

PREFACE

XXXVII Mazurian Lakes Conference on Physics was held in Piaski, a vacation resort located at the lake of Beldany in the heart of the Great Mazurian Lakes District, from September 3rd till 7th, 2023. It was the 37th meeting in a series initiated over 50 years ago, in 1968, by Professor Zdzisław Wilhelmi and his students and collaborators. Throughout the years, the Mazurian conferences have gained a world-wide reputation for their high scientific merit and for a unique atmosphere. The 2023 edition was organized by the University of Warsaw, the National Centre for Nuclear Research and the Pro-Physica Foundation, and chaired by Wojciech Satuła (University of Warsaw) and Krzysztof Rykaczewski (vice-chair, ORNL Oak Ridge). We acknowledge the generous support provided by the University of Warsaw through the Faculty of Physics, Institute for Experimental Physics and Institute for Theoretical Physics, the National Centre for Nuclear Research, and NuPECC.

The title adopted for the 2023 edition, *Probing Fundamental Properties of Matter with Rare Isotopes*, highlighted the fundamental aspects of nuclear and atomic physics and their sensitivity to the signals allowing us to search for new physics in ways that are complementary to other approaches.

The program was arranged with the invaluable help of the International Advisory Board (see <http://mazurian.fuw.edu.pl>) and it was built around several main topics:

- Exotic nuclei and fundamental symmetry tests,
- Intersections of nuclear, particle, and atomic physics,
- Progress in nuclear many-body theory,
- Nuclear structure and reactions,
- Nuclear astrophysics and nucleosynthesis,
- Super-heavy elements and nuclear fission,
- New facilities and instrumentation,
- Interdisciplinary studies and societal applications.

Our conference attracted 125 physicists from 21 countries and 65 institutions, including a large number of young researchers. There were 92 oral contributions and 48 posters presented.

The program consisted of 30-minute lectures, many shorter presentations ranging from 5 to 15 minutes, and a poster session. Posters were available for viewing and discussions with their authors for the whole duration of the conference.

The conference began on Sunday evening with a general lecture — this year on applications of nuclear physics methods to climate science — given by Szymon Malinowski from the University of Warsaw.

The first morning of the conference was focused on experiments looking for new physics beyond the Standard Model. The lectures introduced the search for neutrinoless double- β decay in ^{76}Ge within the LEGEND Collaboration (Ian Guinn), two-nucleon transfer studies in the $A = 136$ region relevant for experiments using xenon detectors to look for hints of new physics (Smarajit Triambak), as well as search for exotic currents with high-precision β -decay measurements (Guy Savard, Leendert Hayen). The meeting continued with talks on β -decay studies: Giovanna Benzoni presented recent results from the DESPEC campaign at GSI, while Charlie Rasco and Oscar Naviliat-Cuncic discussed efforts undertaken to measure β -particle energy spectra.

The lectures on the second day addressed modern theoretical approaches to atomic and nuclear physics. Jacek Dobaczewski reviewed the challenges in describing odd-mass nuclei in nuclear DFT, while Piotr Magierski and Gregory Potel discussed various aspects of pairing correlations in nuclear systems. Shorter talks presented recent results of *ab-initio* and beyond-mean-field calculations, as well as modelling of structure of muonic atoms. These were complemented by an excellent introduction to laser-spectroscopy measurements given by Ági Koszorús, and a fascinating discussion of perspectives for fundamental physics studies with radioactive molecules presented by Ronald Garcia Ruiz.

Sessions on the third day covered various aspects of studies of heavy and super-heavy nuclei. Hide Sakai discussed the status and perspectives of super-heavy element research at RIKEN in the context of the search for the $Z = 119$ element, while Michael Bloch presented an overview of recent mass and laser-spectroscopy measurements addressing structure of nuclei around $Z = 100$ and $N = 152$. Dario Vretenar explored the dynamics of low-energy induced fission using microscopic models. The subject of fission was in the center of multiple short talks that followed, and the session was concluded with a presentation of the NECTAR project, aiming at surrogate-reaction measurements of cross sections for neutron-induced reactions on unstable nuclei (Beatriz Jurado) and a discussion of possible nuclear physics experiments at the future European IFMIF-DONES facility (Wojciech Królas).

We continued on the fourth day on the topic of nuclear astrophysics with a presentation on the first measurements with the SABRE array targeting proton-decaying states important for classical novae (Jeffery Blackmon) as well as results from the LUNA and STELLA collaborations that were the subject of short contributions. Philippe Di Stefano discussed the first experimental evidence for the very rare electron-capture branch from ^{40}K , and its implications for fundamental physics and geochronology, while Magda Kowalska introduced the prospects of studies using polarised unstable nuclei, both in nuclear-structure research and life sciences. Recent results regarding collectivity of mirror nuclei were presented by Kathrin Wimmer, with complementary data discussed in shorter talks.

Light nuclear and atomic systems were the topic of the last day of the conference. Rimantas Lazauskas discussed the experimental search for a narrow resonant tetraneutron, while Arseniy Filin presented the theoretical efforts aiming at reproduction of charge radii of light nuclei at a sub-percent level of accuracy. Krzysztof Pachucki focused on hyperfine splitting in light atomic systems.

Finally, a special session honoured the recipients of the Zdzisław Szymański award (Ragnar Stroberg) and Tomek Czosnyka award (Janne Pakarinen). Awards for the best presentations given by young researchers (Adam Kubiela, Luka Palada, Daniel Fernández Ruiz), short presentations accompanying posters (Andrzej Makowski, Tim Stetz, Arno Claessens), and best posters (Sonja Kujanpää, Giulia Ciconali, Corentin Hiver), sponsored by NuPECC, were presented by an international jury chaired by Giovanna Benzoni. The conference was concluded with a lecture of Witek Nazarewicz discussing challenges and prospects in nuclear theory.

A diverse social program that included activities like sailing with a regatta (won by an international crew led by Corentin Hiver), a camp fire with an international song contest (won by Aysegül Ertoprak), a classical music concert in the picturesque neo-gothic evangelical church in Wejsuny, and a crash course on the traditional Polish dance “Polonez” at the conference dinner, contributed to the unforgettable atmosphere of the Conference.

The Mazurian Conference ended with an invitation to the next nuclear physics conference in Poland, organized by physicists from Cracow, to be held in Zakopane from August 25th till September 1st, 2024. The 38th Mazurian Lakes Conference on Physics will be held in the first week of September 2025, again in the Mazurian Lakes district.

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