



Exotic Nuclei and Nuclear/Particle Astrophysics (V). From Nuclei to Stars

Carpathian Summer School of Physics 2014

Sinaia, Romania

13–26 July 2014

Editors

Livius Trache

Daniela Chesneanu

“Horia Hulubei” Institute for Physics and Nuclear Engineering, Bucharest-Magurele, Romania

Calin Alexandru Ur

“Horia Hulubei” Institute for Physics and Nuclear Engineering, Bucharest-Magurele, Romania

Extreme Light Infrastructure – Nuclear Physics, Bucharest-Magurele, Romania

All papers have been peer reviewed.

Sponsoring Organizations

Ministry of National Education

ATHENA network of ENSAR

Nuclear Astrophysics Virtual Institute

Endorsed by the European Physical Society

iGroup

CAEN

Canberra



Melville, New York, 2015
AIP Proceedings

Volume 1645

Editors

Livius Trache

Daniela Chesneanu

"Horia Hulubei" Institute for Physics

and Nuclear Engineering

Str. Reactorului no. 30

P.O. Box MG-6

Bucharest-Magurele, Romania

E-mail: livius.trache@nipne.ro

chesneanu@nipne.ro

Calin Alexandru Ur

"Horia Hulubei" Institute for Physics

and Nuclear Engineering

Str. Reactorului no. 30

P.O. Box MG-6

Bucharest-Magurele, Romania

Extreme Light Infrastructure – Nuclear Physics

P.O. Box MG-6

Bucharest-Magurele, Romania

E-mail: calin.ur@eli-np.ro

Authorization to photocopy items for internal or personal use, beyond the free copying permitted under the 1978 U.S. Copyright Law (see statement below), is granted by the AIP Publishing LLC for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$30.00 per copy is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923, USA: <http://www.copyright.com>. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transactional Reporting Services is: 978-0-7354-1284-2/15/\$30.00



© 2015 AIP Publishing LLC

No claim is made to original U.S. Government works.

Permission is granted to quote from the AIP Conference Proceedings with the customary acknowledgment of the source. Republication of an article or portions thereof (e.g., extensive excerpts, figures, tables, etc.) in original form or in translation, as well as other types of reuse (e.g., in course packs) require formal permission from AIP Publishing and may be subject to fees. As a courtesy, the author of the original proceedings article should be informed of any request for republication/reuse. Permission may be obtained online using RightsLink. Locate the article online at <http://proceedings.aip.org>, then simply click on the RightsLink icon/"Permissions/Reprints" link found in the article abstract. You may also address requests to: AIP Publishing Office of Rights and Permissions, Suite 300, 1305 Walt Whitman Road, Melville, NY 11747-4300, USA; Fax: 516-576-2450; Tel.: 516-576-2268; E-mail: rights@aip.org.

ISBN 978-0-7354-1284-2

ISSN 0094-243X

Printed in the United States of America

AIP Conference Proceedings, Volume 1645
Exotic Nuclei and Nuclear/Particle Astrophysics (V). From Nuclei to Stars
Carpathian Summer School of Physics 2014

Table of Contents

Conference Organization	1
 Preface: Carpathian Summer School of Physics 2014 Livius Trache, Daniela Chesneanu, and Calin Alexandru Ur	3
 List of Summer Schools of Physics Held in the Carpathians	7
 Conference Pictures	11
 Carpathian Summer School of Physics 2014: Conference Program	15
 PART I: INVITED LECTURES	
1. Exotic Nuclei - Structure and Reactions	
Isospin-symmetry-breaking effects in $A \sim 70$ nuclei within beyond-mean-field approach A. Petrovici and O. Andrei	21
 Knockout beyond the dripline A. Bonaccorso, R. J. Charity, R. Kumar, and G. Salvioni	30
 Peripheral elastic and inelastic scattering of $^{17,18}\text{O}$ on light targets at 12 MeV/nucleon F. Carstoiu, T. Al-Abdullah, C. A. Gagliardi, and L. Trache	39
 Recent results and open questions on collective type phenomena from A-A to pp collisions M. Petrovici, C. Andrei, I. Berceanu, A. Bercuci, A. Herghelegiu, and A. Pop	52

