„Study of silicon photomultipliers in gamma spectrometry with scintillators"

2. *Grzegorz Plewa* (National Centre for Nuclear Research)
„ Holograficzna interpretacja hydrodynamicznego prądu entropii w N=4 supersymetrycznej teorii Yanga-Millsa"

3. *Maciej Pylak* (National Centre for Nuclear Research)
„ Analiza rozkładów gęstości pędów i spinów w gadolinie metodami obliczeń ab-initio i maksymalnej entropii"

4. *Marcin Konior* (Institute of Nuclear Chemistry and Technology
„Nowa technologia wytwarzania generatorów radionuklidowych $^{188}W/^{188}Re$"

II. DEPARTMENTS AND DIVISIONS OF THE INSTITUTE

1. DEPARTMENT OF NUCLEAR ENERGY

Director of Department: Grzegorz Krzysztoszek, MSc .Eng
Phone: +48 22 2731080
e-mail: Grzegorz.Krzysztoszek@ncbj.gov.pl

Overview

The MARIA research reactor operated for 4282 hours in 2014 at power ranging from 18 to 24 MW.
The reactor was mainly used for irradiation of materials used in radioisotope production for RC (Radioisotopes Centre) "Polatom" and Mallinckrodt Pharmaceuticals company and for performing physical research at the outlet of the reactor horizontal beam ports. The supply of Mo-99 for nuclear medicine was limited due to unplanned downtime of the Processing Plant in Petten, Netherlands in the January – April period.
The reactor conversion was completed in August when the last high enriched burnt fuel element was replaced with a low enriched element.

Trial irradiation of MR-6/485 type low enriched fuel made in accordance with Russian technology was completed, whereas the study of spent fuel elements was conducted in October. The positive outcome of the Russian type fuel tests allowed us to acquire a potential second supplier of fuel for the MARIA reactor.

Within the framework of the Global Threat Reduction Initiative program, another batch (44 pcs) of high enriched spent MR type fuel was returned to the Russian Federation.
In September the potential of the reactor was increased after installing a thermal neutron to 14 MeV fast neutron converter.

Within the framework of cooperation between NCNR and CEA-JHR heat generation measurements and calibration of in-core measuring devices in research reactors were made.

The Laboratory for Dosimetry Measurements conducted the following measurements at Świerk:
- contamination of the environment,
- threat to individual employes,
- background of gamma radiation.

The most important achievements of the laboratory for Mixed Radiation are as follows:
1. Construction and tests of a multisignal ionization chamber demonstrator for neutron dosimetry over a wide range of the energy spectrum;
2. Developing the concept of dose planning and restoration methods using PET and SPECT, computer simulations and Monte Carlo calculations based on a phantom with microspheres for SIRT therapy examination.

In the Nuclear Power Engineering division a number of projects associated with safety analyses for the MARIA reactor, power reactors and the interaction of nuclear facilities with the environment were carried out.

The most important of them are:
1. Burnup calculations of three types of MARIA fuel elements and poisoning in beryllium blocks using the APOLLO and MCNP codes;
2. Implementation of the SCALE code package for neutron-physics analysis;
3. Modelling of HTR core with various distributions of fuel and dummy elements.

Grzegorz Krzysztoszek

NUCLEAR ENERGY DIVISION

Head of Division: Tomasz Jackowski, MSc Eng.
phone: +48 22 2731101
e-mail: Tomasz.Jackowski@ncbj.gov.pl

Overview

The main activities of the Deterministic Safety Analysis Team focused on thermal – hydraulic modelling of the MARIA research reactor. The model takes into account various fuel assembly types, the whole primary and secondary cooling circuit and the pool. The core can be configured as a set of single fuel assemblies or groups of assemblies, according to their power. Selected transients were simulated and the results are in good correlation with earlier analyses. The model in RELAP5 is included as part of a project on improved modelling with ANL. The model fuel assemblies in the CATHARE2 code are finished and are being further developed to include cooling circuits.

Another task was the development of a database, workspace and user interface for a REBUS code model of the MARIA reactor. It will improve the capability of the reactor staff in planning of future fuel cycles by examining whether the proposed configuration of the core complies with the limits of safety and operational requirements.

A very important task is related to participation in the NURESAFE FP7 project. Verification of existing models of nuclear fuel dry-out phenomena was performed. A new model that predicts parameters much better has been developed and is being introducing into theCATHARE code.

As the assessment of computer tools, analyses of the HEFUS3 experiment were performed within a benchmark for the ALLIANCE project. Its purpose was to validate severe accident codes against a helium cooled loop with a simulator of a fast gas reactor.

In the area of severe accident phenomena modelling studies and development are being undertaken, specifically studies of corium pool formation in the lower plenum of a reactor vessel and cooling of the reactor vessel wall.

Within the Świerk Computing Centre (CIŚ) project work has been continued on implementation of computational tools (codes) on the computer cluster and development of user interfaces and tools that improve the applications workspace. This concerns development of applications and libraries for thermodynamic analyses of power plant circuits: balance of the plant, mass and energy flow in complex systems.

The Neutronics Team has been engaged in a number of activities – the most important are the following:

1. Modelling of the MARIA research reactor:
   - Burnup calculations of three types of MARIA fuel elements and poisoning in beryllium blocks using the APOLLO and MCNP codes
   - Automation of REBUS code MARIA core cycle calculations; determination of reactivity margins and the energy of individual elements.
2. Power reactor analysis:
   - Implementation of the SCALE code package for neutron-physics analysis.
   - “Preparation of a cross-sections library for nuclear power reactors on the basis of anEPR reactor using the SCALE code for the program PARCS” – agreement with National Atomic Energy Agency.
   - Investigations of Accident Tolerant Fuel, based on PWR fuel assemblies burnup calculations. Calculations included new cladding materials and were carried out using the MCNP code.
3. Participation in the HTR-PL Project “Development of High Temperature Reactors for industrial purposes”:
   - Modelling of HTR core with various distributions of fuel and dummy elements
   - Verification of the safety characteristics of the Chinese pebble bed reactor HTR-10. For the purpose of this study a SCALE/KENO-VI high fidelity Monte Carlo model of HTR-10 was developed, based on the IAEA benchmark specifications and experimental data. A diffusion theory model for practical applications is under development.
4. “Safety and technical aspects of the implementation of nuclear power in Poland” – a study for the Brandenburgische Technische Universität in Cottbus, published in the book “Deutschlands Energiewende und Polens Einstieg in die Kernenergie?”

The work of the Probabilistic Safety Analysis Team has been concentrated mainly on the analysis of the impact of external events.

The consequences of external events and their combination on nuclear safety have been investigated within the FP7 EU project ASAMPSA "Advanced Safety Assessment: Extended PSA". The work was focused on the analysis of initializing events and impact on spent fuel pool and shutdown states. The project will be continued to July 2016.

Similar work for the estimation of major accidents of chemical plants caused by extreme meteorological conditions has been provided for the implementation of the national programme: Country Protection Informatics System.

A new approach to the implementation of the IRIDM (Integrated Risk Informed Decision Making)

methodology of IAEA has been proposed based on the Value Tree Analysis method. This approach allows for better quantification of possible strategies and transparency of the decision making process.

Dedicated expertise for the National Atomic Energy Agency has been provided in the following fields: probabilistic fire safety analysis, implementation of a decision support system for nuclear emergencies and migration of radionuclides in porous media.

A number of thermal-hydraulics studies have been undertaken using tan approach based on computational fluid dynamics. The most important are the following:

1 Thermal hydraulic safety margin determination for an in-core neutron stream converter designed for the MARIA Research Reactor - fuel assembly study.
2 High definition mesh generation for a new design of uranium tray used in Mo-99 production.
3 RANS approaches to analyse the flow and mixing processes within a fuel assembly.
4 Material and shape determination for the design of a calorimeter for in-core gamma heating measurements.
5 CFD-FEM coupled analysis of flow induced structural deformation.
6 Thermal hydraulic study of material sample irradiation channel - multi-body contact issue.
7 Innovative design of low-emission burners with the use of a rotating swirler.
8 Fluid divider geometry optimization as a solution for server room cooling instabilities issues.

In the field of new technologies, work was conducted in several areas. The HTRPL project, focused on the physics of high temperature reactors (HTRs), was continued. Most of the work within this project was concentrated on the thermal-hydraulics of helium flow through a pebble bed, as well as on heat dissipation from the reactor in accident conditions. Moreover, several other projects were conducted in parallel, most notably ALLIANCE and ESNII+, which are devoted to the design of a gas cooled fast reactor ALLEGRO.

The Fuel Cycle Laboratory continued its involvement in the International Research Project “E+T RAW” realized in JINR Dubna, Russia (Cooperation protocol 4382-1-14/16). The project aim is an investigation of nuclear waste utilization with spallation neutrons produced in a natural uranium assembly QUINTA during irradiation with a high energy accelerator beam. A series of experiments was carried out in 2012, 2013 and 2014. Y-89 sample activation method was used for neutron field parameter determination and the actinides Np-237 and Am-241 for fission and neutron capture rate determination.

Work on modelling of helium atom migration in uranium dioxide fuel during neutron irradiation and during annealing has been continued.

The main activities of the Environmental Analysis Laboratory were concentrated on the following issues:

1 The role of natural and anthropogenic radionuclides in the global electrical circuit of the earth based on the selected measurements in the polar regions and medium geographic zone.
2 Introductory measurements of particulate matter concentration in ambient air in the vicinity of the potential location of a Nuclear Power Plant (Krokowa commune).

Within the Bayes-Fits project studies on enhancing the efficiency of the Bayesian approach in the the stochastic event reconstruction have been continued, especially in the context of localizing an atmospheric contamination source. Apart from the previously applied Markov chain Monte Carlo (MCMC) and Sequential Monte Carlo (SMC) the hybrid version of the SMC along with Markov Chain Monte Carlo (MCMC) algorithms have been proposed and examined from the point of view of their effectiveness to estimate the probabilistic distributions of atmospheric release parameters.

We have also extended the reconstruction methodology by modern, inspired by nature, heuristic algorithms i.e. the genetic algorithm (GA), Generalized Extreme Optimization (GEO) algorithm, and Particle Swarm. We have obtained excellent results applying the Genetic Algorithm (GA) to the problem of atmospheric contaminant source localization. Recently, we have set up the particle swarm algorithm to localize a contamination source in an urban area employing as the forward dispersion model the QUIC-URB model. All proposed algorithms were tested using real field tracer experimental data.

Tomasz Jackowski

REPORTS

Safety analysis and technology of irradiation LEU targets for Mo-99 production
E. Borek-Kruszewska, ... , **M. Dorosz**, **J. Jaroszewicz**, **J. Lechniak**, **Z. Marcinkowska**, **P. Nowakowski**, **J. Piąstka**, **Z. Przybysz**, **K. Pytel**, **M. Wierzchnicka**, ... et al.
NCBJ, Report Nr B-40/2014

Bonding Xenon and Kryptonon the surface of a Uranium dioxide single crystal
L. Dąbrowski, **M. Szuta**
NCBJ, Świerk, Ann.Rap. p.224

Geological characteristics of the Lubin-Sieroszowice deposits area - literature review
A. Burakowska
NCBJ

Diffusion of Helium in perfect Uraniumand Thorium dioxide single crystals
L. Dąbrowski, **M. Szuta**
NCBJ, Świerk, Ann. Rap. p. 225,

Modification of UO2 grain Re-crystallization temperature as a functionof burn-up as a base for vitanza experimental curve reconstruction
M. Szuta, **L. Dąbrowski**
NCBJ, Świerk, Ann. Rap. p 227

Natural and manmade radionuclides in soils in the vicinity of Zakłady Azotowe \
A. Burakowska, **B. Mysłek-Laurikainen**, **H. Trzaskowska**
NCBJ

Preparation of cross-sections library for nuclear power reactor on basis EPR reactor using the SCALE code for the program PARCS
K. Andrzejewski, **A. Bujas**, **Ł. Koszuk**
National Centre for Nuclear Research

Status Report on Hydrogen Management and Related Computer Codes (NEA/CSNI/R(2014)8)
Z. Liang, ... , **P. Prusiński**, ... et al.
OECD Nuclear Energy Agency

Material study on silver objects form Medival Period
E. Miśta
Institute of Archaeology and Ethnology Polish Academy of Science (in press)

Thermal to 14 MeV neutron converter
K. Pytel, ... , **R. Prokopowicz**, **M. Dorosz**, **A. Zawadka**, **J. Lechniak**, **M. Lipka**, **Z. Marcinkowska**, **M. Wierzchnicka**, **A. Małkiewicz**, **I. Wilczek**, **T. Krok**, **M. Migdal**, **A. Kozieł**, ... et al.
The National Centre for Research and Development, Warsaw, Poland (in press)

Report from metarial study on objects originate from archaeoelogical site in Łężany
E. Miśta
Warsaw University (in press)

Report from metallographic research on object from archeological site in Czerwony Dwór
E. Miśta
Warsaw University (in press)

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

A multi-scale approach to the simulation of CBRN events
S. Potempski
Workshop on Atmospheric dispersion models and Decisions Support systems in the frame of CBRN events (Italy, Varese, 2014-06-16 - 2014-06-18)

Poland\'s Technical Requirements for Reactor Design and Technology
T. Machtyl
Interregional Workshop on Design, Technology and Deployment Considerations for Small and Medium-sized Reactors (Austria, Vienna, 2014-06-02 - 2014-06-05)

Analizy fizykochemiczne jako śródło wiedzy na temat stopów starożytnych na przykładzie badań zabytków ze stanowiska w Łężanach i innych.
E. Miśta, P. Kalbarczyk, A. Wiśniewska
Modern Heritage - współczesne badania i analizy nad zabytkowym krajobrazem Warmii i Mazur (Poland, Mrągowo, 2014-12-11 - 2014-12-12)

Search for scaling properties of electromagnetic cascades produced by 100-3500 MeV gamma quanta in heavy amorphous media
B. Słowiński, P. Duda, **D. Mączka**, **J. Bzdak**
ION 2014 (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
UMCS (Lublin), Kazimierz Dolny No. (2014) p. 38

Nuclear Cogeneration - perspectives of utilising nuclear energy for other purposes than production of electric power.
K. Różycki, **A. Przybyszewska**
3rd International Nuclear Energy Congress (Poland, Warsaw, 2014-09-24 - 2014-09-24)

Zastosowanie radiografii neutronowej w badaniach bioarcheologicznych.
E. Miśta, **J.J. Milczarek**, A. Sołtysiak, P. Tulik
Zastosowanie technik analitycznych w konserwacji i ochronie zabytków (Poland, Warszawa, 2014-12-04 - 2014-12-05)

Risk limitation in safety improvement for nuclear technologies through the international collaboration
T. Jackowski, **K. Różycki**, **A. Prusiński**, **A. Przybyszewska**
INPRO Dialogue Forum on International Collaboration on Innovations to Support Globally Sustainable Nuclear Energy Systems (Austria, Vienna, 2014-11-18 - 2014-11-21)

Modyfication of UO2 Grain Re-crystallization Temperature In Function of Burm-up as a Base for Incubation Time (burn-up) Experimental Curve Reconstruction.
M. Szuta, **L. Dąbrowski**
Fourth Meeting of the Expert Group on Reactor Fuel Performance (EGRFP) of Working Party on ScienticIssues of Reactor Systems (WPRS) - OCDE/NEA Nuclear Science Committee (France, Paryż, 2014-02-20 - 2014-02-21)

Nuclear Cogeneration in the European and Polish Projects
T. Jackowski, **K. Różycki**, **A. Prusiński**, **A. Przybyszewska**
IAEA TM on Advances in Non-Electric Applications of Nuclear Energy and on Efficiency Improvement at Nuclear power Plants (Canada, Oshawa, 2014-10-06 - 2014-10-08)

Neptunium 237 transmutation measurements using fast neutron spectrum of a subcritical assembly composed of 500kg natural uranium irradiated with 2, 4 and 8 GeV deuterons
M. Szuta, **S. Kilim**, **E. Strugalska-Gola**, **M. Bielewicz**, S. Tiutiunnikov
Technical Meeting on Accelerator Driven Systewms (ADS) Applications and Use of Low Enriched Uranium in ADS (China, Hefei, 2014-09-08 - 2014-09-12)

Zastsowanie radiografii neutronowej w badaniach bioarcheologicznych
E. Miśta, A. Sołtysiak, **J.J. Milczarek**, **P. Tulik**

Konferencja sprawozdawcza Instytutu Archeologii Uniwersytetu Warszawskiego (Poland, Warszawa, 2014-12-01 - 2014-12-01)

Creation of the critical mass for nuclear cogeneration by international cooperation
T. Jackowski, **K. Różycki**, **E. Skrzypek**, **M. Skrzypek**
IAEA TM on Effective Collaboration in the Development of Innovations to Support Sustainable Nuclear Energy Systems (Austria, Vienna, 2014-04-08 - 2014-04-11)

Accurate on-line nuclear heating measurements for MARIA & JHR MTR's
M. Tarchalski, **K. Pytel**, **Z. Marcinkowska**, **M. Wróblewska**, **A. Boettcher**, **R. Prokopowicz**, **A. Małkiewicz**
7th International Symposium on Material Testing Reactors (Poland, Otwock-Świerk, 2014-10-20 - 2014-10-21)

Materials research on archaeological objects using pixe and other non-invasive techniques
E. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
ION 2014 (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
Acta Phys. Pol. A (2014)

Wpływ zanieczyszczeń radioaktywnych i aerozolowych na strukturę elektryczną atmosfery, na podstawie pomiarów Polskiej Stacji Polarnej w Hornsundzie i Obserwatorium Geofizycznym PAN w Świdrze
B. Mysłek-Laurikainen, **H. Trzaskowska**, M. Kubicki, A. Odzimek
IX Międzynarodowa Konferencja Naukowa Ochrona powietrza w teorii i praktyce (Poland, Zakopane, 2014-10-14 - 2014-10-17)

HEFUS3 - helium cooled facility modeling, steady state and transient simulation with the severe accident codes RELAP/SCDAPSIM and MELCOR
M. Skrzypek, **E. Grodzicka**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

Zakład Energetyki Jądrowej EJ1 NCBJ - Możliwości i doświadczenie w przeprowadzaniu analiz bezpieczeństwa
T. Jackowski, **J. Malesa**, **K. Samul**
Analizy Bezpieczeństwa Reaktorów BWR (Poland, Gdańsk, 2014-09-29 - 2014-09-30)

Errichtung eines Atomkraftwerkes in Nordpolen - Standortbezogene Auswirkungen und die gesellschaftliche Bewertung / Budowa elektrowni jądrowej w północnej Polsce – wpływ na rozwój regionu
Ł. Koszuk, **K. Andrzejewski**
Deutschlands Energiewende und Polens Einsteig in die Kernenergie? (Germany, Berlin, 2014-10-08 - 2014-10-08)
Logos Verlag Berlin GmbH, Verlag für wissenschaftliche Publikationen, Berlin No. (2014)

Reactor MARIA in Poland, its History and Future
B. Mysłek-Laurikainen, **A. Gołąb**
Nuclear 2014 The 7th Annual International Conference on Sustainable Development through Nuclear Research and Education (Romania, Pitesti, 2014-05-28 - 2014-05-30)
Raten ICN Pitesti , Rumunia No. (2014) p. 21

The European programmes supporting the development of nuclear energy in Europe, with particular reference to nuclear cogeneration and the role of Poland in these programmes
T. Jackowski, **M. Skrzypek**, **E. Skrzypek**
Stockholm Nuclear Day (Sweden, Stockholm, 2014-06-10 - 2014-06-10)

Znaczenie energetyki jądrowej i odnawialnych źródeł energii dla energetyki polskiej
K. Andrzejewski, **A. Strupczewski**
II KONGRES ELEKTRYKI POLSKIEJ (Poland, Warszawa, 2014-12-01 - 2014-12-02)

Measurements Relevant to High Energy Neutron Spectrum (>10MeV) by Using Threshold Detectors.
M. Bielewicz, **E. Strugalska-Gola**, **S. Kilim**, **M. Szuta**
2nd International Conference of the CENEN-NET (Czech Republic, Prague, 2014-02-04 - 2014-02-07)
Fast Neutron Fluence in Beryllium Matrix of MARIA Reactor using Diffusion Model
Z. Marcinkowska, **K. Pytel**, **R. Wójcik**, A. Struski, **Ł. Koszuk**
7th International Symposium on Material Testing Reactors (Poland, Otwock-Świerk, 2014-10-20 - 2014-10-21)

Spatial and Temporal Distrbution of Radioactive Aerosols on Polar Region and its Effect to Atmospheric Electricity Parameters
B. Mysłek-Laurikainen, **H. Trzaskowska**, M. Kubicki, A. Odzimek
International Conference on Radioecology & Environmental Radioactivity,Ring of Five workshop (Spain, Barcelona, 2014-09-07 - 2014-09-12)

National Centre for Nuclear Research – POLAND – Some Science and Educational Program
M. Bielewicz, **G. Wrochna**
2nd International Conference of the CENEN-NET (Czech Republic, Prague, 2014-02-04 - 2014-02-07)

The Polish way to nuclear power
Ł. Koszuk
The International Youth Nuclear Congress (Spain, Burgos, 2014-07-06 - 2014-07-11)

Oral Presentation

Oddziaływania nadsubtelne i właściwości magnetoelektryczne roztworów stałych $(BiFeO_3)_x$-$(BaTiO_3)_{1-x}$
K. Kowal, M. Kowalczyk, D. Czekaj, E. Jartych
X Ogólnopolskie Seminarium Spektroskopii Mössbauerowskiej - OSSM 2014 (Poland, Wrocław, 2014-06-15 - 2014-06-18)

Measurements of Np-237 incineration in ADS setup QUINTA
E. Strugalska-Gola, **S. Kilim**, **M. Bielewicz**, **M. Szuta**
XXII International Baldin Seminar on High Energy Physics Problems – "Relativistic Nuclear Physics & Quantum Chromodynamics (Russia, Dubna, 2014-09-15 - 2014-09-20)

Measurements of fast neutron spectrum in QUINTA assembly irradiated with 2,4 and 8GeV deuterons
E. Strugalska-Gola, **M. Bielewicz**, **S. Kilim**, **M. Szuta**
XXII International Baldin Seminar on High Energy Physics Problems – "Relativistic Nuclear Physics & Quantum Chromodynamics (Russia, Dubna, 2014-09-15 - 2014-09-20)

Space-dynamic correlations in quasi-two-particles p+Xe→ p+N interactions at GeV energy region.
B. Słowiński, A.Pacan.
XXII International Baldin Seminar on High Energy Physics Problems – "Relativistic Nuclear Physics & Quantum Chromodynamics (Russia, Dubna, 2014-09-15 - 2014-09-20)

Risk-informed, performance-based fire protection in chemical and nuclear industries
M. Borysiewicz, **A. Kaszko**, **K. Kowal**, **S. Potempski**
47th ESReDa Seminar: Fire Risk Analysis (Poland, Warszawa, 2014-10-15 - 2014-10-16)

Measurement of cross-sections of Yttrium (n,xn) threshold reactions by means of gamma spectroscopy
P. Chudoba, **S. Kilim**, **E. Strugalska-Gola**, **M. Bielewicz**, **M. Szuta**
XXII International Baldin Seminar on High Energy Physics Problems – "Relativistic Nuclear Physics & Quantum Chromodynamics (Russia, Dubna, 2014-09-15 - 2014-09-20)

Neutrons production in heavy spallation targets by electrons beams
A. Pacan, **B. Słowiński**
XXII International Baldin Seminar on High Energy Physics Problems – "Relativistic Nuclear Physics & Quantum Chromodynamics (Russia, Dubna, 2014-09-15 - 2014-09-20)
JINR Dubna No. (2014) p. 93

Efficiency of Sequential Monte Carloand Genetic algorithm in Bayesianestimation of the atmosphericcontamination source
A. Wawrzyńczak-Szaban, **P. Kopka**, P. Kopka, M. Jaroszyski, **M. Borysiewicz**,
21st International Conference on Computational Statistics (Switzerland, Genewa, 2014-08-19 - 2014-08-22)
The International Statistical Institute/International Association for Statistical Computin No. (2014) p. 601

Fast neutron spectrum measurement in a subcritical assembly composed of 500kg natural uranium irradiated with 2,4 and 8 GeV deuterons
E. Strugalska-Gola, **M. Bielewicz**, **S. Kilim**, **M. Szuta**
Nutech-2014Development and Applications of Nuclear Technologies (Poland, Warsaw, 2014-09-21 - 2014-09-24)

Data-driven Genetic Algorithm in Bayesian estimation of the abrupt atmospheric contamination source
A. Wawrzyńczak-Szaban, M. Jaroszyński, **M. Borysiewicz**
FEDERATED CONFERENCE ON COMPUTER SCIENCE AND INFORMATION SYSTEMS (Poland, Warszawa, 2014-09-07 - 2014-09-10)
Annals of Computer Science and Information Systems Vol. 2 (2014) 519–527

Application of EULAG to the simulation of flow through the urban structure in Warsaw
M. Korycki, L. Łobocki, A. Wyszogrodzki
4th International EULAG Workshop (Germany, Mainz, 2014-10-20 - 2014-10-24)

Localizing of the atmospheric contamination source by the Sequential Monte Carlo methods and Bayesian inference for the Kori field tracer experiment
P. Kopka, P. Kopka, **A. Wawrzyńczak-Szaban**, **M. Borysiewicz**
XIII Conference Polish Operational and Systems Research Society BOS 2014 (Poland, Warszawa, 2014-09-24 - 2014-09-26)

Structural Reliability Issues in Na-Tech Risk Assessment
M. Borysiewicz, **T. Jackowski**, **S. Potempski**
46th ESREDA Seminar: Challenges in Structural Safety and Risk Analysis (Italy, Torino, 2014-05-29 - 2014-05-30)

Fire risk for chemical industrial installations caused by weather conditions impact
M. Borysiewicz, **O. Dorosh**, **S. Potempski**, **G. Siess**
47th ESReDa Seminar: Fire Risk Analysis (Poland, Warszawa, 2014-10-15 - 2014-10-16)

Structural Reliability Issues in Na-Tech Risk Assessment
T. Jackowski, **M. Borysiewicz**, **S. Potempski**
46th ESReDA Seminar on Challenges in Nuclear Safety and Risk Analysis (Italy, Torino, 2014-05-28 - 2014-05-30)

LOFT in BNCT converter
P. Prusiński, **Ł. Kozioł**, **T. Kwiatkowski**, **S. Potempski**, **A. Prusiński**
CFD4NRS-5 (Switzerland, Zurich, 2014-09-09 - 2014-09-11)
ETH Zurich No. (2014) p. 113

Preparing for MDC with F-stat AllSky pipeline
A. Królak, M. Bejger, **O. Dorosh**
LSC-Virgo collaboration meeting (France, Nice, 2014-03-17 - 2014-03-21)

Właściwości magnetoelektryczne roztworów stałych $(BiFeO_3)_x$-$(BaTiO_3)_{1-x}$
K. Kowal
Warsztaty Doktoranckie Wydziału Elektrotechniki i Informatyki Politechniki Lubelskiej (Poland, Lublin, 2014-01-31 - 2014-02-01)

Spent fuel risk assessment for reactors at low power and shutdown
M. Borysiewicz, **K. Kowal**
Regional Workshop on Advanced Low Power and Shutdown PSA (Austria, Vienna, 2014-03-24 - 2014-03-28)

Experience with RODOS, further possibilities
R. Dąbrowski, I. Matujewicz, **S. Potempski**, **H. Wojciechowicz**
RUG: RODOS User s Group (Switzerland, Brugg, 2014-02-27 - 2014-02-28)

Oddziaływania nadsubtelne i właściwości magnetoelektryczne roztworów stałych $(BiFeO_3)_x$-$(BaTiO_3)_{1-x}$
K. Kowal
Warsztaty Doktoranckie Wydziału Elektrotechniki i Informatyki Politechniki Lubelskiej (Poland, Lublin, 2014-06-13 - 2014-06-14)

Lead shielding impact on fast neutron spectrum (>10MeV) in QUINTA uranium target.
E. Strugalska-Gola, **M. Szuta**, **M. Bielewicz**, **S. Kilim**
XXII International Baldin Seminar on High Energy Physics Problems – "Relativistic Nuclear Physics & Quantum Chromodynamics (Russia, Dubna, 2014-09-15 - 2014-09-20)
Proceedings of Science (2014)

Poster

Structure and some magnetic properties of $(BiFeO_3)_x$-$(BaTiO_3)_{1-x}$ solid solutions prepared by solid-state sintering
K. Kowal, M. Kowalczyk, D. Czekaj, E. Jartych
X Ogólnopolskie Seminarium Spektroskopii Mössbauerowskiej - OSSM 2014 (Poland, Wrocław, 2014-06-15 - 2014-06-18)

Materials research on archaeological objects using PIXE and other non - invasive technique
E. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

The Concept of Licensing Process for Standardised Reactor Technologies and the Role of TSO
T. Jackowski, **K. Różycki**, **A. Prusiński**, **A. Przybyszewska**, **D. Niewiadomska**
International Conference on Challenges Faced by Technical and Scientific Support Organizations TSOs in Enhancing Nuclear Safety and Security (China, Beijing, 2014-10-27 - 2014-10-31)

Research on the corrosion and ornamentation character of the metal artefacts from archaeological site in czaszkowo, poland
E. Miśta, A. Rzeszotarska-Nowakiewicz, P. Kalbarczyk, K. Trela, T. Nowakiewicz
LaconaX. Lasers in the Conservation of Artworks (United Arab Emirates, Sharjah, 2014-06-09 - 2014-06-13)

Thermal-hydraulics calculations for a fuel assembly in a European Pressurized Reactor using the RELAP5 code
M. Skrzypek, R. Laskowski
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)
Nukleonika (2014)

Loss of coolant accident in Pressurized Water Reactor Prediction of a 1 inch cold leg break with RELAP5 and CATHARE 2
K. Samul, M. Pawluczyk, P. Mazgaj
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

Bayesian stochastic reconstruction of theatmospheric contamination source based on thedata from field tracer experiment over the Korinuclear site
P. Kopka, P. Kopka, **A. Wawrzyńczak-Szaban**, **M. Borysiewicz**
Second Bayesian Young Statisticians Meeting BAYSM2014 (Austria, Wiedeń, 2014-09-18 - 2014-09-19)

Neutron activation measurements in MARIA reactoras a benchmark against numerical calculations
R. Prokopowicz, **Z. Marcinkowska**, **K. Pytel**, **K. Andrzejewski**, **B. Pytel**, **T. Kulikowska**, **A. Kozieł**, **A. Boettcher**, **M. Tarchalski**
The 15th International Symposium on Reactor Dosimetry (France, Aix en Provence, 2014-05-18 - 2014-05-23)

Detection of Fukushima Origin Ceasium Isotopes at Polish Polar Station in Hornsund(Spitzbergen and its Efects to AtmosphericElectricity Parameters
B. Mysłek-Laurikainen, **M. Matul**, **S. Mikołajewski**, **H. Trzaskowska**, M. Kubicki, P. Barański, A. Odzimek, S. Michnowski

Air Quality 2014 (Germany, Garmisch-Partenkirchen, 2014-03-24 - 2014-03-28)
Institute of Meteorology and Climate Research (IMK-IFU),Centre for Atmospheric and Instrumentation Research(CAIR)Univercity of Hertfordshire UK No. (2014) p. 193

MARIA Research Reactor Thermal-hydraulic Calculations With RELAP5 Code
E. Grodzicka, **M. Skrzypek**
23nd International Conference Nuclear Energy for New Europe, NENE2014 (Slovenia, Portoroz, 2014-09-08 - 2013-09-11)
Nuclear Society of Slovenia No. (2014)

Safety analysis of the uranium neutron converter for BNCT facility
M. Maciak, **P. Prusiński**, **M.A. Gryziński**, **T. Kwiatkowski**, Ł. Kozioł, **K. Pytel**
16th International Congress on Neutron Capture Therapy (Finland, Helsinki, 2014-06-14 - 2014-06-19)

The role of natural like ^{7}Be and antropogenic radionuclides in Global Electrical Circut(GEC) of the Earth based on the selected measurements in polar regions and medium geographic zone.
B. Mysłek-Laurikainen, **H. Trzaskowska**, M. Kubicki, A. Odzimek
35th Polar Symposium Diversity and state of polar ecosystems (Poland, Wrocław, 2014-06-04 - 2014-06-07)
Uniwersytet Wrocławski, Institute of Geography and regional Development No. (2014) p. ISBN 978 -83-62

Simulation of Large Break LOCA without Safety Injection for EPR Reactor using MELCOR 2.1 Code
P. Darnowski, **E. Grodzicka**, P. Mazgaj, M. Gatkowski
Nutech-2014Development and Applications of Nuclear Technologies (Poland, Warsaw, 2014-09-21 - 2014-09-24)

Vibration diagnostics of cooling circuit in Maria reactor before and after fuel conversion from HEU to LEU
T. Krok, **M. Migdal**
RERTR-2014 International Meeting on Reduced Enrichment for Research and Test Reactors (Austria, Vienna, 2014-10-12 - 2014-10-15)

Brief history of MARIA conversion from HEU to LEU
M. Migdal, **T. Krok**
RERTR-2014 International Meeting on Reduced Enrichment for Research and Test Reactors (Austria, Vienna, 2014-10-12 - 2014-10-15)

Neutron radiography studies of ancient objects from Poland
J.J. Milczarek, **J. Żołądek-Nowak**, **I. Fijał-Kirejczyk**, **E. Miśta**, **J. Żołądek**, **Z. Jurkowski**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

LECTURES, COURSES AND EXTERNAL SEMINARS

Nuclear Power Plant - operation basics and safety[a]
K. Samul
Słupsk, Pomorski Uniwersytet Trzeciego Wieku przy Wyższej Szkole Gospodarki, 2014-01-30

Safety analysis in nuclear power plants, including severe accident phenomena, modelling issues using apropriate tools. Modelling of helium facility using severe accident codes.[a]
M. Skrzypek
Warsaw, Warsaw University of Technology, 2014-03-26

Reactor Safety Analysis Workshop #3 with AREVA: Reactor Safety Analysis in the frame of SARWUT (T/H part)[b]
K. Samul
Warsaw, Warsaw University of Technology, 2014-06-24

Reactor Safety Analysis Workshop #3 with AREVA -Scenario 5: CPY: Main feedwater regulation malfunction (RELAP5, CATHARE)[b]
K. Samul
Warsaw, Warsaw University of Technology, 2014-06-24

EPR - Loss of Offsite Power with Total Failure of all Diesel Generators. Calculations code: MELCOR, MAAP.[b]
E. Grodzicka
Warsaw, Warsaw University of Technology, 2014-06-26

Severe Accidents[b]
E. Grodzicka
Warsaw, Warsaw University of Technology, 2014-06-26

Safety analysis for main feedwater regulation malfunction in PWR900MWe scenario. Comparison of results between two thermall hydraulics codes: RELAP5 and CATHARE.[b]
M. Skrzypek
Warsaw, Warsaw University of Technology, 2014-06-26

Nuclear Energy Division NCBJ – The state of preparation of scientific and technical staff for safety assessment of nuclear reactors[a]
J. Malesa
Gdansk, EUROCON, 2014-09-29

CFD Analysis Group[b]
T. Kwiatkowski
Zittau, Hochschule Zittau/Görlitz University of Applied Sciences, 2014-12-04

a) in Polish
b) in English

INTERNAL SEMINARS

Modeling flow, dispersion and transport of contaminants in porous media.[a]
O. Dorosh
Swierk, NCBJ, 2014-01-13

Modeling flows and the dispersion and transport of contaminants in porous media.[a]
H. Wojciechowicz
Świerk, National Center for Nuclear Research, 2014-01-13

An assessment of the Core Damage Frequency (CDF) of a Pressurized Water Reactor (PWR)[b]
K. Kowal
Otwock, National Centre for Nuclear Research, 2014-01-29

Archaeometallurgy[a]
E. Miśta
Otwock-Świerk, National Centre for Nuclear Research, 2014-02-17

Web service allowing for remote access to the CIŚ computer cluster resources via web browser[a]
R. Możdżonek
Otwock-Świerk, National Centre for Nuclear Research, 2014-03-05

Fluid divider - analysis of the different configurations of CIŚ cluster cooling system.[a]
T. Kwiatkowski
Otwock-Świerk, National Centre for Nuclear Research, 2014-03-12

Bayesian methods in the stochastic identification of the source of atmospheric contamination for the Kori experiment[b]
A. Wawrzyńczak-Szaban
Świerk, CIŚ, 2014-04-08

Model of a LOFT facility[a]
K. Samul
Świerk, National Centre for Nuclear Research, 2014-04-14

Thermodynamic properties of ceramics with structure defects caused by radiation.[a]
O. Dorosh
Swierk, NCBJ, 2014-04-16

Modelling of helium cooled facility using severe accident codes avaiable in NCBJ.[a]
M. Skrzypek
Otwock-Swierk, National Centre for Nuclear Research, 2014-05-07

Analysis of LOCA in PWR plants with use of LOFT facility[a]
K. Samul
Świerk, National Centre for Nuclear Research, 2014-05-14

Representation of urban buildings in structured grids of hydrodynamic models[a]
M. Korycki
Jablonna, Polish Academy of Sciences, 2014-05-16

Webservice for monitoring and analysis of contamination in Maria research reactors fuel channels [a]
K. Gomulski
Świerk, National Centre For Nuclear Research, 2014-05-21

Assessment of infrastructure remaining after the construction of Żarnowiec NPP[a]
M. Łuszcz
Świerk, National Centre for Nuclear Research, 2014-06-02

The hydraulic divider - geometry investigation[b]
D. Zgorzelski
Swierk , National Centre for Nuclear Research, 2014-06-04

MARIA Research Reactor Thermalhydraulic Calculations With RELAP5 Code[b]
E. Grodzicka
Otwock -Świerk, National Center for Nuclear Research, 2014-06-11

Maria Research Reactor. Model in RELAP 5[b]
D. Szymański
Świerk, National Centre for Nuclear Research , 2014-09-04

CFD Analysis for the pebble bed inside the High Temperature Reactor - HTR.[a]
A. Prusiński
Otwock, National Centre for Nuclear Research, 2014-10-13

Attack and protection of webapplication: Basic issues[a]
K. Gomulski
Świerk, National Centre for Nuclear Reactor, 2014-10-28

P1 - computer program for preliminary analyzes of power stations circuits and other thermodynamic systems.[a]
T. Machtyl
Otwock-Swierk, National Centre for Nuclear Research, 2014-11-05

[a)] in Polish
[b)] in English

DIDACTIC ACTIVITY

M. Borysiewicz - Certified Manager of Risk Managment POLRISK

M. Borysiewicz - Determination by ALOHA and HPAC 4 of threatened area after a accidental release of ammonia, The International Centre for Chemical Safety and Security

M. Borysiewicz - Transport and dispertion modeling of chemical substance released in the air by ALOHA software package, IMGW

E. Grodzicka - Master Engineering project promotion - Analytical model of typical boiling water reactor fuel assembly - steady state analysis

E. Grodzicka - Promotion of master engineering project - Comparison of liquid metal flow correlations for sodium, lead, bismuth and lead-bismuth eutectic.

E. Grodzicka - Promotion of the master engineering project - Modelling of ERP fuel assembly in RELAP code.

Ł. Koszuk - Trainig with MARIA reactor simulator for a group of listeners of Nuclear Energy Postgraduate Studies at Warsaw University of Technology

T. Kwiatkowski - Internships students supervision

S. Potempski - Certified Manager for Risk Management POLRISK

S. Potempski - Fundamentals of risk analysis and management for transport accidents, Lodz University of Technology

S. Potempski - Industrial tools for safety and mitigation of the consequences of industrial accidents, Main School of Fire Service

S. Potempski - Modelling of transport and dispersion in atmosphere after the releases of chemical substances using ALOHA code, Institute of Meteorology and Water Management, Cracow

G. Siess - Certified Manager of Risk Managment POLRISK

G. Siess - Determination by ALOHA and HPAC 4 of threatened area after a accidental release of ammonia, The International Centre for Chemical Safety and Security

G. Siess - Transport and dispertion modeling of chemical substance released in the air by ALOHA software package, IMGW

M. Skrzypek - Promotor of two Intermediate Master Project and two Enginieering Project on WUT

B. Słowiński - Jacek Bzdak, MSc, engin., as a PhD student, Faculty of Physics, Warsaw University of Technology. Subject of investigation: the space-temporal dynamics of air pollution

B. Słowiński - Kai Deng, 6-semester student, Faculty of Physics, Warsaw University of Technology. Subject of study: experimental investigation of air pollution characteristics

B. Słowiński - One semester lecture for undergraduate students (30h): Radiation modification of materials. Faculty of Physics, Warsaw University of Technology

B. Słowiński - One semester lectures (30h) "Global development of energetics" for underground students of University of Life Sciences, Warsaw

B. Słowiński - PhD student Klara Rusin, MSc, engin., subject of studies: optimal management of burned nuclear fuel. NCNR.

B. Słowiński - Physics background of nuclear power - one semester lectures for underground i PhD students of Faculty of Physics, Warsaw University of Technology

B. Słowiński - scientific leadership for 7 semester's student Dorota Głazek, Physics Faculty, Warsaw University of Technology. The theme: Development of electromagnetic cascades in segmented amorphous media

B. Słowiński - The subject of PhD thesis of Artur Pacan, MSc, eng.: Physics phenomena in spalation targets of reactors setups driven by electrons and protons beams

B. Słowiński - Undergraduate student Paweł Rożnowski, Faculty of Physics, WUT. Subjest of investigation: modelling of levels of air pollution with atmospheric
suspended particulate matter.

A. Wawrzyńczak-Szaban - Supervisor of the master thesis of the BayesFits project trainee Marcin Jaroszyński. Thesis title 'Application of the genetic algorithm in stochastic events reconstruction of the atmospheric releases'.

A. Wawrzyńczak-Szaban - Supervisor of the master thesis of the BayesFits project trainee Tomasz Kociołek. Thesis title 'Application of the generalized extreme optimization algorithm in stochastic event reconstruction of atmospheric releases'.

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

K. Andrzejewski
Nukleonika, Institute of Nuclear Chemistry and Technology

M. Bielewicz
Polish Astronomical Society

M. Borysiewicz
Member of the European Safety, Reliability and Data Association (ESReDA)

A. Bujas
Member of Organizing Committee on VIIth International School on Nuclear Power in Warszawa-Świerk-Różan, Poland

S. Chwaszczewski
Member of Polish Commitee
Polish Nuclear Society

T. Jackowski
Session chairman on IAEA TM on Effective Collaboration in the Development of Innovations to Support Sustainable Nuclear Energy Systems in Vienna, Austria
Member of Advisory Board on International Conference on Challenges Faced by Technical and Scientific Support Organizations TSOs in Enhancing Nuclear Safety and Security in Beijing, China
Polish Nuclear Society
Steering Commitee member of IAEA TSO Forum
SNETP Executive Committee

A. Kaszko
Member of Organizing Committee on 47th ESReDa Seminar: Fire Risk Analysis in Warszawa, Poland

Ł. Koszuk
Member of Organizing Committee on VIIth International School on Nuclear Power in Warszawa-Świerk-Różan, Poland
ATOMIC FORUM Foundation, President
Polish Nuclear Society, member
Forum Atomowe, Atomic Forum, ATOMIC FORUM Foundation

K. Kowal
Member of Organizing Committee on 47th ESReDa Seminar: Fire Risk Analysis in Warszawa, Poland

D. Mączka
a member of the Polish Physical Society
Lublin Society of Science, a mumber
a member of the Faculty of Math.Inf.Phys., MCS University, Lublin

M. Migdal
Session chairman on 7th International Symposium on Material Testing Reactors in Otwock-Świerk, Poland

E. Miśta
Vice-President, Polish Nuclear Society - Youth Forum
Member, European Nuclear Society - Young Generations (ENS YNG)
Member, Women in Nuclear
member, Inter-Society for Scientific Research and Protection of the World Cultural Heritage HUMANICA

B. Mysłek-Laurikainen
Member, Polish Physical Society
Polish Nuclear Society
Member of Polish Nucleonic Society
Member of Women in Nuclear Poland
National Centre for Nuclear Research
Member of Scientific Counsil of NCBJ

S. Potempski
Member: specialist in numerical analysis and informatics

B. Słowiński
Journal of Nuclear and Radiation Physics. A Periodical of the Egyptian Nuclear Physics Association, Journal of Nuclear and Radiation Physics
a member of the Faculty Council, Faculty of Physics, Warsaw University of Technology

E. Strugalska-Gola
member,Association of Polish Electricians, Committee of Nuclear Power

M. Szuta
OECD/NEA

PERSONNEL

Research scientists

Krzysztof Andrzejewski, PhD
Rafał Baranowski, MScEng.
Agnieszka Boettcher, MSc
Małgorzata Bogusz, MSc Eng
Mieczysław Borysiewicz, PhD
Adrian Bujas, MSc.Eng
Agnieszka Burakowska, PhD
Jacek Bzdak, MScEng.
Orest Dorosh, PhD
Krzysztof Gomulski, MScEng.
Tomasz Jackowski, MScEng.
Henryk Jędrzejec, PhD
Aleksej Kaszko, Eng.
Małgorzata Klisińska, MSc
Michał Korycki, MSc
Łukasz Koszuk, MSc
Karol Kowal, MScEng.
Tomasz Kwiatkowski, MSc Eng.
Mariusz Łuszcz, MScEng.
Tomasz Machtyl, MSc
Janusz Malesa, MScEng.
Zuzanna Marcinkowska, PhD
Dariusz Mączka, Prof. PhD DSc.
Magdalena Mądry, MSc
Ewelina Miśta, MSc
Rafał Możdżonek, MSc Eng
Bogumiła Mysłek-Laurikainen, PhD
Sławomir Potempski, PhD
Piotr Prusiński, MSc Eng
Kajetan Różycki, MSc Eng
Kacper Samul, MSc Eng
Jagoda Sendal, MSc
Grzegorz Siess, MSc Eng
Maciej Skrzypek, MSc Eng
Eleonora Skrzypek, MSc Eng.
Bronisław Słowiński, Prof. PhD DSc.
Michał Spirzewski, MSc Eng
Anna Stadnik, MSc Eng.
Elżbieta Strugalska-Gola, PhD
Jan Szczurek, DSc. Eng.
Marcin Szuta, PhD Eng. Assoc. Prof.
Daniel Szymański, MSc Eng
Anna Wawrzyńczak-Szaban, PhD
Henryk Wojciechowicz, MSc
Andrzej Wojciechowski, PhD
Dariusz Zgorzelski, Eng.

BSc students

Cezary Kowalczyk
Daria Niewiadomska, Eng.
Andrzej Prusiński
Piotr Walczak

PhD students

Marcin Bielewicz, MSc
Stanisław Kilim, MSc
Piotr Kopka, MSc

Technical and administrative staff

Jolanta Przyłuska
Anna Wasiuk

*part-time employee

MARIA REACTOR OPERATIONS DIVISION

Head of Division: Andrzej Gołąb, MSc Eng
phone: +48 22 2731088
e-mail: a.golab@ncbj.gov.pl

Overview

Overview

There are 51 employees (engineers and technicians) working in the Maria Reactor Operation Unit.

The main activity of this unit is carrying out safe operation of the MARIA research reactor.

In 2014 the reactor operated for 4300 hours at power levels from 18 MW to 25 MW.

The main activities carried out at the MARIA reactor were focused on:

- irradiation of target materials in vertical channels and in a rabbit system
- irradiation of uranium targets for ^{99}Mo production
- neutron scattering condensed matter studies with neutron beams from reactor horizontal channel
- neutron radiography studies
- neutron modification of crystals and minerals
- training

Irradiation of target materials such as: TeO_2, KCl, Lu_2O_3, $SmCl_2$, S, Co etc. was performed for the Radioisotope Centre Polatom and irradiation of uranium targets was performed for Covidien. In addition production of ^{192}Ir seeds used for Intravascular Radiation Therapy and low activity ^{192}Ir source ribbon for oncology applications were carried out.

The neutron irradiation service utilizing the MARIA reactor also includes the colouring of topaz minerals. The irradiation of minerals in special channels located outside the reactor core changes their clear natural state to shades of blue, thereby increasing the commercial value of the product. Blue topaz is released to the market as non-radioactive material, conforming to strict international criteria.

The commercial irradiation of uranium plates for ^{99}Mo production was carried out at the MARIA reactor in 2014 within 8 reactor operation cycles. The average ^{99}Mo activity at the end of irradiation (EOI) obtained from one irradiation channel was 280 TBq.

An important activity performed in 2014 was focused on preparation of the technology for irradiation of low enriched uranium plates for ^{99}Mo production, which is related to the Global Threat Reduction Initiative. Also in relation to this programme in 2014 the process of conversion the Maria reactor core to low enriched fuel (enrichment 19,75% in ^{235}U) was completed.

Andrzej Gołąb

REPORTS

Safety Analysis of MR Type Spent Fuel Shipment from MARIA Reactor to Russian Federation in TUK-19 Container in 2014
E. Borek-Kruszewska, **K. Pytel**, **J. Lechniak**
NCBJ, Nr B-11/2014

Safety analysis and technology of irradiation LEU targets for Mo-99 production
E. Borek-Kruszewska, ... , **M. Dorosz**, **J. Jaroszewicz**, **J. Lechniak**, **Z. Marcinkowska**, **P. Nowakowski**, **J. Piąstka**, **Z. Przybysz**, **K. Pytel**, **M. Wierzchnicka**, ... et al.
NCBJ, Report Nr B-40/2014

Estimation of radiological protection on the territory of Nuclear Centre Świerk and its vicinity (2013).
B. Filipiak, ... , **Z. Haratym**, **J. Ośko**, **T. Pliszczyński**, **B. Snopek**, **B. Boimski**, **S. Domański**, **M. Dymecka**, **R. Ejsmont**, **M. Feczko**, **A. Garboliński**, **B. Karpińska**, **J. Lechniak**, **A. Pawełczuk**, **G. Pindara**, **B. Piotrkowicz**, **K. Rzemek**, **R. Sosnowiec**, **W. Śniegoń**, **M. Umaniec**, **K. Wiśniewska**, **K. Wojdowska**, **J. Wojnarowicz**, **Z. Worch**, **M. Tulik**, **D. Zielińska**, ... et al.
NCBJ

Results of testing the LTE MR-6/485 fuel elements
E. Borek-Kruszewska, **I. Hora**, **A. Małkiewicz**, **K. Pytel**, **I. Wilczek**, **A. Zawadka**
NCBJ, Report Nr B-25/2014

Thermal to 14 MeV neutron converter
K. Pytel, ... , **R. Prokopowicz**, **M. Dorosz**, **A. Zawadka**, **J. Lechniak**, **M. Lipka**, **Z. Marcinkowska**, **M. Wierzchnicka**, **A. Małkiewicz**, **I. Wilczek**, **T. Krok**, **M. Migdal**, **A. Kozieł**, ... et al.
The National Centre for Research and Development, Warsaw, Poland (in press)

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Some Items of Operating Programme in Polish Research Reactor Maria
A. Gołąb
Workshop on Operating Programmes for Research Reactors (Australia, Wiedeń, 2014-04-07 - 2014-04-11)

Implementation of the Code of Conduct in Polish Research Reactor Maria
A. Gołąb
International Meeting on Application of the Code of Conduct on the Safety of Research Reactors (Austria, Wiedeń, 2014-06-16 - 2014-06-20)

Research Reactor Maria Operation in 2013
A. Gołąb
Research Reactor Operators Group26-th Annual Meeting (Austria, Wiedeń, 2014-05-14 - 2014-05-17)

Reactor MARIA in Poland, its History and Future
B. Mysłek-Laurikainen, **A. Gołąb**
Nuclear 2014 The 7th Annual International Conference on Sustainable Development through Nuclear Research and Education (Romania, Pitesti, 2014-05-28 - 2014-05-30)
Raten ICN Pitesti , Rumunia No. (2014) p. 21

Progress of MARIA research reactor conversion from HEU to LEU fuel
G. Krzysztoszek
The 8-th Technical Meeting on Lessons Learned from the RRRFR Programe (Vietnam, Da-Nang City, 2014-06-18 - 2014-06-20)

The results of replacement of pumps in primary fuel channel cooling circuit in MARIA RR
G. Krzysztoszek
European Research Reactor Conference - RRFM 2014 (Slovenia, Ljubljana, 2014-03-30 - 2014-04-03)

Status of uranium targets irradiation in MARIA reactor for molybdenum production
G. Krzysztoszek
International Group on Research Reactors (Argentina, Bariloche, 2014-11-17 - 2014-11-20)

LECTURES, COURSES AND EXTERNAL SEMINARS

Status of MARIA research reactor opertaion[b]
G. Krzysztoszek
Paris, AREVA, 2014-01-19

The RER1007 Project Review Meeting[b]
G. Krzysztoszek
Vienna, International Atomic Energy Agency, 2014-02-11

Operation Organization and Reactor Management[b]
G. Krzysztoszek
Otwock-Świerk, National Centre for Nuclear Research, 2014-03-31

Strategic Plan Summary - Research Reactor MARIA, Poland[b]
G. Krzysztoszek
Vienna, International Atomic Energy Agency, 2014-10-14

[b)] in English

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

G. Krzysztoszek
Deputy Chairman of Council for Nuclear Safety and Radiation Protection, National Atomic Energy Agency

[a)] in Polish

PERSONNEL

Technical and administrative staff

Marian Bąk
Sylwester Bąk
Wiesława Bąk
Zdzisław Bąk
Bolesław Broda
Michał Czarnecki, MSc Eng.
Wiesław Ćwiek
Andrzej Frydrysiak, MSc Eng
Marcin Gadoś
Andrzej Gołąb, MSc Eng
Ryszard Góralski
Kazimierz Grzenda
Ireneusz Hora
Jacek Idzikowski, MSc Eng.
Ireneusz Iwański, Eng.
Janusz Jaroszewicz, MSc Eng
Krzysztof Jezierski, MSc Eng
Rober Keler
Dariusz Krawczyński
Waldemar Kultys
Edward Kurdej
Dariusz Kwiatkowski
Rober Laskus
Franciszek Lech
Jan Lechniak, MSc Eng
Krzysztof Lechnik
Mateusz Łysiak
Jan Macios
Krzysztof Majchrowski
Rober Marczak
Adrian Michalski
Dariusz Mucha
Paweł Nowakowski, MSc Eng
Hanna Odziemczyk
Ireneusz Owsianko, MSc Eng
Mariusz Ostanek
Krzysztof Sierański 0.6*
Wiesław Sikorski
Stefan Skorupa
Mieczysław Skwarczyński
Ryszard Stanaszek, MSc Eng.
Janusz Suchocki
Piotr Szaforz, MSc Eng
Paweł Święch
Emil Wilczek, MSc Eng
Piotr Witkowski, Eng.
Tomasz Witkowski
Paweł Wojtczuk
Marcin Wójcik
Jarosław Zienkiewicz, MSc Eng
Krzysztof Żołądek

RESEARCH REACTOR TECHNOLOGY DIVISION

Head of Division: Janusz Piąstka, MSc Eng
phone: +48 22 2731091
e-mail: j.piastka@ncbj.gov.pl

Overview

The main tasks of the Department are to support the operation of the MARIA research reactor in:
- safety and thermal-hydraulic analysis,
- design of new equipment and technological systems for production and experiments,
- preparation of project documentation, construction, technical equipment and technological reactor systems in the framework of modernization or renovation,
- measurement technology, including in core measurements,
- repair of equipment and technological systems of the reactor,
- reactor spent fuel management,
- accomplishment of equipment or technological systems based on our own documentation or other authorized design units in the mechanical workshop,
- conducting the warehouse and archives of the department.

The Department operates on the new Quality Assurance Programme for the MARIA Reactor Facility named PZJ MARIA.

The Department consists of five divisions:
- Reactor Analysis and Measurements Division,
- Reactor Technology Division,
- Design and Technology Division,
- Technical Division,
- Mechanical Workshop.

There are 29 employees including 4 researchers with PhD degree.

The main work carried out in 2014 dealt with:

Spent Fuel Shipment from the MARIA reactor to the Russian Federation was performed under the project for removal of the Russian-origin SFAs due to theGlobal Threat Reduction Initiative. The shipment included 44 pcs of MR type spent fuel assemblies loaded into 11 Russian transport containers of TUK-19 type. Before shipment operations associated with preparing MR type spent fuel for transport were conducted partly in the storage pool of the MARIA reactor and partly in the reactor disassembly cell. The work was performed under the Blanket Master Contract No 00108513.

Technology for irradiation of annular uranium targets for molybdenum production was prepared.

Analysis of the isotopic composition of irradiated materials, coolant and air samples by gamma spectrometry i.e. a routine activity, measurements of minerals, topaz, activity measurements of silicon charges prior to their expedition to the receiver, irradiation of two sets of eight Hall sensors.

Janusz Piąstka

REPORTS

Safety Analysis of MR Type Spent Fuel Shipment from MARIA Reactor to Russian Federation in TUK-19 Container in 2014
E. Borek-Kruszewska, **K. Pytel**, **J. Lechniak**
NCBJ, Nr B-11/2014

Safety analysis and technology of irradiation LEU targets for Mo-99 production
E. Borek-Kruszewska, ... , **M. Dorosz**, **J. Jaroszewicz**, **J. Lechniak**, **Z. Marcinkowska**, **P. Nowakowski**, **J. Piąstka**, **Z. Przybysz**, **K. Pytel**, **M. Wierzchnicka**, ... et al.
NCBJ, Report Nr B-40/2014

Quality Assurance Program for MR Type Spent Fuel Shipping in a Tuk-19 Container from the MARIA Reactor to the Russian Federation in brief PZJ Wywoz_MR_
E. Borek-Kruszewska, **J. Piąstka**
NCBJ, Raport Nr B-5/2014

Measurements of decay factor of flow rate in modernized cooling circuit of fuel channels in reactor MARIA
T. Krok, P. Polny
National Centre for Nuclear Research

Report of the MR type spent fuel shipment from MARIA research reactor to Russian Federation in 2014 (VII Shipment)
E. Borek-Kruszewska, **J. Piąstka**, **A. Małkiewicz**, **I. Wilczek**, **A. Zawadka**
NCBJ, Report Nr B-182014

Technology of loading irradiated material samples into a PT-1 container and transportation them from the MARIA reactor to LBM
E. Borek-Kruszewska, **J. Piąstka**, **M. Wierzchnicka**
NCBJ

Results of testing the LTE MR-6/485 fuel elements
E. Borek-Kruszewska, **I. Hora**, **A. Małkiewicz**, **K. Pytel**, **I. Wilczek**, **A. Zawadka**
NCBJ, Report Nr B-25/2014

Thermal to 14 MeV neutron converter
K. Pytel, ... , **R. Prokopowicz**, **M. Dorosz**, **A. Zawadka**, **J. Lechniak**, **M. Lipka**, **Z. Marcinkowska**, **M. Wierzchnicka**, **A. Małkiewicz**, **I. Wilczek**, **T. Krok**, **M. Migdal**, **A. Kozieł**, ... et al.
The National Centre for Research and Development, Warsaw, Poland (in press)

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Seismic impact on MARIA reactor reactivity changes
M. Lipka
7th International Symposium on Material Testing Reactors (Poland, Otwock-Świerk, 2014-10-20 - 2014-10-21)

Accurate on-line nuclear heating measurements for MARIA & JHR MTR's
M. Tarchalski, **K. Pytel**, **Z. Marcinkowska**, **M. Wróblewska**, **A. Boettcher**, **R. Prokopowicz**, **A. Małkiewicz**
7th International Symposium on Material Testing Reactors (Poland, Otwock-Świerk, 2014-10-20 - 2014-10-21)

Fast Neutron Fluence in Beryllium Matrix of MARIA Reactor using Diffusion Model
Z. Marcinkowska, **K. Pytel**, **R. Wójcik**, A. Struski, **Ł. Koszuk**
7th International Symposium on Material Testing Reactors (Poland, Otwock-Świerk, 2014-10-20 - 2014-10-21)

Oral Presentation

Neutron measurments for graphite DPA evaluation
M. Dorosz
7th International Symposium on Material Testing Reactors (Poland, Otwock-Świerk, 2014-10-20 - 2014-10-21)

MARIA Reactor Safety Analyses: recent upgrades and uncommon issues
R. Prokopowicz
IAEA Workshop on Safety Analysis and Safety Documents for Research Reactors (Austria, Vienna, 2014-05-12 - 2014-05-16)

Fast neutron irradiation facilities in MARIA reactor
R. Prokopowicz
7th International Symposium on Material Testing Reactors (Poland, Otwock-Świerk, 2014-10-20 - 2014-10-21)

Renaissance of the Boron Neutron Capture Therapy, BNCT
M.A. Gryziński, **M. Wielgosz**, **M. Maciak**, **K. Pytel**, **N. Golnik**
8 Międzynarodowe Forum Innowacyjne Technologie dla Medycyny (Poland, Supraśl, 2014-12-04 - 2014-12-06)

Development and qualification of a deterministic scheme for the evaluation of gamma heating in experimental reactors. Application to JHR and to the reactor MARIA.
M. Tarchalski
4th Technical Seminar on JHR Experimental Capacity (France, Cadarache, 2014-04-09 - 2014-04-10)

Poster

Vibration diagnostics of cooling circuit in Maria reactor before and after fuel conversion from HEU to LEU
T. Krok, **M. Migdal**
RERTR-2014 International Meeting on Reduced Enrichment for Research and Test Reactors (Austria, Vienna, 2014-10-12 - 2014-10-15)

Brief history of MARIA conversion from HEU to LEU
M. Migdal, **T. Krok**
RERTR-2014 International Meeting on Reduced Enrichment for Research and Test Reactors (Austria, Vienna, 2014-10-12 - 2014-10-15)

Influence of gamma irradiation on properties of selected thermoelectric materials
K. Wojciechowski, M. Andrzejewska, **K. Pytel**, **T. Krok**, **M. Dorosz**, J. Mietelski, W. Gieszczyk, R. Kopec, M. Bożek
12th European Conference on Thermoelectricity (Spain, Madrid, 2014-09-24 - 2014-09-26)

Neutron activation measurements in MARIA reactoras a benchmark against numerical calculations
R. Prokopowicz, **Z. Marcinkowska**, **K. Pytel**, **K. Andrzejewski**, **B. Pytel**, **T. Kulikowska**, **A. Kozieł**, **A. Boettcher**, **M. Tarchalski**
The 15th International Symposium on Reactor Dosimetry (France, Aix en Provence, 2014-05-18 - 2014-05-23)

Safety analysis of the uranium neutron converter for BNCT facility
M. Maciak, **P. Prusiński**, **M.A. Gryziński**, **T. Kwiatkowski**, Ł. Kozioł, **K. Pytel**
16th International Congress on Neutron Capture Therapy (Finland, Helsinki, 2014-06-14 - 2014-06-19)

INTERNAL SEMINARS

New aspects of the activation method in fast neutron measurements from nuclear fission and fusion devices[a]
R. Prokopowicz
Warsaw, Institute of Plasma Physics and Laser Microfusion, 2014-03-27

[a)] in Polish

DIDACTIC ACTIVITY

E. Borek-Kruszewska - Keeping student internships - 2 apprentices

R. Prokopowicz - Neutron measurements in MARIA reactor - laboratory classes in reactor physics for Warsaw University of Technology

PERSONNEL

Research scientists
Borek-Kruszewska Elżbieta
Marcinkowska Zuzanna
Pytel Krzysztof
Prokopowicz Rafał
Dorosz Michał
Tarchalski Mikołaj
Lipka Maciej
Migdal Marek

Rersearch-technical staff
Wierzchnicka Małgorzata

Technical and administrative staff
Czajka Wacław
Kaczyńska Danuta
Kurdej Jadwiga
Kozieł Alina
Krok Tomasz
Małkiewicz Adam
Piąstka Janusz
Polak Jerzy
Przybysz Zbigniew
Pytel Beatrycze
Sobiech Elżbieta
Święch Bogdan
Urbańczyk Marian
Wróbel Wiesław
Wilczek Ireneusz
Wilczek Janusz
Wójcik Mieczysław
Zawadka Antoni
Zduńczyk Zbigniew
Żurawski Adam

RADIATION PROTECTION MEASUREMENTS LABORATORY

Head of Division: Zbigniew Haratym, PhD
phone: +48 22 2731032
e-mail: zbigniew.haratym@ncbj.gov.pl

Overview

The activities of the Radiation Protection Measurements Laboratory are focused on environmental monitoring and the assessment of radiation exposure of people. Scientific interests mostly concern methods of mixed radiation dosimetry and internal dosimetry.

The main tasks of the Laboratory include:

- Radiation monitoring of the Świerk Centre and Różan (KSOP) sites,
- Surveillance of radiation safety,
- Radioactive waste control (especially liquid waste),
- Preparedness for radiation protection in emergency conditions,
- Development of radiation protection measurements and methods,
- Calibration of radiation protection monitoring instruments,
- Personal dosimetry,
- Sewage and drainage water activity measurements,
- Environmental radiation monitoring,
- Research in dosimetry (described below).

In 2014 the Radiation Protection Measurements Laboratory successfully continued its activities concerning the improvement of measuring procedures within two domains of the Laboratory which are accredited by the Polish Centre for Accreditation (PCA), namely:

- The determination of internal body contamination (whole body counter, thyroid counter and radiological analysis of excretions) – Accreditation No. AB 567.
- Calibration of dosimetric instruments - in reference gamma and neutron radiation fields and surface contamination monitors – Accreditation No. AP 070.

The scientific activities of the Radiation Protection Measurements Laboratory are mostly performed by the **Laboratory of Mixed Radiation Dosimetry (head of laboratory dr. eng. Michał A. Gryziński – contact by e-mail m.gryzinski@ncbj.gov.pl or by phone: +48 22 2731157).** The research group consists of four PhDs, three graduate physicists and one engineer.

The main subjects of study concern:

- Development of dosimetry methods for hadron therapy, with particular emphasis on boron-neutron capture therapy (BNCT) and investigation of radiation fields near radiation therapy facilities;
- Development of methods for the determination of operational dosimetric quantities and dose distribution vs. LET in mixed radiation fields, using high-pressure ionization chambers;
- Design and construction of recombination ionization chambers and dosimeters;
- Investigation of processes of ionization and recombination of ions in gases under pressure up to 5 MPa;
- Metrology of mixed radiation fields (including pulsed and high energy fields);
- Development of methods for internal contamination dosimetry;
- Neutron dosimetry over a wide range of the energy spectrum (neutron spectrometry – passive and active)
- Verification of installed dosimetry systems (medical applications);
- Polish Society of Medical Physics – reactivation of Radiation Protection section. The main goal of the section is maintaining the membership of Poland in the IRPA (International Radiation Protection Association);
- Coordination of the preparation of the Integrated Management System for NCBJ;
- Developing the concept of dose planning and restoration methods using PET and SPECT, computer simulations and Monte Carlo calculations based on a phantom with microspheres for SIRT therapy examination;
- Thermo-hydraulic analyses (CFD) of the neutron converter, aimed at an optimized and safe output of the epithermal neutron beam;
- Shields testing: stands for isotope sources and reactor field (testing concrete samples for shielding).

The research work was partly financed by research grants from the Polish Ministry of Science and Higher Education and from the National Centre for Research and Development (Poland).

Zbigniew Haratym

REPORTS

Assessment of the condition of radiological protection in the territory and in the vicinity of the National Radioactive Waste Repository in Różan (2013).
M. Dymecka, **A. Garboliński**, **Z. Haratym**, **T. Pliszczyński**, **B. Snopek**, **W. Śniegoń**, **D. Zielińska**
NCBJ

Estimation of radiological protection on the territory of Nuclear Centre Świerk and its vicinity (2013).
B. Filipiak, ... , **Z. Haratym**, **J. Ośko**, **T. Pliszczyński**, **B. Snopek**, **B. Boimski**, **S. Domański**, **M. Dymecka**, **R. Ejsmont**, **M. Feczko**, **A. Garboliński**, **B. Karpińska**, **J. Lechniak**, **A. Pawełczuk**, **G. Pindara**, **B. Piotrkowicz**, **K. Rzemek**, **R. Sosnowiec**, **W. Śniegoń**, **M. Umaniec**, **K. Wiśniewska**, **K. Wojdowska**, **J. Wojnarowicz**, **Z. Worch**, **M. Tulik**, **D. Zielińska**, ... et al.
NCBJ

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Zastosowanie radiografii neutronowej w badaniach bioarcheologicznych.
E. Miśta, **J.J. Milczarek**, A. Sołtysiak, P. Tulik
Zastosowanie technik analitycznych w konserwacji i ochronie zabytków (Poland, Warszawa, 2014-12-04 - 2014-12-05)

Zastsowanie radiografii neutronowej w badaniach bioarcheologicznych
E. Miśta, A. Sołtysiak, **J.J. Milczarek**, **P. Tulik**
Konferencja sprawozdawcza Instytutu Archeologii Uniwersytetu Warszawskiego (Poland, Warszawa, 2014-12-01 - 2014-12-01)

A new generation of recombination chambers
M.A. Gryziński
The Second International Conference on Radiation and Dosimetry in Various Fields of Research (Serbia and Montenegro, Niš, 2014-05-27 - 2014-05-30)

Oral Presentation

Renaissance of the Boron Neutron Capture Therapy, BNCT
M.A. Gryziński, **M. Wielgosz**, **M. Maciak**, **K. Pytel**, **N. Golnik**
8 Międzynarodowe Forum Innowacyjne Technologie dla Medycyny (Poland, Supraśl, 2014-12-04 - 2014-12-06)

Badanie trwałości i skuteczności betonowych osłon przed promieniowaniem jonizującym w obiektach energetyki jądrowej
P. Tulik, **M.A. Gryziński**, M.A. Glinicki, **M. Maciak**
Badania materiałowe na potrzeby elektrowni konwencjonalnych i jądrowych oraz przemysłu energetycznego. XXI. Seminarium naukowo techniczne (Poland, Zakopane, 2014-06-25 - 2014-06-27)

Poster

Epithermal neutron source at MARIA reactor
M.A. Gryziński, **S. Domański**, **M. Maciak**, **P. Tulik**, **N. Golnik**
16th International Congress on Neutron Capture Therapy (Finland, Helsinki, 2014-06-14 - 2014-06-19)

Epithermal neutron calibration field
P. Tulik, **K. Tymińska**, M. Maciak
The Second International Conference on Radiation and Dosimetry in Various Fields of Research (Serbia and Montenegro, Niš, 2014-05-27 - 2014-05-30)

Dosimetric quantities measured by recombination chambers in low-energy neutron beams
P. Tulik, M. Dobrzyńska, N. Golnik, **M.A. Gryziński**, M. Vins
16th International Congress on Neutron Capture Therapy (Finland, Helsinki, 2014-06-14 - 2014-06-19)

Multisignal ionization chamber as an directional neutron spectrometer
R. Soboń, **M.A. Gryziński**, **M. Maciak**, P. Tulik
The Second International Conference on Radiation and Dosimetry in Various Fields of Research (Serbia and Montenegro, Niš, 2014-05-27 - 2014-05-30)

Simple detectors for criticality accident dosimetry
Ł. Murawski, **M.A. Gryziński**
The Second International Conference on Radiation and Dosimetry in Various Fields of Research (Serbia and Montenegro, Niš, 2014-05-27 - 2014-05-30)

Safety analysis of the uranium neutron converter for BNCT facility
M. Maciak, **P. Prusiński**, **M.A. Gryziński**, **T. Kwiatkowski**, Ł. Kozioł, **K. Pytel**
16th International Congress on Neutron Capture Therapy (Finland, Helsinki, 2014-06-14 - 2014-06-19)

Invention of unique and development of routine radiation monitoring techniques for polish nuclear programme, industry and medicine
J. Ośko, **T. Pliszczyński**, **M.A. Gryziński**, **K. Rzemek**
International Conference on Occupational Radiation Protection: Enhancing the Protection of Workers – Gaps, Challenges and Developments (Austria, Wiedeń, 2014-12-01 - 2014-12-05)

Renaissance of Boron Neutron Capture Therapy
M.A. Gryziński, **M. Wielgosz**, **M. Maciak**, **E.A. Jakubowska**
8 Międzynarodowe Forum Innowacyjne Technologie dla Medycyny (Poland, Supraśl, 2014-12-04 - 2014-12-06)

Monitoring radiologiczny personelu i środowiska na terenie i wokół ośrodka jądrowego Świerk
T. Pliszczyński, **J. Ośko**, **K. Rzemek**, **M. Dymecka**, **K. Wojdowska**, **M. Tulik**, **R. Sosnowiec**, **M. Umaniec**, **Z. Haratym**
XVII Konferencja Inspektorów Ochrony Radiologicznej (Poland, Skorzęcin, 2014-06-11 - 2014-06-14)

EURADOS survey on in-vivo monitoring data of exposed foreigners in Japan, obtained in their respective countries at early stage after the nuclear accident at Fukushima Daiichi nuclear power plant
M.A. Lopez, P. Fojtik, D. Franck, **J. Ośko**, A.L. Lebacq, C. Li, I. Malatova, S.Holm.J. Huikari, M. Muikku, P. Bérard, B. Breustedt, U. Gerstmann, C. Scholl, V. Kamenopoulou, K. Potiriadis, I. Balásházy, P. Zagyvai, B. Lind, R. Kierepko, J.W. Mietelski, **T. Pliszczyński**, J.F. Navarro, T. Navarro, B. Perez, L. DelRisco, G. Etherington, J.E. Scott, V. Vasylenko
International Experts' Meeting on Radiation Protection after the Fukushima Daiichi Nuclear Power Plant Accident (Austria, Wiedeń, 2014-02-17 - 2014-02-21)

Recent improvements of the neutron calibration facility with old radionuclide neutron sources
S. Domański, **M.A. Gryziński**, **M. Maciak**, **P. Tulik**, **K. Tymińska**
The Second International Conference on Radiation and Dosimetry in Various Fields of Research (Serbia and Montenegro, Niš, 2014-05-27 - 2014-05-30)

Numerical model of thyroid counter
M. Szuchta, **J. Ośko**
Warsaw Medical Physics (Poland, Warsaw, 2014-05-15 - 2014-05-17)

LECTURES, COURSES AND EXTERNAL SEMINARS

Leading out the epithermal neutron beam from nuclear reactor MARIA.[a]
M.A. Gryziński
Kraków, AGH University of Science and Technology, 2014-03-21

[a)] in Polish

INTERNAL SEMINARS

Uruchomienie możliwości odczytu detektorów TLD w Pracowni Dozymetrii Promieniowania Mieszanego NCBJ[a]
A. Araszkiewicz
Warszawa, NCBJ, 2014-01-20

Start of the project: Durability and efficiency of concrete shields against ionizing radiation in nuclear power structures[a]
M.A. Gryziński
Otwock, National Centre for Nuclear Research, 2014-01-27

Methods for determination of radioactive isotopes used for environmental monitoring.[a]
M. Dymecka
Otwock, National Centre for Nuclear Research, 2014-03-10

Methods for determination of radioactive isotopes used for the assessment of internal exposure[a]
K. Rzemek
Otwock, National Centre for Nuclear Research, 2014-03-10

Assessment of internal contamination with Am-241 based on in vivo measurements- measurements and Monte Carlo modeling[a]
J. Ośko
Otwock, National Centre for Nuclear Research, 2014-03-24

Assessment of internal contamination with Am-241 based on in vivo measurements - measurements and Monte Carlo modeling.[a]
K. Tymińska
Otwock, National Centre for Nuclear Research, 2014-03-24

How to get funding from Horizon 2020? EURADOS and COST-ACTION as a source of research funding in European cooperation.[a]
M.A. Gryziński
Otwock, National Centre for Nuclear Researches, 2014-03-31

How to get funding from Horizon 2020? EURADOS and COST-ACTION as a source of research funding in European cooperation.[a]
J. Ośko
Otwock, National Centre for Nuclear Researches, 2014-03-31

Przegląd programów wspierających finansowanie projektów badawczych, m.in. Horyzont 2020[a]
A. Araszkiewicz
Warszawa, NCBJ, 2014-10-29

Summary of projects implemented by LPD NCBJ a grant for young scientists. Developing a model of high-dose chamber to monitor the ionizing radiation field with spent nuclear fuel.[a]
M. Maciak
Otwock, National Centre for Nuclear Research, 2014-11-12

Summary of topics implemented under NCBJ grants for young scientists. Mobile device for automatic measurement of exposure to ionizing radiation[a]
Ł. Murawski
Otwock, National Centre for Nuclear Research, 2014-11-12

The determination of polonium in urine[a]
M. Tulik
Świerk, National Centre for Nuclear Research, 2014-11-12

[a)] in Polish

DIDACTIC ACTIVITY

B. Boimski - Conducting workshops for participants in the VII International School of Nuclear Energy, 4-7 November 2014

B. Boimski - Prowadzenie wykładów, kurs typu A-A.(12-16.05.2014)
Przyrządy dozymetryczne-ogólne zasady budowy, parametry techniczne, klasyfikacja, zakres ich zastosowań oraz legalizacja przyrządów.

B. Boimski - Training for the radiological protection of workers NCBJ (course B), 6-8 October 2014

M. Dymecka - Course for National Atomic Energy Agency employees: "Radiochemical analyses used in environmental monitoring and assessment of internal exposure of nuclear facility personnel".

M. Dymecka - Radiation protection training - 7th International School on Nuclear Power 4th and 7th November 2014

M.A. Gryziński - Auxiliary promoter of PhD thesis of Msc Eng. Edyta Jakubowska titled: "Recombination dosimetric methods for monitoring mixed radiation fields in radiotherapy centers"

J. Ośko - Radiation protection training (type A-A) for custom office

J. Ośko - Radiation Protection training (type B) for NCBJ personnel, 6-8 October 2014

J. Ośko - Radiation Protection training for NCBJ personnel, May 12-16, 2014

J. Ośko - Radiation protection training for NCBJ staff (A-A course), November 12-14 2014

J. Ośko - Radiation Protection Training, 7th International School on Nuclear Power, 4-7.11.2014

J. Ośko - Supervisor of Maciej Szuchta bachelor thesis "Calibration of dosimetry devices for measurements of internal contamination with in vivo method", Warsaw University, Faculty of Physics

A. Pawełczuk - Prowadzenie szkolenia z zakresu ochrony radiologicznej w ramach instruktażu wstępnego dla nowoprzyjmowanych pracowników oraz praktykantów i doktorantów.

T. Pliszczyński - Prowadzenie ćwiczeń z ochrony radiologicznej, VII Międzynarodowa Szkoła Energetyki Jądrowej, 4-7.11.2014

T. Pliszczyński - Szkolenie z ochrony radiologicznej (kurs A-A) dla pracowników Izby Celnej.

T. Pliszczyński - Szkolenie z ochrony radiologicznej dla pracowników NCBJ (Kurs A), 12-16 maja 2014.

T. Pliszczyński - Szkolenie z ochrony radiologicznej dla pracowników NCBJ (Kurs typu B), 6-8 października 2014.

K. Rzemek - Course for National Atomic Energy Agency employees - Radiochemical analyses used in environmental monitoring and assessment of internal exposure of nuclear facility personnel

K. Rzemek - Radiation protection training - 7th International School on Nuclear Power 4th and 7th November 2014

M. Tulik - Course for National Atomic Energy Agency employees - Radiochemical analyses used in environmental monitoring and assessment of internal exposure of nuclear facility personnel

K. Wojdowska - Kurs dla pracowników Państwowej Agencji Atomistyki: "Wykorzystanie analiz radiochemicznych do monitoringu środowiska i oceny narażenia wewnętrznego personelu obiektu jądrowego".

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

S. Domański
Polish Society of Medical Physics

N. Golnik
The Committee on Medical Physics, Radiobiology and Diagnostic Imaging of the Polish Academy of Sciences , member
Polish Society of Medical Physics, Vice President
European Radiation Dosimetry Group, EURADOS, representative of the voting member, member of the WG11 working group
Member, Polish Radiation Research Society
Polish Journal of Medical Physics and Engineering, Polish Journal of Medical Physics and Engineering, Polish Society of Medical Physics

M.A. Gryziński
President of the Mazovia branch
członek grupy roboczej WG3 "Dosimetry and treatment planning"
Corresponding member EURADOS WG9 - Radiation protection dosimetry in medicine
Corresponding member EURADOS WG11 - High energy radiation fields
voiting member
voiting member

Z. Haratym
Association for the Promotion of Quality in Radiotoxicological Analysis (France)

E.A. Jakubowska
Secretary of Polish Society for Medical Physics - Warsaw Division

M. Maciak
Polish Society of Medical Physics

Ł. Murawski
Polish Society of Medical Physics

J. Ośko
Member of Advisory Board on Warsaw Medical Physics in Warsaw, Poland
Polish Society of Medical Physics

T. Pliszczyński
Association for the Promotion of Quality in Radiotoxicological Analysis (France)

P. Tulik
Member, Polish Society of Medical Physics
Polish Journal of Medical Physics and Engineering, Editorial Advisory Board Polish Society of Medical Physics

K. Tymińska
Member, Polish Society of Medical Physics
Corresponding member EURADOS WG6 - Computational dosimetry

M. Zielczyński
Member, Polish Society of Medical Physics
Member, Polish Radiation Research Society

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

M.A. Gryziński
Board member of the Mazovia branch
członek grupy roboczej WG3 "Dosimetry and treatment planning"
Corresponding member EURADOS WG9 - Radiation protection dosimetry in medicine
Corresponding member EURADOS WG11 - High energy radiation fields

Z. Haratym
Association for the Promotion of Quality in Radiotoxicological Analysis (France)

J. Ośko
Polish Society of Medical Physics
Coressponding member EURADOS WG7 - Internal Dosimetry

T. Pliszczyński
Association for the Promotion of Quality in Radiotoxicological Analysis (France)

P. Tulik
Member, Polish Society of Medical Physics
Polish Journal of Medical Physics and Engineering, Editorial Advisory Board Polish Society of Medical Physics

K. Tymińska
Member, Polish Society of Medical Physics
Corresponding member EURADOS WG6 - Computational dosimetry

M. Zielczyński
Member, Polish Society of Medical Physics
Member, Polish Radiation Research Society

PERSONNEL

Research scientist
Gryziński Michał A., PhD Eng
Haratym Zbigniew, PhD
Ośko Jakub, PhD Eng
Pliszczyński Tomasz, MSc Eng
Rzemek Katarzyna, MSc Eng
Tulik Piotr, PhD Eng
Tymińska Katarzyna, PhD
Wielgosz Monika, PhD Eng (since 25.08.2014)

Technical and administrative staff
Araszkiewicz Agnieszka, MSc
Boimski Błażej, Eng.
Domański Szymon, MSc
Dymecka Małgorzata, MSc Eng
Ejsmont Ryszard, Tech.
Feczko Maciej
Garboliński Andrzej, Tech.
Hadyś Tadeusz, MSc Eng
Jakubowska Edyta, MSc Eng (since 25.08.2014)
Karpińska Barbara

Korab Marzena, MSc
Kurdej Alicja, Tech.
Maciak Maciej, MSc Eng.
Murawski Łukasz, Eng.
Pawełczuk Andrzej, Eng.
Pindara Grażyna (until 30.06.2014)
Piotrkowicz Barbara
Snopek Bożydar, Eng.
Soboń Rafał, Eng. (until 11.06.2014)
Sosnowiec Renata, Tech.
Szostak Magdalena, MSc
Śniegoń Wiesława, MSc Eng.
Tulik Maria, MSc. Eng.
Umaniec Marianna, Tech.
Wiśniewska Kazimiera
Wojdowska Katarzyna, MSc
Worch Zofia
Zielińska Danuta

2. DEPARTMENT OF MATERIAL PHYSICS

Director of Department: Professor Jacek Jagielski
phone: +48 22 2731443
e-mail: Jacek.Jagielski@ncbj.gov.pl

Overview

In 2014 the research activities of the MPD were concentrated on studies of materials expected to be used in a nuclear environment and on the use of nuclear techniques for modification and analysis of solids. The MRL laboratory of MPD is the only facility in Poland disposing of the equipment needed to perform analyses of construction materials irradiated in nuclear reactors. The MRL has the Certificate of Testing Laboratory Accreditation No. AB 025. The Laboratory has also been granted 2nd Degree Approval No LB-038/27 by the Office of Technical Inspection. It also has the License of the National Radiological Protection and Nuclear Safety Department Nr. 1/93/"MET" for investigation of irradiated materials up to 100Ci. The laboratory was designed for testing surveillance specimens from a planned nuclear power plant. The hot laboratory consists of an assembly of 12 lead hot cells arranged in a single line. All cells are designed to handle 3700 GBq (100Ci) of 1 MeV gamma emitter. Each of the cells is equipped with a viewing window and master-slave or tong manipulators. The hot cells are connected by a special inert transport system. The assembly of hot cells is equipped with ventilating and active waste systems.

In 2014 the laboratory of nuclear microanalysis working mainly on Rutherford Basckscattering Spectroscopy was moved from the Pure Research Department to the Plasma and Ion technology Division (FM2) of the MPD.

Among the main research topics carried out in the MPD one may list:

- X-ray diffraction: structure of safe antidepressive alkaloid aptazepine obtained in first enantioselective synthesis and topography investigations of crystal lattice defects in ferroelectric niobates with tungsten bronze structure.
- Neutron scattering: magnetic and atomic short range order in $Mn_{0.3}Ni_{0.3}Cu_{0.4}$ pseudo-binary alloy studied with neutron elastic scattering, studies of the drying process.
- Mechanical properties: studies of strength and hardness of materials used in nuclear engineering, analysis of the role of irradiation on the functional properties of elastomers. Study of the correlation between structural and mechanical properties of the interface between the oxide scale and the bulk.
- Corrosion properties: studies of zirconium corrosion in nuclear reactors, modification of oxidation resistance using plasma or ion-beam doping of steels.
- Doping stainless steel with oxygen reactive elements like Rare Earth Elements (REE) and others for improving surface oxidation resistance at high temperatures.
- Development of new ferromagnetic semiconductors for spintronics.
- Studies of the dependence of specific features of plasma surface engineering methods on the layer structure.
- Optimisation of thin film Pb photocathodes
- Development of Monte Carlo simulation procedures for channelled ions.
- Study of ZnO semiconductor and the influence of radiation damage on structural properties of zinc oxide.

In 2014 the high temperature option in the nanoindentation tester NanoTest "Vantage" was optimized. In consequence the system is able to perform measurements up to 700 C.

In 2014 the biggest project conducted in MPD was the 4Labs project worth about 40 mln zlotys. The construction of Neutral Beam Injector system elements for theW7-X stellarator at IPP Greifswald was finished (Polish in-kind contribution to the W7-X project). Total value of these projects exceeds 58 mln PLN. Among smaller projects accepted one may list ion-irradiation of advanced graphene-elastomer composites (PBS III Grafel project). Two projects were submitted to the European Commission: BRILLIANT and VINCO. In the latter project NCBJ plays the role of coordinator of the whole consortium.

In 2014 researchers of MPB published 65 scientific publications and presented 71 presentations at scientific conferences.

Jacek Jagielski

NUCLEAR METHODS IN SOLID STATE PHYSICS DIVISION

Head of Division: Jacek J. Milczarek, PhD
phone: +48 22 2731233
e-mail: Jacek.Milczarek@ncbj.gov.pl

Overview

The Department is involved in research on the microscopic structure and dynamics of condensed matter systems. The techniques employed permit studies to be performed from the atomic level to macroscopic phenomena. Methods based on the interaction of radiation with matter comprise X-ray (XRD and synchrotron radiation), gamma radiation (Mössbauer spectrometry) as well as thermal neutrons (neutron scattering and neutron radiography). Some specialized techniques such as high pressure systems, rapid quenching and the sol-gel method have also been applied. A few theoretical and computational studies on the properties of uranium oxide have also been carried out.

The Department consists of four labs:

Regional Laboratory of Neutronography,
Mössbauer Spectrometry Laboratory,
X-ray Diffraction Laboratory,
High Pressure Laboratory.

There were 16 employees with three full professors and 8 researchers with PhD degree.

The main works completed in 2014 dealt with:

The primary ionization mechanism occurring in matrix-assisted laser desorption ionization (MALDI).

Structure–reactivity relationship in 4,5,6,7-Tetrahalogeno-1H-benzimidazoles:

- The incorporation of lithium atoms into magnesium silicate during formation of $Mg_{2-x}Li_xSi$ alloys
- Phase transformations in multiferroic $GaFeO_3$ (GFO) compounds.
- Nanoscale matrices of phosphors for biomedical applications.
- Nonlinear optical properties of Polymer-Dispersed Liquid Crystals doped with inorganic nanoparticles.
- Structural stability of WO_3-ZrO_2 and WO_3-TiO_2 nano-composites.

Surface effects produced by nuclear reactions induced by gamma radiation in Pd saturated with deuterium.

High pressure properties and structure of complex organic liquids and their solutions.

The effect of phase decomposition on the magnetic structure of $Mn_{0.3}Ni_{0.3}Cu_{0.4}$ pseudo-binary alloy.

Synchrotron topographic investigation of strain induced in silicon by X-Ray Pulses from Free Electron Laser

Spontaneous and gravitation driven migration of water in composite systems containing zeolites.

Kinetics of drying of porous materials saturated with aqueous solutions of salts.

Application of neutron imaging in cultural heritage and paleontological research.

Correlation between the thermal neutron scattering length and the separation energy of the neutron from the nucleus.

.

Jacek J. Milczarek

REPORTS

Bonding Xenon and Kryptonon the surface of a Uranium dioxide single crystal
L. Dąbrowski, **M. Szuta**
NCBJ, Świerk, Ann.Rap. p.224

Diffusion of Helium in perfect Uraniumand Thorium dioxide single crystals
L. Dąbrowski, **M. Szuta**
NCBJ, Świerk, Ann. Rap. p. 225,

Modification of UO2 grain Re-crystallization temperature as a functionof burn-up as a base for vitanza experimental curve reconstruction
M. Szuta, **L. Dąbrowski**
NCBJ, Świerk, Ann. Rap. p 227

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Zastosowanie radiografii neutronowej w badaniach bioarcheologicznych.
E. Miśta, **J.J. Milczarek**, A. Sołtysiak, P. Tulik
Zastosowanie technik analitycznych w konserwacji i ochronie zabytków (Poland, Warszawa, 2014-12-04 - 2014-12-05)

Modyfication of UO2 Grain Re-crystallization Temperature In Function of Burm-up as a Base for Incubation Time (burn-up) Experimental Curve Reconstruction.
M. Szuta, **L. Dąbrowski**
Fourth Meeting of the Expert Group on Reactor Fuel Performance (EGRFP) of Working Party on ScienticIssues of Reactor Systems (WPRS) - OCDE/NEA Nuclear Science Committee (France, Paryż, 2014-02-20 - 2014-02-21)

Zastsowanie radiografii neutronowej w badaniach bioarcheologicznych
E. Miśta, A. Sołtysiak, **J.J. Milczarek**, **P. Tulik**
Konferencja sprawozdawcza Instytutu Archeologii Uniwersytetu Warszawskiego (Poland, Warszawa, 2014-12-01 - 2014-12-01)

Materials research on archaeological objects using PIXE and other non-invasive techniques
E. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
ION 2014 (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
Acta Phys. Pol. A (2014)

Ядерные реакции в плотном гелии при давлении 1,1 кбар под действием облучении тормозными γ-квантами с пороговой энергией 10 МэВ
ДидыкА.Ю. , **R. Wiśniewski**
XXV International conference "Radiation Physics of Solids" (Russia, Sevastopol, 2014-07-07 - 2014-07-13)

Ядерные реакции синтеза и деления химических элементов и образование новых структур в плотных газах H_2, D_2 и He при γ-квантами с облучении энергией 10 МэВ.
ДидыкА.Ю. , **R. Wiśniewski**
XXI Научно-техническая конференция с участием зарубежных специалистов «Вакуумная наука и техника» (Russia, Sochi, 2014-10-12 - 2014-10-18)

Oral Presentation

Lithium as a dopant for p-type Mg2Si
P. Nieroda, A. Koleżynski, **J.J. Milczarek**, K.T. Wojciechowski
Cimtec 2014, 6th Forum on New Materials (Italy, Montecatini Terme, 2014-06-15 - 2014-06-19)

Synthesis, thermoelectric properties and examination of Li dopant location in Mg2Si structure: theoretical and experimental study
P. Nieroda, A. Koleżyński, **J.J. Milczarek**, K.T. Wojciechowski
3rd International PhD Seminar (Germany, Dresden, 2014-09-25 - 2014-09-26)

Drying of capillary-porous materials studied with neutron imaging
J. Żołądek-Nowak, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, **K. Cmiel**, **J. Żołądek**, **Z. Jurkowski**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

Materials research on archaeological objects using PIXE and other non-invasive techniques
E.A. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, I.M. Fijał-Kirejczyk, P. Kalbarczyk
5th Meeting X-ray and other techniques in investigations of the objects of cultural heritage (Poland, Kraków, 2014-05-14 - 2014-05-17)

Multiferroic Properties of Orthorhombic and Hexagonal GaFeO3 Compound
K. Rećko, U. Wykowska, M. Biernacka, B. Kalska-Szostko, **J.J. Milczarek**, J. Waliszewski, D. Satuła
PHYSICS OF MAGNETISM 2014 (PM 14) (Poland, Poznań, 2014-06-23 - 2014-06-27)

Poster

Neutron radiography studies of ancient objects from Poland
J.J. Milczarek, **J. Żołądek-Nowak**, **I. Fijał-Kirejczyk**, **E. Miśta**, **J. Żołądek**, **Z. Jurkowski**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

Synchrotron topographic evaluation of strain around craters generated by irradiation with x-ray pulses from free electron laser with different intensities
W. Wierzchowski, **K. Wieteska**, R. Sobierajski, D. Klinger, J. Pełka, D. Żymierska, C. Paulmann
The 12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) (Poland, Warsaw, 2014-06-15 - 2014-06-20)
Synchrotron Radiation in Natural Science Vol. 13 No 1-2 (2014) 97

Crystal structure and defect structure of selected $Ca_9RE(VO_4)_7$ single crystals: A high-resolution diffraction, white beam topography and powder diffraction study
A. Behrooz, W. Paszkowicz, P. Romanowski, B. Nazarenko, A. Shekhovtsov, W. Wierzchowski, **K. Wieteska**, C. Paulmann
The 12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) (Poland, Warsaw, 2014-06-15 - 2014-06-20)
Synchrotron Radiation in Natural Science Vol. 13 No 1-2 (2014) 77

Materials research on archaeological objects using pixe and other non - invasive technique
E. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

Threshold fluence of ultra-short VUV laser pulse for structure modification of gallium arsenide
D. Żymierska, **K. Wieteska**
The 12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) (Poland, Warsaw, 2014-06-15 - 2014-06-20)
Synchrotron Radiation in Natural Science Vol. 13 No 1-2 (2014) 92

Phase transitions in complex oxides systems
L. Górski
56 konwersatorium krystalograficzne (Poland, Wrocław, 2014-06-25 - 2014-06-27)

The effect of phase decomposition on magnetic structure of $Cu_{0.4}Mn_{0.3}Ni_{0.3}$ alloy
K. Świderska, **J. Jankowska-Kisielińska**
Physics of Magnetism 2014 (PM 14) (Poland, Poznań, 2014-06-23 - 2014-06-27)

The assessment of toxicity of an acive optical nanoparticles by in vitro test.
I. Cieślik, T. Bolek, M. Woźniak, S. Hirano
NIMS Conference 2014 (Japan, Tsukuba, 2014-07-01 - 2014-07-03)
NIMS Tsukuba, Japonia 2014 No. (2014) p. 105

One-pot deracemization of 5-hydroxy-4,5-dihydroisoxazole derivatives
J. Główczyk-Zubek, M. Dziachan, **J.K. Maurin**, E. Łukowska-Chojnacka, M. Wielechowska
2nd Symposium on Biotransformations for Pharmaceutical and Cosmetic Industry (Poland, Warsaw, 2014-10-23 - 2014-10-24)

Assessment of toxicity an active optical nanopartocles in YAl3(BO3)4:RE chemical form by in vitro tests.
I. Cieślik, T. Bolek, M. Woźniak, S. Hirano
4th Summer Symposium of Nanomateials and their Applications to Biology and Medicine (Poland, Poznań, 2014-06-15 - 2014-12-18)
Adam MIckiewicz University, Poznań, Poland No. (2014) p. 42

DIDACTIC ACTIVITY. LECTURES, COURSES AND EXTERNAL SEMINARS

J.J. Milczarek - Lectures on "Application of neutrons in materials research and technology", Warsaw University of Technology, Faculty of Materials Engineering, 2013/2014

J.J. Milczarek - supervising the experimental part of research on neutron radiography features for Ph.D. degree of Mr. Mabuti J. Radebe of Nesca (South Africa)

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

K. Cmiel
Association of Engineers and Technicians of Chemical Industry

J. Jankowska-Kisielińska
member Polish Society of Neutron Scattering

J.J. Milczarek
Polish Neutron Scattering Society
Polish Physical Society

K. Wieteska
Session chairman on Badania Materiałowe na Potrzeby Elektrowni Konwencjonalnych i Jądrowych oraz Przemysłu Energetycznego in Zakopane, Poland
Member of Advisory Board on Badania Materiałowe na Potrzeby Elektrowni Konwencjonalnych i Jądrowych oraz Przemysłu Energetycznego in Zakopane, Poland
member, Polish Synchrotron Radiation Society

INTERNAL SEMINARS

Sorptive Properties of Red Clay
Prof. dr hab. Marek Majdan (Wydział Chemii UMCS)
Świerk, National Centre for Nuclear Research, 2014.02.27

IBIS Project – Genesis and Plans for the Future
Dr Cezary Pochrybniak, mgr Andrzej Horodeński
Świerk, National Centre for Nuclear Research, 2014.11.12
Radiography: Upgrade, Qualitative Analysis, Simulation,
Robert Nshimirimana, (Necsa, RPA),*:*
Świerk, National Centre for Nuclear Research , 2014.11.19

PERSONNEL

Research scientists

Armand Budzianowski, PhD
Iwona Cieślik, MSc
Katrzyna Cmiel, MSc
Andrzej Czachor,Professor
Ludwik Dąbrowski, Professor
Izabela Fijał-Kirejczyk, PhD
Ludwik Górski, PhD
Joanna Jankowska-Kisielińska, PhD
Jan Maurin, PhD
Jacek J. Milczarek, PhD
Świderska Karolina, MSc
Teresa Wilczyńska-Kitowska, PhD
Roland Wiśniewski, Professor
Piotr Zachariasz, PhD
Joanna Żołądek-Nowak, MSc

Technical staff
Janusz Bojarczuk
Jurkowski Zdzisław
Wójcik Tadeusz
Jan Żołądek

PLASMA/ION BEAM TECHNOLOGY DIVISION

Head of Division: Cezary Pochrybniak, PhD
phone: +48 22 2731558
e-mail: cezary.pochrybniak@ncbj.gov.pl

Overview

The FM2 Division was involved in a wide range of topics, and focused on plasma physics applications in materials engineering science, solid state physics, microanalysis in photonics materials and ancient archaerological objects, also computer simulation of defects in solids. Our main topics of activity were as follows:

1. Molecular dynamics simulations of defect transformation at various stress levels,

2. Study of IPD plasma pulse features under gas injection conditions,

3. High Intensity Plasma Ion Beams in technological applications,

4. Development of new ferromagnetic semiconductors for spintronics – ZnO single crystals Co ion implanted: structural and magnetic feature investigations,

5. Superconductive cathodes for efficient electron gun - optimisation of thin film Pb on Nb photocathodes,

6. ZNOLUM project – light emitting photonics structures detailed investigations,

7. Archaerometry – materials study of archaerological objects using non- and microinvasive methods,

8. Strenthening of the innovation potential ofthe Institute in Świerk for the development of technologies based on ionizing radiation – 4Labs Project.