2. Equation of State and Compact Stars	
Introduction to neutron stars James M. Lattimer	61
Hyperons and neutron stars Isaac Vidaña	79
Strangeness driven phase transitions in compressed baryonic matter and their relevance for neutron stars and core collapsing supernovae Ad. R. Raduta, F. Gulminelli, and M. Oertel	86
Neutron-star matter within the energy-density functional theory and neutron-star structure A. F. Fantina, N. Chamel, J. M. Pearson, and S. Goriely	92
3. Nucleosynthesis	
Weak-interaction processes in core-collapse supernovae K. Langanke	101
Relevance of β-delayed neutron data for reactor, nuclear physics and astrophysics applications Karl-Ludwig Kratz	109
And there was light C. A. Bertulani	121
Heavy element production in the early galaxy Mounib F. El Eid	132
4. Nuclear Physics for Astrophysics	
On reaction mechanisms involved in the deuteron-induced surrogate reactions M. Avrigeanu, V. Avrigeanu, and C. Măniulescu	139
Enhanced α-particle optical potential at low energies, for the mass range $A \sim 45$-209 V. Avrigeanu, M. Avrigeanu, and C. Măniulescu	148
Applications of the Trojan Horse method in nuclear astrophysics Claudio Spitaleri	157

Light elements burning reaction rates at stellar temperatures as deduced by the Trojan Horse measurements	
L. Lamia, C. Spitaleri, M. La Cognata, S. Palmerini, S. M. R. Puglia, and M. L. Sergi	167
LUNA: Nuclear astrophysics underground	
A. Best	173
5. Cosmic Rays and Astroparticles	
Cosmic muons, as messengers from the Universe	
I. M. Brancus and H. Rebel	178
New cosmic rays experiments in the underground laboratory of IFIN-HH from Slanic Prahova, Romania	
Bogdan Mitrica, Denis Stanca, Iliana Brancus, Romul Margineanu, Ana-Maria Blebea-Apostu, Claudia Gomoiu, Alexandra Saftoiu, Gabriel Toma, Heinigerd Rebel, Andreas Haungs, Octavian Sima, Alexandru Gherghel-Lascu, and Mihai Niculescu-Oglinzanu	188
News about vs	
Irina Mocioiu	197
6. Physics at ELI-NP. Nuclear Physics with Lasers	
Implementation status of the extreme light infrastructure - nuclear physics (ELI-NP) project	
S. Gales and N. V. Zamfir	201
From laser particle acceleration to the synthesis of extremely neutron rich isotopes via the novel fission-fusion mechanism	
P. G. Thirolf	210
High power femtosecond lasers at ELI-NP	
Razvan Dabu	219
Perspectives for neutron and gamma spectroscopy in high power laser driven experiments at ELI-NP	
F. Negoita, M. Gugiu, H. Petrascu, C. Petrone, D. Pietreanu, J. Fuchs, S. Chen, D. Higginson, L. Vassura, F. Hannachi, M. Tarisien, M. Versteegen, P. Antici, D. Balabanski, S. Balascuta, M. Cernaianu, I. Dancus, S. Gales, L. Neagu, C. Petcu, M. Risca, M. Toma, E. Turcu, and D. Ursescu	228
7. Physics at ELI-NP. Nuclear Physics with Gamma Beams	
Gamma beam system at ELI-NP	
Calin Alexandru Ur	237

Physics with gamma-beams and charged particle detectors: I) Nuclear structure	
II) Nuclear astrophysics	
Moshe Gai	246
New scintillator materials for future and present facilities	
Franco Camera and Agnese Giaz	253
Contemporary research with nuclear resonance fluorescence at the S-DALINAC	
M. Zweidinger, T. Beck, J. Beller, U. Gayer, L. Mertes, H. Pai, N. Pietralla, P. Ries, C. Romig, and V. Werner	259
Mass and isospin dependence of the dipole response in a microscopic transport approach	
V. Baran, M. Colonna, M. Di Toro, A. Croitoru, and A. I. Nicolin	267
PART II: COMMUNICATIONS	
Relativistic mean-field model with energy dependent self-energies	
S. Antic and S. Typel	276
Fragmentation potential for the superheavy element ^{296}Lv	
D. Aranghel and A. Sandulescu	282
X_{max}^μ vs. N^μ from extensive air showers as estimator for the mass of primary UHECR's. Application for the Pierre Auger Observatory	
Nicusor Arsene and Octavian Sima	286
Sub-saturation matter in compact stars: Nuclear modelling in the framework of the extended Thomas-Fermi theory	
François Aymard, Francesca Gulminelli, and Jérôme Margueron	291
A conceptual design of an electron spectrometer for ELI-NP	
S. Balascuta and I. C. E. Turcu	296
3D reconstruction of nuclear reactions using GEM TPC with planar readout	
Jan Stefan Białowicz	301

Development of a Monte Carlo code for the data analysis of the $^{18}\text{F}(p,\alpha)^{15}\text{O}$ reaction at astrophysical energies	
A. Caruso, S. Cherubini, C. Spitaleri, V. Crucillà, M. Gulino, M. La Cognata, L. Lamia, G. Rapisarda, S. Romano, M.L. Sergi, S. Kubono, H. Yamaguchi, S. Hayakawa, Y. Wakabayashi, N. Iwasa, S. Kato, T. Komatsubara, T. Teranishi, A. Coc, F. Hammache, and N. de Séréville	306
Investigating $^{13}\text{C}+^{12}\text{C}$ reaction by the activation method. Sensitivity tests	
Daniela Chesneanu, L. Trache, R. Margineanu, A. Pantelica, D. Ghita, M. Straticiu, I. Burducea, A. M. Blebea-Apostu, C. M. Gomoiu, and X. Tang	311
The mass-radius relationship of massive compact stars	
Partha Roy Chowdhury	317
Geant4 simulations on Compton scattering of laser photons on relativistic electrons	
D. Filipescu, H. Utsunomiya, I. Gheorghe, T. Glodariu, O. Tesileanu, T. Shima, K. Takahisa, and S. Miyamoto	322
Absolute photoneutron cross sections of Sm isotopes	
I. Gheorghe, H. Utsunomiya, D. Filipescu, T. Glodariu, H.-T. Nyhus, T. Renstrøm, O. Tesileanu, T. Shima, K. Takahisa, and S. Miyamoto	327
Refined lateral energy correction functions for the KASCADE-Grande experiment based on Geant4 simulations	
A. Gherghel-Lascu, W. D. Apel, J. C. Arteaga-Velázquez, K. Bekk, M. Bertaina, J. Blümer, H. Bozdog, I. M. Brancus, E. Cantoni, A. Chiavassa, F. Cossavella, K. Daumiller, V. de Souza, F. Di Pierro, P. Doll, R. Engel, J. Engler, B. Fuchs, D. Fuhrmann, H. J. Gils, R. Glasstetter, C. Grupen, A. Haungs, D. Heck, J. R. Hörandel, D. Huber, T. Huege, K.-H. Kampert, D. Kang, H. O. Klages, K. Link, P. Łuczak, H. J. Mathes, H. J. Mayer, J. Milke, B. Mitrica, C. Morello, J. Oehlschläger, S. Ostapchenko, N. Palmieri, M. Petcu, T. Pierog, H. Rebel, M. Roth, H. Schieler, S. Schoo, F. G. Schröder, O. Sima, G. Toma, G. C. Trinchero, H. Ulrich, A. Weindl, J. Wochele, and J. Zabierowski	332
Effect of $^{12}\text{C}+^{12}\text{C}$ reaction & convective mixing on the progenitor mass of ONe white dwarfs	
Ghina M. Halabi and Mounib El Eid	339
The fusion-fission process in the reaction $^{34}\text{S}+^{186}\text{W}$ near the interaction barrier	
I. M. Harca, S. Dmitriev, J. Itkis, E. M. Kozulin, G. Knyazheva, T. Loktev, K. Novikov, F. Azaiez, A. Gottardo, I. Matea, D. Verney, G. Chubarian, F. Hanappe, J. Piot, C. Schmitt, W. H. Trzaska, and E. Vardaci	344
Space-atmospheric interactions of energetic cosmic rays	
Paula Gina Isar	349