A ferromagnetic semiconductor operating at room temperature with ferromagnetism (FM) controlled by an electronic system (charge carriers) is the dream of researchers interested in the development of spintronics. This year we were focused on ZnO doped with cobalt which is believed to be a prospective material in which high temperature FM is predicted theoretically. Admittedly FM was detected in ZnO but its interpretation is far from complete – the results of various groups are inconsistent with one another and depend to a great extent on the preparation technology.

In general we have focused on magnetron sputtering (MS) technology enriched by gas injection as a tool for initiating and effectively controlling the plasma generation process during the deposition of layers by magnetron sputtering – GIMS - Gas Injection Magnetron Sputtering. The Impulse Plasma Deposition (IPD) technique is the only method of plasma surface engineering (among plasma based technologies) which allows a synthesis of layers upon a cold unheated substrate and ensures good adhesion. This year we studied pulsed plasma features under gas injection conditions.

A thin film Pb photocathode is a promising material, planned to be used in a superconducting electron linac. One way in which we tried to prepare this wasby high vacuum arc deposition using the compact deposition system constructed in late 2011. The second way – we tried to prepare such layers using the hot plasma method HIPIB. A thick film of Pb is needed to be deposited on the back wall of a modified electron gun resonator.

The archaeometry studies on ancient objects tried to answer/reconstruct e.g. the circulation of silver in Early Medieval Poland and others. This kind of precious object needs special treatment by non- and microinvasive methods, suchas SEM, EDS, EDX, XRD, Raman Spectroscopy and neutronography. Archaeometry is the subject of a PhD thesis.

In 2014 the FM2 Division employed 29 persons, thirteen members constituted the scientific staff, seven belonged to the research-technical staff, eight constituted the technical and the rest - administrative staff.

Cezary Pochrybniak

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Mechanism of damage buildup in ion bombarded compound single crystals
A. Turos, **P. Jóźwik**, **J. Jagielski**, L. Thomé
7th International Meeting On Recent Developments In The Study Of Radiation Effects In Matter (REM-2014) (Hungary, Budapest, 2014-07-09 - 2014-07-12)

Materials research on archaeological objects using PIXE and other non-invasive techniques
E. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
ION 2014 (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
Acta Phys. Pol. A (2014)

Radiation defects in nanoscale: the case of compound materials
A. Turos
23rd Conference on Application of Accelerators in Research and Industry (USA, San Antonio, 2014-05-25 - 2014-05-30)

Results of recent dense magnetized plasma studies by the NCBJ team, Poland
M.J. Sadowski, **E. Składnik-Sadowska**, **R. Kwiatkowski**, **K. Malinowski**, **K. Nowakowska-Langier**, **J. Żebrowski**, **K. Czaus**, **W. Surała**, **D. Załoga**, M. Kubkowska, M. Paduch, E. Zielińska, P. Kubes, I. Garkusha, V. Makhlay, M. Ladygina
Annual Meeting and Workshop ICDMP-2014 (Poland, Warsaw, 2014-10-10 - 2014-10-11)

Mechanism of damage buildup in ion bombarded compound single crystals
P. Jóźwik, **A. Turos**, **J. Jagielski**, L. Thomé
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

Oral Presentation

Triblogical properties of AISI 316L surface layer implanted with rare earth element (REE)
B. Sartowska, **M. Barlak**, L. Waliś, W. Starosta, J. Senatorski, **A. Kosińska**
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
Acta Phys. Pol. A (2014)

Characterization of Solid State Nuclear Track Detectors of the CR-39/PM-355 type for light charged particle spectroscopy
A. Malinowska, **M. Jaskóła**, **A. Korman**, **A. Szydłowski**, **M. Kuk**
26th International Conference on Nuclear Tracks in Solids (26ICNTS) (Japan, Kobe, 2014-09-15 - 2014-09-19)

Charged projectile spectrometry using the cr-39/pm-355 type of solid state nuclear track detector
A. Malinowska, **M. Jaskóła**, **A. Korman**, **A. Szydłowski**, **M. Kuk**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)
Nukleonika (in press)

Structure of AlN films deposited by magnetron sputtering method
K. Nowakowska-Langier, R. Chodun, **K. Zdunek**, R. Minikayev, **R. Nietubyć**
12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) (Poland, Warsaw, 2014-06-15 - 2014-06-20)

The general concept, parameters, uniqueness and present installation status of Solaris synchrotron facility
R. Nietubyć
X Konferencja Techniki Próżni (Poland, Cedzyna k. Kielc, 2014-09-22 - 2014-09-25)

Polish in-kind contribution to European X-ray free electron laser (XFEL)-status in summer 2014
E. Pławski, J. Sekutowicz, **W. Grabowski**, **K. Kosiński**, **J. Lorkiewicz**, **M. Wojciechowski**, Z. Gołebiewski, K. Meissner, **G. Wrochna**, M. Duda, M. Jeżabek, K. Kasprzak, A. Kotarba, K. Krzysik, M. Stodulski, J. Świerblewski, M. Wiencek, M. Chorowski, E. Rusiński, J. Fydrych, A. Iluk, K. Malcher, J. Poliński, P. Duda, J. Głowinkowski, P. Wilk, M. Winkowski, P. Grzegory, G. Michalski
X konferencja Techniki Prózni (Poland, Cedzyna k. Kielc, 2014-09-22 - 2014-09-25)
Instytut Tele- i Radiotechniczny w Warszawie No. (2014)

Radiation Damage in Nuclear Materials bombarded with low-energy ions - Crystal evolution via ion channeling and Monte Carlo simulations
F. Garrido, T.H. Nguyen, **L. Nowicki**
7th International Meeting On Recent Developments In The Study Of Radiation Effects In Matter (REM-2014) (Hungary, Budapest, 2014-07-09 - 2014-07-12)

Research on interactions of intense deuterium plasma streams with SiC targets in Plasma-Focus experiments
E. Składnik-Sadowska, **R. Kwiatkowski**, **K. Malinowski**, **M.J. Sadowski**, **K. Czaus**, **D. Załoga**, **J. Żebrowski**, **K. Nowakowska-Langier**, M. Kubkowska, M. Paduch, M. Scholz, E. Zielinska, M.S. Ladygina, I.E. Garkusha, V.A. Gribkov, E.V. Demina, S.A. Maslyaev, V.N. Pimenov
International Conference and School on Plasma Physics and Controlled Fusion (ICPPCF-2014) (Ukraine, Kharkov, 2014-09-15 - 2014-09-18)

Nanomechanical properties of irradiated ODS RAF steels.
Ł. Kurpaska, **J. Jagielski**, **K. Nowakowska-Langier**
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

Radiation Damage in Nuclear Oxides bombarded with low-energy ions - Crystal evolution via ion channeling and Monte Carlo simulations
F. Garrido, T.H. Nguyen, **L. Nowicki**, A. Debelle, L. Thomé
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)

Study of tungsten surface interaction with plasma streams at DPF-1000U
M.S. Ladygina, **E. Składnik-Sadowska**, **D. Załoga**, **K. Malinowski**, **M.J. Sadowski**, M. Kubkowska, E. Kowalska-Strzeciwilk, M. Paduch, E. Zielinska, R. Miklaszewski, I.E. Garkusha, V.A. Gribkov
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Ion beam-induced luminescence as method of characterization of radiation damage in polycrystalline materials
I. Jozwik-Biala, **J. Jagielski**, G. Gawlik, G. Panczer, N. Moncoffre, **R. Ratajczak**, **P. Jóźwik**, A. Wajler, A. Sidorowicz
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (in press)

Defect accumulation in Ar-ion bombarded ZnO single crystals
A. Stonert, **R. Ratajczak**, **P. Jóźwik**, **A. Turos**, J. Gaca, Marek. Wójcik, E. Wierzbicka
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

Recent ion measurements within the modified DPF-1000U facility
R. Kwiatkowski, **K. Czaus**, **E. Składnik-Sadowska**, **M.J. Sadowski**, **D. Załoga**, M. Paduch, E. Zielinska
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Ionoluminescence analysis of irradiated oxides. Case study of powellite
J. Jagielski, G. Gawlik, I. Jozwik-Biala, G. Panczer, N. Moncoffre, **R. Ratajczak**, M. Swirkowicz, L. Thomé
X-th International Conference Ion Implantation and Other Applications of Ions and Electrons (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

Comparison of optical spectra recorded during DPF-1000U plasma experiments with gas-puffing
D. Załoga, **E. Składnik-Sadowska**, M. Kubkowska, M. Ladygina, **K. Malinowski**, **R. Kwiatkowski**, **M.J. Sadowski**, M. Paduch, E. Zielinska, V.A. Makhlaj
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Ionoluminescence analysis of irradiated oxides. Case study of powellite
J. Jagielski, G. Gawlik, I. Jozwik-Biala, G. Panczer, N. Moncoffre, **R. Ratajczak**, M. Swirkowicz, L. Thomé
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (2014)

Zinc Oxide Films Grown at Low Temperature Limits – Unusual Behavior of Hydrogen Contamination
E. Guziewicz, T.A. Krajewski, G. Luka, D. Snigurenko, R. Jakiela, W. Lisowski, J.W. Sobczak, **A. Stonert**, **R. Ratajczak**
8th International Workshop on Zinc Oxide and Related Materials (IWZnO 2014) (Canada, Niagara Falls, Ontario, 2014-09-07 - 2014-09-11)

Materials research on archaeological objects using PIXE and other non-invasive techniques
E.A. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, I.M. Fijał-Kirejczyk, P. Kalbarczyk
5th Meeting X-ray and other techniques in investigations of the objects of cultural heritage (Poland, Kraków, 2014-05-14 - 2014-05-17)

Poster

Materials research on archaeological objects using pixe and other non - invasive technique
E.A. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

Deposition and processing of thin-layer lead photo-cathodes for hybrid niobium superconducting RF photoinjector
J. Lorkiewicz, **R. Nietubyć**, **M. Barlak**, **A. Kosińska**, J. Sekutowicz, **R. Mirowski**, **J. Witkowski**
12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) (Poland, Warsaw, 2014-06-15 - 2014-06-20)

Present status of preparation zt NCBJ in Świerk of thin-layer lead photocathodes for hybrid niobium superconductiong RF photoinjector
J. Lorkiewicz, **R. Nietubyć**, **M. Barlak**, **A. Kosińska**, J. Sekutowicz, **R. Mirowski**, **J. Witkowski**, **M. Frelek**, **Ł. Kurpaska**, **W. Pawlak**
X Konferencja Techniki Próżni (Poland, Cedzyna k. Kielc, 2014-09-22 - 2014-09-25)
Instytut Tele- i Radiotechniczny, (Warszawa) No. (2014)

Stainless steel surface modification by alloying with Rare Earth Elements (REE) using High Intense Pulsed Plasma Beams (HIPPB)
B. Sartowska, **M. Barlak**, L. Waliś, W. Starosta, J. Senatorski, **A. Kosińska**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)
Nukleonika (2014)

Influence of soft X-ray radiation on the parameters of tracks induced in CR-39 and PM-355 solid state nuclear track detectors
A. Szydłowski, **A. Malinowska**, **M. Jaskóła**, K. Szewczak, **A. Korman**, M. Paduch, **M. Kuk**

26th International Conference on Nuclear Tracks in Solids (Japan, Kobe, 2014-09-15 - 2014-09-19)
Radiat. Meas. (in press)

Improvement of zirconium claddings oxidations resistance by modification of their surface properties using ion-plasma beams
W. Starosta, **M. Barlak**, M. Buczkowski, **A. Kosińska**, B. Sartowska
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

2D and 3D calculations in modified Tesla-like cavities
M. Staszczak, **T. Wasiewicz**, P. Kneisel, **W. Grabowski**, **R. Nietubyć**, J. Sekutowicz
12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) (Poland, Warsaw, 2014-06-15 - 2014-06-20)

Channeling Study of Co and Mn Implanted and ThermallyAnnealed Wide Band-gap Semiconducting Compounds
R. Ratajczak, **Z. Werner**, **A. Stonert**, **M. Barlak**, **C. Pochrybniak**, Q. Zhao
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
Acta Phys. Pol. A (2014)

Nanomechanical properties of Ar-irradiated zirconia polymorphs developed on pure zirconium.
Ł. Kurpaska, **J. Jagielski**, I. Jozwik-Biala, S. Labdi
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (2014)

RBS/Channeling Analysis of TiO_2 Films Grown by Atomic Layer Deposition
R. Ratajczak, **A. Stonert**, G. Luka, E. Guziewicz, M. Godlewski, **A. Turos**
The 12th International Baltic ALD conference (Finland, Helsinki, 2014-05-12 - 2014-05-13)

Defect accumulation in Ar-ion bombarded ZnO single crystals
A. Stonert, **R. Ratajczak**, **P. Jóźwik**, **A. Turos**, J. Gaca, Marek. Wójcik, E. Wierzbicka
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (2014)

Research on anisotropy of fusion-produced protons and neutrons emission from high-current plasma-focus discharges
K. Malinowski, **E. Składnik-Sadowska**, **M.J. Sadowski**, **A. Szydłowski**, **K. Czaus**, **R. Kwiatkowski**, **D. Załoga**, M. Paduch, E. Zielińska
26th International Conference on Nuclear Tracks in Solids (Japan, Kobe, 2014-09-15 - 2014-09-19)

High temperature nanoindentation.
Ł. Kurpaska, **J. Jagielski**
Materials for Fusion & Fission Power Conference (United Kingdom, Oxford, 2014-12-10 - 2014-12-10)

Spectroscopic studies of plasma streams generated in a 1-MJ Plasma-Focus facility with and without gas-puffing
M.S. Ladygina, **E. Składnik-Sadowska**, **R. Kwiatkowski**, **K. Malinowski**, **M.J. Sadowski**, **D. Załoga**, **J. Żebrowski**, M. Kubkowska, M. Paduch, M. Scholz, E. Zielinska, I.E. Garkusha, V.A. Makhlaj
International Conference and School on Plasma Physics and Controlled Fusion (ICPPCF-2014) (Ukraine, Kharkov, 2014-09-15 - 2014-09-18)

High intensity plasma pulses for the improvement of high temperature resistance of 316L stainless steel
M. Barlak, **Z. Werner**, **C. Pochrybniak**, **A. Kosińska**, B. Sartowska, W. Starosta, L. Waliś
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

LECTURES, COURSES AND EXTERNAL SEMINARS

High-intensity plasma pulses in surface modification[a]
M. Barlak
Warsaw, Faculty of Materials Science and Engineering, Warsaw University of Technology, 2014-01-31

Overall description of SRF photocathodes activities[b]
J. Lorkiewicz
Saclay, 91191 Gif-sur-Yvette, France, CEA, 2014-04-17

Surface optimization of thin film Pb photocathodes[b]
J. Lorkiewicz
Saclay, 91191 Gif-sur-Yvette, France, CEA, 2014-04-17

Overview of cathodic arc deposition activities at NCBJ[b]
R. Nietubyć
Otwock - Swierk, NCBJ, 2014-05-07

a) in Polish
b) in English

INTERNAL SEMINARS

Lead films for photocathodes[b]
J. Lorkiewicz
05-400 Otwock-Swierk, National Centre for Nuclear Research (NCBJ, 2014-05-07

Overview of Cathodic Arc Activities at NCBJ[b]
R. Nietubyć
Otwock - Swierk, NCBJ, 2014-05-07

b) in English

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

J. Jagielski
Member of the Scientific Council
Member of the SCientific Council of SLCJ

R. Nietubyć
Polish Synchrotron Radiation Society

K. Nowakowska-Langier
Member of Organizing Committee on The 12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) in Warsaw, Poland
Polish Synchrotron Radiation Society (PSRS)

C. Pochrybniak
Member Polish Solar Energy Society
Member Polish Photovoltaics Society
Chairman of Economics Council Institute of Atomic Energy Polatom

A. Turos
Member of the Materials Research Society
member of Boehmische Physical Society

K. Zdunek
European Joint Committee on Plasma and Ion Surface Engineering (EJC PISE)
Faculty of Materials Science, Warsaw University of Technology

PERSONNEL

Scientific staff
Barlak Marek, PhD
Jagielski Jacek, Ptofessor
Lorkiewicz Jerzy, PhD Eng.
Mieszczyński Cyprian, PhD
Nietubyć Robert, PhD
Nowakowska-Langier Katarzyna, PhD Eng
Nowicki Lech. PhD
Pochrybniak Cezary. PhD
Ratajczak Renata. PhD
Stonert Anna. PhD
Turos Andrzej, Professor
Werner Zbigniew, Professor
Zdunek Krzysztof, Professor

Research – technical staff
Horodeński Andrzej, MSc Eng
Kosińska Anna, MSc Eng
Kowalska Ewa, MSc Eng
Mirowski Robert, MSc Eng
Miśta Ewelina, MSc
Strzelecki Grzegorz, MSc.
Witkowski Jan Eng

Technical Staff
Bojarczuk Janusz
Gniadek Krzysztof
Karpisz Stanisław
Kuk Mirosław
Staszkiewicz Bogdan
Trembicki Andrzej
Wiraszka Andrzej
Zagórski Jerzy

Administrative staff
Woźnica Magdalena, MSc

MATERIALS RESEARCH LABORATORY

Head of Division: Ewa Hajewska, PhD
phone: +48 22 2731061
e-mail: Ewa.Hajewska@ncbj.gov.pl

Overview

From 1995, the Materials Testing Laboratory has had the Certificate of Testing Laboratory Accreditation No. AB 025, valid until 17.07.2017. The Laboratory has also been granted 2nd Degree Approval No LB-038/27 by the Office of Technical Inspection. It also has the License of the National Radiological Protection and Nuclear Safety Department Nr. 1/93/"MET" for investigation of irradiated materials up to 100Ci. This is the reason that all work is carried out according to the Quality Management System.

The Materials Research Laboratory is engaged in research work covering many aspects of materials engineering. Tests are carried out on both structural materials and their welded joints, including the examination of irradiated materials in the hot laboratory.

This laboratory was destined for testing surveillance specimens from a planned nuclear power station. The hot laboratory consists of an assembly of 12 lead hot cells arranged in line. All cells were designed to handle 3700 GBq (100Ci) of 1 MeV gamma emitter. Each of the cells is equipped with a viewing window and with master-slave or tongs manipulators. The hot cells are connected with one another by a special inert transport system. The assembly of hot cells is equipped with ventilating, active waste systems.

In 2014 the laboratory for non-destructive testing was developed. New equipment for ultrasonic examination was purchased and two employees finished courses and obtained certificates to the effect that they are competent according to PN-EN ISO 9712 and the requirements of the NDT to perform ultrasonic non-destructive investigations.

Using the nanoindentation technique, the nanomechanical properties of materials exposed to radiation are studied. Among many, special interest has been given to zirconium and zirconium alloys, SiC, ODS RAF steels, stainless steel 316L and cermetals. Using the scratch test technique, the mechanical properties of graphene were also studied. Moreover, mechanical investigation of gamma irradiated stainless steels was involved.

Research on the influence of neutron irradiation and hot temperature plasma on the mechanical and structural properties of tungsten within the framework of the Strategic Research Programme: *Technologies supporting safe nuclear energy development in Poland* was also performed.

In MRL three other projects were realized: one was the Hominig project and two others were within the framework of the project for young scientists.

The Laboratory also performed other investigations according to its statutory duty, in this tcase an investigation of the mechanical properties of Zirconium and its alloys.

MRL is engaged in preparing expert opinions and technical reports on materials in relation to the licenses of the Polish Centre of Accreditation and Office of Technical Inspection.

The XXI. seminar on*: Materials Investigation for Power Industry* was organized in Zakopane. About 70 people participated in the seminar, including two from Russia.

Ewa Hajewska

REPORTS

Demonstrating Performance of Spent Fuel and Related System Components. Wkład NCBJ: The investigation of the gamma irradiation influence on the mechanical and corrosion properties of stainless steel used for spent fuel containers and canisters.
E. Hajewska, **Ł. Kurpaska**
IAEA (in press)

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Oral Presentation

Nanomechanical properties of irradiated ODS RAF steels.
Ł. Kurpaska, **J. Jagielski**, **K. Nowakowska-Langier**
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

Poster

Present status of preparation zt NCBJ in Świerk of thin-layer lead photocathodes for hybrid niobium superconductiong RF photoinjector
J. Lorkiewicz, **R. Nietubyć**, **M. Barlak**, **A. Kosińska**, J. Sekutowicz, **R. Mirowski**, **J. Witkowski**, **M. Frelek**, **Ł. Kurpaska**, **W. Pawlak**
X Konferencja Techniki Próżni (Poland, Cedzyna k. Kielc, 2014-09-22 - 2014-09-25)
Instytut Tele- i Radiotechniczny, (Warszawa) No. (2014)

Nanomechanical properties of Ar-irradiated zirconia polymorphs developed on pure zirconium.
Ł. Kurpaska, **J. Jagielski**, I. Jozwik-Biala, S. Labdi
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (2014)

High temperature nanoindentation.
Ł. Kurpaska, **J. Jagielski**
Materials for Fusion & Fission Power Conference (United Kingdom, Oxford, 2014-12-10 - 2014-12-10)

LECTURES, COURSES AND EXTERNAL SEMINARS

Electronic information security, electronic workflow[a]
E. Hajewska
Warszawa, Akademia efektywnej komunikacji, 2014-01-15

Electronic information security, electronic workflow[a]
J. Wasiak
Warszawa, Akademia efektywnej komunikacji, 2014-01-15

Electronic information security, electronic workflow[a]
B. Zając
Warszawa, Akademia efektywnej komunikacji, 2014-01-15

Blok seminriów : „Kierunek rozwoju metrologii na świecie - wydział krajowych instrukcji metrologicznych w programie badawczym EMRP i EMPiR[a]
G. Olszewski
Warszawa , Eurolab, 2014-03-13

Use of digital radiography to assess exploited graphite blocks of Maria reactor[a]
B. Zając
Zakopane, Instytut Podstawowych Problemów Techniki PAN Institute of Fundamental Technological Research, Polish Academy of Sciences, 2014-03-14

Workshop on Interdisciplinary Research[b]
Ł. Kurpaska
Warszawa, Fundacja na Rzecz Nauki Polskiej, 2014-04-15

XXth Symposium of POLLAB club: Statistical methods in laboratory practice[a]
M. Frelek
Jachranka, POLLAB Club, 2014-05-12

Master of Capgemini – menagement of people in project[a]
M. Frelek
Warsaw, Warsaw Univeristy of Technology and CapGemini Counsoulting Group , 2014-05-21

The commercialization of the results of research and development.[a]
Ł. Kurpaska
Krakow, Foundation for Polish Science, 2014-05-21

IX meeting of the Polish Technology Platform for Security Systems[a]
B. Zając
Warsaw, Military University of Technology in Warsaw, 2014-05-28

Badania materiałowe na potrzeby elektrowni konwencjonalnych i jądrowych oraz przemysłu energetycznego. XXI. Seminarium naukowo techniczne[a]
G. Olszewski
Zakopane, NCBJ LBM, 2014-06-25

Badania materiałowe na potrzeby elektrowni konwencjonalnych i jądrowych oraz przemysłu energetycznego.XXI. Seminarium naukowo techniczne[a]
B. Zając
Zakopane, Material Research Laboratory; National Centre for Nuclear Research, 2014-06-25

Influence of the technical conditionhanding elements to the level of stresses of high - presure pipelines of steam[a]
W. Biłous
zakopane, National Centre for Nuclear Research, 2014-06-26

Effects of superdeep penetration of hydrogen and deuterium into metals under high-temperature plasma action[b]
A.Ju.Didyk, V.Semina, **E. Hajewska, W.Biłous, J.Wasiak**:
Zakopane, National Centre Research Laboratory, 2014-06-26

Microstructure and properties of tungsten after deuterium plasma action[a]
E. Hajewska
Zakopane, NCBJ LBM, National Centre for Nuclear Research Material Research Laboratory, 2014-06-26

Effects of superdeep penetration of hydrogen and deuterium into metals under high-temperature plasma action[b]
A.Ju.Didyk, V.Semina, **E.Hajewska, W.Biłous, J.Wasiak:**
Zakopane, NCBJ LBM, National Centre for Nuclear Research Material Research Laboratory, 2014-06-26

Microstructure and properties of tungsten after deuterium plasma action[a]
J. Wasiak
Zakopane, National Centre for Nuclear Research, Material Research Laboratory, 2014-06-26

Effect of superdeep penetration of hydrogen and deuterim into metals undar high-temperature plasma action[a]
J. Wasiak
Zakopane, National Centre for Nuclear Research, Material Resrearch Laboratory , 2014-06-26

Innovative Poland 2015 - Screenplay and prognosis for the future[a]
E. Hajewska
Warszawa, Kierownictwo projektu: Interaktywna baza znanych ekspertek, 2014-11-04

Nanotest Ventage system - what it can deliver...?[b]
Ł. Kurpaska
Otwock/ Swierk, National Center for Nuclear Research, 2014-05-07

Nuclear equipment level 2 and level 3: construction, welding, inspection, qualityin RCC-M and EN standards[b]
M. Frelek
Cracow, Polish Welding Centre of Excellence and AFCEN Codes & Standards, 2014-06-04

Equipment for nuclear power and their non-destructive testing NDT / NDE: construction, welding, inspection, quality control by code RCC-M and EN standards.[b]
W. Pawlak
Cracow, Institute of Welding, AFCEN Codes & Standards, 2014-06-04

7th International Symposium on Material Testing Reactors[b]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-10-20

7th International Symposium on Material Testing Reaktors[b]
G. Olszewski
Świerk-Otwock, NCBJ-Polatom, 2014-10-20

ISMTR-7. 7th International Symposium on Material Testing Reactors.[b]
W. Pawlak
Świerk, National Center for Nuclear Research , 2014-10-20

7th International Symposium on Material Testing Reaktors[b]
B. Zając
Otwock-Świerk, National Centre for Nuclear Research, 2014-10-20

a) in Polish
b) in English

INTERNAL SEMINARS

Hot plasma research - the most important experiments and prospects of fusion energy industry[a]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-01-20

Durability and effectivness of concrete radition shields in nuclear power plants objects[a]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-01-27

An assessment of the Core Demage Frequency (CDF) of a Pressuraized Water Reactor[b]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-01-27

Sustainability and effectiveness of concrete shielding against ionizing radiation in nuclear power stations.[a]
W. Pawlak
Świerk, National Center for Nuclear Research , 2014-01-27

An assessment of the Core Demage Frequency (CDF) of a pressuraized Water Reactor.[b]
W. Pawlak
Świerk, National Center for Nuclear Research , 2014-01-29

Management System in the Material Research Laboratory of NCNR - presentation on the seminar: Implementing in the NCNR of the integrated management system for nuclear installations[a]
E. Hajewska
Otwock-Świerk, National Centre for Nuclear Research, 2014-01-30

The study of hot plasma: the most important experiments and fusion energy prospects.[a]
W. Pawlak
Świerk, National Center for Nuclear Research , 2014-02-20

Metody wykrywania izotopów promieniotwórczych wykorzystywanych w ośrodku radioiziotopów polatom i pomiarów dozymetrycznych[a]
G. Olszewski
Świerk-Otwock, Polatom, 2014-03-10

Training in radiation protection, course A.[a]
W. Pawlak
Świerk, National Center for Nuclear Research , 2014-05-12

An assessment of residual infrastructure of Żarnowiec Nuclear Power Plant construction[a]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-06-02

Ocena infrastruktury pozostałej po budowie elektrowni atomowej Żarnowiec[a]
G. Olszewski
Świerk-Otwock, NCBj, 2014-06-02

Rating infrastructure remaining after the construction of NPP Żarowiec.[a]
W. Pawlak
Świerk, National Center for Nuclear Research , 2014-06-02

Radioprotection training for B category employees[a]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-10-06

Przyczynek do analizy paliwa na bazie toru w zestawach podkrytycznych sterowanych ekaluratprów i w reaktorach ERR[a]
G. Olszewski
Świerk-Otwock, NCBJ, 2014-11-05

IBIS II Project - genesis and intents[a]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-11-12

At the end of 4 Lab[a]
M. Frelek
Swierk, National Centre for Nuclear Research, 2014-11-27
a) in Polish
b) in English

DIDACTIC ACTIVITY

Ł. Kurpaska - Care intern. Practice under the bilateral agreement between NCBJ and UW - Department of Chemistry.
Intern: Marta Gapińska
Practice period: 01/07-31/07/2014

Ł. Kurpaska - Student Internship realized within the Homing Plus project.
Trainee: Krzysztof Lewandowski
Warsaw University of Technology - Faculty of Physics
Internship period: 01/05-31/10/2014

T. Wagner - Workshop for participants of 7-th International Energetic School in the Hot Laboratory LBM.

B. Zając - Magnetic particle inspection course level 2 according to PN-EN ISO 9712 for Staff Training Center "INTERPROFESJA"

B. Zając - Ultrasonic testing course level 2 according to PN-EN ISO 9712 for Staff Training Center "INTERPROFESJA"

PERSONNEL

Research scientists
Waldemar Bilous, PhD
Małgorzata Frelek, MSc Eng
Ewa Hajewska, PhD
Łukasz Kurpaska, PhD
Wioleta Pawlak, MSc Eng
Martyna Przyborska, MSc Eng
Tadeusz Wagner, MSc Eng
Jan Wasiak, PhD
Mariusz Wieczorkowski, MSc Eng
Bogdan Zając, M.Eng.

Technical and administrative staff
Konrad Ćwiek
Mirosław Jagodziński
Jagoda Zdzisław, Eng
Antoni Malczyk, Eng
Stanisław Mucha
Grzegorz Olszewski, Eng (from13.05.2013)
Alicja Ostrowska
Zbigniew Rozenblicki
Jadwiga Wojciechowska-Kwaśniewska
Tadeusz Zych

3. DEPARTMENT OF FUNDAMENTAL RESEARCH

Director of Department: Professor Grzegorz Wilk
Phone: +48 22 5532226
e-mail: wilk@fuw.edu.pl

Overview

The scientific activity of DBP in 2014 is presented in detail in the sections devoted to its four Divisions: Nuclear Physics Division (BP1), Theoretical Physics Division (BP2), High Energy Physics Division (BP3) and Astrophysics Division (BP4) (this is a new division including the former Division of Cosmic Ray Physics and the astrophysical section from the BP3 division). Here I shall present only a short overview referring to the specialized sections presented by the Divisions for details and further references. The main achievements selected as the achievements of the whole Institute to be presented to the broad public are:

(*) Evidence for High Energy Resummation Effects in Mueller-Navelet Jets at the LHC *by the international research group lead by Prof. L. Szymanowski from BP2 DBP NCBJ; main results were presented in Phys. Rev. Lett. 112, 082003 (2014).*

(*) ***Precise Measurement of the Neutrino Mixing Parameter θ_{23} from Muon Neutrino Disappearance in an Off-Axis Beam*** *by the Warsaw Neutrino Group lead by Prof. E.Rondio (**M. Kabirnezhad, J. Łagoda, P. Mijakowski, P. Przewłocki, E. Rondio, J. Zalipska) under the aegis of the world-wide neutrino research collaboration T2K; main results were presented in Phys. Rev. Lett. 112, 181801 (2014).***

The Nuclear Physics Division (BP1) concentrates on low energy nuclear physics (mostly in collaboration with the Heavy Ion Laboratory, University of Warsaw). Its activity in high energy nuclear physics connected with the Hermes collaboration at Deutsches Elektronen Synchrotron (DESY) in Hamburg was limited to preparation of some final publications because the experiment has been definitively closed. Also activity connected with the large-scale international collaboration PANDA in the FAIR project was very limited and most probably will be closed due to serious problems and delays in work on this project experienced recently at the GSI laboratory. The attempts to renew the activity of the BP1 division in true nuclear physics, undertaken by hiring Prof. H. Mach, seemed very promising, but, unfortunately, they came to naught due to his unexpected death at the end of December 2014. At the end of 2014 the BP1 division moved to new quarters in the pavilion section of Hoża 69 and its main scientific equipment, the Van de Graaff accelerator, has finished its activity. New plans concerning the future of this division are now under consideration.

The Theoretical Physics Department (BP2) works in close collaboration with experimental groups in CERN, GSI, Kamiokande and Frascatti and in collaborations with the Universities of Warsaw, Kielce, Paris, Liege, London and such institutes as PAN, CERN, GSI, JINR, RIKEN. It concentrates on the properties of heavy and superheavy nuclei; properties of nuclear matter and nuclear collisions; exotic atoms; phenomenology of collisions of hadrons and leptons; supersymmetry and cosmology, nonlinear effects in extended media and the Bayesian approach to multi-parameter problems in physics and beyond. In all of these areas interesting results were found. Its main achievement was already mentioned above. The others are mentioned in the report by the division leader.

The High Energy Physics Division`s (BP3) activity concentrated mostly on the LHC experiments ALICE, CMS, and LHCb and on neutrino physics. Because of the shutdown of the LHC accelerator no new data were collected, all groups analyzed previously taken data (what resulted in a number of valuable results presented in many publications involving to NCBJ) and very actively participated in upgrading their detectors. It was chosen as one of the two biggest achievements of NCBJ in 2013, as mentioned before. This year special emphasis should be put on the work of our Neutrino Physics group performed within the of K2K collaboration, which was mentioned before as one of the main achievements of the DBP NCBJ.

The Division of Astrophysics, (BP4), now consists of two separate branches: the cosmic ray physics group located in Łódź, and the astrophysical group in Warsaw. The cosmic ray physics group concentrates mostly on the future JEM-EUSO experiment planned to be installed at the International Space Station and on the EUSO-Ballon test experiment; in both cases we are responsible for some dedicated, very sophisticated, pieces of hardware. The long lasting collaboration with the KASKADE-Grande experiment is approaching its end due to the shutdown, only some remaining data are still being analysed. The astrophysics group is vigorously developing. It specializes mainly in investigations of the large scale of the Universe by very actively (and successfully at the same time) participating in many world wide projects in this domain.

Grzegorz Wilk

NUCLEAR PHYSICS DIVISION

Head of Division: Bohdan Mariański, PhD
phone: +48 22 6213829
e-mail: bohdan@fuw.edu.pl

Overview

The year 2014 brought to the Division of Nuclear Physics many significant changes.

From the 01.01.2014 the Microanalysis Group was transferred to the Division of Plasma Ion Beam Technology in the Departments of Materials Science.

The van de graaff “Lech”accelerator cased operation after about 50 years on 31st of December 2014. The accelerator was dismantled and transferred to the institute site in “Świerk”.

From 14^{th} of April until almost end of December the head of the division was Prof. Henryk Mach, who to our greatregret passed away on 17^{th} of December.

Our scientific activities in 2014 concentrated on two subjects: low energy nuclear physics and medium energy physics.

The low energy nuclear reactions group, as in previous years continued its various international collaborations during 2014, working with groups from CEA Saclay (funded by a COPIGAL grant), IPN Orsay and LPC Caen in France, INFN Padova/Legnaro and INFN Catania in Italy, The University of Ioannina in Greece and The Open University in the United Kingdom. A total of five articles in refereed journals plus three contributions to conference proceedings were published by members of the group. Highlights include the review article: “**Strong coupling effects in near- barrier heavy-ion elastic scsttering”** in Eur. Phys. J. A**50**, 145 (2014) by N. Keeley, K.W. Kemper and K. Rusek. Prof. N. Keeley was elected a fellow of the Institute of Physics in the United Kingdom.

The Fast Timing research group, headed by prof. H. Mach, which intends to study low energy nuclear structure by means of ultra fast time-delayed spectroscopy, took part in measurements of quadrupole and octupole degrees of freedom in the neutron-rich ^{150,151}Ba, as a member of the international collaboration IS579 at ISOLDE in CERN.
In the same group four undergraduate students analyzed experimental data (three beta decay chains) from the mass separator IGISOL and HRS at ISOLDE during a half year project. An exact scheme of levels for ^{110}Pd was obtained from their analysis which helps to determine the shape of the nucleus.
Another group of students were involved in investigating chemical components of coins with the PIXE method using the van de graaff “ acceleratorLech”.

The group involved in the Hermes collaboration at the Deutsches Elektronen Synchrotron (DESY) in Hamburg, has finshed the analysis of Spin Density Matrix Elements a in ω vector meson production. The results were published in Eur. Phys. J. C**74**, 3110 (2014). The hermes collaboration also ceased activity at the end of 2014, although to finish running analyses and publication will function without financing at least through the current year.
The same group is continuing analysis of the decay of the Δ resonance into the lepton pair ^{+}e ^{-}e at the WASA experiment. The angular distribution of decay products of the virtual photons is studied in order to establish polarization states of the photon. The wasa experiment also stopped taking data in the middle of the current year.
Part of the group is engaged in analyses of compass experiment.

Prof. B. Zwięgliński, dr D. Melnychuk dr A. Trzciński and Ing. G. Kęsik are involved in a large-scale international collaboration PANDA (antiProton ANnihilation at DArmstadt) in the FAIR project. In 2014 year their activity concentrated on simulation of the particle tracking, emitted in the forward direction, with the GEM detector (gas-electron multiplier) and planning and construction of a slow control system for the hydrogen jet target for the PANDA detector. (in collaboration with Ing. A. Chłopik from department TJ-4 NCBJ).
Dr D. Melnychuk is partially involved in the LHCb experiment.

Bohdan Mariański

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Influence of weak channels on fusion barriers
E. Piasecki
Nuclear Fission and Exotic Nuclei (Japan, Tokai, 2014-12-03 - 2014-12-05)

Mechanism of damage buildup in ion bombarded compound single crystals
P. Jóźwik, **A. Turos**, **J. Jagielski**, L. Thomé
X-th International Conference ION IMPLANTATION AND OTHER APPLICATIONS OF IONS AND ELECTRONS (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

Mechanism of damage buildup in ion bombarded compound single crystals
A. Turos, **P. Jóźwik**, **J. Jagielski**, L. Thomé
7th International Meeting On Recent Developments In The Study Of Radiation Effects In Matter (REM-2014) (Hungary, Budapest, 2014-07-09 - 2014-07-12)

Materials research on archaeological objects using PIXE and other non-invasive techniques
E. A. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
ION 2014 (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
Acta Phys. Pol. A (2014)

Weak channels and barrier distributions
E. Piasecki
The ECT workshop on \ (Italy, Trento, 2014-05-26 - 2014-05-30)*

Oral Presentation

Polar-side and transversal emission of heavy fragments in partitioning of ^{197}Au + ^{197}Au system at 23 A MeV
T. Cap, K. Siwek-Wilczyńska, I. Skwira-Chalot, **J. Wilczyński**
International Workshop on Multi Facets of EOS and Clustering (Italy, Catania, 2014-05-06 - 2014-05-09)

Polar-side emission of heavy IMFs in ^{197}Au + ^{197}Au collisions at 23 A MeV
T. Cap, K. Siwek-Wilczyńska, I. Skwira-Chalot, **J. Wilczyński**
16-th ASRC International Workshop on Nuclear Fission and Structure of Exotic Nuclei (Japan, Tokai, 2014-03-18 - 2014-03-20)

Characterization of Solid State Nuclear Track Detectors of the CR-39/PM-355 type for light charged particle spectroscopy
A. Malinowska, **M. Jaskóła**, **A. Korman**, **A. Szydłowski**, **M. Kuk**
26th International Conference on Nuclear Tracks in Solids (26ICNTS) (Japan, Kobe, 2014-09-15 - 2014-09-19)

Ion beam-induced luminescence as method of characterization of radiation damage in polycrystalline materials
I. Jozwik-Biala, **J. Jagielski**, G. Gawlik, G. Panczer, N. Moncoffre, **R. Ratajczak**, **P. Jóźwik**, A. Wajler, A. Sidorowicz
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (in press)

Defect accumulation in Ar-ion bombarded ZnO single crystals
A. Stonert, **R. Ratajczak**, **P. Jóźwik**, **A. Turos**, J. Gaca, Marek. Wójcik, E. Wierzbicka
X-th International Conference Ion Implantation and Other Applications of Ions and Electrons (ION2014) (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)

Heavy ion beams for radibiology - dosimetry and nanodosimetry at HIL
U. Kaźmierczak, **A. Bantsar**, D. Banaś, J. Braziewicz, J. Czub, **M. Jaskóła**, **A. Korman**, M. Kruszewski, A. Lankoff, H. Lisowska, M. Pietrzak, **S. Pszona**, T. Stępkowski, Z. Szefliński, M. Wojewódzka
II Symposium on Positron Emission Tomography (Poland, Kraków, 2014-09-21 - 2014-09-24)
Acta Phys. Pol. A (in press)

Charged projectile spectrometry using the cr-39/pm-355 type of solid state nuclear track detector
A. Malinowska, **M. Jaskóła**, **A. Korman**, **A. Szydłowski**, **M. Kuk**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)
Nukleonika (in press)

Materials research on archaeological objects using PIXE and other non-invasive techniques
E.A. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, I.M. Fijał-Kirejczyk, P. Kalbarczyk
5th Meeting X-ray and other techniques in investigations of the objects of cultural heritage (Poland, Kraków, 2014-05-14 - 2014-05-17)

Poster

Dosimetry in radiobiological studies with heavy ion beam of the Warsaw cyclotron
U. Kaźmierczak, D. Banaś, J. Braziewicz, J. Czub, **M. Jaskóła**, **A. Korman**, M. Kruszewski, A. Lankoff, H. Lisowska, **A. Malinowska**, T. Stępkowski, Z. Szefliński, M. Wojewódzka
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (2015)

Relative bilogical effectiveness of ^{12}C ions with high LET
J. Czub, D. Banaś, J. Braziewicz, **M. Jaskóła**, U. Kaźmierczak, **A. Korman**, A. Lankoff, H. Lisowska, Z. Szefliński, A. Wójcik
41st Annual Meeting of the European Radiation Research Society ERR2014 (Greece, Rhodes, 2014-09-14 - 2014-09-19)

Defect accumulation in Ar-ion bombarded ZnO single crystals
A. Stonert, **R. Ratajczak**, **P. Jóźwik**, **A. Turos**, J. Gaca, Marek. Wójcik, E. Wierzbicka
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (2014)

Influence of soft X-ray radiation on the parameters of tracks induced in CR-39 and PM-355 solid state nuclear track detectors
A. Szydłowski, **A. Malinowska**, **M. Jaskóła**, K. Szewczak, **A. Korman**, M. Paduch, **M. Kuk**
26th International Conference on Nuclear Tracks in Solids (Japan, Kobe, 2014-09-15 - 2014-09-19)
Radiat. Meas. (in press)

Materials research on archaeological objects using PIXE and other non - invasive technique
E. A. Miśta, **A. Stonert**, **A. Korman**, **J.J. Milczarek**, **I. Fijał-Kirejczyk**, P. Kalbarczyk
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)

LECTURES, COURSES AND EXTERNAL SEMINARS

Omega SDMEs[b]
B. Mariański
Hamburg, DESY Hamburg, 2014-03-17

Studies of barrier distributions at Warsaw Cyclotron[b]
E. Piasecki
Beijing, Peking University, 2014-03-17

Omega SDMEs[b]
B. Mariański
Hamburg, DESY Hamburg, 2014-06-02

Update on omega meson A_{UT} analysis[b]
B. Mariański
Hamburg, DESY Hamburg, 2014-06-02

Status of the h_c-> eta_c gamma analysis[b]
D. Melnychuk
Darmstadt, Germany, GSI, 2014-06-11

Spin Density Matrix Elements in Exclusive ω Leptoproduction on ^1H and ^2H Targets at 23,6 GeV Beam Energy[b]
B. Mariański
Genewa, CERN, 2014-09-23

Weak couplings and barrier distributions[b]
E. Piasecki
Catania, Italy, Laboratori Nationali del Sud, 2014-11-11

A_{UT} for exclusive omega production[b]
B. Mariański
Hamburg, DESY Hamburg, 2014-11-19

Contribution of NCBJ to Slow-Control of the PANDA Cluster-Jet Target in the frame of EU Future-Jet activity.[b]
B. Zwięgliński
Muenster, University of Muenster, 2014-11-20

[b)] in English

INTERNAL SEMINARS

PANDA experiment at the future FAIR facility[b]
D. Melnychuk
Warsaw, University of Warsaw, 2014-04-25

[b)] in English

DIDACTIC ACTIVITY

B. Mariański - Lectures on ekonometry in WSZ-SW

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

N. Keeley
Fellow of the Institute of Physics

J. Wilczyński
Member of the Scientific Council of the National Centre for Nuclear Research in Otwock-Świerk

P. Żuprański
Member of the Scientific Council of the HERMES Collaboration at DESY

B. Zwięgliński
Coordination Board of the PANDA Detector activities, SINS representative
representative of NCBJ, National Consortium FEMTOPHYSICS

PERSONNEL

Research scientists

Witold Augustyniak, PhD	4/5*
Andrzej Bieńkowski, PhD	to March 31
Marian Jaskóła, Professor	1/10*
Nicholas Keeley, Assoc. Prof.	
Andrzej Korman, PhD	
Henryk Mach, Professor	to December 15
Bohdan Mariański, PhD	
Dmytro Melnychuk, PhD	
Ernest Piasecki, Professor.	1/10*
Ewa Ruchowska, PhD	
Krzysztof Rusek, Professor	to June 30
Andrzej Trzciński, PhD	
Janusz Wilczyński, Professor	3/5*
Bogusław Zwięgliński, Professor	1/10*
Paweł Żuprański, Assoc. Prof.	1/10*

Technical and administrative staff

Dorota Dobrowolska	
Ryszard Kacprzak	1/5*
Grażyna Kęsik, Eng	
Władysław Mielczarek	1/5*
Wiesław Pietrzak	1/5*
Zbigniew Szczepaniak	

* part-time employee

THEORETICAL PHYSICS DIVISION

Head of Division: Michał Kowal, PhD
phone: +48 22 5532281
e-mail: m.kowal@fuw.edu.pl

Overview

The Theoretical Physics Department consists of 31 physicists and 6 PhD students working on different aspects of low and high energy physics, plasma and nonlinear phenomena as well as on the general problems of quantization of particle dynamics, astrophysics, string theory and cosmology. The "BayaesFITS" project devoted to the Bayesian approach to multi-parameter problems in physics and beyond involving parallel computing and large data-sets is also carried out within our department.

Close collaboration with experimental groups at CERN (COMPASS, CMS and ALICE) and in other laboratories (like; GSI, Kamiokande or Frascatti) should be mentioned. Results of our scientific activity in 2014 were presented in 211 publications in total, 30 among them with the number of co-authors less than 5. Our results were presented at more than 60 coferences and/or workshops.

Our research effort was mainly concentrated on the following topics:

- properties of heavy and superheavy nuclei;
- properties of nuclear matter and nuclear collisions;
- exotic atoms;
- Bayesian approach to multi-parameter problems in physics.
- phenomenology of collisions of hadrons and leptons;
- theoretical cosmology;
- string theory;
- nonlinear effects in extended media.

In all of these areas very interesting results were achived. Of special relevance and interest in 2014 are the following work:

1) Evidence for High Energy Resummation Effects in Mueller-Navelet Jets at the LHC by L. Szymanowski et. al.
2) Cauchy-Schwarz inequality and particle entanglement by P. Zin et.al.
3) Dynamics and cosmological constraints on Brans-Dicke cosmology by O. Hrycyna et. al.

Collaborations with several universities and institutes have been maintained (e.g. the Universities of Warsaw, Kielce, Paris, Liege, London and Scientific Institutes like: PAN, CERN, GSI, JINR, RIKEN).

Michał Kowal

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Quasi-power law ensembles
G. Wilk, Z. Włodarczyk
27th Marian Smoluchowski Symposium on Statistical Physics (Poland, Zakopane, 2014-09-22 - 2014-09-26)
Acta Phys. Pol. B Vol. 46 (2015) 1103-1122

Euclidean Big Bounce
J. Mielczarek
Wilhelm und Else Heraeus-Stiftung Seminar on Quantum Cosmology (Germany, Bad Honnef, 2014-07-28 - 2014-08-01)

Cosmological constraints on quantum gravity
J. Mielczarek
Experimental Search for Quantum Gravity (Italy, Trieste, 2014-09-01 - 2014-09-05)

Theoretical description of the decay chain of the nucleus $^{289}115$
A. Sobiczewski
The Zakopane Conference on Nuclear Physics (Poland, Zakopane, 2014-08-31 - 2014-09-07)
Acta Phys. Pol. B (2014)

Analysis of the decay chain of the nucleus $^{293}117$
A. Sobiczewski
XXI Nuclear Physics Workshop (Poland, Kazimierz Dolny, 2014-09-23 - 2014-09-28)
Phys. Scr. (2014)

Coupling hydrodynamics to nonequilibrium degrees of freedom in strongly interacting quark-gluon plasma
M. Spaliński
CEREN TH Institute on Numerical Holography (Switzerland, Genewa, 2014-12-08 - 2014-12-18)

K, 4He -> Lambda , pi 3He and some consequences
S. Wycech
New trends in low energy QCD (Italy, Trento, 2014-10-26 - 2014-10-31)

On higher twist chiral odd pion generalized parton distributions
B. Pire, **L. Szymanowski**, S. Wallon
XXII International Workshop on Deep-Inelastic Scatteriong and related Subjects DIS 2014 (Poland, Warszawa, 2014-04-28 - 2014-05-02)
Proceedings of Science (in press)

Baryonium, a common ground for atomic and high energy physics
S. Wycech
EXA2014- International Conference on Exotic Atoms and Related Topics (Austria, Wieden, 2014-09-15 - 2014-09-21)

Superheavy nuclei - their stability and chances of isomers
W. Brodziński, P. Jachimowicz, **M. Kowal**, L. Prochniak, **J. Skalski**
LEA COPIGAL COLLIGA Workshop (France, Paryż, 2014-01-07 - 2014-01-10)

Towards modelization of quark and gluon transversity generalized parton distributions
B. Pire, K. SemenovTian-Shansky, **L. Szymanowski**, S. Wallon
XXII International Workshop on Deep-Inelastic Scatteriong and related Subjects DIS 2014 (Poland, Warszawa, 2014-04-28 - 2014-05-02)
Proceedings of Science (in press)

Time problem in quantum cosmology
P. Małkiewicz
The First Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

Dynamics and observational constraints on Brans-Dicke cosmological model
O. Hrycyna, M. Szydłowski
The 1st Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

Understanding the Nucleon\'s Structure
K. Kurek
Various faces of QCD1st Symposium of the Division for Physics of Fundamental Interactions of the Polish Physical Sociaty (Poland, Kielce, 2014-05-10 - 2014-05-11)

Confronting BFKL dynamics with experimental studies of Mueller-Navelet jets at the LHC
B. Ducloue, **L. Szymanowski**, S. Wallon
XXII International Workshop on Deep-Inelastic Scatteriong and related Subjects DIS 2014 (Poland, Warszawa, 2014-04-28 - 2014-05-02)
Proceedings of Science (in press)

On quantum cosmological models and their limitations
P. Małkiewicz
Fundamental Issues of the Standard Cosmological Model (France, Cargese, 2014-09-21 - 2014-09-26)

From dynamical models to cosmological observables
O. Hrycyna
The 1st Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

Constraints on ΔG from COMPASS data
K. Kurek
The 21st International Symposium on Spin Physics, October 20-24, 2014, Beijing, China (China, Beijing, 2014-10-20 - 2014-11-24)
Journal of Modern Physics, Conference Sieries (2014)

Confronting BFKL dynamics with experimental studies of Mueller-Navelet jets
B. Ducloue, **L. Szymanowski**, S. Wallon
Low x meeting 2014 (Japan, Kyoto, 2014-06-17 - 2014-06-21)

Highlights of dark matter
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**, **A.J. Williams**
Theory Meeting Experiment 2014 :: Neutrinos and Cosmos (Poland, Warsaw, 2014-09-03 - 2014-09-05)

Generalized parton distributions in spacelike and timelike DVCS
J. Wagner
Various faces of QCD1st Symposium of the Division for Physics of Fundamental Interactions of the Polish Physical Sociaty (Poland, Kielce, 2014-05-10 - 2014-05-11)

Towards solving generic singularity problem
W. Piechocki
Quantum Cosmology (Germany, Bad Honnef, 2014-07-28 - 2014-08-01)

Phenomenology of timelike Compton scattering
J. Wagner
International Workshop on Deeply Virtual Compton Scattering: From Observables to GPDs (Germany, Bochum, 2014-02-10 - 2014-02-12)

Big Band as a critical point?
J. Mielczarek
The 1st Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

Towards solving generic cosmological singularity problem
W. Piechocki
The First Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

Power laws in multiparticle production processes
G. Wilk, Z. Włodarczyk
International Conference on Statistical Physics STATPHI2014 (Greece, Rhodes, 2014-07-07 - 2014-11-07)
Entropy Vol. 17 (2015) 384-400

Level spacing distribution for the prototype of the Bianchi IX model
J. Mielczarek, **W. Piechocki**
Random Matrix Theory: Foundations and Applications. (Poland, Kraków, 2014-07-01 - 2014-07-06)
Acta Phys. Pol. B (in press)

Oral Presentation

What next for the CMSSM and NUHM: Improved prospects for superpartner and dark matter detection
L. Roszkowski, **E. Sessolo**, **A.J. Williams**
PLANCK 2014 - 17th International Conference From the Planck Scale to the Electroweak Scale (France, Paryż, 2014-05-26 - 2014-05-30)

Superheavy nuclei- structure, isomers, limits of stability
P. Jachimowicz, **W. Brodziński**, **M. Kowal**, **J. Skalski**
2-nd Conference on Advances in Radioactive Isotope Science (ARIS2014) (Japan, Tokio, 2014-06-01 - 2014-06-06)

Nuclear Enthalpy and Compressibility
J. Rożynek
3rd International Conference on New Frontiers in Physics (Greece, Kolymbari, 2014-07-28 - 2014-08-08)
EPJ Web of Conferences (in press)

A single phenomenological formula for transverse momentum hadrons produced in pp collisions at LHC?
C.Y. Wong, **G. Wilk**, L.J.L. Cirto, C. Tsallis
XLIV International Symposiumon Multiparticle Dynamics (Italy, Bologna, 2014-09-08 - 2014-09-12)
EPJ Web of Conferences Vol. 90 (2015) 01002

Low fine tuning in the MSSM with higgsino dark matter and unification constraints
K. Kowalska, L. Roszkowski, E. Sessolo, S. Trojanowski
26th Rencontres de Blois (France, Blois, 2014-05-18 - 2014-05-23)

Configuration constrained calculations of the potential energy surfaces (PES's) - search for superheavy K-isomers.
P. Jachimowicz, **M. Kowal**, **J. Skalski**
The Zakopane Conference on Nuclear Physics (Poland, Zakopane, 2014-08-31 - 2014-09-07)

System size dependence of the log-periodic oscillations of transverse momentum spectra
M. Rybczyński, **G. Wilk**, Z. Włodarczyk
XLIV International Symposiumon Multiparticle Dynamics (Italy, Bologna, 2014-09-08 - 2014-09-12)
EPJ Web of Conferences Vol. 90 (2015) 01002

Low fine tuning in the MSSM with higgsino dark matter and unification constraints
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**
PLANCK 2014 - 17th International Conference From the Planck Scale to the Electroweak Scale (France, Paryż, 2014-05-26 - 2014-05-30)

Towards the map of quantum gravity
J. Mielczarek
Conceptual and Technical Challenges for Quantum Gravity (Italy, Rzym , 2014-09-08 - 2014-09-12)

Quasi-power laws in multiparticle production processes
G. Wilk, Z. Włodarczyk
International Conference on Statistical Physics STATPHI2014 (Greece, Rhodes, 2014-07-07 - 2014-11-07)
Chaos. Soliton. Fract. (in press)

The 3.5 keV X-ray line from decaying gravitino dark matter
N.E. Bomark, **L. Roszkowski**
PLANCK 2014 - 17th International Conference From the Planck Scale to the Electroweak Scale (France, Paryż, 2014-05-26 - 2014-05-30)

Natural SUSY after the 8 TeV LHC run
K. Kowalska, **E. Sessolo**
PLANCK 2014 - 17th International Conference From the Planck Scale to the Electroweak Scale (France, Paryż, 2014-05-26 - 2014-05-30)

Configuration constrained calculations of the potential energy surfaces (PES's) - search for superheavy K-isomers.
P. Jachimowicz, **M. Kowal**, **J. Skalski**
XXI Nuclear Physics Workshop (Poland, Kazimierz Dolny, 2014-09-23 - 2014-09-28)

Search for baryonium
S. Wycech, J.P. Dedonder, B. Loiseau
13th International Workshop on Meson Production, Properties and Interaction (Poland, Krakow, 2014-05-29 - 2014-06-03)
EPJ Web Conf. Vol. 81 (2014) 2014105029

Low fine tuning in the MSSM with higgsino DM and unification constraints
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**
SUSY 2014 (United Kingdom, Manchester, 2014-07-21 - 2014-07-26)

Natural SUSY after the 8 TeV LHC run
K. Kowalska, **E. Sessolo**
26th Rencontres de Blois (France, Blois, 2014-05-18 - 2014-05-23)

Is the nuclear large amplitude collective dynamics adiabatic or non-adiabatic?
P. Jachimowicz, **M. Kowal**, **J. Skalski**
Challenges in the microscopic description of nuclear large amplitude collective dynamics (France, Ganil, 2014-10-13 - 2014-10-14)

Natural MSSM after the LHC 8 TeV run
K. Kowalska, **E. Sessolo**
SUSY 2014 (United Kingdom, Manchester, 2014-07-21 - 2014-07-26)

Ways to treat spontaneous & other fission from instanton perspective
W. Brodziński, P. Jachimowicz, **M. Kowal**, **J. Skalski**
Challenges in the microscopic description of nuclear large amplitude collective dynamics (France, Ganil, 2014-10-13 - 2014-10-14)

What next for the CMSSM and the NUHM: Improved prospects for superpartner and dark matter **detection**
L. Roszkowski, **EnricoMariaSessolo**, **A.J. Williams**
SUSY 2014 (United Kingdom, Manchester, 2014-07-21 - 2014-07-26)

Gluon contribution to the Sivers effect: COMPASS results on deuteron target
A. Szabelski
Transversity 2014 (Italy, Chia, 2014-06-09 - 2014-06-13)

Low fine tuning in the MSSM with higgsino dark matter and unification constraints
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**
PASCOS 2014 (Poland, Warsaw, 2014-06-22 - 2014-06-27)

What next for the CMSSM and the NUHM: Improved prospects for superpartner and dark matter detection
L. Roszkowski, **E. Sessolo**, **A.J. Williams**
PASCOS 2014 (Poland, Warsaw, 2014-06-22 - 2014-06-27)

Dynamics of the Bianchi IX model near the cosmological singularity
E. Czuchry
The First Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

Dynamics and observational constraints on Brans-Dicke cosmological model
O. Hrycyna
Fundamental Issues of the Standard Cosmological Model (France, Cargese, 2014-09-21 - 2014-09-26)

Gluon Contribution to the Sivers Effect COMPASS Results on Deuteron Target
K. Kurek, **A. Szabelski**
The 21st International Symposium on Spin Physics, October 20-24, 2014, Beijing, China (China, Beijing, 2014-10-20 - 2014-11-24)
Journal of Modern Physics, Conference Series (2014)

Timelike DVCS in Ultraperipheral Collisions
J. Wagner, **L. Szymanowski**, B. Pire
Workshop on photon-induced collisions at the LHC (Switzerland, Geneve, 2014-06-02 - 2014-06-04)

The 3.5 keV line from decaying gravitino dark matter
N.E. Bomark, **L. Roszkowski**
PASCOS 2014 (Poland, Warsaw, 2014-06-22 - 2014-06-27)

Probing Generalized Parton Distributions in Ultraperipheral Collisions
J. Wagner, **L. Szymanowski**, B. Pire, D.Yu. Ivanov
International Workshop on Diffraction in High-Energy Physics (Croatia, Primosten, 2014-09-10 - 2014-09-16)
AIP Conf. Proc. (in press)

Dynamics and observational constraints on Brans-Dicke cosmological model
O. Hrycyna
Dark Energy Interactions (Sweden, Stockholm, 2014-10-01 - 2014-10-03)

Timelike Compton scattering with a linearly polarized photon beam
A.T. Goritschnig, B. Pire, **J. Wagner**
Deep Inelastic Scattering (Poland, Warsaw, 2014-04-28 - 2014-05-02)
PROCEEDINGS OF SCIENCE (PoS) (2014)

Loop deformations of space-time symmetries and their consequences
J. Mielczarek
XXXIII Max Born Symposium Noncommutative geometry, quantum symmetries and quantum gravity (Poland, Wrocław, 2014-07-06 - 2014-07-10)

Interpretation and further integrability propertiesof a Schrödinger equation with Tsallis entropy
P. Goldstein
7th Symposium on Integrable Systems (Poland, Kraków, 2014-06-27 - 2014-06-28)

Poster

Nonextensive Critical Effects in NJL Model
J. Rożynek
3rd International Conference on New Frontiers in Physics (Greece, Kolymbari, 2014-07-28 - 2014-08-08)

Third, hyperdeformed minima with different nuclear shape parameterizations
P. Jachimowicz, **M. Kowal**, **J. Skalski**
The Zakopane Conference on Nuclear Physics (Poland, Zakopane, 2014-08-31 - 2014-09-07)

Bayesian Approach to Supersymmetry and Dark Matter using current LHC and direct DM limits
N. Bomark, **M. Kazana**, **K. Kowalska**, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**, A. Williams
LHC Days in Split (Croatia, Split, 2014-09-29 - 2014-10-04)

From dynamical models to cosmological observables
O. Hrycyna
XIIth School of Cosmology (France, Cargese, 2014-09-15 - 2014-09-20)

From dynamical models to cosmological observables
O. Hrycyna
30th Institut d Astrophysique de Paris Colloquium The primordial Universe after Planck (France, Paris, 2014-12-15 - 2014-12-19)

LECTURES, COURSES AND EXTERNAL SEMINARS

Holography and hydrodynamicsHolografia i hydrodynamika[a]
M. Spaliński
Bialystok, Univ. of Bialystok, 2014-01-21

Generalized Parton Distributions in Deeply Virtual Compton Scattering[a]
J. Wagner
Warsaw, Particles and Fundamental Interactions Division, Institute of Experimental Physics, University of Warsaw, 2014-03-21

AdS/CFT duality as a method of studying Yang-Mills plasma[a]
M. Spaliński
Lublin, Marie Curie Univ. of Lublin, 2014-03-25

Egzitic configurations in the heaviest nuclear systems [a]
M. Kowal
Lublin, UMCS, 2014-04-01

Generalized parton distributions in Deeply Virtual Compton Scattering[b]
J. Wagner
Warsaw, Institute of Theoretical Physics, Warsaw University, 2014-05-26

Exotic nuclear sytems[a]
M. Kowal
Zielona Gora, Uniwersytet Zielonogorski, 2014-11-04

Superheavy K -isomers[a]
M. Kowal
Lublin, UMCS, 2014-11-25

Timelike Compton Scattering and NLO corrections in DVCS[b]
J. Wagner
Newport News, VA, USA, Thomas Jefferson National Laboratory, 2014-03-06

Timelike Compton Scattering[b]
J. Wagner
Newport News, VA, USA, Thomas Jefferson National Laboratory, 2014-11-14

Coupling hydrodynamics to nonhydrodynamic degrees of freedom in strongly interacting quark-gluon plasma[b]
M. Spaliński
Santiago de Compostela, Univerity of Santiago de Compostela, 2014-11-26

Statistics of thermalization in Bjorken flow[b]
M. Spaliński
Barcelona, Univ. of Barcelona, 2014-11-28

Affine Coherent States in Minisuperspaces[b]
P. Małkiewicz
Paris, France, AstroParticule et Cosmologie, Paris University Diderot, 2014-12-09

[a)] in Polish
[b)] in English

INTERNAL SEMINARS

Heaviest atomic nuclei - their structure and stability[a]
J. Skalski
Swierk, NCBJ, 2014-01-16

Natural SUSY, Light charginos and R-parity violation [b]
N.E. Bomark
Lund, Sweden, University of Lund, 2014-01-23

Heaviest atomic nuclei - their structure and limits of stability[a]
J. Skalski
Warszawa, NCBJ, 2014-01-28

BICEP 2 detection of primordial gravitational waves - New constraints on inflation and quantum gravity[b]
J. Mielczarek
Cracow, Institute of Physics of the Jagiellonian University, 2014-03-31

Particle Physics after discovery of Higggs Boson.[a]
K. Kurek
Swierk, National Centre for Nuclear Research, 2014-05-22

[a)] in Polish
[b)] in English

DIDACTIC ACTIVITY

P. Goldstein - Lectures "Elements of Statistical Physics" for graduate students of NCBJ

K. Kurek - Elements of Quantum Mechanics and Qunatum Field Theory, lecture given for PhD students

K. Kurek - Supervision of PhD thesis in COMPASS experiment

K. Kurek - Supervision of PhD thesis in LHCb experiment

A. Sobiczewski - Care of Ph.D. student: Michał Palczewwski

A. Sobiczewski - Seminar on nuclear theory, conducted commonly with prof. J. Dąbrowski (NCBJ) and prof. S.G. Rohoziński (Warsaw University)

L. Szymanowski - Bertrand Ducloue, LPT Orsay
Phenomenology of Low x processes at LHC

L. Szymanowski - Renaud Boussarie, LPT Orsay

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

E. Czuchry
member of Polish Society of Relativity

J. Dąbrowski
Fellow of the American Physical Society
Acta Physica Polonica B, Member of the International Editorial Council of Acta Physica Polonica B

P. Goldstein
Member of the American Mathematical Society
Member of the Polish Physical Society

O. Hrycyna
Ordinary member, Polish Society on Relativity

E. Infeld
Fellow of the Institute of Physics, London, UK
fellow
Journal of Technical Physics, Member of the Editorial Board of Journal of Technical Physics Institute of Fundamental Technical Research, Polish Academy of Sciences

K. Kurek
Member of Advisory Board on XXII International Workshop on Deep-Inelastic Scattering and Related Subjects (DIS 2014), University of Warsaw, Poland, April 28 – May 2, 2014 in Warsaw, Poland

J. Mielczarek
Polish Society on Relativity

W. Piechocki
Member
Polish Physical Society

L. Roszkowski
Reports on Progress in Physics, Reports on Progress in Physics

J. Skalski
National Centre for Nuclear Research

A. Sobiczewski
Corresponding Member of the Polish Academy of Sciences
Corresponding Member of Polish Academy of Learning
full member, Polish Academy of Sciences
full member, Polish Academy of Arts and Sciences
Warsaw Scientific Society, full member
Postępy Fizyki, Honorary editor of "Postępy Fizyki" (Advances in Physics)
Nuclear Physics and Atomic Energy, Editor: Kiev Insitute for Nuclear Research of the National Academy of Sciences of Ukraine
Member of the Scientific Council of the Heavy Ion Laboratory of Warsaw University
Member of the Programme Advisory Committee for Nuclear Physics, JINR, Dubna (Russia)
Nicolaus Copernicus Astronomical Center
Member of the Scientific Council, The Niewodniczański Institute for Nuclear Physics of the Polish Academy

of Sciences (Cracow)
National Center for Nuclear Research: member

M. Spaliński
International Journal of Modern Physics A, Member of the Editorial Board, International Journal of Modern Physics A

L. Szymanowski
member of PANDA Theory Advisoty Group

J. Wagner
Member of Organizing Committee on Deep Inelastic Scattering in Warsaw, Poland

G. Wilk
National Center for Nuclear Research Chief of the PhD section
Institute of Theoretical Physics UW, Member of the commision for competitions for extraordinary professorship; Member of the commision for competitions for ordinary professorship (full professor of UW position)

PERSONNEL

Research scientists

Jan Błocki, Professor
Nils-Erik Bomark, PhD
Ewa Czuchry, PhD
Janusz Dąbrowski, Professor *(to March 2014)*
Piotr Goldstein, PhD
Michał Heller, PhD *on leave*
Orest Hrycyna, PhD
Eryk Infeld, Professor
Michał Kowal, Assoc.Prof.
Krzysztof Kurek, Assoc. Prof.
Przemysław Małkiewicz, PhD
Jakub Mielczarek, PhD
Zygmunt Patyk, Professor
Marek Pawłowski, PhD
Włodzimierz Piechocki, Professor
Grzegorz Plewa, PhD (*from November 2014)*
Maciej Pylak, PhD *(from February 2014)*
Leszek Roszkowski, Professor
Jacek Rożynek, PhD
Enrico Sessolo, PhD
Janusz Skalski, Assoc. Prof.
Andrzej Skorupski, PhD
Robert Smolańczuk, Assoc. Prof.
Adam Sobiczewski, Professor
Michał Spaliński, Assoc.Prof.
Lech Szymanowski, Assoc.Prof.
Jakub Wagner, PhD
Andrew Williams, PhD
Grzegorz Wilk, Professor
Sławomir Wycech, Professor
Paweł Ziń, PhD

PhD students
Varvara Batozskaya, MSc
Wojciech Brodziński, MSc
Palczewski Michal, MSc
Grzegorz Plewa, MSc
Adam Szabelski, MSc
Sebastian Trojanowski, MSc

Technical and administrative staff
Anna Sidor

HIGH ENERGY PHYSICS DIVISION

Head of Division: Maciej Górski, PhD
phone: +48 22 5532269
e-mail: Maciej.gorski@ncbj.gov.pl

Overview

During 2014 part of the division, namely the astrophysics group under the leadership of prof. Agnieszka Pollo, became a separate group within the Department of Fundamental Research. Its achievements are described.

The Division employs 40 persons, among them 7 full professors, 3 professors, 21 assistant professors, 3 researchers, 7 PhD students, 2 technicians/engineers and two administrative /technical staff. The Division is organized in two groups: the Accelerator Experiments Group and the Neutrino Physics Group.

The Accelerator Experiments Group`s activities concentrate on participation in three LHC experiments: the ALICE, CMS and LHCb, COMPASS and NA61/SHINE experiments at the CERN SPS accelerator, the WASA medium energy experiment at Juelich, KLOE at the electron-positron storage ring in Frascati, ZEUS at DESY and DELPHI at LEP.

During 2014 all three LHC experiments continued analysis of data taken during the Run I period of the accelerator and prepared for the second period of data taking at higher energies and luminosities (Run II starting in 2015). ALICE continued its investigation of pi-zero mesons and single photon production, LHCb worked on CP violation in heavy flavour decays while CMS analyzed data on Higgs boson decay into two tau leptons and searched for new heavy charged particles proposed by extensions of the Standard Model.

The COMPASS experiment participated in the analysis of previously taken data, specially on the origin of the nucleon spin and on the physics of vector mesons produced in deep inelastic scattering of high energy muons .

The KLOE experiment analyzed previously recorded data concentrating on the properties of the decoherence effects in the decays of the f meson into two neutral kaons.

The WASA experiment studied the production of light mesons and especially, searched for the so-called “dark photon” proposed by certain theoretical models.

The Neutrino Physics Group studied the properties of neutrinos in the T2K experiment in Japan. Their activities concentrate on the determination of the neutrino flux in the so-called Near Detector. Its data are used in the comparison of the neutrino beam observed 300 kilometers from the production with predictions containing oscillations and not containing them.

The NA61 group continued its analysis of meson production, which is a very important subject for determination of the properties of neutrino beams produced through their decays.

Two publications coauthored by employees of BP3 were recognized as of special value. They are:

- Precise Measurement of the Neutrino Mixing Parameter θ(23) from Muon Neutrino Disappearance in an Off-Axis Beam , Published in Phys.Rev.Lett. 112 (2014) 18, 181801
- Evidence for the 125 GeV Higgs boson decaying to a pair of tau leptons , JHEP 05 (2014) 104

The Division`s employees coauthored a total of 258 papers published in peer-reviewed journals, gave 42 talks at international conferences and 24 seminars.

One of us (Piotr Zalewski) was awarded the Dr. Sci (habilitation) degree during 2014.

Maciej Górski

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

wyklad o neutrinach i ich detekcji
E. Rondio
Danube School on Instrumentation in Elementary Particles and Nuclear Physics (Serbia and Montenegro, Novi Sad, 2014-09-08 - 2014-09-13)

Neutrino Oscillations, today and tomorrow.
E. Rondio
Future Prospects in High Energy Physics (Israel, TelAviw, 2014-01-05 - 2014-01-06)

Exclusive meson production at COMPASS
P. Sznajder
XXII International Workshop on Deep-Inelastic Scattering and Related Subjects (DIS 2014), University of Warsaw, Poland, April 28 – May 2, 2014 (Poland, Warsaw, 2014-04-28 - 2014-05-02)
Proceedings of Science Vol. DIS2014 (2014) 220

Program of COMPASS-II at CERN
A. Sandacz
QCD Evolution Workshop (USA, Santa Fe, NM, 2014-05-12 - 2014-05-16)
International Journal of Modern Physics: Conference Series (IJMPCS) (2014)

Heavy-Ion results from the CMS experiment
B. Boimska
Cracow Epiphany Conference 2014 (Poland, Cracow, 2014-01-08 - 2014-01-10)
Acta Phys. Pol. B Vol. 45 No 7 (2014) 1291

Probing Heavy-Ion Collisions with Jets in the CMS Experiment
B. Boimska
XXXIV-th IEEE-SPIE Joint Symposium Wilga 2014 (Poland, Wilga, 2014-05-26 - 2014-06-01)
Proc. SPIE Int. Soc. Opt. Eng. Vol. 9290 (2014) 92902D

Search for a new dark interaction with the WASA detector at COSy
J. Stepaniak
II International Symposium on Applied Nuclear Physics and Innovative Technologies (Poland, Kraków, 2014-09-24 - 2014-09-27)

Hadron production measurements from NA61
K. Kowalik
NOW2014 (Italy, Otranto, Lecce, 2014-09-07 - 2014-09-14)
Nucl. Phys. B Proc. Sup. (2014)

National Centre for Nuclear Research – POLAND – Some Science and Educational Program.
M. Bielewicz, **G. Wrochna**
2nd International Conference of the CENEN-NET (Czech Republic, Prague, 2014-02-04 - 2014-02-07)

Classical limit of QCD and partons energy loss
M. Carrington, **K. Deja**, **St. Mrówczyński**
Various faces of QCD1st Symposium of the Division for Physics of Fundamental Interactions of the Polish Physical Sociaty (Poland, Kielce, 2014-05-10 - 2014-05-11)

Results from ND280 Near Detector
J. Zalipska
3rd International Conference on New Frontiers in Physics (Greece, Kolymbari, 2014-07-28 - 2014-08-08)
EPJ Web Conf. (2014)

Wigner Functional of Fermionic Fields
St. Mrówczyński
Symposium on Strong and Electroweak Matter (SEWM 2014) (Switzerland, Lausanne, 2014-07-14 - 2014-07-18)

Energy loss in unstable quark-gluon-plasma
M. Carrington, **K. Deja**, **St. Mrówczyński**
Rencontres de Moriond `QCD and High Energy Interactions (Italy, La Thuile, 2014-03-22 - 2014-03-29)

NuWro: Wrocław Neutrino Event Generator
T. Golan, **P. Przewłocki**
NuInt14 - 9th International Workshop on Neutrino-Nucleus Interactions in the Few-GeV Region (United Kingdom, South Croydon, 2014-05-19 - 2014-05-24)

Gluon Collective Excitations in Anisotropic Quark-Gluon Plasma
M. Carrington, **K. Deja**, **St. Mrówczyński**
International Workshop on Collectivity in Relativistic Heavy Ion Collisions (Greece, Kolymbari, Crete, 2014-09-14 - 2014-09-20)

Charm mixing and CP violation at LHCb
A. Ukleja
XI International Conference on Hyperons, Charm and Beauty Hadrons, BEACH 2014 (United Kingdom, Birmingham, 2014-07-21 - 2014-07-26)

Highlights of dark matter
K. Kowalska, **L. Roszkowski**, E. Sessolo, **S. Trojanowski**, **A.J. Williams**
Theory Meeting Experiment 2014 :: Neutrinos and Cosmos (Poland, Warsaw, 2014-09-03 - 2014-09-05)

N=4 super Yang-Mills Plasma
A. Czajka, **St. Mrówczyński**
Excited QCD 2014 (Bosnia and Herzegovina, Bjelasnica Mountain, Sarajevo, 2014-02-02 - 2014-02-08)

CMS Physics Highlights
M. Kazana
XXXIV-th IEEE-SPIE Joint Symposium Wilga 2014 (Poland, Wilga, 2014-05-26 - 2014-06-01)

Plasmons in Anisotropic Quark Gluon Plasma
M. Carrington, **K. Deja**, **St. Mrówczyński**
Symposium on Strong and Electroweak Matter (SEWM 2014) (Switzerland, Lausanne, 2014-07-14 - 2014-07-18)

Search for Long-lived particles in CMS
M. Kazana
LHC Days in Split (Croatia, Split, 2014-09-29 - 2014-10-04)

Oral Presentation

Natural SUSY after the 8 TeV LHC run
K. Kowalska, **E. Sessolo**
PLANCK 2014 - 17th International Conference From the Planck Scale to the Electroweak Scale (France, Paryż, 2014-05-26 - 2014-05-30)

Search for a new dark boson in η mesom decays
J. Stepaniak, **M. Berłowski**
MESON2014, 13th International Workshop on Meson Production, Properties and Interactions (Poland, Kraków, 2014-05-29 - 2014-06-03)
Eur. Phys. J. A (in press)

Natural SUSY after the 8 TeV LHC run
K. Kowalska, **E. Sessolo**
26th Rencontres de Blois (France, Blois, 2014-05-18 - 2014-05-23)

Low fine tuning in the MSSM with higgsino dark matter and unification constraints
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**
26th Rencontres de Blois (France, Blois, 2014-05-18 - 2014-05-23)

Low fine tuning in the MSSM with higgsino dark matter and unification constraints
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**
PLANCK 2014 - 17th International Conference From the Planck Scale to the Electroweak Scale (France, Paryż, 2014-05-26 - 2014-05-30)

Polish in-kind contribution to European X-ray free electron laser (XFEL)-status in summer 2014
E. Pławski, J. Sekutowicz, **W. Grabowski**, **K. Kosiński**, **J. Lorkiewicz**, **M. Wojciechowski**, Z. Gołebiewski, K. Meissner, **G. Wrochna**, M. Duda, M. Jeżabek, K. Kasprzak, A. Kotarba, K. Krzysik, M. Stodulski, J. Świerblewski, M. Wiencek, M. Chorowski, E. Rusiński, J. Fydrych, A. Iluk, K. Malcher, J. Poliński, P. Duda, J. Głowinkowski, P. Wilk, M. Winkowski, P. Grzegory, G. Michalski
X konferencja Techniki Prózni (Poland, Cedzyna k. Kielc, 2014-09-22 - 2014-09-25)
Instytut Tele- i Radiotechniczny w Warszawie No. (2014)

Supersymmetric Higgs boson with General Flavour Violation
K. Kowalska
SUSY 2014 (United Kingdom, Manchester, 2014-07-21 - 2014-07-26)

Low fine tuning in the MSSM with higgsino DM and unification constraints
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**
SUSY 2014 (United Kingdom, Manchester, 2014-07-21 - 2014-07-26)

Measurements of the CP-violating phase φ_s at LHCb
K. Klimaszewski
II Symposium on applied nuclear physics and innovative technologies (Poland, Kraków, 2014-09-24 - 2014-09-27)

Natural MSSM after the LHC 8 TeV run
K. Kowalska, **E. Sessolo**
SUSY 2014 (United Kingdom, Manchester, 2014-07-21 - 2014-07-26)

Low fine tuning in the MSSM with higgsino dark matter and unification constraints
K. Kowalska, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**
PASCOS 2014 (Poland, Warsaw, 2014-06-22 - 2014-06-27)

Poster

Bayesian Approach to Supersymmetry and Dark Matter using current LHC and direct DM limits
N. Bomark, **M. Kazana**, **K. Kowalska**, **L. Roszkowski**, **E. Sessolo**, **S. Trojanowski**, A. Williams
LHC Days in Split (Croatia, Split, 2014-09-29 - 2014-10-04)

Parton energy loss in an unstable QGP - two-stream & extremly prolate systems
M. Carrington, **K. Deja**, **St. Mrówczyński**
XXIV Quark Matter (Germany, Darmstadt, 2014-05-19 - 2014-05-24)

LECTURES, COURSES AND EXTERNAL SEMINARS

What next after the LHC - report from the Future Circular Colliders Workshop in Geneva[a]
M. Szleper
Warsaw, University of Warsaw, 2014-03-07
Measurements of the CP-violating phase φ_s at LHCb[b]
K. Klimaszewski
Cracow, Faculty of Physics, Astronomy and Applied Computer Science of the Jagiellonian University, 2014-03-18

Relativistic ion collisions at the LHC[a]
H. Białkowska
Warsaw, Institute of Experimental Physics, Warsaw University, 2014-04-07

Experimental verification of the CPT symmetry in physics of neutral kaons[a]
W. Wiślicki
Warsaw, University of Warsaw, 2014-05-16

The GPD program at COMPASS[a]
P. Sznajder
Warsaw, University of Warsaw, 2014-05-23

Physics of neutrino oscillations: a look forward[b]
P. Przewłocki
Warsaw, Warsaw University, 2014-12-12

Nuclear effects in HEPGEN[b]
P. Sznajder
Geneva, CERN, 2014-03-11

Testing CPT and Lorentz invariance: physics background and experimental results with neutral kaons[b]
W. Wiślicki
Warsaw, University of Warsaw, 2014-03-17

EXOTICA at the CMS[b]
M. Kazana
Louvain, Université catholique de Louvain, Belgium, 2014-04-02

Constrains on GK model of GPDs from $A^{\sin(\varphi-\varphi_S)}$ data[b]
P. Sznajder
Freiburg im Breisgau, University of Freiburg, 2014-04-23

CMS Physics Highlights[b]
M. Kazana
Wilga, Poland, XXXIV-th IEEE-SPIE Joint Symposium 26-30 May, 2014-05-28

Reproduction of 2010 data - comparison between slot1 and slot3[b]
P. Sznajder
Saclay, CEA, 2014-07-02

How the Higgs boson was discovered?[a]
P. Zalewski
Warsaw, National Centre for Nuclear Research, 2014-01-25

a) in Polish
b) in English

INTERNAL SEMINARS

Taus at HLT and vertexing[b]
M. Bluj
Geneva, CERN, 2014-02-06

Stutus of tau trigger studies[b]
M. Bluj
Geneva, CERN, 2014-02-20

Higgs panorama after LHC Run-I[b]
M. Bluj
Warsaw, Institute of Theoretical Physics, University of Warsaw, 2014-03-10

Discovery of a Higgs boson with LHC: an unprecedented scientific adventure [a]
M. Bluj
Swierk, National Centre for Nuclear Research, 2014-04-03

Status of tau triggers[b]
M. Bluj
Annecy, LAPP, 2014-04-08

Uppdate on RE4 patterns[b]
M. Kazana
Geneve, CERN, 2014-05-21

Report from CMS trigger (TSG) workshop[b]
M. Bluj
Geneva, CERN, 2014-05-23

RPC in Run2 - L1 report[b]
M. Kazana
Geneve, CERN, 2014-06-26

Discussion of H->tau,tau parts in new trigger menus[b]
M. Bluj
Geneva, CERN, 2014-09-12

Search for matter - antimatter asymmetry in three-body charm nesons decays in LHCb experiment[a]
M. Szczekowski
Swierk, National Centre for Nuclear Research, 2014-09-25

Architecture of the service manager at CIS[a]
K. Klimaszewski
Otwock, Świerk, National Centre for Nuclear Research, 2014-09-29

Strategy for tau triggers in 2015[b]
M. Bluj
Strasbourg, Institut Pluridisciplinaire Hubert Curien (IPHC), 2014-10-27

The CMS experiment in 2014[a]
M. Bluj
Warsaw, NCBJ, 2014-12-03

Status and strategy of tau triggers for 2015[b]

M. Bluj
Geneva, CERN, 2014-12-19

a) in Polish
b) in English

DIDACTIC ACTIVITY

H. Białkowska - Head of Doctoral Studies of NCBJ since 10.09.2014

H. Białkowska - Student seminar consultations at the University Physics Department

P. Mijakowski - Advisor of Katarzyna Frankiewicz, her PhD thesis is being realized within the Super-Kamiokande experiment.

E. Rondio - PhD student in NCBJ on fist year, Katarzyna Frankiewicz

E. Rondio - PhD student on third year in NCBJ, Monireh Kabirnezhad

E. Rondio - student of III year in NCBJ, Aleksander Kiliński
resign in September 2014

A. Sandacz - supervision of the Ph.D. student mgr Paweł Sznajder

T. Siemiarczuk - graduate student: Iryna Ilkiv

T. Siemiarczuk - graduate student: Oleksandr Kovalenko

J. Stepaniak - Supervision of D. Pszczel PhD

M. Szeptycka - M. Kasztelan works on the neutron shielding for low background experiments.

W. Wiślicki - Guiding PhD student Izabela Balwierz

W. Wiślicki - Guiding PhD student Paweł Kowalski

W. Wiślicki - Seminar of CIŚ

P. Zalewski - Tutoring during student internships (2 students for 4 weeks)

J. Zalipska - Lectures for secondary school students (age 14) during Festival of Science. "Zobaczyć niewidzialne" lectures covered topic of elementary particle physics with stress put on neutrinos properties and experiments. During lecture pupils were divided into groups and build cloud chambers.

J. Zalipska - Supervising student during his laboratory project. Winter semester of academic year 2013/2014.

J. Zalipska - Supervising student during laboratory excercise. Study of signatures of meson exchange current processes using NuWro Monte Carlo generator of neutrino interactions in T2K experiment.

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

H. Białkowska
Warsaw Scientific Society
Member of the Scientific Council of the Institute of Experimental Physics, Warsaw University
Scientific Council of the National Centre for Nuclear Research, deputy president

K. Kowalska
Session chairman on 26th Rencontres de Blois in Blois, France

J. Łagoda
Member of Organizing Committee on Theory Meeting Experiment 2014 :: Neutrinos and Cosmos in Warsaw, Poland

P. Przewłocki
Member of Organizing Committee on Theory Meeting Experiment 2014 :: Neutrinos and Cosmos in Warsaw, Poland

E. Rondio
Member of Organizing Committee on Theory Meeting Experiment - Neutrinos and Cosmoss in Warszawa, Poland
Electron-Ion-Collider Advisory Committee
member of Scientific Advisory Committee Institute Cosmology and Physics of Americas (COFI)

R. Sosnowski
Corresponding member of Polish Academy of Learning
Member of the Warsaw Scientific Society
Member of the European Physical Society
Full member of the Polish Academy of Sciences
Active member Polish Academy of Knowledge
Fellow European Physical Society
member Scientific Council of the Institute of High Ptessure Polish Academy of Sciences
president National Centre for Nuclear Research
member of the Committee of the Polish Academy of Sciences
member of the commission for JINR of the Plenipotentiary of Poland to JINR
chairman National Center of Nuclear Research
Uniwersity of Warsaw Heavy Ion Laboratory
member
Member Heavy Ion Laboratory

J. Stepaniak
Session chairman on MesonNet Meeting in Frascati, Italy

W. Wiślicki
Pl-Grid National Consortium
Member of Scientific Board, National Centre for Nuclear Research
Member of the Institution Board of the KLOE-2 Experiment
Member of the LHCb Collaboration Board
Member of the National Computing Board in LHCb
NCBJ

G. Wrochna
Member of the Polish Nuclear Society
Member of the Committee on Nuclear Physics of the Council for Atomic Energy Matters
Coordinator of Polish Nuclear Technology Platform
Member of the Physics Committee PAN
President of the Council of Atomic Center consortium
President of the Council of Polish Astroparticle Physics Network
President of the Council of XFEL-Polska consortium

Societas Scientiarum Varsaviensis
Member of the Scientific Council of the Heavy Ion Laboratory, Warsaw University

J. Zalipska
Member of Organizing Committee on Theory Meeting Experiment - Neutrinos and Cosmoss in Warszawa, Poland

A.Sandacz
Member of the Organising Committee of the Conference DIS2014, Warsaw, Poland
Member of the COMPASS Collaboration Board

PERSONNEL

Research scientists

Marek Adamus, PhD	
Marcin Berłowski, PhD	
Helena Białkowska, Professor	
Michał Bluj, PhD	
Bożena Boimska, PhD	
Andrzej Deloff, Assoc.Prof.	1/10*
Tomasz Fruobes, PhD	
Maciej Górski, PhD	
Julia Hoffman, PhD	on leave
Mariusz Karpiarz, MSc	½*
Małgorzata Kazana, PhD	
Konrad Klimaszewski, PhD	
Katarzyna Kowalik, PhD	
Kamila Kowalska, PhD	
Andrzej Kupść, PhD	on leave
Podist Kurashvili, PhD	
Justyna Łagoda, PhD	
Piotr Marciniewski, PhD	on leave
Piotr Mijakowski, PhD	
Stanisław Mrówczyński, Professor	2/3*
Krzysztof Nawrocki, PhD	
Adam Nawrot, Eng	3/5*
Paweł Przewłocki, PhD	
Ewa Rondio, Professor	
Andrzej Sandacz, Professor	
Teodor Siemiarczuk, Professor	3/5*
Ryszard Sosnowski, Professor	
Joanna Stepaniak, Professor	3/5*
Robert Sulej, PhD	
Marek Szczekowski, Assoc.Prof.	
Maria Szeptycka, Professor	4/5*
Michał Szleper, PhD	
Paweł Sznajder, MSc	½*
Piotr, Traczyk PhD	on leave
Artur Ukleja, PhD	
Wojciech Wiślicki, Professor	
Piotr Zalewski, PhD	
Joanna Zalipska, PhD	

PhD students

Katarzyna Deja, MSc
Katarzyna Frankiewicz, MSc
Monireh Kabirnezhad, MSc
Oleksandr Kovalenko, MSc
Damian Pszczel, MSc

Technical and administrative staff

Piotr Gawor
Tadeusz Marszał
Teresa Świerczyńska

* part-time employee

ASTROPHYSICS DIVISION

Head of Division:	Assoc. Prof. Agnieszka Pollo (from July 2014)
Head (deputy) of Division:	Jacek Szabelski, PhD (until June 2014)
phone:	+48 42 6783223
e-mail:	agnieszka.pollo@ncbj.gov.pl

Overview

The Division of Astrophysics was formed in the middle of 2014 by merging the former Division of Cosmic Ray Physics (BP4) in Łódź and the Laboratory of Astrophysics belonging to the High Energy Physics Division (BP3) in Warsaw, with the aim of creating a unified and strong unit dedicated to astrophysical research and participation in space projects, both technologically and scientifically. The Division of Astrophysics now consists of two laboratories: the Laboratory of Cosmic Ray Physics in Łódź, and the Laboratory of Astrophysics in Warsaw.

The Laboratory of Astrophysics in Warsaw performs active research in observational cosmology, high-energy astrophysics, the search for astrophysical transient sources of different origin – from gravitational wave sources to gamma ray bursts (GRBs).

Our cosmology group specializes in the statistics and evolution of the large scale structure of the Universe, galaxy evolution and their classification. It participates and/or actively uses data from the largest projects in the field: VIPERS, VVDS, AKARI, WISE. In particular, in 2014 the VIPERS project almost completed its planned spectroscopic observations of ~100,000 galaxies at the epoch when the Universe was a half of its present age, and our efforts concentrates on exploitation of this unique dataset – the largest spectroscopic survey of the z~1 Universe up to date. The IX VIPERS Science Meeting in 2014 was co-organized by our team in Cracow.

Another centre of activitis the Pi of the Sky experiment, aiming at prompt detection of optical counterparts of GRBs, as well as other transient phenomena. In 2014, modernization and optimization of the research equipment and software in San Pedro de Atacama in Chile and in Spain, as well as the data centre in Warsaw, were carried out. Of particular interest are transients which can potentially be connected with sources of gravitational waves. With this aim in mind, in 2014 Pi of the Sky signed a Memorandum of Understanding with an international consortium to search for sources of gravitational waves, LSC-VIRGO. Our team has developed an algorithm for simultaneous use by the Pi of the Sky and for the LIGO/VIRGO data, which can be further applied to the search for a common signal from future gravitational waves experiments and wide-angle optical observatories.

Our teams were involved in two cosmic mission proposals submitted to the ESA M4 call: CORE+, aiming at measurements of the polarisation of the cosmic microwave background, and LOFT, filling aniche in high energy astrophysics, for which our team modelled future measurements of neutron star properties.

The Laboratory of Cosmic Ray Physics is continuing its traditional line of research, concentrating on Cosmic Rays - energetic particles from outside the Solar System, and high-energy astrophysics. Energetic Cosmic Rays produce cascades of particles in the atmosphere, called Extensive Air Showers (EAS). Measuring EAS and their properties is the main technique for experimental studies of very high energy Cosmic Rays.

Finding the sources of the highest energy Cosmic Rays is the main goal of the satellite experiment JEM-EUSO which will observe EASs from the International Space Station. We participate in the preparation of the hardware (sophisticated high voltage power suppliers) for the mission. An important achievement of 2014 was a successful flight of a high altitude test balloon (EUSO-Balloon), with the Łódź-made high voltage power supplier onboard. Data collected during this test flight will be the subject of further analysis.

We have designed, developed and build an engineering model of a high voltage power supply unit for the satellite gamma ray detector POLAR. The detector will measure X-ray polarisation from Gamma Ray Bursts and is supposed to be launched next year. We contribute to the analysis of the POLAR test measurements.

KASCADE-Grande addresses experimentally the problems of the mass composition and EAS development in the atmosphere in the energy range 1E15-1E18 eV. The LOPES Collaboration in KIT – Karlsruhe develops radio techniques for EAS measurements in Karlsruhe. These experiments, in which our group has participated from the beginning, have finished data-taking, but we continue data analysis publishing results in the top journals with high impact factors.

The Laboratory in Łódź also concentrates on methodological studies of the detection of neutrons and interpretation of multiple neutron registrations in the underground laboratory. Among other tasks, we performed GEANT4 simulations of neutron transport for the ISOTTA project.

Presentation of Cosmic Ray registration to high school students has become a popular way to introduce particle physics detectors and elementary particle detection techniques to young people. We organize in Łódź and Poznań workshops on particle physics for high school students, in the framework of the international IPPOG's Masterclasses – Hands on Particle Physics.

In the area of high energy particle physics our Division participates in the ZEUS experiment at DESY (Hamburg, Germany), and in the WASA @ COSY Collaboration in Juelich, Germany.

Agnieszka Pollo

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Fale Grawitacyjne
A. Zadrożny
Harmonia Mundi – Sacra et Profana (Poland, Warszawa, 2014-11-28 - 2014-11-28)

Astronomia promieniowania kosmicznego - czy to możliwe?
J. Szabelski
Astronomia w Krakowie wczoraj - dziś - jutro (Poland, Kraków, 2014-05-17 - 2014-05-17)

Polgraw-Virgo group and its contribution to gravitational wave searches
A. Królak
The 1st Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

KASCADE-Grande: Review, recent Results, Future Endavors
S. Schoo, **P. Łuczak**, **J. Zabierowski**
2014 Conference on Ultrahigh Enenrgy Cosmic ays (USA, Springdale, Utah, 2014-10-12 - 2014-10-15)
No. (2015)

Status of CW searches
A. Królak
LSC-Virgo collaboration meeting (France, Nice, 2014-03-17 - 2014-03-21)

The cosmic ray spectrum and composition measured by KASCADE-Grande between 10^{16} eV and **10^{18} eV**
M. Bertaina, **P. Łuczak**, **J. Zabierowski**
International Conference (Italy, San Vito de Cadore, 2014-03-16 - 2014-03-22)
Nucl. Phys. B Proc. Sup. Vol. 256-257 (2014) 149

The heavy knee and the light ankle observed with KASCADE-Grande
A. Haungs, **P. Łuczak**, **J. Zabierowski**
Vulcano Workshop 2014 Frontier Objects in Astrophysics and Particle Physics (Italy, Vulcano Island, Sicily, 2014-05-18 - 2014-05-24)
Frascati Physics Series Vol. 58 (2014) 238

How bright galaxies trace a dark Universe
A. Pollo
VI Częstochowska Konferencja Naukowa Młodych „Astrophisica Nova" (Poland, Częstochowa, 2014-05-09 - 2014-05-10)

Pi of the Sky telescope contribution to the LSC-Virgo Electromagnetic Follow-up project
A. Zadrożny
The 1st Conference of Polish Society on Relativity (Poland, Spała, 2014-06-29 - 2014-07-04)

Oral Presentation

Accuracy of basic parameters determination for neutron stars in X-ray bursters from simulated LOFT spectra
A. Majczyna, A. Różańska, J. Madej, M. Należyty
LOFT Fifth Consortium meeting (Italy, Roma, 2014-11-11 - 2014-11-13)

On a new investigation of the spectrum of cosmic rays in the energy range of 10^{14} eV - 10^{18} eV with KASCADE and KASCADE-Grande
S. Schoo, **P. Łuczak**, **J. Zabierowski**
24^{th} European Cosmic Ray Symposium - ECRS2014 (Germany, Kiel, 2014-09-01 - 2014-09-05)
J.Phys.Conf.Ser (in press)

Preparing for MDC with F-stat AllSky pipeline
A. Królak, M. Bejger, **O. Dorosh**
LSC-Virgo collaboration meeting (France, Nice, 2014-03-17 - 2014-03-21)

A limit on the diffuse gamma ray flux measured with KASCADE-Grande
D. Kang, **P. Łuczak**, **J. Zabierowski**
24th European Cosmic Ray Symposium - ECRS2014 (Germany, Kiel, 2014-09-01 - 2014-09-05)
J. Phys. Conf. Ser. (in press)

The POLAR gamma-ray burst polarimeter onboard the Chinese Spacelab
S. Orsi, F. Cadoux, C. Leluc, M. Paniccia, M. Pohl, D. Rapin, T. Bao, J. Chai, Y. Dong, M. Kong, L. Lu, J. Liu, X. Liu, H. Shi, J. Sun, R. Wang, X. Wen, B. Wu, H. Xiao, H. Xu, Li. Zhang, L. Zhang, S. Zhang, Y. Zhang, **T. Batsch**, **A. Rutczyńska**, **J. Szabelski**, **A. Zwolińska**, I. Britvich, W. Hajdas, **R. Marcinkowski**, **D. Rybka**, N. Gauvin, N. Produit
SPIE Astronomical Telescopes + Instrumentation (Canada, Montreal, 2014-06-22 - 2014-06-27)
Proceedings of the SPIE Vol. 9144 (2014) 0

The POLAR Gamma-Ray Burst Polarimeter onboard the Chinese Spacelab
S. Orsi, F. Cadoux, C. Leluc, M. Paniccia, M. Pohl, D. Rapin, T. Bao, J. Chai, Y. Dong, M. Kong, L. Lu, J. Liu, X. Liu, H. Shi, J. Sun, R. Wang, X. Wen, B. Wu, H. Xiao, H. Xu, Li. Zhang, L. Zhang, S. Zhang, Y. Zhang, **T. Batsch**, **A. Rutczyńska**, **J. Szabelski**, **A. Zwolińska**, I. Britvich, W. Hajdas, **R. Marcinkowski**, **D. Rybka**, N. Gauvin, N. Produit
Swiss Physical Society Annual Meeting 2014 (Switzerland, Fribourg, 2014-06-30 - 2014-07-02)

Refined LateralEnRgy Correction Functions for the KASCADE-Grande Experiment Based on Geant4 Simulations
A. Gherghel-Lascu, **P. Łuczak**, **J. Zabierowski**
Carpatian Summer School of Physics CSSP14 (Romania, Sinaia, 2014-07-13 - 2014-07-26)
AIP Conf. Proc. Vol. 1645 (2015) 332

Unification theory of BL and NL AGNs in redshift range 0.5-1.0 – an update
K. Małek
10th VIPERS SCIENCE MEETING (Poland, Kraków, 2014-10-06 - 2014-10-10)

POLAR construction and qualification
S. Orsi, F. Cadoux, C. Leluc, M. Paniccia, M. Pohl, D. Rapin, T. Bao, J. Chai, Y. Dong, M. Kong, L. Lu, J. Liu, X. Liu, H. Shi, J. Sun, R. Wang, X. Wen, B. Wu, H. Xiao, H. Xu, Li. Zhang, L. Zhang, S. Zhang, Y. Zhang, **T. Batsch**, **A. Rutczyńska**, **J. Szabelski**, **A. Zwolińska**, I. Britvich, W. Hajdas, **R. Marcinkowski**, **D. Rybka**, N. Gauvin, N. Produit
X-ray polarisation in astrophysics - a window about to open? (Sweden, Stockholm, 2014-08-25 - 2014-08-28)

LOPES 3D - studies on the benefits of EAS-radio measurements with vertically aligned antennas
D. Huber, **P. Łuczak**, **J. Zabierowski**
ARENA 2014 (USA, Annapolis, 2014-06-09 - 2014-06-12)
AIP Conf. Proc. (in press)

Marked correlation functions in VIPERS
A. Pollo
9th Vipers Science Meeting (Italy, Bologna, 2014-02-17 - 2014-02-21)

Investigation of the radio wavefront of air showers with LOPES measurements and CoREAS simulations
F.G. Schroeder, **P. Łuczak**, **J. Zabierowski**
ARENA 2014 (USA, Annapolis, 2014-06-09 - 2014-06-12)
AIP Conf. Proc. (in press)

Marked correlation functions from VIPERS mocks
A. Pollo
10th Vipers Science Meeting (Poland, Kraków, 2014-10-06 - 2014-10-10)

Confronting the EPOS-LHC model predictions on the charged particle and muon attenuations lengths of EAS with the measurements of the KASCADE-Grande observatory
J.C. Arteaga-Velázquez, **P. Łuczak**, **J. Zabierowski**
International Symposium on Very High Energy Cosmic Ray Interactions (ISVHECRI 2014) (Switzerland, Genewa, 2014-08-18 - 2014-08-22)
Eur. Phys. J. A (in press)

The study with the Muon Tracking Detector in the KASCADE-Grande experiment – comparison of hadronic interaction models
P. Łuczak, **J. Zabierowski**
International Symposium on Very High Energy Cosmic Ray Interactions (ISVHECRI 2014) (Switzerland, Genewa, 2014-08-18 - 2014-08-22)
Eur. Phys. J. A (in press)

LOPES - Recent Results and Open Questions on the Radio Deetection of Air Showers
F. Schroeder, **P. Łuczak**, **J. Zabierowski**
24th European Cosmic Ray Symposium - ECRS2014 (Germany, Kiel, 2014-09-01 - 2014-09-05)
J. Phys. Conf. Ser. (in press)

Pi of the Sky preperations towards Advanced Gravitational Detector Era
A. Zadrożny
XXXIV-th IEEE-SPIE Joint Symposium Wilga 2014 (Poland, Wilga, 2014-05-26 - 2014-06-01)

Confronting the EPOS-LHC model predictions for the muon content of high-energy EAS with **KASCADE-Grande measurements**
J.C. Arteaga-Velásquez, **P. Łuczak**, **J. Zabierowski**
24th European Cosmic Ray Symposium - ECRS2014 (Germany, Kiel, 2014-09-01 - 2014-09-05)
J.Phys.Conf.Ser (in press)

Poster

Extinction properties of 8 μm selected sources from the AKARI NEP Deep field
K. Małek, **A. Pollo**, T.T. Takeuchi, V. Buat, D. Burgarella, E. Giovannoli, M. Malkan
International Astronomical Union Symposium 309 Galaxies In 3d Across the Universe (Austria, Vienna, 2014-07-07 - 2014-07-11)
Cambridge University Press No. (2014)

Learning algorithms at the service of modern multiwavelength large surveys. SVM algorithms applied to the VIPERS data.
K. Małek, **A. Pollo**, A. Solarz, B. Garilli, A. Fritz
Multiwavelength-surveys: Galaxy Formation and Evolution from the early universe to today (Croatia, Dubrovnik, 2014-05-12 - 2014-05-16)

Mass and light: probing dark matter field by clustering of different types of galaxies at z ~ 1
A. Pollo
Multiwavelength-surveys: Galaxy Formation and Evolution from the early universe to today (Croatia, Dubrovnik, 2014-05-12 - 2014-05-16)

Accuracy of surface gravity and gravitational redshift determination for neutron stars in X-ray bursters from simulated LOFT spectra
A. Majczyna, A. Różańska, J. Madej, M. Należyty
Physics of Neutron Stars - 2014 (Russia, Sankt Petersburg, 2014-07-28 - 2014-08-01)

LECTURES, COURSES AND EXTERNAL SEMINARS

Prospects for Detection of Gravitational Waves[b]
A. Królak
Cracow, Astronomical Observatory of Jagellonian University, 2014-01-23

The Highest Energy Cosmic Ray Measurements and other *EUSO Tasks. EUSO-Balloon – the First Test ofthe Method[a]
J. Szabelski
Warsaw, Department of Fundamental Research NCBJ, 2014-11-19

a) in Polish
b) in English

INTERNAL SEMINARS

Neutron Stars - beyond nuclear density[a]
A. Majczyna
Warsaw, National Centre for Nuclear Research, 2014-10-01

Vipers: how bright galaxies trace a dark universe[b]
A. Pollo
Warsaw, NCBJ, 2014-10-21

a) in Polish
b) in English

DIDACTIC ACTIVITY

A. Majczyna - 3 astronomical lectures for PhD students in NCBJ (6 hour total duration)

A. Pollo - Grzegorz Gajda, OA UJ, final exam 27.06.2014

A. Pollo - Magdalena Krupa, Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Agata Pępiak, Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Agnieszka Świętoń (Kurcz), Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Aleksander Kurek, Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Aleksandra Nadkańska, Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Magdalena Krupa, Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Małgorzata Bankowicz, Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Michał Wypych, Astronomical Observatory of the Jagiellonian University

A. Pollo - MSc Tobiasz Górecki, Astronomical Observatory of the Jagiellonian University

A. Pollo - OA UJ, lecture "Galactic and extragalactic Astronomy II"

A. Pollo - OA UJ, monographic lecture in English "Observational cosmology"

T. Tymieniecka - Lectures on High Energy Physics, at Mikolaj Kopernik University in Torun and for students from NCBJ, Łódź

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

J. Karczmarczyk
member of JEM-EUSO Collaboration

A. Królak
member

P. Łuczak
Member of the LOPES Collaboration
Member of the KASCADE-Grande Collaboration

A. Majcher
member
member of the Audit Committee of the Main Board of the Polish Amateur Astronomers Association

A. Majczyna
member Polskie Towarzystwo Astronomiczne
member of Polish Fireball Network

A. Pollo
Member of Organizing Committee on 10th VIPERS SCIENCE MEETING in Kraków, Poland
member
member
member
member, National Council for Astroparticle Physics
member
member

B. Szabelska
JEM-EUSO Collaboration memeber

J. Szabelski
Polish PI (Principal Investigator) of JEM-EUSO Collaboration
Polish representative in the International Particle Physics Outreach Group (IPPOG)
Member of the International Advisory Committee (IAC) of the European Cosmic Ray Symposia
Polish group PI in the EUSO-Balloon Collaboration
Advances in High Energy Physics, Special Issue, Advances in High Energy Physics, Hindawi Publishing Corporation

T. Tymieniecka
JEM-EUSO Collaboration member

T. Wibig
Polish Physical Society
JEM-EUSO Collaboration member

J. Zabierowski
Member of the Polish Physical Society
Member of The LOPES Collaboration

Chairman of the Steering Committee and the Collaboration Board of The KASCADE-Grande Collaboration
Member of the WAS@COSY Collaboration Board
Chairman of the KASCADE-Grande Collaboration Board and Chairman of the KASCADE-Grande Steeering Committee

PERSONNEL

Research scientists
in Łódź:
Pluciński Paweł, PhD, Assistant Professor, on leave
Szabelski Jacek, PhD, Assistant Professor
Tymieniecka Teresa (*), Associate Professor
Wibig Tadeusz (*), Associate Professor
Zabierowski Janusz, Associate Professor
in Warsaw:
Królak Andrzej (*), Associate Professor
Majczyna Agnieszka, Dr. Assistant Professor
Małek Katarzyna, PhD, Assistant Professor
Pollo Agnieszka, Professor
Sokołowski Marcin, PhD, Assistant Professor, on leave

PhD students
in Łódź
Plebaniak Zbigniew, Msc Eng
Zwolińska Anna, Msc Eng

Technical and admnistrative staff
in Łódź:
Dębicki Zdzisław
Feder Jadwiga (*)
Jędrzejczak Karol, PhD, on leave
Karczmarczyk Jacek
Kasztelan Marcin, Msc
Lewandowski Ryszard
Łuczak Paweł, PhD
Orzechowski Jerzy, Msc Eng
Szabelska Barbara PhD (*)
Tokarski Przemysław, Msc Eng
in Warsaw:
Ćwiek Arkadiusz, Msc
Majcher Ariel, Msc
Zadrożny Adam, Msc

(*) part-time employee

4. DEPARTMENTOF NUCLEAR TECHNIQUES &EQUIPMENT

Head of Department: Jacek Rzadkiewicz, PhD
Phone: +48 22 2731465/2731413
e-mail: jacek.rzadkiewicz@ncbj.gov.pl

Overview

In 2014 most of the department's activity was related to the completion of the Accelerators and Detectors (A&D) project where three medical accelerators as well as a neutron activation analyser and X-ray radiography system were developed. Work within the AiD project created interdisciplinary highly-qualified teams, combining the physics of particle detection and acceleration with mechanics and electronic systems. Within the project it was possible to submit patent applications, prepare and defend PhD and habilitation thesis and build competences. The constructed accelerators have been the subject of extensive tests which have shown that they can provide good clinical parameters for radiotherapy beams. It was found that the Coline 6 accelerator needs further optimization in order to reach the maximum photon energy (6 MV). To this end a new acceleration structure was designed. In the case of the intraoperative medical accelerator INTRALINE, it was confirmed that the rapid control of RF power creates the possibility of simple, dynamic and controlled electron energy changes in a single exposure screening.

The CANIS accelerator system which effectively allows fast alternating power at a frequency of 300 Hz was successfully integrated with a set of scintillator detectors. The system is fully able to identify smuggled goods like cigarettes or weapons. Also, the neutron activation analyser SWAN and XRF systems (based on the NALR medical x-ray technology) after successful tests were directed to further stages of development and commercialization. Both systems are prepared for commercialization within a project supported by KGHM Polska Miedź, a global producer of copper and silver.

In 2014 other research or development projects (selected) continued:

- 4LABs - modernization of the Environmental Measurements Laboratory (EML) and building a new Accelerating Structure Laboratory (ASL). The EML performed preliminary air quality investigations in the Mazowieckie district using a set of advanced apparatus designed for atmospheric air monitoring (e.g. PM10 and PM2.5). The ASL buildings were completed and prepared for the new quality development and manufacture of accelerating structures and other key accelerator elements.
- MODES_SNM - development of a modular detection system for special nuclear materials detection using high pressure gas detectors based on He-4 (neutron detection) and Xe (gamma-ray detection). This European project was aimed at building detection systems for land-border security purposes.
- EUROFUSION programme – development of a diagnostic technique based on Solid State Nuclear Track Detectors designed for measurements of fluxes, angular distributions and energy spectra of fast primary ions and energetic alpha particles produced in the nuclear reactions induced in laser plasma. Development of a diagnostic technique based on a Cherenkov-type detector, designed especially for an FTU tokamak as well as manufacture of a new ion pinhole camera and a special manipulator, suitable for inserting such a camera into the vacuum vessel of the COMPASS tokamak. Preliminary studies were carried out to find the most suitable scintillation detectors for gamma rays detection at the JET facility, Culham,UK.
- XFEL - in the framework of the in-kind preliminary contribution provided by NCBJ to the European XFEL Project the whole Higher Order Modes (HOM) suppression system was developed and delivered to XFEL-GmbH DESY.
- BioQuaRT – participation in the EURAMET project "Biologically weighted quantities in radiotherapy". Nanodosimetry studies of carbon ions using the Jet Counter technique.

The Department has 200^+ employees (60^+ under 35), including 2 professors, 5 associate professors (2 new) and 30^+ employees with PhD degrees. Most of the scientific achievements of the department were summarized in top level peer reviewed publications, published in 2014.

Jacek Rzadkiewicz

PARTICLE ACCELERATION PHYSICS & TECHNOLOGY DIVISION

Head of Division: Sławomir Wronka PhD Eng
phone: +48 22 2731539
e-mail: s.wronka@ncbj.gov.pl

Overview

The activity of the TJ1 department is focused on the development of new acceleration techniques and technologies, as well as on applications of particle accelerators. The main know-how is concentrated in cavity optimisation, calculations of magnets, transfer lines, sources and targets, collimators and applicators. In particular, beam dynamics calculations and Monte Carlo simulations of accelerator heads and detectors are continuously performed for different projects.
The main activity of the TJ1 department in 2014 was related to continuation of the XFEL project, start up and measurements of the accelerators for the AiD project: IORT and cargo screening (CANIS), calculations for ESS (European Spallation Source) and participation in the GBAR experiment.
Some of these topics are described in detail in separate articles.

The TJ1 department is quite well equipped with experimental accelerator stands. During any year, typically at least a few different configurations of the linacs are tested. High energy X-ray and electron beams are continuously available, thus external users are commercially invited for industrial irradiations or specific scientific tests.
Radiographic detectors are also available due to the development of radiation-resistive technology of imaging sensors, therefore an industrial 2D radiography service as well as high energy CT is being offered.
Thanks to the AiD project and the CANIS demonstrator, the development of cargo scanning techniques is being continued both in the high energy region and with classical X-rays. Interlaced energy linacs over a wide energy range have been developed in the TJ1 department. In 2014 the construction of a cargo scanning system equipped with high resolution imaging detectors SMOC began, planned for final commercialization in 2015.

The TJ1 department offers a friendly surrounding for young people, for many years engineering- and masters-degree theses have been carried out in cooperation and under the supervision of our experts.
Also summer placements are offered to students, typically from Warsaw University and Warsaw University of Technology.

Sławomir Wronka

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Movable Collimator System in ESS Project.
P. Warzybok
Beam Losses and Collimators in Transfer Lines (Sweden, LUND, 2014-05-13 - 2014-05-14)

NCBJ-designed medical accelerators
A. Wysocka-Rabin
Warsaw Medical Physics Meeting (Poland, Warszawa, 2014-05-15 - 2014-05-17)

Kontrola rentgenowska obiektów wielkogabarytowych - demonstrator CANIS
S. Wronka, **W. Dziewiecki**
Krajowa Konferencja Badań Radiograficznych (Poland, Popów, 2014-09-10 - 2014-09-12)

Naukowiec - instytut - firma - jak zorganizować wspólny biznes
S. Wronka
Współpraca między sferą naukową a przemysłem w zakresie badań i transferu technologii (Poland, Warszawa, 2014-09-25 - 2014-09-25)

High Doses Radiation Facility at NCBJ
M. Matusiak
Workshop on Radiation Effects in Superconducting Magnets and Materials 2014 (RESMM 14) (Poland, Wrocław, 2014-05-12 - 2014-05-15)

Fixed Collimator in ESS
K. Szymczyk
Beam Losses and Collimators in Transfer Lines (Sweden, LUND, 2014-05-13 - 2014-05-14)

Oral Presentation

IntraLine - a demonstrator of a new mobile linear accelerator for Intraoperative Electron Radiation Therapy
P. Adrich, **R. Hanke**, **J. Kopeć**, J. Kopec, **K. Kosiński**, **E. Kulczycka**, **A. Masternak**, **B. Meglicki**, **A. Misiarz**, **E. Pławski**, **K. Swat**, **M. Staszczak**, **M. Wójtowicz**, **A. Wysocka-Rabin**, **A. Syntfeld-Każuch**
8th International Conference of the ISIORT (Germany, Kolonia, 2014-09-25 - 2014-09-27)

Polish in-kind contribution to European X-ray free electron laser (XFEL)-status in summer 2014
E. Pławski, J. Sekutowicz, **W. Grabowski**, **K. Kosiński**, **J. Lorkiewicz**, **M. Wojciechowski**, Z. Gołebiewski, K. Meissner, **G. Wrochna**, M. Duda, M. Jeżabek, K. Kasprzak, A. Kotarba, K. Krzysik, M. Stodulski, J. Świerblewski, M. Wiencek, M. Chorowski, E. Rusiński, J. Fydrych, A. Iluk, K. Malcher, J. Poliński, P. Duda, J. Głowinkowski, P. Wilk, M. Winkowski, P. Grzegory, G. Michalski
X konferencja Techniki Prózni (Poland, Cedzyna k. Kielc, 2014-09-22 - 2014-09-25)
Instytut Tele- i Radiotechniczny w Warszawie No. (2014)

Development and future perspective of CANIS X-ray system
A. Syntfeld-Każuch, **S. Wronka**, **A. Chłopik**, CANISgroup
1st Workshop on Customs Detection Technologies (Hungary, Budapest, 2014-10-07 - 2014-10-09)

Chipless Passive Sensor for Wireless Monitoring of High Radiation Doses in Nuclear Infrastructures
P. PONS, H. AUBERT, E. DEBOURG, A. RIFAI, **M. Olszacki**, **M. Matusiak**, I. Augustyniak, P. Knapkiewicz, J. Dziuban, D. Lavielle, C. Chatry
European Workshop on Structural Health Monitoring (France, Nantes, 2014-07-08 - 2014-07-11)

Wireless passive high-doses radiation sensor
E. Debourg, A. Rifai, H. Aubert, P. Pons, I. Augustyniak, P. Knapkiewicz, J. Dziuban, **M. Matusiak**, **M. Olszacki**
IEEE sensors 2014 (Spain, Valencia, 2014-11-03 - 2014-11-05)

The IOERT IntraLine Accelerator – the development, current state and future plans
P. Adrich, **R. Hanke**, **K. Kosiński**, **E. Kulczycka**, B. Meglicki, **A. Misiarz**, **E. Pławski**, **K. Swat**, **M. Wójtowicz**, **A. Wysocka-Rabin**, **A. Syntfeld-Każuch**
Warsaw Medical Physics Meeting (Poland, Warszawa, 2014-05-15 - 2014-05-17)

Poster

FIXED collimator in ESS
K. Szymczyk
Joint International Accelerator School on (USA, Newport Beach, 2014-11-05 - 2014-11-14)

IntraLine - a demonstrator of a new mobile linear accelerator for Intraoperative Electron Radiation Therapy
P. Adrich, **R. Hanke**, **J. Kopeć**, J. Kopec, **K. Kosiński**, **E. Kulczycka**, **B. Meglicki**, **A. Misiarz**, **E. Pławski**, **K. Swat**, **M. Staszczak**, **M. Wójtowicz**, **A. Wysocka-Rabin**, **A. Syntfeld-Każuch**
8th International Conference of the ISIORT (Germany, Kolonia, 2014-09-25 - 2014-09-27)

Movable Collimator System in ESS Project.
P. Warzybok
Joint International Accelerator School on (USA, Newport Beach, 2014-11-05 - 2014-11-14)

Detection of delayed radiation from highly enriched ^{235}U samples induced by bremsstrahlung photons
P. Sibczyński, **J. Kownacki**, **A. Syntfeld-Każuch**, **M. Moszyński**, **M. Kisieliński**, M. Kisielinski, J. Kozieł, **M. Matusiak**, **K. Kosiński**, **W. Dziewiecki**, **K. Wincel**, **B. Zaręba**, **J. Wojnarowicz**
The Zakopane Conference on Nuclear Physics (Poland, Zakopane, 2014-08-31 - 2014-09-07)

2D and 3D calculations in modified Tesla-like cavities
M. Staszczak, **T. Wasiewicz**, P. Kneisel, **W. Grabowski**, **R. Nietubyć**, J. Sekutowicz
12th International School and Symposium on Synchrotron Radiation in Natural Science (ISSRNS 2014) (Poland, Warsaw, 2014-06-15 - 2014-06-20)

LECTURES, COURSES AND EXTERNAL SEMINARS

Possible In-kind Contributions in Accelerator, ESS Partner and Industry Day in Poland[b]
S. Wronka
Cracow, IFJ, 2014-03-24

Using Monte Carlo codes to calculate therapeutical beams in conformal radiotherapy[a]
A. Wysocka-Rabin
Krakow, Faculty of Physics and Applied Computer Science, AGH - University of Science and Technology, 2014-04-14

Hadrontherapy in Poland and in the world[a]
A. Wysocka-Rabin
Bydgoszcz, Oncology and Brachytherapy Clinic of Collegium Medicum in Bydgoszcz, 2014-05-08

Heavy particles accelerators[a]
A. Wysocka-Rabin
Bydgoszcz, Oncology and Brachytherapy Clinic of Collegium Medicum in Bydgoszcz, 2014-10-23

Accelerator principles - \[a]
S. Wronka
Cracow, Jagiellonian University, 2014-12-19

4th Open Collaboration Meeting on Superconducting Linacs for High Power Proton Beams (SLHiPP-4)[b]
K. Szymczyk
GENEVA, CERN, 2014-05-15

4th Open Collaboration Meeting on Superconducting Linacs for High Power Proton Beams (SLHiPP-4)[b]
P. Warzybok
Geneva, CERN, 2014-05-15

CERN Accelerator School\[b]
K. Szymczyk
Prague, CERN Accelerator School in collaboration with the The Czech Technical University in Prague (Faculty of Nuclear Sciences and Physical Engineering), 2014-08-31

The CERN Accelerator School: Introduction to Accelerator Physics[b]
P. Warzybok
Prague, CERN, Czech Technical University in Prague Faculty of Nuclear Sciences and Physical Engineering, 2014-08-31

a) in Polish
b) in English

INTERNAL SEMINARS

Checking the photon energy generated on border accelerator by attenuation on steel plates method[a]
A. Wasilewski
Świerk, National Centre for Nuclear Research, 2014-05-09

Research of possibilities of Monte-Carlo simulation of atomic characteristic radiation of the elements found in the lithosphere by the FLUKA code[a]
A. Wasilewski
Świerk, National Centre for Nuclear Research, 2014-05-19

Beam centering in the IntraDose accelerator[a]
P. Adrich
Otwock, NCBJ, 2014-05-28

The energy and intensity of the 3MV photon beam as a function of the thickness of the copper iris[a]
A. Wasilewski
Świerk, National Centre for Nuclear Research, 2014-08-29

Report from the ISIORT 2014 conference[a]
P. Adrich
Otwock-Świerk, National Centre for Nuclear Research, 2014-10-01

a) in Polish

DIDACTIC ACTIVITY

P. Adrich - Supervision of apprenticeship of miss Monika Korczak, student of Warsaw Technical University.

P. Adrich - Supervision of miss Monika Korczak thesis entitled "Monte Carlo methods in modeling of therapeutic electron beams from medical intraoperative accelerators" written as partial fulfillment of the requirements for the title of engineer, Warsaw Technical University, 2014

S. Wronka - Accelerators in medicine

S. Wronka - Modern trends in the applications of accelerators in medicine

A. Wysocka-Rabin – „Accelerators for Hadrontherapy" – lecture for medical specialists

A. Wysocka-Rabin – „Basis of Hadronotherapy " – lecture for medical specialists

A. Wysocka-Rabin – Supervision of PhD candidate B.Zaręba, thesis topic: „Optimization of High-Dose Rate (HDR) Photon Needle parameters for topical applications, based on Monte Carlo simulation"

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

J. Borkowski
European Spallation Source Scandinavia; member of Accelerator group

S. Wronka
Member of Organizing Committee on Workshop on Radiation Effects in Superconducting Magnets and Materials in Wrocław, Poland
Polish Society of Medical Physics
National Centre for Nuclear Research

A. Wysocka-Rabin
Polish Society of Medical Physics
PTCOG
member, European Society for Therapeutic Radiology and Oncology
Polish Society of Radiation Oncology
WiN Poland, Women in Nuclear
Polish Nuclear Society
National Centre for Nuclear Research

PERSONNEL

Research Scientists

Przemysław Adrich, PhD
Eugeniusz Pławski, PhD
Adam Wasilewski, PhD
Sławomir Wronka, PhD
Anna Wysocka-Rabin, Assoc. Prof.

Technical And Administrative Staff

Józef Bogowicz
Oliwia Chołuj- Dziewiecka
Wojciech Drabik, MSc
Michał Dziewiecki, PhD
Wojciech Dziewiecki, MSc
Adam Galant
Wojciech Grabowski, MSc
Michał Jarosz, MSc
Marian Klimasz, MSc
Konrad Kosiński, MSc
Andrzej Łubian
Michał Matusiak, M. Sc.
Marcin Staszczak, MSc
Karol Szymczyk, MSc
Michał Świniarski
Piotr Warzybok, MSc
Marcin Wojciechowski, MSc
Maria Zielińska

INTERDISCIPLINARY APPLICATIONS OF PHYSICS DIVISION

Head of Division: Jan Sernicki, PhD
phone: +48 22 2731461
e-mail: jan.sernicki@ncbj.gov.pl

Overview

The activities of the Division in 2014 were focused on the following areas of applications of physics:

- Medical physics:
  - modernization of X-ray generators for applications in medicine and for applications in scientific research as a source of 50 keV X-rays;
  - work on application of the photon needle in HDR radiotherapy;
  - work on a demonstrator-device of a low energy accelerator with X-ray tube for applications in medicine.
- Environmental physics:
  - air quality investigation at two Warsaw crossroads using the Mobile Environmental Measurements Laboratory;
  - tests of the hybrid process of electron beam irradiation combined with catalyst for purification of exhaust gases with high NO_x concentrations, performed in the laboratory plant at INCT;
  - study of electron beam technology for multipollutant emission control from heavy fuel oil-fired boilers.
- Nanodosimetry, radiation field modelling, radiation detectors, cyclotron operation:
  - study of the ionization cluster distributions produced by carbon ions within structures of nanometre sizes using the “Jet Counter” facility;
  - experiments on carbon ion beams at HIL with the Jet Counter and Ion Counter were carried out;
  - mathematical modelling of nuclear radiation sources and calculations of the radiation field parameters; tests of the MCNP transport code (version 5) for various applications;
  - study of some spectrometric properties of Parallel Plate Avalanche Counters;
  - modernization of our 25 MeV proton cyclotron for applications in experimental studies on the activation method for heavy metals.
- Nuclear physics:
  - modelling of the nuclear spallation processes induced by high energy protons and deuterons, calculations of radioactive isotope generation. The aim was tostudy the processes and analyse experimental data obtained at the experimental set up Quinta at JINR in Dubna;
  - numerical simulation of transmutation of minor actinides. The calculations determine the conditions for the use of spent PWR fuel in generation IV reactors with closed fuel cycles.
- Program “4Labs”:
  - modernization of the environmental measurements laboratory.
- Project “BioQuaRT”:
  - a group from our Division has been actively participating in the EURAMET project “Biologically weighted quantities in radiotherapy**”.** The Jet Counter technique has been applied to nanodosimetry studies of carbon ions as a work package in this project.
- Project NCBiR:
  - project financed by the National Centre for Research and Development (NCBiR) **“**Improvement of a high sensitivity measuring station for neutron and gamma radiation detection for environmental measurements and for workplace monitoring inside a nuclear power plant”**.** A prototype measurement set up was assembled and tested.

We collaborate among others with the Jagiellonian University, Silesian University in Katowice, Warsaw Technical University, Oncology Institute in Warsaw, Radioisotope Centre POLATOM, Institute of Nuclear Chemistry and Technology, Institute of Experimental Physics of Warsaw Univ., Institute of Medical Physics of Warsaw Univ., Institute for Plasma Physics and Laser Microsynthesis in Warsaw, Central Office of Measures in Warsaw, Voivodeship Inspectorate for Environmental Protection in Warsaw, Interdisciplinary Centre for Mathematical and Computational Modelling of Warsaw Univ., Heavy Ion Laboratory of Warsaw Univ., PTB Braunschweig, LNL–INFN Legnaro, ENEA Italy, PoliMi Italy, IRSN France, ITN Portugal, NPL United Kingdom, JINR Dubna, Reactor Physics Division of KTH Royal Institute of Technology in Stockholm and also other divisions of our Centre.

Jan Sernicki

REPORTS

Natural and manmade radionuclides in soils in the vicinity of Zakłady Azotowe \
A. Burakowska, **B. Mysłek-Laurikainen**, **H. Trzaskowska**
NCBJ

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Wpływ zanieczyszczeń radioaktywnych i aerozolowych na strukturę elektryczną atmosfery, na podstawie pomiarów Polskiej Stacji Polarnej w Hornsundzie i Obserwatorium Geofizycznym PAN w **Świdrze**
B. Mysłek-Laurikainen, **H. Trzaskowska**, M. Kubicki, A. Odzimek
IX Międzynarodowa Konferencja Naukowa Ochrona powietrza w teorii i praktyce (Poland, Zakopane, 2014-10-14 - 2014-10-17)

Spatial and Temporal Distrbution of Radioactive Aerosols on Polar Region and its Effect to Atmospheric Electricity Parameters
B. Mysłek-Laurikainen, **H. Trzaskowska**, M. Kubicki, A. Odzimek
International Conference on Radioecology & Environmental Radioactivity,Ring of Five workshop (Spain, Barcelona, 2014-09-07 - 2014-09-12)

Jednoczesna redukcja stężeń wielu zanieczyszczeń w spalinach przy użyciu wiązki elektronów z akceleratora
J. Licki, A.G. Chmielewski, A. Pawelec, Z. Zimek
12 Konferencja Naukowa POL-EMIS 2014, Inżynieria i Ochrona Powietrza (Poland, Karpacz, 2014-06-04 - 2014-06-07)
Oficyna Wydawnicza Politechniki Wrocławskiej No. (2014) p. 275-283

Electron bream treatment of marine diesel exhaust gases
J. Licki, A.G. Chmielewski, A. Pawelec, Z. Zimek, S. Witman-Zając
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)
Nukleonika (2014)

Flue gas treatment
A.G. Chmielewski, B. Tymiński, **J. Licki**, Z. Zimek, Y. Sun, A. Pawelec, S. Witman-Zając
EuCARD2 workshop on The industrial and environmental applications of electron beams (Poland, Warsaw, 2014-11-06 - 2014-11-07)
Institute of Nuclear Chemistry and Technology, Warsaw No. (2015)

Search for scaling properties of electromagnetic cascades produced by 100-3500 MeV gamma quanta in heavy amorphous media
B. Słowiński, P. Duda, **D. Mączka**, **J. Bzdak**
ION 2014 (Poland, Kazimierz Dolny, 2014-06-23 - 2014-06-26)
UMCS (Lublin), Kazimierz Dolny No. (2014) p. 38

Simulation of the Time Evolutions of Spallation Reaction
A. Polański, G. Musulmanbekov
5th High Power Targetry Workshop (USA, Batavia, 2014-05-20 - 2014-05-23)

Oral Presentation

Heavy ion beams for radibiology - dosimetry and nanodosimetry at HIL
U. Kaźmierczak, **A. Bantsar**, D. Banaś, J. Braziewicz, J. Czub, **M. Jaskóła**, **A. Korman**, M. Kruszewski,

A. Lankoff, H. Lisowska, M. Pietrzak, **S. Pszona**, T. Stępkowski, Z. Szefliński, M. Wojewódzka
II Symposium on Positron Emission Tomography (Poland, Kraków, 2014-09-21 - 2014-09-24)
Acta Phys. Pol. A (in press)

The metadata driven e-laboratory web client
M. Olszewski, **J. Bzdak**
XIV Konferencja "Uniwersytet Wirtualny – model, narzędzia, praktyka" (Poland, Warszawa, 2014-06-25 - 2014-06-26)

Ionization cluster size distributions for C+6 ions at HIL - comparison of the experiments by Ion Counter PTB and Jet Counter NCBJ.
S. Pszona
5th BioQuaRT Project Meeting (Portugal, Lisbon, 2014-11-18 - 2014-11-21)

Ionization cluster size distribution for C+6 ions at HIL.
S. Pszona
4th BioQuaRT Project Meeting (United Kingdom, Teddington, 2014-05-12 - 2014-05-15)

Poster

The role of natural like ^{7}Be and antropogenic radionuclides in Global Electrical Circut(GEC) of the Earth based on the selected measurements in polar regions and medium geographic zone.
B. Mysłek-Laurikainen, **H. Trzaskowska**, M. Kubicki, A. Odzimek
35th Polar Symposium Diversity and state of polar ecosystems (Poland, Wrocław, 2014-06-04 - 2014-06-07)
Uniwersytet Wrocławski, Institute of Geography and regional Development No. (2014) p. ISBN 978 -83-62

Application of the nanodosimetric devices for FELX ray metrology.
S. Pszona, **A. Bantsar**
Advanced X-ray spatial and temporal metrology -COST MP1203 (Croatia, Dubrovnik, 2014-10-01 - 2014-10-03)

Towards a new concept of radiation quality based on experimental nanodosimetry
V. Conte, **A. Bantsar**, P. Colautti, G. Hilgers, D. Moro, H. Rabus, **S. Pszona**
3rd Conference Nano-IBCT 2014 (Germany, Boppard am Rhein, 2014-10-27 - 2014-10-31)

Common Approach to Study Scintillators Response to Gamma-rays and Protons
Ł. Świderski, **M. Szawłowski**, **M. Moszyński**, A. Para, **W. Czarnacki**, **M. Grodzicka**, **J. Iwanowska**, **M. Kisieliński**, **J. Wojtkowska**
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

Detection of delayed radiation from highly enriched ^{235}U samples induced by bremsstrahlung photons
P. Sibczyński, **J. Kownacki**, **A. Syntfeld-Każuch**, **M. Moszyński**, **M. Kisieliński**, M. Kisielinski, J. Kozieł, **M. Matusiak**, **K. Kosiński**, **W. Dziewiecki**, **K. Wincel**, **B. Zaręba**, **J. Wojnarowicz**
The Zakopane Conference on Nuclear Physics (Poland, Zakopane, 2014-08-31 - 2014-09-07)

Modelowanie zanieczyszczeń powietrza metodami eksploracji danych pomiarowych. Perspektywa światowa oraz przykładowe wdrożenia w Narodowym Centrum Badań Jądrowych.
J. Bzdak
IX Międzynarodowa Konferencja Naukowa Ochrona powietrza w teorii i praktyce (Poland, Zakopane, 2014-10-14 - 2014-10-17)

Detection of Fukushima Origin Ceasium Isotopes at Polish Polar Station in Hornsund(Spitzbergen and its Efects to AtmosphericElectricity Parameters
B. Mysłek-Laurikainen, **M. Matul**, **S. Mikołajewski**, **H. Trzaskowska**, M. Kubicki, P. Barański, A. Odzimek, S. Michnowski
Air Quality 2014 (Germany, Garmisch-Partenkirchen, 2014-03-24 - 2014-03-28)
Institute of Meteorology and Climate Research (IMK-IFU),Centre for Atmospheric and Instrumentation Research(CAIR)Univercity of Hertfordshire UK No. (2014) p. 193

Zastosowanie wysokoczułego mobilnego monitoringu powietrza dla oceny zagrożeń naturalnych i technologicznych w miejscach proponowanych jako lokalizacje przyszłych obiektów jądrowych
M. Bogusz, **J. Bzdak**, **M. Lasiewicz**, **M. Sowiński**, **H. Trzaskowska**
IX Międzynarodowa Konferencja Naukowa Ochrona powietrza w teorii i praktyce (Poland, Zakopane, 2014-10-14 - 2014-10-17)

LECTURES, COURSES AND EXTERNAL SEMINARS

Nanodosimetry based on At-211[a]
A. Bantsar
Warsaw, Heavy Ion Laboratory, University of Warsaw, 2014-04-09

PlasTEP seminar New trends in application of modern electron beam generation in air pollution//Analytical methods for electron beam flue gas treatment control[b]
J. Licki
Warsaw, Institute of Nuclear Chemistry and Technology, 16 Dorodna St. 03-195 Warsaw, 2014-01-15

Simulation of Nuclear Spallation[b]
A. Polański
Dubna, JINR, 2014-04-24

a) in Polish
b) in English

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

J. Bielecki
member, European Cooperation in Science and Technology Action CM1002 "Convergent Distributed Environment for Computational Spectroscopy"

T. Kozłowski
Member of Scientific Council
Member of NCBJ Scientific Council

J. Licki
Polish Standards Committe, member of Technical Committe No 280 on Air Quality
Polish Academy of Sciences, member of the Plasma Physics Section of Physics Committe

S. Pszona
Institute of Electrical and Electronics Engineers, Inc

PERSONNEL

Research scientists

Aliaksandr Bantsar, PhD
Aleksander Polański, PhD
Stanisław Pszona, PhD
Jan Sernicki, PhD
Piotr Szymański, Assoc.Prof.
Jolanta Wojtkowska, PhD
Barbara Zaręba, MSc

Technical and administrative staff

Andrzej Bigos
Bogusz Małgorzata, MSc
Jacek Bzdak, MSc
Adam Dudziński
Stanisław Gębalski, MSc
Elżbieta Jaworska
Krystian Grodzicki, MSc
Maciej Kisieliński, MSc
Ewa Krogulska, MSc
Patryk Lalik
Janusz Licki, PhD
Magdalena Kośla, MSc
Marek Kowalski, MSc
Alicja Kurdej
Marek Lasiewicz, MSc
Marian Laskus
Paweł Matuszczak, Eng.
Stefan Mikołajewski
Piotr Mazarewicz, MSc
Piotr Markowski, MSc Eng
Marcin Pietrzak, MSc
Mieczysław Słapa, PhD
Mirosław Snopek
Mieczysław Sowiński, PhD
Jakub Szymanowski, Eng.
Marek Traczyk, MSc
Halina Trzaskowska
Krzysztof Wincel, MSc
Mieczysław Zając

RADIATION DETECTORS DIVISION

Head of Division: Tomasz Szczęśniak, PhD
phone: +48 22 2731414
e-mail: t.szczesniak@ncbj.gov.pl

Overview

Most of the activity of the Radiation Detectors Division is focused on the characterization of scintillation detectors for neutron and gamma-ray radiation. The studies concern the performance of various scintillation materials as well as different photodetectors in different applications, including fundamental research, nuclear medicine, border monitoring devices and industrial systems. In the last year our efforts were concentrated on:

- Comparative studies of neutron detectors in the 3He supply crisis.
- Photofission of nuclear materials and fission signature detection with applications in border monitoring.
- Common Approach to Study Scintillator Response to Gamma-rays and Protons.
- Characterization of high density Silicon Photomultiplier (SiPM) performance in gamma and X-ray spectrometry using scintillators.
- Analogue and digital neutron-gamma discrimination methods with PMTs and SiPMs.
- Characterization of basic properties of scintillators, including non-proportional response to the deposited energy and its relation to energy resolution, decay time, timing resolution and detection efficiency.
- Studies of various plasma diagnostic methods for detection of X-rays, gamma rays, fast electrons, neutrons and ions.
- Development of special silicon detectors used in physical experiments and environmental protection.

The results of our studies were used in the realization of several projects, including:

- TAWARA_RTM: the aim of the project is improvement of drinking water security management and mitigation in large municipalities against major deliberate, accidental or natural CBRN-related contamination. The TJ3 Division is responsible for the development of a gamma radiation monitor and final tests of the integrated system in MPWiK
- MODES_SNM: we were involved in the development of a modular detection system for special nuclear material detection using high pressure gas detectors based on He-4 (neutron detection) and Xe (gamma-ray detection). In the last year, laboratory characterization of the integrated system performance has been carried out.
- EURATOM: we are involved in the construction of a gamma camera for inspection of thermofusion reactions. The programme covers a comparative study of scintillators that may potentially be used in a gamma camera. Simulations of the detector response to gamma radiation are performed in parallel in order to choose the optimal configuration of the detector.
- RaM-ScaN: the aim of the project is to develop a system for controlling the chemical composition of raw materials used in cement production. The method of scanning is based on prompt gamma neutron activation analysis and a DD neutron generator.
- COST network: COST is a programme for experience exchange between scientists involved in projects related to nuclear medicine. Our participation allows us to visit other Institutes and companies to develop new measurement techniques and to host guests from other Institutions.

Most of the scientific achievements of the Division were summarized in 15 peer-reviewed publications, published mainly in IEEE Trans. Nucl. Sci., J. of Instrum. and Nucl. Instrum. and Meth. A. Besides that, our scientists presented 16 contributions at international conferences – including 2 oral presentations at the IEEE Nuclear Science Symposium and Medical Imaging Conference 2014 in Seattle, USA, 1 oral presentation at the Symposium on Radiation Measurements and Applications (SORMA 2014) in Ann Arbor, USA, and 2 invited talks during various Workshops.

The Division has also been involved in scientific collaborations with a number of international centre, such as the Royal Institute of Technology, Stockholm, KMUTT Bangkok, Thailand, CEA-Saclay, France, ISC Kharkov, Ukraine, LNL INFN, Italy, Tohoku University, Japan, Fondazione Bruno Kessler (FBK) , Italy, and companies as Saint-Gobain, France, Scionix B.V., Holland, Siemens, USA, SensL, Ireland, Hamamatsu Photonics K.K., Tokuyama and C-and-A., Japan.

Details regarding the Division`s achievements in selected areas can be found in the dedicated records of this Annual Report.

Tomasz Szcześniak

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Spectral characteristics and spectra simulations for high-resolution X-Ray diagnostic at JET
J. Rzadkiewicz
Workshop ADAS 2014 (Poland, Warsaw, 2014-09-28 - 2014-09-30)

Oral Presentation

The K X-Ray Line Structures of the 3d-Transition Metals in Warm Dense Plasma
E. Szymańska, K. Słabkowska, Ł. Syrocki, N.R. Pereira, **J. Rzadkiewicz**, M. Polasik
The 16th International Workshop on Radiative Properties of Hot Dense Matter (Austria, Vienna, 2014-09-29 - 2014-10-03)

Flexible composite scintillator based on Eu:LiCAF crystal grains
J. Iwanowska, **M. Moszyński**, **P. Sibczyński**,
Symposium on Radiation Measurements and Applications (SORMA 2014) (USA, Ann Arbor, 2014-06-09 - 2014-06-12)

The IOERT IntraLine Accelerator – the development, current state and future plans
P. Adrich, **R. Hanke**, **K. Kosiński**, **E. Kulczycka**, B. Meglicki, **A. Misiarz**, **E. Pławski**, **K. Swat**, **M. Wójtowicz**, **A. Wysocka-Rabin**, **A. Syntfeld-Każuch**
Warsaw Medical Physics Meeting (Poland, Warszawa, 2014-05-15 - 2014-05-17)

Digital Neutron-Gamma Discrimination Methods: Charge Comparison versus Zero-Crossing
T. Szczęśniak, **M. Grodzicka**, **M. Moszyński**, **D. Wolski**, **Ł. Świderski**, **M. Szawłowski**, P. Schotanus
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

IntraLine - a demonstrator of a new mobile linear accelerator for Intraoperative Electron Radiation Therapy
P. Adrich, **R. Hanke**, **J. Kopeć**, J. Kopec, **K. Kosiński**, **E. Kulczycka**, **A. Masternak**, **B. Meglicki**, **A. Misiarz**, **E. Pławski**, **K. Swat**, **M. Staszczak**, **M. Wójtowicz**, **A. Wysocka-Rabin**, **A. Syntfeld-Każuch**
8th International Conference of the ISIORT (Germany, Kolonia, 2014-09-25 - 2014-09-27)

Temperature Properties of Scintillators for PET Detectors: a Comparative Study
W. Wolszczak, **M. Moszyński**, **T. Szczęśniak**, **M. Grodzicka**, K. Kacperski
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

Non-Proportionality Components in Doped CsI
A. Syntfeld-Każuch, **Ł. Świderski**, **M. Moszyński**, A.V. Gektin
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

Development and future perspective of CANIS X-ray system
A. Syntfeld-Każuch, **S. Wronka**, **A. Chłopik**, CANISgroup
1st Workshop on Customs Detection Technologies (Hungary, Budapest, 2014-10-07 - 2014-10-09)

Polish Participation to JET4 Projects
I. Zychor
3rd Italy-Poland Workshop (Poland, Warszawa, 2014-09-15 - 2014-09-16)

Micromechanical high-doses radiation sensor with bossed membrane and interferometry optical read-out
I. Augustyniak, P. Knapkiewicz, K. Sarelo, J. Dziuban, E. Debourg, P. Pons, **M. Olszacki**
Eurosensors 2014 (Italy, Brescia, 2014-09-07 - 2014-09-10)

Chipless Passive Sensor for Wireless Monitoring of High Radiation Doses in Nuclear Infrastructures
P. Pons, H. Aubert, E. Debourg, A. Rifai, **M. Olszacki**, **M. Matusiak**, I. Augustyniak, P. Knapkiewicz, J. Dziuban, D. Lavielle, C. Chatry
European Workshop on Structural Health Monitoring (France, Nantes, 2014-07-08 - 2014-07-11)

Diagnostics of plasma parameters based on the x-ray line positions for various elements
E. Szymańska, K. Słabkowska, Ł. Syrocki, M. Polasik, N.R. Pereira, **J. Rzadkiewicz**, J.F. Seely
The 17th International Conference on the Physics of Highly Charged Ions (Argentina, Bariloche, 2014-08-31 - 2014-09-05)

Wireless passive high-doses radiation sensor
E. Debourg, A. Rifai, H. Aubert, P. Pons, I. Augustyniak, P. Knapkiewicz, J. Dziuban, **M. Matusiak**, **M. Olszacki**
IEEE sensors 2014 (Spain, Valencia, 2014-11-03 - 2014-11-05)

Influence of the technology aspects on the objectionable betavoltaic phenomenon in gan diodes
P. Laskowski, **M. Olszacki**, S. Grzanka, L. Marona, M. Leszczynski, P. Perlin, **P. Sobkowicz**
ISROS Symposium 2014, on Reliability of Optoelectronics for Systems (France, Toulouse, 2014-06-16 - 2014-06-19)

Poster

Fast neutron detection efficiency of EJ-313 and BaF_2 scintillators by ^{19}F activation
P. Sibczyński, **J. Kownacki**, **M. Moszyński**, **J. Iwanowska**, **A. Syntfeld-Każuch**, **A. Gójska**, F. Carrel
Symposium on Radiation Measurements and Applications (SORMA 2014) (USA, Ann Arbor, 2014-06-09 - 2014-06-12)

The K X-Ray Line Positions as diagnostics of Warm Dense Plasma
K. Słabkowska, N.R. Pereira, E. Szymańska, **J. Rzadkiewicz**, Ł. Syrocki, M. Polasik
The 16th International Workshop on Radiative Properties of Hot Dense Matter (Austria, Vienna, 2014-09-29 - 2014-10-03)

Characterization of TSV MPPC Arrays (4x4 ch and 8x8 ch) in Scintillation Spectrometry
M. Grodzicka, **T. Szczęśniak**, **M. Moszyński**, **S. Korolczuk**, **M. Kapusta**, J. Baszak
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

Modeling of the K and L X-Ray Line Structures for Molybdenum Ions in Warm Dense Plasma
Ł. Syrocki, K. Słabkowska, N.R. Pereira, **J. Rzadkiewicz**, E. Szymańska, M. Polasik
The 16th International Workshop on Radiative Properties of Hot Dense Matter (Austria, Vienna, 2014-09-29 - 2014-10-03)

Study of neutron-gamma Discrimination by Zero-Crossing Method with SiPM Based Scintillation Detectors
M. Grodzicka, **T. Szczęśniak**, **M. Moszyński**, **D. Wolski**, **L. Swiderski**, **S. Korolczuk**, J. Baszak
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

IntraLine - a demonstrator of a new mobile linear accelerator for Intraoperative Electron Radiation Therapy
P. Adrich, **R. Hanke**, **J. Kopeć**, J. Kopec, **K. Kosiński**, **E. Kulczycka**, **B. Meglicki**, **A. Misiarz**, **E. Pławski**, **K. Swat**, **M. Staszczak**, **M. Wójtowicz**, **A. Wysocka-Rabin**, **A. Syntfeld-Każuch**
8th International Conference of the ISIORT (Germany, Kolonia, 2014-09-25 - 2014-09-27)

Detection of delayed radiation from highly enriched ^{235}U samples induced by bremsstrahlung photons
P. Sibczyński, **J. Kownacki**, **A. Syntfeld-Każuch**, **M. Moszyński**, **M. Kisieliński**, M. Kisielinski, J. Kozieł, **M. Matusiak**, **K. Kosiński**, **W. Dziewiecki**, **K. Wincel**, **B. Zaręba**, **J. Wojnarowicz**
The Zakopane Conference on Nuclear Physics (Poland, Zakopane, 2014-08-31 - 2014-09-07)

Energy shifts of K- and L-lines as spectroscopic diagnostic of Z-pinch plasmas
N.R. Pereira, K. Słabkowska, **J. Rzadkiewicz**, E. Szymańska, Ł. Syrocki, M. Polasik
The 9th International Conference on Dense Z-Pinches (USA, California, 2014-08-03 - 2014-08-07)

Shake process accompanying single K-shell ionization for selected atoms with
K. Słabkowska, M. Polasik, E. Szymańska, Ł. Syrocki, **J. Rzadkiewicz**
The 17th International Conference on the Physics of Highly Charged Ions (Argentina, Bariloche, 2014-08-31 - 2014-09-05)

Common Approach to Study Scintillators Response to Gamma-rays and Protons
Ł. Świderski, **M. Szawłowski**, **M. Moszyński**, A. Para, **W. Czarnacki**, **M. Grodzicka**, **J. Iwanowska**, **M. Kisieliński**, **J. Wojtkowska**
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

Shake process accompanying single K-shell ionization for selected atoms with 20≤Z≤32
K. Słabkowska, E. Szymańska, M. Polasik, Ł. Syrocki, Y. Ito, **J. Rzadkiewicz**, T. Tochio, S. Fukushima
The 17th International Conference on the Physics of Highly Charged Ions (Argentina, Bariloche, 2014-08-31 - 2014-09-05)

LECTURES, COURSES AND EXTERNAL SEMINARS

Hard X-ray and gamma ray diagnostic based on the scintillator detectors for tokamaks.[a]
J. Rzadkiewicz
Warsaw, Institute of Plasma Physics and Laser Microfusion, 2014-01-23

Participation of Polish institutions in the JET4-EUROFusion Project (2014-2018)[a]
I. Zychor
Warsaw, Plasma Physics Section, Polish Physical Society , 2014-10-21

CAMPAIGNS C31-C34 at JET[a]
I. Zychor
Warsaw, Institute of Plasma Physics and Laser Microfusion, 2014-10-29

Proposal for the upgrade of the Gamma-Ray Camera (GCU)[b]
I. Zychor
Culham, United Kingdom, Culham Centre for Fusion Energy (CCFE), 2014-01-09

Upgrade of the Gamma-Ray Camera - Simulations of the best scintillator material for gamma-ray spectroscopy measurements in the camera[b]
I. Zychor
Culham, United Kingdom, Culham Centre for Fusion Energy (CCFE) , 2014-07-09

Lost Alpha Gamma Rays Monitor (LRM)[b]
I. Zychor
Culham, United Kingdom, Culham Centre for Fusion Energy (CCFE), 2014-10-22

a) in Polish
b) in English

INTERNAL SEMINARS

Measurements with using of PiN diode[a]
A. Gójska
Swierk, National Centre for Nuclear Research, 2014-03-27

EUROFUSION_NCBJ_JET4 Project[a]
I. Zychor
Swierk, National Centre for Nuclear Research (NCBJ), 2014-12-18

a) in Polish

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

A. Gójska
Polish Physical Society

M. Moszyński
Fellow of IEEE
Member of TransNational Committee of IEEE Nuclear and Plasma Science Society
Member of the Management Committee of COST Action TD1007, "Bimodal PET-MRI molecular imaging technologies and applications for in vivo monitoring of disease and biological processes" (www.pet-mri.eu)
Neutron Detectors Array (NEDA)
Nuclear Instruments & Methods in Physics Research A, Elsevier, Member of Advisory Editorial Board
Journal of Instrumentation, Institute of Physics Publishing, Member of Editorial Board
Recent Patents on Engineering, Bentham Science Publishers, Member of Editorial Board
National Centre for Nuclear Research, Member of Scientific Council

J. Rzadkiewicz
Session chairman on Workshop ADAS 2014 in Warsaw, Poland
Member of Organizing Committee on Workshop ADAS 2014 in Warsaw, Poland
Chairman of the Governing Board of the Centre for Scientific and Industrial New Energy Technologies

Ł. Świderski
Member of IEEE Nuclear and Plasma Sciences Society

A. Syntfeld-Każuch
Member of IEEE Nuclear and Plasma Sciences Society
member of scientific council, National Centre for Nuclear Research

PERSONNEL

Scientific staff

Eugeniusz Belcarz, MSc Eng
Wiesław Czarnacki, PhD
Aneta Gójska, PhD
Martyna Grodzicka-Kobyłka, MSc Eng
Joanna Iwanowska-Hanke, MSc
Andrzej Kotlarski, MSc Eng
Marek Moszyński, Professor
Olszacki Michał, PhD
Jacek Rzadkiewicz, PhD
Paweł Sibczyński, MSc
Agnieszka Syntfeld-Każuch, PhD
Marek Szawłowski, MSc .Eng
Tomasz Szczęśniak, PhD
Łukasz Świderski, PhD
Dariusz Wolski, MSc Eng
Izabella Zychor, PhD
Maciej Kapusta, PhD
Slawomir Mianowski, MSc

Technical and administration staff

Andrzej Dziedzic
Kostrzewa Krzysztof
Kos Monika, MSc
Sworobowicz Tadeusz

ELECTRONICS AND DETECTION SYSTEMS DIVISION

Head of Division: Michał Gierlik, PhD
phone: +48 22 2731299
e-mail: michal.gierlik@ncbj.gov.pl

Overview

The end of 2014 marks the third year of existence of the Division of Electronics and Detection System. The team participates in various projects, providing expertise and support whenever the need for high-end electronics arises. Our goal is to maintain our technology edge by participating in challenging projects and collaborations while actively seeking commercial opportunities and applications for our solutions.

In the year 2014 the division's effort was focused on the following topics:

- The R&D contract with KGHM "Polska Miedź" S. A.

  The technology of neutron activation analysis, refined during the years of the A&D projects, meets with rising interest from industry. In the summerof 2014 a contract was signed between NCBJ and the large mining company, KGHM "Polska Miedź" S. A. The details of the contract are classified, however, the research programme is in general related to appraising the ore quality at various stages of extraction and excavation.

- NCBJ research projects database

A normalized database structure for data collected by the International R&D Projects and Cooperation Department has been designed, as well as subsequent tasks performed; implementation of the database on MS SQL, data import from Excel, design and programming of a web user interface for data browsing and editing (incomplete).

- Astrophysics

In 2014 work carried out earlier was continued. Due to the approaching end of the grant this work was largely focused on refining the details. It proceeded smoothly without significant interference. The most important results are as follows:

- "Pi of the Sky" project. In addition to the current observations and data processing, the design phase of building a new remotely-controlled robot for observations of optical phenomena associated with GRBs (gamma ray bursts) was completed. The majority of the necessary components have been machined and purchased. The software for remote control of robots and processing the collected data was set in order and improved.
- "POLAR" project. The flight model of the detector was assembled together with improved digital electronics modules.
- Centre of Informatics Świerk. With the use of the previously developed Universal User Interface CIS pilot calculations of neutron star atmospheres for the BURSTERS project were set in operation. The software for data processing in the WISE experiment was developed. Monte-Carlo simulations of reactions of cosmic rays with the POLAR detector were accomplished.
- In the field of astrophysical research (Task 8) numerous works, mainly related to the AKARI, VIPERS, VVDS projects were published.

Michał Gierlik

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Data Analysis in Neutron Activation Analysis for Homeland Security
Ł. Kaźmierczak
II Symposium on applied nuclear physics and innovative technologies (Poland, Kraków, 2014-09-24 - 2014-09-27)

Oral Presentation

The POLAR Gamma-Ray Burst Polarimeter onboard the Chinese Spacelab
S. Orsi, F. Cadoux, C. Leluc, M. Paniccia, M. Pohl, D. Rapin, T. Bao, J. Chai, Y. Dong, M. Kong, L. Lu, J. Liu, X. Liu, H. Shi, J. Sun, R. Wang, X. Wen, B. Wu, H. Xiao, H. Xu, Li. Zhang, L. Zhang, S. Zhang, Y. Zhang, **T. Batsch**, **A. Rutczyńska**, **J. Szabelski**, **A. Zwolińska**, I. Britvich, W. Hajdas, **R. Marcinkowski**, **D. Rybka**, N. Gauvin, N. Produit
Swiss Physical Society Annual Meeting 2014 (Switzerland, Fribourg, 2014-06-30 - 2014-07-02)

POLAR construction and qualification
S. Orsi, F. Cadoux, C. Leluc, M. Paniccia, M. Pohl, D. Rapin, T. Bao, J. Chai, Y. Dong, M. Kong, L. Lu, J. Liu, X. Liu, H. Shi, J. Sun, R. Wang, X. Wen, B. Wu, H. Xiao, H. Xu, Li. Zhang, L. Zhang, S. Zhang, Y. Zhang, **T. Batsch**, **A. Rutczyńska**, **J. Szabelski**, **A. Zwolińska**, I. Britvich, W. Hajdas, **R. Marcinkowski**, **D. Rybka**, N. Gauvin, N. Produit
X-ray polarisation in astrophysics - a window about to open? (Sweden, Stockholm, 2014-08-25 - 2014-08-28)

Development and future perspective of CANIS X-ray system
A. Syntfeld-Każuch, **S. Wronka**, **A. Chłopik**, CANISgroup
1st Workshop on Customs Detection Technologies (Hungary, Budapest, 2014-10-07 - 2014-10-09)

The POLAR gamma-ray burst polarimeter onboard the Chinese Spacelab
S. Orsi, F. Cadoux, C. Leluc, M. Paniccia, M. Pohl, D. Rapin, T. Bao, J. Chai, Y. Dong, M. Kong, L. Lu, J. Liu, X. Liu, H. Shi, J. Sun, R. Wang, X. Wen, B. Wu, H. Xiao, H. Xu, Li. Zhang, L. Zhang, S. Zhang, Y. Zhang, **T. Batsch**, **A. Rutczyńska**, **J. Szabelski**, **A. Zwolińska**, I. Britvich, W. Hajdas, **R. Marcinkowski**, **D. Rybka**, N. Gauvin, N. Produit
SPIE Astronomical Telescopes + Instrumentation (Canada, Montreal, 2014-06-22 - 2014-06-27)
Proceedings of the SPIE Vol. 9144 (2014) 0

Poster

European XFEL RF gun commissioning and LLRF LINAC installation
J. Branlard, G. Ayvazyan, V. Ayvazyan, Ł. Butkowski, M. Grecki, M. Hoffmann, F. Ludwig, U. Mavric, S. Pfeiffer, H. Schlarb, C. Schmidt, H. Weddig, B. Yang, S. BouHabib, K. Czuba, M. Grzegrzółka, E. Janas, J. Piekarski, I. Rutkowski, R. Rybaniec, D. Sikora, Ł. Zembala, M. Zukocinski, W. Cichalewski, D. Makowski, A. Mielczarek, P. Perek, T. Pozniak, K. Przygoda, **S. Korolczuk**, **M. Kudła**, **J. Szewiński**, K. Oliwa, W. Wierba, A. Piotrowski
5th International Particle Accelerator Conference IPAC'14 (Germany, Dresden, 2014-06-15 - 2014-06-20)

Design and Integration of the Optical Reference Module at 1.3 GHz for FLASH and the European XFEL
E. Janas, K. Czuba, P. Kownacki, D. Sikora, M.K. Czwalinna, M. Felber, T. Lamb, H. Schlarb, S. Schulz, C. Sydlo, M. Titberidze, F. Zummack, **J. Szewiński**
5th International Particle Accelerator Conference IPAC'14 (Germany, Dresden, 2014-06-15 - 2014-06-20)

New MTCA.4-based hardware developments for the control of the optical synchronization systems at DESY
M. Felber, M.K. Czwalinna, H.T. Duhme, M. Fenner, C. Gerth, M. Heuer, T. Lamb, U. Mavric, J. Mueller, P. Peier, H. Schlarb, S. Schulz, B. Steffen, C. Sydlo, M. Titberidze, T. Walter, R. Wedel, F. Zummack, **J. Szewiński**, T. Kozak, P. Prędki, K. Przygoda, E. Janas
3rd International Beam Instrumentation Conference, IBIC 2014 (USA, Monterey, 2014-09-14 - 2014-09-18)

Standardized Solution of Management Controller for MicroTCA.4
D. Makowski, M. Fenner, F. Ludwig, U. Mavric, A. Mielczarek, A. Napieralski, P. Perek, **J. Szewiński**, H. Schlarb
19th Real-Time conference , RT2014 (Japan, Nara, 2014-05-26 - 2014-05-30)

Using Industrial Standard FMC Carrier for Measurement Applications
M. Fenner, H.-T. Duhme, M. Killenberg, **S. Korolczuk**, D. Makowski, K. Przygoda, **J. Szewiński**, R. Wedel
19th Real-Time conference , RT2014 (Japan, Nara, 2014-05-26 - 2014-05-30)

MMC Implementation for the MTCA Devices Used in X-FEL
J. Szewiński, U. Mavric, H. Schlarb
Topical Workshop on Electronics for Particle Physics, TWEPP 2014 (France, Aix en Provence, 2014-09-22 - 2014-09-26)

Study of neutron-gamma Discrimination by Zero-Crossing Method with SiPM Based Scintillation Detectors
M. Grodzicka, **T. Szczęśniak**, **M. Moszyński**, **D. Wolski**, **L. Swiderski**, **S. Korolczuk**, J. Baszak
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

Characterization of TSV MPPC Arrays (4x4 ch and 8x8 ch) in Scintillation Spectrometry
M. Grodzicka, **T. Szczęśniak**, **M. Moszyński**, **S. Korolczuk**, **M. Kapusta**, J. Baszak
IEEE NSS-MIC 2014 (USA, Seattle, 2014-11-08 - 2014-11-15)

DIDACTIC ACTIVITY

T. Batsch - Participation in the development of a series of popular films in the field of astrophysics.

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

Z. Guzik
POLSKIE NORMY, POLISH STANDARDS Polish Stanardization Committee
Member of Scientific Council in National Centre of Nuckear Research

PERSONNEL

Scientific staff:

Tadeusz Batsch, PhD
Stanisław Borsuk, MSc Eng
Arkadiusz Chłopik, MSc Eng
Michał Gierlik, PhD
Marcin Gosk, M.Eng.
Zbigniew Guzik, Assoc. Prof.
Łukasz Kaźmierczak, MSc
Tomasz Kaźmierczak MSc
Stefan Korolczuk, MSc Eng
Tomasz Krakowski, MSc
Ignacy Kudła, MSc Eng
Dominik Rybka, MSc Eng
Jarosław Szewiński, MSc Eng
Arkadiusz Urban

Technical and administrative staff:

Krzysztof Leśniewski
Maciej Sitek
Agata Szubińska

PLASMA STUDIES DIVISION

Head of Division: Jarosław Żebrowski, PhD
phone: +48 22 2731611
e-mail: Jaroslaw.Zebrowski@ncbj.gov.pl

Overview

In 2014 the research activities of the Plasma Studies Division (TJ5) were devoted to two main tasks:

- Studies of fast electrons, ions, neutrons, and X-ray emissions within different research facilities of the PF-, RPI-, ICF- and Tokamak-type by means of different diagnostic techniques;
- Investigations of high-temperature plasma streams and their interactions with solid targets.

In 2014 some novel studies, to determine the conditions of runaway electron generation and to investigate mitigation techniques, were started under the leadership of the IPP AS CR in Prague as part of the one of MST-2 projects carried out within the framework of the EUROfusion Consortium. Two single-channel measuring heads with Cherenkov-type radiators, made of aluminium nitride (AlN) or diamond, were prepared for experimental studies at the COMPASS tokamak. The measuring head with the AlN radiator was installed within the COMPASS facility and during the experimental session some runaway electrons were observed at a discharge disruption.

As regards applications of solid-state nuclear track detectors (SSNTDs) for studies of fast ions and fusion reaction products, the TJ5 team was involved in measurements of angular distributions and energy spectra of fast primary protons and energetic alpha particles at the PALS laser facility, which were obtained from $^{11}B + p \rightarrow 3\alpha + 8.7$ MeV nuclear reactions. In 2014 some studies were also performed to determine so-called mean grey-level values of tracks produced in PM-355 by fast protons, deuterons and alpha particles. In addition, the influence of soft X-ray radiation on craters formed in SSNTD was investigated in detail.

Studies of X ray, ion and neutron-emission from plasmas in experimental facilities of the RPI- and PF-type were continued. Withinthe framework of the scientific collaboration with the IFPiLM in Warsaw and CVUT in Prague an investigation of the neutron emission from D-D fusion reactions in the PF-1000U facility at the pulsed injection of deuterium was performed. Many efforts were also devoted to measurements of pulsed beams of fast ions emitted from the PF-1000U facility. Use was made of the new technique of so-called “sandwich detectors” which enabled the simultaneous recording of fast protons and images produced by fast neutrons (by recoil protons from an apprpriate converter).

In 2014 the national programme concerning the “Studies and development of technology for controlled thermonuclear fusion“ was finalized. Significant improvements in the construction and the final assembling of two measuring heads were completed. These heads were designed for recording high-energy ions, including products of D-D and D-T nuclear fusion reactions at conditions occurring within a tokamak scrape-off layer. Detailed laboratory tests of these heads have been carried out within plasma facilities available at the NCBJ. The second task of the described programme, which concerned the technical modernization of the PF-360 facility, was also succesfully finalized.

As regards investigations of pulsed plasma streams, most effort was devoted to a new investigation of the behaviour of silicon carbide (SiC) samples, which were irradiated by intense plasma streams within a modified PF-1000U facility at the IPPLM and PF-360U facility at NCBJ. Another task was optical emission spectroscopy of plasma streams generated within the PF-1000U facility with and without the use of additional gas-puffing. On the basis of the D_{alpha} line profile it was possible to determine changes in the electron concentration at different phases of the investigated discharges.

Jarosław Żebrowski

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Comments on results of recent high-temperature plasma studies at NCBJ (former IPJ) in Poland
M.J. Sadowski
International Conference and School on Plasma Physics and Controlled Fusion (ICPPCF-2014) (Ukraine, Kharkov, 2014-09-15 - 2014-09-18)

Optical and X-ray emission spectroscopy of high-current pulse discharges of the Plasma-Focus type
M.J. Sadowski
Atomic Data and Analysis Structure (ADAS) Workshop 2014 (Poland, Warszawa, 2014-09-29 - 2014-09-30)

Results of recent dense magnetized plasma studies by the NCBJ team, Poland
M.J. Sadowski, **E. Składnik-Sadowska**, **R. Kwiatkowski**, **K. Malinowski**, **K. Nowakowska-Langier**, **J. Żebrowski**, **K. Czaus**, **W. Surała**, **D. Załoga**, M. Kubkowska, M. Paduch, E. Zielińska, P. Kubes, I. Garkusha, V. Makhlay, M. Ladygina
Annual Meeting and Workshop ICDMP-2014 (Poland, Warsaw, 2014-10-10 - 2014-10-11)

Neutron production at compression of deuterium and neon in plasma focus discharges
P. Kubes, D. Klir, J. Kravarik, K. Rezac, J. Cikhardt, J. Kortanek, B. Batobolotova, M. Paduch, E. Zielinska, **W. Surała**, **M.J. Sadowski**
Annual Meeting and Workshop ICDMP-2014 (Poland, Warsaw, 2014-10-10 - 2014-10-11)

Ważne problemy przyszłych reaktorów termojądrowych
M.J. Sadowski
Konferencja Polski Mix Energetyczny PME-2014 (Poland, Ustroń, 2014-10-15 - 2014-10-17)

Selected methods of electron- and ion-diagnostics in tokamak scrape-off layer
M.J. Sadowski
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Oral Presentation

Research on interactions of intense deuterium plasma streams with SiC targets in Plasma-Focus experiments
E. Składnik-Sadowska, **R. Kwiatkowski**, **K. Malinowski**, **M.J. Sadowski**, **K. Czaus**, **D. Załoga**, **J. Żebrowski**, **K. Nowakowska-Langier**, M. Kubkowska, M. Paduch, M. Scholz, E. Zielinska, M.S. Ladygina, I.E. Garkusha, V.A. Gribkov, E.V. Demina, S.A. Maslyaev, V.N. Pimenov
International Conference and School on Plasma Physics and Controlled Fusion (ICPPCF-2014) (Ukraine, Kharkov, 2014-09-15 - 2014-09-18)

Characterization of Solid State Nuclear Track Detectors of the CR-39/PM-355 type for light charged particle spectroscopy
A. Malinowska, **M. Jaskóła**, **A. Korman**, **A. Szydłowski**, **M. Kuk**
26th International Conference on Nuclear Tracks in Solids (26ICNTS) (Japan, Kobe, 2014-09-15 - 2014-09-19)

High power plasma interaction with tungsten grades
I.E. Garkusha, V.A. Makhlaj, N.N. Aksenov, O.V. Byrka, S.V. Malykhin, A.T. Pugachov, B. Bazylev, I. Landman, G. Pinsuk, J. Linke, M. Wirtz, **M.J. Sadowski**, **E. Składnik-Sadowska**
21 IEAE Technical Meeting on Research Using Small Fusion Devices (Costa Rica, San Jose, 2014-01-27 - 2014-01-29)

Charged projectile spectrometry using the CR-39/PM-355 type of solid state nuclear track detector
A. Malinowska, **M. Jaskóła**, **A. Korman**, **A. Szydłowski**, **M. Kuk**
NUTECH-2014 - International Conference on Development and Applications of Nuclear Technology (Poland, Warszawa, 2014-09-21 - 2014-09-24)
Nukleonika (in press)

Study of tungsten surface interaction with plasma streams at DPF-1000U
M.S. Ladygina, **E. Składnik-Sadowska**, **D. Załoga**, **K. Malinowski**, **M.J. Sadowski**, M. Kubkowska, E. Kowalska-Strzeciwilk, M. Paduch, E. Zielinska, R. Miklaszewski, I.E. Garkusha, V.A. Gribkov
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Comparison of optical spectra recorded during DPF-1000U plasma experiments with gas-puffing
D. Załoga, **E. Składnik-Sadowska**, M. Kubkowska, M. Ladygina, **K. Malinowski**, **R. Kwiatkowski**, **M.J. Sadowski**, M. Paduch, E. Zielinska, V.A. Makhlaj
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Recent ion measurements within the modified DPF-1000U facility
R. Kwiatkowski, **K. Czaus**, **E. Składnik-Sadowska**, **M.J. Sadowski**, **D. Załoga**, M. Paduch, E. Zielinska
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Recent measurements of soft X-ray emission from the DPF-1000U facility
W. Surała, **M.J. Sadowski**, M. Paduch, E. Zielinska, K. Tomaszewski
12th Kudowa Summer School (Poland, Kudowa Zdrój, 2014-06-09 - 2014-06-13)

Poster

Research on anisotropy of fusion-produced protons and neutrons emission from high-current plasma-focus discharges
K. Malinowski, **E. Składnik-Sadowska**, **M.J. Sadowski**, **A. Szydłowski**, **K. Czaus**, **R. Kwiatkowski**, **D. Załoga**, M. Paduch, E. Zielińska
26th International Conference on Nuclear Tracks in Solids (Japan, Kobe, 2014-09-15 - 2014-09-19)

Cherenkov emission provides detailed picture of non-thermal electron dynamics in the presence of magnetic islands
F. Causa, G. Pucella, P. Buratti, E. Giovannozzi, B. Esposito, **L. Jakubowski**, **K. Malinowski**, **M. Rabiński**, **M.J. Sadowski**, **J. Żebrowski**, FTUTeam
25th Fusion Energy Conference (FEC 2014) (Russia, Saint Petersburg, 2014-10-13 - 2014-10-18)

Dosimetry in radiobiological studies with heavy ion beam of the Warsaw cyclotron
U. Kaźmierczak, D. Banaś, J. Braziewicz, J. Czub, **M. Jaskóła**, **A. Korman**, M. Kruszewski, A. Lankoff, H. Lisowska, **A. Malinowska**, T. Stępkowski, Z. Szefliński, M. Wojewódzka
19th International Conference on Ion Beam Modification of Materials (Belgium, Leuven, 2014-09-14 - 2014-09-19)
Nucl. Instr. and Meth. B (2015)

Influence of soft X-ray radiation on the parameters of tracks induced in CR-39 and PM-355 solid state nuclear track detectors
A. Szydłowski, **A. Malinowska**, **M. Jaskóła**, K. Szewczak, **A. Korman**, M. Paduch, **M. Kuk**
26th International Conference on Nuclear Tracks in Solids (Japan, Kobe, 2014-09-15 - 2014-09-19)
Radiat. Meas. (in press)

Spectroscopic studies of plasma streams generated in a 1-MJ Plasma-Focus facility with and without gas-puffing
M.S. Ladygina, **E. Składnik-Sadowska**, **R. Kwiatkowski**, **K. Malinowski**, **M.J. Sadowski**, **D. Załoga**, **J. Żebrowski**, M. Kubkowska, M. Paduch, M. Scholz, E. Zielinska, I.E. Garkusha, V.A. Makhlaj
International Conference and School on Plasma Physics and Controlled Fusion (ICPPCF-2014) (Ukraine, Kharkov, 2014-09-15 - 2014-09-18)

LECTURES, COURSES AND EXTERNAL SEMINARS

Report on realization of an NCBiR project \[a]
M.J. Sadowski
Warsaw, Warsaw Technical University, 2014-02-06

Myths of Chernobyl[a]
M. Rabiński
Gdansk, Gdansk University of Technology, 2014-04-10

a) in Polish

INTERNAL SEMINARS

Studies of hot plasmas: The most important experiments and prospects of thermonuclear energetics[a]
M.J. Sadowski
Otwock-Swierk, National Centre for Nuclear Research (NCBJ), 2014-02-20

About prospects of the use of energy from controlled nuclear fusion reactions[a]
M.J. Sadowski
Warsaw, High Energy Physics Division at NCBJ, 2014-02-28

The most important experiments and theoretical issues of research on controlled nuclear fusion[a]
M.J. Sadowski
Warsaw, Theoretical Physics Division at NCBJ, 2014-05-13

a) in Polish

DIDACTIC ACTIVITY

M. Rabiński - Lectures on "Thermonuclear Fusion" - postgraduate studies in Nuclear Engineering, Warsaw University of Technology

M.J. Sadowski - Superiviser of a Ph.D. thesis of Kamil Szewczak, entitled "Estimates of radiation hazards during fusion research at the PF-1000 facility"; Ph.D. process opened at NCBJ on 5 February 2013; the thesis under final editorial corrections

M.J. Sadowski - Superviser of a Ph.D. thesis of Roch Kwiatkowski, entitled "Analysis of results of recent measurements of ions, electrons and visible radiation from plasma within PF-360 and PF-1000 facilities", the thesis under review

M.J. Sadowski - Superviser of Ph.D. courses of Dobromil Zaloga (III year)

M.J. Sadowski - Superviser of Ph.D. courses of Wladyslaw Surala (IV year)

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

A. Malinowska
Session chairman on Nutech-2014Development and Applications of Nuclear Technologies in Warsaw, Poland
International Nuclear Track Society, member
Plasma Physics Section of the Committee of Physics at the Polish Academy of Sciences

M. Rabiński
Member of the Board of the Polish Nuclear Society, Head of the Information Committee
Member of the European Nuclear Society
Member of the Board of the Environmentalists for Nuclear Energy - Poland (treasurer)
Polish Physical Society
Postępy Techniki Jądrowej, Member of the Editorial Board of the Advances of Nuclear Technique, National Atomic Energy Agency
Ekoatom, "Ecoatom" - Environmentalists for Nuclear Energy - Poland
member of Scientific Council

M.J. Sadowski
Member of the European Physical Society (Plasma Physics Division)
Fellow of the Institute of Physics, London, UK
Member of the Polish Physical Society (PPS), since 2012 - Chairman of Plasma Physics Section at PPS
Member of the Polish Society of Applied Electromagnetics
Physica Scripta, IOP on behalf of the Royal Swedish Academy of Sciences
Member of the Scientific Council, National Centre for Nuclear Research
Honorary Chairman of the Scientific Council, Institute of Plasma Physics and Laser Microfusion

A. Szydłowski
International Nuclear Track Society, member

PERSONNEL

Bigolas Krztszto
Krzysztof Czaus, B.Sc.E.E.
Krzysztof Gątarczyk
Alicja Gawrońska
Marcin Jakubowski
Lech Jakubowski, PhD
Marek Jędrzejczyk
Paweł Karpiński
Roch Kwiatkowski, MSc
Aneta Malinowska, PhD
Karol Malinowski, MSc
Kamil Namyślak, MSc
Marek Rabiński, PhD
Marek Sadowski, Professor
Elżbieta Składnik-Sadowska, PhD
Adam Szydłowski, PhD
Jarosław Żebrowski, PhD

NUCLEAR EQUIPMENT DIVISION - HITEC

Director of Centre: Paweł Krawczyk, PhD
phone: +48 22 2732102
e-mail: p.krawczyk@ncbj.gov.pl

Overview

The Division of Nuclear Equipment - HITEC specializes in applications of accelerator technologies in medicine and industrial radiography. It combines research and development with manufacturing activities.

The year 2014 was a busy time for HITEC, with great promise for the future. In the middle of the year, HITEC finalized R&D work in the framework of Project No. POIG.01.01-14-012/08-00 (known under the short name of *Accelerators and Detectors*) funded by EU Structural Funds. These efforts were concentrated on the second model of a multi-energy medical accelerator for advanced radiotherapy and on the implementation of the highly specialized treatment techniques both for it and for the earlier manufactured first model. As planned, in the second half of the year, HITEC started to build a full commercial prototype of a low energy medical accelerator Coline 6, derived from the first model.

The work initiated in the *Accelerators and Detectors* project were also continued for a mobile accelerator for intra-operative radiation therapy, INTRALINE, within a new project *INTRA-DOSE*, funded by NCBiR in the framework of the *Applied Research* call. *INTRA-DOSE* is a collaborative effort that involves Wielkopolskie Centrum Onkologii as well as commercial partners. The aim of the project is to develop a complete, ready for commercialization, intra-operative radiotherapy system with functionality fitting the needs of medical users. HITEC work on *INTRA-DOSE* was concentrated in 2014 on optimization of accelerator components and on designing a new lightweight mechanical structure that will enhance the mobility of the system.

The *4LABs* project (Project No. RPMA.01.01.00-14-030/10-00, co-funded by EU Regional Development Funds) allowed HITEC significantly to upgrade its infrastructure. In 2014 the construction of a new building for the Accelerating Structure Laboratory was finished. The Laboratory includes 2 new bunkers capable of housing high energy (up to 18 MeV) medical accelerators. It will greatly improve HITEC`s research and development capabilities in the area of linear accelerators. The Laboratory will be ready for use after the installation of the R&D instruments and equipment, in the first half of 2015.

Also within the *4LABs* project, HITEC started to build advanced equipment for the Radiographic Laboratory: a radiographic system based on a newly developed linear accelerator. As with other development of linear accelerators, this work was done in collaboration with NCBJ TJ1 Division. It will be continued throughout the first months of 2015.

HITEC continued the manufacture of PI-Mode Structure (PIMS) accelerating cavities for Linac 4 in the framework of a Collaboration Agreement with CERN aimed at upgrading the performance of the CERN Large Hadron Collider (LHC). The progress achieved so far should allow us to achieve the desired delivery schedule of one structure a month in 2015.

Under another Collaboration Agreement signed with CERN in 2014, HITEC will design, manufacture and deliver a specialized linear accelerator intended for use by the GBAR experiment, aimed at measuring the gravitational behaviour of antimatter. This ambitious project will involve extensive development work (together with TCBJ TJ1 Division) and, upon successful installation of the accelerator, participation of NCBJ researchers in the experiment.

It is also worth mentioning that in 2014 HITEC delivered to a foreign customer a fully integrated, accelerator based digital radiography system. HITEC specialists were also contracted to perform vacuum installation for the SOLARIS synchrotron system at Narodowe Centrum Promieniowania Synchrotronowego in Kraków.

Paweł Krawczyk

5. EDUCATION AND TRAINING DIVISION

Head of Division: Professor Ludwik Dobrzyński
phone: +48 22 2731570
e-mail: Ludwik.Dobrzynski@ncbj.gov.pl

Overview

The Department of Education and Training leads a number of activities. A summary of its work and achievements in 2014 may be presented as follows:

- 6800 visitors from high-schools, 25 universities, governmental and scientific institutions from many cities and villages were served by the Department. The ages of our visitors ranged from about 12 to 85 years. An especially demanding visit by blind children from the high-school in Laski near Warsaw should be particularly mentioned.

- The fortieth anniversary of the MARIA reactor was celebrated. Six distinguished scientists from abroad, specialists in the use of experimental reactors, took part in a seminar dedicated to this event. A special photo-exhibition "From EWA to MARIA" was prepared and exhibited during the seminar, which was mainly organised by the Department.

- 2 scientific papers were published and another 2 accepted in peer-reviewed, internationally renowned journals. Our personnel delivered 5 invited talks during international and all-Poland conferences.

- Our PhD student (M. Pylak) obtained the PhD degree for his dissertation on the momentum and spin density distributions in gadolinium. The dissertation was prepared under the guidance of prof. L. Dobrzyński.

- Training courses were organized for students and employees of NCBJ. Increased activity by our staff at so called Children's Universities, bringing together children below the age of about 12 years, should also be noted.

- The Department was heavily involved in the Project "A school with a future" (a special additional training course for science teachers). The project, which commenced at the end of 2014, resulted in the preparation of a textbook "The Basics of Nucleonics" dedicated to technicians and teachers. In addition the Department took part in a joint Japan-France-Belarus-Poland project consisting of measuring the level of radiation in various places. The measurements were carried out by high-school students who used special monitors (D-Shuttle) constructed by our Japanese colleagues. The results will be published in an internationally known journal.
- A web-page http://ncbj.edu.pl was prepared.

- As usual, the Department participated actively in the Science Picnic and Science Festival in Warsaw.

- Organization of the competition "The Paths of Physics" was continued. This was the 10th edition of this competition.

- The Department was also represented (L. Dobrzyński as alternate of the Polish Delegate) in UNSCEAR; L. Dobrzyński served as an expert in the preparation of the report on the Fukushima event by the IAEA.

Ludwik Dobrzyński

REPORTS

UNSCEAR 2013 REPORT, vol. II, Effects of radiation exposure of children
L. Dobrzyński, ... , ... et al.
United Nations

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Lessons with consequences
L. Dobrzyński
3rd European Nuclear Briefing 2014 (Poland, Warszawa, 2014-10-14 - 2014-10-15)

Low level radiation effects on human health
L. Dobrzyński
VIIth International School on Nuclear Power (Poland, Warszawa, 2014-11-04 - 2014-11-07)

Wielkie katastrofy w przemyśle jądrowym
L. Dobrzyński
Ogólnopolska Konferencja Młodych Elektryków (Poland, Gdańsk, 2014-10-23 - 2014-10-26)

Wpływ innowacyjnych technologii na zarządzanie bezpieczeństwem państwa
M.P. Sadowski, **E. Jamrozy**
Inżynieria bezpieczenstwa a zagrożenia cywilizacyjne (Poland, Częstochowa, 2014-10-08 - 2014-10-10)
Częstochowa No. (2014)

O katastrofach w przemyśle jądrowym
L. Dobrzyński
Inżynieria bezpieczenstwa a zagrożenia cywilizacyjne (Poland, Częstochowa, 2014-10-08 - 2014-10-10)

LECTURES, COURSES AND EXTERNAL SEMINARS

How to survive a multimedia presentation?, Part I (presentation design)[a]
M.P. Sadowski
Warszawa, Wydział Fizyki, Uniwersytet Warszawski, 2014-02-25

How to survive a multimedia presentation?, Part II (presentation graphic, body language)[a]
M.P. Sadowski
Warszawa, Wydział Fizyki, Uniwersytet Warszawski, 2014-03-05

Developing the future professions for the Polish economy[a]
M.P. Sadowski
Warszawa, Mazowieckie Samorządowe Centrum Doskonalenia Nauczycieli, 2014-11-13

Developing the future professions for the Polish economy[a]
M.P. Sadowski
Płock, Mazowieckie Samorządowe Centrum Doskonalenia Nauczycieli, 2014-11-20

Paper physicist[a]
M.P. Sadowski

Józefów, Nadwiślański Uniwersytet Dziecięcy, 2014-11-29

Developing the future professions for the Polish economy[a]
M.P. Sadowski
Ostrołęka, Mazowieckie Samorządowe Centrum Doskonalenia Nauczycieli, 2014-12-02

Physicist at the wintering grounds[a]
M.P. Sadowski
Warszawa, Bródnowski Uniwersytet Dziecięcy, Domu Kultury „Świt", 2014-03-08

The energy around us[a]
M.P. Sadowski
Józefów, Nadwiślański Uniwersytet Dziecięcy, 2014-06-07

Calendar and Time[a]
M.P. Sadowski
Warszawa, XVIII Festiwal Nauki w Warszawie, 2014-09-27

The energy around us[a]
M.P. Sadowski
Świerk, Nadwiślański Uniwersytet Dziecięcy, 2014-12-01

a) in Polish

INTERNAL SEMINARS

Biologic effects of ionizing radiation[a]
L. Dobrzyński
Częstochowa, Jan Dlugosz Academy, 2014-04-23

a) in Polish

DIDACTIC ACTIVITY

Ł. Adamowski - Lectures about nuclear reactors at "Szkoła Z Przyszłością" popularizing conferences in Warsaw and Płock.

Ł. Adamowski - Lectures and exercises at the training of fire service.

Ł. Adamowski - Lectures for visitors in NCBJ Department of Education and Training.

L. Dobrzyński - Leading professional courses for accelerators' operators (type A-A)

L. Dobrzyński - Leading the courses on radiation protection for NCBJ's employees

L. Dobrzyński - Lectures on basis of radiation physics, physics and technology of nuclear reactors

L. Dobrzyński - PhD Thesis by Maciej Pylak, MSc Eng. (with distinction)

M. Kirejczyk - Delivering lectures on "Physical Basis of Radioprotection" and "Basics of Accelerator Physics" on AA training for employees of Customs Service and NCBJ

M. Kirejczyk - Delivering lectures on "Physical Basis of Radioprotection" and "Biological Effects of Ionising Radiation" for employees of NCBJ (training for category A and B employees).

M. Kirejczyk - Lectures for pupils, students and other guests visiting DEiS NCBJ

M. Kirejczyk - Training for pupils visiting teaching lab DEiS NCBJ

M. Marcinkowska-Sanner - Laboratory classes for high school students.

M. Marcinkowska-Sanner - Lectures for visitors in National Centre for Nuclear Reasearch (Department of Education and Trainings).