Calibration of photo sensors for the space-based cosmic ray telescope JEM-EUSO Michael Karus	353
Production and dosimetry of simultaneous therapeutic photons and electrons beam by linear accelerator: A Monte Carlo study Navid Khledi, Azim Arbabi, Dariush Sardari, Mohammad Mohammadi, and Ahmad Ameri	358
Properties of low-lying intruder states in ^{34}Al and ^{34}Si populated in the beta-decay of ^{34}Mg R. Lică, F. Rotaru, F. Negoită, S. Grévy, N. Mărginean, Ph. Desagne, T. Stora, C. Borcea, R. Borcea, S. Călinescu, J. M. Daugas, D. Filipescu, I. Kuti, L. M. Fraile, S. Franchoo, I. Gheorghe, D. G. Ghită, R. Mărginean, C. Mihai, P. Mourface, P. Morel, J. Mrazek, A. Negret, D. Pietreanu, T. Sava, D. Sohler, M. Stănoiu, I. Stefan, R. Șuvăilă, S. Toma, and C. A. Ur	363
Reducing the uncertainties in particle therapy C. Oancea, K. N. Shipulin, G. V. Mytsin, and Y. I. Luchin	367
Positron production at extreme light infrastructure – nuclear physics (ELI-NP) A. Oprisa, S. Balascuta, and C. A. Ur	372
The AGB star nucleosynthesis in the light of the recent $^{17}\text{O}(\text{p},\alpha)^{14}\text{N}$ and $^{18}\text{O}(\text{p},\alpha)^{15}\text{N}$ reaction rate determinations S. Palmerini, M. L. Sergi, M. La Cognata, L. Lamia, R. G. Pizzone, and C. Spitaleri	377
Study of the $^{10}\text{B}(\text{p},\alpha)^7\text{Be}$ reaction through the indirect Trojan Horse method S. M. R. Puglia, C. Spitaleri, L. Lamia, S. Romano, V. Burjan, N. Carlin, L. Chengbo, M. G. Del Santo, V. Kroha, Z. Hons, B. Irgaziev, M. La Cognata, J. Mrazek, A. Mukhamedzhanov, M. G. Munhoz, R. G. Pizzone, W. Qungang, G. G. Rapisarda, Z. Shu-Hua, M. L. Sergi, E. Somoryai, F. Souza, A. Szanto de Toledo, G. Tabacaru, A. Tumino, Y. Wakabayashi, and H. Yamaguchi	382
β-delayed α decay of ^{16}N and the $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ cross section at astrophysical energies: A new experimental approach S. Sanfilippo, S. Cherubini, S. Hayakawa, A. Di Pietro, P. Figuera, M. Gulino, M. La Cognata, M. Lattuada, C. Spitaleri, H. Yamaguchi, D. Kahl, T. Nakao, S. Kubono, Y. Wakabayashi, T. Hashimoto, N. Iwasa, Y. Okoda, K. Ushio, T. Teranishi, M. Mazzocco, C. Signorini, D. Torresi, J. Y. Moon, T. Komatsubara, P. S. Lee, K. Y. Chae, and M. S. Gwak	387
THM determination of the 65 keV resonance strength intervening in the $^{17}\text{O}(\text{p},\alpha)^{14}\text{N}$ reaction rate M. L. Sergi, C. Spitaleri, S. V. Burjan, S. Cherubini, A. Coc, M. Gulino, F. Hammache, Z. Hons, B. Irgaziev, G. G. Kiss, V. Kroha, M. La Cognata, L. Lamia, A. Mukhamedzhanov, R. G. Pizzone, S. M. R. Puglia, G. G. Rapisarda, S. Romano, N. de Séréville, E. Somorjai, and A. Tumino	392

Elastic scattering measurements for the system ${}^7\text{Be}+{}^{28}\text{Si}$ at 17.2 MeV	
O. Sgouros, A. Pakou, D. Pierroutsakou, M. Mazzocco, L. Acosta, X. Aslanoglou, A. Boiano, C. Boiano, J. Grebosz, N. Keeley, M. La Commara, G. Marquez-Duran, I. Martel, C. Parascandolo, K. Rusek, A. M. Sánchez-Benítez, C. Signorini, V. Soukeras, E. Stiliaris, E. Strano, I. Strojek, and D. Torresi	397
Impact of nuclear fission on r-process nucleosynthesis and origin of solar r-process elements	
Shota Shibagaki, Toshitaka Kajino, Grant J. Mathews, and Satoshi Chiba	402
Elastic scattering for the system ${}^6\text{Li}+p$ at near barrier energies with MAGNEX	
V. Soukeras, A. Pakou, F. Cappuzzello, L. Acosta, C. Agodi, N. Alamanos, M. Bondi, D. Carbone, M. Cavallaro, A. Cunsolo, M. De Napoli, A. Di Pietro, J. P. Fernández-García, P. Figuera, M. Fisichella, A. Foti, N. Keeley, G. Marquez-Duran, I. Martel, M. Mazzocco, D. Nicolosi, D. Pierroutsakou, K. Rusek, O. Sgouros, E. Stiliaris, E. Strano, and D. Torresi	406
Interacting supernovae and supernova impostors: Evidence of incoming supernova explosions?	
L. Tartaglia	410
Strong field physics and QED experiments with ELI-NP 2×10^{15}W laser beams	
I. C. E. Turcu, S. Balascuta, F. Negoita, D. Jaroszynski, and P. McKenna	416
Cosmic rays muon flux measurements at Belgrade shallow underground laboratory	
N. Veselinović, A. Dragić, D. Maletić, D. Joković, M. Savić, R. Banjanac, V. Udovičić, and I. Aničin	421
PART III: OUTREACH ACTIVITIES AND CLOSING	
The outreach sessions	
Livius Trache	426
CERN and 60 years of science for peace	
Rolf-Dieter Heuer	430
Closing Remarks and List of Awards	437
List of Participants	439