M. Marcinkowska-Sanner - Training for Fire Service (12 V - 14 V 2014) - prepation and teaching.

M.P. Sadowski - Lectures and classes for students, youth and other visitors to the Department of Education and Training

R. Wołkiewicz - Teaching firemans in laboratory DEiS NCBJ.

R. Wołkiewicz - Teaching on conferance "Szkoła z Przyszłością"

R. Wołkiewicz - Teaching students in NCBJ

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

L. Dobrzyński
Physica Scripta, Ohysica Scripta, Institute of Physics
Adviser of the Polish Delegation to UNSCEAR, alternate of the delegate of Polish delegation since 2011
Polish Atomic Agency, member of the Advisory Board, Chairman of the Commission of Social Education and Information
National centre for Nuclear Research

M.P. Sadowski
Polish Physical Society
National Club of Physics Demonstrators

K. Żuchowicz
BIULETYN NCBJ, Bulletin National Centre for Nuclear Research

PERSONNEL

Ludwik Dobrzyński Professor
Ewa Droste, MSc (2/5)
Łukasz Adamowski, MSc Eng
Marek Matych
Robert Wołkiewicz (2/5 from 01.09.2013)
Maciej Pylak, MSc Eng. – PhD student
Grażyna Swiboda, MSc
Anna Szubińska,
Gabryela Kosicka
Marek Kirejczyk, PhD
Maja Marcinkowska-Sanner, MSc
Marcin Sadowski, MSc
Marcin Sierpiński, MSc (4/5)
Władysław Szymczyk, PhD (3/5)
Krzysztof Masłowski, MSc

6. RADIOISOTOPE CENTRE POLATOM

Director of Centre: Eng.Dariusz Socha, PhD
phone: +48 22 273 1700
e-mail: d.socha@polatom

Overview

The Radioisotope Centre POLATOM is a self-contained unit of the National Centre for Nuclear Research engaged in scientific research and development in the field of the use of radioisotopes in nuclear medicine, industry and science and the production of radiopharmaceuticals and radioactive sources.

The history of POLATOM's operations dates back to the 1950's. In 1957, at the then Institute of Nuclear Research in Świerk near Warsaw, Ewa, the first research reactor in Poland, was commissioned. This was the beginning in Poland of activities related to the development of methods for obtaining isotopes and radioactive preparations. Further opportunities for development came in 1974, with the launching of Maria, another research reactor with which POLATOM's activities have been inextricably connected up to the present day.

Currently, POLATOM combines basic scientific statutory objectives and the successful commercialisation of its own potential and research achievements. In the scientific arena it is a leading centre in Poland for interdisciplinary research in the field of the production of radioactive preparations. The main areas of POLATOM's research activities include nuclear chemistry, radiochemistry, the physical chemistry of radioactive elements, analytical chemistry, biochemistry and the metrology of ionising radiation. POLATOM carries out intensive scientific cooperation in Poland and abroad, taking part in international projects and research programmes. Research and development are primarily oriented towards applications and often lead to the implementation of innovative products and technologies. The vast majority of commercial products on offer, including approximately 150 items, are the result of our own work.

In recent years POLATOM has launched the manufacture of several innovative products, among them a ^{99m}Tc-Tektrotyd radiopharmaceutical kit for diagnostic imaging of tumours expressing somatostatin receptors useful in oncology, or ItraPol (^{90}Y) and LutaPol (^{177}Lu) as radiopharmaceutical precursors for radiolabelling of peptides and other biomolecules for cancer therapy.

POLATOM is a world famous supplier of high quality radiopharmaceuticals and diagnostic kits for nuclear medicine and an important manufacturer of radiochemical products for customers all over the world. Products are exported to more than 70 countries.

POLATOM's current commercial package includes:

- A wide range of scintigraphic kits for ^{99m}Tc labelling for the examination of organs and cancer diagnoses,
- Preparations of radioactive iodine-131 for the diagnosis and treatment of thyroid diseases,
- Preparations for the palliative treatment of bone metastases,
- Radionuclide ^{99}Mo/^{99m}Tc generator,
- Precursors for the preparation of therapeutic radiopharmaceuticals,
- Ophthalmic applicators for brachytherapy,
- Industrial sealed sources,
- Radioactive standard solutions,
- Radiochemical reagents,
- A wide range of special customised radioactive preparations,
- Accessories for nuclear medicine units,
- The calibration and servicing of dose calibrators,
- The installation and maintenance of isotopic equipment,
- The handling and transportation of radioactive materials.

POLATOM's activities in all areas meet European and international standards; with regard to its quality-assurance system, POLATOM holds the PN-EN/ISO 9001:2009 Certificate of Compliance and with regard to trading of dual use items and technology, the Internal Control System Certificate. Its standard of radiopharmaceutical production is confirmed by the GMP Certificate and its qualifications as an ionising radiation metrology laboratory are confirmed by the Calibration Laboratory Accreditation Certificate in compliance with PN-EN/ISO 17025:2005.

Dariusz Socha

REPORTS

Estimation of radiological protection on the territory of Nuclear Centre Świerk and its vicinity (2013).
B. Filipiak, ... , **Z. Haratym**, **J. Ośko**, **T. Pliszczyński**, **B. Snopek**, **B. Boimski**, **S. Domański**, **M. Dymecka**, **R. Ejsmont**, **M. Feczko**, **A. Garboliński**, **B. Karpińska**, **J. Lechniak**, **A. Pawełczuk**, **G. Pindara**, **B. Piotrkowicz**, **K. Rzemek**, **R. Sosnowiec**, **W. Śniegoń**, **M. Umaniec**, **K. Wiśniewska**, **K. Wojdowska**, **J. Wojnarowicz**, **Z. Worch**, **M. Tulik**, **D. Zielińska**, ... et al.
NCBJ

State and perspectives of development of metrology as a branch of science (in a global scale).
J. Gajda, ... , **R. Broda**, ... et al.
Committee on Metrology and Scientific Instrumentation, Polish Academy of Sciences, Zielona Góra

PARTICIPATION IN CONFERENCES AND WORKSHOPS

Invited Talk

Novel Radionuclide Production at POLATOM
R. Mikołajczak
8-th International Conference on Isotopes and Expo, ANS Conference (USA, Chicago, 2014-08-24 - 2014-08-28)

Radiometals in PET diagnostics
R. Mikołajczak
II Symposium on Positron Emission Tomography (Poland, Kraków, 2014-09-21 - 2014-09-24)

Oral Presentation

Production options and capacity for 47Sc and 46Sc
R. Mikołajczak
COST TD1004 Theragnostic Imaging and Therapy: An Action to Develop Novel Nanosized Systems for Imaging-Guided Drug Delivery, meeting of WG1: Imaging reporters for theranostic agents (Poland, Warsaw, 2014-07-12 - 2014-07-12)

Accelerator-based alternatives to non-HEU production of $^{99}Mo/^{99m}Tc$
R. Mikołajczak, **I. Cieszykowska**, **D. Pawlak**, **T. Janiak**, **W. Wojdowska**, **K. Jerzyk**, **M. Mielcarski**, **J.L. Parus**
Conference on Development and Applications of Nuclear Technology (Poland, Warsaw, 2014-09-21 - 2014-09-24)

Fizyko-chemiczna oraz radiochemiczna charakterystyka kompleksów analogu DOTA-Gastryny **(CP04) z radiometalami**
M. Maurin, **D. Pawlak**, **P. Garnuszek**, **A. Jaroń**, N. Matzler-Nolte, R. Stoll, **R. Mikołajczak**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Overall lecture WG1: Imaging reporters of theranostic agents
R. Mikołajczak
Annual Meeting of COST TD1004, Theranostic Imaging and Therapy: An Action to Develop Novel Nanosized Systems for Imaging-Guided Drug Delivery (Turkey, Istanbul, 2014-10-03 - 2014-10-04)

TD1004 Theragnostic Imaging and Therapy: An Action to Develop Novel Naosized Systems for Imaging-Guided Drug Delivery
R. Mikołajczak
COST DC Chemistry and Molecular Sciences and Technologies, 8th Annual Progress Conference & 24th DC Meeting (Iceland, Keflavik, 2014-05-14 - 2014-05-16)

Nowości w ofercie Ośrodka Radioizotopów POLATOM
U. Karczmarczyk
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Physico-chemical and radiochemical characteristic of DOTA-(DGlu)$_6$-gastrin (CP04)complexes with radiometals
M. Maurin, **P. Garnuszek**, P. Baran, **D. Pawlak**, N. Matzler-Nolte, R. Stoll, **R. Mikołajczak**
2nd International Symposium on Functional Metal Complexes that Bind to Biomolecules.3rd Whole Action Meeting of the COST Action CM1105 (Switzerland, Zurich, 2014-08-22 - 2014-08-23)
COST Action CM1105 No. (2014)

Synteza nowych pochodnych nortropanu jako potencjalnych prekursorów do otrzymywania radioznacznika [18F]FECNT
J. Pijarowska-Kruszyna, **A. Jaroń**, A. Kachniarz, K. Kasprzak, A. Kowalska, B. Małkowski, S. Demphel, F. Dolle, **R. Mikołajczak**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Quality Control of the Radiopharmaceutical Precursors ItraPol ($^{90}YCl_3$) and LutaPol ($^{177}LuCl_3$) Produced at POLATOM.
P. Garnuszek, **A. Markiewicz**, **D. Pawlak**, **A. Filiks**, **I. Sasinowska**, **T. Dziel**, **M. Korytkowski**, **R. Mikołajczak**
8-th International Conference on Isotopes and Expo, ANS Conference (USA, Chicago, 2014-08-24 - 2014-08-28)

Czy potrzebujemy badania PET/CT z 18FDG do kwalifikacji pacjentów do terapii znakowanymi analogami somatostatyny (PRRT)
J. Kurnikowska, **D. Pawlak**, B. Kos-Kudła, T. Bednarczuk, **R. Mikołajczak**, L. Królicki
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

99mTc-Glucagon-like Peptide 1 (99mTc-GLP-1) scintigraphy - results of 3 years\' experience.
A. Sowa-Staszczak, A. Stefańska, M. Tomaszuk, M. Buziak-Bereza, M. Trofimiuk-Muldner, A. Jabrocka-Hybel, M. Małecki, T. Bendarczuk, G. Kamiński, A. Kowalska, **R. Mikołajczak**, **B. Janota**, A. Hubalewska-Dydejczyk
Annual Congress of the European Association of Nuclear Medicine (Sweden, Gothenburg, 2014-10-18 - 2014-10-22)

Wstępne badanie klinicznego użycia radioembolizacji za pomocą 188Re-Human Serum Albumin(HSA) mikrosfer u chorych na progresywną, nieresekcyjną postać pierwotnych lub wtórnych nowotworów złośliwych wątroby
M.L. Nowicki, A. Sankowski, **D. Pawlak**, **R. Mikołajczak**, S. Shcherbinin, J. Grimes, A. Celler, A. Bator, J.B. Ćwikła
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Scynografia analogiem GLP-1 znakowanym 99mTc oraz 111In - 3 lata doświadczeń
A. Hubalewska-Dydejczuk, **R. Mikołajczak**, **B. Janota**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Wartość kliniczna badania scyntygrafii receptorów somatostatyny w technice całego ciała(WB) SPECT 99mTcHYNICTOC (Tektrotyd), w diagnostyce chorych na dobrze zróżnicowane nowotwory neuroendokrynne układu pokarmowego (GEN-NEN)
J.B. Ćwikła, A. Lewczuk, E. Wachuła, **D. Pawlak**, **B. Janota**, **R. Mikołajczak**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Przypadkowo wykryte zmiany w tarczycy w badaniu PET/CT z 68Ga-DOTATATE u pacjentów diagnozowanych z powodu nowotworu neuroendokrynnego
J. Kunikowska, **D. Pawlak**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Preliminary radiochemical studies with the ^{64}Cu-labelled complex from the ligand 2-tert-butyl-6-(pyridine-2-yl-hydrazonomethyl) phenol (HL-1)
D. Kłudkiewicz, **M. Maurin**, **P. Garnuszek**, Anne-KatrinBachon, PatrickGamez, **R. Mikołajczak**
2nd International Symposium on Functional Metal Complexes that Bind to Biomolecules.3rd Whole Action Meeting of the COST Action CM1105 (Switzerland, Zurich, 2014-08-22 - 2014-08-23)

Blood clearance of Exendin-4 labeled with ^{99m}Tc,^{111}In and ^{68}Ga in comparative biological studies
B. Janota, **P. Garnuszek**, **U. Karczmarczyk**, **R. Mikołajczak**
17th European Symposium on Radiopharmacy and Radiopharmaceuticals (Spain, Pamplona, 2014-04-24 - 2014-04-27)

Role of 68Ga_DOTATATE PET/CT in evaluation of patient with lung neuroenocrine tumors
K. Kunikowska, R. Matyskiel, A. Zemczak, **D. Pawlak**, L. Krolicki
Annual Congress of the European Association of Nuclear Medicine (Sweden, Gothenburg, 2014-10-18 - 2014-10-22)

Immunoreaktywność przeciwciała anti-CD20 chelatowanego DOTA do znakowania ^{90}Y i ^{177}Lu
A. Sawicka, **W. Wojdowska**, **U. Karczmarczyk**, **M. Maurin**, **E. Byszewska**, **R. Mikołajczak**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Development and preclinical evaluation of therapeutic radiopharmaceuticals based on Lu-177 and Y-90 labelled monoclonal antibodies and peptides
W. Wojdowska, **U. Karczmarczyk**, **M. Maurin**, **E. Byszewska-Szpocińska**, **P. Garnuszek**, **R. Mikołajczak**
3th Research Co-ordination Meeting of the CRP (Czech Republic, Rez, 2014-04-07 - 2014-04-11)

Badania in vivo ^{90}Y/^{177}Lu-DOTA-Rytuksymab z wykorzystaniem układu do obrazowania optycznego
U. Karczmarczyk, **W. Wojdowska**, **A. Sawicka**, **M. Maurin**, **E. Laszuk**, **P. Garnuszek**, **R. Mikołajczak**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Badanie czystości radionuklidowej w procesie syntezy radiofarmaceutyków
Z. Tymiński, **T. Dziel**, K. Sobczak, A. Wałęcka-Mazur, P. Kozanecki
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Alternatywne metody produkcji technetu-99m
I. Cieszykowska, **R. Mikołajczak**, **T. Janiak**, **D. Pawlak**, **W. Wojdowska**, **M. Żółtowska**, **T. Barcikowski**, **M. Mielcarski**, **J.L. Parus**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Poster

Active targeting of Y-90 and Lu-177 radiolabelled TATE functionalized ultra-small AGuIX nanoparticles
M. Maurin, **U. Karczmarczyk**, **P. Garnuszek**, **R. Mikołajczak**, E. Thomas, C. Truillet, F. Lux, O. Tillement
Annual Meeting of COST TD1004, Theranostic Imaging and Therapy: An Action to Develop Novel Nanosized Systems for Imaging-Guided Drug Delivery (Turkey, Istanbul, 2014-10-03 - 2014-10-04)

Łowicz Meteorite — Mesosiderite fromVesta
Z. Tymiński, T. Brachaniec
77th Annual Meeting of the Meteoritical Society (Morocco, Casablanca, 2014-09-07 - 2014-09-13)

Single institution experience, including 1200 studies, of clinical value somatostatin receptor scintigraphy - 99mTc HYNICTOC (Tektrotyd), to evaluate patients with well differentiated **gastroenteropancreatic neuroendocrine neoplasm/tumors.**
J.B. Ćwikła, A. Lewczuk, E. Wachula, A. Kolasinska, **D. Pawlak**, **B. Janota**, **R. Mikołajczak**
SNMMI, Society of Nuclear Medicine and Molecular Imaging Annual Meeting (USA, St. Louis, Missouri, 2014-06-07 - 2014-06-11)

Patient with dissemination of neuroendocrine neoplasm of unknown origin and carcinoid syndrome: diagnostic and therapeutic difficulties.
A. Stefańska, A. Sowa-Staszczak, A. Hubalewska-Dydejczyk, **R. Mikołajczak**
16th European Congress of Endocrinology ECE2014 (Poland, Wrocław, 2014-05-03 - 2014-05-07)

Detection of delayed radiation from highly enriched ^{235}U samples induced by bremsstrahlung photons
P. Sibczyński, J. Kownacki, A. Syntfeld-Każuch, M. Moszyński, M. Kisieliński, M. Kisielinski, J. Kozieł, **M. Matusiak**, **K. Kosiński**, **W. Dziewiecki**, **K. Wincel**, **B. Zaręba**, **J. Wojnarowicz**
The Zakopane Conference on Nuclear Physics (Poland, Zakopane, 2014-08-31 - 2014-09-07)

Preparation of metallic target of 100Mo for production of 99mTc in cyclotron
T. Janiak, I. Cieszykowska, T. Barcikowski, K. Jerzyk, M. Mielcarski
The 15th International Workshop on Targetry and Target Chemistry (Czech Republic, Prague, 2014-08-18 - 2014-08-21)

Alternative Method For Separation of Technetium-99m from Dissolved Mo Target.
D. Pawlak, **J.L. Parus**, **W. Wojdowska**, **R. Mikołajczak**
8-th International Conference on Isotopes and Expo, ANS Conference (USA, Chicago, 2014-08-24 - 2014-08-28)

Selection of free-radical scavengers composition for the shelf life improvement of the radiolabelled minigastrin analogue CP04
D. Pawlak, **P. Garnuszek**, E. VonGuggenberg, C. Decristoforo, P. Kolenc-Peitl, T. Maina-Nock, **R. Mikołajczak**
Annual Congress of the European Association of Nuclear Medicine (Sweden, Gothenburg, 2014-10-18 - 2014-10-22)

MetroMetal - Ionizing Radiation Metrology for Metallurgical Industry
Z. Tymiński, F. Tzika, J. Šolc, E. García-Toraño, O. Burda, F.J. Maringer, B. Vodenik, M. Reis, **E. Kołakowska**, **A. Listkowska**, **R. Broda**, **T. Dziel**, **A. Patocka**, **E. Lech**, M. Nowicka
Nutech-2014Development and Applications of Nuclear Technologies (Poland, Warsaw, 2014-09-21 - 2014-09-24)

Radioimmunoreactivity of Lu-177 and Y-90 DOTA-anti-CD20(Rituximab®) obtained from the freeze-dried kit
W. Wojdowska, **U. Karczmarczyk**, **A. Sawicka**, **M. Maurin**, E. Byszewska, **P. Garnuszek**, F. Galli, A. Signore, **R. Mikołajczak**
Annual Congress of the European Association of Nuclear Medicine (Sweden, Gothenburg, 2014-10-18 - 2014-10-22)

Porównanie pomiarów aktywności ^{89}Sr i ^{90}Y w zakładach medycyny nuklearnej w Polsce.
T. Dziel, **A. Listkowska**, **Z. Tymiński**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Preliminary radiochemical studies with the ^{64}Cu-labelled complex from the ligand 2-tert-butyl-6-(pyridine-2-yl-hydrazonomethyl) phenol (HL-1)
D. Kłudkiewicz, **M. Maurin**, **P. Garnuszek**, Anne-KatrinBachon, PatrickGamez, **R. Mikołajczak**
2nd International Symposium on Functional Metal Complexes that Bind to Biomolecules.3rd Whole Action Meeting of the COST Action CM1105 (Switzerland, Zurich, 2014-08-22 - 2014-08-23)

HPLC and LC-MS investigations of CP04 complexes with radiometals
M. Maurin, P. Baran, **D. Pawlak**, **P. Garnuszek**, **R. Mikołajczak**
Annual Congress of the European Association of Nuclear Medicine (Sweden, Gothenburg, 2014-10-18 - 2014-10-22)

Możliwości badawcze zmodernizowanego Laboratorium Badań Przedklinicznych w Ośrodku Radioizotopów POLATOM NCBJ
P. Garnuszek, **M. Maurin**, **U. Karczmarczyk**, **E. Laszuk**, **R. Mikołajczak**
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Comparison of Lu-177-anti-CD20 (Rituximab) efficacy on human and canine B-cell lymphoma xenografts
L. Balogh, **R. Mikołajczak**, **W. Wojdowska**, D. Mathe, A. Polyak, Z. Postenyi, V. Haasz, G. Janoki, J. Thuroczy, R. PeterJoba, G. Dabasi, M. Barra, K. Bus, L. Jorgov, G.A. Janoki
Annual Congress of the European Association of Nuclear Medicine (Sweden, Gothenburg, 2014-10-18 - 2014-10-22)

Badania wydajności znakowania 68Ga-DOTA-TATE
W. Tkacz, **D. Pawlak**, A. Kopatys, J. Kunikowka, L. Królicki
XIV Naukowy Zjazd Polskiego Towarzystwa Medycyny Nuklearnej (Poland, Lublin, 2014-05-28 - 2014-05-30)

Development of analytical methods for investigation of new ^{64}Cu(II) complex with HL-1 -Potential anticancer agent
D. Kłudkiewicz, **M. Maurin**, **P. Garnuszek**, A-K. Bachon, P. Gomez, **R. Mikołajczak**
2nd International Symposium on TECHNETIUM and OTHER RADIOMETALS in CHEMISTRY and MEDICINE (Italy, Brixen-Bressanone, 2014-09-10 - 2014-09-13)

Development of 177Lu-Rituximab kits for the treatment of non-Hodgkin lymphoma
F. Galli, A. Carollo, M. Chinol, **W. Wojdowska**, **R. Mikołajczak**, H. Mukhallalati, E. Janevik-Ivanovska, K. Smilkov, A. Signore
22nd International Congress of the International Research Group in Immuno-scintigraphy and Therapy, IRIST (Mexico, Cancun, 2014-08-26 - 2014-08-26)

Efficiency of labeling 68Ga-DOTATATE
D. Pawlak, J. Kunikowska, W. Tkacz, A. Kopatys, L. Królicki
XI Congress of World Federation of Nuclear Medicine and Biology, XXIV Congress of ALASBIMN (Mexico, Cancun, 2014-08-27 - 2014-08-31)

Active targeting with Y-90 radiolabelled octreotate functionalized AGuIX ultra-small nano-particles
M. Maurin, **U. Karczmarczyk**, **P. Garnuszek**, **R. Mikołajczak**, **A. Sawicka**, C. Truillet, F. Lux, A. Clabaut, O. Tillement
2nd International Symposium on TECHNETIUM and OTHER RADIOMETALS in CHEMISTRY and MEDICINE (Italy, Brixen-Bressanone, 2014-09-10 - 2014-09-13)

In vitro and in vivo investigation of ^{177}Lu and ^{90}Y labeled DOTA(SCN)-Rituximab radioimmunoconjugates
W. Wojdowska, **U. Karczmarczyk**, **M. Maurin**, **A. Sawicka**, **E. Laszuk**, **P. Garnuszek**, **R. Mikołajczak**
17th European Symposium on Radiopharmacy and Radiopharmaceuticals (Spain, Pamplona, 2014-04-24 - 2014-04-27)

99mTc-GLP-1 molecular imaging - 3 years experience in the detection of insulinoma
A. Hubalewska-Dydejczyk, A. Sowa-Staszczak, D. Pach, M. Tomaszuk, A. Stefańska, M. Buziak-Bereza, A. Jabrocka-Hybel, A. Gilis-Januszewska, M. Małecki, T. Bednarczuk, G. Kamiński, A. Kowalska, M. Trofimiuk-Muldner, **R. Mikołajczak**, **B. Janota**
22nd International Congress of the International Research Group in Immuno-scintigraphy and Therapy, IRIST (Mexico, Cancun, 2014-08-26 - 2014-08-26)

Physico-chemical and radiochemical characteristic of DOTA-Gastrin (CP04)Analogue Complexes with radiometals
M. Maurin, **D. Pawlak**, **P. Garnuszek**, **A. Jaroń**, **R. Mikołajczak**, N. Metzler-Nolte, R. Stoll
17th European Symposium on Radiopharmacy and Radiopharmaceuticals (Spain, Pamplona, 2014-04-24 - 2014-04-27)

In vitro and in vivo evaluation of 90Y- and 177Lu-labelled DOTA-Rituximab prepared using a newly developed radiopharmaceutical kit
W. Wojdowska, **U. Karczmarczyk**, **A. Sawicka**, **M. Maurin**, E. Byszewska, **P. Garnuszek**, F. Galli, A. Signore, **R. Mikołajczak**
22nd International Congress of the International Research Group in Immuno-scintigraphy and Therapy, IRIST (Mexico, Cancun, 2014-08-26 - 2014-08-26)

68Ga-DOTATATE PET/CT in evaluation of somatostatin receptor expression in juvenile nasopharyngeal abgiofibroma. Is it enough for the peptide radionuclide therapy?
J. Kunikowska, W. Kukwa, R. Matyskiel, Z. Gronkiewicz, **D. Pawlak**, L. Krolicki
Annual Congress of the European Association of Nuclear Medicine (Sweden, Gothenburg, 2014-10-18 - 2014-10-22)

Separation of 99mTcO4- from excess of MoO4 2- using PEG coated C18 SPE cartridge
D. Pawlak, **J.L. Parus**, **W. Wojdowska**, **R. Mikołajczak**
17th European Symposium on Radiopharmacy and Radiopharmaceuticals (Spain, Pamplona, 2014-04-24 - 2014-04-27)

Characterization of a Radionuclide Specific Laboratory Detection System for the Metallurgical Industry
J. Šolc, P. Dryák, H. Moser, T. Branger, M.-Ch. Lépy, E. García-Toraño, V. Peyrés, M. Capogni, A. Luca, B. Vodenik, C. Oliveira, L. Portugal, F. Tzika, G. Lutter, L. Szucs, **T. Dziel**, O. Burda, D. Arnold, J. Martinkovič, T. Siiskonen, A. Mattila
9th International Topical Meeting onIndustrial Radiation and Radioisotope Measurement Applications (Spain, Valencia, 2014-07-06 - 2014-07-11)

Translation of 111In labelling of a Minigastrin analogue towards a clinical kit formulation for a first in human clinical trial
D. Pawlak, **P. Garnuszek**, E. VonGuggenberg, C. Decristoforo, P. Kolenc-Petil, T. Maina-Nock, H. Maecke, P. Erba, A. Hubalewska-Dydejczyk, **R. Mikołajczak**
17th European Symposium on Radiopharmacy and Radiopharmaceuticals (Spain, Pamplona, 2014-04-24 - 2014-04-27)

Development of a pharmaceutical formulation to utilize an 111In-labelled Minigastrin analogue for a first in human clinical tiral.
L. Ihli, E. VonGuggenberg, **R. Mikołajczak**, **D. Pawlak**, P. Kolenc-Peitl, T. Maina-Nock, C. Decristoforo
Radioactive Isotopes in Molecular Imaging, 31st International Austrian Winter Symposium (Austria, Zell am See, 2014-01-22 - 2014-01-25)

Chemical and biological studies on ^{105}Rh-labelled tetrathioethers conjugated to TATE
S. Krajewski, **U. Karczmarczyk**, **P. Garnuszek**, **W. Wojdowska**, **E. Laszuk**, **R. Mikołajczak**, **M. Pruszyński**, **A. Bilewicz**, S. Krajewski
17 th Radiochemical Conference (Czech Republic, Marianske Lazne, 2014-05-11 - 2014-05-16)

DIDACTIC ACTIVITY

P. Garnuszek - Lecture "Radiopharmaceuticals: Characteristic, Application, Lawful aspects"
 Specialization Hospital Pharmacy

P. Garnuszek - Lecture for pharmacy students "Radiopharmaceuticals:preparation, characteristic, application, quality and safety". Department of Applied Pharmacy, Warsaw Medical University

E. Iller - New technology for manufacturing of 188W/188Re generators

U. Karczmarczyk - I was taking care of Małgorzatą Główką the student from Warsaw University of Technology, Faculty of Chemical and Process Engineering during her monthly traineeship. She was introduced to in vitro study of radiopharmaceuticals.

P. Kulicki - training of ERP System module for employees duties

PARTICIPATION IN SCIENTIFIC COUNCILS, ASSOCIATIONS AND ORGANIZING COMMITTEES

K. Bańko
Member of Europen Association of Nuclear Medicine
Member of Reactor and Isotope Group of Association of Imaging Producers & Equipment Suppliers
Member of Polish Society of Nuclear Medicine.

R. Broda
Delegate. Consultative Committee for Ionizing Radiation (CCRI). Section II - Measurement of radionuclides.
Member. Polish Physical Society.
Delegate member. International Committee for Radionuclide Metrology (ICRM).
Elected member. Committee for Metrology and Scientific Instrumentations of Polish Academy of Science

I. Chwalińska
Europen Association of Nuclear Medicine, member

T. Dziel
Radiation Protection Inspectors Association
Polish Society of Medical Physics

P. Garnuszek
European Association of Nuclear Medicine (EANM)
Polish Society of Nuclear Medicine
Expert of Group 14 (radioactive compounds) European Pharmacopoeia,European Directorate for the Quality of Medicines & HealthCare, Council of Europe

E. Iller
European Association of Nuclear Medicine (EANM)
member of Scientific Council of National Center for Nuclear Research.
external member of Scientific Council of Institute of Nuclear Chemistry and Technology, Warsaw

B. Janota
Member of Europen Association of Nuclear Medicine

U. Karczmarczyk
Member, Polish Society of Nuclear Medicine
Member, Polish Labnoratory Animal Science Association (PolLASA)

A. Markiewicz
member of Scientific Council of National Center for Nuclear Research.

M. Maurin
Member, Polish Society of Nuclear Medicine

M. Mielcarski
member of Scientific Council of National Center for Nuclear Research.

R. Mikołajczak
Session chairman on Annual Meeting of COST TD1004, Theranostic Imaging and Therapy: An Action to Develop Novel Nanosized Systems for Imaging-Guided Drug Delivery in Istanbul, Turkey
Member of Advisory Board on Annual Meeting of COST TD1004, Theranostic Imaging and Therapy: An Action to Develop Novel Nanosized Systems for Imaging-Guided Drug Delivery in Istanbul, Turkey
Member of Advisory Board on II Symposium on Positron Emission Tomography in Kraków, Poland
European Association of Nuclear Medicine, EANM
Polish Society of Nuclear Medicine, PTMN, member of the General Board of PTMN since 2006
Society of Radiopharmaceutical Sciences
European Society for Molecular Imaging, ESMI
member of Expert Group evaluating units applying for the rights to run specialization program in Radiopharmacy, called by The Medical Centre of Postgraduate Education
Nuclear Medicine Revew , member of Editorial Board, Grupa Via Medica

D. Pawlak
European Association of Nuclear Medicine
Society of Radiopharmaceutical Sciences
Polish Society of Nuclear Medicine
World Association of Radiopharmaceutical and Molecular Therapy

D. Socha
member of Scientific Council of National Center for Nuclear Research.

Z. Tymiński
Polish Fireball Network
Meteoritical Society

W. Wojdowska
Polish Society of Nuclear Medicine
European Association of Nuclear Medicine

PERSONNEL

Iller Edward PhD
Mielcarski Mieczysław PhD DSc
Mikołajczak Renata PhD
Broda Ryszard PhD
Byszewska-Szpocińska Ewa PhD
Cieszykowska Izabela PhD
Wojdowska Wioletta PhD
Socha Dariusz PhD
Garnuszek Piotr PhD DSc
Parus Józef Professor
Lipka Robert MSc.
Birnbaum Grażyna MSc Eng.
Fiszer Marzena MSc.
Karczmarczyk Urszula PhD
Korsak Agnieszka MSc
Konior Marcin MSc
Listkowska Anna MSc Eng
Małetka Krzysztof PhD
Markiewicz Alina MSc
Pawlak Dariusz MSc
Sasinowska Iwona MSc
Staniszewska Joanna MSc
Szyszko vel Chorąży Tomasz PhD
Janiak Tomasz MSc Eng
Janota Barbara MSc
Jaroń Antoni MSc Eng
Kłudkiewicz Dominik Daniel MSc
Maurin Michał MSc. Eng
Pijarowska-Kruszyna Justyna MSc Eng
Sawicka Agnieszka PhD
Żółtowska Małgorzata MSc.Tymiński Zbigniew MSc
Filiks Anna MSc
Korytkowski Michał MSc.

III. REPORTS ON RESEARCH

1. **ASTROPHYSICS, COSMIC RAYS & ELEMENTARY PARTICLE PHYSICS**

2. **NUCLEAR PHYSICS**

3. **PLASMA PHYSICS & TECHNOLOGY**

4. **DETECTORS, ACCELERATORS, PHYSICS OF MATERIALS & APPLICATIONS**

5. **SOLID STATE PHYSICS**

6. **NUCLEAR TECHNOLOGY IN ENERGY GENERATION**

7. **NUCLEAR TECHNIQUES IN HEALTH AND ENVIRONMENTAL PROTECTION MANAGEMENT OF HAZARDS**

ASTROPHYSICS, COSMIC RAYS & ELEMENTARY PARTICLE PHYSICS

The Hermes Collaboration Report: Spin density matrix elements in exclusive ω meson electroproduction on ^{1}H and ^{2}H targets at 27.6 GeV lepton beam energy

W. Augustyniak, B. Mariański, A.Trzciński, P. Żuprański
National Centre for Nuclear Research, Warsaw, Poland

The process of the production of a meson can be considered as consisting of three subprocesses:

i) the scattered lepton emits a virtual photon γ^* which dissociates into a $q\bar{q}$ pair; which then

ii) interacts strongly with the nucleon

iii) forming a meson.

In the Regge phenomenology the interaction of the $q\bar{q}$ pair with the nucleon proceeds through an exchange of a particle (e.g. π, ρ, ω...). If the quantum numbers of the particle lying on the Regge trajectory are $J^P=0^+1^-\ldots$, the process is called Natural Parity Exchange (NPE), the process of Unnatural Parity Exchange (UPE)corresponds to the quantum numbers of the exchanged particle of $0^-,1^+\ldots$.

Spin Density Matrix Elements (SDMEs) describe the dependence of the final spin states of the produced vector meson on the spin states of the virtual photon given by the photon spin density matrix, calculated in quantum electrodynamics. The SDMEs can be expressed through the helicity amplitudes depending on the helicities of the vector meson λ_V, virtual photon λ_γ, and on the helicities of the nucleon in the initial and final state. Transitions with equal helicities of the virtual photon and of the vector meson, $\lambda_\gamma=\lambda_V$, satisfy s-channel helicity conservation (SCHC).

After the decomposition of the SDMEs into a standard set of 3x3 hermitian matrices the vector-meson spin density matrix is expressed in terms of nine matrices $\rho^{\alpha}_{\lambda_V\lambda_V}$ related to various photon polarisation states α.

The SDMEs of the ω meson have been obtained from an analysis of the angular distribution of its decay particles.

$$\omega \rightarrow \pi^+ + \pi^- + \pi^0,\ \pi^0 \rightarrow 2\gamma.$$

This distribution depends on the angle Φ between the lepton scattering plane and the ω production plane in the hadronic CM system and on the polar (Θ) and azimuthal (φ) angles of the unit vector normal to the decay plane in the ω rest frame. In this frame the Z - axis is taken along the opposite to the outgoing nucleon momentum p. The SDMEs are fitted as parameters of the distributions $W^{U+L}(\Phi,\varphi,\cos\Theta)$ which are decomposed into W^U and W^L, for an unpolarised and longitudinally polarised lepton beam.

The data on SDMEs of the ω meson were accumulated with the HERMES spectrometer using the 27.6 GeV longitudinally polarized electron or positron beam of HERA, and gaseous hydrogen and deuterium targets. The HERMES forward spectrometer consisted of a dipole magnet equipped with tracking and particle identification detectors.

Particle acceptance amounted to ±170 mrad horizontally and to ±(40-140) mrad vertically. The particle momentum resolution was 1.5% and the separation of leptons was achieved with an efficiency of 98% and hadron contamination below 1%.

The SDMEs of the ω meson for the entire kinematic region $\langle Q^2\rangle=2.42\mathrm{GeV}^2$ are presented in Fig. 1. They are divided into 5 classes corresponding to different helicity transitions, transverse (index T) and longitudinal (index L).The SDMEs for the proton and deuteron are found to be consistent with each other within their quadratically combined total uncertainties.

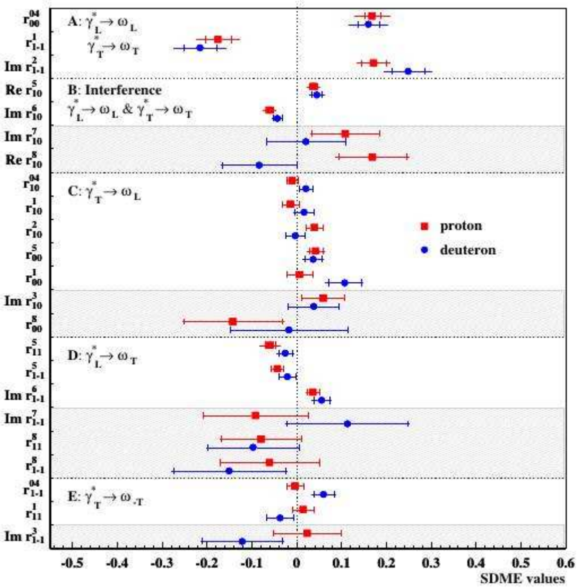


Fig. 1. The 23 SDMEs for exclusive ω electroproduction extracted in the entire HERMES kinematic region $\langle Q^2\rangle=2.42$ GeV^2. Proton data are denoted by squares and deuteron by circles. The inner error bars represent the statistical uncertainites, while the outer ones indicate the statistical and systematic uncertainties added in quadrature. Unpolarised (polarised) SDMEs are displayed in the unshaded (shaded) areas.

Cauchy-Schwarz inequality and particle entaglement

T. Wasak[1], P. Szańkowski[1], P. Ziń[2], M. Trippenbach[1], J. Chwedeńczuk[1]
[1]Faculty of Physics, University of Warsaw,Warsaw, Poland
[2]National Centre for Nuclear Research, Warsaw, Poland

The challenging question whether, and in what sense, pulse of light is not classical, is one of the central issues of quantum optics. This problem was addressed by Glauber and Sudarshan in their studies on coherence in the context of correlation functions [1]. They defined a classical state if an outcome of any measurement of the normally ordered correlation function can be explained in terms of classical electromagnetic fields. They showed that such a state is a mixture of coherent states. If an outcome of measurements of correlation functions cannot be explained in terms of classical fields the state is said to be quantum.

Recently, in cold atom physics an experiment [2] was performed which showed a violation of the Cauchy-Schwarz inequality. This inequality was applied to the two body correlation function of particles scattered in the collision of Bose-Einstein condensates.

$$(G^{(2)}(x,x'))^2 < G^{(2)}(x,x)\, G^{(2)}(x',x') \quad (1)$$

where $G^{(2)}(x,x')$ is the two body correlation function of simultaneous measurement of two particles in position x and x' respectively.

Looking at quantum optics the authors of [2] attributed the observed violation of the Cauchy-Schwarz inequality to some nonclassical character of the observed correlation. However, the meaning of “nonclassical” was not made precise. There are no coherent states of massive particles – they are forbidden by the superselection principle. Therefore, one cannot apply the definition of a classical state used in quantum optics.

These facts motivated the present work. We looked at the problem from the point of view of particle entanglement. We have shown that for a general separable state of identical bosons the Cauchy-Schwartz inequality (1) is satisfied. Therefore, the violation of this inequality proves that the state under investigation is particle entangled. Thus it makes the experimental intuition of “nonclassicality” for the identical massive bosons precise.

References

[1] E. C. G. Sudarshan, Physical Reviev Letters, 277 (1963); R. J. Glauber, Phys. Rev. 131, 2766 (1963)
[2] K. V. Kheruntsyan et. al. , Phys. Rev. Lett. 108, 260401 (2012)

1 TeV Higgsino dark matter in SUSY and prospects for CTA

L. Roszkowski, E. M. Sessolo, A. J. Williams
National Centre for Nuclear Research, Warsaw, Poland

The recent discovery of a Higgs boson at the LHC raised widespread excitement in the particle physics community and spurred a lot of activity to interpret the new discovery in the context of the Standard Model (SM) and models of ``new physics''. In particular, the mass of the newly discovered particle, $m_h \approx 125$ GeV, is well within the predictions of low-scale supersymmetry (SUSY).

Several other questions prompt the search for "new physics" beyond the SM, including why there is an excess of matter over anti-matter in the Universe, the origin of neutrino masses, etc. One of the most important of these is the search for the identity of the particles that comprise the dark matter (DM) component of the Universe. The search for DM is a central problem in modern physics and one of the most well motivated candidates arises in SUSY extensions of the Standard Model.

The search for dark matter has made remarkable progress in recent years. The most impressive advances in sensitivity have arguably been made in direct detection experiments, where improvement happened rapidly and led to the most recent null results by XENON100 and LUX. As a consequence, the upper bounds on the spin-independent DM-nucleon elastic scattering cross section, , have become increasingly constraining for many models of weakly interacting massive particles (WIMPs). On the other hand, interesting upper bounds on the cross section for WIMP production have been placed at the LHC, which have become particularly constraining for many models of low-mass DM. At the same time, strong limits on the present-day DM annihilation cross section, σv, as a function of the WIMP mass, have been provided by γ-ray experiments. In particular, the most stringent ones for masses up to ~ 1 TeV come from Fermi-LAT data on dwarf spheroidal galaxies (dSphs). For larger masses the air Cherenkov radiation telescope H.E.S.S. produces the strongest limits from observation of the Galactic Center (GC).

In Ref. [1] we re-examined two important SUSY models in the light of recent experimental results from the DM search by LUX as well as the most up to date results from the LHC on the Higgs properties and direct SUSY searches. As well as new experimental results more complete theoretical predictions for the Higgs mass in the MSSM are now available.

The impact of this has been to favour smaller values for the scale of superpartner masses than before. As a consequence, the statistical weight of the *A*-resonance region increases to about 30% of the total probability, with interesting new prospects for the 14TeV run at the LHC.

As we previously found, an important solution where the dark matter is a neutralino, which is nearly pure higgsino (fermionic partner of Higgs bosons) with a mass m_χ of approximately 1 TeV, dominates the parameter space. It has previously been argued that the best prospects for detection of the ~ 1 TeV higgsino region come from dark matter direct detection experiments. In [1] we explored the enticing possibility that independent detection of the ~ 1 TeV higgsino could be made at the future Cherenkov Telescope Array (CTA) experiment.

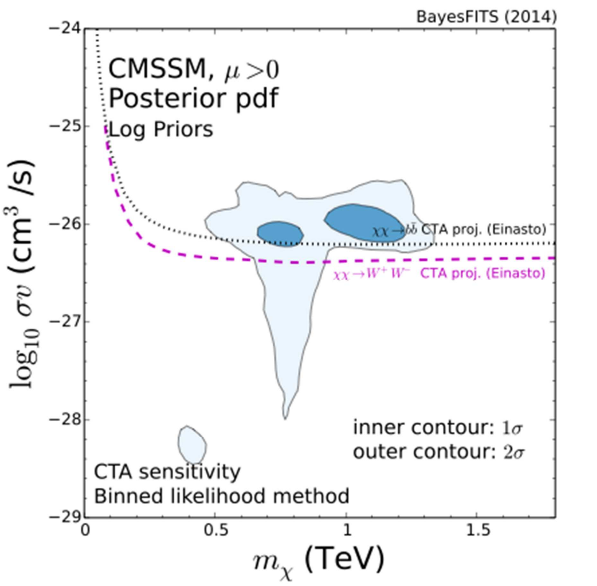


Fig. 1.Total marginalized posterior probability in the $(m_\chi \sigma v)$ plane of the CMSSM. The projected limit from CTA to different final states are shown.

The CTA project will build the next generation air Cherenkov telescope observatory. For DM masses greater than ~100 GeV CTA is expected to significantly exceed current limits for WIMP annihilation from the Cherenkov imaging telescopes. CTA should play an important role in constraining or discovering heavy dark matter candidates in the future.

As was the case for direct detection, the ~1 TeV higgsino region presents a particularly promising target for indirect detection since the annihilation cross section is restricted to a relatively small range close to the thermal value compared to other dark matter candidates in the Minimal Supersymmetric Standard Model (MSSM) which can have much lower annihilation cross sections. The dashed magenta and dot-dashed black lines in Fig.1 show the expected sensitivity of CTA in the popular Constrained MSSM (CMSSM). The W^+W^- final state provides a goodapproximation in the ~1 TeV

higgsino region and points in this region lying above the W^+W^- line have the potential to be constrained.
This result requires an accurate understanding of the projected sensitivity of CTA. This was provided by our work in Ref [2] where we derived a realistic projection of the sensitivity of CTA. In doing so we used the most up to date instrument response functions and background estimates provided by the CTA Collaboration. We presented results for the two most popular DM halo profiles and performed a systematic study of the different statistical methods that can be used to set limits with CTA.

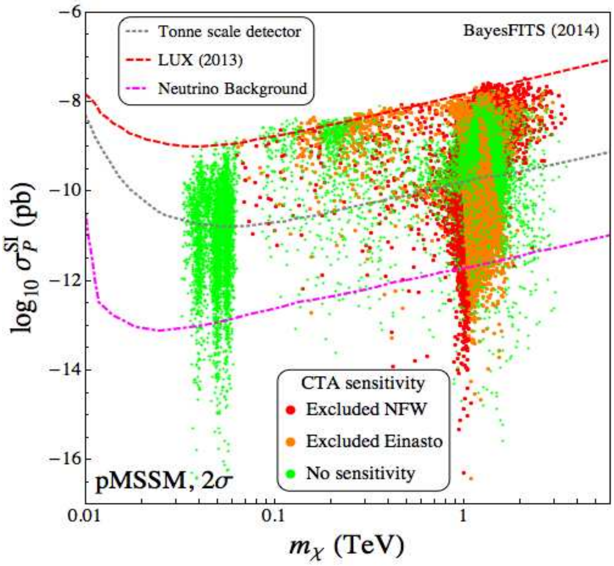


Fig. 2. Sensitivity of CTA to the pMSSM in the (m_χ,) plane. Red points are within reach of CTA assuming an NFW profile, orange points assuming an Einasto profile, green points are beyond the sensitivity of CTA.

In addition to deriving projections for CTA the main result of Ref. [2] was to undertake a thorough analysis of the 19 parameter version of the MSSM, the p19MSSM (also denoted pMSSM). The pMSSM gives a generic coverage of the properties of the CP and R parity conserving MSSM, however the high dimensionality makes full coverage of the parameter space difficult. This highlights the need for the state of the art scanning methodology we use to generate millions of model points.

Here we showed again the important role that the ~ 1 TeV higgsino plays in the allowed parameter space. We also found that, in complementarity with other direct and indirect detection experiments, CTA will significantly probe the favoured parameter region of the pMSSM, far beyond the reach of 1-tonne underground detectors alone. We showed that many of the points well within our calculated sensitivity of CTA lie below the onset of the irreducible atmospheric and diffuse supernova neutrino background for direct detection as shown in Fig. 2.

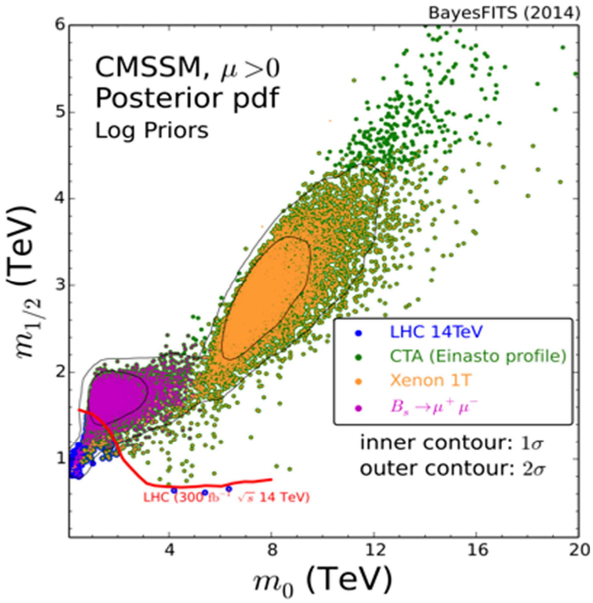


Fig. 3. Total marginalized posterior probability in the (m_0, $m_{1/2}$) plane of the CMSSM. A sample of points from the scan is overlapped showing the sensitivity of various future observations.

We finally show in Fig. 3 the regions of Bayesian posterior in the parameter space of the CMSSM calculated in Ref. [1]. Points belonging to the posterior distribution are shown colored according to their future sensitivity to a handful of experiments. Blue points are sensitive to CMS and ATLAS direct SUSY searches at the LHC Run II. Magenta points may be excluded by precise measurement of BR (Bs → μ+μ−) at LHCb in Run II. Orange points can be constrained by direct searches for dark matter at XENON-1T and other tonne-scale experiments. Green points are within the projected reach of indirect detection of dark matter at CTA through γ rays from the GC. We stress that every point of the parameter space is covered by at least one experiment allowing the entire parameter space to be explored.

References

[1] L. Roszkowski, E.M. Sessolo, A. J. Williams, JHEP 1408 (2014) 067
[2] L. Roszkowski, E.M. Sessolo, A. J. Williams, JHEP
[3] 1502 (2015) 014

Dynamics and cosmological constraints on brans-dicke cosmology

O. Hrycyna[1], M. Szydłowski[2], M. Kamionka[3]
[1]Theoretical Physics Division, National Centre for Nuclear Research, Warszawa, Poland
[2]Astronomical Observatory, Jagiellonian University, Kraków, Poland
Mark Kac Complex Research Centre, Jagiellonian University, Kraków, Poland
[3]Astronomical Institute, University of Wrocław, Wrocław, Poland

The best description of the accelerated expansion of our Universe gives standard cosmological model, the ΛCDM model. In this model we assume that the general relativity describes gravitational interactions at cosmological scales and we postulate validity of the cosmological principle. Such an attempt to describe the current Universe in terms of standard cosmological model is justified by a pragmatic approach of a simple model with two parameters. In general, in physics, such a model corresponds to what is known as an effective theory, for example, a standard model in particle physics. In these theories, like in ΛCDM model, there are parameters which value should be obtained from mode fundamental theory or determined from observations. In cosmology the role of such parameters play the density parameters. The nature of some parameters describing dark sector of the Universe (dark matter and dark energy) in unknown. From an effective theory point of view it may suggest that in the construction of the standard cosmological model the cosmological constant term play only the role of a useful fiction; i.e., the ΛCDM model describes cosmological observations well but unveils nothing about the nature of the cosmological constant. The methodology of effective theories may provide us with useful tools in order to shed some light on the nature of these parameters revealing new hints toward a more fundamental theory which we are looking for.Because of well known problems with the cosmological constant term in the standard cosmological model related with its substantial interpretation we are looking for solution of the conundrum of accelerated expansion of the current Universe in the framework of Brans-Dicke theory of gravity. In this theory the gravitational sector is described both by the metric and a scalar field. In the Brans-Dicke theory, which is a scalar-tensor theory of gravity, a scalar field does not play the role of a substance but is rather an integral part of the gravitational sector. In this description a free parameter ω_{BD} appears as a consequence of the effective theory approach.

We found observational constraints on the Brans-Dicke cosmological model assuming the Robertson-Walker symmetry working at the cosmological scale. Therefore the Hubble function was our starting point for further estimations of the model parameters. The ω_{BD} parameter is hidden behind the density parameters of the Brans-Dicke modification of the Friedmann equation. The next step is to estimate the value of the density parameters from the astronomical data and compare the model with the standard cosmological model ΛCDM using information criteria. Because we treat the new model as a generalization of the ΛCDM model it is naturally to interpret a prime contribution to the Hubble relation as a corresponding term in the ΛCDM model.

We have shown that the observational data point toward values of the ω_{BD} parameter close to the value suggested by the low energy limit of the bosonic string theory.

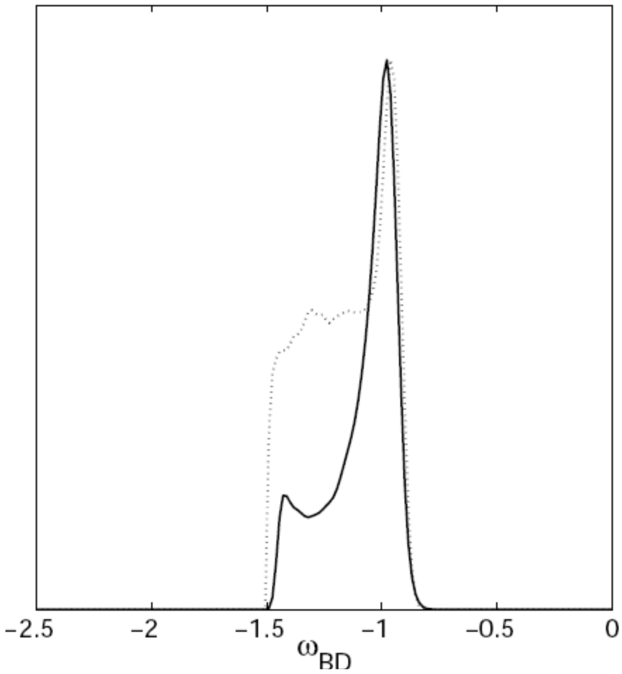


Fig. 1. Fully marginalized probability (solid line) and mean likelihood (dashed line) for the parameter of the Brans-Dicke theory ω_{BD} calculated using observational data coming distant supernovae type Ia, the Hubble function measurements, information coming from the Alcock-Paczński test and baryon acoustic oscillations.

Reference

[1] O. Hrycyna, M. Szydłowski, M. Kamionka, Physical Review D 90, 124040 (2014)

KASCADE-grande measurements of energy spectra for elemental groups of cosmic rays

P. Łuczak and J. Zabierowski (for the KASCADE-Grande Collaboration)
National Centre for Nuclear Research, Łódz, Poland

The KASCADE-Grande air shower experiment [1] is optimized for cosmic ray measurements in the energy range 10 PeV to about 2000 PeV, where exploring the composition is of fundamental importance for understanding the transition from galactic to extragalactic origin of cosmic rays. Following earlier studies of the all-particle and the elemental spectra reconstructed in the knee energy range from KASCADE data [2] (the number of citations of this work already approaches 300) these measurements have been extended to beyond 200 PeV and results published in [3]. By analyzing the two-dimensional shower size spectrum N_{ch} vs. N_{μ} for nearly vertical events (Fig.1) the energy spectra of different mass groups were reconstructed by means of unfolding methods over the energy range, where the detector is fully

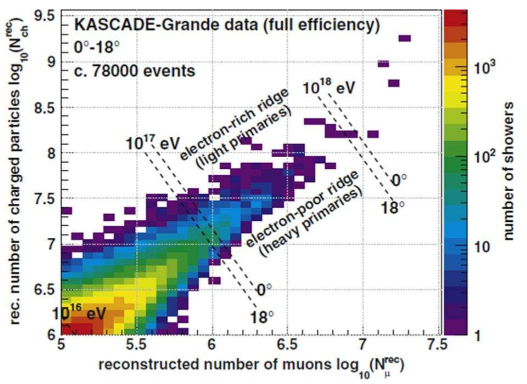


Fig. 1. Two-dimensional distribution of the shower sizes (total number of charged particles and of muons) measured with KASCADE-Grande and used for this analysis[3].

efficient. Based on this analysis, the energy spectra for five primaries representing the chemical composition of cosmic rays have been determined, as well as the all-particle spectrum which is the sum of the elemental spectra (Fig. 2). For this analysis the response matrix of the experiment was computed based on the hadronic interaction models QGSJET-II-02 and FLUKA 2002.4.

The all-particle spectrum, being structureless within the given uncertainties, agrees well with that determined in an alternative analysis of the KASCADE-Grande data [4], where a small break-off at about 80 PeV was found.

Furthermore, both KASCADE-Grande all-particle spectra are compatible with the findings of most of the other experiments.

The unfolded spectra of light and intermediate primaries are rather featureless in the sensitive energy range. However, the slight indications for possible recovery of protons at higher energies, statistically not significant here, are in agreement with the finding of a significant hardening in the cosmic ray spectrum of light primaries in [5].

The spectrum of iron exhibits a clear knee-like structure at about 80 PeV. The position of this structure is consistent with that of a structure found in spectra of heavy primaries determined by other analysis methods of the KASCADE-Grande data [6]. The energy where this knee-like structure occurs conforms to that where

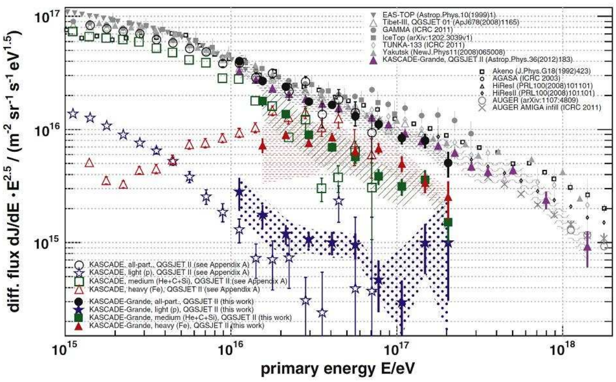


Fig. 2. The all-particle energy spectrum obtained in [3]based on an unfolding of KASCADE-Grande measurements, and the spectrum based on an unfolding of KASCADE measurements, are compared to spectra determined by other analysis methods of our collaboration [4] or other experiments (see legend for references).

the break-off in the all-particle spectrum is observed. Hence, the findings in this work [3] and in [6] demonstrate for the first time experimentally that the heavy knee exists, and the kink in the all-particle spectrum is presumably caused by this decrease in the flux of heavy primaries.

References

[1] W. Apel et al. (KASCADE-Grande Collaboration), Nucl. Instrum. Methods. A620 (2010) 202
[2] T. Antoni et al., (KASCADE-Grande Collaboration), Astropart. Phys. 24 (2005) 1
[3] W. Apel et al. (KASCADE-Grande Collaboration), Astropart. Phys. 47 (2013) 54
[4] W. Apel et al. (KASCADE-Grande Collaboration), Astropart. Phys. 36 (2012) 183
[5] W. Apel et al., (KASCADE-Grande Collaboration), Phys. Rev. D 87, 081101(R) (2013)
[6] W. Apel et al. (KASCADE-Grande Collaboration) Phys. Rev. Lett. 107, 171104 (2011)

EUSO-Balloon – the first test flight

J. Karczmarczyk, R. Lewandowski, Z. Plebaniak, B. Szabelska, J. Szabelski
National Centre for Nuclear Research, Łódź, Poland

Ultra high energy cosmic rays (UHECRs) are particles with the largest energies per particle known in the Universe. The largest measured energy of one particle exceeded 10^{20}eV, more than 10 million times higher than the 7TeV proton energy scheduled for LHC at CERN. The existence of UHECRs is a wonder the Nature, which at first look ignores the statistical rules of energy dissipation. The first UHECR event was discovered by John Linsley in the Volcano Ranch extensive air shower (EAS) detector in 1962. Since then it has been a challenge for astrophysicists to understand their origin and to identify their sources. If UHECR are protons with great energies then their trajectories are only slightly bent in Galactic and extra-galactic magnetic fields, so their directions (relatively easy to measure) should point to the astrophysical sources (if they exist). However, from measurements made in the last 50 years we know that the flux of particles with energies above 10^{20}eV is extremely low, about 1 particle per 100km^2 per year (or 2 particles per 100000km^2 per day). Currently, results of UHECR measurements made by the Pierre Auger Observatory (PAO) observing

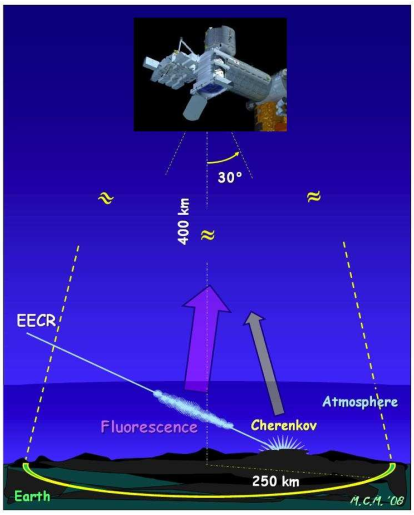


Fig. 1. Principle of the EUSO-family experiments.

particles from the Southern Hemisphere using a detector of area about 3000km^2 are consistent with an isotropic distribution. Another huge detector of UHECR placed in the Nothern Hemisphere – the Telecope Array (TA) with a nearly 1000km^2 detector reported large scale anisotropy. Both results created an experimental situation very complicated for astrophysical interpretation.

The JEM-EUSO Collaboration [1] is going to use one of the UHECR detection methods used by the PAO and TA experiments, namely measurements of scintillation in the atmosphere emitted by N_2 molecules excited by hundreds of billions of EAS particles. The advantage is to observe these events from the International Space Station (~400km altitude) which allows for monitoring an area of about 160000km^2 (or much more for inclined observations). Measurements could be made on the dark side of the Earth, with a duty cycle of about 0.4, and allow nearly 1 UHECR event to be measure per day. The Collaboration is working on the development of a large UV telescope with more than 300000 pixels and a very fast camera (one frame per 2.5microseconds) which enables us "to film" an event lasting less than 30microseconds [2]. The telescope (2.5m in diameter and weight about 2tonnes) would have sensors grouped a in modular structure (made of about 140 units).

The **EUSO-Balloon** is a separate experiment led by IRAP/CNES to test the detection method and performance of the JEM-EUSO detection unit at 40km. For the apparatus, the first flight was to test the first implementation of the JEM-EUSO Fresnel optics concept, an innovative Cockcroft-Walton power supply with automatic switches of the PMT gain (all **designed and made in NCBJ-Łódź**) to allow continuous data taking even in the presence of large variations of the background, as well as dedicated electronics with SPACIROC ASICs and an adapted FPGA and complete data processing system. A prototype of the JEM-EUSO infra-red camera was also developed and implemented [3].

Fig. 2. EUSO-Balloon gondola.

The first EUSO-Balloon flight took place from the Timmins Stratospheric Balloon Base of the Canadian Space Agency during a new moon night on 24/25 of August, 2014. The balloon reached a maximum altitude of 38.3km. During the first 2 hours of high altitude flight a helicopter was flying at the 3000m altitude below the balloon. It was emitting vertical flashes towards the balloon and horizontal laser pulses. Each pulse was a “moving with light speed source” of scattered photons measured by the EUSO-Balloon telescope [4].

The flight was successful. All instruments performed at least as well as during the best pre-flight tests. Collected data are processed and results should be published in 2015. Scientific institutions and national space agencies from France, Germany, Italy, Japan, Korea, Mexico, Poland, Spain, and the USA took anactive role in the preparation and support of the EUSO-Balloon flight.

References

[1] http: //jemeuso.riken.jp
[2] J.H.Adams et. al, Astropart. Phys., 44 (2013) 76
[3] http://www.appec.org/9-features/92-first-steps-towards-uhecr-detection-from-space-the-beautiful-success-of-euso-balloon.html
[4] http://www.scientificamerican.com/article/cosmic-ray-telescope-flies-high

LOPES radio measurements enable determination of the energy and mass of primary cosmic-ray particles

P. Łuczak, J. Zabierowski (for the LOPES Collaboration)
National Centre for Nuclear Research,Łódź, Poland

A hundred years have passed since the discovery of cosmic radiation, and an accurate reconstruction of both the energy and mass of primary cosmic rays at high energies still remains a compelling need in contemporary astroparticle physics. Only recently methods for detection of coherent MHz radiation from extensive air showers as well as our understanding of the underlying emission physics have been coonsiderably improved. A precise reconstruction of both the primary energy and the depth of the shower maximum (X_{max}) of air showers is a fundamental goal for modern radio detection, which aims to become competitive and complementary to the already well-established fluorescence and Cherenkov detection techniques, limited, in contrast to the radio technique, to a low duty cycle .

This goal has been recently achieved by the LOPES collaboration and reported in Physical Review D [1].

LOPES [2] is a digital radio interferometer located at Karlsruhe Institute of Technology (KIT), Germany. In [1] a method (slope method) is presented, which obtains information on the energy and depth of maximum of air showers (related to the primary mass) from features of the lateral distribution of the radio signals.

On the one hand, a defined distance from the shower axis exists where the reconstruction of the primary energy is affected least by shower-to-shower fluctuations. On the basis of state-of-the-art CoREAS simulations it was shown that such a characteristic distance is still present when refractive index effects and radiation due to the variation in the number of charged particles are taken into account (as it is in CoREAS), and that measurements at this distance can thus be exploited for an energy determination (Fig.1).

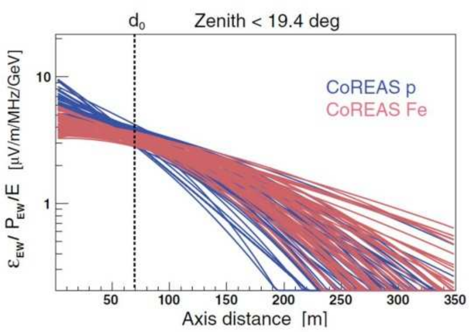


Fig. 1. Mean X_{max} as a function of the primary cosmic-ray energy. LOPES-reconstructed values (blue points) are compared with the results from other experiments and Monte Carlo expectations for pure iron (red line) and pure proton (blue line).

The value of this distance d_0, predicted by the CoREAS simulation and present also in LOPES measurements, equals 70 – 100 m. An upper limit for the LOPES precision on the total energy reconstruction was determined from the combined LOPES-KASCADE-Grande energy uncertainty (20-25%) but the intrinsic energy resolution of the radio measurements suggested by the simulations is approximately 13%.

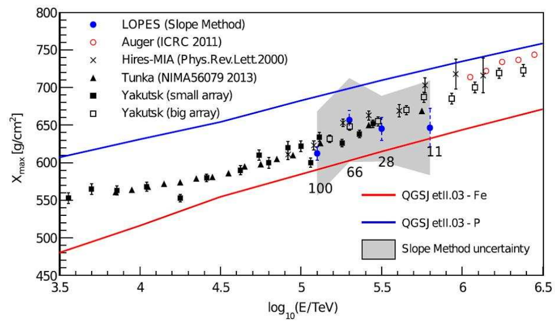


Fig. 2. Normalized CoREAS lateral distribution function fits for events with zenith angles smaller than 19.4°, simulated as proton and as iron primaries. The dotted line represents the distance d_0 at which the rms spread of the fitted normalized amplitudes is minimal.

On the other hand, the slope of the radio lateral distribution is related to the geometrical distance between the observer and the radio source. Therefore, information on the depth of the shower maximum (X_{max}), and consecutively on the type of primary particle initiating the shower, can be directly extracted from the radio lateral distribution measurement: the slope for a proton-initiated shower is steeper than the slope for a shower initiated by an iron primary (Fig.1). By itself, and for the specific situation of LOPES, the slope method predicted a precision of X_{max} around 50 g/cm^2, depending on the zenith angle of the event.

X_{max} is a principle indicator for cosmic-ray composition and it the possibility of reconstructing it with the slope method applied to the LOPES radio measurementswas demonstrated. The comparison of the LOPES-reconstructed values with those from other experiments and simulations for proton and iron showers is shown in Fig. 2.

References

[1] W.D. Apel et al. (The LOPES Collaboration), Phys. Rev. D 90, 062001 (2014)
[2] H. Falke et al. (TheLOPES Collaboration), Nature 435, (2005) 31

NUCLEAR PHYSICS

Fast neutron sepectrum measurement in a subcritical assemblycomposed of 500 kg natural uranium irradiated with 2, 4 and 8 GeV deuterons

E. Strugalska-Gola, M. Bielewicz, S. Kilim, M. Szuta
National Center for Nuclear Research, Otwock-Swierk, Poland

Study of deep subcritical electronuclear systems and radioactive waste transmutation using relativistic beams from an accelerator were performed. This work is a preliminary step toward an study of the physical properties of ADS systems, in which a deeply subcritical active core is irradiated by a pulsed beam of relativistic ions. The Quinta assembly (Fig.1) (E+T Raw Collaboration [1]) of the JINR, Dubna, Russia consists of 512 kg of natural uranium rods arranged hexagonally, surrounded by a lead reflector. The setup was irradiated with 2, 4 and 8 GeV deuteron beams using the JINR NUCLOTRON accelerator. The (n,xn) reaction rates of yttrium samples located inside the assembly were determined through gamma spectrometry. We attempted to obtain the fast neutron energy spectra inside the volume of the assembly using the threshold reaction in natural yttrium (^{89}Y).

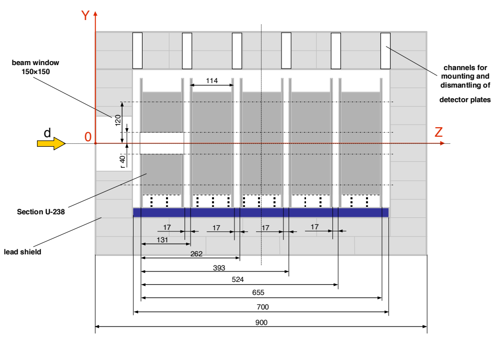


Fig. 1. Dimensions of the Quinta assembly and the location ofthe ^{89}Y foils. Measurement plate distances from the front of assembly 0=0cm, 1=13.1cm, 2=26.2cm, 3=39.3cm, 4=52.4cm and 5=65.5cm [1].

Using the microscopic cross sections for the reactions ^{89}Y(n, 2n), (n, 3n) and (n,4n) generated by the TALYS code [2] and the experimental data we have evaluated the average high energy neutron flux in the ^{89}Y foils located inside the Quinta assembly for the three energy ranges (11.5 - 20.8 MeV), (20.8 - 32.7MeV) and (32.7 - 100 MeV) [3]. An example of a comparison of average neutron flux density per deuteron and per unit energy of deuteron for the three deuteron beams of energies equal to 2, 4 and 8 GeV as a function of the Quinta target axis at R=4 cm and the energy range 20.8 - 32,7 MeV is presented in Fig. 2.

The general feature of the experimental spatial distribution of ^{88}Y, ^{87}Y, ^{86}Y and ^{85}Y isotope production is that the maximum yield is at about 13 cm from the front of the ^{238}U spallation target and that the yield decreases with increasing radial distance from the target axis. The shape of the neutron flux density per deuteron in the Quinta assembly produced by the neutrons generated in the assembly irradiated by relativistic deuteron beams of 2 GeV, 4 GeV and 8 GeV energies is in general the same. The main contribution to the uncertainties in the experimental results are due to the peak area calculation and the statistical error coming from the DEIMOS program [4]. Moreover, there are uncertainties in the measurements involving the total number of primary deuterons in each experiment. We estimate the overall uncertainties of the experimental data to be in the range 15%-20%.

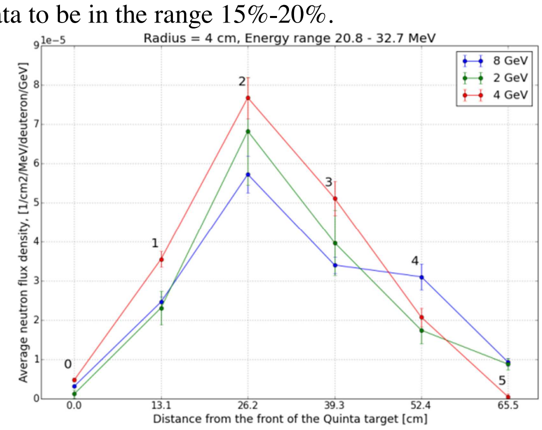


Fig. 2. Average neutron flux density per deuteron and its energy as a function of the Quinta target axis at R=4 cm for three deuteron energies (2, 4, 8 GeV) in the neutron energy range (20.8 - 32.7 MeV).

The results presented here are of great importance for future use of Accelerator Driven Systems (ADS) for long lived nuclear waste utilization. ADS parameters like what target material to be used, what impinging particle, what particle energy, what geometry should be selected to get the highest transmutation efficiency. Deuterons in the energy interval 1.0-1.5 GeV are optimal for actinides incineration.

References

[1] W. Furman et al.; Recent results of the study of ADS with 500 kg natural uranium target assembly QUINTA irradiated by deuterons with energies from 1 to 8 GeV at JINR NUCLOTRON; PoS (Baldin ISHEPP XXI) 086
[2] Koning J., Hilaire S., Duijvestijn M. TALYS-1.0: A Nuclear reaction code. www.talys.eu
[3] M. Bielewicz at al.; Measurements of fast neutron spectrum in QUINTA assembly irradiated with 2, 4 and 8 GeV deuterons. PoS (baldin ISHEPP XXII) 052, (2015), http://pos.sissa.it
[4] Frana J. (2003) Program DEIMOS32 for Gamma Ray Spectra Evaluation. Radioanal. and Nucl. Chem., V. 257, p.583

Study of the lead shielding on the fast neutron spectrum in the quinta uranium target

M. Szuta, E. Strugalska-Gola, S. Kilim, M. Bielewicz
National Centre for Nuclear Research, Otwock-Świerk, Poland

The QUINTA uranium target is a deeply sub-critical active core consisting of 512 kg of natural uranium rods arranged hexagonally. The target is irradiated by a pulsed beam of relativistic ions using the JINR NUCLOTRON accelerator The fast neutron energy spectra inside the volume of the QUINTA uranium target using the threshold reaction in natural yttrium (^{89}Y) were measured for the same deuteron energy of 4 GeV when the uranium target of the assembly was enfolded with lead shielding and without the shielding (See Fig. 1).

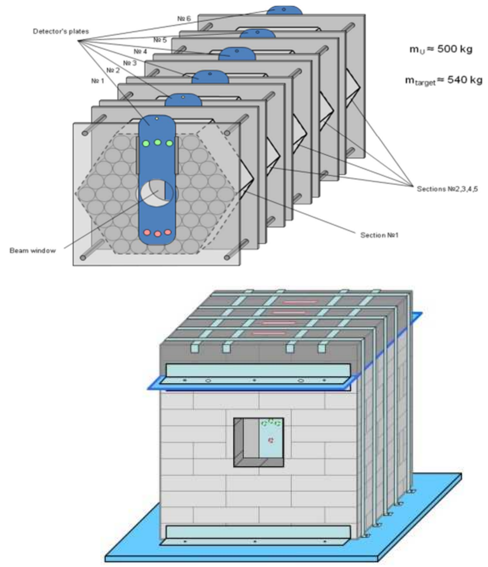


Fig. 1. Schema of Quinta assembly. Above is a view of the uranium target with supporting structures and plastics used for sample placement (detector plates), below is a view of the lead shielding enfolding the target.

A total of twelveYttrium-89 activation foils (purity > 99.99%) were placed in the Quinta target on the detector plates in front of, between the five sections, and at the rear of the target in two positions at varying radial distances (4 and 8 cm) from the deuteron beam axis for each irradiation.

After irradiation, the samples were removed and transported away to be analyzed with gamma spectrometry.

Since the curves of the neutron flux densities nearly overlap at the radius 4 cm in the area close to the spallation uranium target for both of the experiments (with and without the lead shielding) we can assume that the irradiation conditions were alike (see Figs 2a and 2b).

Comparisons of average neutron flux densities for the three neutron energy ranges and for the deuteron beam energy equal to 4 GeV of both experiments show that the neutron flux density increases our the whole volume of the QUINTA assembly due to the lead shielding (see Figs 2a -2b). The influence of the lead shielding on the neutron spectra is more pronounced in the volume located closer to the shielding.

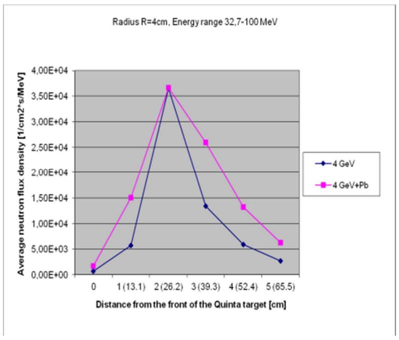


Fig. 2a. Average neutron flux densities in the Quinta uranium target at 4 cm radius enfolded with lead reflector and without it in the range 32,7-100 MeV irradiated with deuterons of energy 4 GeV.

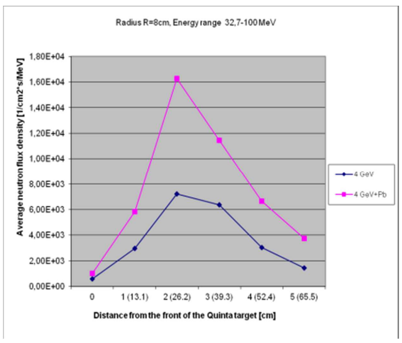


Fig.2b. Average neutron flux densities in the Quinta uranium target at 8 cm radius enfolded with lead reflector and without it in the range of 32,7-100 MeV irradiated with deuterons of energy 4 GeV.

While the lead shield of the Quinta assembly causes a decrease in the neutron flux for the area close (4 cm) to the spallation target (especially in the position where the maximum flux occurs), on the other hand, away from (8 cm) the spallation target it causes a comparative increase of the flux.

Reference

[1] Lead shielding impact on fast neutron spectrum(10 MeV) in QUINTA assembly, M. Szuta et al. http://pos.sissa.it/archive/conferences/225/060/Baldin%20ISHEPP%20XXII_060.pdf

Bonding xenon and krypton on the surface of a uranium dioxide single crystal

L. Dąbrowski, M. Szuta
National Centre for Nuclear Research, Otwock-Świerk, Poland

We present density functional theory (DFT) calculations for the interaction of krypton and xenon atoms with the surface of a uranium dioxide crystal. A pseudo-potential approach in the generalized gradient approximation (GGA) was applied using the ABINIT program package. For numerical calculations we chose a 25 atom super-cell of dimensions 4axaxa (21,88x5,47x5,47Å), which we half filled with 8 uranium atoms and 16 oxygen atoms. The second half of the super-cell is a space free of oxygen and uranium atoms. In this space we placed the krypton atom in positions S_O,a, S_O,b, S_U,a and S_U,b. Because the krypton atom is separated from the nearest oxygen or uranium atoms by a distance of nearly two lattice constants, we assume that Kr interacts really only with 24 U and O atoms, located on the left side, i.e. with the atoms of the surface and subsurface layers. It does not interact with the atoms located on the right side, and belonging to the next, periodically repeated super-cell. The binding energy depends on the distance between the Kr – UO_2 surface, and the shape and depth of the potential well in which the krypton atom is close to the surface, for the configuration of S_O,a, S_O,b, are shown in Figure 1, and for the configuration of S_U,a i S_U,b in Figure 2.

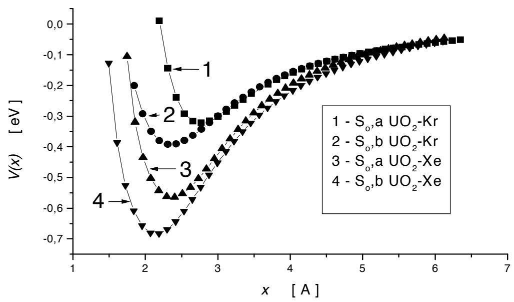


Fig. 1. The binding energy depending on x in the S_o configurations x – Kr or Xe distance - from the surface of UO_2.

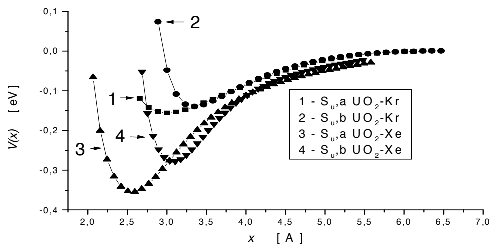


Fig. 2. The binding energy. depending on x in the S_u configurations: x – Kr or Xe distance - from the surface of UO_2.

Let us assume that the krypton or xenon atomis located between two oxygenic surfaces in the potential well, disposed near one of the surfaces. Then, after some time, it jumps along the x axis, perpendicular to the surface to the next analogous well, near the second surface. Diffusion coefficients for krypton and xenon perpendicular to the surface are shown in Fig. 3

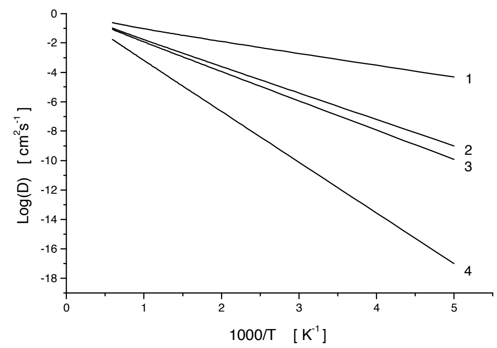


Fig. 3. Temperature dependence of perpendicular diffusion coefficients for krypton and xenon depending from configurations:1,3 – configurations S_U,a and S_O,b for krypton, 2,4– configurations S_U,a and S_O,b for xenon.

Let us assume that in the surrounding gas there are also particles of escaping krypton (xenon) atoms. The situation is similar to the evaporation of a liquid. At the proper pressure, the stream of particles escaping from the surface will be compensated by the stream of particles inflowing from the gas. Applying the WKB method, the results of numerical computations of this pressure are shown in Fig. 4.

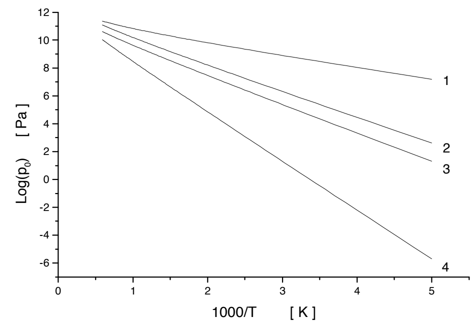


Fig. 8. Dependence of equilibrium gas pressure on temperatureon for different configuration: 1, 3 – configurations S_U,a and S_O,b for krypton.

Reference

[1] L. Dąbrowski, M. Szuta." Bonding xenon and krypton on the surface of uranium dioxide single crystal", Nukleonika 59 # 3 (2014) pp. 83-89

Measurements of Np-237 incineration in the ADS setup quinta

S. Kilim, M. Bielewicz , E. Strugalska-Gola, M. Szuta et al.
National Centre for Nuclear Research, Otwock-Swierk, Poland

This work was carried out within the fraamework of the international research project “E+T RAW” and presented at ISHEPP XXII in Dubna, Russia [1].

The three actinides – neptunium, americium and curium (called the minor actinides - MA) – are byproducts of energy production in reactors resulting in the effect of parasitic neutron capture. About 10-20% of fissionable isotopes are transmuted in a reactor into minor actinides. As they are long lived and in a typical nuclear power reactor parasitic neutron capture prevails, it is difficult to incinerate them. They of cumulate. The only way to incinerate them is fission.

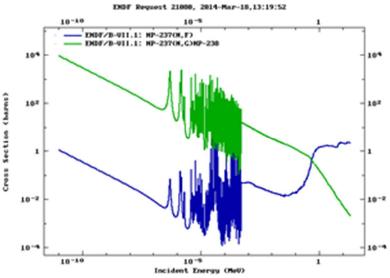


Fig. 1. Np-237 neutron induced fission (dark blue) and capture (green) cross section dependence on energy [2].

High energy neutrons (En > 1 MeV) are needed for Np-237 fission to prevail over capture. The “E+T RAW” collaboration investigates various ADS setups and their applicability to actinide incineration [3].

Np-237 samples were irradiated by spallation neutrons produced in theADS (Accelerator Driven System) setup QUINTA. Three experiments were carried out. The accelerated beam consisted of deuteron ions of energy 2, 4 and 8 GeV respectively. The measurement method was based on gamma-ray spectrometry. During analysis of the spectra several fission products and one actinide were identified. Fission product activities gave the number of fissions. The actinide (Np-238), a result of neutron capture by Np-237, gave the number of captures.

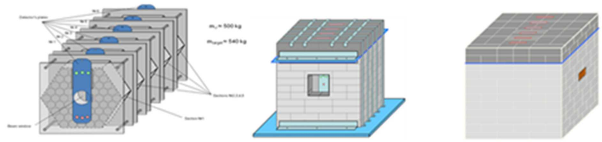


Fig. 2. QUINTA setup view - internal core, front view and rear view.

Gamma spectra were analyzed with the DEIMOS program. Identified peak area was then corrected for cooling time, irradiation time, detector efficiency and fission product yield to get the Np-237 fission rate.

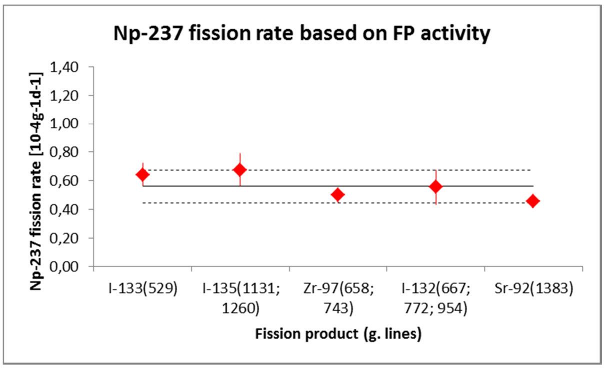


Fig. 3. Example results of Np-237 fission rate based on Fission Product activities.

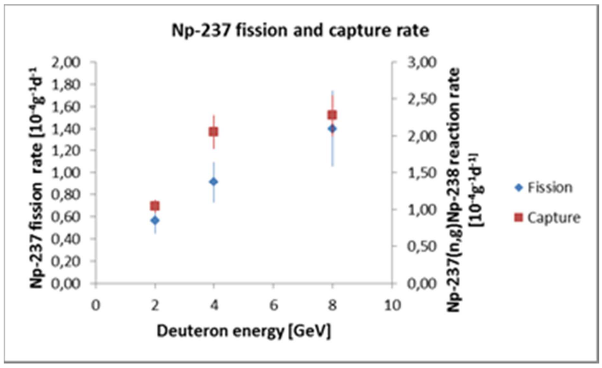


Fig. 4. Np-237 fission and capture rate dependence on impinging deuteron energy.

Table 1. Fission to capture and fission to absorption ratio results.

Ed [GeV]	F/Cap	±σ	±σ [%]	F/Abs	±σ	±σ [%]
2	0.541	0.119	21.96%	0.35	0.08	22.26%
4	0.445	0.101	22.70%	0.31	0.07	22.12%
8	0.615	0.166	27.03%	0.38	0.10	27.00%

The above ratios are about 50% larger than in SFRs. They seem not to depend on deuteron energy. This suggests the neutron spectra do not depend on deuteron energy either. Neutron capture still prevails in Np-237 in the QUINTA setup.

References

[1] Measurements of Np-237 incineration in ADS setup QUINTA , S. Kilim et al. http://pos.sissa.it/archive/conferences/225/056/Baldin%20ISHEPP%20XXII_056.pdf
[2] Evaluated Nuclear Data File (ENDF); https://www-nds.iaea.org/exfor/endf.htm
[3] W. Furman et al.; Recent results of the study of ADS with 500 kg natural uranium target assembly QUINTA irradiated by deuterons with energies from 1 to 8 GeV at JINR NUCLOTRON; PoS(Baldin ISHEPP XXI)086.

Quasi-two-particle π+Xe → π +n interactions in the GeV energy region as a probe of nuclear structure

A. Pacan[1], B. Słowiński[1,2]
[1]Faculty of Physics, Warsaw University of Technology, Warsaw, Poland
[2]National Centre for Nuclear Research, Otwock-Świerk, Poland

It is commonly known that the impact parameter (IP) is a very important quantity determining the initial interaction geometry of hadron-nucleus interactions. It is also of special interest to study in this way the possibility of the location of available nontrivial intranuclear ingredients. However only the momenta and energies of identified secondary particles are directly measured. So, the question arises whether and to what extent one can estimate the interval of IPs at which a specific reaction channel occurred. In the first place quasi-two-particle interactions are important as the simplest probe for such investigation. To clear up this problem it is appropriate to analyze the correlation between some constructions of the measured features and the IP using reliably established codes.

Earlier [1] we investigated the correlation between multiplicity, rapidity and IP of charged pions, protons and neutrons produced in π +Xe interactions at intermediate energies by means of the JAM code and found that there exists some meaningful correlation between the IP and both the average multiplicity and average rapidity of the produced particles, and it is possible in principle to infer more than simply qualitatively about the initial interaction geometry on the basis of the available observables.

Next, we studied the correlation between the rapidity, transverse momentum and impact parameter of pions, η^0-mesons and protons produced in quasi-two-particle π+Xe interactions at 2.34 GeV in order to clarify the possibility of a plausible estimation of the IP interval where these reactions occur. This work was performed using the JAM simulation code [2].

In Fig.1 we demonstrate the results of a simulation of rapidity (η), transverse momentum (p_T) and impact parameter (b) distributions of pions, η0-mesons and protons emitted in the quasi-two-particle channels of the π+Xe interaction at 2.34 GeV/c.

One can conclude that it is possible to estimate the intranuclear situation of these quasi-two-particle channels of the investigated reactions at least for ~50% of the emitted particles concentrated symmetrically around their p_T and η distributions. The result obtained for the relevant impact parameters is $b \approx 6 \pm 1$ fm. Moreover, a similar investigation has also been done for the two-particle channels of the π^-+Xe interaction at 3.5 GeV/c leading to quite analogous conclusions. Our results may also be useful for the investigation of nontrivial intranuclear ingredients using quasi-two-particle channels as a probe.

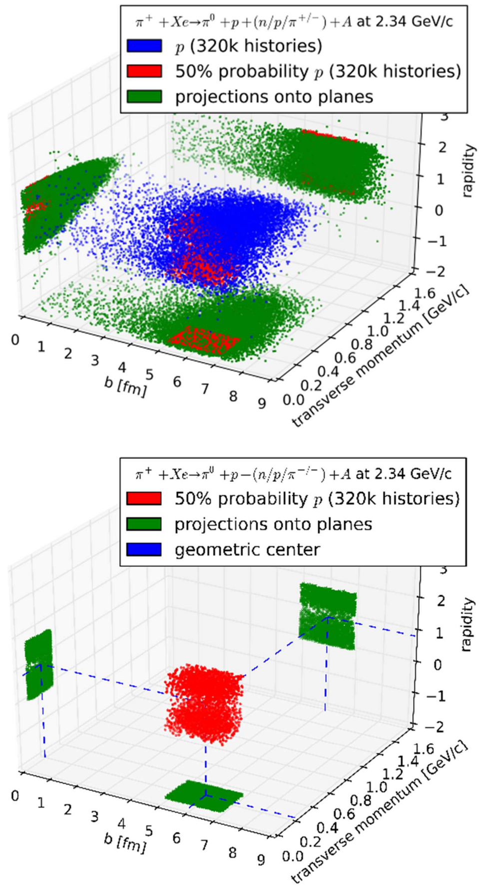


Fig. 1. The 3D (η-p_T-b) distribution of all protons above 21 MeV emitted in the reaction (upper). Similar scatter plot of the 50% of protons symmetrically concentrated around the maximum value of their p_T and η distributions which appear much more localized as shown in the lower part.

References

[1] B.Słowiński, R.Korzeniowski and R.Sobczak. NIM A 694(2012)280-5

[2] B. Słowiński, A.Pacan. In: Relativistic Nuclear Physics and Quantum Chromodynamics. XXII Intern. Seminar on High Energy Physics Problems. Baldin ISHEPP XXII. Book of Abstracts. Dubna 2014, p.92

Production of neutrons in heavy spallation targets by electrons of energy from 200 to 1000 MeV and realativistic protons

A. Polański[1], B. Słowiński[1,2] , T. Jackowski[1], A. Pacan[2]
[1]National Centre for Nuclear Research, Otwock-Świerk, Poland
[2] Faculty of Physics, Warsaw University of Technology, Warsaw, Poland

One of the main problems of present and future nuclear power is the safe and rational management of radioactive waste from nuclear plants, in particular, by means of transmutation and incineration in neutron fields. Although it is commonly accepted that for this purpose ~1 GeV protons producing neutrons in heavy spallation targets like Pb, W and U, are optimal accelerators of such beams are expensive and not available in many laboratories.

Therefore, keen interest has also been displayed in neutron generation by electronuclear reactions initiated by electrons because the relevant accelerators are much cheaper and sufficiently popular.

In this work we compare the results of our calculation of the energy spectra of neutrons produced in heavy spallation targets such as Pb and W rods by electrons from 200 MeV to 1 GeV with analogous distributions of neutrons generated by 1 GeV protons in the same targets. All calculations were performed with the MCNPX and FLUKA codes [1].

The modelling of neutron flux and energy generation were carried out for a subcritical fast neutron reactor cooled with gas and based on MOX fuel. The calculated energy spectra of neutrons produced in different experimental channels both by electrons and protons are depicted in Fig.1.

The radioactivity of a target set-up induced in the course of longtime irradiation is an important feature from a practical and a safety viewpoint. Fig.2 shows the radioactivity evolution of lead and tungsten targets irradiated by 600 MeV electron and proton beams during one year of irradiation. The results were obtained using the FLUKA code. One can see that the radioactivity of the target in the case of proton beams is greater than after electron irradiation by about three orders of magnitude for a lead target and two orders of magnitude for a tungsten target during the whole irradiation time. So, the smaller target radioactivity produced by electrons is a great advantage of an Accelerator Driven System (ADS) operating in transmutation mode. It has also been shown that for a tungsten target the overall radioactivity is higher up to ~10 years after irradiation as compared to the lead target.

The shapes of the neutron energy spectra created by both 1GeV protons and electrons are acceptably comparable below ~1 MeV whilst above this value electronuclear neutrons are numerous enough to be used as a spallation neutron source for several aims like transmutation and incineration, at least at the experimental level. Additionally, the heat release and remnant radioactivity of the investigated targets have also been estimated.

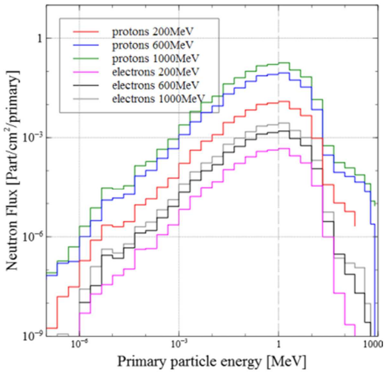


Fig. 1. Energy spectra of neutrons produced by electrons of energy 200, 600 and 1000 MeV, and protons of energy 600 and 1000 MeV.

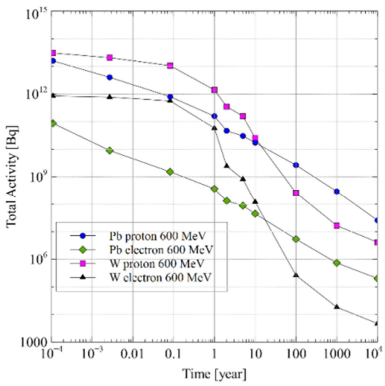


Fig. 2. Total radioactivity evolution of lead (natural) and tungsten (natural) targets irradiated by 600 MeV electron and proton beams. The dimensions of the targets considered: radius 9cm, thickness 70cm. Calculation results from the FLUKA code for irradiation time – 1 year with statistics of the order of 10^7 histories. The beams parameters: $9.45*10^{12}$particles/s (1kW).

Reference

[1] A. Polański, B. Słowiński, T. Jackowski, A. Pacan. Progress in Nuclear Energy. http://dx.doi.org/10.1016/j.pnucene.2014.07.00

Diffusion of helium in perfect and non perfect uranium dioxide crystals and their local structures

L. Dąbrowski, M. Szuta
National Centre for Nuclear Research, Otwock-Świerk, Poland

Local nano structures and their changes relevant tothe diffusion of helium were determined by applying density functional theory (DFT). With its help we calculated the deformation of the crystal lattice while moving helium atoms between octahedral sites. The optimal mutual coordinates of the atoms were determined by minimizing the Hellman-Feyman forces, allowing at the same time a precisely specify dynamic height and the shape of the potential barrier. For a crystal containing single oxygen or uranium vacancies, both the deformation associated with the presence of vacancy, as well as additional deformation related to the migration of the helium atom in the lattice have been described. It was found that in the case of vacancies, the migration of helium atoms between octahedral sites is not along a straight line but along a polyline. For the adiabatic approach we numerically determine the potential values of the crystal field in UO_2 along the direction of neighbour interstitial octahedral positions. The results of "ab initio" calculations of the height and shape of the potential barrier for pure uranium dioxide and containing single oxygen and uranium vacancies, are shown in Figs 1 and 2.

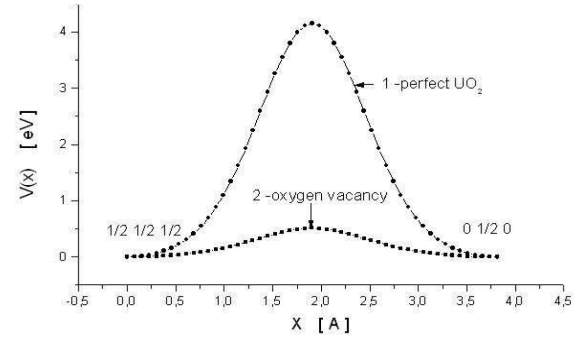


Fig. 1. Crystal field potential V versus helium location x.along the direction ½ ½ ½ → 0 ½ 0 –(through the position ¼ ½ ¼) – for perfect UO_2.along the direction ½ ½ ½ → 0 ½ 0 – (through the position ¼ 0,265 ¼) – for UO_2 containing an oxygen vacancy in the position ¼ ¼ ¼ .

Applying a two site –model we evaluated the time for an over-barrier jump and diffusion of interstitial He. The calculation results are shown in Figure 3. In this Figure are also shown the results of measurements using the ^{3}He(d, α)^{1}H Nuclear Reaction Analysis Technique (see points *, ▲, ■, and ● in Figure 3).

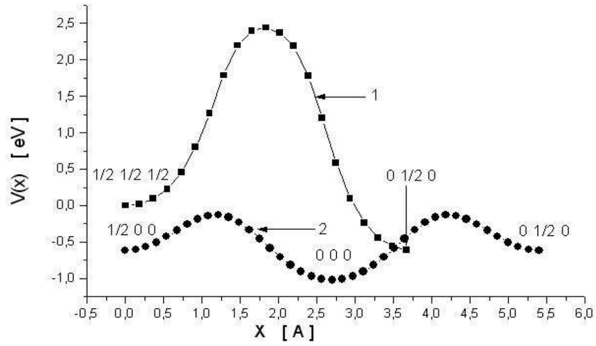


Fig. 2. Crystal field potential V versus helium location x with the presence of a uranium vacancy situated in position 0 0 0. For the zero energy level the value of the cohesion Energy is assumed, when the atom of helium is found in the octahedral position.along the direction ½ ½ ½ → 0 ½ 0 – (through position ¼ ½ ¼) – for perfect UO_2.along the direction ½ 0 0 → 0 ½ 0 – (through the position ¼ 0,2842 0 0, position 0 0.2842 0).

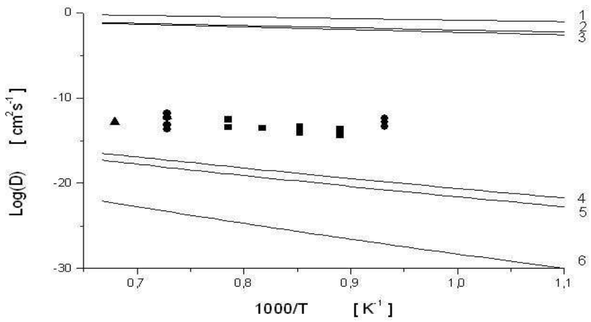


*Fig 3. Temperature dependence of the helium diffusion coefficient in perfect and non perfect UO_2 within the Arrhenius range.1÷6 curves - dependence obtained in this work for potential barriers 0.18, 0.32, 0.51, 2.44, 3.05 and 4.15 eV (see Table I) *,■,▲,●, ,- experimental values of diffusion coefficients*

Conclusions

The local structure, namely the local parameters of the lattice and the local positions of atoms and their modifications during the migration of the diffusing helium atoms exert an essential influence on the value of the local barriers of the potential, which directly affects the value of the local diffusion coefficients This applies to both perfect and non perfect uranium dioxide crystals.

In UO_2 crystals containing uranium defects local deformation of the lattice is large enough that it changes visibly the crystalline field potential values in the octahedral positions in the first coordination shell in relation to the second coordination shell. As a consequence, diffusion from one octahedral interstitial position to another, in accordance with the law of energy conservation may take place only with the emission or absorption of phonons.

Reference

[1] L. Dąbrowski, M. Szuta „Diffusion of helium in the perfect and non perfect uranium dioxide crystals and their local structures" J. All. Comp. 615 (2014) 598-603

Strong coupling effects in near-barrier heavy-ion elastic scattering

N. Keeley[1], K.W. Kemper[2], K.Rusek[3]
[1]*National Centre for Nuclear Research, Otwock-Świerk,, Poland*
[2]*Department of Physics, The Florida State University, Tallahassee,, USA*
[3]*Heavy Ion Laboratory, University of Warsaw, Warsaw, Poland*

Angular distributions of heavy-ion elastic scattering differential cross sections at incident energies close to the Coulomb barrier, when divided by the Rutherford scattering cross section, usually exhibit the characteristic form often referred to as a Fresnel scattering pattern, see Fig. 1 (a) for a typical example.

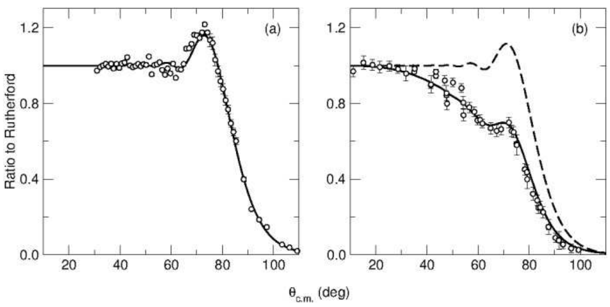


Fig. 1 (a) Elastic scattering angular distribution for 95 MeV ^{16}O incident on a ^{208}Pb target. (b) Elastic scattering angular distribution for 90 MeV ^{18}O incident on a ^{184}W target.

However, some systems have angular distributions of a markedly different form; instead of the usual Fresnel pattern with its characteristic peak — due to interference between the nuclear and Coulomb components of the scattering potential — followed by an approximately exponential fall-off with angle, there is instead a large *reduction* of the cross section compared to the Rutherford value, see Fig. 1 (b).

This deviation from the expected Fresnel scattering pattern is due to strong couplings to other reaction channels, most often Coulomb excitation of strongly-coupled low-lying rotational levels. In the case of the ^{18}O + ^{184}W scattering shown in Fig. 1 (b) it is coupling to the first 2^+ excited state of ^{184}W that causes the effect; the solid and dashed curves in Fig. 1 (b) denote the results of calculations with and without this coupling included, respectively.

With the advent of radioactive beam facilities elastic scattering experiments with light, weakly-bound exotic nuclei have become possible. It has been found that many of these nuclei, when scattered from sufficiently heavy targets, also exhibit the "strong coupling" angular distribution pattern, see Fig. 2 for an extreme example, that of ^{11}Li scattered from a ^{208}Pb target. In these cases it is strong coupling to low-lying breakup channels, most often dipole Coulomb coupling to the non-resonant continuum, that gives rise to the effect.

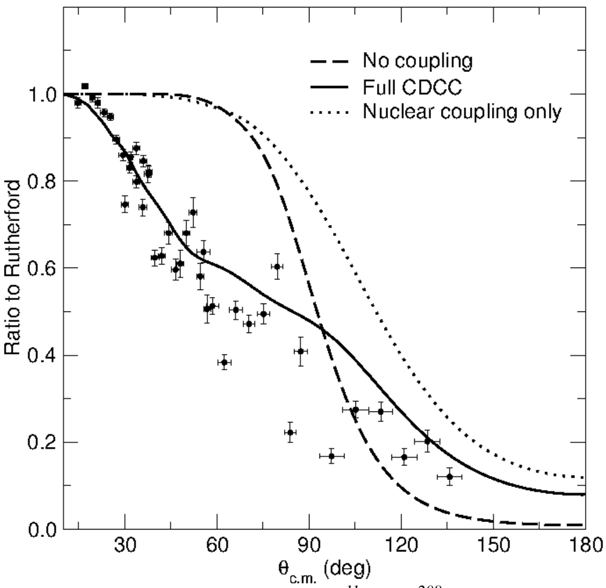


Fig. 2. Elastic scattering for the ^{11}Li + ^{208}Pb system at an incident energy of 29.8 MeV. The curves denote the results of calculations without (dashed) and with (solid and dotted) couplings to the non-resonant continuum of ^{11}Li and show the dominance of Coulomb coupling effects.

This fascinating aspect of heavy-ion reaction dynamics formed the subject of a recent invited review article in European Physical Journal A [1]. Such a review was timely due to the growing interest in the scattering and reactions of radioactive beams. In it we trace the history of the subject from its beginnings in the 1970s and also make some predictions of systems that should provide interesting subjects for future studies. In particular, the availability of beams of light, weakly-bound neutron-rich nuclei provides the intriguing prospect of systems where the strong coupling effect is due to couplings to *transfer* channels.

Reference

[1] N. Keeley, K.W. Kemper and K. Rusek, Eur. Phys. J. 50, 145 (2014)

Q-alpha values in superheavy nuclei from the deformed Woods-Saxon model

P. Jachimowicz[1], M. Kowal[2], J. Skalski[2]
[1]Institute of Physics, University of Zielona Góra, Zielona Góra, Poland
[2]National Centre for Nuclear Research, Warsaw, Poland

Most of the currently known heaviest nuclei, in particular all beyond Z=114, decay via a sequence of alpha particle emissions. Masses of superheavy (SH) nuclei with Z = 98-128, including odd and odd-odd nuclei, are systematically calculated within the microscopic-macroscopic model based on the deformed Woods-Saxon potential [1]. Ground states are found by minimizing energy over deformations and configurations. Pairing in odd particle-number systems is treated either by blocking or by adding the BCS energy of the odd quasiparticle. For systems with odd proton or neutron (or both), a standard treatment is that of blocking. Considered configurations consist of an odd particle occupying one of the levels close to the Fermi level and the rest of the particles forming a paired BCS state on the remaining levels. The ground state is found by looking for a configuration (blocking particles on levels from the 10-th below to 10-th above the Fermi level) and deformation giving the energy minimum. In the present study, we used this procedure including mass-symmetric deformations. Three new parameters introduced in [1] may be interpreted as the constant mean pairing energies for even-odd, odd-even, and odd-odd nuclei. They are adjusted by a fit to masses of heavy nuclei. Other parameters of the model, fixed previously by fitting masses of even-even heavy nuclei, are kept unchanged. One should bear in mind that calculated decay energies are independent of the fitted energy shifts (average pairing energies). With this adjustment, the masses of SH nuclei are predicted and then used to calculate alpha-decay energies to be compared to known measured values. It turns out that the agreement between calculated Q(alpha) values with data in SH nuclei is better than in the region of the mass fit. The model overestimates Q(alpha) for Z = 111-113. Ground state (g.s.) configurations in some SH nuclei hint to a possible alpha-decay hindrance. The calculated configuration-preserving transition energies show that in some cases this might explain discrepancies, but more data are needed to explain the situation. As an example of odd-odd systems, the alpha-chain for the nucleus ^{294}117 is show in Fig.1. One may note the a good agreement between our Q_α values and the recently reported experimental data. The other models deviate more from the measured Q_α values in this chain. This has an impact on the predicted alpha-decay lifetimes, as shown in Fig. 1. For example, in the case of the HFB-14 approach, the half-life of ^{274}Bh is overestimated by four orders of magnitude while that for ^{278}Mt is underestimated by three orders of magnitude. The resulting half-lives are systematically overestimated as a consequence of the underestimated Q_α values. (The Viola-Seaborg–type formula was used to convert Q_α to half-lives). In all three discussed chains, our results are slightly overestimated. At present, however, the explanation that the allowed decays go to the excited states (lying slightly above the ground state), is not excluded, especially in the context of recent spectroscopic studies of element Z = 115.

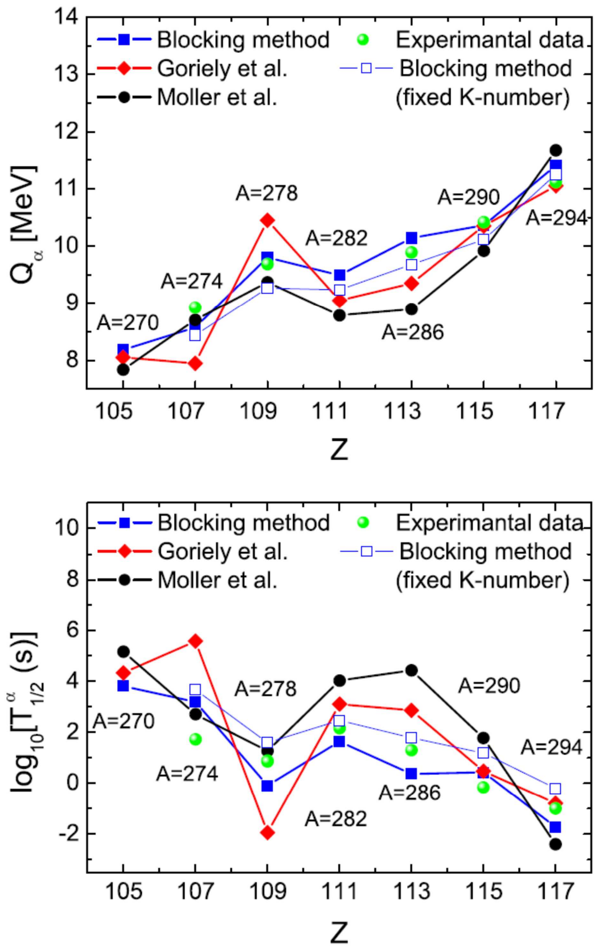


Fig. 1. Calculated vs experimental Q alpha values and α half-lives for the decay chain of Z = 117, A = 294.

Reference

[1] P. Jachimowicz, M. Kowal, J. Skalski, Physical Review C 89, 024304 (2014

Numerical simulation of transmutation of minor actinides

A. Polański
National Centre for Nuclear Research, Otwock-Świerk, Poland

The elimination or transmutation of minor actinides is a key to the sustainability of the back-end of the fuel cycle. Advanced experimental tests as well as numerical simulation tools will be required to conduct this interdisciplinary research encompassing basic as well as applied sciences. A simulation of the transmutation of minor actinide in subcritical reactor is presented in this paper.

The geometry of the subcritical reactor is presented in Fig.1.

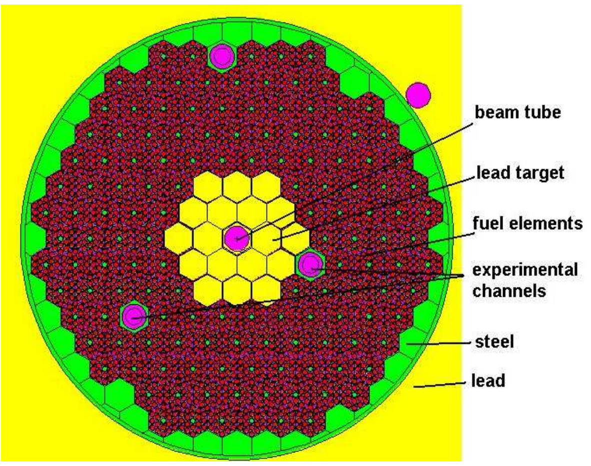


Fig.1.Geometry of subcritical core.

In the framework of this work the calculations of nuclear burning of MOX fuel (30% PuO2+70% UO2) and transmutation of minor actinides were performed. The transmutation of isotopes of plutonium in MOX fuel and actinides (Np-237, Am-241, Am-243, Cm-244, Cm-245) in the experimental channels of a ubcritical fast reactor (three channels as shown in Fig.1) was calculated using the MCNPX and CINDER codes. Calculations were performed for the transmutation of TRU (1.35%) spent PWR fuel after 4 years of cooling after removal of fission products (5.145%) and uranium (93.505%). TRU consists of: 5.33% Np-237, 2.81% Am-241, 2.07% Am-243, 0.74% Cm-244, 0.07%Cm-245 and 88.98% isotopes of Pu. The subcritical reactor with thermal power 30 MWth was driven by a beam of protons of energy 1GeV. The spectrum of neutrons escaping the spallation target was presented in [1].

The calculations of the presented system showed that the neutron multiplication factor varies from 0.96315 at t=0 to a value of 0.91687 after one year and 0.52125 after ten years continuous operation. The degree of burn-up of the system was 29 GWd/MTU per year for a power of 30 MWth and 48 GWd/MTU per year for a power of50 MWth. Total flux density was in the range 1.72E15[n/(cm2 s)] for t=0 and 1.83E15 [n/(cm2 s)] for 1 year. Results of calculations of transmutation of minor actinides are presented in Fig.1-Fig.3.

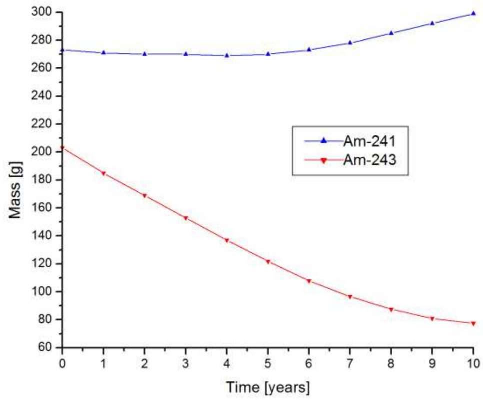


Fig.1 Transmutation of Americium.

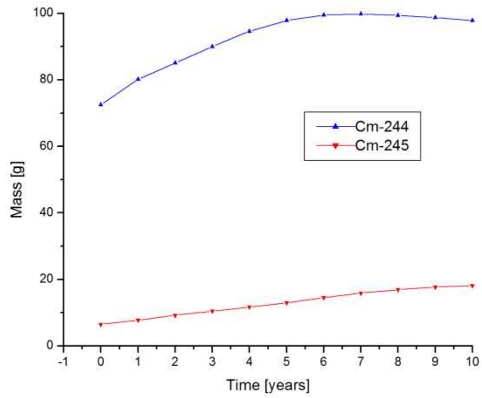


Fig.2. Transmutation of Curium.

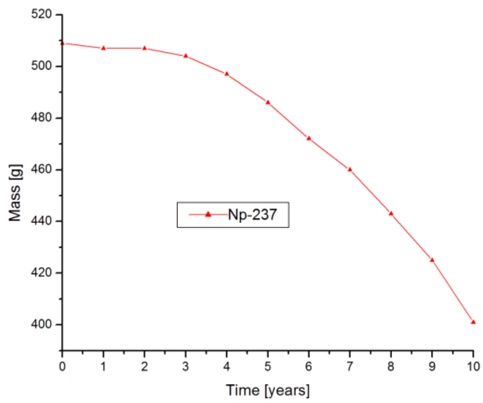


Fig.3. Transmutation of Neptunium.

Calculations showed that the mass of isotopes of americium Am-241 falls within four years and Am-243 and neptunium Np-237 falls within ten years while the mass of Cm-244 and Cm-245 grows. The calculations determine the conditions for the use of spent PWR fuel in generation IV reactors with closed fuel cycles. Spent fuel after the separation of actinides can be used as MOX fuel (oxides of uranium and plutonium mixture) and with a cartridge containing actinides (Am, Cm, Np).

Reference

[1] A.Polański at all . Progress in Nuclear Energy 78 (2015)

PLASMA PHYSICS & TECHNOLOGY

Investigation of visible radiation emitted from hot plasma streams and the interaction of such streams with solid targets*

E. Skladnik-Sadowska[1], K. Malinowski[1], M.J. Sadowski[1-2], K. Czaus[1], R. Kwiatkowski[1], D. Załoga[1], J. Żebrowski[1], K. Nowakowska-Langier[1], M. Kubkowska[2], M. Paduch[2], E. Zielińska[2], V.A. Gribkov[2], I.E. Garkusha[3], M.S. Ladygina[3] and V.A. Makhlay[3]

[1]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
[2]*Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland*
[3]*Institute of Plasma Physics, Kharkov, Ukraine*

At the very beginning of 2014 the authors of earlier studies, those concerned with the removal of deuterium deposits from graphite and structural changes of tungsten irradiated by intense plasma streams, made the final revisions of two papers, which have been published in recognized scientific journals [1-2].

During the first quarter of 2014 the NCBJ team has also produced supplements and revisions of five papers, which were presented earlier at the PLASMA-2013 conference. Three papers described experimental studies of plasma stream interaction with targets made of tungsten and carbon fibre composite (CFC) within the PF-1000 facility, and estimates of adhesion of layers deposited by means of the IPD technique. Two other papers described studies which were performed in collaboration with a Ukrainian team and concerned the behaviour of different tungsten samples during irradiation by plasma streams, and particularly the melting and erosion of the tungsten surface under conditions simulating the exposure of the internal walls in ITER. All these papers have finally been published in Physica Scripta [3-7].

The Polish-Ukrainian team also prepared a paper on the interaction of plasma streams with tungsten targets and completed the final revisions of a paper which has been accepted for publication in Journal of Physics [8].

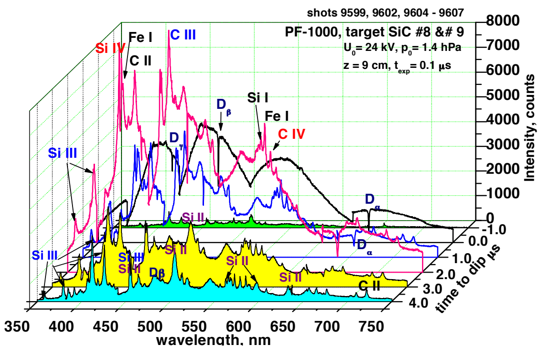


Fig. 1. Optical spectra of discharges within the PF-1000U with a SiC target, as recorded with different delays after the maximum plasma compression.

Most effort was devoted to new research on the behaviour of silicon carbide (SiC) samples, which were irradiated by intense plasma streams within a modified PF-1000U facility. Optical spectra of the visible radiation emitted at different instants were recorded and analysed, as shown in Fig.1.

Analogous spectroscopic measurements were performed within the modified PF-360U facility at NCBJ. Some examples of the optical spectra, which were recorded in this device, are shown in Fig. 2.

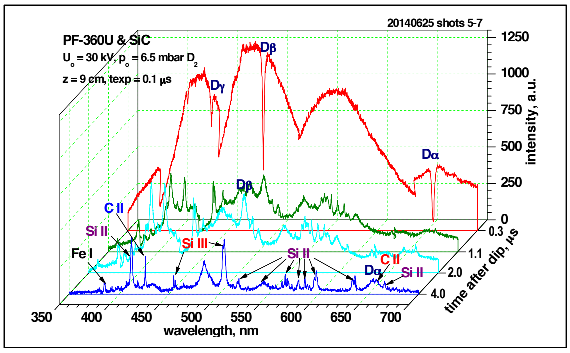


Fig. 2. Optical spectra of plasma at different instants of PF-360U discharges performed with an SiC target.

Morphological changes in the structure of the SiC target surface irradiated by plasma streams were also studied, as shown in Fig. 3.

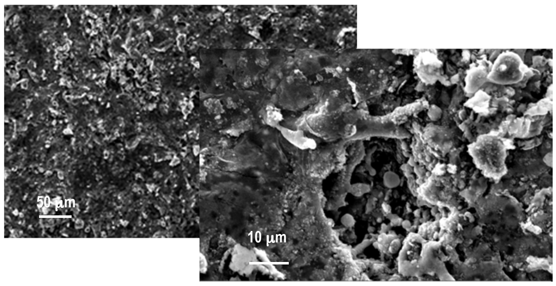


Fig. 3. SEM pictures of a virgin SiC target (left) and that irradiated within the PF-360U facility (right).

The results of an analysis of the recorded optical spectra and the observed changes in the surface structure were discussed in a paper presented at an international conference in Kharkov and published in PAST journal [9].

Another task was optical emission spectroscopy of plasma streams generated within the PF-1000U facility without and without the use of additional gas-puffing by means of a gas valve placed along the z-axis. On the basis of the recorded optical spectra it was possible to determine changes in the plasma electron concentration, as shown in Fig. 4.

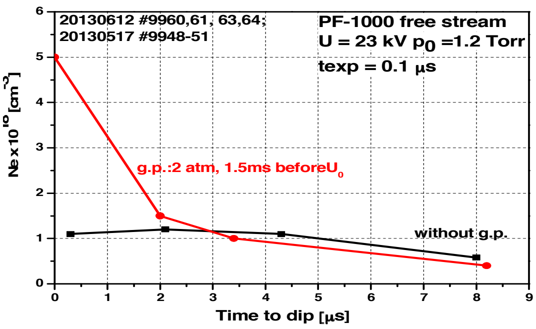


Fig. 4. Changes of the electron concentration in discharges performed within the PF-1000U facility with gas-puffing.

The results of an analysis of such PF-1000U discharges were summarized in a separate paper which was presented at ICPPCF-2014 in Kharkov and submitted for publication in PAST [10].

Particular attention was paid to a comparison of the optical spectra of plasma generated within the PF-1000U facility during several experiments, which were performed with the deuterium puffing, at different instants before the main discharge triggering. Some examples of such optical spectra are presented in Fig. 5.

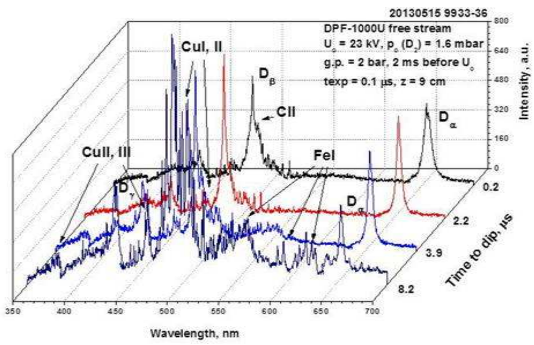


Fig. 5. Changes of optical spectra from plasma produced within the PF-1000U facility with the gas-puffing started 2 ms before the discharge initiation.

On the basis of the Dα line profile it was possible to determine changes in the electron concentration at different phases of the investigated discharges. The results were summarized in a paper presented at the Kudowa-2014 Summer School and submitted for publication in Nukleonika [11].

Another research topic was a summary of studies performed so far, which concerned the interaction of plasma streams generated within the PF-1000U at the deuterium puffing, and used for irradiation of tungsten samples placed at a distance of 9 cm from the electrode outlets. A comparison of the recorded optical spectra and macro-pictures of the investigated targets are presented in Fig. 6.

The results of the detailed analysis of changes in the optical spectra and changes of the target surface structure were summarized in a separate paper presented at the Kudowa-2014 School and submitted for publication in Nukleonika [12].

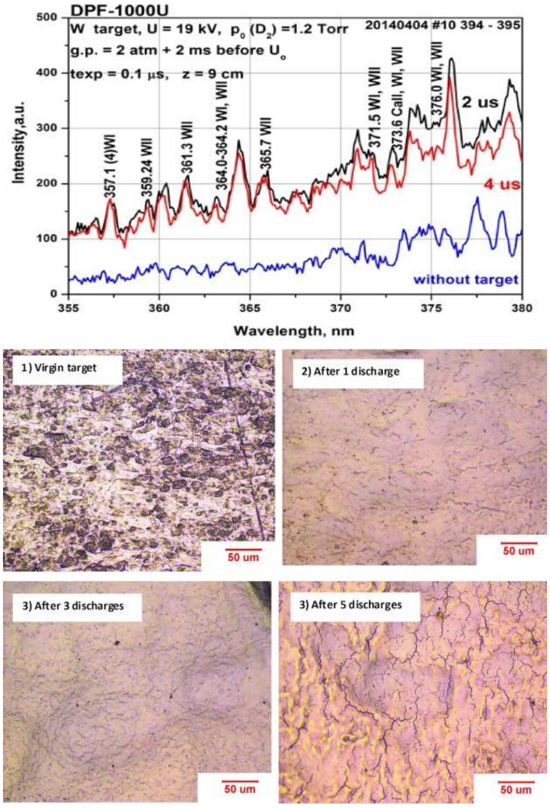


Fig.6. Optical spectra of plasma in the PF-1000U facility, as recorded with and without a W-target (top), and pictures of changes in the target surface irradiated by plasma streams (bottom).

References

[1] M. Kubkowska, E. Składnik-Sadowska, et al., J. Phys.: Conf. Ser. Vol. 508 (2014) 012015
[2] I.E. Garkusha, V.A. Makhlaj, et al. Fusion Sci. Tech. Vol. 65, No. 2 (2014) 186-193
[3] M. Kubkowska, E. Skladnik-Sadowska, et al., Phys. Scripta T161 (2014) 014038
[4] E. Skladnik-Sadowska, R. Kwiatkowski, et al., Phys. Scripta T161 (2014) 014039
[5] K. Nowakowska-Langier, K. Zdunek, et al., Phys. Scripta T161 (2014) 014063
[6] V.A. Makhlaj, I.E. Garkusha, et al., Phys. Scripta T161 (2014) 014040
[7] V.A. Makhlaj, I.E. Garkusha, et al., Phys. Scripta T159 (2014) 014024
[8] I.E. Garkusha, V.A. Makhlaj, et al., accepted for publication in J. Phys. Conf. Ser. (2014)
[9] E. Skladnik-Sadowska, R. Kwiatkowski, et al., PAST Ser. Plasma Phys. No. 6(94) (2014) 72-75
[10] M.S. Ladygina, E. Skladnik-Sadowska, et al., accepted for publication in PAST Ser. Plasma Phys. (2014)
[11] D. Załoga, E. Skladnik-Sadowska, et al., accepted for publication in Nukleonika (2014)
[12] M.S. Ladygina, E. Skladnik-Sadowska, et al., accepted for publication in Nukleonika (2014)

*Collaboration with IFPiLM and IPP KIPT

.

Studies of fast electron streams in compass and other mcf experiments in the framework of the eurofusion consortium*

L. Jakubowski, M. Rabiński, M.J. Sadowski, J. Żebrowski, M.J. Jakubowski, K. Malinowski, R. Mirowski
National Centre for Nuclear Research, Otwock-Świerk, Poland

High-temperature plasmas in tokamaks usually contain large populations of high-energy electrons and ions. The determination of their parameters is an important part of plasma fusion studies. First of all, the investigation of fast runaway electrons in tokamaks makes it possible to collect important information about plasma behaviour. From the practical point of view the control of high-energy electron beams, which have the potential to damage the first wall, also plays a significant role in the avoidance and mitigation of disruptions during tokamak operation. In 2014 an experimental and theoretical study to determine the conditions of runaway electron generation and to investigate mitigation techniques, was started under the leadership of the IPP ASCR in Prague as part of the MST-2 project carried out within the framework of the EUROfusion Consortium.

A group of physicists and engineers from the NCBJ has for several years been involved in a project to develop and use a novel diagnostic technique based on the Cherenkov effect (i.e. the emission of intense radiation by fast electrons within appropriate radiators). This technique ensures direct, spatially well-defined and instantaneous measurements of fast electron beams. The experience of this team in the construction and testing of Cherenkov-type measuring heads, as well as in running experimental studies of fast electron beams (within the CASTOR, ISSTOK, TORE-SUPRA, and FTU facilities), was used in studies on time-correlations of the recorded signals with other phenomena within tokamaks, e.g. the generation of soft and hard X-ray pulses.

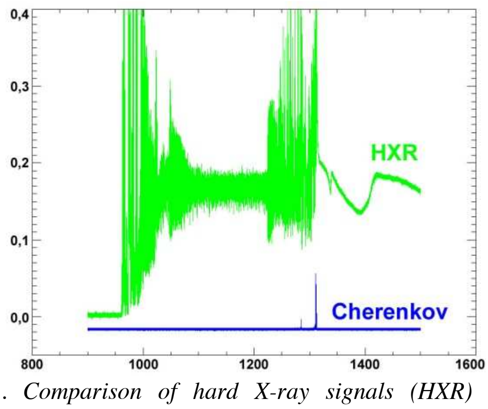


Fig. 1. Comparison of hard X-ray signals (HXR) and electron-induced signals from a single-channel Cherenkov detector (signal intensity [V] versus time [ms]). Fast runaway electrons were only recorded during a discharge disruption only.

On the basis of experience collected up-to-now several measuring heads with Cherenkov radiators made of aluminium nitride (AlN) or diamond were prepared for experimental studies at the COMPASS tokamak. The measuring head with the AlN radiator was installed within the COMPASS facility. During the performed experimental session some beams of runaway electrons were observed during a discharge disruption (see Fig. 1.).

In 2014 also the design and manufacture of a new, single-channel measuring head was also performed at NCBJ. The Cherenkov radiator constituted a thin cylindrical diamond plate. Its surfaces were coated by a thin metal-layer, which determined the low-energy detection threshold for impinging electrons (equal to 58 keV). This detector was mounted within a stainless-steel head equipped with CFC shielding, as shown in Fig. 2.

Fig. 2. Picture of the new Cherenkov detector and manipulator.

In 2014 construction of a new multi-channel Cherenkov-type measuring head for future COMPASS experiments was also prepared.

The results of the earlier experimental campaigns, which were carried out within the ISTTOK tokamak, were summarized in two papers [1-2]. A summary of results obtained within the different tokamaks was presented in another paper [3].

During the recent studies within the FTU tokamak a new kind of modulated signal has been identified and interpreted [4]. The correlation of Cherenkov-signals with MHD instabilities has for the first time been found and it will be an object of further studies, both theoretical and experimentals.

References

[1] L. Jakubowski, V.V. Plyusnin, K. Malinowski, M.J. Sadowski, et al., Phys. Scr. Vol. T161 (2014) 014012;L
[2] . Jakubowski, V.V. Plyusnin, K. Malinowski, M.J. Sadowski, et al., Nucl. Instr. Meth. A Vol. 767 (2014) 61;
[3] L. Jakubowski, M.J. Sadowski, J. Żebrowski, et al., Phys. Scr. Vol. T161 (2014) 014011
[4] F. Causa,…..... L. Jakubowski, K. Malinowski, M. Rabiński, M.J. Sadowski, J. Żebrowski, 25th Fusion Energy Conference (FEC 2014) Russia, Saint Petersburg, 2014-10-13 - 2014-10-18, Poster EX/P2-49

Assembling and laboratory lests of new diagnostic equipment for analysis of high-energy ions at conditions of fusion reactors (SPREJ2)*

M.J. Sadowski[1-2], K. Czaus[1], K. Malinowski[1], E. Składnik-Sadowska[1], J. Żebrowski[1], R. Kwiatkowski[1], D. Załoga[1]
[1]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
[2]*Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland*

At the beginning of 2014 the NCBJ team, which was engaged in a special research project of the NCBiR entitled "Research and development of technology for controlled thermonuclear fusion" (denoted SPREJ2), performed some revisions of a paper describing computer simulations of fast ion trajectories. Such ions can be products of D-D fusion reactions, e.g. in plasma experiments within a COMPASS tokamak, where one could use the developed ion probes. After this revision the paper was published in Physica Scripta [1].

Subsequently, the NCBJ team made some improvements in the construction and the final assembling of two measuring heads designed for recording high-energy ions, including products of D-D and D-T nuclear fusion reactions at conditions which can occur within a scrape-off layer inside a tokamak. In particular, a measuring head of the "pinhole" type, equipped with arotating drum and several nuclear track detectors for recording of successive ion pinhole images was assembled. Another measuring head equipped with a miniature mass- and energy- analyser of the Thomson type was also assembled. The team also finished constructional improvements to a universal manipulator which might be equipped with a chosen measuring head and placed in the diagnostic port of a tokamak.

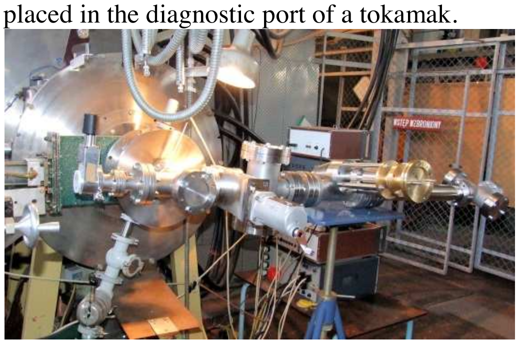


Fig. 1. General view of the RPI-IBIS facility during tests of the manipulator with ion probes.

Since the COMPASS facility in Prague was not accessible in time because of other research tasks, the detailed laboratory tests of the developed ion probes were carried out within the plasma facilities available at NCBJ in Swierk. Initially more detailed laboratory tests of both measuring heads were performed within the RPI-IBIS facility, which can generate intense plasma-ion streams. A picture of this facility is shown in Fig. 1.

The tests of the pinhole-type measuring head proved that it can be used for recording images of ion beams, which after an analysis make it possible to determine the spatial structure and the amount of emitted ions, as shown in Fig. 2.

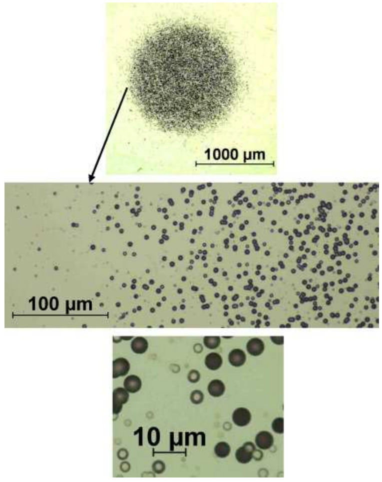


Fig. 2. Ion pinhole images which were recorded within the RPI-IBIS facility by means of the pinhole-type measuring head equipped with a rotated drum and nuclear track detectors.

The subsequent tests performed by means of the measuring head with a miniature Thomson-type mass-spectrometer have proved that such a probe makes it possible to record mass- and energy-spectra of the investigated ions, as shown in Fig. 3.

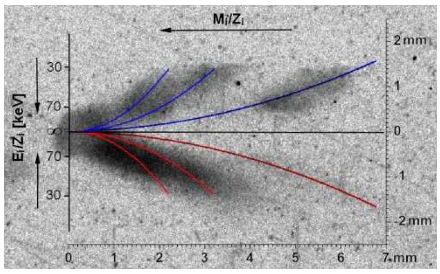


Fig. 3. Ion parabolas which were obtained by means of aThomson-type probe within the RPI-IBIS facility for two successive plasma discharges (after reversal of the analyzing electrodes polarization).

Subsequently, the laboratory tests of the both ion probes were repeated within the PF-360U experimental facility, which within the framework of another task of the SPREJ2 project was modernized and adapted for studies of pulsed plasma-ion streams. A general view of this facility during tests of the developed probes is presented in Fig. 4.

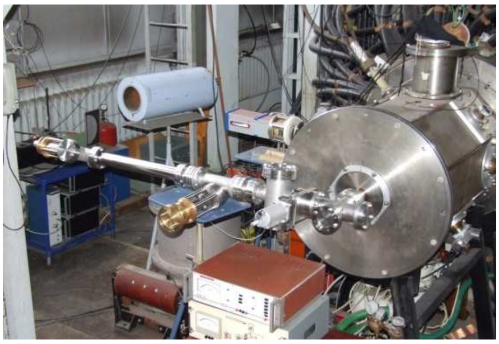


Fig. 4. Picture of the PF-360U experimental chamber, as taken during tests of the ion probes.

Simultaneously with the described tests technical documentation of the both probes and documentation connected with the modernization of the current pulse generator and the PF-360U facility were completed.

All the laboratory tests performed demonstrated the usability of the developed ion probes for measurements of high-energy ions within the determined range of their masses and energies. Examples of the application of the developed probes were presented in two invited lectures given at the Kudowa-2014 Summer School "Towards Fusion Energy" and the international ICPPCF-2014 conference in Kharkov as well as in two publications [2-3].

References

[1] R, Kwiatkowski, K. Malinowski and M.J. Sadowski, Phys. Scripta T161 (2014) 014013

[2] M.J. Sadowski, Selected methods of electron and ion-diagnostics in tokamak scrape-off layers, accepted for publication in Nukleonika (2014)

[3] M.J. Sadowski, PAST Ser. Plasma Phys. No. 6(94) (2014) 245-249

* This research was supported by an NCBiR grant under contract No. SP/J/2/143234/11.

Studies of X-ray, ion- and neutron-emission from plasmas in experimental facilities of the RPI- and PF-type

M.J. Sadowski[1-2], K. Malinowski[1], E. Składnik-Sadowska[1], J. Żebrowski[1], K. Czaus[1], R. Kwiatkowski[1], W. Surała[1], D. Załoga[1], M. Paduch[2], E. Zielińska[2], P. Kubes[3]

[1]*National Centre for Nuclear Research, Otwock-Świerk, Poland*

[2]*Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland*

[3]*Czech Technical University (CVUT), 16-627 Prague, Czech Republic*

At the beginning of 2014 the authors of a paper on measurements and computer modelling of fast ion emission from an RPI-type facility made the final revision of this publication [1]. During the whole of 2014 a team from NCBJ continued experimental studies of X-ray pulses, fast ions and neutrons emitted from high-current discharges within a Plasma-Focus (PF) type facility. In the framework of the scientific collaboration with IFPiLM in Warsaw and CVUT in Prague an investigation of the neutron emission from D-D fusion reactions in the PF-1000U facility at the pulse injection of deuterium was performed. The yields of X-ray and neutron emissions as well as interferometric images of discharges carried out with and without gas puffing were compared. Also compared were X-ray pinhole images recorded by means of a pinhole camera. A detailed comparative analysis of the investigated PF-1000U discharges was presented in a paper [2].

Particular attention was paid to detailed studies of X-ray pinhole images which were recorded for PF-1000U discharges performed under different gas conditions, as shown in Fig. 1.

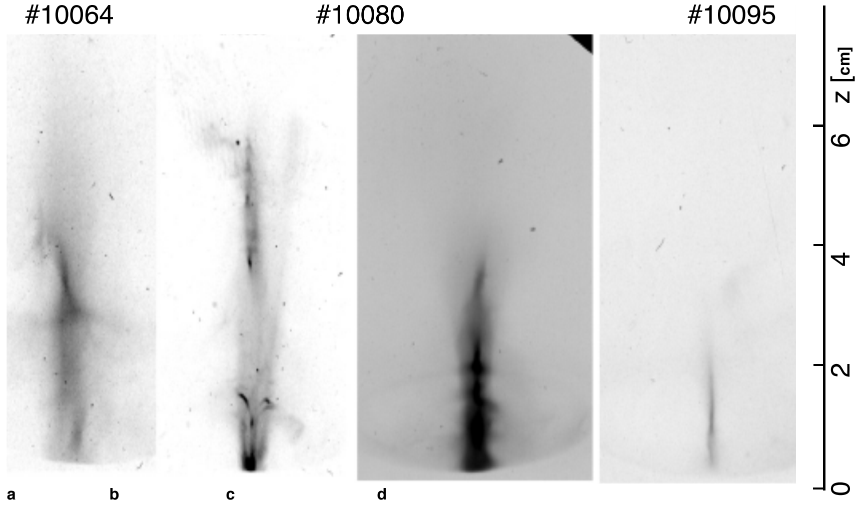


Fig. 1. X-ray pinhole pictures of PF-1000U D2-shots without (a) and with gas puffing (b) as well as Ne-shots without (c) and with D2- puffing (d).

A comparison of the X-ray images was given in another paper presented at the Kudowa School and submitted for publication in Nukleonika [3].

Much effort was devoted to measurements of pulsed beams of fast ions emitted from the PF-1000U facility. In particular, the spatial micro-structure of these ion beams was investigated, as shown in Fig. 2.

Energy distributions of the emitted ions were also investigated, and the results were presented in another paper presented at Kudowa and submitted for publication in Nukleonika [4].

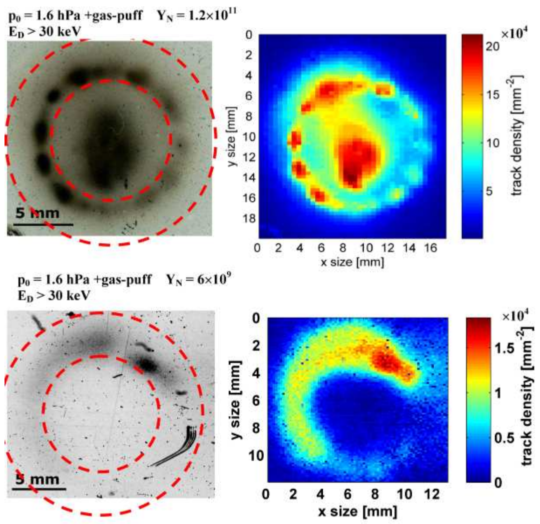


Fig. 2. Ion pinhole images and corresponding density maps of PF-1000U shots with a high (top) and low (bottom) neutron yield.

The results of research on ion- and electron-beams were summarized in a Ph.D. thesis [5]. Other interesting results were obtained during studies of the emission anisotropy of fast protons and neutrons from D-D reactions in the PF-1000U. Use was made of a new technique of so-called “sandwich detectors” composed of an absorption filter (eliminating all ions of energy < 3 MeV) and two layers of nuclear track detectors of the PM-355 type, separated by a thin polyethylene layer (serving as a converter of neutrons into recoil protons). The application of this technique enabled the simultaneous recording of the fast protons and images produced by the fast neutrons. This technique and the results obtained were presented at the ICNTS-2014 conference and later accepted for publication in RSI [6].

References

[1] K. Malinowski, M.J. Sadowski, E. Składnik-Sadowska, Phys. Scripta T161 (2014) 014054
[2] P. Kubes, M. Paduch, et al., Phys. Plasmas 21 (2014) 082706
[3] W. Surala, M.J. Sadowski, et al., accepted for publication in Nukleonika (2014)
[4] R. Kwiatkowski, K. Czaus, et al., accepted for publication in Nukleonika (2014)
[5] R. Kwiatkowski, Ph.D. Thesis (NCBJ, Świerk 2014)
[6] K. Malinowski, E. Składnik-Sadowska, et al., accepted for publication in RSI (2014)

High intensity plasma pulses in joining different materials

M. Barlak[1], Z. Sienkiewicz[1], A. Kosińska[1], M. Chmielewski[2],.
[1]National Centre for Nuclear Research,Otwock-Świerk, Poland
[2]Institute of Electronic Materials Technology, Warsaw, Poland

There is a continuous need in modern technology for joints of different materials, including vacuum tight ones (where a helium leak should be no higher than 1.3e-9 Pa/s) [1].

An accelerating structure is a good example of a system of material joints. Apart from typical copper-copper joints, we can find in these system for example alumina ceramic-stainless steel joints (RF windows) or titanium-stainless steel joints (electron beam windows).

In the processes of production of joints of different materials, several methods are applied around the world, and yet so far a universal technique for preparation of the surface of the joined materials has not been developed.

One popular method for joining different materials is brazing, using active or non-active filler metals.

The liquid filler metal provides good wettability of the surfaces of the joined materials, but is necessary to obtain a correct joint, especially in the case of brazing of ceramic materials or materials with a surface oxide layer like for example stainless steels. An improvement in wettability can be obtained by the formation of an additional metallic layer on the surface of the brazed material. There are several methods of surface metallization, e.g. galvanic methods, arc methods or the vacuum method. We propose for this purpose the use a high intensity pulse plasma beam (HIPPB) technique as a method characterized by much greater universality.

The HIPPB technique allows for melting the modified surface and the simultaneous introduction of a modifying element. The melting depth is about a few micrometre and the fluence of the introduced element is at the level of a few 10^{16} ions per cm^2 per pulse. The deposited layers are alloyed into the surface (not only adhesive joints), new phases can be created in the interface area and additionally there is the possibility of designing the depth profile of the introduced element (e.g. graded profile) to relax the generated stresses [2].

In our work, we used a Rod Plasma Injector (RPI) referred to as IBIS. The main parameters of the modification process were:

- modified materials: 304 steel, 316L steel, 430 steel, H18N9T steel, Al_2O_3 type ceramic,
- introduced material (material of layer): nickel, titanium,
- working gas: argon,
- number of pulses: to 50, mono- and multienergetic pulses,
- energy density: from 1 J/cm^2 to 7 J/cm^2,
- regime of generator work: DPE (Deposition by Pulse Erosion).

Fig. 1 shows a scanning photography of a typical microstructure on the surface of 430 ferritic steel (without nickel) modified with 50 multienergetic Ni+Ar plasma pulses. We can see that the surface is melted, without cracks and contains small Ni drops. Nickel was also present in the melted substrate. The total Ni content, determined by the EDX method from a depth of about 1.5 μm was more than 13 at.%.

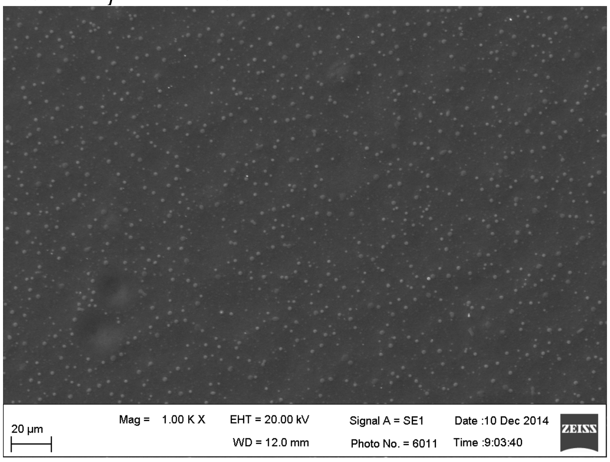


Fig. 1. SEM photography of modified 430 steel.

Wettability tests of the modified samples with "Cusil" (72% Ag, 28% Cu) and "Incusil 15" (61.5% Ag, 23.5% Cu, 15% In) brazes were conducted in a hydrogen atmosphere (40 l/min., 800°C, 30 min.) and/or in vacuum (1e-4 Pa, 800°C or 860°C, 20 min.).

In the best cases, the value of the wetting angle was 35-40° (see Fig. 2 - for 430 steel).

Fig. 2. An example of a good result of the sessile drop test.

In the near future we plane the experiments with new materials and for new process parameters.

Acknowledgments

Many thanks to Ms./Mr. M. Rutkowska, S. Karpisz, B. Staszkiewicz, K. Gniadek, J. Zagórski for technical assistance.

References

[1] W. Włosiński: The joining of advanced materials; Oficyna Wydawnicza Politechniki Warszawskiej, Warsaw 1999
[2] M. Barlak: High intensity plasma pulses in ceramic wettability improvement; The Andrzej Sołtan Institute for Nuclear Studies, Otwock-Świerk, 2010

DETECTORS, ACCELERATORS, PHYSICS OF MATERIALS & APPLICATIONS

Numerical model of thyroid counter

J. Ośko[1], M. Szuchta[2]
[1]National Centre for Nuclear Research, Otwock-Świerk, Poland
[2]Warsaw University, Faculty of Physics, Poland

Introduction

The aim of this study was to develop a numerical model of a spectrometric thyroid counter, used for the measurement of internal contamination by the in vivo method. The modelled scintillation NaI(Tl) detector and water thyroid phantom are used for routine monitoring of internal exposure in the Radiation Protection Measurements Laboratory of the National Centre for Nuclear Research. This method may also be used for monitoring occupationally exposed nuclear medicine personnel.

The gamma radiation spectrum registered by the thyroid counter was calculated using the FLUKA Monte Carlo code.

Materials and methods

FLUKA is a general purpose tool for calculating of particle transport and interactions with matter, covering an extended range of applications spanning from proton and electron accelerator shielding to target design, calorimetry, activation, dosimetry, detector design, Accelerator Driven Systems, cosmic rays, neutrino physics, radiotherapy etc. FLUKA can simulate with high accuracy the interaction and propagation in matter of about 60 different particles [2].

The developed model includes the thyroid counter used in NCBJ and a thyroid water phantom filled with an iodine ^{131}I radioactive source. The thyroid counter consists of a Canberra-Packard NaI(Tl) detector, model 802-2x2, and Tukan8k multichannel analyzer.

The thyroid water phantom is a cylinder shaped Lucite (PMMA) vessel (128 mm diameter, 165 mm high), with a cover and two small (13 cm^3) cylindrical vessels inside. The construction of the phantom makes it possible to move the small vessels in two directions (horizontal and vertical).

The developed model allows the calibration of the meter and the examination of the compatibility of experimental spectra and spectra obtained by simulation. The modelled geometry is presented in Fig. 1.

Results

The model developed was used to calculate the gamma energy spectrum emitted from the iodine ^{131}I source and registered in the detector. The results of the calculation were compared to the spectrum obtained during experimental measurements using the thyroid counter. The comparison results are presented in Fig. 2.

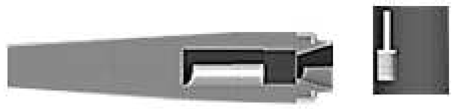


Fig. 1. Modelled detector and thyroid water phantom.

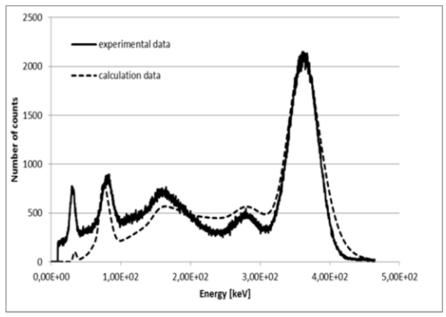


Fig. 2. Calculated and experimental iodine ^{131}I gamma spectrum registered by the scintillation detector.

The simulations gave good agreement between the calculation results and the experimental spectrum in the high energy range, including the 364 keV energy peak used for detector efficiency calculation. The agreement of low energies is not as good as for high energies but this range is irrelevant for efficiency calculations.

The comparison of the 364 keV peak area determined using experimental and calculated data also showed a good agreement. The calculateded value is 3.3% higher than the experimental value.

Conclusions

The calculation obtained using the developed Monte Carlo model shows good agreement with experimental data and may be used for further studies of the thyroid counter efficiency for various measurement geometries, e.g. various thyroid dimensions. It seems interesting to continue these studies and compare the data obtained to other Monte Carlo codes.

The results of this work were presented at the Warsaw Medical Physics Meeting 2014 [2] and were a part of M. Szuchta's bachelor thesis at Warsaw University, Faculty of Physics supervised by J. Ośko.

References

[1] Ferrari et al, CERN-2005-10 (2005), INFN/TC_05/11, SLAC-R-773
[2] M. Szuchta, J. Ośko, poster Warsaw Medical Physics Meeting, 15-17 May 2014

Towards X-ray powder micro-diffraction

A. Budzianowski[1], J. K. Maurin[1,2], Z. Jurkowski[1], J. Żołądek[1], T. Wójcik[1], M. Meyer[3], A. Kowalski[3], D. Kucharczyk[3]
[1]*National Centre for Nuclear Research*
[2]*National Medicines Institute, Warsaw, Poland*
[3]*Agilent Technologies, Wrocław, Poland*

The X-Ray powder diffraction technique is non-destructive and is useful in identification of materials, quantity analysis and sometimes structure determination, etc. A typical powder sample of volume a few dozen cubic millimetre is commonly investigated with a diffractometer in the Bragg-Brentano (BB) geometry. However, sometimes much smaller samples (of less than 1 mm^3 [1]) have to be investigated, when there is no access to a synchrotron with a beam of 1×1 μm for μ-XRD [2]. To find a solution to this problem we performed a series of measurements using a 4-circle X-Ray diffractometer with a 2D CCD detector (KM4-Xcalibur R Oxford Diffraction). The diameter of the cross-section of the beam is 0.8-0.3 mm. A similar diffractometer was used previously for powder diffraction of spherical samples [3]. The 2D images could be reduced to 1D diffraction patterns using CrysAlis software (Fig. 1). The quality of the 1D diffraction patterns depends on the absorption, size and shape of the sample as well as on the measuring procedure and data reduction method.

For larger samples a special mounting on a typical goniometer head was employed, which permits precise selection of a sample region for micro-diffraction (Fig 1).

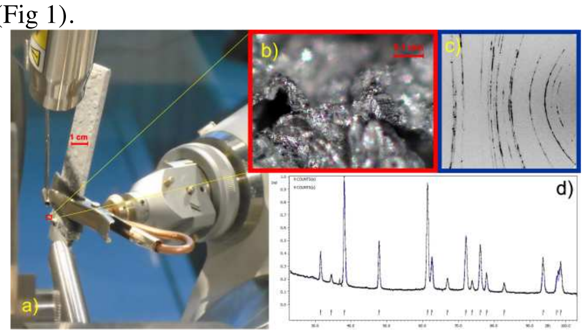


Fig. 1. Special a) handle for typical goniometer head allowing mounting of the metal plate. b) The surface of the verge of the plate where c) 2D diffraction image was recorded. d) 1D diffraction d) LeBail profile (blue line) refined of cadmium (space group $P6_3/mmc$) for data (black line) from 2D image c).

Reasonably good results were obtained for approximately spherical powder samples with a diameter less than 0.5 mm (Fig. 2). The size of the sample is also limited by the absorption coefficient. The sample can be made spherical using an amorphous glue. The best results were obtained for the reflected beam using few degree *phi* or *omega scans*. Since the surface of the sample is almost constant during measurements – the 1D diffraction pattern is similar to that of the BB technique with variable aperture. As a consequence higher-angle reflections are better visible than with a typical BB diffractometer (Fig. 2). In effect the micro-diffraction pattern can help in phase identification and the whole diffraction pattern profile fitting [4]. However, the resolution of micro-diffraction is much lower than in BB diffraction, and the FWHM value is about twice that obtained in BB or parallel beam settings, posing some limitations on the analyzed method.

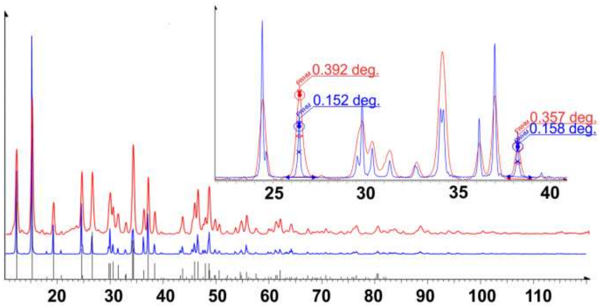


Fig. 2. Powder diffraction pattern of cadmium chloride hydrate recorded: (upper) on the KM4-Xcalibur R Oxford Diffraction diffractometer as micro-diffraction, (lower) on a Bruker D8 Discovery in parallel-beam configuration with a large active area VÅNTEC-1 detector in scanning mode. In the bottom the fingerprint of pattern no.: 00-027-0073. Inset, the same patterns measured with a $K\alpha_2$ strip.

Our powder diffraction results are also very promising for use of a single crystal diffractometer with well-matched X-Ray optics also for high-pressure powder experiments in miniature DAC [5] as an alternative to synchrotron radiation [6].

References

[1] Une, K. et. al (1992) J. Nucl. Mater. 188, 65-72
[2] Mieszczynski, C. et. al (2014) J. Nucl. Mater. 444, 274-282
[3] Stankowski, W. et. al (2006), Planet. Space Sci. 54(1), 60-70
[4] LeBail, A. (2005) Powder Diffr. 20, 316
[5] Patyk, E. et al. (2012) Angew. Chem. Int. Ed. 51(9), 2146-2150
[6] Smith, J. V. (1995) Analyst 120, 1231-1245

A comparison of the magnetic properties of radiation damaged or Co implanted ZnO single crystals

Z. Werner[1], J. Gosk[2,3], A. Twardowski[2], M. Barlak[1], C. Pochrybniak[1]
[1]National Centre for Nuclear Research, Otwock-Świerk, Poland
[2]Faculty of Physics, Warsaw University, Warsaw, Poland
[3]Faculty of Physics, Warsaw Technical University, Warsaw, Poland

Experimental

The measurements were performed on commercial Mateck 5×5×0.5 mm^3 ZnO single crystals grown by the hydrothermal method. The following treatments were applied to the samples:

1) 1.5 MeV electron irradiation (Van de Graaff accelerator) at room temperature with 1 μA/cm^2 current density using water cooled sample holders. The applied doses were $8\cdot10^{17}$ e/cm^2,
2) 6.5 MeV electron irradiation (6.5 MeV linear accelerator) at room temperature with about 30 μA/cm^2 current density using water cooled sample holders; the applied doses were $2\cdot10^{17}$ e/cm^2 and $4\cdot10^{17}$ e/cm^2,
3) 60 keV proton irradiation (gaseous direct beam implanter) nominally at room temperature to a dose of $1\cdot10^{16}$ and $1\cdot10^{17}$ ions/cm^2,
4) 60 kV (ion source high voltage) Co implantation (MEVVA source direct beam implanter) nominally at room temperature to a dose of $1\cdot10^{16}$ ions/cm^2. This source operates in pulse mode with about 10% duty cycle and pulse current greatly exceeding the average one.

Magnetization of the samples was measured as a function of magnetic field B (up to 7 T) and temperature (2-400 K) using a SQUID MPMS XL magnetometer (Quantum Design). To enhance the magnetic signal, two samples of the same kind were prepared in each case and glued together prior to the measurements. For all samples magnetization was corrected for a diamagnetic contribution determined from magnetization measurements at high temperature.

The results of Co implantation are shown in Fig. 1 which presents the M(B) dependence in a Co-implanted sample at various temperatures. In contrast to the above discussed samples, the Co implantation of ZnO results in: i) significant increase of the PM phase being about two times stronger than those in other samples, ii) appearance of a significant ferromagnetic contribution (FM), with high T_C above 300 K (see the magnetization curve for T = 300 K in Fig. 1) Note, due to the Curie law the PM contribution is negligible at high temperatures where the FM contribution dominates. Since the FM signal appears only in Co-implanted samples, it seems to be related to Co content.

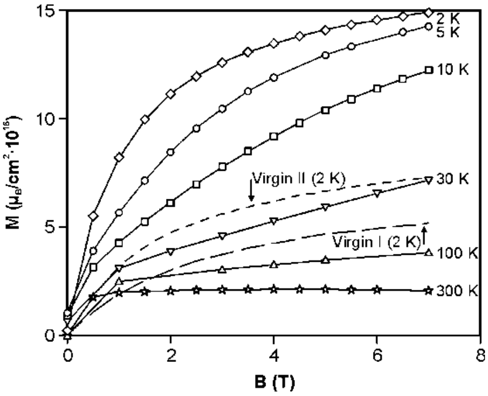


Fig.1. M(B) dependence at various temperatures in Co implanted ZnO single crystals (open circles), as compared to magnetization in virgin material (broken lines).

Conclusions

Defects created in the ZnO single crystal by various irradiations like electrons, protons and Co ions reveal their paramagnetic properties only in the case of accompanying Co implantation. The differences between various irradiations can be interpreted in terms of dynamic annealing or weak magnetic moment of the created defects and different structure of defects of various origin. Co ions seem to stabilize the radiation defects.

Pb photocathode deposition for SRF guns in 2014 within the framework of EUCARD^2. Annealing of a Co-implanted ZnO layer. Collaboration with NCPS "SOLARIS"

R. Nietubyć[1], J. Sekutowicz[2], J. Lorkiewicz[1], M. Barlak[1], A. Kosińska[1], R. Mirowski[1], A. Witkowski[1], R. Barday[3], R. Xiang[4], T. Sworobowicz[1], W. Grabowski[1]

[1]*National Centre for Nuclear Research (NCBJ), Otwock-Świerk, Poland*
[2]*Deutsches Elektronen Synchrotron (DESY), Hamburg, Germany*
[3]*Helmholtz Zentrum Berlin (HZB), Berlin, Germany*
[4]*Helmholtz Centrum Dresden Rossendorf (HZDR), Dresden, Germany*

Electron emission from a photo-cathode in a high electric field impedes the electron gun operation, causing a dark current. The emission is enhanced by surface roughness, particularly by the presence of sharp protrusions (for instance, solidified lead micro-droplets or peeling products) which can locally magnify the field intensity. The presence of these features depends on the way in which the layer was deposited and treated later on.

Test thin layer lead cathodes for XFEL-type hybrid Pb-Nb RF photo-injectors were coated on niobium by UHV arc deposition or by evaporation. Arc deposition was done using angular magnetic arc filters of lead micro-droplets or a short, straight arc without filtering [1-2]. To flatten the lead surface the latter samples were subsequently irradiated by pulsed plasma Ar^+ ions at various fluency values in the IBIS rod plasma injector at NCBJ. The impact of coating method and post-deposition treatment on surface morphology and purity was inspected with a scanning electron microscope and electron induced emission spectroscopy. Particular attention was paid to the population and shapes of micro-droplets, presence of impurities and to the continuity of Pb layer coverage. Typical morphologies of lead layers obtained by filtered and non-filtered arc and by evaporation obtained at NCBJ are shown in SEM micrographs in Fig. 1. Studies of dark current were begun for variously prepared Pb layers using a dedicated experimental setup consisting of a UHV chamber, sub-millimetre precise manipulator and 12 kV, 1 μs pulser. The system was designed and built at the beginning of 2014. Samples were mounted in a holder installed in the manipulator which enabled a copper anode to approach Pb-Nb cathode as close as 50 μm with an accuracy of ±5 μm. The mean electric field intensity was varied from 30 to 240 MV/m to reveal the occurrence of breakdown between the cathode and anode. Lead layer surfaces depicted in Fig. 1(b) and (c) did not show any real breakdowns and the density of the dark current at 30 MV/m was below 30 nA/cm^2. Breakdowns accompanied by a visible flash were observed for the samples prepared by filtered arc coating (Fig. 1(a)) at field intensities above 100 MV/m with a corresponding current density of up to 1.6 μm/cm^2 at 200 MV/m. The consecutive surface conditioning at 200 MV/m for 30 min. resulted in current reduction by a factor of 4 at this field intensity. Dark current and photoemission from lead film cathodes of this type were tested at HZB and HZDR at field intensities of up to 20 MV/m. Dark current mapping at HZB revealed some local centre of enhanced field emission on the cathode surface (Fig.2). In these tests it took extra conditioning to reduce the dark current intensity down to a satisfactorily low value of < 10 nA/cm^2.

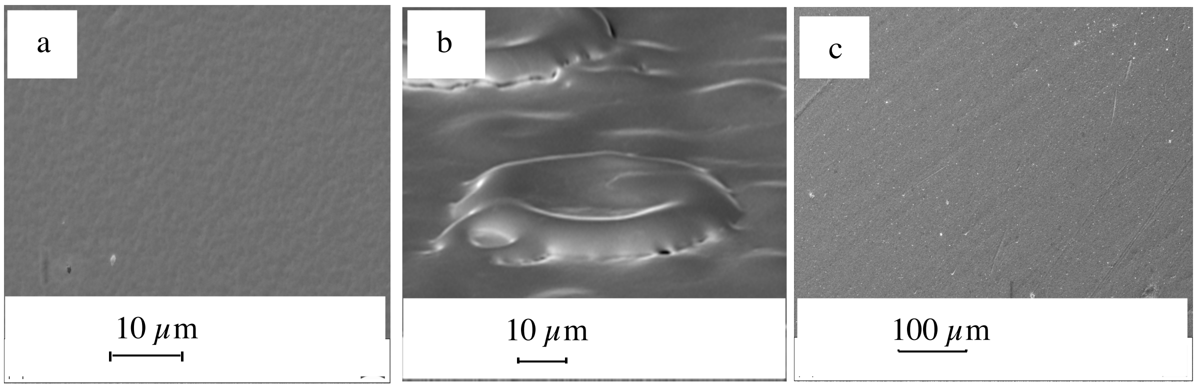


Fig. 1. SEM pictures of 2μm thick lead layers on niobium substrate obtained by using a filtered UHV arc (a), non-filtered arc followed by pulsed argon plasma ions irradiation in IBIS injector at NCBJ (b) and by evaporation. Note the scale difference.

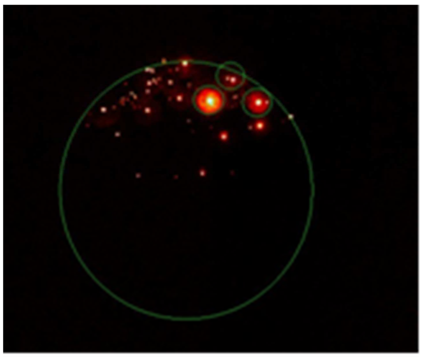


Fig. 2. Dark current map measured at HZB laboratory on the surface of thin layer lead film reached at NCBJ by using filtered UHV arc deposition. Local emission centers are clearly visible.

2D finite element calculations of the temperature distribution across a lead layer on niobium as a function of time were performed for a Pb-Nb sample irradiated with a plasma ion pulse of fluency and duration $1.5 \cdot 10^4$ Jm^{-2} and 1 μs, which are typical of the IBIS injector. The computations revealed that the lead film is melted down to 8 μm in depth. The near surface region including droplets remain in the liquid state up to 20 μs. It can be deduced from these results that in order to obtain a planar and continuous lead layer one has to increase its thickness to more than 8 μm and apply a long series of ion pulses to melt massive extrusions of diameters bigger than 30 μm and height up to 10 μm.

Resonant quality vs field gradient measurements were begun at DESY for a niobium photocathode plug coated with lead by evaporation in our laboratory. The quality of the pure plug (before coating) was found to be exceptionally good. In the first test the accelerating field reached 63.5 MV/m on the cathode surface at an unloaded quality factor Q_o above 10^{10} - the highest electric field ever demonstrated for a superconducting injector cavity! The measurements with a Pb-Nb cathode started in November. 27.11.2014 they were still in progress.

Energy pulse annealing associated with transient melting and crystallization of an implanted surface layer is considered as an effective method of implantation damage removal and impurity solubility enhancement. To examine the applicability of this method to manufacturing of diluted magnetic semiconductors (DMS) we implanted monocrystalline ZnO with then cobalt to a dose of 10^{16} ions/cm^2. The samples were either thermally annealed at 800^0C in argon or treated with high energy plasma pulses of fluency in the range of 1 – 1.5 J/cm^2. The location of cobalt atoms in the lattice was studied by X-ray absorption near edge spectroscopy (XANES) using ELETTRA synchrotron radiation. Collaboration with Narodowe Centrum Promieniowania Elektromagnetycznego Solaris included coordination of magnet and DC power supply procurement and installation.

Acknowledgments:

Pb-Nb photocathodes investigations were supported with European Coordination in Accelerator Research and Development (Eucard2), a part of FP7.

References

[1] R. Nietubyć, J. Lorkiewicz, R. Mirowski, M. Barlak, J. Witkowski, J. Sekutowicz, P. Kneisel, Proc. of SPIE Vol. 8903 (2013), 89032B-1

[2] J. Lorkiewicz, R. Nietubyć, M. Barlak, R. Mirowski, A. Bartnik, J. Kostecki, J. Sekutowicz, A. Malinowska, P. Kneisel and J. Witkowski, Phys. Scr. Vol. T161 (2014)014071

Materials study of archaeological objects using non- and micro-invasive techniques

E.A. Miśta[1], P.Kalbarczyk[2], A. Brojanowska[3], I. Żmuda-Trzebiatowska[4], J.J.Milczarek[1], A.Turos[1], A. Stonert[1], A. Korman[1],

[1]*National Centre for Nuclear Research,Otwock-Świerk, Poland*

[2] *Institute of Nuclear Chemistry and Technology, Warsaw, Poland*

[3] *Faculty of Materials Science and Engineering, Warsaw University of Technology,Warsaw, Poland*

[4] *Photophysics Dept., The Szewalski Institute, Polish Academy of Sciences, Gdansk, Poland*

Archaeometry studies began at NCNR in 2013. This project was carried out within the framework of official cooperation with archaeological institutions like the National Archaeological Museum in Warsaw, the Institute of Archaeology, Warsaw University (IA UW) and the Institute of Archaeology and Ethnology, Polish Academy of Science (IAE PAS).

The study is focused on: (a) determination of raw material provenance of archaeological objects (as part of the realization of the NCN project "*The origin and circulation of silver in Early Medival Poland with the use of lead isotopic analysis*" – Principal Investigator (PI) is IAE PAS and the MNiSW project "*Łężany-burial site from the Roman and Migration Period in Mrągowo Lake District*" – PI is IA UW), (b) elucidation of technological processes applied, (c) determination of the degree of corrosion of the objects. Principally, radiography imagining methods were used (as part of CRP IAEA "*Application of Two and Three Dimensional Neutron Imaging with Focus on Cultural Heritage*

Research" in which NCNR is the Principal Investigator), (d) laboratory smelting, metallurgical and corrosion treatment of produced metal alloys. The aim of this research is the elucidation of material changes occurring in archaeological objects over the years of soil deposition.

In this report selected results of the interdisciplinary study are presented. The study of chemical and structural composition of metallic objects was performed using SEM/EDX, LA-ICP-MS, PIXE and radiography techniques.

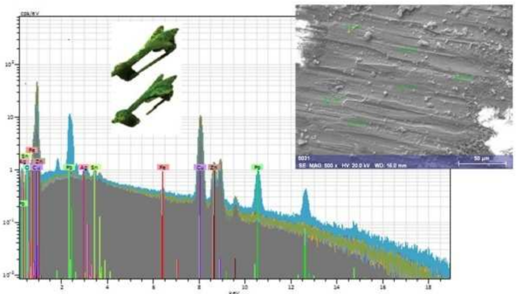


Fig. 1. Photo of cycada type fibulae and the EDX spectra (three times sampling) with SEM image of sampling points obtained for the artifact.

The results provided information about the technological process used for manufacture of the artifacts [1-2]. For example, the (unique in Poland) cycada type fibulae (brass alloy) from the Łężany site were made by a secondary smelting process used by local manufactures. Fig.1. shows a real photo of the objects and the results of SEM/EDX analysis.

In the case of the unique silvered shield grip from the Czersk site the aim of the study was to reveal the silvering technology of the objects. This was a complicated task because of surface corrosion and the varying structure of the subsurface layers [3]. It has been shown that the base alloy of the grip is bronze doped with Pb, Fe and Zn. The most important result was detection of chlorine and sulphur in the silvered surface layer. XRD analysis showed the presence of crystallographic components like silver, Cu-Sn conglomerate, covellite (CuS), copper and tin oxide and silico-amonium phosphate apparently originating from the conservation process. By SEM/EDX linescan analysis a Sn-Ag correlation in the silvered surface layer was observed. This can be explained in two ways: either as a intentional process of doping silver by tin, which was typical in the Middle Ages (the object is dated to an earlier period).

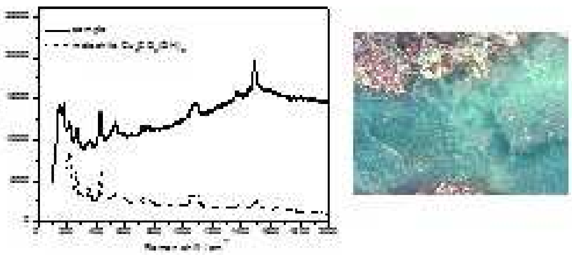


Fig. 2. Results of shield grip spectrometry analysis. Raman spectra of corrosion products and reference sample of malachite.

Raman Spectroscopy was used to analyse corrosion components which can have an influence on the shape of the surface ornamentation. Raman analysis revealed the presence of malachite ($Cu_2CO_3(OH)_2$, (Fig.2.), chalcopyrite ($CuFeS_2$), litharge (PbO).

Consequently, two silvering techniques were considered as the most probable: tinning of the silver surface and the silver chloride technique. The influence of corrosion layer morphology [3] has also been taken into account.

References

[1] E.A. Miśta et al., Acta Physica Polonica A , in review (2015)

[2] E.A. Miśta, P. Kalbarczyk, pp. 131-154 in Monography *Łężany cemetery of the Roman Period and the Migration Period in The Mrągowo Lake District, Research in the season 2013* by A. Wiśniewska, Dajna Fundation Warsaw 2014

[3] E.A. Miśta et al., Archaeometry, in review (2015)

A project for the slow-control system for the hydrogen cluster-jet target: control of nozzle temperature and gas pressure

A. Chłopik, G. Kęsik, A. Trzciński, B. Zwięgliński
National Centre for Nuclear Research,Otwock-Świerk, Poland

The NCBJ team continues designing the Slow-Control System for the Hydrogen Cluster-Jet Target of the PANDA experiment at FAIR-Darmstadt.
The current stage is concentrated on the control of nozzle temperature and gas pressure at the nozzle entrance, the basic parameters defining the produced cluster-jet density. Fig. 1 is a schematic presentation of the cold-head with the Laval-nozzle installed in a copper block in thermal contact with its second 'cold' stage. We refer here to the Leybold two-stage cold-head COOLPOWER 10MD, which is able to provide temperatures down to 10K at the second 'cold stage, while the temperature at the first 'warm' stage is then at ca. 70K. The cold-head is operated in conjunction with a COOLPAK6000H MD helium compressor. The plumbing consists of copper tube sections soldered to the 'warm' and 'cold' stages of the cold-head and stainless-steel tube sections providing an interstage thermal isolation and an isolation between the 'warm' stage and the baseplate carrying the entire gas-cooling column. The column is located inside the Insulation Vacuum Chamber of the target in a vacuum of~10^{-6} mb.

The nozzle temperature is measured with a pair of calibrated Si-diode sensors and a LakeShore temperature controller. The desired set-point value (in the range 20 - 30K) is read-in by an operator via an ethernet input of the instrument. The LakeShore acts as a PID controller having two cartridge heaters with an overall power of 100W in contact with the Cu-block and powered with a constant current in the negative feedback loop programmed to bring the difference between the actual and the set- point value to zero.

Hydrogen pressure at the nozzle input is the second parameter, besides temperature, determining in an essential way the cluster-jet target density. Ultra-pure H_2 gas is fed into the system by passing through a heated Pd-filter [not shown in Fig. 1]. The pressure control action is performed with a SLA5810A precision pressure sensor [1 – 30 bar] and a pressure metering and PID-control program running in channel #2 of a Brooks 0254 instrument. A valve coupled with the SLA5810A is an element permitting the negative feedback loop to be closed to stabilize the pressure around the set-point value by varying the mass-flow. The latter is monitored with the aid of a Brooks SLA5860S and a program running in channel #1 of the Brooks 0254 instrument. A baratron ABB 266AST is an additional device to monitor gas pressure. Access to both channels of the Brooks 0254 from the level of CompactRIO$_1$ is forseen via RS-232<-->RS485 converters.

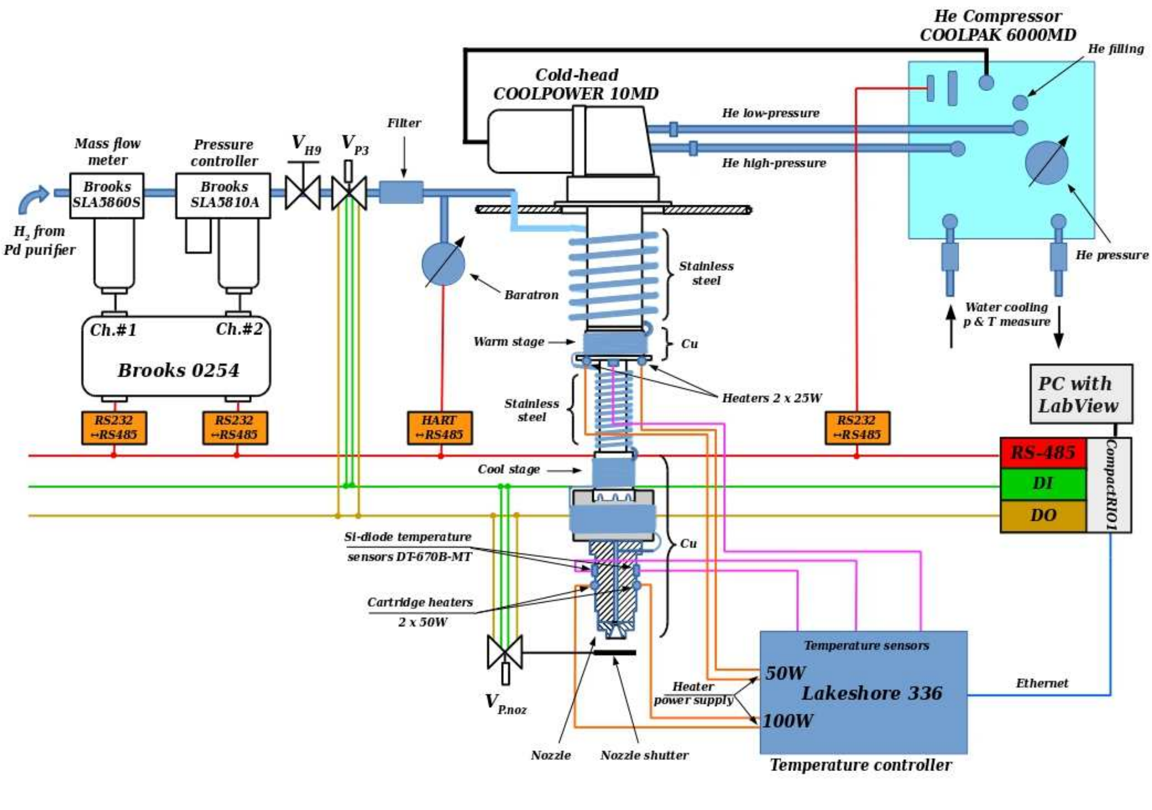


Fig. 1. Schematic of the nozzle temperature and gas pressure control for the PANDA cluster-jet target.

On some inapplicable voltages of the conventional avalanche counter spectrometric mode at moderate specific ionization

J. Sernicki
National Centre for Nuclear Research, Otwock-Świerk, Poland

There are generally insufficient data the available on the spectrometric properties of avalanche counters. The spectrometric properties of the detectors may be evaluated based on only partial data on the detector energy resolution (ER) (see e.g. refs. [1÷3]). Thus, the voltage relations between the detector gas gain (M) characteristics and ER-curves are available only as insufficient data [4]. Therefore, investigation of the spectrometric properties of avalanche counters is also interesting from a cognitive point of view.

In general, the properties of avalanche counters depend on the electrical field intensity and gas pressure. It should be fully realized, however, that the counter's spectrometric properties depend on not only the statistical fluctuations of the charge generated in the interelectrode space, which are affected by the basic ionization processes, but also on additional factors. However, the effect of additional factors, being generally typical under measurement conditions for the majority of physical experiments in which avalanche counters are used, can be minimized.

It has been found that a moderate specific ionization in n-heptane the empirical ER-curves of parallel-plate avalanche counters (PPAC) have some plateau range that extends with the increase in both n-heptane vapour pressure (p) and interelectrode gap (d). This plateau range falls within that section of M-curve which has a strictly linear course in a semilogarithmic coordinate system. The M-curve is limited by the U_0 and U_{max}-supply voltages (i.e. M-curve beginning voltage and maximum voltage just below the detector breakdown voltage).

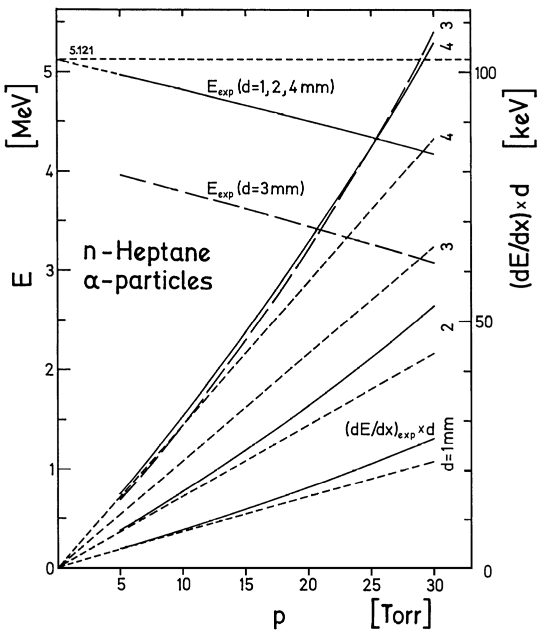


Fig. 1. Mean effective energy E of alpha particles and the corresponding particle energy loss in the PPAC interelectrode gas space, determined for actual measurement conditions. The plots apply to those alpha particles which follow paths perpendicular to the counter electrodes.

The object of this investigation was an analysis of the PPAC characteristic voltages at both conventional electronic instrumentation and under typical measurement conditions and at a moderate specific ionization in n-heptane (see fig. 1), carried out from the view-point of further inferences relating to the spectrometric mode voltages of the detector.

It has been found that –for given p and d-value –are ranges of the inapplicable voltages. The range variability vs n-heptane vapour pressure is shown in figs. 2÷4. The determined values of the lower voltage range width lie between 0 V and 92,8 V. The values of the upper voltage range width lie between 20 V and 140 V. The empirical curves of the PPAC detector certain voltage relations are shown in fig. 5.

As shown in the plots, generally a PPAC having d=0.3 cm is however characterized by the best voltage properties.

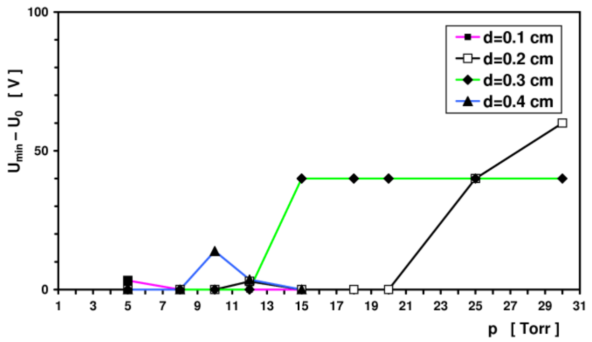


Fig. 2. Differences of the PPAC supply voltages; the U_{min} voltage relates to the lower end of the gas gain characteristic strictly linear course in a semilogarithmic coordinate system; for the U_0 voltage see text.

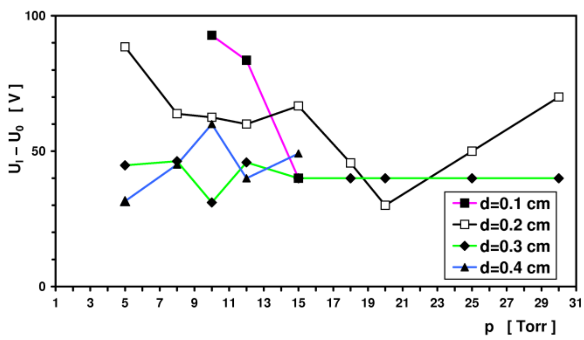


Fig. 3. Differences of the PPAC supply voltages; the U_l voltage relates to the lower end of the detector energy resolution (ER) plateau range; for the U_0 voltage see fig. 2.

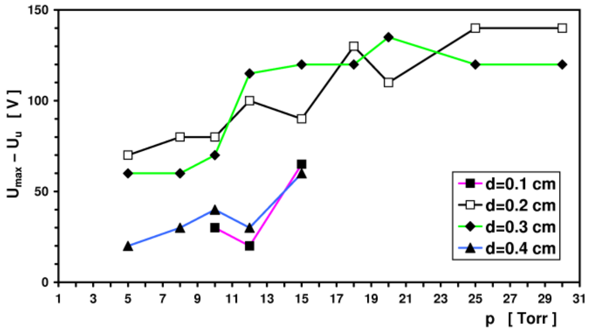


Fig. 4. Differences of the PPAC supply voltages; for the U_{max} voltage see text, and the U_u voltage relates to the upper end of the detector ER-plateau range.

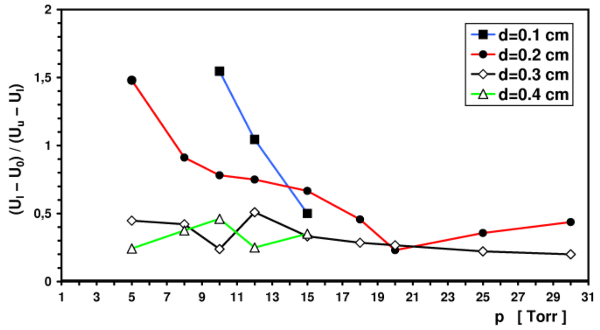


Fig. 5. Ratios of the range of inapplicable supply voltages for the PPAC ER-plateau (see fig. 3) to the plateau width.

References
[1] G. Brunner, Nucl. Instr. and Meth. 154 (1978) 159
[2] J. Sernicki, Nucl. Instr. and Meth. 212 (1983) 195
[3] J. Sernicki, Nucl. Instr. and Meth. A572 (2007) 817
[4] J. Sernicki, Annual Report 2013 NCBJ, p.204

A common approach to study scintillator response to gamma-rays and protons

L. Świderski[1], M. Szawłowski[1], M. Moszyński[1], A. Para[2], W. Czarnacki[1], M. Grodzicka[1], J. Iwanowska-Hanke[1], M. Kisieliński[1], J. Wojtkowska[1]
[1]National Centre for Nuclear Research, Otwock-Świerk, Poland
[2]Fermi National Accelerator Laboratory, Batavia, USA

Non-proportionality of scintillator response has usually been studied by means of the gamma-ray absorption process, the Compton coincidence technique, or recently K-shell dip spectroscopy. Using these methods gamma or electron response can be investigated starting from several MeV down to 0.1 keV. Due to insufficient light output it is technically difficult to register the scintillator response at energies smaller than 0.1 keV using γ-rays, X-rays or electrons. For this reason we decided to study the scintillator response to protons and heavy ions and we proposed a common representation of the non-proportionality characteristics probed with different types of primary ionizing particles. The excitation density has often been recalled as the main factor influencing the scintillation efficiency in scintillators. Therefore, we transformed the energy of the incoming particles into their velocities, as the excitation density is inversely proportional to the velocity of the ionizing particle.

The response of the CsI:Tl scintillator to protons and deuterons was measured for a 6 mm cube. The surface coupled to the photodetector and the opposite side were left open in order to allow light readout and to absorb incoming particles without any energy loss before they hit the tested scintillator, respectively.

The experiment at the van de Graaff accelerator was performed with proton and deuteron beams of energy between 0.5 MeV and 2.0 MeV. The beam was scattered by a thin Au target and scattered ions were registered at angle of 150° with respect to the beam axis. The CsI:Tl detector was coupled to a 6 mm × 6 mm MPPC matrix.

The measurements at the C-30 cyclotron were made with proton beams of 23 MeV and 24 MeV. The beam was scattered by a thin polyethylene target $(C_2H_4)_n$ and scattered ions were registered at an angle of 30° with respect to the beam axis. Due to the large energy of incoming charged particles, the CsI:Tl crystal was coupled to a 10 mm × 10 mm APD (Hamamatsu) instead of an MPPC to avoid its nonlinear response.

For all measurements with CsI:Tl the registered amplitudes of γ-ray, proton and deuteron pulses were normalized to the amplitude of 662 keV γ-rays from a Cs-137 source.

Fig. 1 presents overlaid spectra registered with 662 keV γ-rays and 1 MeV deuterons from the van de Graaff accelerator. Full energy peaks are clearly separated from the continua in both cases. A series of measurements with deuterons of energy between 0.5 MeV and 2 MeV was performed. Next, the CsI:Tl response to protons of energy between 0.75 MeV and 2 MeV was also recorded.

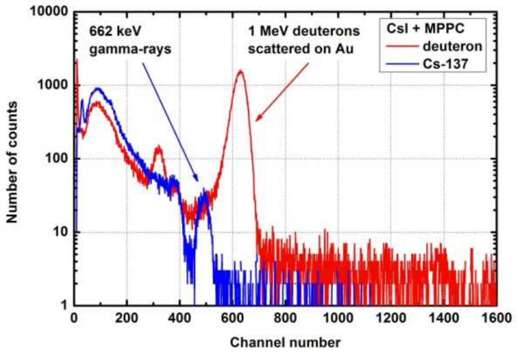


Fig. 1. CsI:Tl spectrum registered with 662 keV γ-rays and 1 MeV deuterons scattered by a Au target at 150°.

Non-proportionality characteristics measured for γ-rays, protons and deuterons in CsI:Tl are presented in Fig. 2. Irrespective of the type of primary ionizing particle (electrons induced by γ-rays, protons and deuterons) the scintillation efficiency followa a common trend over a wide range of velocities. Scaling velocities of primary ionizing particles into the electron equivalent energy allows the non-proportionality curve for CsI:Tl to be extended to the energy range as low as 0.1 keV. As one can see from fig. 2, protons of energy about 20 MeV (measured at the C-30 cyclotron) entering a CsI:Tl scintillator with a speed of about 0.2 c, show the same excess of scintillation efficiency as electrons that hit the scintillator at the same velocity that corresponds to an energy of about 10 keV.

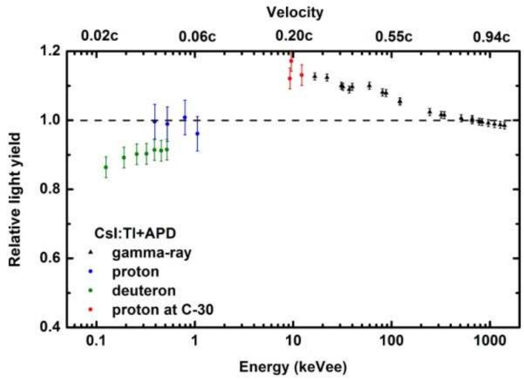


Fig. 2. Non-proportionality of CsI:Tl light output as a function of velocity of incoming primary ionizing particles. The ower axis depicts the electron equivalent energy of the particles.

We would like to thank prof. M. Jaskóła, PhD A. Korman and the staff of the NCBJ BP1 van de Graaff "Lech" accelerator for providing the proton and deuteron beams and for allowing access to the scattering chamber to carry out experiments.

Flexible composite scintillator based on Eu:LiCAF crystalline grains

J. Iwanowska-Hanke[1], M. Moszyński[1], H. Saitob[2], K. Fukuda[2]
[1]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
[2]*Tokuyama corporation, Yamaguchi, Japan*

^{3}He detectors, used for neutron detection in Radiation Portal Monitors, are sensitive to slow neutrons, and have ahigh γ-ray rejection factor [1]. However, due to the rapidly increasing price of ^{3}He, they need to be replaced by other neutron detectors. One of the alternative methods of slow neutron detection is the registering of signals from α particles originating in the ^{6}Li(n,α) reaction. Recently developed by Tokuyama Corp. ^{6}Li-based scintillators such as Ce:LiCAF, show comparable γ-ray discrimination and thermal neutron detection efficiency to GS20 glass [2], [3]. However, low light output limits their wider application. On the other hand, Eu:LiCAF presents a significantly higher light output, but worse γ-ray rejection [4]. The newest solution is a flexible sheet consisting of LiCAF crystals (Eu:LiCAF rubber). The unique configuration of the detector, in which wavelength shifting fibres are incorporated in the scintillation crystalline grains, makes efor fficient light collection from a large scintillator to a small area photodetector. The measurements cover the tests of rubber Eu:LiCAF (NEW) and standard, Eu:LiCAF (OLD). Both scintillators have almost the same ^{6}Li content (see Table I).

a) γ-ray response

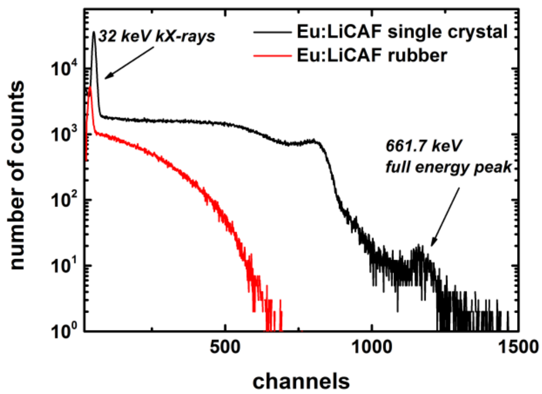


Fig. 1. The response of the OLD and the NEW Eu:LiCAF for γ-rays from a ^{137}Cs source.

The estimation of the photoelectron (phe) yield in phe/MeV in the case of an OLD sample, was made using the Compton edge of the γ rays from ^{137}Cs, and a single photoelectron spectrum from the XP 5500 Photonis PMT (Bertolaccini method). In the case of a NEW sample, only a small fraction of the electrons loses full energy in the grains, and we do not observe typical Compton edges (Fig.1). The end of the ^{137}Cs spectrum recorded for the NEW sample is at about 70% of the distance to the Compton edge measured for the OLD one. Low phe number in the NEW Eu:LiCAF is due to the small size of the crystalline grains, much lower than the range of secondary electrons produced by γ-rays.

Table I. Basic properties and the phe yield of the tested samples

Sample	Dimension (mm3)	6Li content (atoms/cm^3)	phe/MeV
Eu:LiCAF (OLD)	15×15×1	7.60×10^{21}	8100 ± 150
Eu:LiCAF (NEW)	15×15×5	7.67×10^{21}	~ 5600

b) Neutron response

$^{238}PuBe$ was used to measure neutron spectra for both Eu:LiCAFs. To slow down the neutrons, the source was put behind a polyethylene wall of thickness 10 cm. To reduce the flux of 4.4-MeV γ-rays following the (α,n) reaction in the $^{238}PuBe$, we used 10 cm thick lead. A sample neutron spectrum measured with the OLD Eu:LiCAF is presented in Fig. 2, left panel. Neutron events appear as the Gaussian peak with a resolution of 4.7% at about 1 MeV Gamma Equivalent Energy (GEE). γ-ray events, associated with the ^{60}Co, overlap the neutron peak. In the case of the NEW Eu:LiCAF sample (Fig. 2, right panel), γ rays from ^{60}Co are much better separated from the neutron events.

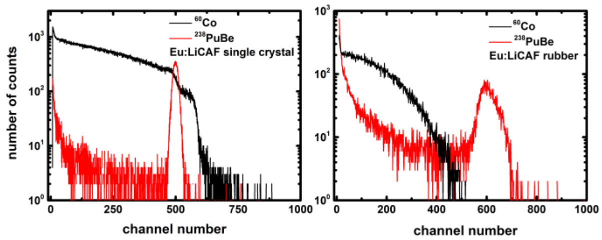


Fig. 2. The response of the OLD and the NEW Eu:LiCAF to neutrons.

References

[1] Ł. Świderski et al. IEEE Trans. Nucl. Sci. NS-57 (2010), 2857 – 2861 10.1109/TNS.2010.2064790

[2] J. Iwanowska et al. Nucl. Instr. Meth. A Vol. 652 (2010), 319-322 10.1016/j.nima.2010.09.182

[3] T. Fujiwara et al. Neutron NEWs Vol. 23 (2012), 31 http://dx.doi.org/10.1080/10448632.2012.725335

[4] N. Kawaguchi et al. IEEE Conf. Rec. NSS/MIC (2012) 4304 - 4307 10.1109/NSSMIC.2012.6551981

Study of the threshold activation detection (TAD) technique in fast neutron detection using BaF_2 and EJ-313 scintillators

P. Sibczyński[1], J. Kownacki[1,2], M. Moszyński[1], J. Iwanowska-Hanke[1], A. Syntfeld-Każuch[1], A. Gójska[1], M. Gierlik[1], Ł. Kaźmierczak[1], E. Jakubowska[1], G. Kędzierski[1], Ł. Kujawiński[1], F. Carrel[3], M. Ledieu[3], F. Lainé[3]

[1]*National Centre for Nuclear Research, 05-400 Otwock-Świerk, Poland*

[2]*Heavy Ion Laboratory, Warsaw, Poland*

[3]*CEA, LIST, Sensors and Electronic Architectures Laboratory, Gif-sur-Yvette, France*

Over the last few years, detection of fast neutrons by ^{19}F activation in the scintillator medium has triggered considerable interest in the field of Homeland Security. The method, known as Threshold Activation Detection (TAD), was proposed in order to detect prompt neutrons emitted due to photofission of Special Nuclear Materials (SNMs) [1][2]. Due to the $^{19}F(n,\alpha)^{16}N$ or $^{19}F(n,p)^{19}O$ reactions with an effective neutron energy threshold of 2.5 MeV, it is possible to determine the presence of nuclear material by registering β particles from ^{16}N and ^{19}O decay with half-lives of 7.1 s and 26.9 s, respectively. The endpoint energy of the emitted β^- particles is approximately 10.4 MeV. Due to the two orders of magnitude yield ratio between the emission of prompt photofission neutrons and that of delayed neutrons, the detection of prompt neutrons emitted in the photofission reaction seems to be a promising solution for SNM detection. Due to the higher prompt neutron mean energy, the method could be well-suited for the detection of shielded SNM inside a cargo container.

In the present study 2” × 3” BaF_2 and 5” × 3” EJ-313 scintillators were used for fast neutron detection using the TAD technique [3]. The former is a hydrogen-free high density scintillator (4.77 g/cm^3), the latter is an organic scintillator based on highly-purified hexafluorobenzene and contains very low amount of hydrogen, resulting in an F/H ratio of 307.8. The small amount of hydrogen is particularly important in the detection of the neutrons above the reaction threshold. This is due to the avoidance of neutron slowing down by scattering of hydrogen in the scintillator medium.

The BaF_2 and EJ-313 scintillators were exposed to neutrons from the Sodern Genie 16GT D+T generator, emitting neutrons with an energy of 14.1 MeV. Neutron pick-up in the $^{19}F(n,\alpha)^{16}N$ reaction results in the emission of β particles with the endpoint at 10.4 MeV, then the integral N between 6.0 – 10.5 MeV was obtained with these two scintillators. Relative efficiency ε_{rel} of the scintillators was estimated to be:

$$\varepsilon_{rel} = \frac{N_{BaF2}}{N_{EJ313}} = 39.3\% \pm 1.4\%$$

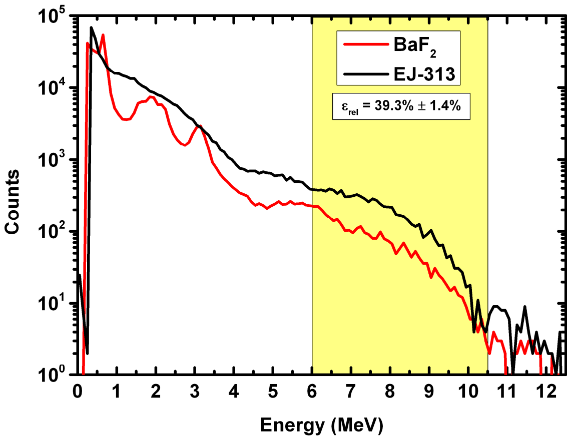


Fig. 1. Relative efficiency of the BaF_2 and EJ-313 scintillators for detection of the beta particles between 6 – 10.5 MeV.

Summarizing, both BaF_2 and EJ-313 can be successfully applied to the detection of fast neutrons by means of fluorine activation in the scintillator medium. The intrinsic efficiency of the BaF_2 is better due to the higher density and lack of hydrogen in the scintillator medium. The relative efficiency is 39.3 % of the 5” × 3” EJ-313, however, it is important to emphasize that the volume of the BaF_2 is 6.25 times lower than that of the EJ-313. The main drawbacks of the EJ-313 liquid scintillator are its toxicity and flammability, as the scintillator flashpoint is 10°C. This fact could be a serious limitation in the application of this scintillator in Homeland Security.

This work was performed within the framework of the 2013-2014 POLONIUM "Photofissium" project - a Polish- French collaboration programme partially supported by the Polish Ministry of Science and Campus France.

References

[1] J. Stevenson et al., NIM A 652 (2011) 124
[2] T. Gozani et al., In 2nd International Workshop on Fast Neutron Detectors and Applications, November 6–11 2011, Ein Gedi, Israel, 2012
[3] P. Sibczynski et al., JINST 2015, under review
[4] M. Hamel, P. Sibczynski et al. NIM A 768 (2014) 26

Monte Carlo simulation of high-pressure ^{3}He detector response to a ^{252}Cf neutron source

K. Wincel[1], B. Zaręba[1], P. Sibczyński[1], J. Kownacki[1,2]
[1]National Centre for Nuclear Research, Otwock-Swierk, Poland
[2]Heavy Ion Laboratory, Warsaw, Poland

In this paper the results of reconstruction of the response of a cylindrical ^{3}He detector to a ^{252}Cf source is presented. The detector, manufactured by LND Inc., was under a pressure of 10 atm ^{3}He and a trace form of CO_2. Simulation of the ^{3}He detector and calibrated neutron source is the most accurate method before further simulation of delayed neutron response. The motivation of this study is to simulate the response to the experiment with the best possible accuracy. The research is especially important in the field of Homeland Security and Border Monitoring for preventing the illicit trafficking of radioactive and nuclear materials. The latter can be used for construction of nuclear bombs, being a deadly weapon in possession of unauthorized groups. The nuclear materials, undergoing photofission, emit characteristic radiation, like delayed neutrons, which can be easily detected by ^{3}He detectors. Using the off-beam technique enabling the measurement of pulses between LINAC pulses, it is possible to measure delayed neutrons even with bremsstrahlung photons with an endpoint of 6 MeV, see Figure 1. Simultaneously, in order to improve the detection of nuclear materials, delayed γ ray detectors can also be used as a support due to good penetration of hydrogenous type cargo content [1]. In contrast, the delayed neutrons can be significantly attenuated in hydrogenous content, as shown in [2]. Moreover, the performed simulations can also be supportive during the design of detectors for nuclear power monitoring.

The ^{3}He detector was exposed to neutrons from a calibrated ^{252}Cf source, emitting 55000 neutrons per second. The detector was covered by a 5.5 cm polyethylene cylinder and 1 mm of Cd foil, and was primarily optimized for photofission delayed neutron detection. The neutron source was placed 56.5 cm from the geometrical centre of the detector, both the detector and source were placed 1 metre above the concrete.

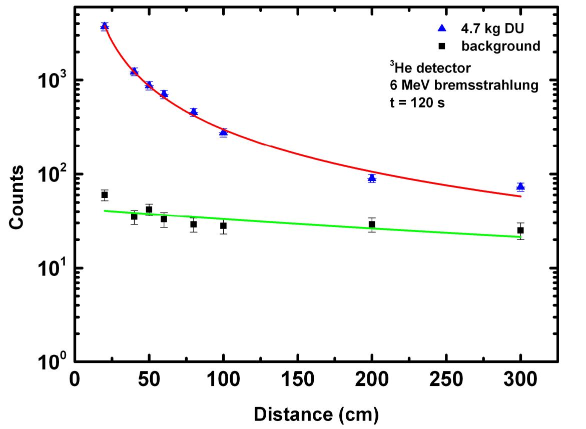


Fig. 1. The measured number of photofission delayed neutrons from 4.7 kg DU registered with the ^{3}He detector as a function of distance. The 6 MeV bremsstrahlung photons were used.

The signal from the ^{3}He detector was amplified by a Cremat CR-110 high gain preamplifier, and then shaped by an Ortec 570 spectroscopy amplifier. Finally, the spectrum was recorded by a Tukan 8K USB Multi-Channel Analyzer [3]. The measurement lasted 2 h.

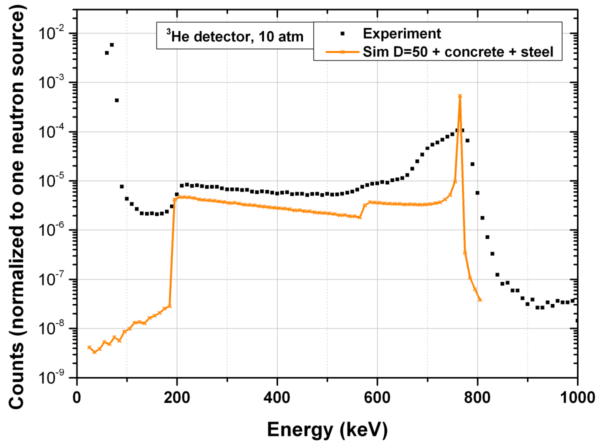


Fig. 2. Simulated and experimental response of the ^{3}He detector. Both spectra are normalized to one neutron source.

References

[1] P. Sibczyński et al., *Applied Radiation and Isotopes, Vol. 82 (2013) 170-174*

[2] M. Agelou et al., *"Detecting Special Nuclear Materials Inside Cargo Containers Using Photofission" IEEE Nuclear Science Symposium Conference Record (NSS/MIC), 2009*

[3] Z. Guzik et al., *IEEE Trans. Nucl. Sci.*, Vol. 53, no. 1, (2006) 231-235, Tukan 8k Multi-Channel Analyzer website: http://www2.ipj.gov.pl/tukan_en/

Characterization of TSV MPPC Arrays (4x4 CH and 8x8 CH) in scintillation spectrometry

M. Grodzicka[1], M. Moszyński[1], T. Szczęśniak[1], M. Szawłowski[1], S. Korolczuk[1], J.Baszak[2], M. Kapusta[1]
[1]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
[2]*Hamamatsu Photonics Deutschland GmbH, Germany*

The main aim of this work was characterization of the newest MPPC arrays (with 12x12 mm^2 and 24x24mm^2 active areas) made using through silicon via (TSV) technology in gamma-ray spectrometry with five different scintillators: CsI:Tl, NaI:Tl, LSO/LYSO, BGO, LaBr3. The results of the study are compared with that obtained previously with an older sample of the 12x12mm^2 MPPC array made as a monolithic device (monolithic array, see Fig.1a, and TSV technology, see Fig.1b). The main parameters of the MPPCs used are summarized in Table 1.

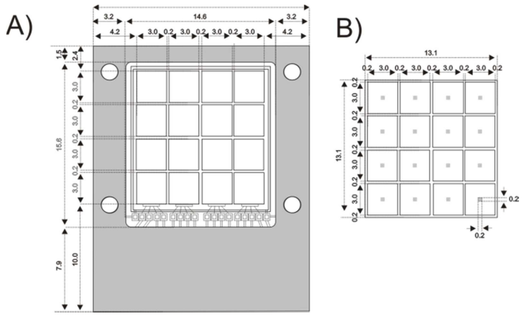


Fig.1. Schematic of a) the S11827-3344MG(X1) MPPC (monolithic array), b) the S12642-0404PA-50(X) MPPC, Hamamatsu data sheet.

Table 1: Main parameters of the MPPC arrays used.

Manufacturer	Hamamatsu		
Technology	Wire bonding	TSV(through silicon via)	
Type	S11827-3344MG	S12642-0404PA	S12642-0808PA
Number of channels	16 (4x4ch)	16 (4x4ch)	64 (8x8ch)
Active area/channel	3x3 mm		
Effective active area (mm)	12x12	12x12	24x24
Number of APD cells/channel	3 600	3 464	
Total Number of APD cells	57 600	55 424	221 696
APD cell size	50x50 μm		
Fill factor	61.5	62	
Gain	7.5 x 10^5	1.25x10^6	
Spectral resp. range (maximum sensitivity)	320-900nm (440nm)	320-900 nm (450 nm)	
Capacitance/channel	320 pF	342 pF [1]	

TSV MPPC array with a size of 24x24mm^2 is one of the first commercially available SiPMs with so large an active area and with the dead space between channels minimized to only 0.2mm.

Moreover, in these devices Hamamatsu introduced resistors made from a new type of material. Such a change allowed lowering of crosstalks and afterpulses. These improved TSV MPPC arrays can be used commercially for scintillation light readout of "large" crystals with diameter of 1x1inch or 2x2inch, suitable for gamma spectrometry.

Figure 3A presents the energy spectrum of a 2x2 inch NaI:Tl crystal directly coupled to the 24x24 mm^2 TSV MPPC array. Energy resolution for this configuration is equal to 7.92%. The optical surface of the MPPC array is smaller than the front surface of the scintillator package (see Fig. 2).

Fig. 2. NaI:Tl crystal (2x2inch) coupled to the 8x8ch TSV MPPC array (65.75V).

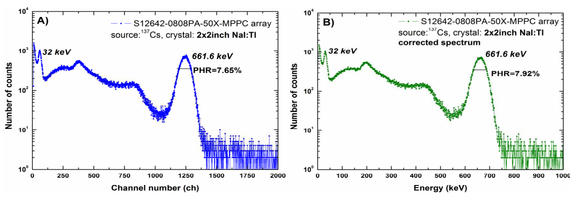


Fig. 3 A) The energy spectrum of 662 keV gamma rays, as measured with the 2x2inch NaI:Tl (non corrected for MPPC non-linear response), B) The spectrum after the correction for non-linearity.

Such a combination may allow replacement of PMTs in handheld monitoring devices. The studies presented here with MPPCs were carried out under two main experimental conditions: direct illumination of the SiPM using an LED pulser and measurements with scintillators. The first method allowed the measurement of basic parameters of the MPPCs such as breakdown voltage and excess noise factor (ENF). The second method allowed the measurement of the full scintillation detector parameters, such as: optimum operating voltage, number of photoelectrons (number of fired APD cells), photon detection efficiency (PDE), linearity and energy resolution.

References

[1] K. Yamamoto, et. al., Nucl. Instrum. Meth. A 732 (2013) 547-550
[2] M. Grodzicka, M. Moszyński, et al. 2013 JINST 8 P09020

Tests of a 12×12 mm² MPPC photodetector as a candidate for a light readout device for Ø20×20 mm $CeBr_3$ scintillator in the JET Gamma Camera Upgrade

M. Grodzicka, T. Szczęśniak, M. Moszyński, M. Szawłowski
National Centre for Nuclear Research, Otwock-Świerk, Poland

The TJ3 Division is involved in the Gamma Camera Upgrade of the plasma diagnostics detectors in the JET tokamak in the framework of the EUROfussion Consortium. The aim of the upgrade is the replacement of the existing scintillation detectors with new ones, possessing improved parameters: faster rise time, shorter decay time, good efficiency and energy resolution of 5% for 1MeV gamma rays. One of the candidates for a new detector is $CeBr_3$ scintillator with light readout by means of a Multi Pixel Photon Counter (MPPC or SiPM).

The tests were done with a Hamamatsu MPPC array made in Through Silicon Via (TSV) technology (S12642-0404PA) with 55424 pixels. The summed signal from 16 channels of the MPPC array was sent to readout electronics.

The gain of an MPPC photodetector depends on the overvoltage, that is the difference between the applied bias voltage and the breakdown voltage. Since breakdown voltage depends on the ambient temperature, the MPPC gain is sensitive to temperature changes. Therefore, knowledge of the temperature dependence of the breakdown voltage is crucial for stable operation of the final detector. The method of determining the breakdown voltage used in this report was previously presented by Grodzicka et al. [1]. Measurements were made in a climatic chamber at temperatures varied from -20ºC to 0ºC with +5ºC step. The measured temperature coefficient (breakdown voltage change) for the tested MPPC is equal to 69.9mV per degree Celsius. Also. The full energy peak amplitude (662 keV gamma-rays from 137Cs) registered by the $CeBr_3$ scintillator was recorded as a function of temperature. Measurements were made in a climatic chamber at temperatures varied from +20ºC to +30ºC with +1ºC step (Fig. 1). Bias voltage was constant and equal to 65.85V.

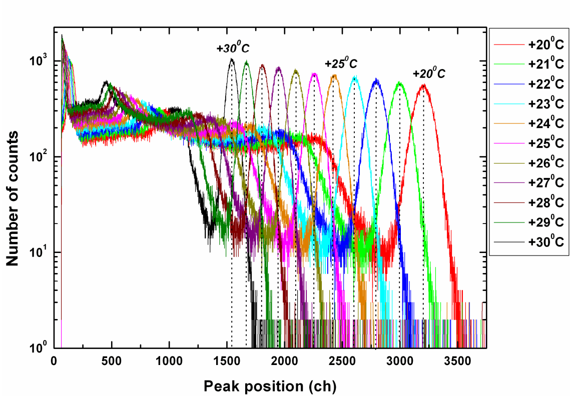


Fig. 1. ^{137}Cs gamma-ray spectra recorded with a $CeBr_3$ scintillator coupled to an MPPC measured at different temperatures.

Measurements showed that a temperature change of +1ºC resulted in the shift of the peak position by (-7.6±0.7)%. The reason for this is threefold: reduction of the overvoltage (gain) of the MPPC, reduction of the photon detection efficiency (PDE), increase of the range of linear response.

The effect of bias voltage variation on the gain of the MPPC was also investigated by recording the amplitude of the full energy peak for 662 keV gamma-rays. Measurements were made in a climatic chamber at +25ºC. Bias voltage was varied between 65.75 V and 65.95 V. Change of the bias voltage by +10 mV changes the peak position by about +1%. In the second part of an study the analysis of the light pulse shapes and energy resolution for different readouts was carried out. The digital data acquisition setup was based on an oscilloscope Tektronix TDS5104B (vertical resolution of 8 bits). The energy spectra and average pulse shape were recorded in three conditions (Fig. 2): direct readout of the MPPC output pulse with short cable, direct readout using 80m cable (as at JET), readout of the shortened (crucial for high counting rates at JET) MPPC output pulse using 80m cable. The results for energy resolution are similar for all three conditions of MPPC readout. The detector is capable of producing short pulses (fall time ~100 ns) that can be transmitted through 80 m signal cables without deterioration of energy resolution (about 6% at 662keV).

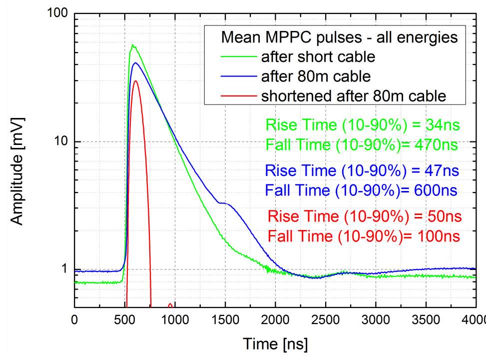


Fig. 2. Average light pulse shapes recorded with a $CeBr_3$ scintillator and ^{137}Cs gamma source under3 conditions.

An MPPC is a compact photodetector with large internal gain that makes this device well suited for light readout from scintillators in the GCU project.

This work was partially supported by the Polish Ministry of Science and Higher Education within the framework of the scientific financial resources in the years 2015-2017 allocated for the realization of international co-financed project.

Reference

[1] M. Grodzicka, M. Moszyński et al., 2013 JINST 8 P02017

Characterization of GAGG:Ce and $CeBr_3$ scintillators for high energy gamma ray monitoring in plasma devices

P. Sibczyński, A. Gójska, S. Mianowski, M. Szawlowski, I. Zychor
National Centre for Nuclear Research, Otwock-Świerk, Poland

NCBJ is involved in the modernization of gamma in for the Joint European Tokamak (JET). One of the diagnostic tools is tokamak plasma tomography, currently based on 19 detectors with Ø20×15mm CsI:Tl scintillators coupled to PiN diodes. However, the response of CsI:Tl is crystal to radiation slow, therefore the detectors will be replaced with faster scintillators within the Gamma Camera Upgrade project. The $CeBr_3$ [1] and GAGG:Ce (Gadolinium Aluminum Gallium Garnet) [2] scintillators are the potential candidates for this application.

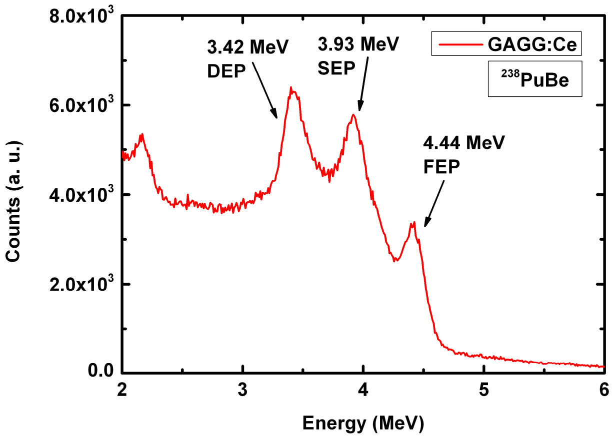


Fig. 1. ^{238}PuBe spectrum measured with the 1”×1” GAGG:Ce scintillator coupled to a PiN-diode.

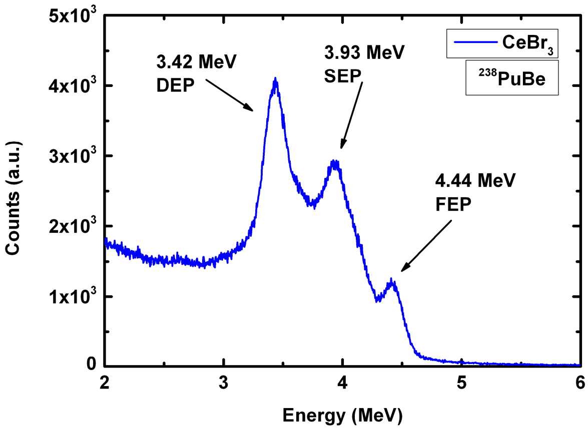


Fig. 2. ^{238}PuBe spectrum measured with the 1”×1” $CeBr_3$ scintillator coupled to a PiN-diode.

The $^{9}Be(\alpha,n\gamma)^{12}C$ reactionis used for plasma monitoring in tokamaks. 4.4 MeV photons produced in this reaction are registered in detectors placed outside the fusion device.

To find the best scintillation material we tested two 1”×1” cylindrical scintillators, $CeBr_3$ and GAGG:Ce coupled to 10×10 mm^2 Hamamatsu S3590 series PiN diodes. In this report we focused on energy resolution measurements with both scintillators. The signal from the PiN diode was amplified by a Cremat CR-110 preamplifier, and shaped with an Ortec 672 spectroscopy amplifier with a shaping time of 2 μs. Finally, the signals were recorded with a Tukan8K Multichannel Analyzer.

Fig. 1 and Fig. 2 present the response of the GAGG:Ce and $CeBr_3$ scintillators to a ^{238}PuBe source, emitting 4.4 MeV γ rays. The single and double escape peaks (SEP and DEP, respectively) are also indicated in the spectra. 4.4 MeV γ rays are detected in a scintillator by an electron-positron pair creation. After annihilation of a positron inside the crystal, two 511 keV photons are emitted. It is possible that one or two of those photons can escape the scintillator, which gives rise to the 3.42 MeV and 3.93 MeV peaks in the spectrum.

In Table 1 the results of the energy resolution measurements are presented.

Table 1. The energy resolution of the GAGG:Ce and $CeBr_3$ scintillators.

Energy (MeV)	FWHM (%)	
	GAGG:Ce	$CeBr_3$
3.416	5.6	5.8
3.927	4.5	5.0
4.438	3.8	3.6

Summarizing, the GAGG:Ce and $CeBr_3$ scintillators coupled to a PiN diode have sufficient energy resolution of a few % at 4.4 MeV, see Table 1. GAGG:Ce has the advantage over $CeBr_3$, as it has a higher density and a higher atomic number, therefore it is more efficient for high energy γ ray detection. However, GAGG:Ce contains Gd and Oxygen, contributing to a higher radiation background when exposed to neutron radiation.

This work was partially supported by the Polish Ministry of Science and Higher Education within the framework of the scientific financial resources in the years 2015-2017 allocated for the realization of international co-financed projects.

References

[1] P. Guss et al., NIM A 608 (2009) 297–304
[2] P. Sibczyński et al., NIM A 772 (2014) 112–117

SOLID STATE PHYSICS

Determination of elemental composition of soil samples from meteorite fall regions

E.A. Miśta[1], Z. Tymiński [1,2], P.Kalbarczyk[3],
[1]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
,[2]*Polish Fireball Network, PKiM,*
[3]*Institute of Nuclear Chemistry and Technology, Warsaw, Poland*

From 2013, in cooperation with different Institutes, NCNR has taken part in cosmogenic material research. The study is focused on: meteorite find structure by the SEM/EDX method supported by LA-ICP-MS and environmental study of soil from falls regions.

Here we report results on the strewnfield in the "Meteorite Morasko" reserve and reference in the Pułtusk area [1-2]. The fall region in Morocco called Tata is also bein studied (research is in progress).

The main goal of the project was to find a correlation between the chemical composition of the soil and the concentration of cosmogenic material. The first step was field prospection and-soil sampling. Three regions in the reserve were studied. The ICP MS method was used to determine the elemental composition of collected soil samples. Special attention was paid to the chemical components of which on iron meteorite matrix is built like Fe, Ni and Co. Results of the study provided information about the distribution and correlation of chemical components in the reserve.

Based on the map [3] three regions were selected for sampling: from the periphery of the fall region, the eastem part of the reserve (*Region A*), an area with a range of 0,003 - 0,5 kg of meteorite finds – on the south of Meteorytowa Street (*Region B*) and an area with concentration above 50 kg (Region C) which is presented in Photo 1. There were 17 soil samples were taken at a depth of 10 cm, and were chemically prepared for the ICP-MS measurements.

Fot. 1. Region with craters (probably impact) in the "Meteorite Morasko" reserve. Sampling Region C (photo by T. Jakubowski).

The working hypothesis was that trhe content of Fe, Ni and Co in the soil could be used for determination of the extraterrestrial matter concentration in the sampling areas.

The results provided information about the elemental distribution of soil components which originate from the meteoritic matter scattered in the studied areas. There are some correlations between the amount of meteorite finds and the concentration of Ni, Fe and Co in the soil. Fig.1. shows the results obtained for the Co distribution.

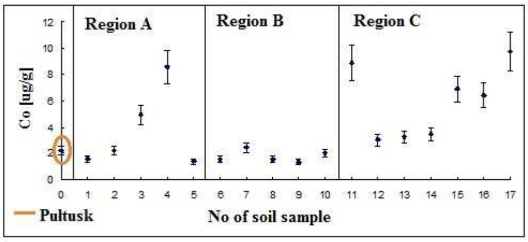


Fig.1. The Co content in the soil samples from "Meteorite Morasko" reserve obtained by the ICP-MS technique.. As a reference determine the Co content in a soil sample from the Pultusk meteorite strewnfield was determined .

Generally, the highest content of all the studied elements is in Region C, then in the cultivated area - Region A and the lowest content recorded for Region B.

Fig.2. Meteorite strewn fields in Poland (http://wiki.meteoritica.pl/index.php5/Mapa_Spadk%C3%B3w_Materii_Kosmicznej from day 27/03/15).

In the reported study a research methodology was developed. In the future a similar programme will be realized for selected meteorite fall regions in Poland. Fig.2. show the meteorite strewn fields in Poland.

References

[1] E.A. Miśta, Z. Tymiński, P.Kalbarczyk, Proceedings of 46th Lunar and Planetary Science Conference, U.S.A. (2015)

[2] E.A. Miśta et al., PTMet 2014, in review (2015)

[3] Muszyński A. et al., Map of contemporary finds of meteorite Morasko, 2012

Thermal stability and phase transitions in WO_3-ZrO_2 and WO_3-TiO_2 composites

L. Górski, E. Iller, M. Konior
National Centre for Nuclear Research, Otwock-Świerk, Poland

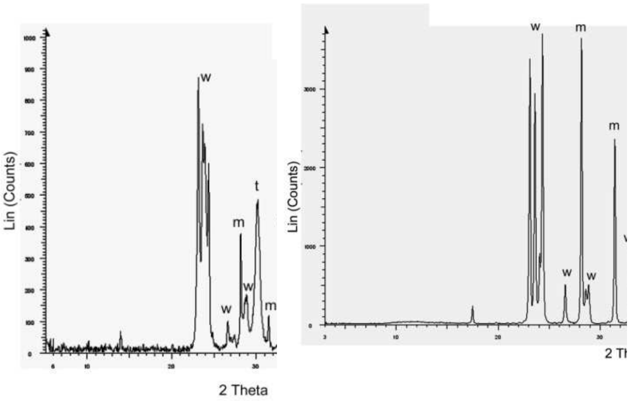
The complex sol-gel process was carried out at the Institute of Nuclear Chemistry and Technology to synthesize WO_3-ZrO_2 and WO_3-TiO_2 composites with various oxide content.

These composites are used in the manufacture of radionuclide W-Re generators widely used in nuclear medicine. WO_3-ZrO_2 composites are also potential catalysts in the hydrocarbon isomerization process [1].

The gels obtained were thermally treated at temperatures indicated by thermal analysis results. Their structure was studied by X-ray and neutron diffraction methods depending on the annealing temperature.[2]. At 500^{o} C the material is practically amorphous, at 650^{o}C some peaks occur in the diffraction pattern whereas after annealing at 800^{o}C the material is fully polycrystalline. Both oxides exist as separate crystalline phases.

The purpose of this work was to determine the thermal stability of the system. Therefore, samples of both composites were annealed at 1000^{o}C for 5 - 50 hours. We found no phase transitions occurring durins such annealing. Monoclinic WO_3 and TiO_2 were found in the crystal forms of anatase and rutile, and remained practically unchanged.

More complex effects appear in the case of WO_3-ZrO_2 composites. The crystalline samples after annealing at 800^{o}C contain two phases: monoclinic WO_3 and tetragonal ZrO_2. This latter phase is stable only in the presence of some other oxide additions which form a stable solid solution with ZrO_2. In our case tetragonal ZrO_2 is stable in the presence of WO_3 occurring as separate phase. After experiments with annealing at 1000^{o}C a phase transition is observed. Tetragonal ZrO_2 transforms to the monoclinic form. This effect is shown in the X-ray diffraction pattern (Fig. 1). The transition velocity is rather slow and after 5h annealing one can observe coexistence of both tetragonal and monoclinic forms (Fig. 1a). Further annealing causes disappearance of the tetragonal phase and high intensity monoclinic peaks (Fig. 1 b). WO_3 is stable to thermal treatment.



a b

Fig.1. X-ray diffraction pattern of WO_3-ZrO_2 composite, w- WO_3, m-monoclinic ZrO_2, t- tetragonal ZrO_2, a-5h at 1000^{o}C, b- 50h at 1000^{o}C.

References

[1] E.Iller, D. Wawszczak, L. Górski, Archiv.of Metall and Mat.57(2) (2012), 452-458

[2] E. Iller, H. Polkowska-Motrenko, J. Milczarek, L.Górski, Appl. Radiat. Isot.. 75 (2013), 115-127

Synchrotron topographic investigation of strain around craters generated by irradiation with X-ray pulses from a free electron laser with different intensities

W. Wierzchowski[1], K. Wieteska[2], R. Sobierajski[3], D. Klinger[3], J. Pełka[3], D. Żymierska[3], C. Paulmann[4]
[1]*Institute of Electronic Materials Technology, Warsaw, Poland*
[2]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
[3]*Polish Academy of Sciences, Institute of Physics, Warsaw, Poland*
[4]*DESY HASYLAB, Hamburg, Germany*

A silicon sample irradiated with femtosecond soft X-ray pulses at the Linac Coherent Light source was studied with a number of synchrotron X-ray diffraction topographic methods at HASYLAB. The irradiations were performed at two different wavelengths, 1832 eV and 2000 eV, combined with various impact energies controlled by means of a gas attenuator. The topographic investigation revealed characteristic images of the created craters, including the inner region reflecting X-rays at a lower angle, coming most probably from part of the silicon melted during the irradiation. The melted region covered probably by an amorphous material was surrounded by a strained outer region, similar to those observed in the case of a rod-like inclusion but less regular in view of some irregularity of the beam used for generation of the craters. It was observed that the higher energy and higher impact dose of the irradiating pulses resulted in increasing the diameter of the melted area of the crater and the range of the strained region around it. The monochromatic beam topography indicated the change of the lattice parameter which was greatest in the melted region and slightly lower in the outer strained region.

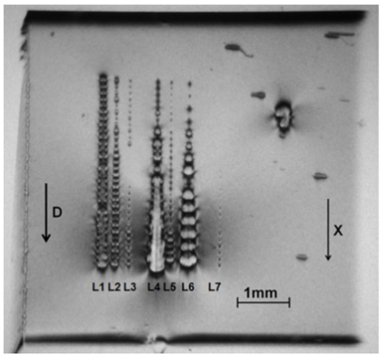


Fig. 1. Bragg-case white beam projection topograph $5\bar{1}\bar{1}$ *reflection of 0.0706 nm radiation. "X" denotes the direction of incjdent beam and "D" the direction of increasing impact energy: L1 1832 eV; impact energy 0.003 J – 0.02 J, L2 1832 eV; impact energy 0.000055 J – 0.000047 J, L3 1832 eV; impact energy 0.000018 J – 0.000013 J, L4 wavelength 2000 eV; impact energy 0.00008 J – 0.002 J, L5 2000 eV; impact energy 0.000055 J – 0.000047 J, L6 2000 eV; impact energy 0.000059 J – 0.0018 J.*

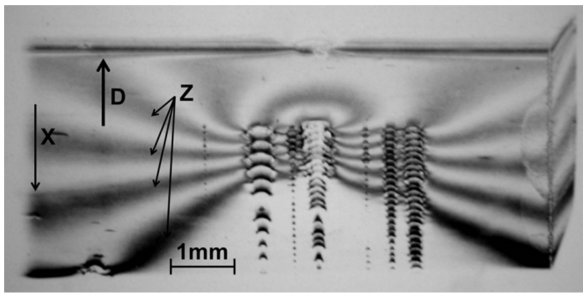


Fig. 2. Monochromatic beam topograph taken in 004 reflection of 0.1115nm - "zebra pattern" taken with an angular step of the 0,002°. "Z" denotes the stripes of "zebra-pattern". The picture is turned through180° with respect to Fig. 1.

Nonlinear refractive index for PDLC composites doped with inorganic nanoparticles

R.Węgłowski[1], I.Cieślik[2], Ł. Zinkiewicz[3], P.Fita[3]
[1]*Military University of Technology,Warsaw, Poland*
[2]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
[3]*University of Warsaw, Warsaw, Poland*

The nonlinear optical properties of a PDLC system on an elastic substrate, with nanocrystal dopant were investigated with the Z-scan technique. Composites with different concentrations of $La_2CaB_{10}O_{19}$ (LCBO) and BiB_3O_6 (BIBO) nanocrystals were studied. The LCBO matrix was obtained using the modified sol-gel method. Nanocrystallites of BiBO were prepared by acoustic milling of a monocrystal. The PDLC composites were obtained by photopolymerization-induced phase separation. In our work PDLC systems containing 30 wt % of LC and 5 – 10 wt % of LCBO and BIBO were used. At the beginning the nanoparticles were mixed with liquid crystal for 30 min. Then the prepolymer was added and mixed. Then the mixture was heated for degassing. In the next step the mixture was sandwiched between two plastic plates (PET) coated with indium tin oxide (ITO) electrodes. The thickness of all samples was fixed at 25 μm by glass spacers. The polymerization was performed by UV light (Hamamatsu lamp LC8 L9588) with wave length λ=365 nm for 30 min. at a power flux of 4 mW/cm^2.The LC droplet diameters in the polymer matrix were about 10μm. The sample without applied voltage (OFF state) distracting the light but after applying an appropriate voltage becomes transparent (ON state for 50V DC) [Fig.1]. It was shown that the nonlinear refractive index of PDLC composites depends on the nanocrystal content. Moreover, we found that BIBO nanoparticles have a positive (self-focusing) refractive index and LCBO a negative (self-defocusing) (Tab.1). With the increase of the concentration of nanoparticles the difference between the nonlinear refractive index of doped and undoped PDLC increases. This confirms that the nanoparticles are responsible for the change in the nonlinear refractive index of PDLC systems. Our results have shown the feasibility of flexible nonlinear electro-optical modulators based on PDLC systems with borate nanocrystals

Fig. 1. The elastic PDLC systems: a) switched ON with 50V DC, b) switched OFF at 0V.

Table 1. The nonlinear refractive index

The % w.t. content of nanoparticles in the composite	*Nonlinear refractive index of PDLC with nanoparticles (10^{-16} [cm^2/W])*	*Nonlinear refractive index of nanoparticles (10^{-16} [cm^2/W])*
0 %	14. 1	0
BIBO 5%	14. 3	0.2
BIBO 10%	31. 7	17. 6
LCBO 5%	13. 1	–1.0
LCBO 10%	10. 6	–3.5

Structure–reactivity relationship in 4,5,6,7-tetrahalogeno-1H-benzimidazoles: A combined X-ray, DSC, DFT/QTAIM, hirshfeld surface-based, and molecular docking approach

J.N.Latosińska[1], M. Latosińska[1], J.K.Maurin[2], A. Orzeszko[3], Z. Kazimierczuk[1]
[1]*Faculty of Physics, Adam Mickiewicz University, Poznań, Poland*
[2]*National Centre for Nuclear Research, Otwock-Świerk, Poland*
[3]*Institute of Chemistry, Warsaw Uniwersity of Life Science, Warsaw Poland*

The weak interaction patterns in 4,5,6,7-tetrahalogeno-1H-benzimidazoles, protein kinase CK2 inhibitors, in the solid state were studied by the X-ray method and quantum chemistry calculations. Protein casein kinase II (CK2) is a highly pleiotropic enzyme whose high activity is responsible for the development and potentiation of many tumour diseases. Abnormally high levels of CK2 have been documented in a number of cancers including kidney [1], mammary gland [2], lung [3], head and neck [4] and prostate [5]. Thus, CK2 inhibitors have been indicated as potentially promising drugs for anticancer therapy. Up to now a number of inhibitors of CK2 have been discovered from various chemical groups, e.g. elagic acid [5-oxo-5,6-dihydroindolo-(1,2a)quinazolin-7-yl]acetic acid (IQA) 4,5,6,7-tetrabromo-1H-benzotriazole (TBBT) 4,5,6,7-tetraiodo-1H-benzimidazole (TIBI), 4,5,6,7-tetrabromo-1H-benzimidazole (TBBI) [6]. The crystal structures of 4,5,6,7-tetrachloro-1H-benzimidazole (TCBI) and 4,5,6,7-tetrabromo-1H-benzimidazole (TBBI) were determined by X-ray diffraction. The compounds crystallize in *P-1* and $I4_1/n$ space groups with 4 and 1 symmetry independent molecules in the unit cells, respectively. The main structural motifs determining the crystal packing in both structures are N-H··N hydrogen bonds linking the imidazole rings of adjacent molecules. In TBBI, hydrogen bonds link 4_1 symmetry related molecules (Fig. 1), whereas in TCBI the molecules (Fig. 2) differ slightly in geometry.

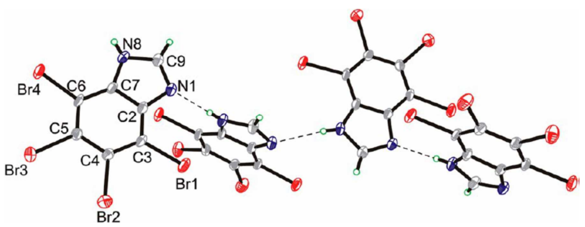


Fig. 1. Crystal packing of 4,5,6,7-tetrabromo-1H-benzimidazole.

The results were published [7] and detailed crystallographic data were deposited with the Cambridge Crystallographic Data Centre [8]

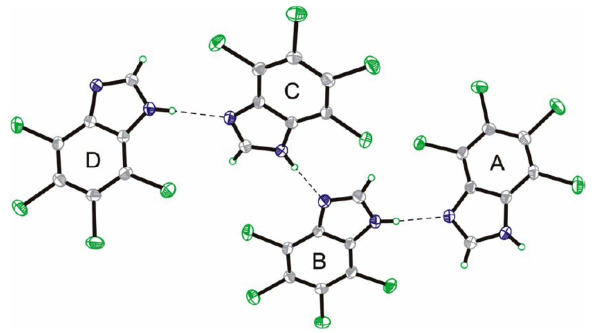


Fig. 2. Crystal packing of 4,5,6,7-tetrachloro-1H-benzimidazole.

The lack of 3D isostructurality found in all 4,5,6,7-tetrahalogeno-1H-benzimidazoles is explained on the basis of the intra- and intermolecular interactions (hydrogen bonding, van der Waals contacts, and C-H···π interactions). The 3D packing in 4,5,6,7-tetrahalogeno-1H-benzimidazole crystals is forced by noncovalent, strongly directional, mainly electrostatic interactions: N1−H···N3′ hydrogen bonds and much less directional, dispersion forces−van der Waals (Hal···Hal, Hal = H, F, Cl, Br, I) contacts. The formation ability of a given type of bonds by 4,5,6,7-tetrahalogeno-1H-benzimidazole molecules is the same in the crystal and in CK2.

References

[1] G. Stalter, S. Siemer, E. Becht, M. Ziegler, K. Remberger, O.G. Issinger, *Biochem. Biophys. Res. Commun.* 1994, *202,* 141
[2] E. Landesman-Bollag, R. Romieu-Mourez, D.H. Song, *Oncogene* 2001, *20 (25),* 3247–3257
[3] M. Daya-Makin, J.S. Sanghera, T.L. Mogentale, M. Lipp, J. Parchomchuk, J.C. Hogg, S.L. Pelech, *Cancer Res.* 1994, *54 (8),* 2262–2268
[4] R.A. Faust, S. Tawfic, A.T. Davis, L.A. Bubash, K. Ahmed, *Head Neck* 2000, *22,* 341
[5] S. Yenice, A.T. Davis, S.A. Goueli, A. Akdas, C. Limas, K. Ahmed, *Prostate* 1994, *24,* 11
[6] M.A. Pagano, J. Bain, Z. Kazimierczuk, S. Sarno, M. Ruzzene, G. Di Maira, M. Elliott, A. Orzeszko, G. Cozza, F. Meggio, L.A. Pinna, *Biochem. J.* 2008, *415,* 353
[7] J.N. Lotosińska, M. Latosińska, J.K. Maurin, A. Orzeszko, Z. Kazimierczuk, *J.Phys. Chem. A.* 2014, *118*, 2089
[8] CCDC 955361 and CCDC 955360

The effect of phase decomposition on the magnetic structure of $Cu_{0.4}Mn_{0.3}Ni_{0.3}$ alloy

J. Jankowska-Kisielińska, K. Świderska
National Centre for Nuclear Research, Otwock- Świerk, Poland

$Cu_{1-2x}Mn_xNi_x$ alloys harden as a result of phase decomposition [1-3]. An atomically disordered alloy of the FCC structure can be achieved by annealing at 1070-1220 K and subsequent quenching [1, 3]. Annealing at 670-770 K induces alloy decomposition into two phases [1-3] - one of a tetragonal structure, poor in Cu atoms and rich in the atomically ordered intermetallic compound MnNi, and another one, of FCC structure which is a solid solution, rich in Cu atoms and poor in Mn and Ni.

The subject of the present investigation was the effect of phase decomposition of the $Cu_{0.4}Mn_{0.3}Ni_{0.3}$ alloy on its magnetic ordering. A single-crystal sample was homogenized by annealing at 1170 K and quenching. It was subjected to five runs of annealing at 700-730 K. It was than examined by elastic neutron scattering after each annealing run [4].

In the quenched alloy the Bragg reflections expected for the FCC structure were found. In addition, we observed super-structure reflections of different shape and intensity two orders of magnitude lower (Fig. 1a).

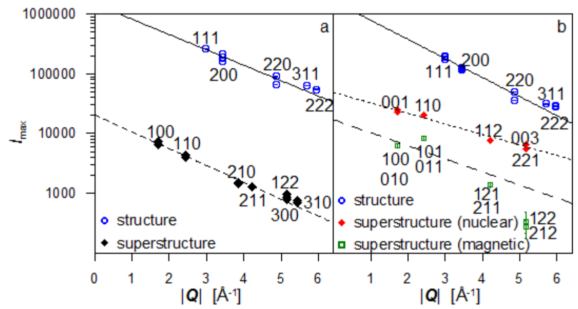


Fig. 1. (a) Intensity at the maximum of the FCC Bragg reflections (open circles) and additional super-structure reflections (filled squares) versus scattering vector, measured at 295 K before sample annealing. (b) Intensity at the maximum of the FCC Bragg reflections (open circles) and the maximum of the nuclear (filled squares) and magnetic (open squares) components of super-structure reflections versus scattering vector, measured at 295 K after 8 h of sample annealing.

The superstructure reflections are complex, containing Gaussian and Lorentzian components. Their widths and the dependence of the intensity on temperature (Fig. 2) indicate long range magnetic ordering of AF1-type in some (small) fraction of the sample and short range ordering of another type in another small fraction.

After annealing the lattice structure and parameters of the main part of the sample do not change (Fig. 1b). The intensity of the magnetic component of the super-structure reflections increases with the total annealing time at a lower rate than the component due to atomic order, as shown in Fig. 3. The positions of the superstructure reflections change indicating an increasing tetragonal distortion parameter. The positions of the Gaussian components of reflections (001), (110), (112) and (221) are consistent with the position of the atomic super-lattice reflections and the positions of the Lorentzian component of reflections (100), (101), (211) and (122) are consistent with the positions of the magnetic reflections in a pure MnNi compound [5].

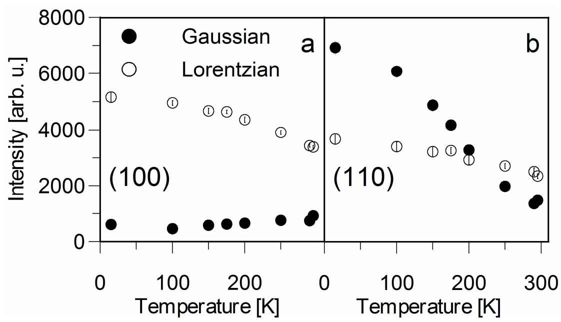


Fig. 2 The temperature dependence of the intensity of the Gaussian and Lorentzian components of the (100) reflection – a, and the (110) reflection – b, for the quenched sample.

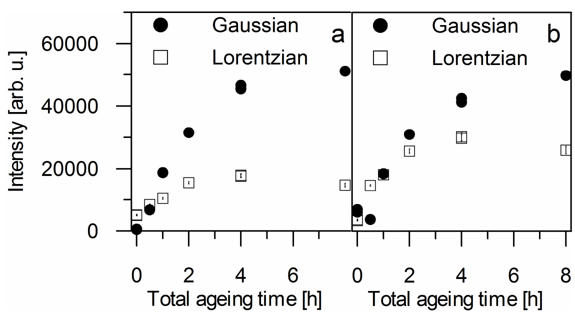


Fig. 3 Intensity of the nuclear and magnetic components of the super-structure reflections measured at 15 K: (a) for (100) and (b) for (110) reflections, versus sample annealing time.

References

[1] J. Rolland, P. Priester et D. Whitwham, C. R. Acad. Sc. Paris. C, 270, 1777 (1970)
[2] D. Rondot, J. Mignot, Acta Metall., 26, 217 (1978) DOI:10.1016/0001-6160(78)90121-9
[3] N.A. Polyakova, V.A. Udovenko, E.D. Chichua, Fiz. Metal. Metalloved., 71, 178, (1991), (in Russian)
[4] K. Świderska, J. Jankowska-Kisielińska, Acta Phys. Pol. A, 127, 394 (2015)
[5] J.S. Kasper, J.S.Kouvel, J. Phys. Chem. Solids, 11, 231 (1959) DOI:10.1016/0022-3697(63)90515-8

Material Research Laboratory - activities on nano-technics in 2014

Ł. Kurpaska
National Centre for Nuclear Research, Otwock-Świerk, Poland

In 2014 the Materials Research Lab was involved in several studies regarding materials for new generation nuclear power-plants. In order to perform high quality research, new techniques such as nanoindentation and a magnetic particle testing system were used. Research was focused mainly on the nano-mechanical investigation of the Zr/ZrO_2 system, irradiated ODS RAF samples, thin layer characterization and investigation of 316 L SS samples (HAZ – Heat Affected Zone, base material and welding).

The Materials Research Lab is currentlyinvolved in several research programmes coordinated and/or sponsored by different organizations, i.e. IAEA – International Atomic Energy Agency, FNP – Foundation for Polish Science and most recently EERA - JPNM an organism (European Energy Research Alliance - Joint Programme on Nuclear Materials) whose objective is to improve the safety and sustainability of Nuclear Energy by focusing on materials aspects.

In 2014 the Material Research Lab strengthened its collaboration with the MARIA research rector and the Laboratory of Radiation Protection. Due to the very expensive process of irradiation, the limited research area in the spent fuel pool and costs the associated with conducting standard mechanical investigations in hot cell facilities, we would like to reduce the surface of the samples. For this reason, methods such as Small Punch Testing (SPT) or nanoindentation are increasingly appreciated by nuclear engineers. Additionally, in the case of neutron irradiation, reduction of the mass and surface of the sample results in a faster cooling process of the irradiated material which allows one to carry out the research in a much shorter time.

Several gamma, neutron and ion irradiated samples were investigated using SPT methodology and the nanoindentation technique. The SPT samples were irradiated in the spent fuel pool of the research reactor continuously for 30 and 90 days. In order to provide maximally accurate calculation of the gamma dose, using a dosimetric marker, a gamma dose measurement was performed every 2-3 weeks. Based on these measurements, at the end of each irradiation period the final gamma dose for the material irradiated over 30 and 90 days was estimated to be 0.81 and 2.10 MGy. The SPT method consists of measuring the deflection in the course of applying a force which is transferred into the sample by a very hard ball. Based on the sample deflection test a typical curve is created showing the relationship between the force and the displacement measured by an extensometer. One of the goals of the Materials Research Lab is to find a correlation between nanomechanical measurements, i.e. nanoindentation and micromechanical, i.e. the SPT methodology and the classical hardness test in the hot cell facility. For this reason, extensive research using the nanoindentation technique is currently being performed at the Materials Research Lab. Our latest interest in the field of new potential materials for IV-gen nuclear reactors is focused on the study of mechanical effects of irradiation on ODS RAF samples and zirconium alloys. Recently, we proved that the addition of Vanadium improves the hardness of ODS RAF steels, which is more pronounced thay the radiation hardening effect. In all irradiated samples, a higher dose leads to higher nanohardness values. Several mechanisms can be invoked to explain these results: (i) ion irradiation induces defect generation, dislocation loops and vacancies, which act as obstacles for dislocation glide and an cause irradiation hardening effect or (ii) vanadium causes an increase in mean particle size and density in the matrix. Therefore, nanohardness related to V content increases with increasing amount of vanadium due to precipitation and a dispersion hardening effect. Modification of chemical composition also seems to be more efficient to improve the mechanical properties than ion irradiation.

Moreover, the addition of vanadium dissolves oxygen located in the proximity of grain boundaries and creates nanoparticles in Ti-Cr oxides/carbides. Therefore, we have proved that nanohardness may to some extent serve as a complementary method for monitoring the oxygen content in V-modified ODS RAF steels. In our opinion future study should focus on use of pre-alloyed, argon atomised vanadium powders. High resolution TEM images should be made in order to confirm the combined effect of nanoparticles and dislocation loops at high irradiation doses.

NUCLEAR TECHNOLOGY IN ENERGY GENERATION

CFD-FEM coupled analysis of flow induced structural deformation

P. A. Prusiński[1], K. Wawrzyk[2], D. Zgorzelski[1]
[1]National Centre for Nuclear Research (NCBJ), Otwock-Świerk, Poland
[2]Institute of Fundamental Technological Research, Warsaw, Poland

Real industrial scale issues are mostly complex problems involving different phenomena and different physics. While analysing their source or development and definitely looking for the solution, one can use a wide range of tools (i.e. engineering software) dedicated to every single issue. However, treating them separately may lead to wrong conclusions, i.e. losing the scope of conjugated effects and introducing extra uncertainty factors. For this reason, such problems require a multi-physics approach.

In the case of nuclear safety assessments, it becomes regular practice to couple the codes in order to get a comprehensive answer, e.g. by coupling thermal hydraulic and structural mechanics codes in order to follow fluid-structure interactions (FSI). To understand this term, one should imagine a solid structure with some degrees of freedom. When it is subjected to flow it may change its shape, changing the flow domain in turn and that should be incorporated back into the fluid model.

The CFD Analysis Group, working in the framework of the Świerk Computing Centre, has made an effort towards basic research on coupling a thermal hydraulic, i.e. a Computational Fluid Dynamics (CFD) model with its structural mechanics (based on the Finite Element Method - FEM) counterpart to prepare a know-how base for further development of real life models.

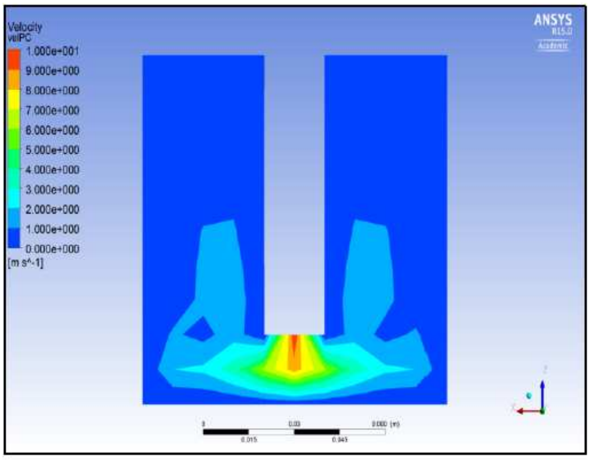


Fig. 1. Velocity pattern in the tank – middle cross-section.

The aim of this work was to find an efficient procedure, first manual then automatic, to translate the results of the CFD code (ANSYS Fluent) to be an input for a structural mechanics code (EDF Code_Aster).

The sample case assumes a setup that consists of a tank filled with a fluid and a vertical concentric duct immersed in it. The fluid coming out of the duct hits the bottom of the tank (Fig. 1.) generating a stress in its material, finally resulting in a deformation (Fig. 2.).

The model is under development, but its general purpose is to raise the level of knowledge in this field.

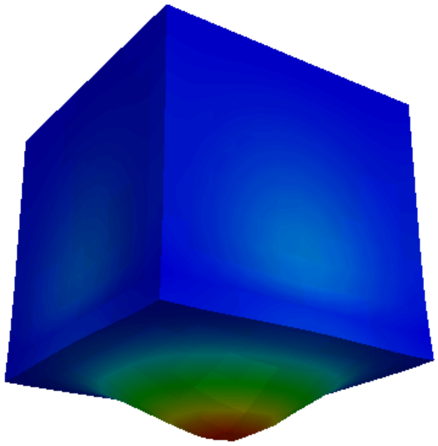


Fig. 2. Deformation of the tank after flow impact.

The ultimate goal of the project is to provide a tool capable of predicting the effects of flow induced vibrations in the MARIA Research Reactor. This topic needs an in-depth study as it pose a threat to the safe operation of the reactor, a threat that is hard to estimate at the moment because the oscillatory character of the flow leads to impaired heat removal from the core. This in turn may cause reactor pool heat-up, in extreme conditions even local onset of boiling and active fuel release.

Such a threat always appears when new equipment is designed for implementation both in the reactor core lattice and in the reactor core cooling circuit. It may also manifest in the case of abnormal reactor operation.

The final effect should be a tool of general application purpose, namely industrial applications.

Thermodynamic properties of ceramics with defects caused by irradiation

O. Dorosh
National Centre for Nuclear Research, Świerk-Otwock, Poland

Ceramics are an important subject for the nuclear industry as they are the main material for nuclear fuel. All of them undergo the effects of radiation damage whether during their life-time in a nuclear reactor or in long term storage. Depending on their structure they show very different behaviour under irradiation. Their responses to irradiation vary from almost perfect resistance to complete amorphization, with possible phase transitions. Impressive progress in computers over the last decade makes possible perform simulation of the ceramics by means of Molecular Dynamics.

We used MD simulations to study the process of defect formation caused by irradiation in MgO ceramic. The present calculation was made with the molecular dynamics (MD) program LAMMPS created at Sandia National Laboratory [1]. We used two potentials proposed by Uberuaga [2] and Akamatsu [3]. Both potentials are composed of a Coulomb term with full charges for both oxygen and magnesium and a Buckingham term.

Our goal is to explain the process of the formation defects in the material caused by irradiation. We performed a simulation of the molecular dynamics to get the same defect pattern known from experiment.

We performed calculation for a MgO system consisting of 110 thousand atoms. The size of the cell was 100x100x100 angstrom. For such a structure we performed calculations for different pressures on the border. The pressure ranged from 0 to 100 GPa in steps of 5 GPa. The pressure is set on the cell border. We used an “aniso” parameter, and this gives more flexibility of the cell for relaxation under pressure.

The cascade damage structure is initiated by one atom with an additional energy of 2 keV. The process of defect formation is presented in figure 1. As can be seen initially many atoms are displaced from their positions in the crystal, but in a short time they return to the points of lattice and the energy of a irradiation is dispersed in the crystal. The atoms that do not return to the points of the lattice form stable in time defects.

Our simulation demonstrates how stable the defect appears, and our further work is to find the conditions that give defects similar to those observed in experiment.

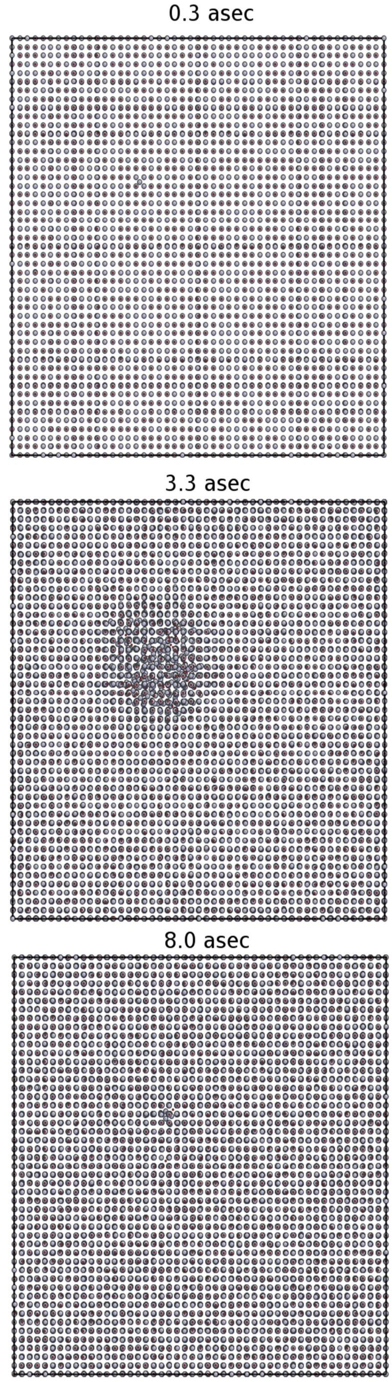


Fig. 1. Process of defect creation.

References

[1] http://lammps.sandia.gov/
[2] B. P. Uberuaga, R. Smith, A. R. Cleave, G. Henkelman, R. W. Grimes, A. F. Voter, and K. E. Sickafus, Phys. Rev. B 71, (2005) 104102
[3] T. Akamatsu, K. Kawamur, Mol. Sim. Vol.21
[4] issue 5-6, (1999) pp. 387-399

MARIA research reactor – thermal-hydraulic calculations with the RELAP5 code

E. Skrzypek, M. Skrzypek, K. Gomulski
National Centre for Nuclear Research, Otwock- Świerk, Poland

The concept of the performance of an analysis for the research reactor came from the need to verify past calculations and create an easy to assess and modify reactor model - useful for a range of thermal-hydraulic calculations. In the past the calculations for the safety analysis report were conducted with various tools and a self-developed (by the reactor operator) computational tool for the transient calculation of only one separate core channel. The characteristics of the reactor of channel type allowed transient calculations to be performed for the separate hottest channel, which gave an overview of the possible most threatening scenario.

With the conversion from HEU (High Enriched Uranium) to LEU (Low Enriched Uranium), there was a need for coolant circuit design modifications and additional safety report preparation due to the safety requirements of IAEA. The necessity of the modifications was caused by the different geometry of LEU fuel compared to the old design. Changes in the primary circuit resulted in the requirement of a new model of the reactor thermalhydraulic system for the purposes of the safety analysis report.

Due to the multiplicity of the channels type of LEU and HEU respectively, some channels are identical and can be merged into zones (peripheral and central), representing different power distributions. This decreases the time needed for calculation of scenarios and enables the flexibility to create various core configurations.

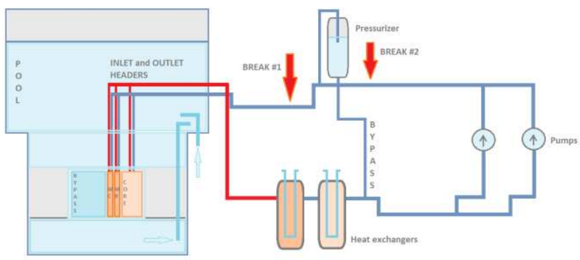


Fig. 1. Main components, core zones and break locations in the RELAP5 model of the MARIA reactor.

The use of programming skills allowed the amount of actions taken by the code user while defining channels in the core to be decreased. The automation is made by connections of the pre-modelled channels into zones and finally into a core, by the use of adedicated program written in Python.

Simulations of potential transient situations are a Loss of Flow Accident for a separate fuel channel of MC type, Small Break Loss of Coolant Accident and Large Break Loss Of Coolant Accident for the entire primary and secondary reactor model.

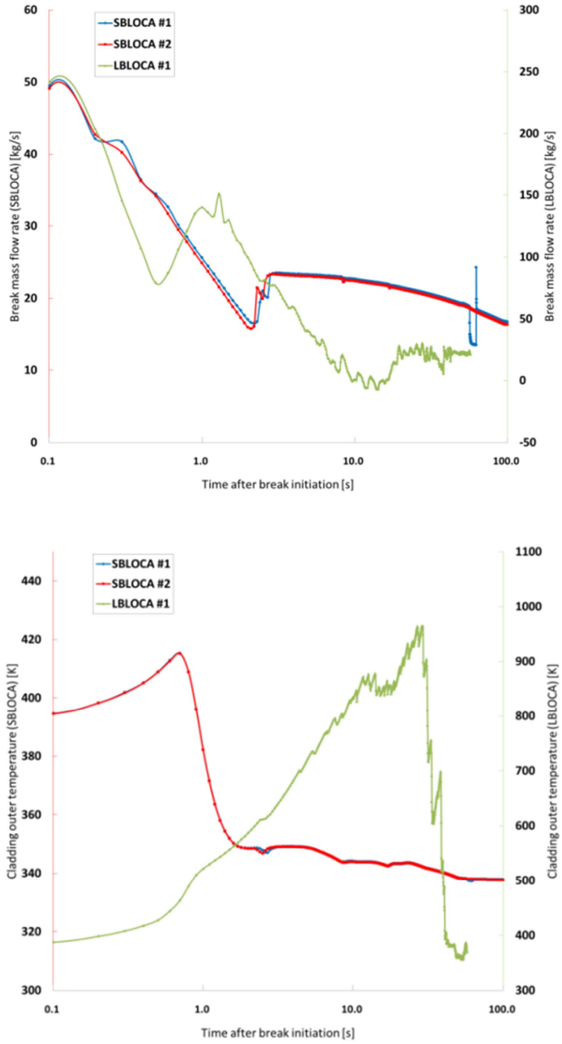


Fig. 2. SBLOCA and LBLOCA mass flow rate through the break and Peak Cladding Temperature for the 6th pipe.

The model can be developed in the future for the purposes of the safety analysis of the MARIA research reactor. With the variety of possibilities of defining core zones and the configuration tool based on the Python language, the model in the RELAP5 code is a flexible and useful application for the diagnosis of transient states in the reactor.

References

[1] 2011National Centre for Nuclear Research, „Safety Analysis Report for Maria Research Reactor," NCBJ, Otwock, Świerk

[2] International Atomic Energy Agency, „IAEA Safety Standards - Safety Assessment for Research Reactors and Preparation of Safety Analysis Report SSG no.SSG-20," IAEA, Vienna, 2012

[3] [3] A. P. a. F. D'Auria, „Thermal-Hydraulic System Codes in Nuclear Reactor Safety and Qualification Procedures," Science and Technology of Nuclear Installations, tom 2008, p. 16, 2008

Library for thermodynamic analyses of power plant circuits

T. Machtyl

National Centre for Nuclear Research, Otwock - Świerk, Poland

This library was developed to simplify and expedite preliminary analysis of power plants, combined heat and power (CHP) plants - both conventional and nuclear, such as presented in *Fig.*. The library provides a simple and fast way to get information about the mass and energy flows in complex systems and, related to these values, the efficiency of the system. It also allows the study of the effects of configuration changes or certain system parameters on the overall system efficiency.

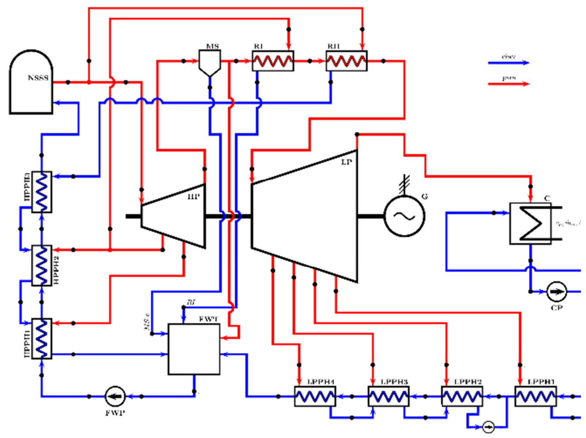


Fig. 1. Example of analyzed power plant.

The results of an analysis can be presented on automatically generated graphs, e.g. temperature – specific entropy (T-s), specific enthalpy – specific entropy for expansion in a steam turbine (h-s, see *Fig.*), or temperature changes in heat exchangers.

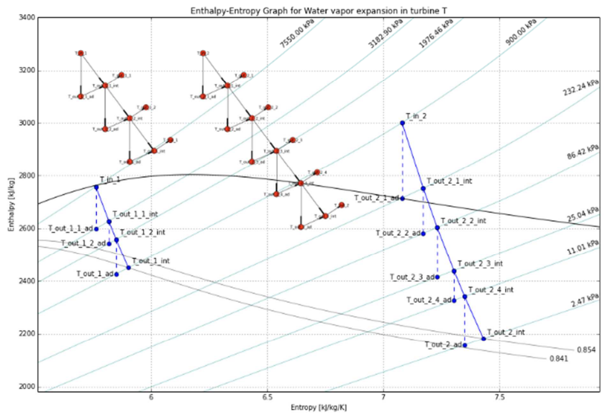


Fig. 2. Graph representation of steam turbine and its enthalpy-entropy plot.

Main steam line break in a typical PWR - transient modelling and analysis
The system code used for the transient calculation was RELAP5

R. Baranowski
National Centre for Nuclear Research, Otwock-Świerk, Poland

A main Steam Line Break (MSLB) accident may occur as a consequence of a rupture of one steam line. This event is characterized by large heat removal over the steam generator (SG) in the broken line, fast depressurization, and consequently boil-off of the fluid inventory in the broken SG's secondary side. The cool-down and the negative reactivity coefficients for the coolant and fuel may introduce significant positive reactivity in the core and lead to recriticality.

A MSLB accident simulation was carried out on a reactor model of Zion Nuclear Power Station which was adopted from the Large Break Loss of Coolant accident (LB LOCK) simulation conducted previously. To meet the objective the model was substantially modified and adjusted according to the operating parameters and thermal-hydraulic properties of the Zion reactor [1] (Fig [1]).

The reactor cycle was assumed to be at end of life (EOL), which, due to more negative reactivity coefficients, is an adverse condition for accidents with rapid depressurization and cool-down of a reactor coolant. The moderator and fuel temperature coefficients were distributed over the core according to the volume and the heat nodes, respectively

The break was located inside the containment upstream of the flow restrictor. An abrupt area change, nonhomogeneous model, and the Henry-Fauske critical flow model were chosen to simulate the break. The water levels in the SGs downcomers were controlled by a Proportional-Integral controller. The set points were adjustable according to two different modes of operation (full power operation and the shutdown condition). The transient simulation was preceded by a steady-state calculation. All of the compared parameters were within 0.5% deviation from the Zion nominal operation parameters (Table 1).

The transient was initiated at hot full power (HFP) when the steam generator (SG) liquid inventory was highest and its rapid outflow could result in greater cool-down of the reactor coolant. This assumption increases the conservatism.

The final analysis of the main steam pipe rupture shows that the risk of return to power and dangerous increase of the cladding temperature for the given assumptions can be excluded. However, it was also noticed that this conclusion is heavily dependent on the stuck rod assumption and the injection time of borated water from the Safety Injection system. For instance, for the worth of the stuck rod about 4$ the reactor may come to criticality, which in turn may increase fuel temperature and pose a threat to its integrity.

Table 1. Times of accident events

EVENT	TIME
Break initiation	0.0
Signal to close the turbine valve (TCSV	0.0
Initiation of scram	0.0
TCSV fully closed	2.0
Shut down rods fully inserted	3.1
Isolation valves fully closed (MSIV)	7.0
Feedwater valves fully closed	10.0
Activation of auxiliary feedwater	60.0
Decrease of the primary pressure below 12.82 MPa	150.2
Activation of the HPI system	177.2
Restore of the SG water level in the intact lines	410.0
Restore of the SG water level in the broken line	8000.0
Primary system pressure above 12.82 MPa	11500.0
Deactivation of the HPI system	11500.0

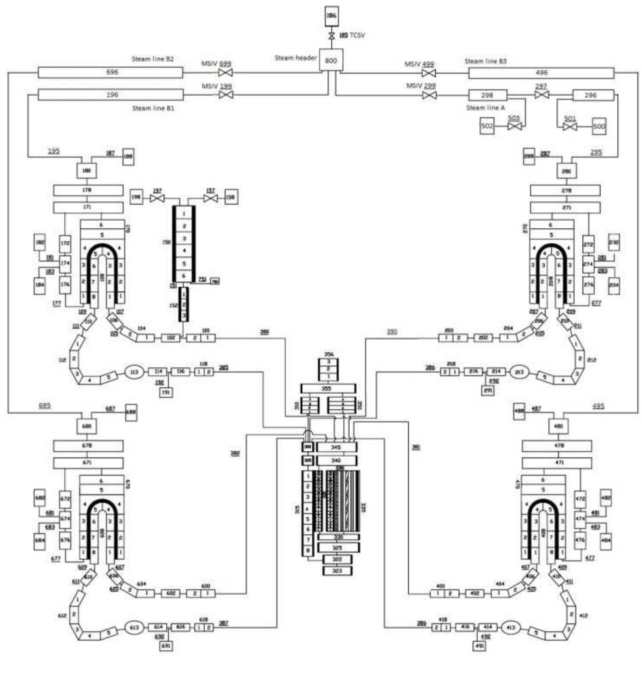


Fig. 1. Nodalization of the ZION reactor mode.

Reference

[1] Zion Station Updated Final Safety Analysis Report, volume 1, volume 2, volume 3, Commonwealth Edison Company

Rebus code-based automated calculations of core cycles of the Maria reactor

R. Możdżonek, K. Gomulski
National Centre for Nuclear Research, Otwock - Świerk, Poland

The application was developed to automate calculations of reactivity margins for the MARIA reactor core with operators of the reactor in mind. The program allows to:

- update of the isotopic composition of fuel elements and beryllium blocks during the core operating cycle;
- determination of the bias between measured and calculated k_{ef} based on the positions of control rods;
- design of new reactor operating cycles (duration, core power, position of fuel elements and control rods) and ensures that operational safety limits are satisfied.

The application consists of two elements: a frontend web browser-based graphical user interface and a Rebus-based computational backend.

The GUI provides an easy way to:

- load and view historic data of reactor operating cycles;
- design a new operating cycle by moving graphical elements representing fuel and control rods and entering basic parameters such as core power and dates of the beginning and end of the cycle.

The computational backend allows the user to run simultaneously many instances of the Rebus code a (neutronic code designed for the analysis of reactor fuel cycles) on an HPC cluster. Configuration of each simulation is provided by the frontend and includes core layout and cycle parameters entered by the user. Code input files are created separately for every simulation but they are based on one general input created beforehand by an experienced Rebus user. The server observe the ongoing computation and notifies the user about any errors ora successful run. At the end the backend returns to the user values of k_{ef} and isotopic concentrations in the requested time slots.

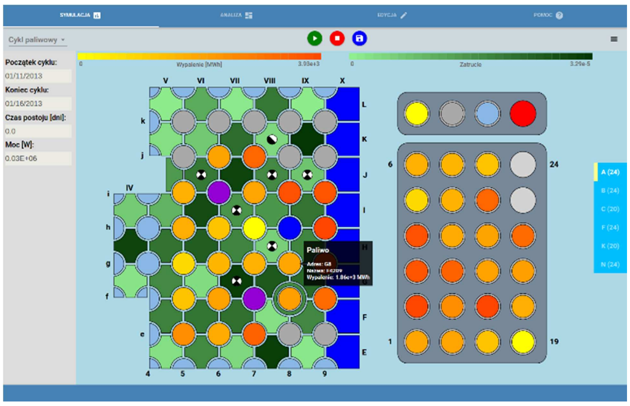


Fig. 1. Graphical user interface with visualisation of the maria reactor core.

Dryout prediction comparison – Cathare-2 and Cathare-3 codes

M. Spirzewski
National Centre for Nuclear Research, Otwock-Świerk, Poland

The Boiling Water Reactor has proven its reliability and extensive usage in recent decades all over the world. Despite its unobvious simple idea, complex phenomena occur during the realization of the boiling process. Well fitted models and mathematical descriptions of the most complicated problems have always been a driving force for further experimental work in the nuclear industry**.**

As Boiling Water Reactors are optimized in their design, new models applied to margin calculations are employed in order to bring competitive technology to the market of nuclear power production. One such area of interest is the critical heat flux estimation. One branch, is the proper model prediction of the phenomena of entrainment and redeposition of water droplets in the upward vertical flow in Boiling Water Reactor cores.

These phenomena are of exceptional interest mainly in the annular flow which is preceded by the bubbly, cap-bubbly, slug, churn-turbulent flow regimes in the water reactor on the length of 3.5 meters – fig. 1.

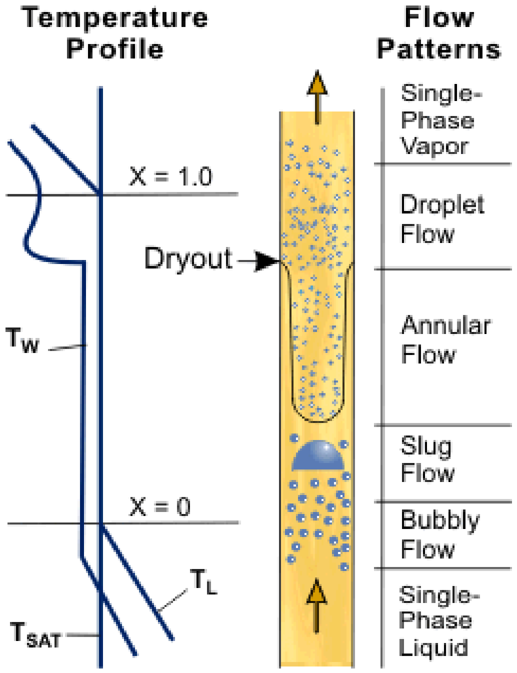


Fig.1. Boiling WaterFig. 1. Reactor two-phase flow regimes.

With progress in the field of experimental measurements and design it is possible to extract more details from the measurements of two phase flows without disturbing the flow itself. This advancement enables the development of more sophisticated mathematical models which incorporate properties such as bubble diameter, friction factors and surface tension [1].

In the following study, two system code models were used to simulate the dryout phenomenon.

These codes were – Cathare-2 and Cathare-3 – both developed by the Commissariat à l'énergie atomique et aux énergies alternatives – that specializes in the field of nuclear research in France.

There are two significant differences between these codes that should be underlined. First by the fact that Cathare-2 is only a 2-phase code. This means that anywhere and anytime in the code there are only two phases considered – namely, water and vapour [2]. Contrary to Cathare-2, Cathare-3 was equipped with tools that allow it to run three phases. In this case these phases are water, vapour and water droplets travelling with the gaseous phase. Additionally, Cathare-3 was enriched by entrainment and deposition models by Hewitt and Govan.[1][3] Cathare-2 only has simple correlation that estimates the proportion of water that is treated as a film and water as droplets in the flow.

Results produced by both codes were compared with measurements. First observation of these two codes tells us that neither is correctly predicts the occurrence of dryout. As far as Cathare-2 is concerned, it was required to raise the power by almost 30% in relation to the experimental value of the power delivered to the flow in order to achieve film evaporation. However, when Cathare-3 results were compered with experiment, it turned out that the code underestimated the power by 20% in relation to the experimental power.

Surprisingly, Cathare-3 has yielded the phenomenon of rewetting of the dry surface, which is highly improbable and unphysical. This effect may be due to an incorrect heat regime transfer – which is governed by Groeneveld look up tables translated into polynomial form.

The second hypothesis explaining this effect may be due to the way thatthe Hewitt-Govan model was incorporated into the code. Briefly speaking, when dryout occurs the entrainment phenomenon stops, while deposition is still happening. This leads to film build up and flow regime change and rewetting.

References

[1] Film flow measurements for high-pressure diabatic annular flow in tubes with various axial power distribution, Carl Adamsson, Henryk Anglart, Royal Institute of Technology, Stockholm, Sweden, 2006
[2] Cathare-2 Manual, CEA, Grenoble, France, 2011
[3] Cathare-3 Manual, CEA, Grenoble, France, 2013

MARIA reactor operation

A. Gołąb, I. Owsianko, J. Jaroszewicz, G. Krzysztoszek
National Centre for Nuclear Research, Otwock-Świerk, Poland

The multipurpose high flux research reactor MARIA is a water and beryllium moderated reactor of pool type with a graphite reflector and pressurised channels containing concentric tube assemblies of fuel elements (Fig. 1, 2). It has been designed to provide a high degree of flexibility.

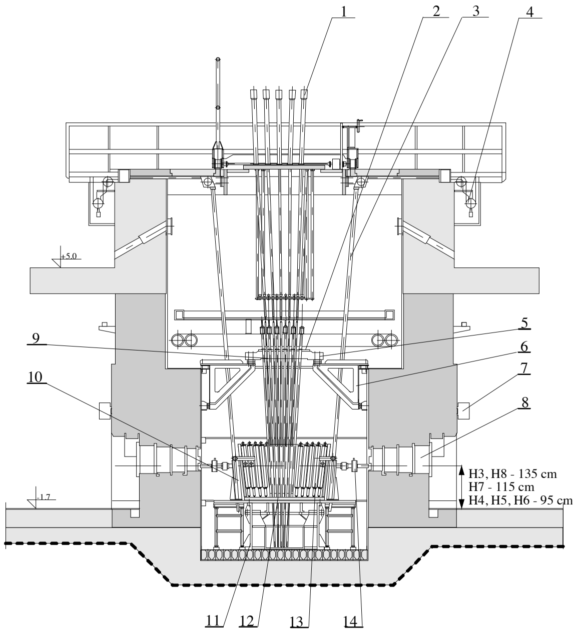


Fig. 1. Vertical section of the MARIA reactor. 1. control rod drive mechanism, 2. mounting plate, 3. ionisation chamber channel, 4. ionization chamber drive mechanism, 5. fuel and loop channels support plate, 6. plate support console, 7. horizontal beam tube shutter drive mechanism, 8. beam tube shutter, 9. fuel channel, 10. ionization chamber shield, 11. core support structure, 12. core and reflector support plate, 13. reflector blocks, 14. beam tube compensation joint.

The fuel channels are situated in a matrix containing beryllium blocks and enclosed by a lateral reflector made of graphite blocks in aluminium cans. The MARIA reactor is equipped with vertical channels for irradiation of target materials, a rabbit system for short irradiations and six horizontal neutron beam channels.

The main characteristics and data of the MARIA reactor are as follows:

- nominal power 30 MW(th)
- thermal neutron flux density $2.5\cdot10^{14}$ n/cm^{2}s
- moderator H_2O, beryllium
- cooling system channel type
- fuel assemblies:
  - material U_3Si_2Al
  - enrichment 19,75%
  - cladding aluminium
  - shape five concentric tubes
  - active length 1000 mm
- output thermal neutron flux at horizontal channels $3\div5\cdot10^9$ n/cm^{2}s

The MARIA reactor reached its first criticality in December 1974. The reactor was in operation until 1985 when it was shut down for modernization. The modernization encompassed refurbishment and upgrading of the technological systems. In particular, the efficiency of the ventilation and cooling systems was improved. In 1993 the MARIA reactor was put into operation again.

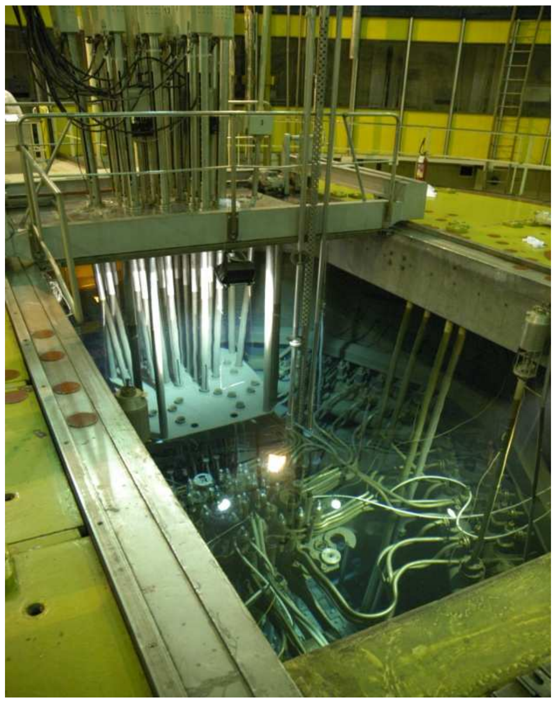


Fig. 2. View of the reactor pool.

The main areas of reactor application are as follows:

- irradiation of target materials in vertical channels and in the rabbit system
- testing of fuel and structural materials for nuclear power engineering
- neutron radiography
- neutron activation analysis
- neutron transmutation doping
- research in neutron and condensed matter physics
- training

In 2014 the reactor completed 33 operation cycles at power levels from 30 kW to 25 MW (Fig. 3). The overall operation time: 4300 h.

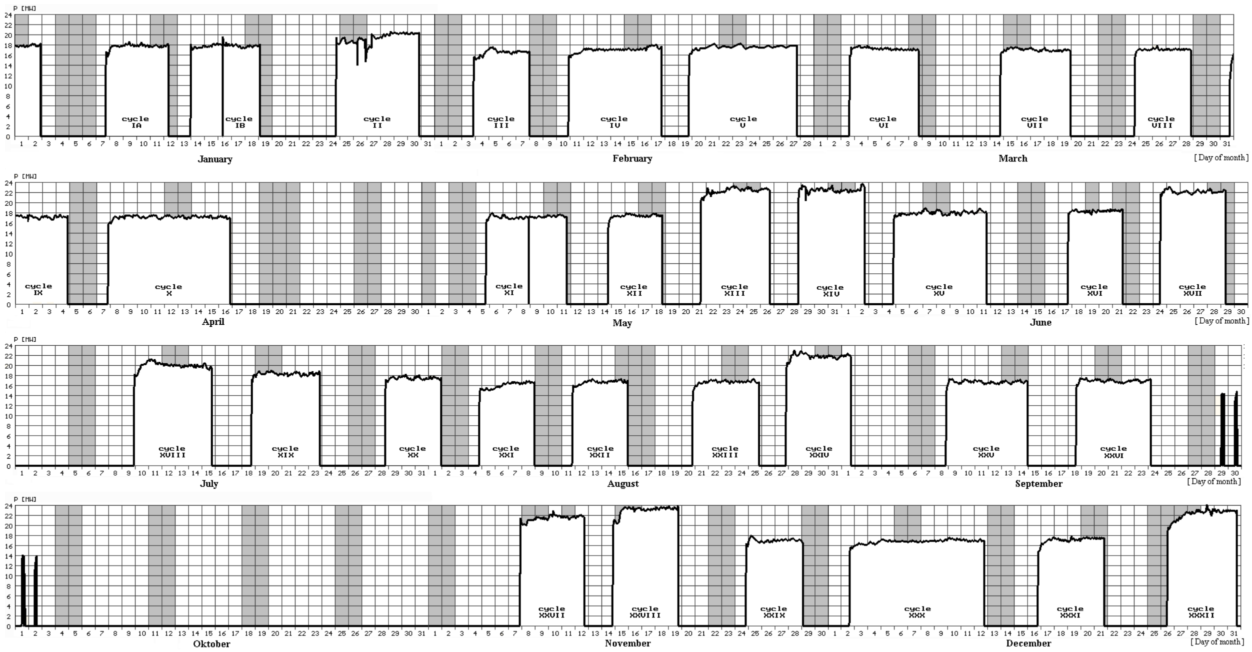


Fig. 3. Schedule of „MARIA" reactor operation in 2014.

The main activities carried out at the MARIA reactor were focused on:

- irradiation of target materials in vertical channels and in the rabbit system
- neutron scattering condensed matter studies with neutron beams from the reactor horizontal channel
- neutron radiography studies
- neutron modification of crystals and minerals
- training

In 2014 the conversion process of the Maria reactor core to low-enriched fuel with enrichment 19.75% in ^{235}U was finalized. In the second half of 2014 the last MR-6 type fuel assemblies with enrichment 36% of ^{235}U left the reactor core. This process has been realised progressively since 2012, meaning that highly enriched fuel has been replaced, by low enriched fuel of MC-5 type, fabricated by the AREVA company. The MC-5 fuel assemblies have 19.75% enrichment and 485g of ^{235}U. The release of fission products from this fuel is very low and achievable burn-up is over 50%.

During the first half of 2014 two prototype fuel assemblies manufactured by a Russian fuel company were tested. These assemblies were made of UO_2-Al alloy with 19,75% enrichment and 485g contents of ^{235}U. The results of the test were positive, so they will be used in future reactor operation.

The core configuration has been changed several times because of fuel and irradiation requirements. The core configuration of December 2014 consisting of 25 fuel assemblies and 2 special channels for molybdenum ^{99}Mo production is presented in Fig. 4.

In 2014 the MARIA reactor was operated successfully. The reactor scram was activated 4 times. Operational availability factors were as follows:

$$A1 = \frac{OT}{NH} \cdot 100\% = 98,7$$

$$A2 = \frac{OT}{8760} \cdot 100\% = 49$$

where OT (operational time) denotes the number of hours on power and NH is the sum of number of hours on power and the number of unscheduled shutdowns.

In 2014 the total emissions of radioactive materials to the environment were:

- inert gases (mainly ^{41}Ar): $9.3 \cdot 10^{12}$ Bq, i.e. 0.9% of the limit determined by the NAEA
- iodine: $5.8 \cdot 10^{7}$Bq, i.e. 1.2% of the limit determined by the NAEA
- ^{88}Rb and ^{138}Cs: $2.3 \cdot 10^{8}$ Bq.

The yearly emissions of the noble gases, iodines and aerosols are presented in Fig. 5,6,7.

In 2014 one hundred and one workers received measurable whole body doses from 0.10 to 2.02 mSv and 8 workers received skin doses from 0.18 to 2.48 mSv.

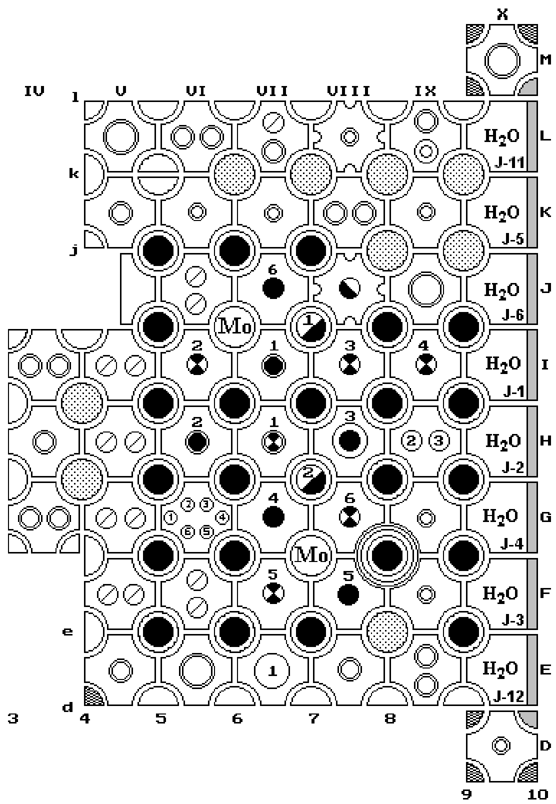


Fig. 4. Core configuration of December 2014.

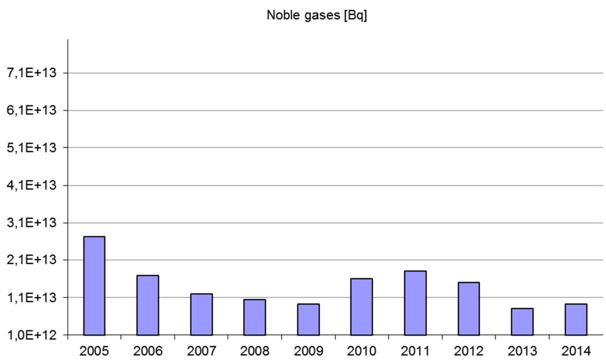


Fig. 5. Yearly emissions of noble gases in the last ten years.

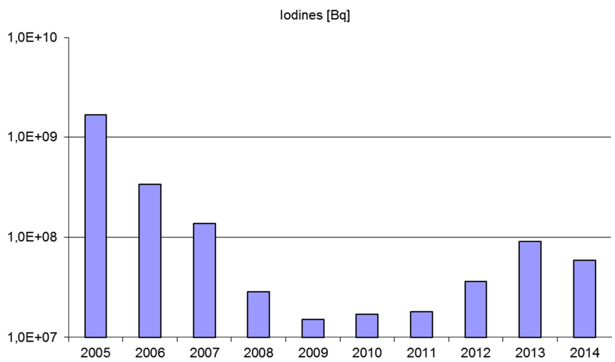


Fig. 6. Yearly iodines total emissions in the last ten years.

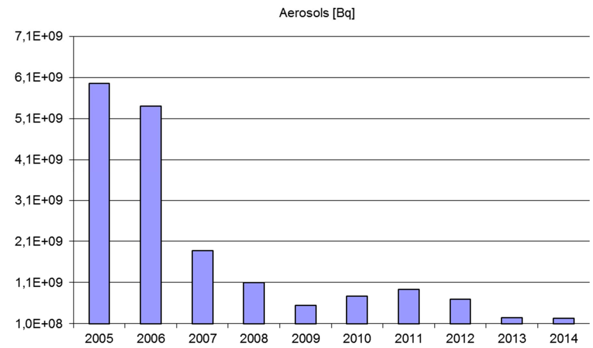


Fig. 7. Yearly aerosols total emissions in the last ten years.

Neutron irradiation services

Neutron irradiation services provided at the MARIA research reactor include radioisotope production, neutron transmutation doping of silicon, neutron activation analyses and biomedical technology.

Available services cover the activation of a large variety of target materials for the production of isotopes, which can be processed at the discretion of the customer. Irradiation services are performed in various facilities constructed in the MARIA reactor, depending on the required neutron flux levels, irradiation time, target mass and geometry. Standard vertical in-core isotope channels as well as the special ones equipped with a hydraulic transport system are in operation.

For domestic customers targets of S, TeO_2, Lu_2O_3, Yb_2O_3, Cu, Se, $SmCl_3$ and KCl were irradiated (Fig.8). Most of them were produced for the Radioisotope Centre of the National Centre for Nuclear Research. Among them, irradiation of ^{192}Ir seeds used for Intravascular Radiation Therapy (IRT) and low activity ^{192}Ir source ribbon for Oncology Applications werecontinued. Total annual isotope production reached 1073.5 TBq in 2014.

The neutron irradiation service utilizing the MARIA reactor also includes the colouring of topaz minerals. The irradiation of minerals in special channels located outside the reactor core change their clear natural state to shades of blue, thereby increasing the commercial value of the product. Blue topaz is released to the market as non-radioactive material, conforming to strict international criteria.

Nuclear reactors remain a key component in the production of useful isotopes. mainly for nuclear medicine treatments. A key medical isotope is ^{99m}Tc, which is a decay product of ^{99}Mo. One of the possible sources of ^{99}Mo can be obtained in the course of the ^{235}U fission reaction. The main objective of ^{235}U irradiation is to obtain the ^{99m}Tc isotope, which is widely used in the domain of medical diagnostic. The ^{99m}Tc from a source of decaying ^{99}Mo can be easily transported to hospitals, where it is extracted and used for a variety of nuclear medicine diagnostics procedures.

Current technology for ^{99}Mo production is based on use of a loop that contains a standard fuel channel equipped with its own control infrastructure for irradiation of highly-enriched uranium targets (HEU). Realization of the molybdenum programme has confirmed the correctness of the irradiation technology developed at the MARIA reactor. During 2014 112 uranium targets were irradiated. At the same time production of the radioisotope ^{99}Mo by irradiation of highly-enriched uranium targets reached the level at 3630 TBq.

Following the shortage of the key medical radioisotope ^{99}Mo and its daughter ^{99m}Tc related to long-term reliability the MARIA reactor has declared its readiness to irradiate new design LEU targets. The first step, supporting such a conversion, is certification of the new LEU targets. The programme is being performed under collaboration with Mallinckrodt Medical b.v. and with the HFR (Netherlands) and BR-2 (Belgium) reactors. The programme includes a safety analysis calculation, out-of reactor mechanical, hydraulic and vibration tests. At the same time a new programme dedicated to irradiation of HEU cylindrical type targets for the Belgian company IRE has been started. Hot tests in the MARIA core are expected in 2015.

Based on the feasibility study and experience in irradiation of ^{235}U targets in the MARIA reactor a new project for production of ^{99}Mo, the “Molybdenum Świerk Project” is beingdeveloped. The project of a production facility foresees the adoption of the existing infrastructure in the MARIA reactor and the infrastructure of POLATOM for ^{99}Mo/^{99m}Tc generator assembly.

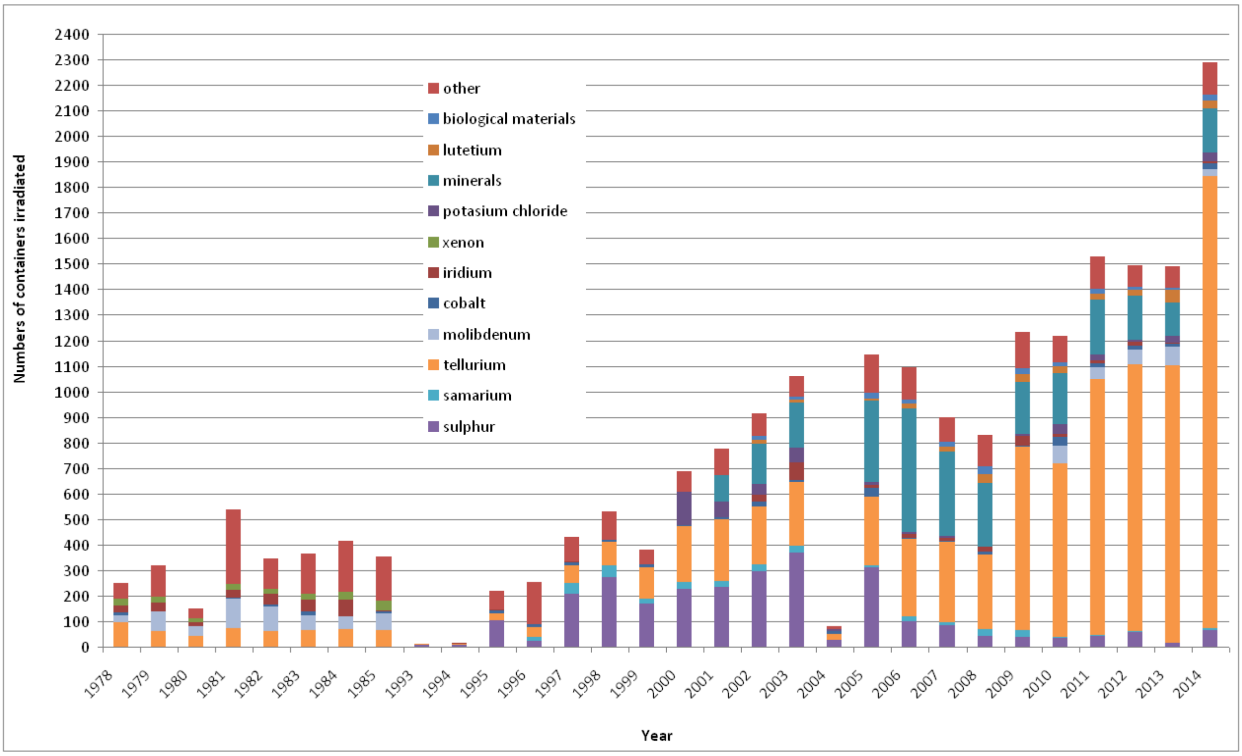


Fig. 8. Distribution of target materials irradiated.

New facility for irradiation in the gamma field of spent fuel elements in the storage pool

M. Dorosz
National Centre for Nuclear Research, Otwock-Swierk, Poland

Spent fuel elements are a "strong" source of radiation. The resulting high gamma dose rates allow research on radiation resistance of materials used in electronics and complete electron devices.

During the existence of the Maria reactor and the Ewa reactor, a number of attempts were made to use "waste" gamma rays generated in the spent fuel elements. An example would be the installation for sterilization, which attempted their use for sterilization of medical equipment and pasteurization of food.

Due to the increasing interest in high gamma field irradiation, a new position for irradiation was created.

The basic assumptions for the construction of the reservoir for exposures in the high field of gamma radiation from the spent fuel in the technological pool of the Maria Reactor:

- container must provide a tight seal so that the centre does not get water from the technological pool,
- container should not corrode during operation,
- external tank dimensions should be chosen so that it fits into the slot in the separator to spent fuel elements.

The new container for gamma irradiation is made from 1H18N9T steel.

The gamma container design is shown in Fig. 1. It is composed of the following parts:

1 pipe, ϕ=80mm, wall thickness 2mm and length 680mm,
2 base plate, ϕ= 80mm, thickness 5mm,
3 the rod, ϕ=8mm, length 500mm,
4 cover with handle, ϕ=130mm, height 40mm,
5 section of the fuel channel filled with lead,
6 ring, inner diameter ϕ=80mm, outer diameter ϕ=110mm, height 18,5mm
7 ring seal, made from 70A rubber.

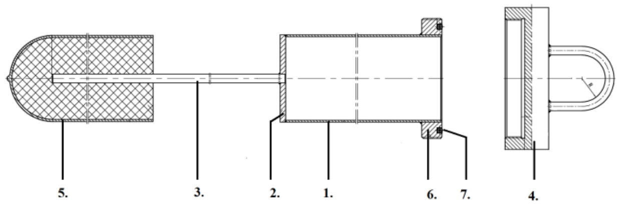


Fig. 1. Schematic view of the container for gamma irradiation by spent fuel elements in the storage pool.

As an example the containers have been used in the irradiation of stainless steel for: The Investigations of Gamma Irradiation Influence on the Mechanical and Corrosion Properties of Stainless Steel Used for Spent Fuel Containers.

Neutron measurments between graphite blocks

M. Dorosz
National Centre for Nuclear Research, Otwock-Swierk, Poland

The goal of this work was determination of neutron flux density between reflector graphite blocks of the Maria Research Reactor. This quantity is crucial to aging menagment of reactor core elements. After evaluation of neutron flux density we can calculate the displacement per atom-DPA. This quantity is related to radiation damege caused by nautron raddiation in graphite blocks. This work is describes measurment procedure and the results of neutron density flux calculations.

The Maria reactor core consist of fuel elements beryllium blocks and graphite blocks.

The graphite blocks are in an aluminum clading. The upper dimension of the block (overlay) is 140 mm, and the lower 120 mm. The height of the blocks with the pads is 1585 mm. Graphite blocks are truncated pyramids with a square base. Such a conical shape allows the installation of a core of much larger overall dimensions of the reactor components (drives) and experimental equipment. Graphite blocks are covered with aluminum sheet (2 mm). Due to the possibility of working at a temperature exceeding 800^{o}C, the graphite has been adequately prepared i.e. degassed under vacuum at a temperature of about 800^{o}C and saturated with nitrogen. The gap between the cladding and the graphite is filled with nitrogen at a pressure of 0.01 MPa. In order to allow manipulation of the corresponding blocks and place them in the core blocks are arranged at the top and bottom of the aluminum covers. The lower cap has a leg and the upper a head for the handle. These overlay results in a gap of 1.5 mm over the entire height of the block, which ensures the flow of coolant between the blocks. In the current configuration, graphite blocks are not adjacent to the fuel elements.

For neutron measurements the following activation detectors where chosen:

-AlCo (0,1%), was chosen for thermal and epithermal neutron,

-Ni, for fast neutrons region.

The neutron induced reaction's for these detectors are:

$$^{59}Co\,(n,\gamma)\;^{60}Co$$

$$^{58}Ni\,(n,p)\;^{58}Co$$

Neutron activation detectors where in form of disc (ϕ=3mm), made from thin foil.

Four such detectors were placed in aluminum foil, then placed in a measuring plate, then the tip was bent in a press.

Measuring plate dimensions:
length – 550mm,
width – 20mm,
thickness – 2mm.

Two AlCo and two Ni detectors were inserted in one plate.

Six measuring plates were prepared, but because of problems with lifting the graphite blocks, three of them were used. The length of the measuring plate was chosen so that the detectors were placed in the middle of the core. A plate with neutron detectors was then placed at selected locations, between graphite blocks (Fig. 1.).

Measurements were carried out between May 28th and June 2nd. Reactor operated for 118 hours, with thermal power of 24MW. In the summer period we calculated the neutron flux.

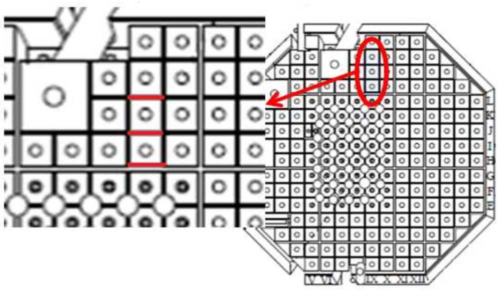


Fig. 1. Location of experiment in Maria Reactos core.

Calculated neutron fluxes are presented in Fig. 2. and Fig 3. The graphs shows the dependence of changes in the neutron flux on graphite blocks grid changes.

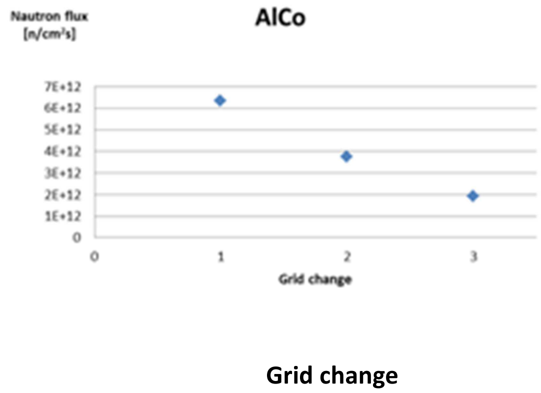


Fig. 2. Thermal neutron flux measured in Maria Reactor core.

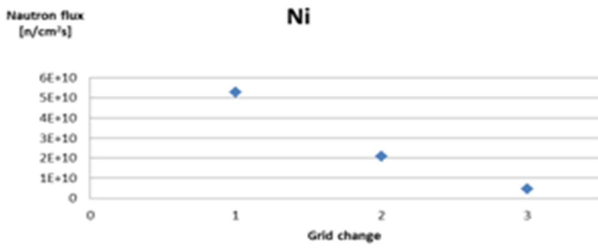


Fig. 3. Fast neutron flux measured in Maria Reactor core.

Reference

[1] M. Dorosz, Pomiary strumieni neutronów pomiędzy blokami grafitowymi, B – 32 /2014 NCBJ

Shipment of MR type spent fuel from the Maria reactor to the Russian Federation in 2014

E. Borek-Kruszewska, J. Piąstka
National Centre for Nuclear Research, Otwock-Świerk, Poland

This report concerns the shipment of MR type spent fuel from the Republic of Poland to the Russian Federation under the Global Threat Reduction Initiative. The GTRI programme intended to reduce global threats, consisting among others in financing the return of spent fuel from research reactors to the producer of the nuclear fuel. The first shipments took place in 2010.

With reference to the above, spent fuel of MR type enriched 36% with U-235 from the Polish MARIA research reactor was taken back to the Russian Federation for reprocessing. The high radioactive waste coming from the reprocessing of fuel will stay in the Russian Federation.

The shipment took place in September 2014 and included 44 pcs of spent fuel elements loaded into 11 Russian transport containers of TUK-19 type.

The TUK-19 containens were delivered by road and road to the forwarding point in the area of the Nuclear Centre in Świerk. Next, they were brought one by one (Fig.1) to the MARIA reactor facility where the spent fuel was loaded to the containers.

The technological operations concerning loading the spent fuel from the MARIA reactor storage pool into the TUK-19 containers were successfully performed according to the developed technology [1].

Fig. 1. TUK-19 containers in the MARIA reactor decontamination hall.

The preparatory work for shipment was carried out in accordance with the developed technology presented in [2].

The most important operations of the shipment of MR type spent fuel using the TUK-19 containers took place in the disassembly cell of the MARIA reactor (Fig.2). A TUK-19 container loaded with spent fuel was prepared for the final lock. Checking the dose rate on the container and in the surrounding area was performed. Next, a EUROATOM inspector started the work of sealing the TUK-19 container (Fig. 3).

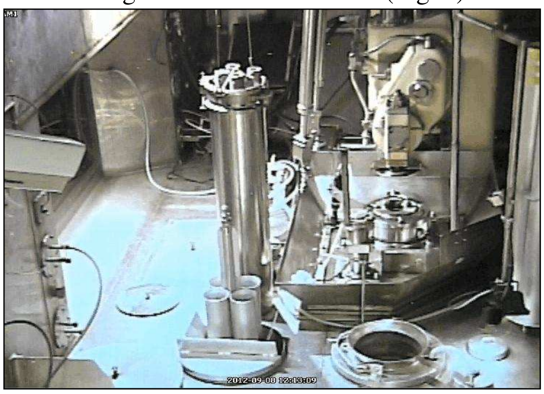


Fig. 2. Handling operations in the disassembly cell.

Fig. 3. Operation of sealing a TUK-19 container.

The sealed seal TUK-19 container left the reactor hall and ran into the decontamination hall in order to complete final operations associated with preparing for transport such as: screwing down the cover and checking the tightness of the container.

The TUK-19 containers loaded with spent fuel returned to the forwarding point, where they were put back into ISO type containers and then shipped back to the Russian Federation.

During the transport-handling operation conducted in the MARIA reactor facility neither abnormalities nor increased radiological threat was detected.

References

[1] Borek-Kruszewska E., Piąstka J., .: Technological Documentation No. EJ3/1/2012 of Shipment of the MR type spent fuel from the MARIA reactor to the Russian Federation using the TUK-19 container

[2] Borek-Kruszewska E., Małkiewicz A., Piąstka J., Wilczek I., Zawadka A.: Technological Documentation No. EJ3/2/2012 of MR Type Spent Fuel Preparations for Shipping in a TUK-19 Container

NUCLEAR TECHNIQUES IN HEALTH AND ENVIRONMENTAL PROTECTION, MANAGEMENT OF HAZARDS

The genetic algorithm in bayesian estimation of an atmospheric contamination source

A. Wawrzyńczak-Szaban, P. Kopka, M. Borysiewicz
National Centre for Nuclear Research, Świerk-Otwock, Poland

We continued work on enhancing the efficiency and enlarging the scope of application of the Bayesian approach in stochastic event reconstruction, especially in the context of localizing an atmospheric contamination source.

Based on the previously applied Markov chain Monte Carlo (MCMC) and Sequential Monte Carlo (SMC) we have proposed a hybrid version of the SMC along with Markov Chain Monte Carlo (MCMC) algorithms and examined its effectiveness to estimate the probabilistic distributions of atmospheric release parameters [1]. We have successfully applied the developed algorithm to localize a contamination source with the use of the real Kori field tracer experiment data conducted over the Kori nuclear site in 2001 [2]. The reconstruction of the contamination source for this test was challenging due to very complicated wind field pattern resulting from the hilly terrain and the closeness of the sea coast [3].

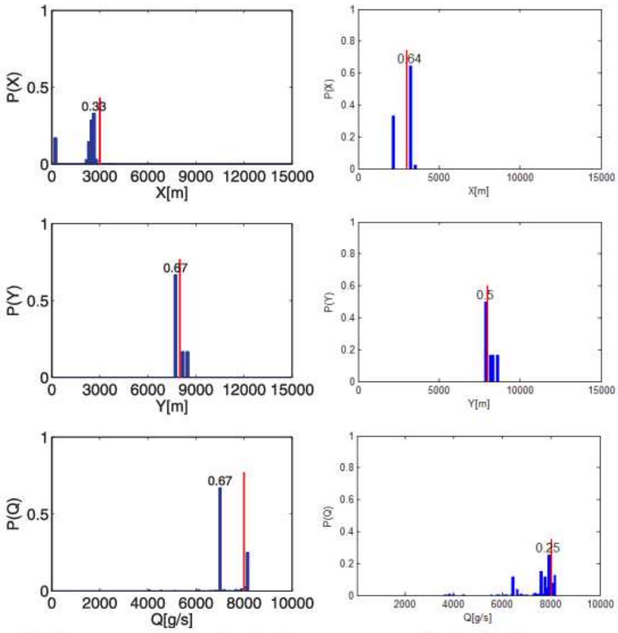
We have extended the reconstruction methodology by modern, inspired by nature heuristic algorithms i.e. the genetic algorithm (GA), the Generalized Extreme Optimization (GEO) algorithm.

We have obtained excellent results applying the Genetic Algorithm (GA) to the problem of atmospheric contaminant source localization. The algorithm input data are information about the concentration of a given substance registered by the distributed sensor network. Based on the series of tests we have specified the most efficient genetic operators in the stochastic reconstruction i.e. rank and tournament selections; multipoint crossover and uniform mutation [4].

Applying the GA to the problem of the localization of a contamination source the most important factor is the computational time. The usual criterion implemented in the GA is a fixed number of generations. However, in this case it is not an optimal scenario. Thus, we have proposed dynamic termination criteria for the GA. Consequently, the reconstruction algorithm is terminated when the coordinates of the contamination source are obtained with a probability greater than 0.8 and the release rate with a probability greater than 0.7. If this condition is fulfilled, the posterior distributions of all parameters are calculated. We showed that dynamic termination criteria can significantly shorten the computational time of the reconstruction algorithm. Moreover, we presented that the rank selection is more efficient than the hard tournament selection and ten times faster [4].

A comparison of the efficiency ofSequential Monte Carlo (SMC) and GA proved that GA can reconstruct the atmospheric contamination source parameters faster than the SMC. This was confirmed based on synthetic experiment data and the Kori field tracer data [5].

The Generalized Extreme Optimization (GEO) algorithm turned out to be the least efficient of all the tested parameter scanning algorithms in event reconstruction.



Hard tournament of size 2 selection. Rank selection.

Fig. 1. Cumulative probability distributions of the contamination source coordinates x, y, and release rate Q averaged over all time steps for two selection types. Vertical red lines represent the target value.

References

[1] Wawrzynczak A., P. Kopka, M. Borysiewicz, Sequential Monte Carlo in Bayesian assessment of contaminant source localization based on the distributed sensors measurements, Lecture Notes in Computer Sciences 8385, PPAM 2013, Part II, ch.38, 2014

[2] Wawrzynczak A., P. Kopka, M. Borysiewicz, Bayesian Methodology in the Stochastic Event Reconstruction Problems, Chapter 10 in: E. Lanzarone and F. Ieva (eds.), The Contribution of Young Researchers to Bayesian Statistics, Springer Proceedings in Mathematics & Statistics 106, Springer International Publishing Switzerland, 2014

[3] K. S. Suh, et al.,: Atmospheric Dispersion Modeling over the Kori Nuclear Site, 11th International Congress of the International radiation Protection Association, Madrid, Spain, 2004

[4] Wawrzynczak A., M. Jaroszynski, M. Borysiewicz, Data-driven Genetic Algorithm in Bayesian estimation of the abrupt atmospheric contamination source, Proc. of the 2014 Federated Conference on Computer Science and Information Systems pp. 519–527, Annals of Computer Science and Information Systems, vol. 2, 2014, http://dx.doi.org/10.15439/2014F272

[5] Wawrzynczak A., P.Kopka, M. Jaroszynski, M. Borysiewicz, Efficiency of sequential Monte Carlo and genetic algorithm in Bayesian estimation of the atmospheric contamination source, Proc. of International Conference on Computational Statistics (COMPSTAT) 2014, pp 601-608, 2014, ISBN 978-2-8399-1347-8, The International Statistical Institute/International Association for Statistical Computing

Fire probabilistic safety assessment for nuclear power plants

M. Borysiewicz, A. Kaszko, K. Kowal, S. Potempski
National Centre for Nuclear Research, Otwock-Świerk, Poland

The aim of this work was to review the methodology, tools and data necessary to carry out the Fire Probabilistic Safety Assessment (Fire PSA) for nuclear power plants (NPP). The methodology of Fire PSA analysis for nuclear power plants has been developed by the U.S. Nuclear Regulatory Commission (U.S. NRC) and the Electric Power Research Institute (EPRI), and published in an extensive report entitled: *Fire PRA methodology for Nuclear Power Facilities* [1]. In this work the applicability of the procedures postulated by NRC and EPRI has been investigated in the context of:

- plant boundary definition and partitioning,
- quantitative screening,
- scoping fire modelling,
- detailed electrical circuit failure analysis,
- circuit failure mode likelihood analysis,
- detailed fire modelling,
- post-fire human reliability analysis,
- seismic-fire interactions assessment,
- fire risk quantification,
- uncertainty and sensitivity analysis,
- and appropriate documentation.

Moreover, the possibility of using the results of other studies of fire analysis made for nuclear power plants was taken into account, including the results of the assessment of external events and deterministic analysis of safe reactor shutdown in case of fire.
Description of the fire database structure, which should be prepared during the course of fire PSA studies, and examples based on actual examples of electrical systems in nuclear power plants were included in this work.

The results of this work will be used by the National Atomic Energy Agency as training material for employees and as guidance for regulatory activities. It can be used by nuclear operators to perform Fire PSA for their facilities and minimize fire propagation in case of fire events.

Reference

[1] EPRI/NRC-RES, „Fire PRA Methodology For Nuclear Power Facilities” (2004)

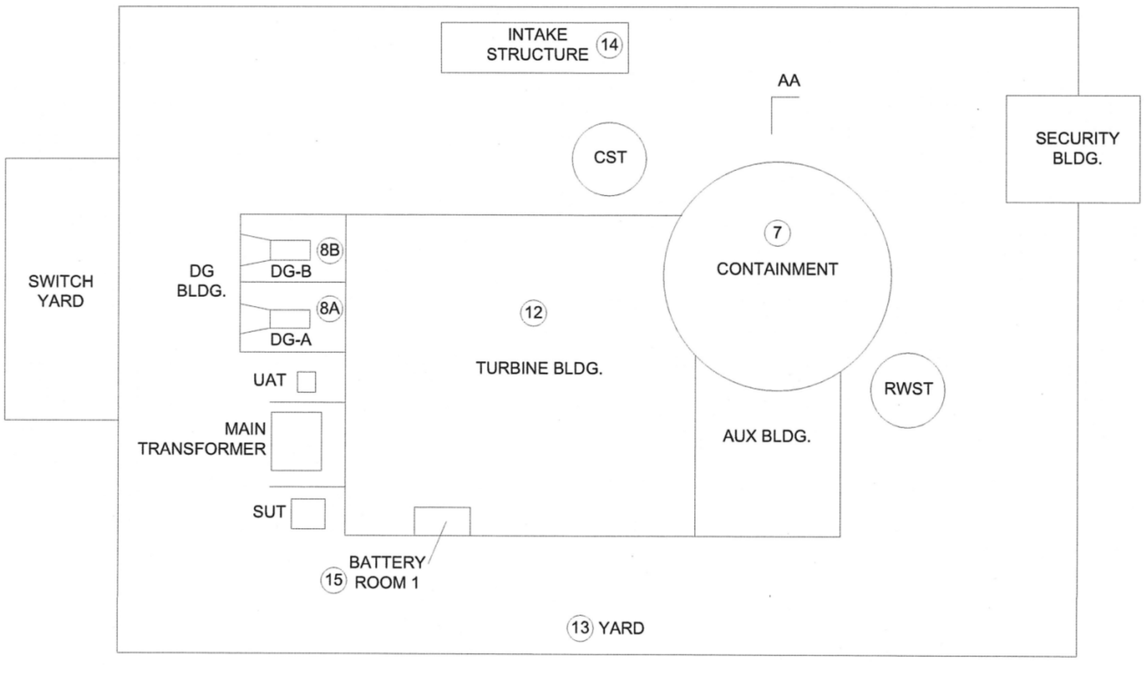


Fig. 1. An example on how the NPP could be divided into the fire areas to be used in fire PSA analysis [1.].

Fault tree analysis of the ESBWR gravity-driven cooling system

M. Borysiewicz, A. Kaszko, K. Kowal, S. Potempski
National Centre for Nuclear Research, Otwock-Świerk, Poland

The primary function of the Gravity-Driven Cooling System (GDCS) of the ESBWR (Economic Simplified Boiling Water Reactor) is passively to provide emergency core cooling after any event that threatens the reactor coolant inventory. This system is capable of passively injecting large volumes of water into the reactor pressure vessel (RPV) to keep the fuel covered. GDCS includes the inventory of water in the pools (short-term cooling subsystem), injection lines, equalization lines (long-term cooling subsystem) from the suppression pool, and related strainers and pool piping penetrations. Another function is to provide water to the lower drywell in case of a severe accident that causes RPV breach. In this study only a short term injection phase has been considered.

GDCS injection supplies gravity driven flow to eight separate nozzles on the RPV with suction flow from three separate GDCS pools. There are four divisions of GDCS injection configured with Pool A and Pool D each supplying one division and Pool BC supplying two divisions. Each division of the GDCS injection system consists of pipe and a block valve exiting from the GDCS pool and branching into two parallel flow paths, each containing a check valve, squib valve, and block valve. A simplified diagram of a single GDCS division (two parallel flow paths, A and E) is shown in Fig. 1.

In addition, each GDCS injection line has two locked open, manually operated maintenance valves with one located near the vessel nozzle (F001) and one near the water source (F004). A check valve (F003) is located upstream of the injection squib actuated valve. Downstream of the injection squib valves (F002) is a test line that can be used to backflush.

During normal operation, the squib valve is designed to provide zero leakage. Once the squib valve is actuated, it provides a permanent open flow path to the vessel. When the GDCS squib valves actuate, reactor pressure is significantly below the normal operating pressure but above the GDCS injection pressure. The GDCS check valves will remain closed until the reactor pressure is just above the GDCS injection pressure. As reactor pressure drops further, GDCS injection will begin at a low flow rate and gradually increase, such that chatter is not expected to occur.

During normal operation, GDCS is in a standby condition. During a LOCA, GDCS is initiated following a confirmed ECCS signal. At the appropriate time following the confirmed ECCS signal, the eight squib valves (F002A-H) open to allow water flow from the GDCS pools to the RPV. This water flow maintains the RPV water level high enough to maintain the core submerged [1].

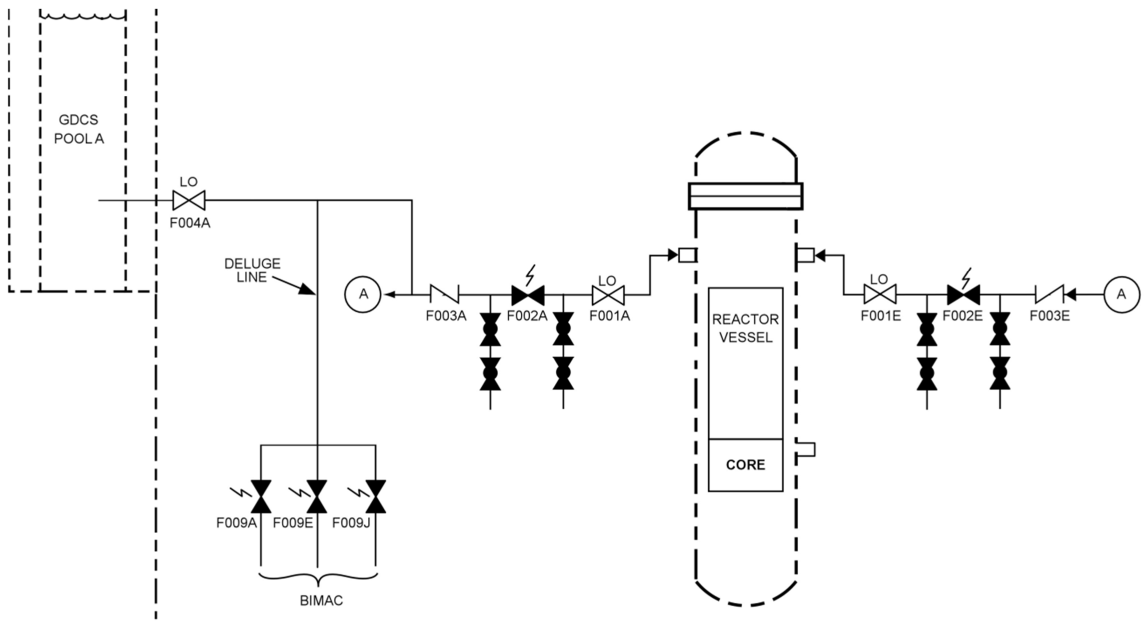


Fig. 1. A simplified diagram of the GDCS [1].

The aim of this work was to assess the reliability of the GDCS system during the injection phase after a LOCA. For this purpose, a fault tree analysis has been performed using the U.S. NRC software, SAPHIRE. The model developed in this work consists of 406 basic events (failures of components and human errors) and 102 logic gates. The reliability data, i.e. probability of basic events and its uncertainty, were adopted from the ESBWR Certification Probabilistic Risk Assessment provided by GE Hitachi Nuclear Energy [1].

Success of the GDCS during the short-term injection phase after a LOCA requires injection through at least two of the eight GDCS injection lines and the discharge of one of the three GDCS pools (Fig. 1-3).

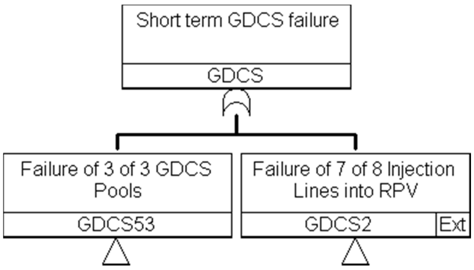


Fig. 1. Main fault tree developed for the GDCS.

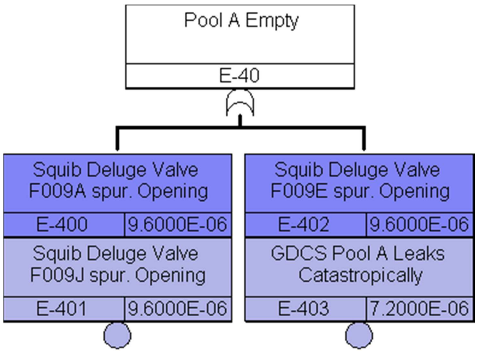


Fig. 2. Subtree developed for a single GDCS pool.

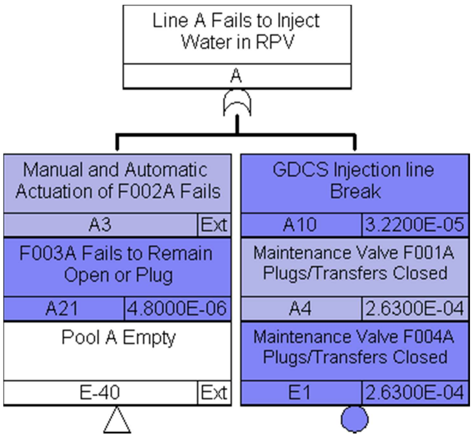


Fig. 3. Subtree developed for a single GDCS injection line.

As a result of this work the GDCS failure probability (P_{GDCS}) has been calculated and its uncertainty has been assessed by applying Monte Carlo techniques (Fig. 4). Moreover, main the contributors to the failure probability of a single GDCS line have been identified (Fig. 5-6).

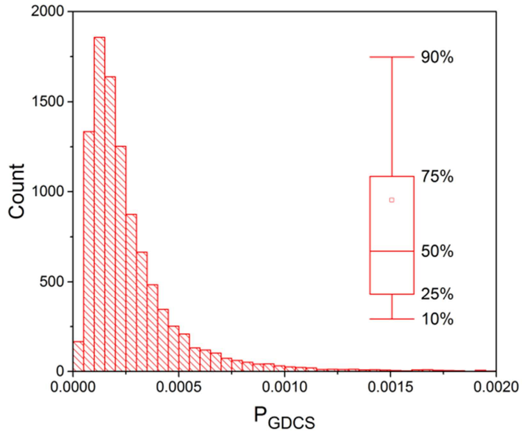


Fig. 4. The GDCS failure probability distribution – P_{GDCS} (Mean: 2.87E-04, Median: 2.00 E-04).

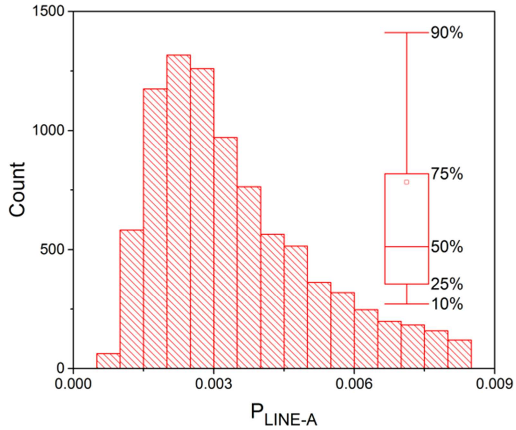


Fig. 5. Failure probability distribution for a single GDCS line (Mean: 5.13E-03, Median: 3.31E-03).

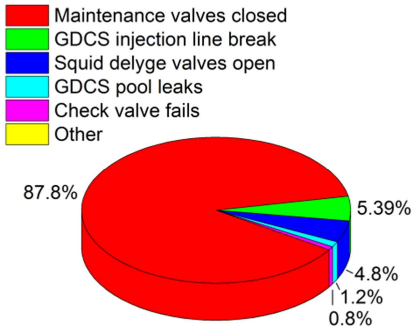


Fig. 6. Main contributors to a single line failure probability.

Reference

[1] GE Hitachi Nuclear Energy, „ESBWR Certification Probabilistic Risk Assessment" (2010)

Methods and models of radioactive substance migration and the distribution of concentrations in surface water, groundwater and soil

M. Borysiewicz, A. Kaszko, K. Kowal, S. Potempski
National Centre for Nuclear Research, Otwock-Świerk, Poland

Radionuclides released from a nuclear power plant into surface water (e.g. rivers, lakes, estuaries), groundwater and the soil can contaminate the surrounding environment, and ultimately affect the health of the population. Most of them are not immediately life-threatening, as in the case of releases to the atmosphere, but cause long-term impact on the flora and fauna of the water and thus, owing to bioaccumulation, potential threat to human health and life.

This work was initiated by the National Atomic Energy Agency, which needed various expertize for use in the National Nuclear Program. The aim of the paper was to describe the general requirements for the calculation of the dispersion of radioactive contamination in the aquatic environment. Such calculations for water include the use of the following mathematical models:

- Numerical mathematical model associated with the transformation of the basic forms of dispersion equations of finite differences and finite elements. This model provides a comprehensive treatment of the physical and chemical processes of transport and handling, which take place in the aquatic environment[1];
- Zonal model (segment), where the aqueous medium is described by one or more compartments in which it is assumed that the distribution of radionuclides is uniform. Calculation of average concentrations for each compartment is carried out on the basis of the transfer coefficient, which combines all the segments. Usually the mathematical formulas that involve interaction with sediment radionuclide are exactly the same type[2];
- A simplified analytical model for which analytical solutions are obtained of the basic transport equations. Simplification refers to the aqueous environment geometry, flow conditions and the coefficients of the dispersion. It is most commonly used in the analysis of the dispersion model for surface waters.

Therefore, mathematical models of varying complexity are used for the calculation of aqueous dispersion. The complexity of such a model depends on the specific nature of the situation. The use of complex models requires detailed knowledge of aspects of the local and regional hydrogeological description of the zone of influence of the nuclear installations. In the absence of such information, one can use simplified models to calculate the aqueous dispersion. The results of the simplified model are verified by the hydrological measurements and radioactivity in the aquatic environment [3].

The results of this work will be used by the National Atomic Energy Agency as a position paper and guidance for eventual regulatory purposes, and as basic training material regarding "Methods and models of radioactive substance migration and distribution of concentrations in surface water, groundwater and soil" for new employees. It can be used for prediction of migration and distribution of radioactive substances and contamination prevention of inhabited areas.

References

[1] M. Abramowitz, I. Stegun, ”Handbook of Mathematical Functions. Applied Mathematics Series 55”. National Bureau of Standards. U.S. Government Printing Office, Washington, DC (1964)

[2] P. Ackers, White R. ”Sediment transport: new approach and analyses”. J.Hydr.Div. ASCE, Vol. 99, No.11, 2041-2060 (1973)

[3] AIChE, ”Chemical Process Quantitative Risk Analysis Guidelines for Center for Chemical Process Safety of the American Institute of Chemical Engineers” (1989)

Implementation of radioecological regions in the RODOS decision support system for nuclear emergencies

M. Borysiewicz, S. Potempski, H.Wojciechowicz
National Centre for Nuclear Research, otwock-Świerk, Poland

The RODOS ("Real-time On-line DecisiOn Support) project was launched in 1989 and increased in size through the European Commission's 3rd, 4th, 5th and 6th Framework Programmes [1]. The system was finally installed and is now being used in the Centre of Radiation Events of the National Atomic Energy Agency. The system has capabilities in providing coherent support at all phases of an accident, including both short-term countermeasures based on intervention levels and long-term management and restoration of contaminated areas. In this respect it is important to customize the system to national conditions, in particular the FDMT (Food Dose Model Terrestrial) model, which is the main module responsbile for calculation of doses from contaminated food- and feedstuffs.

Various criteria for the sub-division of Poland into radiological macro-regions have been evaluated. The basic set of parameters for defining the regions comprises:

- climate elements relevant to the growing cycle of vegetation and agricultural activities,
- aggregated soil characteristics, and
- the soil types in agricultural production for different crops.

Taking into account:

- the type of cattle-breeding,
- the type of human settlements and housing, and
- food consumption

the following decisive factors have been identified:

- the climate characteristics (temperature, precipitation) of the regions relevant to the growing cycle of the vegetation,
- soild bonitation index, and
- the availability of data for the selected regions, to allow for collection and periodic updating by using routine services of national institutions.

The selection of seven radiological regions was mainly based on the agro-climatological properties and the long experience in Poland of collecting statistical agricultural data for these regions (Fig.1).

Within the process of evaluation of the applicability of FDMI to Polish conditions, the following conclusions can be formulated:

The general functional structure of FDMT is flexible enough to include local conditions through the tuning of the parameter data base. In particular, it is necessary to:

a) include other plants (alfalfa, cabbage, open area and green house cultivated lettuce) in the database,
b) adjust parameters for some components (e.g. leafy and root vegetables), and
c) extend the human diet and animal diets to account for polish habits.

Reference

[1] J. Ehrhardt, A. Weis (eds), RODOS: Decision Support System for Off-site Nuclear Emergency Management in Europe. European Commission, Brussels, Report EUR 19144, 2000

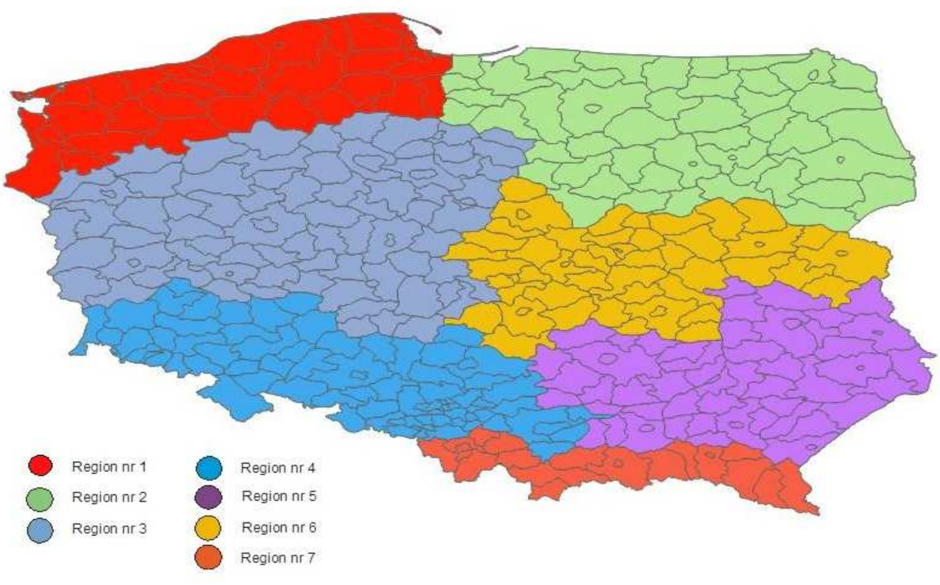


Fig. 1. Polish radioecological regions for RODOS system.

Study of natural radioactivity of rocks based on the Permian volcanic and sedimentary complex – drill cores analysis

A. Burakowska, B.Mysłek-Laurikainen
National Centre for Nuclear Research, Otwock-Świerk, Poland

The Polish Rotliegend Permian Basin is part of the great Southern Permian Basin in Western and Central Europe. Rocks of the Rotliegend succession occur in Western Wielkopolska at an average depth of 2550 metre. There are two main kinds of rock in this complex: volcanic and volcaniclastic. The clastic part of the sequence is found as volcaniclastic sedimentary rocks which come mainly from the disintegration of a Permian volcanic edifice, with interbedded pyroclastic deposits [2].

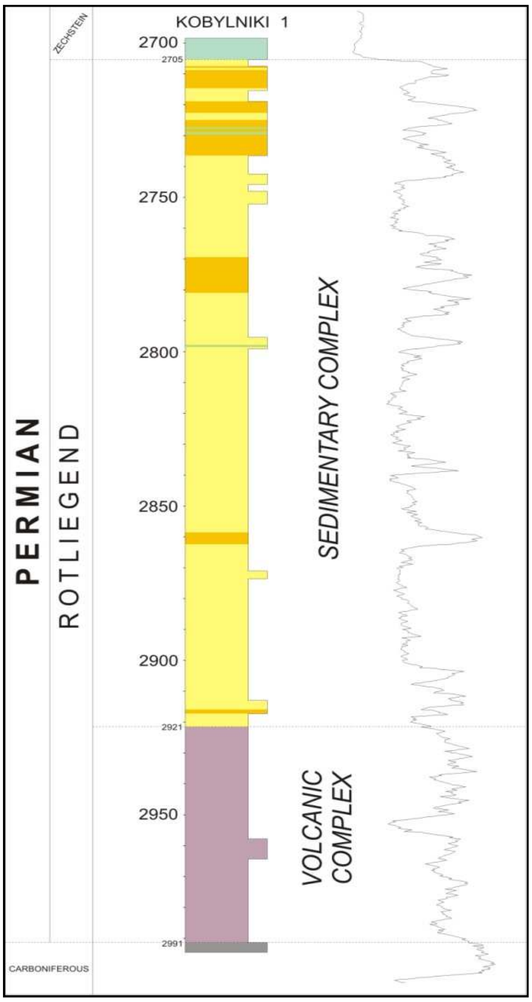


Fig. 1. Stratigraphy and lithology, Kobylniki-1 borehole.

The acid volcanic rocks were the main source of material for the sedimentary Rotliegend succession, secondary intermediate - andesitic and pyroclastic and older rocks (sandstones and schists of the Carboniferous). Development of the Polish Permian Basin was controlled mainly by climatic and tectonic factors. Sedimentary rocks were formed in arid and semiarid climates during periods of intense tectonic activity [1], where water had a major influence on erosion and deposition. The lower part of the Rotliegend clastic sediments was formed in a humid climate (fluvial deposits and lacustrine sediments), whereas the upper part was drier (eolianite deposits).

Over the whole area, before the development of the sedimentary complex, acid explosive volcanism dominated, shown by analysis of cores. In the upper part of the Lower Rotliegend there is an acid volcanic edifice and ignimbrites, mainly of rhyolitic composition with lesser amounts of rhyodacite and dacite. Beneath, there are intermediate rocks with andesitic composition [2]. The remaining volcanic edifice attained a thickness not greater than a few hundred metre; because of pre- and post-volcanic erosion, they have been preserved only fragmentarily [3].

The aim of this work is to supplement geological studies of drill cores with gamma spectrometric measurements and demonstrate the relationship between the lithological variability of the complex and natural radionuclide content. Initially about fifteen gamma spectrometric measurements of drill core samples were made for both volcanic and sedimentary rocks in the geological profile. Assuming that each type of rock in the Rotliegend profile contains different natural radionuclide concentrations, spectrometric measurements can be used as a tool to determine the nature and variability of rocks in the geological profile without the need for costly sample preparation for petrographic studies. These analyses can be very useful for the preparation of the Permian geological profile, and they will shed new light on the controversial stratigraphic divisions of Permian volcanic rocks. The resulting data can also be used in hydrocarbon exploration of western Wielkopolska.

References

[1] Karnkowski P.H., 1991, Zagadnienia ruchów tektonicznych w czerwonym spągowcu. *Przegląd Geol.*, 39 (7-8): 352-356

[2] Maliszewska A., Kiersnowski H., Jackowicz E., 2003, Wulkanoklastyczne osady czerwonego spągowca dolnego na obszarze Wielkopolski. Prace PIG CLXXIX, Warszawa

[3] Geiβler M., Breitkreuz Ch., Kiersnowski H., 2008, Late Paleozoic volcanism in the central part of the Southern Permian Basin (NE Germany, W Poland): facies distribution and volcano-topographic hiati

Participation by NCBJ in the EURADOS survey on in-vivo monitoring data of exposed foreigners in Japan, obtained in their respective countries at an early stage after the nuclear accident at the Fukushima Daiichi nuclear power plant

J. Ośko, T. Pliszczyński
National Centre for Nuclear Research, Otwock-Świerk, Poland

Introduction

The radiation situation in Japan after the Fukushima NPP accident in 2011 increased concern among foreigners staying in Japan at the time of the nuclear event. Some of them left Japan and were *in vivo* monitored in their respective countries at an early stage after the nuclear accident, for detection and assessment of potential internal exposure.

This type of internal exposure monitoring was also carried out on Polish citizens by Polish institutions, including the Radiation Protection Measurements Laboratory of NCBJ.

Materials and methods

NCBJ is a member of EURADOS (European Radiation Dosimetry Group e.V.) which was contacted by NIRS (National Institute of Radiological Sciences) and the NIRS-EURADOS collaboration was established. Some EURADOS members of the WG7 "Internal Dosimetry" network were invited and attended the 2nd NIRS Symposium "Reconstruction of Early Internal Dose in the TEPCO Fukushima Daiichi NPS Accident" that took place in Tokyo in January 2013. A EURADOS survey was proposed on *in vivo* monitoring data of exposed foreigners in Japan, obtained in their respective countries at an early stage after the nuclear accident.

Interest was focused on the results of *in vivo* monitoring of ^{131}I, ^{132}I, ^{132}Te, ^{134}Cs and ^{137}Cs by gamma spectrometry (whole body counting and thyroid measurements). Different detector systems were used by different laboratories – HPGe detectors, NaI(Tl) detectors and HPGe + NaI(Tl) detector systems. Shielded Rooms, Whole Body Counters (WBC) and Mobile Units were included in this study.

Results

The EURADOS Survey gathered *in vivo* monitoring data carried out by 19 institutions from 15 countries (Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Norway, Poland, Spain, Sweden, UK and Ukraine. The data base includes more than 300 foreigners who were in Japan at the time of the Fukushima accident; 176 of them were evaluated as contaminated persons. All values of the estimated Committed Effective Doses E(50) were below 1 mSv. The results are presented in Fig. 1 and Tab.1.

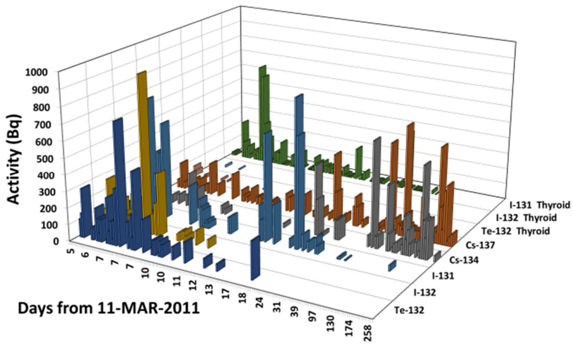


Fig. 1. The activity of different isotopes gathered in the whole body or thyroid of different people at the time period 11 March 2011.

Table 1. The results of whole body and thyroid monitoring and measured activity

Isotope	Whole body counting: No. of cases	Whole body counting: Activity (Bq)	Thyroid Monitoring: No. of cases	Thyroid Monitoring: Activity (Bq)
^{137}Cs	77	Max: 670		
		Min: 18		
^{134}Cs	40	Max: 637		
		Min: 24		
^{131}I	45	Max: 890	100	Max: 644
		Min: 6		Min: 9
^{132}I	26	Max: 953	2	Max: 86
		Min: 41		Min: 3
^{132}Te	26	Max: 744	7	Max: 15
		Min: 24		Min: 8

Conclusions

The collected data will be analyzed together with the data on residence, activity and alimentary habits of the monitored people and used for intake and internal dose estimates. The results of this work were presented at [1]. The project will continue with further NCBJ participation.

Reference

[1] M.A. Lopez et al, poster RP9P at International Experts' Meeting on Radiation Protection after the Fukushima Daiichi Nuclear Power Plant Accident, 17-21 February 2014

Durability and efficiency of concrete shields against ionizing radiation in nuclear power structures

M. A. Gryziński[1], M. A. Glinicki[2], M. Maciak[1], P. Tulik[1], S. Domański[1], E. Jakubowska[1], Ł. Murawski[1], J. Ośko[1], K. Tymińska[1], M. Wielgosz[1]

[1]*National Centre for Nuclear Research, Otwock-Świerk, Poland*

[2]*Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland*

Introduction

The consortium of IPPT PAN, NCBJ, Hydrobudowa-1 and OSiMB began the Project Durability and efficiency of concrete shields against ionizing radiation in nuclear power structures (ATOMSHIELD) in 2014. The Project is financed by the National Centre for Research and Development.

The objective of the Project is to develop design methods and criteria for functional evaluation and durability of special concrete in nuclear radiation shielding. The methods will be used for innovative mix design of shielding concrete of increased performance and verified at industrial scale of concrete batching plant using special type of cements. Tests of the microstructure of the concrete and the long term material properties, including shielding capacity, will be aided by numerical simulations. The results will be useful for designers and producers of shielding materials as well as for technical supervision of construction and technical condition diagnostics of concrete structures in nuclear power plants during operation. The scope of the investigation is justified by the state of the art concerning the deleterious influence of radiation on the stability of concrete microstructure as well as news about premature concrete damage in the Seabrook plant and quality problems in the Olkiluoto plant.

Requirements for concrete shielding may be defined based on foreign instructions and numerous publications as follows:

- homogeneity and raised density to gamma radiation attenuation
- sufficient hydrogen content to maximize neutron flux slowdown (also in raised temperature)
- good thermal conductivity due to the possibility of increasing the temperature and the need to reduce the temperature differences and tensions
- strength and durability, according to the design and operating conditions.

The effeciency of the sheilding concrete may be degraded during long-term operation due to environmental factors, mechanical loads, internal destruction (alkaline aggregate reaction, hardened cement paste leaching)) and activation.

Materials and methods

The aim of these studies is to find a solution to two problems, necessary for the construction of nuclear reactors in Poland:

- obtain protective concrete of several categories, optimal for various utility and production conditions;
- ensure the required concrete stability (40-60 years) under conditions of elevated temperature, humidity and other external influences, especially radiation [1].

The scope of the Project includes the development of a number of shielding concrete compositions for various applications in construction associated with nuclear power, taking into account the various requirements depending on the type and intensity radiation or safety and durability requirements. The abilities of the developed concrete compositions will be studied after exposure to ionizing radiation. The Project will also include studies on the abilities of concrete shielding from the EWA research nuclear reactor operated in 1958-1995.

Predicted results

The results of the Project will be recipes and technologies for several compositions of concrete shielding for different applications.

The results of the Project will be useful for construction companies working on elements of nuclear power plants; quality control authorities of the construction of nuclear power plants by foreign companies; national construction and supervising companies in the implementation of concrete objects for therapy and medical diagnostics; national supervising and monitoring bodies for objects associated with the nuclear reactors and storing nuclear materials over the next decades.

Conclusion

Studies of new types of the shielding concrete are very important according to the Polish Nuclear Programme which predicts the start of the first Polish nuclear power plant in 2024. The results of these studies will also be useful for radiation shielding constructors for purposes other than the nuclear industry (medicine, etc.).

The Project will be completed in 2014-2016.

Reference

[1] M.Gryziński et al, Material research for conventional and nuclear power plants and energy industry, Conference Proceedings, p. 123-126

Recent improvements in the neutron calibration facility

S. Domański, P.Tulik, M.A. Gryziński, M. Maciak, K. Tymińska
National Centre for Nuclear Research, Otwock-Świerk, Poland

The Radiation Protection Measurements Laboratory (LPD) in the National Centre for Nuclear Research (NCBJ) is the only calibration laboratory in Poland with reference neutron fields. The history of the LPD began in the mid-1980s, when reference neutron fields were established for the calibration and testing of dosimetric equipment. Well-specified radioactive neutron sources of bare ^{252}Cf, ^{241}Am-Be and ^{239}Pu-Be, with well known emission rates and anisotropies, were installed in the centre (1 metre above the floor) in adedicated neutron irradiation room, 4×4×16 m^3 in size. Since that time, the fields have been periodically examined and inspected in case of long term changes in their physical and dosimetric parameters. As a result, the LPD is able to show their continued usefulness as reference sources.

Recently, to characterize the neutron fields in the LPD, detailed calculations were performed with the MCNP-code with realistic geometry and materials for the source and the irradiation room. These results show the differentiation of components of the neutron radiation in the reference points (i.e. direct neutrons, scattered and backscattered) when sources are placed at different heights.

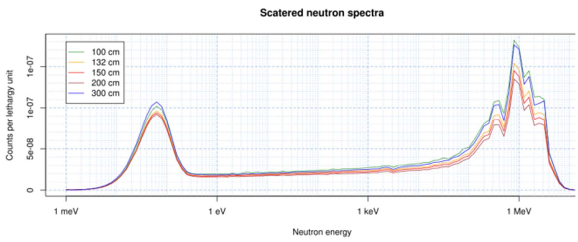


Fig. 1. MCNPX calculated neutron spectra for a realistic geometry 252Cf source situated inside the calibration room in the middle of the flour. Detector (tally f5) placed on calibration bench at distance 100 cm from the source and detector placed consecutively at various heights.

Additionally, numbers of measurements were evaluated in describing the real reference neutron sources. The instrument used for measurements was a Studsvik-Alnor 2202D neutron remmeter with DAQPad 6020E card aided digital data acquisition software. The recalibration of the remmeter carried out at NPL with standard 252Cf and 241Am-Be sources. The response values were the same as those measured in previous calibrations. To measure scattered neutrons a shadow cone was used. The cone dimensions and construction ensure proper shielding at a distance of 0.8-3 m. The front part of the cone shields the detector from direct gamma radiation and the rear part shields it from direct neutrons. An Example of these measurements is shown in Figure 2 as Studsvik count rate × squared distance to distance**.**

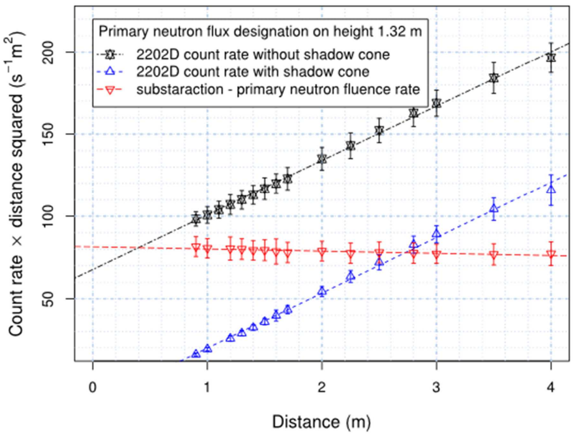


Fig. 2. Measurements made along the calibration bench with source and detector placed at height 1.32 m.

The value of the dose equivalent along the calibration bench was determined for unscattered neutrons. The contribution of scattered neutrons to be neutron dose equivalent is shown in Fig. 3.

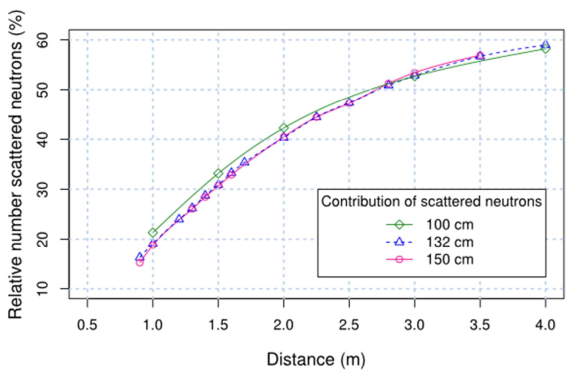


Fig. 3 Contribution of scattered neutrons to ambient dose equivalent along the LPD neutron calibration bench for a 252Cf source.

The MCNPX calculations and measurements were found to be in good agreement, showing that the neutron calibration field in LPD-NCBJ is well established.

Reference

[1] S. Domański, P.Tulik, M.A. Gryziński, M. Maciak, K. Tymińska, The Second International Conference on Radiation and Dosimetry in Various Fields of Research, Book of Abstracts p.128, Niš, Serbia 2014

Laboratory of Radioactivity Standards of the Radioisotope Centre POLATOM – overview of activity

T. Dziel, Z. Tymiński, A. Listkowska
National Centre for Nuclear Research, Radioisotope Centre POLATOM, Otwock-Świerk, Poland

The Laboratory of Radioactivity Standards (LRS) of the Radioisotope Centre POLATOM, National Centre for Nuclear Research, in Otwock, is the only laboratory in Poland performing radioactivity measurements of α-, β- and γ-emitters by absolute methods and performing calibration of standard solutions and radioactive sources.

LRS has implemented and maintains the quality management system compliant with the international standard ISO/IEC 17025:2005, confirmed by the accreditation certificate awarded by the Polish Centre for Accreditation (accreditation no. AP 120).

One of the main tasks performed by the LRS is the continuous improvement and expanding of measurement capabilities in the field of radionuclide metrology. Our primary goal is to ensure traceability with a National Standard for activity measurements of radioisotopes used in nuclear medicine. It is done by development of primary methods and calibration of secondary and working standards.

Fig. 1. Capintec dose calibrator as a working standard for radionuclides activity.

In 2014 the absolute method for standardization of ^{111}In was developed. This radionuclide is used in many diagnostic procedures in nuclear medicine, so there is a constant need for precise standards for calibration of medical instruments in order to optimize the internal dose absorbed by the patient.

For standardization of ^{111}In activity a 4π(LS)-γ coincidence and anticoincidence counting method was used. Absolute measurements were performed for samples with different concentration of carrier solution and for different window settings in the gamma channel. The radioactive concentration of the master solution calculated on the same reference date was consistent for all measurements. Possible gamma emitting impurities were checked according to the procedure described in the European Pharmacopoeia.

Additionally, the half-life value for ^{111}In was determined with the use of an ionization chamber. 70 data points (ionization current readings) were recorded during 16 days (nearly 6 half-lives). Analysis of the data gave a value of 2.8073 ± 0.0015 days which is 0.085% lower than the Decay Data Evaluation Project recommended value.

LRS also participates in international comparisons of radioactivity measurements linked to the global system of national standards. These comparisons are organized by the International Bureau of Weights and Measures (BIPM) and the European Association of National Metrology Institutes EURAMET. The laboratory also participates in comparisons within the framework of the International Reference System (SIR).

The most important international comparisons that LRS participated in during 2014 were:

- activity measurements of ^{151}Sm connected with determination of a new half-live value with a low uncertainty,
- activity measurements of ^{68}Ge+^{68}Ga solution registered by BIPM as a key comparison.

Table 1. Final results for the ^{151}Sm activity concentration A, with combined standard uncertainties (k = 1) u, as reported by the comparison participants.

Participant	A in kBq g^{-1}	u in kBq g^{-1}
PTB	79.22	0.41
LNE-LNHB	77.87	0.41
IRMM	78.7	0.4
POLATOM	79.51	0.48
CMI	77.9	0.93
SMU	80.247	0.376

LRS also participated in comparisons within the framework of the European Metrology Research Programme, focused primarily on characterization of reference materials used in EURAMET Joint Research Projects.

RC POLATOM is recognized by the Central Office of Measures in Poland as a Designated Institute (DI). Therefore, it is entitled to direct contacts with EURAMET and to participation in scientific projects supported by this organization. During 2011-2014 LRS carried out two projects coordinated by EURAMET on the applications of ionization radiation metrology in environmental sciences and industry:

- IND04 MetroMetal "Ionizing radiation metrology for the metallurgical industry",
- ENV09 MetroRWM "Metrology for radioactive waste management".

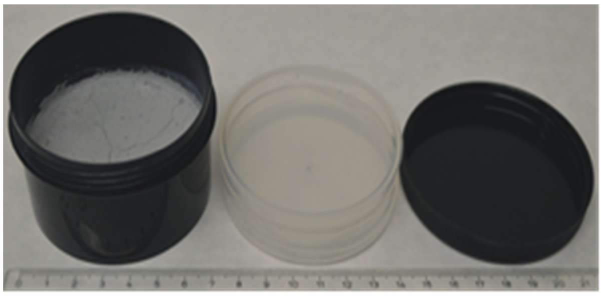


Fig. 2. Fume dust source contaminated with ^{137}Cs and ^{60}Co in the container, fixing inner discs and lid.

One of the outputs of the IND04 MetroMetal project was the recommendation of a novel radionuclide specific detector system optimized for the measurement of radioactivity in metallurgical samples. Prototypes of the recommended system, constructed at two project partner laboratories, were characterized by Monte Carlo (MC) simulations. Different MC codes were used to model the system and a range of cylindrical samples of cast steel, slag and fume dust were taken into account. The sample shape, density, and elemental composition were the same as the calibration standards developed within the project to provide traceability to end-users.

Within this project in 2014 LRS participated in activity measurement comparisons of different materials spiked with ^{241}Am, ^{226}Ra, ^{137}Cs and ^{60}Co. Also, computer models of these sources were prepared for simulation with a previously defined geometry of the reference gamma spectrometer. Full-energy peak and total detection efficiencies were calculated with the use of the PENELOPE code and compared with results from other participants.

In the result of the ENV09 MetroRWM the optimized experimental Free Release Measurement Facility (FRMF) was built with spectrometric detectors and suitable low background concrete shielding, modular and transportable, flow through configuration, radon daughters free, homogeneity testing capable. The testing performed using this facility enabled the creation of a design of FRMF for worldwide use in operational nuclear facilities and on decommissioning sites also beyond the end of the JRP. This sophisticated method for scale factor determination enabled involvement of indirectly measured radionuclides for free release decision.

Similar to the earlier described project, here LRS performed characterization of spiked reference materials, specifically activity measurements of ^{60}Co, ^{110m}Ag, ^{226}Ra, ^{228}Th and ^{40}K.

Both projects ended with the development of reliable, SI traceable methods optimized for the control/measurement of radioactive waste activity, novel instruments and methods for in-situ measurements, gaseous effluent monitors/samplers for stored wastes, and new types of standard sources and reference materials. The decay data for long-lived radionuclides (^{151}Sm, ^{166m}Ho, ^{129}I) were also improved.

In 2014 new fume-hoods for radiochemical preparations were installed in LRS. They were equipped for production of radioactive standards and development of new types of sources.

Fig. 3. New station for production of radioactivity standards.

Optimization of high-dose X-ray medical needle device parameters, based on Monte Carlo simulations

B. Zaręba, K. Wincel, M. Słapa, A.Wysocka-Rabin
National Centre for Nuclear Research, Otwock-Świerk, Poland

HDR brachytherapy is a very effective treatment for skin cancer. Surface applicators used in this therapy could become the standard treatment for skin irradiation in the near future. In 2014 activities concerned with the improvement of the homogeneity of the X radiation from a Photon Needle were continued. The Photon Needle allows the placement of the rtg. lamp target within the target or its close vicinity. That in turn allows high dose X-ray deposition within the object of interest, thus reducing the radiation time to several minutes. The PN is a "point" source of spherical isotropy of the applied X-ray radiation. The irradiation treatment based solely on the spherical isotropy seems to utilize only a part of the full potential of the PN radiotherapy.

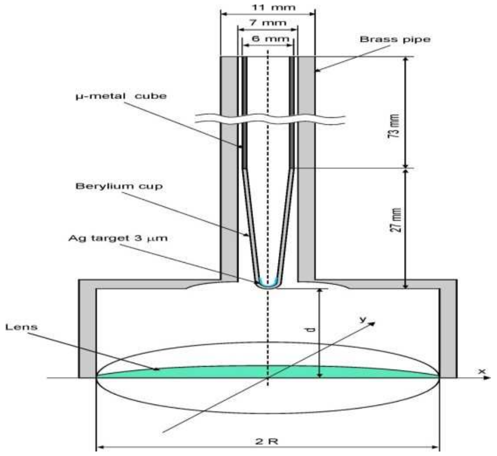


Fig. 1. Model of Photon Needle with corrective lens.

The proposed device with the corrective lenses is depicted in Fig. 1. The anode of the rtg. PN lamp is placed within a specially designed collimator with the lens. The design of the collimator ensures full absorption of the X-rays from the PN. The choice of appropriate lens may, and should, ensure isotropic radiation on a circular surface of diameter equal to that of the collimator (2R).

A Monte Carlo simulation of the dose surface distribution was performed based on three parameters: surface diameter (2R), lens curvature and lens material. The upgraded model HDR Photon Needle was developed using the Monte Carlo code MCNP version 6. [1] and the MCPLIB84 and El03 photon and electron cross-section library, elements of MCNPDATA [2]. The Monte Carlo simulations were performed for an HDR Photon Needle of Ua=50 kV. Its circular-shaped surface electron source had a radius of 0.099cm, and emitted electrons perpendicular to the plane in which it was located. The number of histories-nps was set to 8000 000 000 and the energy cutoff for photons and electrons was set to 0.001 MeV. The appropriate esteps for each material were used. The simulations were performed for filters (lenses) whose main elements had either a paraboloid or spherical shape. Filters were made from PMMA and polystyrene material. The choice of an appropriate set of filters should ensure that isotropic radiation on the circular surface of the diameter is equal to that of the collimator (2R). By calculating and investigating a large number of filters of different shapes and thicknesses, we were able to select the few that ensure the most homogenous dose distribution.

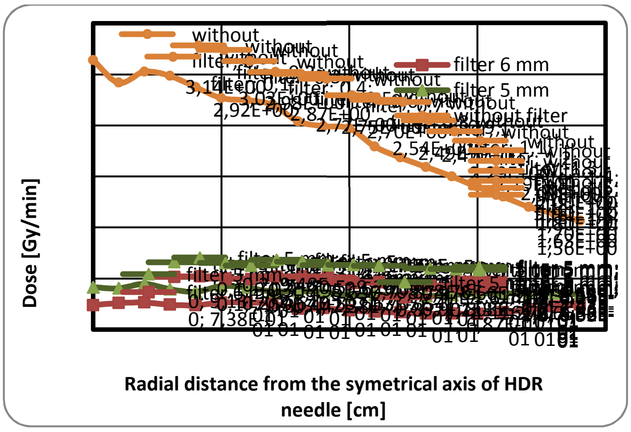


Fig. 2 Dose distribution in water for different filter thicknesses

Fig.2 illustrates the dose rate distribution in the water phantom (skin layer) of 1 mm thickness. Optimal isotropy was obtained with a paraboloid filter of 5 mm thickness, at an average dose rate of 0.87 Gy/min and standard variation of 3.2%. Further improvement of the isotropy could be obtained by additional modification of the filter's shape. An HDR Photon Needle with upgraded corrective filter could therefore be regarded as a compact, low-cost, low-energy X-ray source that ensures uniform dose rate distribution in treating skin cancers.

References

[1] Monte Carlo N–Particle Transport Code System, MCNP6
[2] MCNPDATA: ENDF/B-VII.1 nuclear and atomic data, 2012

Air quality investigation at two Warsaw crossroads using the mobile environmental measurements laboratory

J. Sernicki, J. Licki, M. Kowalski, M. Lasiewicz, A. Bigos, M. Laskus
National Centre for Nuclear Research, Otwock-Świerk, Poland

The mobile environmental measurements laboratory has been developed in the Division of Interdisciplinary Applications of Physics within the framework of the "Strengthening of the innovation potential of the Institute in Świerk for development of technologies based on ionizing radiation" project (as known as 4 LABs). The project was co-financed by the European Union from the European Regional Development Fund under the Regional Operational Programme of the Mazovian Voivodeship 2007-2013. The mobile environmental measurements laboratory (in short: laboratory) is a dedicated, mobile, air conditioned container equipped with the state-of-the-art instruments for determination of concentrations of the main atmospheric air pollutants such as: particulate matter, gaseous pollutants: nitrogen oxides (NO_x), carbon oxide (CO) and ozone (O_3) along with a meteorological station for measurements of air temperature, pressure, humidity, wind direction and velocity.

The investigations of air quality at two Warsaw crossroads were performed within the cooperation with the Green Mazovia Association and the Światowid Ecology Association. The aim was the determination of airborne particulate matter concentrations at two near-highway regions in Warsaw. The first measuring point was located in the area of the crossroads of the Aleja Krakowska Street with the South Ring Road of Warsaw in the Włochy quarter (Figs. 1 and 2).

Fig. 1. The satellite photograph of the first point.

The Aleja Krakowska Street is the main road in south-western Warsaw with an average traffic volume of 83.420 cars per 24h. To the north-east, the Okęcie airport is located, where many pollutants are released during take-off and landing of planes.

Fig. 2. Location of the laboratory. The South Ring Road is to the left and the Aleja Krakowska Street to the right. Both roads are surrounded by acoustic shields.

The second air quality testing point was in the Żoliborz quarter within the area of the following streets crossroads: Aleja Armii Krajowej, Adama Mickiewicza, Rudzka and Klaudyny. The Aleja Armii Krajowej is a high-traffic-volume roadway with an average traffic volume of 153.513 cars per 24h. During the investigations, one half of the street was under repair and the other half had a reduced traffic volume – without heavy trucks.

Current legislation in Europe [1] requires mass concentration measurements of the fractions of $PM_{2.5}$ (ambient particles with diameter $\leq 2.5\mu$m) and PM_{10} (particles with diameter $\leq 10\mu$m) of suspended particulate matter in atmospheric air. The PM_{10} mass concentration was determined by two methods: the manual gravimetric method using the sequential sampler PNS3D15 with nominal flow rate of 2.3m^3/h of air and the automatic method using the ambient air dust meter AMIZ 2007-G/J. The higher 24-hour mass concentrations of PM10 were recorded in Włochy (Fig. 3) during the continuous measurements which were performed from 28.10.2014 until 03.11.2014. In each measuring day the recorded PM_{10} concentration exceeded the limit value for one-day mass concentration (50 μg/m^3). Whereas in Żoliborz, lower 24-hour mass concentrations of PM_{10} were recorded (Fig. 4). During 16 measuring days, no exceedence of the limit value of 50 μg/m^3 was observed.

Additionally, number concentrations of six fractions of ambient dust particles with diameters: 20-30, 30-50, 50-70, 70-100, 100-200, and 200-1000 nm were measured with a TSI Model 3031 ultrafine particle monitor.

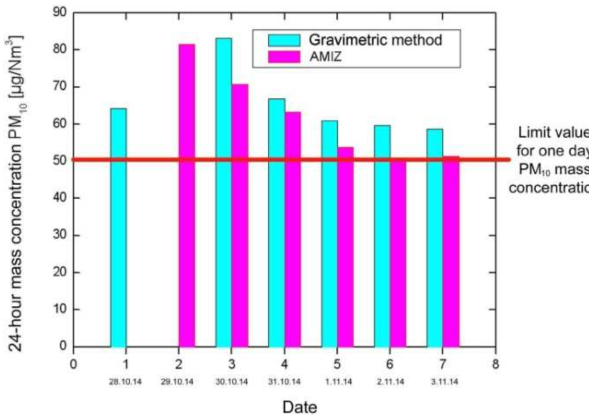


Fig. 3. The one-day mass concentrations of PM_{10} fraction recorded in Włochy.

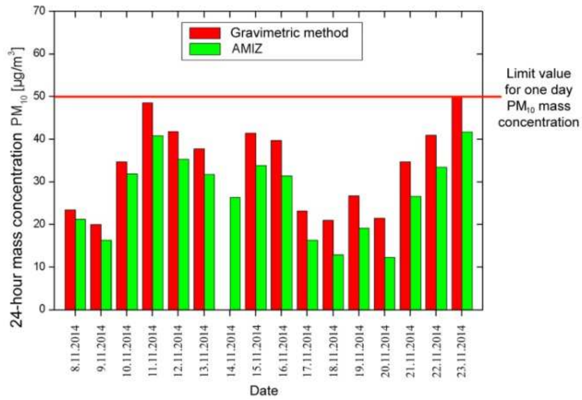


Fig. 4. The one-day mass concentrations of PM_{10} fraction recorded in Żoliborz.

Fig. 5 presents the results of measurements for ultrafine particles.

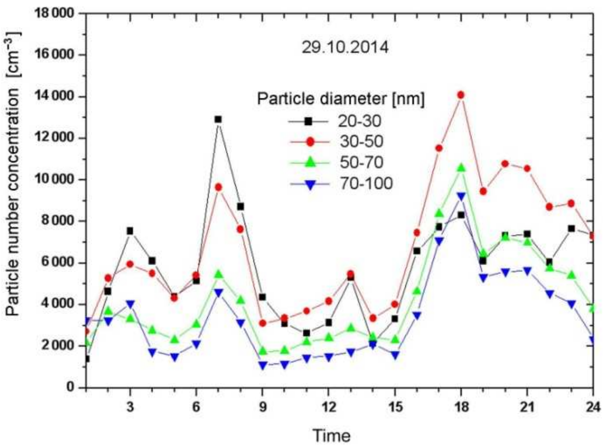


Fig. 5. The diurnal variation of the hourly averaged number concentrations of ultrafine particles measured on 29.10.2014 in Włochy.

Ultrafine particles are defined as those with diameters up to 100 nm while fine particles have greater diameters between 100 nm and 1000 nm. Together they form the PM_1 fraction (all particles with diameters up to 1 μm). Due to their small sizes, inhaled ultrafine particles can easily penetrate and are retained in the deepest areas of the respiratory tracts, e.g. [2, 3].

The curves (Fig. 5) show two peaks: the first one in the morning (between 6:00 and 9:00) and the second in the afternoon (between 15:00 and 18:00). These peaks are associated with the road traffic emissions from the Aleja Krakowska Street during traffic rush hours. So traffic is an important source of ultrafine particles. Figs. 6 and 7 present the percentages of ultrafine and fine particles in the PM_1 fraction of suspended particulate matter as recorded in Włochy and Żoliborz.

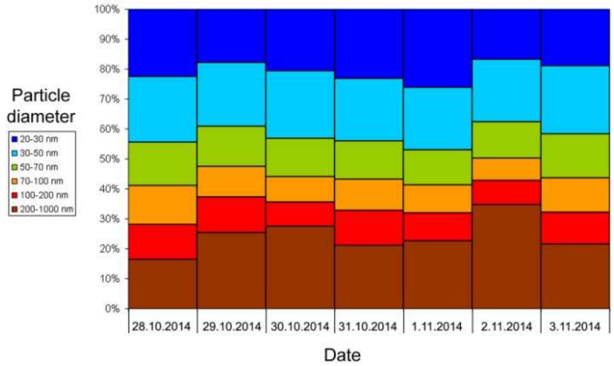


Fig. 6. The percentages of particulate fractions of ultrafine and fine particles in the PM_1 fraction of suspended particulate matter recorded in Włochy from 28.10.2014 until 3.11.2014.

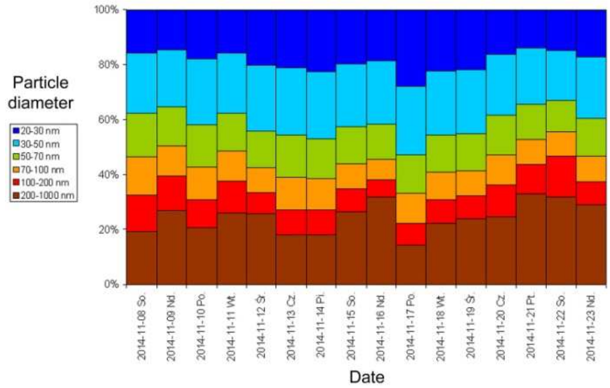


Fig. 7. Analogous results recorded in Żoliborz from 8.11.2014 until 23.11.2014.

In both quarters the average percentages of ultrafine particles (with diameters within range 20-100 nm) were about 66% of the PM_1. The average daily number concentration of all ultrafine particles in Włochy was 352.629 particles per cubic centimetre and fine particles was 176.277, respectively. In Żoliborz the number concentrations were three times lower and were equal to 109.445 ultrafine particles and 57.087 fine particles.

References

[1] Directive 2008/50/EC of the European Parliament and the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

[2] HEI Perspectives, Health Effects Institute, Boston, Massachusetts 3, January 2013

[3] Occup Environ Med 2001;58:211–216

IV. LIST OF PUBLICATIONS

PUBLICATIONS IN PEER-REVIEWED JOURNALS

1 A New Mobile Electron Accelerator for Intra Operative Electron Radiation Therapy
P. Adrich, ... , **A. Baczewski**, **M. Baran**, **W. Drabik**, **K. Gryn**, **R. Hanke**, **E.A. Jakubowska**, **E. Jankowski**, **G. Kędzierski**, **N. Kielar**, **Ł. Kujawiński**, **J. Kopeć**, **K. Kosiński**, **R. Kozioł**, **P. Kraszewski**, **P. Krawczyk**, **E. Kulczycka**, **P. Lalik**, **M. Marczenko**, **A. Masternak**, **A. Misiarz**, **J. Olszewski**, **K. Ozon**, **E. Pławski**, **A. Polak**, **W. Psonka**, **M. Rutkowska**, **J. Rzadkiewicz**, **Z. Sienkiewicz**, **M. Staszczak**, **K. Swat**, **A. Syntfeld-Każuch**, **M. Terka**, **A. Wasilewski**, **J. Wilczek**, **M. Wojciechowski**, **M. Wójtowicz**, **S. Wronka**, **A. Wysocka-Rabin**, **K. Zalewski**, ... et al.
International Journal of Modern Physics: Conference Series Vol. 27 (2014) 1460125

2 Changes in the Chemical Composition of Nuclear Reaction Products Irradiated with 100MeV γ Quanta in Deuteriumm Saturated Palladium
A.Yu. Didyk, **R. Wiśniewski**, **T. Wilczyńska-Kitowska**, V.M. Shilov
Journal of Surface Investigation, X-ray, Synchro-tron and Neutron Techniques Vol. 8 No 6 (2014) 1100

3 Eciency of Sequential Monte Carloand Genetic algorithm in Bayesianestimation of the atmosphericcontamination source
A. Wawrzyńczak-Szaban, **P. Kopka**, P. Kopka, M. Jaroszyński, **M. Borysiewicz**
Proceedings of 21st International Conference on Computational Statistics Vol. 1 (2014) 601

4 Bayesian Approach to Environmental Problem Based on PFLOTRAN Package
O. Dorosh, **H. Wojciechowicz**, **P. Kopka**, P. Kopka
The Contribution of Young Researchers to Bayesian Statistics Springer Proceedings in Mathematics & Statistics Vol. 63 (2014) 101-103

5 64-Element Photodiode Array for Scintillation Detection of X-Rays
M. Węgrzecki, ... , **D. Wolski**, **A. Chłopik**, ... et al.
13th International Conference on Optical Sensors and Electronic Sensors, Łódź, 22-25.06.2014, [w serii: Proceedings of SPIE: tom 9291] Vol. 9291 (2014) 929104

6 Production of Mo+ Beams Using an Arc Discharge Ion Source
M. Turek, A. Droździel, K. Pyszniak, S. Prucnal, **D. Mączka**
Acta Phys. Pol. A Vol. 125 No 6 (2014) 1388

7 Thermal Desorption Studies of Ar+ Implanted Silicon
A. Droździel, ... , **D. Mączka**, **B. Słowiński**, ... et al.
Acta Phys. Pol. A Vol. 125 No 6 (2014) 1400

8 ALICE experimental results
A. Matyja, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Acta Phys. Pol. B Vol. 45 (2014) 1521

9 Analysis of the biological response in CHO-K1 cells to high LET radiation
U. Kaźmierczak, ... , **M. Jaskóła**, **Ł. Kaźmierczak**, **A. Korman**, ... et al.
Acta Phys. Pol. B Vol. 45 No 2 (2014) 553

10 Barrier height distributions – the influence of weak channels
A. Trzcińska, ... , **E. Piasecki**, **W. Czarnacki**, **N. Keeley**, **M. Kisieliński**, **K. Rusek**, **I. Strojek**, ... et al.
Acta Phys. Pol. B Vol. 45 No 2 (2014) 383

11 D-meson nuclear modification factor in Pb-Pb collisions measured with ALICE
C. Bedda, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Acta Phys. Pol. B Vol. 45 (2014) 1281

12 Direct and Compound Nucleus Reactions for the System ^{7}Be + ^{58}Ni at Near-barrier Energies
M. Mazzocco, ... , **N. Keeley**, **K. Rusek**, ... et al.
Acta Phys. Pol. B Vol. 45 (2014) 363

13 Energy Loss in Unstable QGP — the Upper Cut-off Dependence
M.E. Carrington, **K. Deja**, **St. Mrówczyński**
Acta Phys. Pol. B Vol. 7 (2014) 209

14 Heavy-Ion Results from the CMS Experiment
B. Boimska
Acta Phys. Pol. B Vol. 45 No 7 (2014) 1291

15 Illustration of accuracy of presently used nuclear-mass models
Yu.A. Litvinov, **M. Palczewski**, E.A. Cherepanov, **A. Sobiczewski**
Acta Phys. Pol. B Vol. 45 (2014) 1979

16 POLAR the Space Experiment to Study Origin of Gamma Ray Bursts
A. Zwolińska, ... , **T. Batsch**, **K. Jędrzejczak**, **J. Karczmarczyk**, **R. Marcinkowski**, **A. Rutczyńska**, **D. Rybka**, **J. Szabelski**, **T. Tymieniecka**, ... et al.
Acta Phys. Pol. B Vol. 45 No 2 (2014) 255

17 Separation Between $d_{5/2}$ and $s_{1/2}$ Neutron Single Particle Strength in ^{15}N
C.E. Mertin, ... , **N. Keeley**, ... et al.
Acta Phys. Pol. B Vol. 45 (2014) 159

18 Studies of mesic nuclei via decay reactions
S. Wycech, W. Krzemien
Acta Phys. Pol. B Vol. 45 No 3 (2014) 745

19 Non-equilibrium Ghosts
A. Czajka, **St. Mrówczyński**
Acta Phys. Pol. B Proc. Suppl. Vol. 7 (2014) 505

20 Super Yang–Mills Plasma
A. Czajka, **St. Mrówczyński**
Acta Phys. Pol. B Proc. Suppl. Vol. 7 (2014) 145

21 Supersymmetric Yang–Mills Plasma
A. Czajka, **St. Mrówczyński**
Acta Phys. Pol. B Proc. Suppl. Vol. 7 (2014) 499

22 A balloon-borne prototype for demonstrating the concept of JEM-EUSO
P. VonBallmoos, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Adv. Space Res. Vol. 53 No 10 (2014) 1544-1550

23 Calibration for extensive air showers observed during the JEM-EUSO mission
J.H. Adams, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Adv. Space Res. Vol. 53 No 10 (2014) 1506-1514

24 KASCADE-Grande energy spectrum of cosmic rays and the role of hadronic interaction models
W.D. Apel, ... , **P. Łuczak**, **J. Zabierowski**, ... et al.
Adv. Space Res. Vol. 53 (2014) 1456 -1469

25 Observation of extensive air showers in cloudy conditions by the JEM-EUSO Space Mission
G. Sáez-Cano, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Adv. Space Res. Vol. 53 No 10 (2014) 1536-1543

26 Performance and air-shower reconstruction techniques for the JEM-EUSO mission
M. Bertaina, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Adv. Space Res. Vol. 53 No 10 (2014) 1515-1535

27 The JEM-EUSO Mission
T. Ebisuzaki, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Adv. Space Res. Vol. 53 No 10 (2014) 1499-1505

28 Energy shifts of K- and L-lines as spectroscopic diagnostic of Z-pinch plasmas
K. Słabkowska, **J. Rzadkiewicz**, E. Szymańska, L. Syrocki, M. Polasik, N.R. Pereira,
AIP Conf. Proc. Vol. 1639 (2014) 47

29 Neutron counter based on beryllium activation
B. Bieńkowska, ... , **R. Prokopowicz**, **K. Pytel**, ... et al.
AIP Conf. Proc. Vol. 1612 (2014) 105

30 Data-driven Genetic Algorithm in Bayesian estimation of the abrupt atmospheric contamination source
A. Wawrzyńczak-Szaban, M. Jaroszyński, **M. Borysiewicz**
Annals of Computer Science and Information Systems Vol. 2 (2014) 519–527

31 Proficiency tests of ^{90}Y and ^{89}Sr activity measurements in Polish hospitals
T. Dziel, **A. Listkowska**, **Z. Tymiński**
Appl. Radiat. Isot. Vol. 87 (2014) 24-26

32 Standardization of ^{153}Sm solution by absolute methods
T. Dziel, **R. Broda**, **T. Ziemek**, **A. Muklanowicz**, **A. Listkowska**
Appl. Radiat. Isot. Vol. 87 (2014) 19-23

33 Channeled PIXE and magnetic measurements in Co implanted and thermally annealed ZnO
Z. Werner, **R. Ratajczak**, J. Gosk, **M. Barlak**, **C. Pochrybniak**, Q. Zhao
Appl. Surf. Sci. Vol. 310 (2014) 242-247

34 Properties of star forming galaxies in AKARI Deep Field-South
K. Malek, ... , **A. Pollo**, ... et al.
Astron. Astrophys. Vol. 562 (2014) 15

35 The VIMOS Public Extragalactic Redshift Survey (VIPERS) Omega(m0) from the galaxy clustering ratio measured at z similar to 1
J. Bel, ... , **A. Pollo**, ... et al.
Astron. Astrophys. Vol. 563 (2014) A37

36 The VIMOS Public Extragalactic Redshift Survey (VIPERS): A quiescent formation of massive red-sequence galaxies over the past 9 Gyr
A. Fritz, ... , **A. Pollo**, ... et al.
Astron. Astrophys. Vol. 563 (2014) A92

37 The VIMOS Public Extragalactic Redshift Survey (VIPERS). An unprecedented view of galaxies and large-scale structure at $0.5 < z < 1.2$
L. Guzzo, ... , **A. Pollo**, ... et al.
Astron. Astrophys. Vol. 566 (2014) 108

38 The VIMOS Public Extragalactic Redshift Survey (VIPERS). Never mind the gaps: comparing techniques to restore homogeneous sky coverage
O. Cucciati, ... , **A. Pollo**, ... et al.
Astron. Astrophys. Vol. 565 (2014) 67

39 The VIMOS Public Extragalactic Redshift Survey. Searching for cosmic voids
D. Micheletti, ... , **A. Pollo**, ... et al.
Astron. Astrophys. Vol. 570 (2014) A106

40 First Searches for Optical Counterparts to Gravitational-Wave Candidate Events
J. Aasi, ... , **A. Ćwiek**, **A. Królak**, **A. Majcher**, **K. Nawrocki**, **M. Sokołowski**, **A. Zadrożny**, ... et al.
Astroph.J. Vol. 211 No 1 (2014) 7

41 Gravitational-waves from known pulsars: results from the initial detector era
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Astroph.J. Vol. 785 (2014) 119

42 Pi of the Sky - Roboty w badaniach astrofizycznych
A. Ćwiek, ... , **T. Batsch**, **A. Majcher**, **K. Nawrocki**, **M. Sokołowski**, ... et al.
Biblioteka Urani Vol. 30 (2014) 49

43 A novel method based solely on FPGA units enabling measurement of time and charge of analog signals in Positron Emission Tomography
M. Pałka, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 1 (2014) 41-45

44 A novel method for calibration and monitoring of time synchronization of TOF-PET scanners by means of cosmic rays
M. Silarski, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 1 (2014) 19-25

45 Application of WLS strips for position determination in Strip PET tomograph based on plastic scintillators
J. Smyrski, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 2 (2014) 59-63

46 Calibration of photomultipliers gain used in the J-PET detector
T. Bednarski, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 1 (2014) 13-17

47 Computing support for advanced medical data analysis and imaging
W. Wiślicki, ... , **P. Kowalski**, **L. Raczyński**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 2 (2014) 53-58

48 Database and data structure for the novel TOF-PET detector developed for J-PET project
E. Czerwiński, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 2 (2014) 79-83

49 Determination of the map of efficiency of the J-PET detector with the GATE package
P. Kowalski, ... , **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 2 (2014) 85-90

50 J-PET analysis framework for the prototype TOF-PET detector
W. Krzemień, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 1 (2014) 33-36

51 Simulations of gamma quanta scattering in a single module of the J-PET detector
K. Szymański, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Bio-Algorithms and Med-Systems Vol. 10 No 2 (2014) 71-77

52 Changes of tribological properties of Inconel 600 after ionimplantation process
M. Barlak, M. Chmielewski, **Z. Werner**, P. Konarski, K. Pietrzak, A. Strojny-Nędza
Bulletin of the Polish Academy of Science Vol. 62 No 4 (2014) 827

53 Application of a Hough search for continuous gravitational waves on data from the 5th LIGO science run
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Class. Quantum Grav. Vol. 31 No 8 (2014) 085014

54 Implementation of an F-statistic all-sky search for continuous gravitational waves in Virgo VSR1 data
J. Aasi, ... , **O. Dorosh**, **A. Królak**, **A. Zadrożny**, ... et al.
Class. Quantum Grav. Vol. 31 (2014) 165014

55 Observational issues in loop quantum cosmology
A. Barrau, T. Cailleteau, J. Grain, **J. Mielczarek**
Class. Quantum Grav. Vol. 31 (2014) 053001

56 Reconstruction of the gravitational wave signal h(t) during the Virgo science runs and independent validation with a photon calibrator
T. Accadia, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Class. Quantum Grav. Vol. 31 No 16 (2014) 165013

57 Reconstruction of the gravitational wave signal h(t) during the Virgo science runs and independent validation with a photon calibrator
T. Accadia, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Class. Quantum Grav. Vol. 31 No 16 (2014) 165013

58 The NINJA-2 project: detecting and characterizing gravitational waveforms modelled using numerical binary black hole simulations
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Class. Quantum Grav. Vol. 31 No 11 (2014) 115004

59 A frequency and semiquantitative analysis of pathological 68Ga DOTATATE PET/CT uptake by primary site-dependent neuroendocrine tumor metastasis
J. Kunikowska, **D. Pawlak**, A. Kolasa, **R. Mikołajczak**, L. Królicki
Clinical Nuc. Med. Vol. 39 No 10 (2014) 855-861

60 Commentary: Ethical Issues of Current Health-Protection Policies on Low-Dose Ionizing Radiation
Y. Socol, ... , **L. Dobrzyński**, ... et al.
Dose-Resp. Vol. 12 No 2 (2014) 342

61 Zastosowanie metody IPD do syntezy warstw c-AlN
R. Chodun, **K. Nowakowska-Langier**, S. Okrasa, P. Firek, J. Szmidt, **K. Zdunek**
Elektronika Vol. 10 (2014) 11

62 Loop-deformed Poincaré algebra
J. Mielczarek
EPL-EUROPHYS LETT Vol. 108 No 4 (2014) 40003

63 Cross section ratio and angular distributions of the reaction p+d$\rightarrow$ ^{3}He + η at 48.8 MeV and 59.8 MeV excess energy
P. Adlarson, ... , **W. Augustyniak**, **M. Berłowski**, **A. Kupść**, **B. Mariański**, **H.P. Morsch**, **D. Pszczel**, **J. Stepaniak**, **A. Trzciński**, **J. Zabierowski**, **P. Żuprański**, ... et al.
Eur. Phys. J. A Vol. 50 No 6 (2014) 100

64 Crossed channel analysiis of quark and gluon generalized parton distributions with helicity flip
B. Pire, K. Semenov-Tian-Shansky, **L. Szymanowski**, S. Wallon
Eur. Phys. J. A Vol. 50 (2014) 90

65 Measurement of radiative widths of $a_2(1320)$ and $\pi_2(1670)$
C. Adolph, ... , **K. Klimaszewski**, **K. Kurek**, **A. Sandacz**, **R. Sulej**, **A. Szabelski**, **P. Sznajder**, ... et al.
Eur. Phys. J. A Vol. 50 (2014) 79

66 Strong coupling effects in near-barrier heavy-ion elastic scattering
N. Keeley, K.W. Kemper, **K. Rusek**
Eur. Phys. J. A Vol. 50 (2014) 145

67 The FAZIA project in Europe: R&D phase
R. Bugault, ... , **E. Piasecki**, ... et al.
Eur. Phys. J. A Vol. 50 (2014) 47

68 Constrains for non-standard statistical models of particle creations by identified hadron multiplicity results at LHC energies
T. Wibig
Eur. Phys. J. C Vol. 74 (2014) 2966

69 Event-by-event mean p_T fluctuations in pp and Pb–Pb collisions at the LHC
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3077

70 Measurement of differential cross sections for the production of a pair of isolated photons in pp collisions at $\sqrt{s}$= 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3129

71 Measurement of jet multiplicity distributions in ttbar production in pp collisions at $\sqrt{s}$ = 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3014

72 Measurement of negatively charged pion spectra in inelastic p+p interactions at p_{lab} = 20, 31, 40, 80 and 158 GeV/c
N. Abgrall, ... , **T. Palczewski**, **E. Rondio**, **J. Stepaniak**, ... et al.
Eur. Phys. J. C Vol. 74 No 2794 (2014) 6

73 Measurement of pseudorapidity distributions of charged particles in proton-proton collisions at $\sqrt{s}$ = 8 TeV by the CMS and TOTEM experiments
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3053

74 Measurement of quarkonium production at forward rapidity in pp collisions at $\sqrt{s}$ = 7 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2974

75 Measurement of the B^+_c meson lifetime using $B^+_c \to J/\psi\mu^+\nu_\mu X$ decays
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2839

76 Measurement of the top-quark mass in all-jets ttbar events in pp collisions at $\sqrt{s}$=7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2758

77 Measurement of top quark-antiquark pair production in association with a W or Z boson in pp collisions at $\sqrt{s}$= 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3060

78 Measurement of WZ and ZZ production in pp collisions at $\sqrt{s}$= 8 TeV in final states with b-tagged jets
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2973

79 Measurement of Y production in pp collisions at $\sqrt{s}$=2.76 TeV
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2835

80 Measurement of ψ(2S) polarisation in pp collisions at $\sqrt{s}$=7 TeV
A. Ukleja, ... , **M. Szczekowski**, **W. Wiślicki**, **K. Kurek**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2872

81 Neutral pion production at midrapidity in pp and Pb–Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3108

82 Observation of the diphoton decay of the Higgs boson and measurement of its properties
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3076

83 Probing color coherence effects in pp collisions at $\sqrt{s}$= 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2901

84 Search for heavy neutrinos and W bosons with right-handed couplings in proton-proton collisions at $\sqrt{s}$=8TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3149

85 Search for invisible decays of Higgs bosons in the vector boson fusion and associated ZH production modes
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2980

86 Searches for electroweak production of charginos, neutralinos, and sleptons decaying to leptons and W, Z, and Higgs bosons in pp collisions at 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3036

87 Spin density matrix elelments in exclusive omega electroproduction on ^{1}H and ^{2}H targets at 27.6 GeV beam energy.
W. Augustyniak, ... , **B. Mariański**, **A. Trzciński**, **P. Żuprański**, ... et al.
Eur. Phys. J. C Vol. C74 (2014) 3110

88 Studies of dijet pseudorapidity distributions and transverse momentum balance in pPb collisions at $\sqrt{s_{NN}}$= 5.02 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2951

89 Study of the production of charged pions, kaons, and protons in pPb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 2847

90 Study of χ_b meson production in pp collisions at$\sqrt{s}$= 7 and 8 TeV and observation of the decay $\chi_b(3P)\rightarrow\Upsilon(3S)\gamma$
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 10, 3092

91 Transverse momentum dependence of inclusive primary charged-particle production in p–Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Eur. Phys. J. C Vol. 74 (2014) 3054

92 JEM-EUSO observational technique and exposure
M. Bertaina, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Exp. Astr. (2014) 27 Mar

93 JEM-EUSO: Meteor and nuclearite observations
M. Bertaina, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Exp. Astr. (2014) 03 Apr

94 Performances of JEM-EUSO: angular reconstruction
S. Biktemerova, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Exp. Astr. (2014) 03 Feb

95 The atmospheric monitoring system of the JEM-EUSO instrument
S. Toscano, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Exp. Astr. (2014) 23 Jul

96 The infrared camera onboard JEM-EUSO
J.A. MoralesdelosRios, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Exp. Astr. (2014) 04 Sep

97 The JEM-EUSO instrument
M. Casolino, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Exp. Astr. (2014) 26 Oct

98 The JEM-EUSO observation in cloudy conditions
A. Guzman, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Exp. Astr. (2014) 18 Jul

99 On Deeply Virtual Compton Scattering at Next-to-Leading Order
H. Moutarde, B. Pire, F. Sabatie, **L. Szymanowski**, **J. Wagner**
Few Body Syst. Vol. 55 No 5-7 (2014) 339-349

100 The heavy knee and the light ankle observed with KASCADE-Grande
A. Haungs, ... , **P. Łuczak**, **J. Zabierowski**, ... et al.
Frascati Physics Series Vol. 58 (2014) 238

101 Fusion yield measurements on JET and their calibration
D.B. Syme, ... , **R. Prokopowicz**, ... et al.
Fusion Eng. Des. Vol. 89 (2014) 2766-2775

102 Measurement and calculations of long-lived radionuclide activity forming in the fast neutron field in some ITER construction steels
W. Pohorecki, P. Jodłowski, **K. Pytel**, **R. Prokopowicz**
Fusion Eng. Des. Vol. 89 No 7-8 (2014) 932–936

103 Tungsten melt losses under QSPA Kh-50 plasma exposures simulating ITER ELMs and disruptions
I.E. Garkusha, V.A. Makhlai, N.N. Aksenov, B. Bazylev, I. Landman, **M.J. Sadowski**, **E. Składnik-Sadowska**
Fusion Sci. Tech. Vol. 65 No 2 (2014) 186-193

104 Coherent meson production in antiproton annihilation on nuclei
S. Lourenco, H. Lenske, **S. Wycech**
Hyperfine Interact. Vol. 229 No 1 (2014) 55

105 Fast life-time measurements on fission products
H. Mach, L.M. Fraile
Hyperfine Interact. Vol. 147 (2014) 223

106 Study of resolution of the PANDA GEM detector with Garfield
D. Melnychuk, B. Voss, **B. Zwięgliński**
Hyperfine Interact. Vol. 229 No 1 (2014) 165

107 Market Coupling as the Universal Algorithm to Assess Zonal Divisions
G. Oryńczak, **M. Jakubek**, **K. Wawrzyniak**, **M. Kłos**
IEEE Proc. European Energy Markets Vol. 1 (2014) 1-5

108 The Scheme of a Novel Methodology for Zonal Division Based on Power Transfer Distribution Factors
M. Kłos, **K. Wawrzyniak**, **M. Jakubek**, **G. Oryńczak**
IEEE Proc. Industrial Electronics Society Vol. 1 (2014) 3598-3602

109 microPMT – a New Photodetector for Gamma Spectrometry and Fast Timing?
T. Szczęśniak, **M. Grodzicka**, **M. Moszyński**, **M. Szawłowski**, J. Baszak
IEEE Trans. Nucl. Sci. Vol. 61 No 5 (2014) 1

110 Supramolecular Control over Molecular Magnetic Materials: γ-Cyclodextrin-Templated Grid of Cobalt(II) Single-Ion Magnets
N. Nedelko, ... , **O. Dorosh**, ... et al.
Inorg. Chem. Vol. 53 No 24 (2014) 12870–1287

111 Scalar Field Cosmology -- Geometry of Dynamics
M. Szydłowski, **O. Hrycyna**, A. Stachowski
Int. J. Geo. Meth. Mod. Phys Vol. 11 (2014) 1460012

112 Performance of the ALICE experiment at the CERN LHC
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Int. J. Mod. Phys. A Vol. 29 No 24 (2014) 1430044

113 Test of Identified Hadron Multiplicities for Nonextensive Statistical Model at LHC Energies
T. Wibig
Int. J. Mod. Phys. A Vol. 29 (2014) 1450021

114 Irradiated rare-earth-doped powellite single crystal probed by confocal Raman mapping and transmission electron microscopy
X. Wang, ... , **J. Jagielski**, ... et al.
J Raman Spect. Vol. 45 (2014) 383

115 Diffusion of helium in the perfect and non perfect uranium dioxide crystals and their local structures
L. Dąbrowski, **M. Szuta**
J. Alloys and Compounds Vol. 615 (2014) 598-603

116 Comprehensive study of the effect of the irradiation temperature on the behavior of cubic zirconia
A. Debelle, ... , **J. Jagielski**, ... et al.
J. Appl. Phys. Vol. 115 (2014) 183504

117 Inflationary power spectra with quantum holonomy corrections
J. Mielczarek
J. Cosm. Astroparticle Phys. Vol. 03 (2014) 048

118 The Polarized Radiation Imaging and Spectroscopy Mission
P. André, ... , **A. Pollo**, ... et al.
J. Cosm. Astroparticle Phys. Vol. 2 (2014) 6

119 The wavefront of the radio signal emitted by cosmic ray air showers
W.D. Apel, ... , **P. Łuczak**, **J. Zabierowski**, ... et al.
J. Cosm. Astroparticle Phys. Vol. 09 (2014) 025

120 Angular analysis of charged and neutral $B \rightarrow K\mu^+\mu^-$ decays
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1405 (2014) 082

121 Beam-helicity asymmetry in associated electroproduction of real photons $ep \rightarrow e\gamma\pi N$ in the Δ resonance region
A. Airapetian, ... , **W. Augustyniak**, **B. Mariański**, **A. Trzciński**, **P. Żuprański**, ... et al.
J. High Energy Phys. Vol. 01 (2014) 077

122 Differential branching fractions and isospin asymmetries of $B \rightarrow K^{(*)}\mu^+\mu^-$ decays
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1406 (2014) 133

123 Event activity dependence of Y(nS) production in $\sqrt{s_{NN}}$=5.02 TeV pPb and $\sqrt{s}$=2.76 TeV pp collisions
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 04 (2014) 103

124 Evidence for the 125 GeV Higgs boson decaying to a pair of τ leptons
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 05 (2014) 104

125 Evidence for the decay $B^+_c \rightarrow J/\psi 3\pi^+ 2\pi^-$
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1405 (2014) 148

126 First observations of the rare decays $B^+ \rightarrow K^+\pi^+\pi^-\mu^+\mu^-$ and $B^+ \rightarrow \phi K^+\mu^+\mu^-$
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1410 (2014) 64

127 Further studies of the photoproduction of isolated photons with a jet at HERA
H. Abramowicz, ... , **M. Adamus**, **T. Tymieniecka**, ... et al.
J. High Energy Phys. Vol. 08 (2014) 023

128 Identification techniques for highly boosted W bosons that decay into hadrons
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 12 (2014) 017

129 Impact factor for high-energy two and three jets diffractive production
R. Boussarie, A.V. Grabovsky, **L. Szymanowski**, S. Wallon
J. High Energy Phys. Vol. 09 (2014) 026

130 J/Ψ production and nuclear effects in p-Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. High Energy Phys. Vol. 02 (2014) 073

131 Long lived charginos in Natural SUSY?
N.E. Bomark, A. Kvellestad, S. Lola, P. Osland, A.R. Raklev
J. High Energy Phys. Vol. 1405 (2014) 007

132 Low fine tuning in the MSSM with higgsino dark matter and unification constraints
K. Kowalska, L. Roszkowski, E. Sessolo, S. Trojanowski
J. High Energy Phys. Vol. 1404 (2014) 166

133 Measurement of associated W+charm production in pp collisions at $\sqrt{s}$ = 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 02 (2014) 013

134 **132. Measurement of beauty and charm production in deep inelastic scattering at HERA and measurement of the beauty-quark mass**
H. Abramowicz, ... , **M. Adamus**, **T. Tymieniecka**, ... et al.
J. High Energy Phys. Vol. 09 (2014) 127

135 Measurement of charged jet suppression in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. High Energy Phys. Vol. 03 (2014) 013

136 Measurement of CP asymmetries in the decays $B^0 \to K^{*0}\mu^+\mu^-$ and $B^+ \to K^+\mu^+\mu^-$
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 09 (2014) 177

137 Measurement of CP asymmetry in $D^0 \to K^-K^+$ and $D^0 \to \pi^-\pi^+$ decays
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1407 (2014) 041

138 Measurement of D* photoproduction at three different centre-of-mass energies at HERA
H. Abramowicz, ... , **M. Adamus**, **T. Tymieniecka**, ... et al.
J. High Energy Phys. Vol. 10 (2014) 3

139 Measurement of Higgs boson production and properties in the WW decay channel with leptonic final states
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 01 (2014) 096

140 Measurement of polarization amplitudes and CP asymmetries in $B^0 \to \phi K^*(892)^0$
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1405 (2014) 069

141 Measurement of prompt J/ψ pair production in pp collisions at $\sqrt{s}$= 7 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 09 (2014) 94

142 Measurement of the CKM angle γ using $B^{\pm} \to DK^{\pm}$ with $D \to K^0{}_S\pi^+\pi^-, K^0{}_S K^+ K^-$ decays
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1410 (2014) 97

143 Measurement of the production cross sections for a Z boson and one or more b jets in pp collisions at $\sqrt{s}$ = 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 06 (2014) 120

144 Measurement of the t-channel single-top-quark production cross section and of the $|V_{tb}|$ CKM matrix element in pp collisions at $\sqrt{s}$= 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 06 (2014) 090

145 Measurement of the triple-differential cross section for photon+jets production in proton-proton collisions at $\sqrt{s}$=7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 06 (2014) 009

146 Measurement of the ttbar production cross section in the dilepton channel in pp collisions at $\sqrt{s}$= 8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 02 (2014) 024

147 Measurement of the $\chi_b(3P)$ mass and of the relative rate of $\chi_{b1}(1P)$ and $\chi_{b2}(1P)$ production
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1410 (2014) 88

148 Measurements of the B^+, B^0, $B^0{}_s$ meson and $\Lambda^0{}_b$ baryon lifetimes
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
J. High Energy Phys. Vol. 1404 (2014) 114

149 Measurements of the ttbar charge asymmetry using the dilepton decay channel in pp collisions at $\sqrt{s}$= 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 04 (2014) 191

150 Observation of the $B^0{}_s \to J/\psi K^0{}_s K^{\pm}\pi^{\mp}$ decay
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1407 (2014) 140

151 Observation of the $\Lambda^0_b \to J/\psi p \pi^-$ decay
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1407 (2014) 103

152 Observation of Z production in proton-lead collisions at LHCb
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1409 (2014) 030

153 Phenomenology of SUSY with General Flavour Violation
K. Kowalska
J. High Energy Phys. Vol. 1409 (2014) 139

154 Search for CP violation in $D^\pm \to K^0_S K^\pm$ and $D^\pm_s \to K^0_S \pi^\pm$ decays
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1410 (2014) 25

155 Search for CP violation using T-odd correlations in $D^0 \to K^+ K^- \pi^+ \pi^-$ decays
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1410 (2014) 5

156 Search for massive resonances decaying into pairs of boosted bosons in semi-leptonic final states at $\sqrt{s}$= 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 08 (2014) 174

157 Search for massive resonances in dijet systems containing jets tagged as W or Z boson decays in pp collisions at $\sqrt{s}$= 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 08 (2014) 173

158 Search for neutral MSSM Higgs bosons decaying to a pair of tau leptons in pp collisions
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 10 (2014) 160

159 Search for new physics in events with same-sign dileptons and jets in pp collisions at $\sqrt{s}$=8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 01 (2014) 163

160 Search for new physics in the multijet and missing transverse momentum final state in proton-proton collisions at $\sqrt{s}$= 8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 06 (2014) 055

161 Search for pair production of excited top quarks in the lepton+jets final state
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 06 (2014) 125

162 Search for standard model production of four top quarks in the lepton + jets channel in pp collisions at $\sqrt{s}$ = 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 11 (2014) 154

163 Search for the associated production of the Higgs boson with a top-quark pair
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 09 (2014) 87

164 Search for W'→ tb decays in the lepton + jets final state in pp collisions at $\sqrt{s}$ = 8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 05 (2014) 108

165 Statistics of thermalization in Bjorken Flow
J. Jankowski, **G. Plewa**, **M. Spaliński**
J. High Energy Phys. Vol. 1412 (2014) 105

166 Studies of azimuthal dihadron correlations in ultra-central PbPb collisions at $\sqrt{s_{NN}}$= 2.76 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 02 (2014) 088

167 Study of double parton scattering using W + 2-jet events in proton-proton collisions at $\sqrt{s}$= 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 03 (2014) 032

168 Study of forward Z + jet production in pp collisions at $\sqrt{s}$=7 TeV
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
J. High Energy Phys. Vol. 1401 (2014) 033

169 Study of hadronic event-shape variables in multijet final states in pp collisions at $\sqrt{s}$= 7 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
J. High Energy Phys. Vol. 10 (2014) 87

170 Study of J/ψ production and cold nuclear matter effects in pPb collisions at $\sqrt{s_{NN}}$=5 TeV
A. Ukleja, ... , **M. Szczekowski**, **W. Wiślicki**, **K. Kurek**, ... et al.
J. High Energy Phys. Vol. 1402 (2014) 072

171 Study of the kinematic dependences of Λ^0_b production in pp collisions and a measurement of the $\Lambda^0_b \rightarrow \Lambda^+_c \pi^-$ branching fraction
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1408 (2014) 143

172 Study of Y production and cold nuclear matter effects in pPb collisions at √sNN=5 TeV
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J. High Energy Phys. Vol. 1407 (2014) 094

173 Suppression of Ψ(2S) production in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. High Energy Phys. Vol. 12 (2014) 073

174 The mass-hierarchy and CP-violation discovery reach of the LBNO long-baseline neutrino experiment
S.K. Agarwalla, ... , **J. Łagoda**, **P. Przewłocki**, **E. Rondio**, **M. Szeptycka**, **J. Zalipska**, ... et al.
J. High Energy Phys. Vol. 1405 (2014) 094

175 What next for the CMSSM and the NUHM: improved prospects for superpartner and dark matter detection
L. Roszkowski, **E. Sessolo**, **A.J. Williams**
J. High Energy Phys. Vol. 1408 (2014) 067

176 Alignment of the CMS tracker with LHC and cosmic ray data
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. Instrum. Vol. 9 (2014) P06009

177 Description and performance of track and primary-vertex reconstruction with the CMS tracker
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
J. Instrum. Vol. 9 (2014) P10009

178 Measurement of visible cross sections in proton-lead collisions at $\sqrt{s}$ = 5.02 TeV in van der Meer scans with the ALICE detector
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Instrum. Vol. 9 (2014) P11003

179 The trigger system of the ICARUS experiment for the CNGS beam
M. Antonello, ... , **J. Łagoda**, **R. Sulej**, ... et al.
J. Instrum. Vol. 9 (2014) P08003

180 Synthesis of novel halo and tosyloxy nortropane derivatives as effcient precursors for the one-step synthesis of the dopamine transporter PET ligand [18F]FECNT
J. Pijarowska-Kruszyna, ... , **A. Jaroń**, **R. Mikołajczak**, ... et al.
J. Labelled Comp. & Radiophar. Vol. 57 No 3 (2014) 148-157

181 Synthesis and dynamic stereochemistry of 4-aryl-thiomorpholine-3,5-dione derivatives
J. Szawkało, **J.K. Maurin**, F. Pluciński, Z. Czarnocki
J. Mol. Struct. Vol. 1079 (2014) 383-390

182 Implantation of high concentration noble gases in cubic zirconia and silicon carbide: A contrasted radiation tolerance
G. Velişa, ... , **J. Jagielski**, ... et al.
J. Nucl. Mater. Vol. 451 (2014) 14

183 Comparative study of large samples plastic scintillators and EJ309 liquid with pulse shape discrimination (PSD) capabilities
J. Iwanowska, **Ł. Świderski**, **M. Moszyński**, **P. Sibczyński**, **T. Krakowski**, P. Schotanus
J. of Instr. Vol. 9 (2014) P06014

184 Development of GEM gas detectors for X-ray crystal spectrometry
M. Chernyshova, ... , **J. Rzadkiewicz**, ... et al.
J. of Instr. Vol. 9 (2014) C03003

185 Light yield nonproportionality of doped CeF_3 scintillators
W. Klamra, **P. Sibczyński**, **M. Moszyński**, V. Kozlov
J. of Instr. Vol. 9 (2014) P07013

186 Performance of FBK high-density SiPMs in scintillation spectrometry
M. Grodzicka, ... , **M. Moszyński**, **T. Szczęśniak**, **M. Szawłowski**, **K. Grodzicki**, ... et al.
J. of Instr. Vol. 9 (2014) PO8004

187 Anisotropic flow of identified particles in Pb-Pb collisions at 2.76 TeV with the ALICE detector
YouZhou, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012029

188 Charmonium production measurements in Pb-Pb collisions with ALICE at the LHC
L.V. Palomo, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012111

189 Elliptic flow of heavy-flavour decay electrons in Pb-Pb collisions at 2.76 TeV with ALICE
A. Dubla, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012062

190 Kos&Λ production in ALICE
L. Hanratty, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012091

191 Measurement of D-meson production in p-Pb collisions with the ALICE detector
G. Luparelloo, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012101

192 Measurements of heavy-flavour decay leptons in pp,p-Pb an Pb-Pb collisions with ALICE
S. LaPointe, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 535 (2014) 012029

193 Measurements of J/Ψ→e+e- with ALICE at the LHC
F. Fionda, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012110

194 Measurements of the correlation between electrons from heavy-flavour hadron decays and light hadrons with ALICE at LHC
E. PereiraDeOliveiraFilho, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012060

195 Multi-strange baryon production in Pb-Pb and pp collisions at 2.76 TeV with the ALICE experiment at the LHC
D. Colella, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012090

196 Nuclear modification factor and elliptic flow of muons from heavy-flavour decays in Pb-Pb collisions at 2.76 TeV
XiaomingZhang, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012045

197 Open heavy-flavour results from ALICE
D. Stocco, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012011

198 Overview of results from ALICE
M. Ploskoń, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012003

199 p-Pb results from ALICE with an emphasis on centrality determination
A. Morsch, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012021

200 Production of π/K/p in pp and Pb-Pb collisions measured with ALICE
M. Chojnacki, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012041

201 **Prrospects of heavy-flavour measurements with the ALICE inner tracker upgrade**
C. Terrevoli, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012082

202 Results on angular correlations with ALICE
P. Christakoglou, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012024

203 Search for exotic hyper-matter and measurement of nuclei with ALICE at the LHC
B. Doenigus, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012109

204 Study of h-h and V°-h angular correlations in Pb-Pb collisions 2.76 TeV
M. Bombara, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 01204

205 Transverse momentum distributions of identified particles in p-Pb collisions at 5.02 TeV
J. Anielski, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012106

206 Two-particle correlations in p-Pb collisions at the LHC with ALICE
L. Milano, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012105

207 Upsilon production in Pb-Pb and p-Pb collisions at forward rapidity with ALICE at the LHC
P. Khan, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. of Phys. Conf. S. Vol. 509 (2014) 012112

208 Research on laser-removal of a deuterium deposit from a graphite sample
M. Kubkowska, **E. Składnik-Sadowska**, **K. Malinowski**, **M.J. Sadowski**, M. Rosinski, P. Gasior
J. of Phys.: Conf. S. Vol. 508 (2014) 012015

209 Some exact solutions to the Lighthill Richarsd Payne traffic flow equations II
E. Infeld, G. Rowlands, **A. Skorupski**
J. Phys. A: Math. Theor. Vol. 47 (2014) 415203

210 Quantum-Chemical Insight into Structure Reactivity Relationship in 4,5,6,7-Tetrahalogeno-1H-benzimidazoles: A Combined X-ray, DSC, DFT/QTAIM, Hirshfeld Surface-Based, and Molecular Docking Approach.
J.N. Latosińska, M. Latosińska, **J.K. Maurin**, A. Orzeszko, Z. Kazimierczuk
J. Phys. Chem. A. Vol. 118 (2014) 2089-2106

211 Cross-section studies of important neutron and relativistic deuteron reactions
V. Wagner, ... , **M. Bielewicz**, **S. Kilim**, **E. Strugalska-Gola**, **M. Szuta**, ... et al.
J. Phys. Conf. Ser. Vol. 533 No 012052 (2014)

212 D meson-hadron angular correlations in pp and p-Pb collisions with ALICE at the LHC
F. Colamaria, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. Conf. Ser. Vol. 509 (2014) 012103

213 D-meson nuclear modification factor and v2 in Pb-Pb collisions at the LHC
E. Bruna, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. Conf. Ser. Vol. 509 (2014) 012080

214 Impulse Plasma in Surface Engineering - a review
K. Zdunek, ... , **K. Nowakowska-Langier**, **M. Rabiński**, ... et al.
J. Phys. Conf. Ser. Vol. 564 (2014) 012007

215 Inclusive J/Ψ production in p-Pb collisions with ALICE at the LHC
I. Lakomov, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. Conf. Ser. Vol. 509 (2014) 012104

216 Isospin against size effects in projectile dynamical fission for $^{112,124}Sn + ^{58,64}Ni$ and $^{124}Xe + ^{64}Zn$ reactions at 35A MeV
P. Russotto, ... , **E. Piasecki**, **J. Wilczyński**, ... et al.
J. Phys. Conf. Ser. Vol. 515 (2014) 012020

217 Measurements of electrons from heavy-flavour hadron decays in pp and p-Pb collisions with ALICE
M. Heide, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. Conf. Ser. Vol. 509 (2014) 012102

218 Multiple parton interactions with ALICE:from pp to p-Pb
A. Morsch, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. Conf. Ser. Vol. 535 (2014) 012030

219 Production of hypernuclei in Pb-Pb collisions at 2.76 TeV with ALICE at the LHC
R. Lea, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. Conf. Ser. Vol. 509 (2014) 012108

220 Technical Design Report for the Upgrade of the ALICE Inner Tracking System
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. G: Nucl. Part. Phys. Vol. 41 (2014) 087002

221 Upgrade of the ALICE Experiment: Letter Of Intent
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J. Phys. G: Nucl. Part. Phys. Vol. 41 (2014) 087001

222 Comparison of Simple Design of Sodium and Lead Cooled Fast Reactor Cores
P. Mazgaj, P. Darnowski, S. Gurgacz, **M. Lipka**, K. Dziubanii
J. Power Technol. Vol. 94 No Nuclear (2014) 16-24

223 Computer codes in the safety analysis for the nuclear power plants. Computationalcapabilities of the thermal-hydraulics tools on the example of the RELAP5 code
E. Grodzicka, **M. Skrzypek**
J. Power Technol. Vol. 94 (2014) 39-48

224 Inclusion of Specific Geometry of the Beryllium Blocks in the Computational Model of MARIA Reactor
M. Migdal, G. Niewiński
J. Power Technol. Vol. 94 No Nuclear (2014) 67-74

225 A new material in the nuclear technology: gadolinium zirconate pyrochlore prepared by reactive sintering
U. Brykała, ... , **J. Jagielski**, ... et al.
J. Radioanal. Nucl. Chem. Vol. 299 (2014) 637

226 The application of selected radionuclides for monitoring of the D–D reactions produced by dense plasma-focus device
S. Jednoróg, **A. Szydłowski**, B. Bieńkowska, **R. Prokopowicz**
J. Radioanal. Nucl. Chem. Vol. 301 No 1 (2014) 23-31

227 Observation of charmonium pairs produced exclusively in pp collisions
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
J.Phys. G Vol. 41 (2014) 115002

228 Updated measurements of exclusive J/ψ and $\psi(2S)$ production cross-sections in pp collisions at $\sqrt{s} = 7$ TeV
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
J.Phys. G Vol. 41 (2014) 055002

229 ALICE results on quarkonium production in pp,p-Pb and Pb-Pb collisions
G.E. Bruno, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J.Phys.Conf.Ser Vol. 509 (2014) 012008

230 Hadronic resonances in heavy-ion collisions at ALICE
A.G. Knospe, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J.Phys.Conf.Ser Vol. 509 (2014) 012087

231 Measurement of D-meson production in pp,p-Pb,and Pb-Pb collisions at the LHC with the ALICE detector
C. Jena, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J.Phys.Conf.Ser Vol. 535 (2014) 012027

232 Measurement of electrons from heavy-flavour decays in Pb-Pb collisions at 2.76 TeV with ALICE
DeepaThomas, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J.Phys.Conf.Ser Vol. 509 (2014) 012079

233 Study of b-jet tagging performance in ALICE
L. Feldkamp, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
J.Phys.Conf.Ser Vol. 509 (2014) 012061

234 Mössbauer Spectroscopy and Magnetoelectric Effect Studies of Multiferroic Ceramics Based on $BiFeO_3$
E. Jartych, T. Pikula, **K. Kowal**, A. Lisińska-Czekaj, D. Czekaj
Key Engineering Materials Vol. 602-603 (2014) 936-941

235 Domain-oriented services for High Energy Physics in Polish computing centers
K. Nawrocki, A. Olszewski, **A. Padee**, A.K. Padee, M. Witek, P. Wójcik, M. Zdybał
Lecture Notes in Computer Sciences Vol. 8500 (2014) 226

236 Sequential Monte Carlo in Bayesian assessment of contaminant source localization based on the distributed sensors measurements
A. Wawrzyńczak-Szaban, **P. Kopka**, P. Kopka, **M. Borysiewicz**
Lecture Notes in Computer Sciences Vol. 8385 No 2 (2014) 407

237 Parki Naukowo Technologiczne: rola w komunikacji miedzy instytucjami naukowymi a przemysłem
P. Sobkowicz
Marketing Instytucji Naukowych i Badawczych Vol. 10 (2014) 3-18

238 Formation of the surface layer with improved tribological properties on austenitic steel by alloying with REE using HIPPB
B. Sartowska, **M. Barlak**, L. Waliś, J. Senatorski, W. Starosta
Mat. Sci. Forum Vol. 790-791 (2014) 479-484

239 Optimization of Gas Injection Condition During Depositionof AlN Layers by Novel Reactive Gims Method
K. Zdunek, **K. Nowakowska-Langier**, R. Chodun, J. Dora, S. Okrasa, E. Talik
Materials Science-Poland Vol. 3 (2014) 1-5

240 Initial study of radiological and clinical efficacy radioembolization using 188Re-human serum albumin (HSA) microspheres in patients with progressive, unresectable primary or secondary liver cancer
M. Nowicki, ... , **R. Mikołajczak**, **D. Pawlak**, ... et al.
Med Sci Monit Vol. 20 (2014) 1353-1362

241 Łowicz Meteorite - Mesosiderite from Vesta
Z. Tymiński, T. Brachaniec
Meteoritics & Planetary Science Vol. 49 No S1 (2014) 5426

242 Classic Radionuclide 188W/188Re Generator (experiments, design and construction)
M. Konior, E. Iller
Modern Chemistry & Applications Vol. 2 No 4 (2014) 1000143

243 Evidence for the direct decay of the 125 GeV Higgs boson to fermions
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Nature Vol. 10 (2014) 557

244 Influence of moderator to fuel ratio (MFR) on burning thorium in a subcritical assembly
A. Wojciechowski
Nuc. Eng. Design Vol. 278 (2014) 661-668

245 Luminescence analysis of damage accumulation: case study of calcium molybdate
J. Jagielski, ... , **R. Ratajczak**, ... et al.
Nucl. Instr. and Meth. B Vol. 332 (2014) 60

246 Radiation damage in urania single crystals irradiated with low-energy ions
T.H. Nguyen, ... , **L. Nowicki**, ... et al.
Nucl. Instr. and Meth. B Vol. 326 (2014) 264

247 A fluorocarbon plastic scintillator for neutron detection: Proof of concept
M. Hamel, **P. Sibczyński**, P. Blanc, **J. Iwanowska**, F. Carrel, **A. Syntfeld-Każuch**, S. Normand
Nucl. Instr. Meth. A Vol. 768 (2014) 26-31

248 Calibration of the Super-Kamiokande Detector
P. Mijakowski, ... et al.
Nucl. Instr. Meth. A Vol. A737 (2014) 253-272

249 Characterization of GAGG:Ce scintillators with various Al-to-Ga ratio
P. Sibczyński, ... , **J. Iwanowska**, **M. Moszyński**, **Ł. Świderski**, **M. Szawłowski**, **M. Grodzicka**, **T. Szczęśniak**, ... et al.
Nucl. Instr. Meth. A Vol. 772 (2014) 112

250 Germanium-gated γ-γ fast timing of excited states in fission fragments using the EXILL&FATIMA spectrometer
J.-M. Régis, ... , **H. Mach**, ... et al.
Nucl. Instr. Meth. A Vol. 763 (2014) 210

251 Latest results from the KASCADE-Grande experiment
A. Chiavassa, ... , **P. Łuczak**, **J. Zabierowski**, ... et al.
Nucl. Instr. Meth. A Vol. 742 (2014) 10

252 Measuring the scintillation decay time for different energy deposits in NaI:Tl, LSO:Ce and $CeBr_3$ scintillators
Ł. Świderski, **M. Moszyński**, **A. Syntfeld-Każuch**, **M. Szawłowski**, **T. Szczęśniak**
Nucl. Instr. Meth. A Vol. 749 (2014) 68

253 Novel method for hit-position reconstruction using voltage signals in plastic scintillators and its application to Positron Emission Tomography
L. Raczyński, ... , **P. Kowalski**, **W. Wiślicki**, ... et al.
Nucl. Instr. Meth. A Vol. 764 (2014) 186-192

254 Particle identification with the ALICE transition radiation detector
Y. Pachmayer, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Instr. Meth. A Vol. 766 (2014) 292

255 Pattern recognition and PID procedure with the ALICE-HMPID
G. Volpe, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Instr. Meth. A Vol. 766 (2014) 259

256 Research on mutual influence of Cherenkov-type probes within the ISTTOK tokamak chamber
L. Jakubowski, ... , **K. Malinowski**, **M.J. Sadowski**, **J. Żebrowski**, **M. Rabiński**, **M.J. Jakubowski**, ... et al.
Nucl. Instr. Meth. A Vol. 767 (2014) 61-66

257 Scintillation properties of CsI:In single crystals
S. Gridin, A. Belsky, **M. Moszyński**, **A. Syntfeld-Każuch**, N. Shiran, A. Gektin
Nucl. Instr. Meth. A Vol. 761 (2014) 13

258 Test of a single module of the J-PET scanner based on plastic scintillators
P. Moskal, ... , **P. Kowalski**, **L. Raczyński**, **W. Wiślicki**, ... et al.
Nucl. Instr. Meth. A Vol. 764 (2014) 317-321

259 Test of digital neutron–gamma discrimination with four different photomultiplier tubes for the NEutron Detector Array (NEDA)
X.L. Luo, ... , **M. Moszyński**, ... et al.
Nucl. Instr. Meth. A Vol. A767 (2014) 83

260 The ALICE data acquisition system
F. Carena, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Instr. Meth. A Vol. 766 (2014) 130

261 The ALICE-HMPID performance during the LHC run period 2010-2013
G. DeCastaldo, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Instr. Meth. A Vol. 766 (2014) 19

262 The infrared camera prototype characterization for the JEM-EUSO space mission
J.A. MoralesdelosRios, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Nucl. Instr. Meth. A Vol. 749 (2014) 74-8

263 Ion channeling study of defects in compound crystals using Monte Carlo simulations
A. Turos, P. Jóźwik, L. Nowicki, N. Sathish
Nucl. Instr. Meth. B Vol. 332 (2014) 50

264 Monte Carlo simulations of backscattering process in dislocation-containing SrTiO3 single crystal
P. Jóźwik, **N. Sathish**, **L. Nowicki**, **J. Jagielski**, **A. Turos**, L. Kovarik, B. Arey
Nucl. Instr. Meth. B Vol. 326 (2014) 234

265 ALICE measurements in p-Pb collisions: charged particle multiplicity, centrality determination and implications for binary collisions
A. Toia, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 926 (2014) 78

266 ALICE results on the production of the light-flavor hadrons at the LHC
J. Otwinowski, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 205

267 Angular correlations of identified charged particles measured in pp collisions by ALICE at the LHC
L. Graczykowski, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 926 (2014) 2005

268 Azimuthal correlations with ALICE
A. Dobrin, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 365

269 Azimuthally differential pion femtoscopy in Pb–Pb collisions at 2.76 TeV with ALICE at the LHC
V. Loggins, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1088

270 Centrality dependence of particle production in p–A collisions measured by ALICE
A. Toia, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 315

271 Charge-dependent anisotropic flow studies and the search for the Chiral Magnetic Wave in ALICE
R. Belmont, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 981

272 Event activity dependence of inclusive J/ψproduction in p–Pb collisions at $\sqrt{s_{NN}}$=5.02 TeVwith ALICE atthe LHC
I. Lakomov, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1179

273 Freeze-out radii extracted using two-and three-pion Bose–Einstein correlations in pp, p–Pb, and Pb–Pb collisions at the LHC
D.R. Gangadharan, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1066

274 Future upgrade and physics perspectives of the ALICE TPC
T. Gunji, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1152

275 Hadronic resonance production measured by ALICE at the LHC
F. Bellini, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 846

276 Heavy flavour production in ALICE
S. Sakai, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 926 (2014) 41

277 Heavy-flavour correlations in pp, p–Pb and Pb–Pb collisions
S. Bjelogrlic, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 563

278 Heavy-flavour decay lepton measurements in pp,p-Pb and Pb-Pb collisions with ALICE at the LHC
S. LaPointe, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 926 (2014) 2013

279 Heavy-flavour elliptic flow measured in Pb–Pb collisions at $\sqrt{s_{NN}}$=2.76TeVwith ALICE
R. Bailhache, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 530

280 Heavy-flavour production and nuclear modification factor in Pb–Pb collisions at $\sqrt{s_{NN}}$=2.76TeVwithALICE
A. Festanti, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 514

281 Identified particle production in p-Pb collisions measured with the ALICE detector
P. Christiansen, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 926 (2014) 264

282 Inclusive J/$\psi$and ψ(2S) production in p–Pb collisions at $\sqrt{s_{NN}}$=5.02TeVwith ALICE at the LHC
M. Winn, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 427

283 Inclusive jet spectra in p–Pb collisions at ALICE
M. Connors, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1174

284 Inclusive ψ(2S) production in p–Pbcollisions withALICE
R. Arnaldi, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 628

285 J/Ψ photoproduction in Pb-Pb and p-Pb ultraperipheral collisions with ALICE at LHC
D. DeGruttola, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 926 (2014) 136

286 J/ψproduction in p–Pb collisions with ALICE at the LHC
J.M. Blanco, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 612

287 J/ψproduction in Pb–Pb collisions at $\sqrt{s_{NN}}$=2.76TeV
J. Book, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 591

288 Jet production and structure in pp, p–Pb and Pb–Pb collisions measured by ALICE
R. Reed, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 189

289 K^0_S and Λproduction in charged particle jets in p–Pb collisions at $\sqrt{s_{NN}}$=5.02 TeVwith ALICE
X. Zhang, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 444

290 Light (hyper-)nuclei production at the LHC measured with ALICE
N. Martin, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1103

291 Light flavor hadron spectra at low p_T and search for collective phenomena in high multiplicity pp, p–Pb and Pb–Pb collisions measured with the ALICE experiment
C. Andrei, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 888

292 Light-flavour hadron production in p-Pb collisions measured with the ALICE detector at LHC
F. Barile, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 926 (2014) 177

293 Long-range angular correlations at the LHC withALICE
L. Milano, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1017

294 Measurement of D-meson production in pp, p–Pb and Pb–Pb collisions with ALICE at the LHC
A. Rossi, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 51

295 Measurement of hadron composition in charged jets from pp collisions with the ALICE experiment
X. Lu, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 428

296 Measurement of jet p_T spectra and RAAin pp and Pb–Pb collisions at $\sqrt{s_{NN}}$ =2.76TeV with the ALICE detector
S. Aiola, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 382

297 Measurements of electrons from heavy-flavour hadron decays in pp, p–Pb and Pb–Pb collisions with ALICE at the LHC
E. Pereira~de~Oliveira~Filho, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 258

298 Measurements of the heavy-flavour nuclear modification factor in p–Pb collisions at $\sqrt{s_{NN}}$=5.02TeV with ALICE at the LHC
S. Li, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 546

299 Minijet analysis with two-particle correlations in p–Pb collisions with ALICE at LHC
E. Leogrande, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 409

300 298. Multi-strange baryon production in pp, p–Pb and Pb–Pb collisions measured with ALICE at the LHC
D. Alexandre, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1093

301 Neutral meson production in pp and Pb–Pb collisions measured by ALICE at the LHC
A. Marín, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 438

302 Nuclear modification factor and elliptic flow of muons from heavy-flavour hadron decays in Pb–Pb collisions at $\sqrt{s_{NN}}$=2.76TeV
S. Li, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 32

303 ööDielectron measurements in pp, p–Pb and Pb–Pb collisions with ALICE at the LHC
M.K. Koehler, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 665

304 Overview of ALICE results at Quark Matter 2014
J.F. Grosse-Oetringhaus, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 22

305 p–Pb collisions: Particle production and centrality determination in ALICE
C. Oppedisano, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 399

306 Photonuclear production of vector mesons in ultra-peripheral Pb–Pb collisions at the LHC
J. Nystrand, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 298

307 Production of light flavour hadrons at intermediate and high p_T in pp, p–Pb and Pb–Pb collisions measured with ALICE
M.L. Knichel, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 309

308 Quarkonium production in ALICE at the LHC
C. Hadjidakis, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 541

309 Searches for p_T dependent fluctuations of flow angle and magnitude in Pb–Pb and p–Pb collisions
Y. Zhou, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 949

310 The upgrade of the Inner Tracking System of ALICE
S. Siddhanta, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 931 (2014) 1147

311 Y production measurements in pp and p–Pb collisions with ALICE at the LHC
F. Bossù, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Nucl. Phys. A Vol. 932 (2014) 111

312 Evidence for the decay $X(3872)\rightarrow\psi(2S)\gamma$
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Nucl. Phys. B Vol. 886 (2014) 665-680

313 Measurement of azimuthal hadron asymmetries in semi-inclusive deep inelastic scattering off unpolarised nucleons
C. Adolph, ... , **K. Klimaszewski**, **K. Kurek**, **E. Rondio**, **A. Sandacz**, **R. Sulej**, **A. Szabelski**, **P. Sznajder**, **W. Wiślicki**, ... et al.
Nucl. Phys. B Vol. 886 (2014) 1046

314 Measurement of CP violation and constraints on the CKM angle γ in $B^{\pm} \rightarrow DK^{\pm}$ with $D \rightarrow K^0{}_S\pi^+\pi^-$ decays
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Nucl. Phys. B Vol. 888 (2014) 169-193

315 Spin alignment and violation of the OZI rule in exclusive ω and φ production in pp collisions
C. Adolph, ... , **K. Klimaszewski**, **K. Kurek**, **A. Sandacz**, **R. Sulej**, **A. Szabelski**, **P. Sznajder**, ... et al.
Nucl. Phys. B Vol. 886 (2014) 1078

316 The cosmic ray spectrum and composition measured by KASCADE-Grande between 10^{16} eV and 10^{18} eV
M. Bertaina, ... , **P. Łuczak**, **J. Zabierowski**, ... et al.
Nucl. Phys. B Proc. Sup. Vol. 256-257 (2014) 149

317 The JEM-EUSO mission: a space observatory to study the origin of Ultra-High Energy Cosmic Rays
M. Bertaina, ... , **T. Batsch**, **J. Karczmarczyk**, **B. Szabelska**, **J. Szabelski**, **T. Tymieniecka**, **T. Wibig**, ... et al.
Nucl. Phys. B Proc. Sup. Vol. 256-257 (2014) 275–286

318 Measurements of High Energy Neutron Spectrum (>10MeV) by Using Yttrium Foils in a U/Pb Assembly
M. Bielewicz, **E. Strugalska-Gola**, **M. Szuta**, **A. Wojciechowski**, M. Kadykov, S. Tiutiunnikov
Nuclear Data Sheets journal Vol. 119 (2014) 296-298

319 Evaluation of dead-time corrections for post-radionuclide therapy 177Lu quantitative imaging with low-energy high resolution collimators
A. Celler, H. Piwowarska-Bilska, S. Shcherbinin, C. Uribe, **R. Mikołajczak**, B. Birkenfeld
Nuclear Medicine Communications Vol. 31 No 1 (2014) 73-87

320 Bonding xenon and krypton on the surface of uranium dioxide single crystal.
L. Dąbrowski, M. Szuta
Nukleonika Vol. 59 No 3 (2014) 83

321 Monte Carlo calculated CT numbers for improved Heavy Ion Treatment Planning
A. Wysocka-Rabin, S. Qamhiyeh, O. Jakel
Nukleonika Vol. 59 No 1 (2014) 15-23

322 Production of Fission Product Mo-99 using High-Enriched Uranium Plates in Polish Nuclear Research Reactor MARIA: Technology and Neutronic Analysis
J. Jaroszewicz, **Z. Marcinkowska**, **K. Pytel**
Nukleonika Vol. 59 No 2 (2014) 43-52

323 Validation of the method for plutonium isotopes determination in urine samples and its application in nuclear facility in Otwock
K. Rzemek, A. Czerwiński, **M. Dymecka**, **J. Ośko**, **T. Pliszczyński**, **Z. Haratym**
Nukleonika Vol. 60 (2014) 181-186

324 Computational modelling of discharges within Impulse Plasma Deposition accelerator with gas valve
M. Rabiński, R. Chodun, **K. Nowakowska-Langier**, **K. Zdunek**
Phys Scripta T Vol. T161 (2014) 014049

325 Modeling of the L and M x-ray line structures for tungsten in high-temperature tokamak plasmas
K. Slabkowska, M. Polasik, E. Szymanska, J. Starosta, L. Syrocki, **J. Rzadkiewicz**, N.R. Pereira
Phys Scripta T Vol. T161 (2014) 014015

326 Symmetry breaking in the collisions of double channel BEC solitons
N.V. Hung, P. Ziń, **E. Infeld,** M. Trippenbach
Phys. D Vol. 269 No 1 (2014) 37

327 Suppression of Y(1S) at forward rapidity in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Lett. B Vol. 738 (2014) 361-372

328 A high statistics measurement of transverse spin effects in dihadron production from muon-proton semi-inclusive deep-inelastic scattering
C. Adolph, ... , **K. Klimaszewski**, **K. Kurek**, **E. Rondio**, **A. Sandacz**, **R. Sulej**, **A. Szabelski**, **P. Sznajder**, **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. 736 (2014) 124

329 A study of CP violation in $B^{\pm}\to DK^{\pm}$ and $B^{\pm}\to D\pi^{\pm}$ decays with $D\to K^0{}_S K^{\pm}\pi^{\mp}$ final states
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Lett. B Vol. 733 (2014) 36-45

330 Beauty production in pp collisions at $\sqrt{s}$=2.76 TeV measured via semi-electronic decays
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Lett. B Vol. 738 (2014) 97-108

331 Centrality, rapidity and transverse momentum dependence of J/ψ suppression in Pb–Pb collisions at $\sqrt{s_{NN}}$=2.76TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Lett. B Vol. 734 (2014) 314-327

332 Charge Symmetry Breaking in dd → ^{4}He π^0 with WASA-at-COSY
P. Adlarson, ... , **W. Augustyniak**, **M. Berłowski**, **A. Kupść**, **B. Mariański**, **H.P. Morsch**, **D. Pszczel**, **J. Stepaniak**, **A. Trzciński**, **J. Zabierowski**, **P. Żuprański**, ... et al.
Phys. Lett. B Vol. 739 (2014) 44-49

333 Constraints on the Higgs boson width from off-shell production and decay to Z-boson pairs
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Frueboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 736 (2014) 64

334 Determination of the top-quark pole mass and strong coupling constant from the ttbar production cross section in pp collisions at $\sqrt{s}$ = 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 728 (2014) 496

335 Effective lifetime measurements in the $B^0{}_s\to K^+K^-$,$B^0\to K_+\pi^-$ and $B^0{}_s\to\pi^+K^-$ decays
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. 736 (2014) 446-454

336 Freeze-out radii extracted from three-pion cumulants in pp, p–Pb and Pb–Pb collisions at the LHC
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Lett. B Vol. 739 (2014) 139-151

337 Inclusive search for a vector-like T quark with charge 2/3 in pp collisions at $\sqrt{s}$=8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 729 (2014) 149

338 Measurement of the absolute branching ratio of the $K^+\to\pi^+\pi^+\pi^-(\gamma)$ decay with the KLOE detector
D. Babusci, ... , **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. B738 (2014) 128

339 Measurement of the charge asymmetry in $B^{\pm}\to\phi K^{\pm}$ and search for $B^{\pm}\to\phi\pi^{\pm}$ decays
A. Ukleja, ... , **M. Szczekowski**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Lett. B Vol. 728 (2014) 85-94

340 Measurement of the CP-violating phase ϕ_s in $B^0_s \to J/\psi\pi^+\pi^-$ decays
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. 736 (2014) 186

341 Measurement of the electron structure function F-2(e) at LEP energies
J. Abdallah, ... , **M. Bluj**, **R. Gokieli**, **J. Hoffman**, **K. Nawrocki**, **R. Sosnowski**, **M. Szczekowski**, **M. Szeptycka**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 737 (2014) 39

342 Measurement of the production cross section for a W boson and two b jets in pp collisions at √s= 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 735 (2014) 204

343 Measurement of the ratio B(t→Wb)/B(t→Wq) in pp collisions at √s = 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 736 (2014) 33

344 Measurement of the ttbar production cross section in pp collisions at √s=8 TeV in dilepton final states containing one τ lepton
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 739 (2014) 23

345 Measurement of the Ξ^-_b and Ω^-_b baryon lifetimes
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. 736 (2014) 154-162

346 Modification of jet shapes in PbPb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 730 (2014) 243

347 Multi-strange baryon production at mid-rapidity in Pb–Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Lett. B Vol. 728 (2014) 216-227

348 Multiplicity dependence of pion, kaon,proton and lambda production in p–Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Lett. B Vol. 728 (2014) 25-38

349 No chance for synthesis of super-heavy nuclei in fusion of symmetric systems
T. Cap, K. Siwek-Wilczyńska, J. Wilczyński
Phys. Lett. B Vol. 736 (2014) 478

350 Observation of a peaking structure in the J/ψϕ mass spectrum from $B^\pm \to J/\psi\phi K^\pm$ decays
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 734 (2014) 261

351 Photoproduction of Isolated Photons, Inclusively and with a Jet, at HERA
H. Abramowicz, ... , **M. Adamus**, **T. Tymieniecka**, ... et al.
Phys. Lett. B Vol. 730 (2014) 293

352 Production of charged pions, kaons and protons at large transverse momenta in pp and Pb–Pb collisions at √sNN=2.76TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Lett. B Vol. 736 (2014) 196-207

353 Search for baryon number violation in top quark decays
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 731 (2014) 173

354 Search for CP violation in the decay $D^+ \to \pi^- \pi^+ \pi^+$
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Lett. B Vol. 728 (2014) 585-595

355 Search for excited quarks in the γ+jet final state in proton-proton collisions at $\sqrt{s}$= 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 738 (2014) 274

356 Search for light vector boson production in $e^+e^- \to \mu^+\mu^- \gamma$ interactions with the KLOE experiment
D. Babusci, ... , **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. 736 (2014) 459

357 Search for pair production of third-generation scalar leptoquarks and top squarks in proton-proton collisions at $\sqrt{s}$= 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 739 (2014) 229

358 Search for supersymmetry in pp collisions at $\sqrt{s}$= 8 TeV in events with a single lepton, large jet multiplicity, and multiple b jets
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 733 (2014) 328

359 Search for the decay $D^0 \to \pi^+ \pi^- \mu^+ \mu^-$
A. Ukleja, ... , **M. Szczekowski**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Lett. B Vol. 728 (2014) 234-243

360 Search for top-squark pairs decaying into Higgs or Z bosons in pp collisions at $\sqrt{s}$= 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 736 (2014) 371

361 Searches for light- and heavy-flavour three-jet resonances in pp collisions at $\sqrt{s}$= 8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Lett. B Vol. 730 (2014) 193

362 Test of CPT and Lorentz symmetry in entangled neutral kaons with the KLOE experiment
D. Babusci, ... , **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. 730 (2014) 89

363 Transverse target single-spin asymmetry in inclusive electroproduction of charged pions and kaons
A. Airapetian, ... , **W. Augustyniak**, **B. Mariański**, **A. Trzciński**, **P. Żuprański**, ... et al.
Phys. Lett. B Vol. 728 (2014) 183

364 Transverse target spin asymmetries in exclusive ρ^0 muoproduction
C. Adolph, ... , **K. Klimaszewski**, **K. Kurek**, **E. Rondio**, **A. Sandacz**, **R. Sulej**, **A. Szabelski**, **P. Sznajder**, **W. Wiślicki**, ... et al.
Phys. Lett. B Vol. 731 (2014) 19

365 Violation of energy-momentum conservation in Mueller-Navelet jets production
B. Ducloué, **L. Szymanowski**, S. Wallon
Phys. Lett. B Vol. 738 (2014) 311

366 Ionization energy shift of characteristic K x-ray lines from high-Z materials for plasma diagnostics
K. Slabkowska, ... , **J. Rzadkiewicz**, ... et al.
Phys. of Plasmas Vol. 21 (2014) 031216

367 Neutron production from puffing deuterium in plasma focus device
P. Kubes, ... , **W. Surała**, **M.J. Sadowski**, ... et al.
Phys. of Plasmas Vol. 21 (2014) 082706

368 Cauchy-Schwarz inequality and particle entanglement
T. Wasak, P. Szańkowski, **P. Ziń**, **M. Trippenbach**, J. Chwedeńczuk
Phys. Rev. A Vol. 90 (2014) 033616

369 Competition between self focusing and self defocusing invarious NLS equations
H. Hung, B. Malomed, **M. Trippenbach**, **E. Infeld**
Phys. Rev. A Vol. 90 (2014) 012907

370 $^{T}T_2$ analyzing powers from $^{12}C(^{7}Li,\alpha)^{15}N$
F.J. Rodríguez, J.A. Liendo, **N. Keeley**, K.W. Kemper, J.A. Mielgo, B.T. Roeder, W.D. Weintraub
Phys. Rev. C Vol. 90 (2014) 047601

371 Accuracy of theoretical descriptions of nuclear masses
A. Sobiczewski, Yu.A. Litvinov
Phys. Rev. C Vol. 89 No 024311 (2014)

372 Azimuthal anisotropy of D-meson production in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Rev. C Vol. 90 (2014) 034904

373 $B(E2;2^+_1 \rightarrow 0^+_1)$ value in ^{90}Kr
J.-M. Regis, ... , **H. Mach**, ... et al.
Phys. Rev. C Vol. 90 (2014) 067301

374 Dynamic polarization potential and dynamical nonlocality in nuclear potentials:Nucleon-nucleus potential
N. Keeley, R.S. Mackintosh
Phys. Rev. C Vol. 90 (2014) 044602

375 Low-lying isomeric states in ^{80}Ga from the β^- decay of ^{80}Zn
R. Lica, ... , **H. Mach**, ... et al.
Phys. Rev. C Vol. 90 (2014) 014320

376 Measurement of higher-order harmonic azimuthal anisotropy in PbPb collisions at $\sqrt{s_{NN}} = 2.76$ TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. C Vol. 89 (2014) 044906

377 Measurement of jet fragmentation in PbPb and pp collisions at $\sqrt{s_{NN}} = 2.76$ TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. C Vol. 90 (2014) 024908

378 Measurement of the $\eta \rightarrow \pi^+ \pi^- \pi^0$ Dalitz plot distribution
P. Adlarson, ... , **W. Augustyniak**, **M. Berłowski**, **A. Kupść**, **B. Mariański**, **H.P. Morsch**, **D. Pszczel**, **J. Stepaniak**, **A. Trzciński**, **J. Zabierowski**, **P. Żuprański**, ... et al.
Phys. Rev. C Vol. 90 (2014) 045207

379 Measurements of production properties of K0S mesons and Λ hyperons in proton-carbon interactions at 31 GeV/c
N. Abgrall, ... , **T. Palczewski**, **E. Rondio**, **J. Stepaniak**, ... et al.
Phys. Rev. C Vol. 89 No 025205 (2014)

380 Multiparticle azimuthal correlations in p-Pb and Pb-Pb collisions at the CERN Large Hadron Collider
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Rev. C Vol. 90 (2014) 054901

381 Neutron-Proton Scattering in the Context of the d^*(2380) Resonance
P. Adlarson, ... , **W. Augustyniak**, **M. Berłowski**, **A. Kupść**, **B. Mariański**, **H.P. Morsch**, **D. Pszczel**, **J. Stepaniak**, **A. Trzciński**, **J. Zabierowski**, **P. Żuprański**, ... et al.
Phys. Rev. C Vol. 90 (2014) 035204

382 Phase-space dependence of particle-ratio fluctuations in Pb+Pb collisions from 20 A to 158 AGeV beam energy
T. Anticic, ... , **H. Białkowska**, **B. Boimska**, ... et al.
Phys. Rev. C Vol. 89 (2014) 054902

383 Phonon coupling effects in proton scattering from ^{40}Ca
R.S. Mackintosh, **N. Keeley**
Phys. Rev. C Vol. 90 (2014) 044601

384 Plasmons in Anisotropic Quark-Gluon Plasma
M. Carrington, **K. Deja**, **St. Mrówczyński**
Phys. Rev. C Vol. 90 (2014) 034913

385 Predictive power of nuclear-mass models
A. Sobiczewski, Yu.A. Litvinov
Phys. Rev. C Vol. 90 (2014) 017302

386 Q-alpha values in superheavy nuclei from the deformed Woods-Saxon model
P. Jachimowicz, M. Kowal, J. Skalski
Phys. Rev. C Vol. 89 (2014) 024304

387 Two- and three-pion quantum statistics correlations in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV at the CERN Large Hadron Collider
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Rev. C Vol. 89 (2014) 024911

388 A search for WWγ and WZγ production and constraints on anomalous quartic gauge couplings in pp collisions at $\sqrt{s}$ = 8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 032008

389 Dalitz plot analysis of $B^0_s \to \bar{D}^0 K^- \pi^+$ decays
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. D Vol. 90 (2014) 072003

390 Deep inelastic cross-section measurements at large y with the ZEUS detector at HERA
H. Abramowicz, ... , **M. Adamus**, **T. Tymieniecka**, ... et al.
Phys. Rev. D Vol. 90 (2014) 072002

391 Dynamics and cosmological constraints on Brans-Dicke cosmology
O. Hrycyna, M. Szydłowski, M. Kamionka
Phys. Rev. D Vol. 90 (2014) 124040

392 First all-sky search for continuous gravitational waves from unknown sources in binary systems.
A. Królak, ... , **A. Zadrożny**, ... et al.
Phys. Rev. D Vol. D90 (2014) 062010

393 Ghosts in Keldysh-Schwinger Formalism
A. Czajka, **St. Mrówczyński**
Phys. Rev. D Vol. 89 (2014) 085035

394 Measurement of CP violation in $B^0_s \rightarrow \phi\phi$ decays
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. D Vol. 90 (2014) 052011

395 Measurement of four-jet production in proton-proton collisions at $\sqrt{s}$= 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 89 (2014) 092010

396 Measurement of Neutral Current e^{+-} p Cross Sections at High Bjorken x with the ZEUS Detector
H. Abramowicz, ... , **M. Adamus**, **T. Tymieniecka**, ... et al.
Phys. Rev. D Vol. 89 (2014) 072007

397 Measurement of resonant and CP components in $\mathrm{Bbar}^0_s \rightarrow J/\psi\pi^+\pi^-$ decays
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. D Vol. 89 (2014) 092006

398 Measurement of the inclusive numu charged current cross section on iron and hydrocarbon in the T2K on-axis neutrino beam
K. Abe, ... , **M. Kabirnezhad**, **J. Łagoda**, **P. Mijakowski**, **P. Przewłocki**, **E. Rondio**, **J. Zalipska**, ... et al.
Phys. Rev. D Vol. 90 (2014) 052010

399 Measurement of the intrinsic electron neutrino component in the T2K neutrino beam with the ND280 detector
K. Abe, ... , **M. Kabirnezhad**, **J. Łagoda**, **P. Mijakowski**, **P. Przewłocki**, **E. Rondio**, **J. Zalipska**, ... et al.
Phys. Rev. D Vol. 89 (2014) 092003

400 Measurement of the muon charge asymmetry in inclusive pp $\rightarrow$ W + X production at $\sqrt{s}$= 7 TeV and an improved determination of light parton
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 032004

401 Measurement of the neutrino-oxygen neutral-current interaction cross section by observing nuclear de-excitation gamma-rays
K. Abe, ... , **M. Kabirnezhad**, **J. Łagoda**, **P. Mijakowski**, **P. Przewłocki**, **E. Rondio**, **J. Zalipska**, ... et al.
Phys. Rev. D Vol. 90 (2014) 072012

402 Measurement of the properties of a Higgs boson in the four-lepton final state
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 89 (2014) 092007

403 Measurement of the ratio of B^+_c branching fractions to $J/\psi\pi^+$ and $J/\psi\mu^+\nu\mu$
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. D Vol. 90 (2014) 032009

404 Measurement of the ratio of inclusive jet cross sections using the anti-kT algorithm with radius parameters R=0.5 and 0.7 in pp collisions at √s= 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 072006

405 Measurement of the W gamma and Z gamma inclusive cross sections in pp collisions at √s = 7 TeV and limits on anomalous triple gauge boson couplings
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 89 (2014) 092005

406 Methods and results of a search for gravitational waves associated with gamma-ray bursts using the GEO 600, LIGO, and Virgo detectors
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Phys. Rev. D Vol. 89 No 12 (2014) 122004

407 Multimessenger Search for Sources of Gravitational Waves and High-Energy Neutrinos: Results for Initial LIGO-Virgo and IceCube
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Phys. Rev. D Vol. 90 No 10 (2014) 102002

408 Quantum theory of the Bianchi II model
H. Bergeron, **O. Hrycyna**, **P. Małkiewicz**, **W. Piechocki**
Phys. Rev. D Vol. 90 (2014) 044041

409 Reconstruction of the energy and depth of maximum of cosmic-ray air-showers from LOPES radio measurements
W.D. Apel, ... , **P. Łuczak**, **J. Zabierowski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 062001

410 Search for anomalous production of events with three or more leptons in pp collisions at √s=8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 032006

411 Search for gravitational radiation from intermediate mass black hole binaries in data from the second LIGO-Virgo joint science run
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Phys. Rev. D Vol. 89 No 12 (2014) 122003

412 Search for gravitational wave ringdowns from perturbed intermediate mass black holes in LIGO-Virgo data from 2005-2010
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Phys. Rev. D Vol. 89 No 10 (2014) 102006

413 Search for jet extinction in the inclusive jet-pT spectrum from proton-proton collisions at √s = 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 032005

414 Search for Proton Decay via $p \rightarrow \nu K^+$ using 260 kiloton·year data of Super-Kamiokande
P. Mijakowski, ... et al.
Phys. Rev. D Vol. 90 (2014) 072005

415 Search for supersymmetry with razor variables in pp collisions at √s=7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 112001

416 Search for the standard model Higgs boson produced in association with a W or a Z boson and decaying to bottom quarks
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 89 (2014) 012003

417 Searches for electroweak neutralino and chargino production in channels with Higgs, Z, and W bosons in pp collisions at 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 092007

418 Searches for heavy Higgs bosons in two-Higgs-doublet models and for t→ch decay using multilepton and diphoton final states in pp collisions at 8 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Rev. D Vol. 90 (2014) 112013

419 Smooth big bounce from affine quantization
H. Bergeron, A. Dapor, J-P. Gazeau, **P. Małkiewicz**
Phys. Rev. D Vol. 89 No 8 (2014) 083522

420 Studies of beauty baryon decays to D^0ph^- and $\Lambda^+_c h^-$ final states
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. D Vol. 89 (2014) 032001

421 The 3.5 keV X-ray line from decaying gravitino dark matter
N.E. Bomark, **L. Roszkowski**
Phys. Rev. D Vol. 90 (2014) 011701

422 Timelike Compton scattering with a linearly polarized photon beam
A.T. Goritschnig, B. Pire, **J. Wagner**
Phys. Rev. D Vol. 89 (2014) 094031

423 Transverse polarization o Lambda hyperons from quasireal photoproduction on nuclei.
W. Augustyniak, ... , **B. Mariański**, **A. Trzciński**, **P. Żuprański**, ... et al.
Phys. Rev. D Vol. 90 (2014) 072007

424 Shallow water dynamics beyond KdV
AKarczewska, PRozmej, **E. Infeld**
Phys. Rev. E Vol. 90 No 1 (2014) 012907

425 A Search for Nucleon Decay via $n \rightarrow \bar{\nu}\,\pi 0$ and $p \rightarrow \bar{\nu}\,\pi+$ in Super-Kamiokande
K. Abe, ... , **P. Mijakowski**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 121802

426 Constraints on Cosmic Strings from the LIGO-Virgo Gravitational-Wave Detectors
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Phys. Rev. Lett. Vol. 112 No 13 (2014) 131101

427 Coupling hydrodynamics to nonequilibrium degrees of freedom in strongly interacting quark-gluon plasma
M.P. Heller, R. Janik, **M. Spaliński**, P. Witaszczyk
Phys. Rev. Lett. Vol. 113 (2014) 261601

428 Evidence for a New Resonance from Polarized Neutron-Proton Scattering
P. Adlarson, ... , **W. Augustyniak**, **M. Berłowski**, **A. Kupść**, **B. Mariański**, **H.P. Morsch**, **D. Pszczel**, **J. Stepaniak**, **A. Trzciński**, **J. Zabierowski**, **P. Żuprański**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 202301

429 Evidence for CP violation in $B^+ \to p\bar{p}K^+$ decays
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 141801

430 Evidence for high-energy resummation effects in Mueller-Navelet jets at the LHC
B. Ducloue, **L. Szymanowski**, S. Wallon
Phys. Rev. Lett. Vol. 112 (2014) 082003-1

431 Evidence of b-jet quenching in PbPb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 132301

432 Exclusive J/Ψ photoproduction off protons in ultraperipheral p-Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 232504

433 First Experimental Characterisation of Microwave Emission from Cosmic Ray Air Showers
R. Šmida, ... , **P. Łuczak**, **J. Zabierowski**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 221101

434 First Indication of Terrestrial Matter Effects on Solar Neutrino Oscillation
A. Renshaw, ... , **P. Mijakowski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 091805

435 First measurement of the charge asymmetry in beauty-quark pair production at a hadron collider
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 082003

436 First observation of a baryonic B^+_c decay
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 152003

437 Improved Upper Limits on the Stochastic Gravitational-Wave Background from 2009-2010 LIGO and Virgo Data
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Phys. Rev. Lett. Vol. 113 No 23 (2014) 231101

438 Measurement of CP violation in the phase space of $B^\pm \to K^+K^-\pi^\pm$ and $B^\pm \to \pi^+\pi^-\pi^\pm$ decays
A. Ukleja, ... , **M. Szczekowski**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 011801

439 Measurement of inclusive W and Z boson production cross sections in pp collisions at $\sqrt{s}$ =8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 191802

440 Measurement of prompt D-meson production in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV
B. Abelev, ... , **A. Deloff**, **I. Ilkiv**, **P. Kurashvili**, **T. Siemiarczuk**, **G. Wilk**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 232301

441 Measurement of Prompt $\psi(2S) \to J/\psi$ Yield Ratios in Pb-Pb and p–p Collisions at $\sqrt{s_{NN}}$= 2.76 TeV
V. Khachatryan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 262301

442 Measurement of the Bbar^0_s→$D^-_s D^+_s$ and Bbar^0_s→$D^- D^+_s$ effective lifetimes
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 111802

443 Measurement of the Isoscalar Monopole Response in the Neutron-Rich Nucleus ^{68}Ni
M. Vandebrouck, ... , **N. Keeley**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 032504

444 Measurements of indirect CP asymmetries in $D^0 \rightarrow K^- K^+$ and $D^0 \rightarrow \pi^- \pi^+$ decays
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 041801

445 Measurements of ttbar spin correlations and top-quark polarization using dilepton final states in pp collisions at $\sqrt{s}$ = 7 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 182001

446 Observation of $B^0_{(s)}$ -> J/\\psi f_1(1285) decays and measurement of the f_1(1285) mixing angle
A. Ukleja, ... , **M. Szczekowski**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 091802

447 Observation of Electron Neutrino Appearance in a Muon Neutrino Beam
K. Abe, ... , **J. Łagoda**, **P. Mijakowski**, **P. Przewłocki**, **E. Rondio**, **J. Zalipska**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 061802

448 Observation of overlapping spin-1 and spin-3 $D^{-\,0}K^-$ resonances at mass 2.86 GeV/c2
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 162001

449 Observation of photon polarization in the $b \rightarrow s\gamma$ transition
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 161801

450 Observation of the associated production of a single top quark and a W boson in pp collisions at $\sqrt{s}$= 8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 231802

451 Observation of the resonant character of the $Z(4430)^-$ state
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 222002

452 Precise Measurement of the Neutrino Mixing Parameter θ_23 from Muon Neutrino Disappearance in an off-axis Beam
K. Abe, ... , **M. Kabirnezhad**, **J. Łagoda**, **P. Mijakowski**, **P. Przewłocki**, **E. Rondio**, **J. Zalipska**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 181801

453 Precision measurement of the mass and lifetime of the Ξ^0_b baryon
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 032001

454 Search for Dinucleon Decay into Kaons in Super-Kamiokande
M. Litos, ... , **P. Mijakowski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 131803

455 Search for flavor-changing neutral currents in top-quark decays $t \rightarrow Zq$ in pp collisions at $\sqrt{s}$= 8 TeV
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 171802

456 Search for Gravitational Waves Associated with γ-ray Bursts Detected by the Interplanetary Network
J. Aasi, ... , **A. Królak**, **A. Zadrożny**, ... et al.
Phys. Rev. Lett. Vol. 113 No 1 (2014) 011102

457 Search for Majorana neutrinos in $B^{-}\rightarrow\pi^{+}\mu^{-}\mu^{-}$ decays
A. Ukleja, ... , **M. Szczekowski**, **V. Batozskaya**, **W. Wiślicki**, **K. Kurek**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 131802

458 Search for top squark and higgsino production using diphoton Higgs boson decays
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 161802

459 Search for top-quark partners with charge 5/3 in the same-sign dilepton final state
S. Chatrchyan, ... , **H. Białkowska**, **M. Bluj**, **B. Boimska**, **T. Fruboes**, **M. Górski**, **M. Kazana**, **K. Nawrocki**, **K. Romanowska-Rybińska**, **M. Szleper**, **G. Wrochna**, **P. Zalewski**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 171801

460 Search for Trilepton Nucleon Decay via $p\rightarrow e^{+}\nu\nu$ and $p\rightarrow\mu^{+}\nu\nu$ in the Super-Kamiokande Experiment
V. Takhistov, ... , **P. Mijakowski**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 101801

461 Study of beauty hadron decays into pairs of charm hadrons
V. Batozskaya, ... , **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 112 (2014) 202001

462 Test of lepton universality using $B^{+}\rightarrow K^{+}\ell^{+}\ell^{-}$ decays
V. Batozskaya, ... , **K. Klimaszewski**, **K. Kurek**, **M. Szczekowski**, **A. Ukleja**, **W. Wiślicki**, ... et al.
Phys. Rev. Lett. Vol. 113 (2014) 151601

463 Boron-Proton Nuclear-Fusion Enhancement Induced in Boron-Doped Silicon Targets by Low-Contrast Pulsed Laser
A. Picciotto, ... , **A. Szydłowski**, **A. Malinowska**, ... et al.
Phys. Rev. X Vol. 4 (2014) 031030

464 Aligned ternary partitioning of the ^{197}Au + ^{197}Au system at 23A MeV beam energy
T. Cap, ... , **J. Wilczyński**, **E. Piasecki**, ... et al.
Phys. Scr. Vol. 89 (2014) 054005

465 Cherenkov-type diagnostics of fast electrons within tokamak plasmas
L. Jakubowski, **M.J. Sadowski**, **J. Żebrowski**, **K. Malinowski**, **M. Rabiński**, **M.J. Jakubowski**, **R. Mirowski**
Phys. Scr. Vol. T161 (2014) 014011

466 Computer simulation of charged fusion-products trajectories and detection efficiency expected for future experiments within COMPASS tokamak
R. Kwiatkowski, **K. Malinowski**, **M.J. Sadowski**
Phys. Scr. Vol. T161 (2014) 014013

467 Deposition and optimization of thin lead layers for superconducting accelerator photocathodes
J. Lorkiewicz, ... , **R. Nietubyć**, **M. Barlak**, **R. Mirowski**, **A. Malinowska**, **J. Witkowski**, ... et al.
Phys. Scr. Vol. T161 (2014) 014071

468 Electron beam treatment of exhaust gas with high NO_x concentration
J. Licki, A.G. Chmielewski, A. Pawelec, Z. Zimek, S. Witman
Phys. Scr. Vol. 161 No 014067 (2014) 1-4

469 Investigation of interactions of intense plasma streams with tungsten and CFC targets in the PF-1000 facility
M. Kubkowska, ... , **E. Składnik-Sadowska**, **R. Kwiatkowski**, **K. Malinowski**, **M.J. Sadowski**, ... et al.
Phys. Scr. Vol. T161 (2014) 014038

470 Isovector dipole resonance structure within the effective surface approximation
J. Błocki, A.G. Magner, P. Ring
Phys. Scr. Vol. 89 (2014) 054019

471 Measurements and computer modeling of fast ion emission from plasma accelerators of the RPI type
K. Malinowski, **M.J. Sadowski**, **E. Składnik-Sadowska**
Phys. Scr. Vol. T161 (2014) 014054

472 New data on electron beams and hard X-ray emission in the ISTTOK tokamak
L. Jakubowski, ... , **K. Malinowski**, **M.J. Sadowski**, **J. Żebrowski**, **M. Rabiński**, **M.J. Jakubowski**, ... et al.
Phys. Scr. Vol. T161 (2014) 014012

473 On coatings adhesion during the Impulse Plasma Deposition
K. Nowakowska-Langier, ... , **K. Zdunek**, **R. Kwiatkowski**, **K. Malinowski**, **E. Składnik-Sadowska**, **M.J. Sadowski**, ... et al.
Phys. Scr. Vol. T161 (2014) 014063

474 Plasma exposures of different tungsten grades with plasma accelerators at ITER-relevant conditions
V.A. Makhlaj, ... , **M.J. Sadowski**, **E. Składnik-Sadowska**, ... et al.
Phys. Scr. Vol. T161 (2014) 014040

475 Research on interactions of intense plasma-ion streams with a SiC target in a modified PF-1000 facility
E. Składnik-Sadowska, ... , **R. Kwiatkowski**, **K. Malinowski**, **M.J. Sadowski**, ... et al.
Phys. Scr. Vol. T161 (2014) 014039

476 Theoretical description of the decay chain of the nucleus $^{287}115$
A. Sobiczewski
Phys. Scr. Vol. 89 No 054014 (2014)

477 Tungsten damage and melt losses under plasma accelerator exposure with ITER ELM relevant conditions
V.A. Makhlaj, ... , **M.J. Sadowski**, **E. Składnik-Sadowska**, ... et al.
Phys. Scr. Vol. T159 (2014) 014024

478 Upper hybrid turbulence and resonant absorption of high-power laser light by underdense plasma
P. Goldstein
Phys. Scr. Vol. T161 (2014) 014019

479 Tsallis distribution with complex nonextensivity parameter q
G. Wilk, Z. Włodarczyk
Physica A Vol. 413 (2014) 53-58

480 Results from the Irradiation of Stainless Steel and Copper by 23 MeV γ-Quanta in the Atmosphere of Molecular Deuterium at a Pressure of 2 kbar
DidykA.Yu. , **R. Wiśniewski**
Physics of Particle and Nuclei Letters Vol. 11 No 3 (2014) 309

481 Results of Irradiating Aluminum and Homogeneous Alloy YMn_2 by 23 MeV γ�Quanta in a Molecular Deuterium Atmosphere at 2 kbar Pressure
DidykA.Yu. , **R. Wiśniewski**
Physics of Particle and Nuclei Letters Vol. 11 No 2 (2014) 169

482 Structure and Chemical Composition Changes of Pd Rod and Reaction Product Collector Irradiated by 100MeV Braking Gamma Quanta inside High Pressure Chamber Filled with 2.5 kbar Molecular Hydrogen.
DidykA.Yu. , **R. Wiśniewski**
Physics of Particle and Nuclei Letters Vol. 11 No 4 (2014) 513

483 Measurement of cross-sections of yttrium (n,xn) threshold reactions by means of gamma spectroscopy
P. Chudoba, ... , **S. Kilim**, **M. Bielewicz**, **E. Strugalska-Gola**, **M. Szuta**, ... et al.
Physics Procedia No 59 (2014) 114-118

484 Radio emission from dusty galaxies observed by AKARI
A. Pepiak, ... , **A. Pollo**, ... et al.
Planetary and Space Sci. Vol. 100 (2014) 12

485 Comments on results of recent high-temperature plasma studies at NCBJ (former IPJ) in Poland
M.J. Sadowski
Probl. Atom. Sci. Technol., Series Plasma Phys. Vol. 20 No 6(94) (2014) 245-249

486 Research on interactions of intense deuterium plasma streams with SiC targets in Plasma-Focus experiments
E. Składnik-Sadowska, ... , **R. Kwiatkowski**, **K. Malinowski**, **M.J. Sadowski**, **K. Czaus**, **D. Załoga**, **J. Żebrowski**, **K. Nowakowska-Langier**, ... et al.
Probl. Atom. Sci. Technol., Series Plasma Phys. Vol. 20 No 6(94) (2014) 72-75

487 Pi of the Sky robotic observatories in Chile and Spain
A. Ćwiek, **T. Batsch**, **A. Majcher**, **K. Małek**, **K. Nawrocki**, **M. Sokołowski**, **G. Wrochna**, ... et al.
Proc. SPIE Vol. 9290 (2014) 8

488 Comparison of different photometric algorithms on Pi of the Sky data
L. Obara, A. Zarnecki, **A. Zadrożny**, R. Opiela
Proc. SPIE 9290, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2014 Vol. 9290 (2014) 92900K

489 Fast modular data acquisition system for GEM-2D detector
G. Kasprowicz, ... , **J. Rzadkiewicz**, ... et al.
Proc. SPIE 9290, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2014 Vol. 9290 (2014) 92902F

490 Pi of the Sky preparations towards advanced gravitational detector era
A. Zadrożny, R. Opiela, L. Obara, M. Sokołowski
Proc. SPIE 9290, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2014 Vol. 9290 (2014) 929010

491 Python based integration of GEM detector electronics with JET data acquisition system
W.M. Zabołotny, ... , **J. Rzadkiewicz**, ... et al.
Proc. SPIE 9290, Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2014 Vol. 9290 (2014) 929024

492 Probing Heavy-Ion Collisions with Jets in the CMS Experiment
B. Boimska
Proc. SPIE Int. Soc. Opt. Eng. Vol. 9290 (2014) 92902D

493 Ensembles of Instance Selection Methods Based on Feature Subset
M. Blachnik
Procedia Engineering Vol. 35 (2014) 388–396

494 Localizing of the atmospheric contamination source by the Sequential Monte Carlo methods and Bayesian inference for the Kori field tracer experiment
P. Kopka, **A. Wawrzyńczak-Szaban**, **M. Borysiewicz**
Proceedings of the BOS 2014 XIII Conference Vol. 1 (2014) 1

495 Samples at Gamma Spectrometry Laboratory - Investigations of Specific Radioactivity
Z. Tymiński, ... , **E. Miśta**, **A. Patocka**, **E. Kołakowska**, **A. Listkowska**, **K. Tymińska**, ... et al.
Proceedings of the IMC Vol. 2 (2014) 193

496 Radiation Protection Studies for a New Mobile Electron Accelerator for Intra Operative Radiation Therapy (IORT)
A. Wysocka-Rabin, P. Adrich, A. Wasilewski
Prog. Nucl. Sci. Technol. Vol. 4 (2014) 298-302

497 A micro-gap, air filled ionization chamber as a detector for criticality accident dosimetry
M. Zielczyński, **N. Golnik**, **Ł. Murawski**, **M.A. Gryziński**
Radiat. Prot. Dosim. Vol. 161 No 1-4 (2014) 130 - 133

498 A ring-shape recombination chamber for hadron therapy dosimetry
E.A. Jakubowska, **M. Zielczyński**, **M.A. Gryziński**, Ł. Krzemiński
Radiat. Prot. Dosim. Vol. 161 No 1-4 (2014) 201-204

499 Characterisation of radiation field for irradiation of biological samples at nuclear reactor - comparison of twin detector and recombination methods
N. Golnik, **M.A. Gryziński**, M. Kowalska, K. Meronka, **P. Tulik**
Radiat. Prot. Dosim. Vol. 161 No 1-4 (2014) 196-200

500 Low-level gamma and neutron monitoring based on use of proportional counter filled with ^{3}He in polythene moderator: study of the responses to gamma and neutrons
S. Pszona, A. Bantsar, **P. Tulik**, **K. Wincel,** B. Zaręba
Radiat. Prot. Dosim. Vol. 161 No 1-4 (2014) 237-240

501 Study on the influence of B_4C layer thickness on the neutron flux and energy distribution shape in multi-electrode ionization chamber
K. Tymińska, M. Maciak, **J. Ośko**, **P. Tulik, M. Zielczyński**, **M.A. Gryziński**
Radiat. Prot. Dosim. Vol. 161 No 1-4 (2014) 210-215

502 Investigation of bystander effect in CHO-K1 cells
U. Kaźmierczak, ... , **M. Jaskóła**, **Ł. Kaźmierczak**, **A. Korman**, ... et al.
Reports of Practical Oncology and Radiotherapy Vol. 19 (2014) S37 S41

503 Status report: nanodosimetry of carbon ion beam at HIL
A. Bantsar, M. Pietrzak, **M. Jaskóła**, **A. Korman**, **S. Pszona**, Z. Szefliński
Reports of Practical Oncology and Radiotherapy Vol. 19 (2014) S42-S46

504 Pi of the Sky full system and the new telescope
L. Mankiewicz, ... , **T. Batsch**, **A. Ćwiek**, **A. Majcher**, **A. Majczyna**, **K. Nawrocki**, **M. Sokołowski**, **G. Wrochna**, ... et al.
Rev. Mexicana de Astron. Astrof. Vol. 45 (2014) 7

505 Characterization of solid state nuclear track detectors of the polyallyl-diglycol-carbonate (CR-39/PM-355) type for light charged particle spectroscopy
A. Malinowska, **M. Jaskóła**, **A. Korman**, **A. Szydłowski**, **M. Kuk**
Rev. Sci. Instrum. Vol. 85 (2014) 123505

506 University of Lodz an electron spectrometer - A new conversion - electron spectrometer for in beam measurements
J. Perkowski, ... , **A. Korman**, ... et al.
Rev. Sci. Instrum. Vol. 85 (2014) 043303

507 X-ray crystal spectrometer upgrade for ITER-like wall experiments at JET
A.E. Shumack, ... , **J. Rzadkiewicz**, ... et al.
Rev. Sci. Instrum. Vol. 85 (2014) 11E425

508 Separation of ytterbium from $^{177}Lu/Yb$ mixture by electrolytic reduction and amalgamation
I. Cieszykowska, **M. Żółtowska**, **M. Mielcarski**
SOP Transactions on Applied Chemistry Vol. 1 No 2 (2014) 6-13

509 Comment on NAIRAS aircraft radiation model development, dose climatology, and initial validation by ChristopherJ. Mertens, Matthias M. Meier, Steven Brown, Ryan B. Norman and Xiaojing Xu
Y. Socol, ... , **L. Dobrzyński**, ... et al.
Space Weather Vol. 12 (2014) 120

510 Bayesian methodology in the stochastic event reconstruction problems
A. Wawrzyńczak-Szaban, P. Kopka, P. Kopka, M. Borysiewicz
Springer Proceedings in Mathematics & Statistics Vol. 63 (2014) 45

511 Crystal structure and defect structure of selected $Ca_9RE(VO_4)_7$ single crystals: A high-resolution diffraction, white beam topography and powder diffraction study
A. Behrooz, ... , **K. Wieteska**, ... et al.
Synchrotron Radiation in Natural Science Vol. 13 No 1-2 (2014) 77

512 Synchrotron topographic evaluation of strain around craters generated by irradiation with x-ray pulses from free electron laser with different intensities
W. Wierzchowski, **K. Wieteska**, R. Sobierajski, D. Klinger, J. Pełka, D. Żymierska, C. Paulmann
Synchrotron Radiation in Natural Science Vol. 13 No 1-2 (2014) 97

513 Threshold fluence of ultra-short VUV laser pulse for structure modification of gallium arsenide
D. Żymierska, ... , **K. Wieteska**, ... et al.
Synchrotron Radiation in Natural Science Vol. 13 No 1-2 (2014) 92

514 Development of a Mobile Modular System for the Detection of Special Nuclear Material (MODES_SNM)
D. Cester, ... , **Ł. Świderski**, **M. Moszyński**, ... et al.
X LASNPA Vol. 040 (2014) 1

515 Результаты по облучению алюминия и гомогенного сплава YMn_2 γ-квантами с энергией 23 МэВ в атмосфере молекулярного дейтерия при давлении 2 кбар
ДидыкА.Ю. , **R. Wiśniewski**
Письма в ЭЧАЯ Vol. 11 No 3 (2014) 284

PUBICATIONS RELATED TO PHYSICS EDUCATION AND POPULARIZATION OF PHYSICS

1. Młodość gwiezdnych wysp
A. Pollo, **K. Małek**, J. Krywult, A. Solarz
Academia Vol. 309 No 39 (2014) 16-19

2. Program Polskiej Energetyki Jądrowej przyjęty przez Rząd
A. Strupczewski
Biuletyn Vol. 3 No 2 (2014)

3. Dziesięć kilo splątanych kubitów
P. Zalewski
Delta Vol. 476 No 1 (2014) 21

4. Japońskie tajemnice neutrin
P. Przewłocki
Delta Vol. - No 10 (2014) 14

5. Magnetyczna chłodziarka
P. Zalewski
Delta Vol. 483 No 8 (2014) 21

6. Metamateriał znaleziony w łazience
   P. Zalewski
   Delta Vol. 481 No 6 (2014) 21

7. Naturalna skuteczność strzykania wyjaśniona
   P. Zalewski
   Delta Vol. 477 No 2 (2014) 23

8. Nieopisany mangan
   P. Zalewski
   Delta Vol. 484 No 9 (2014) 21

9. Nobel 2014
   P. Zalewski
   Delta Vol. 487 No 12 (2014) 21

10. Nowe degradowalne duromery; Małpy liczą niedościgle
    P. Zalewski
    Delta Vol. 482 No 7 (2014) 21

11. Nowo dostrzeżona kwantowa zasada niezaszlufladkowywania
    P. Zalewski
    Delta Vol. 485 No 10 (2014) 21

12. Piorun kulisty in flagranti
    P. Zalewski
    Delta Vol. 478 No 3 (2014) 21

13. Zawirowanie BICEP2 - 17.03.2014
    P. Zalewski
    Delta Vol. 480 No 5 (2014) 21

14. Komentarz do prezentacji przedstawiciela Greenpeace'u, pana Mycle Schneidera, na temat stanu energetyki jądrowej
    A. Strupczewski
    Eko-atom Vol. październi (2014)

15. Podróż w czasie w poszukiwaniu atomowych zagrożeń Greenpeace'u
    A. Strupczewski, Ł. Koszuk
    Eko-atom Vol. 13 (2014) 9

16. Korzyści i uciążliwości w okolicy budowy elektrowni jądrowej
    Ł. Koszuk
    Forum Atomowe Vol. 3 (2014) 12

17. Odgłosy z jaskini
    P. Goldstein
    Foton Vol. 125 (2014) 41

18. Raport z eksploatacji reaktora badawczego Maria w 2013 roku
    A. Gołąb
    Postępy Techniki Jądrowej Vol. 57 No Z.1 (2014) 18-22

PUBLICATIONS WITHOUT PEER REVIEW

1 Decay competition for IMF produced in the collisions Kr-78+Ca-40 and Kr-86+Ca-48 at 10 A.MeV
M. LaCommara, ... , **E. Piasecki**, ... et al.
EPJ Web Conf. Vol. 66 (2014) 03052

2 Energy loss in unstable QGP - problem of the upper cut-off
M. Carrington, **K. Deja**, **St. Mrówczyński**
EPJ Web Conf. No 71 (2014) 00095

3 Search for baryonium and the physics of FAIR
S. Wycech, J.P. Dedonder, B. Loiseau
EPJ Web Conf. Vol. 81 (2014) 2014105029

4 Toksyczna chmura na celowniku
M. Borysiewicz, **K. Gomulski**, **S. Potempski**
Chem. Przem. BMP Vol. 3 (2014) 75-80

5 Postępowanie z wysokoaktywnymi odpadami promieniotwórczymi. Głębokie składowiska geologiczne.
M. Lipka
Ekoatom Vol. 12 (2014) 46 - 51

6 Atom lekiem na CO2? Bilans energetyczny i emisje CO2 energetyki jądrowej
A. Strupczewski
Energetyka Cieplna i Zawodowa No 4 (2014)

7 Bezpieczne nawet po awarii Nowe elektrownie jądrowe
A. Strupczewski
Energetyka Cieplna i Zawodowa Vol. 2 No 2 (2014) 64-69

8 Elektrownia jądrowa to dobry sąsiad
A. Strupczewski
Energetyka Cieplna i Zawodowa Vol. 2 No 1 (2014)

9 Która energia tańsza? Z elektrowni jądrowych czy wiatraków?
A. Strupczewski
Energetyka Cieplna i Zawodowa Vol. 2 No 1 (2014) 5-7

10 Search for exotic phenomena at the CMS
M. Kazana
EPJ Web of Conference Vol. 71 No 00066 (2014)

11 Biologically Weighted Quantities in Radiotherapy: an EMRP Joint Research Project
H. Rabus, ... , **S. Pszona**, ... et al.
EPJ Web of Conferences Vol. 77 (2014) 00021

12 Probing the symmetry energy at low density using observable from neck fragmentation
E. DeFilippo, ... , **E. Piasecki**, **J. Wilczyński**, ... et al.
EPJ Web of Conferences Vol. 66 (2014) 03032

13 Recent precision experiments with exotic nucleiproduced with uranium projectiles and experimen-tal prospects at fair
H. Geissel, ... , **Z. Patyk**, ... et al.
EPJ Web of Conferences Vol. 66 (2014) 01005

14 Spin Density Matrix Elements in exclusive production of ω mesons at Hermes
B. Mariański, **W. Augustyniak**, **A. Trzciński**, **P. Żuprański**
EPJ Web of Conferences Vol. 66 (2014) 06012

15 NA61/SHINE facility at the CERN SPS: beams and detector system
N. Abgrall, ... , **T. Palczewski**, **E. Rondio**, **J. Stepaniak**, ... et al.
JINST Vol. 9 No P0 (2014) 6005

16 Produkcja Technetu-99m w Cyklotronach Medycznych (Alternatywne Metody Produkcji Technetu-99m)
J. Parus, **R. Mikołajczak**
Postępy Techniki Jądrowej Vol. 57 No 3 (2014) 19-22

17 Wpływ energetyki jądrowej i odnawialnych źródeł energii na koszty w systemie energetycznym Polski
A. Strupczewski
Postępy Techniki Jądrowej Vol. VOL.57 No 1 (2014) 28-35

18 Exclusive meson production at COMPASS
P. Sznajder
Proceedings of Science Vol. DIS2014 (2014) 220

19 The study Higgs decaying into tau tau in CMS
M. Bluj
Proceedings of Science (pos) vol. Epshep2013 (2014) 262

20 Timelike Compton scattering with a linearly polarized photon beam
A.T. Goritschnig, B. Pire, **J. Wagner**
Proceedings of Science (pos) (2014)

21 Measurement of cross-sections of Yttrium (n,xn) threshold reactions by means of gamma spectroscopy
P. Chudoba, ... , **S. Kilim**, **M. Bielewicz**, **E. Strugalska-Gola**, **M. Szuta**, ... et al.
Proceedings of the ERINDA Workshop, CERN, Geneva, Switzerland, 1-3 Oct 2013, edited by Enrico Chiaveri, CERN-Proceedings-2014-002 (CERN, Geneva, 2014) (2014) 53

22 The POLAR gamma-ray burst polarimeter onboard the Chinese Spacelab
S. Orsi, ... , **T. Batsch**, **A. Rutczyńska**, **J. Szabelski**, **A. Zwolińska**, **R. Marcinkowski**, **D. Rybka**, ... et al.
Proceedings of the SPIE Vol. 9144 (2014) 0

23 Accuracy of mass and radius determination of neutron star in X-ray bursters from simulated LOFT spectrum
A. Majczyna, A. Różańska, J. Madej, M. Należyty
PTA Proceedings Vol. 1 (2014) 109

24 The VIMOS VLT Deep Survey: Final Public Release of ~ 35 000 Galaxies and Active Galactic Nuclei Covering 13 Billion Years of Evolution
O. LeFevre, ... , **A. Pollo**, ... et al.
The Messenger Vol. 155 (2014) 33

25 The VIMOS VLT Deep Survey: Final Public Release of ~ 35 000 Galaxies and Active Galactic Nuclei Covering 13 Billion Years of Evolution
O. LeFèvre, ... , **A. Pollo**, ... et al.
The Messenger Vol. 155 (2014) 33

OTHERS

1. Badania i rozwój technologii dla kontrolowanej fuzji termojądrowej
UrszulaWoźnicka, **K. Pytel, R. Prokopowicz, M. Dorosz, A. Zawadka, J. Lechniak, M. Lipka, Z. M. Marcinkowska, A. Wierzchnicka, I. Małkiewicz, T. Wilczek, M. Krok , l.A. Migdał, J. Kozieł, M.J. Żebrowski, E. Sadowski, E. Hajewska, J. Wasiak**, ... et al.
Institute of Nuclear Physics PAS, Kraków, Poland

2. Energetyka Jądrowa: Spotkanie Drugie
L. Dobrzyński, **K. Różycki**, **K. Samul**
National Centre for Nuclear Research

3. Historia (nie)Naturalna Rozumu Ludzkiego na przykładzie niejakiego Hieronima
T. Wibig
Bezkresy Wiedzy, Saarbrucken

4. Jednoczesna redukcja stężeń wielu zanieczyszczeń w spalinach przy użyciu wiązki elektronów z akceleratora
J. Licki, A.G. Chmielewski, A. Pawelec, Z. Zimek
Publishing House of Wroclaw Technical Univercity

5. Liniowy akcelerator elektronów z szybkim przełączaniem energii
S. Wronka

6. Łężany cmentarzysko z okresu wpływów rzymskich i wędrówek ludów na Pojezierzu Mrągowskim. Badania w sezonie 2013.
A. Wiśniewska**E. Miśta,** P. Kalbarczyk, ... et al.
Warszawa, Polska (Warsaw, Poland)

7. Minimalizacja poboru mocy w procesorze o superskalarnej architekturze przesłań SMOVE
A. Łuczyk
Oficyna Wydawnicza Politechniki Warszawskiej, Warsaw

8. Podstawy nukleoniki - model podręcznika do nauczania zawodu technik nukleonik, wersja dla nauczyciela
L. Dobrzyński, Ł. Adamowski, E. Droste, M. Kirejczyk, M. Marcinkowska-Sanner, M. Pylak, M.P. Sadowski, R. Wołkiewicz, K. Żuchowicz
National Centre for Nuclear Research

9. Podstawy nukleoniki - model podręcznika do nauczania zawodu technik nukleonik, wersja dla ucznia
L. Dobrzyński, Ł. Adamowski, E. Droste, M. Kirejczyk, M. Marcinkowska-Sanner, M. Pylak, M.P. Sadowski, R. Wołkiewicz, K. Żuchowicz
National Centre for Nuclear Research

10. Podstawy nukleoniki - podstawy fizyczne praktycznych ćwiczeń laboratoryjnych
L. Dobrzyński, Ł. Adamowski, E. Droste, M. Kirejczyk, M. Marcinkowska-Sanner, M. Pylak, M.P. Sadowski, R. Wołkiewicz, K. Żuchowicz
National Centre for Nuclear Research

11. Podstawy nukleoniki - zbiór zadań sprawdzających wiedzę
L. Dobrzyński, Ł. Adamowski, E. Droste, M. Kirejczyk, M. Marcinkowska-Sanner, M. Pylak, M.P. Sadowski, R. Wołkiewicz, K. Żuchowicz
National Centre for Nuclear Research

12. UNSCEAR 2013 Report, vol. I:Repport to the General Assembly,Levels and effects of radiation exposure due to the nuclear accident after the 2011 great east-Japan earthquake and tsunami
L. Dobrzyński, About100delegatestoUNSCEAR
United Nations

AUTHOR INDEX