HK 70: Structure and Dynamics of Nuclei XII

Time: Thursday 16:00–17:45 Location: HK-H6

Group Report HK 70.1 Thu 16:00 HK-H6

Lifetime studies in self-conjugate even-even nuclei in the $0f_{7/2}$ shell — •K. Arnswald[1], A. Blazhev[1], F. Nowacki[2], P. Petkov[3,1], and P. Reiter[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Université de Strasbourg, CNRS, IPHC UMR 7178, Strasbourg, France — [3]*„Horia Hulubei“* National Institute for Physics and Nuclear Engineering, Bucharest-Măgurele, Romania

Reduced transition strengths are sensitive signatures to describe collective excitations of atomic nuclei and the evolution of shell structures. They allow for stringent tests of present-day shell-model interactions in the $0f1p$ shell. In recent years, data were obtained from lifetime experiments utilizing the recoil-distance Doppler-shift technique as well as the Doppler-shift attenuation method and cover the even-even $N = Z$ nuclei between ^{44}Ti and ^{56}Ni. An enhanced collective behavior has been observed for the 2_1^+ states [1]. In ^{44}Ti this collectivity has been associated with core excitations. Precise values along the negative parity band in this nucleus were obtained. These states arise from a strong interplay between *sd*- and *pf*-shell orbitals and provide refined tests of cross-shell contributions [2]. For the doubly-magic nucleus ^{56}Ni only the $B(E2, 2_1^+ \rightarrow 0_{\text{g.s.}}^+)$ value was known. Lifetimes of the 4_1^+ and 6_1^+ states were newly obtained and confronted with modern shell-model calculations. A comparison along the chain of $N = 28$ isotones between ^{48}Ca and ^{58}Zn shows maximum $B(E2)$ values for these states [3].

[1] K. Arnswald *et al.* Phys. Lett. B **772**, (2017) 599-606
[2] K. Arnswald *et al.* Phys. Rev. C **102**, 054302 (2020)
[3] K. Arnswald *et al.* Phys. Lett. B **820**, (2021) 136592

HK 70.2 Thu 16:30 HK-H6

Lifetime Measurement of the ^{26}O g.s. at SAMURAI — •S. Storck-Dutine[1,3], T. Aumann[1,2], C. Caesar[2,3], J. Kahlbow[4,3], V. Panin[2,3], and D. Rossi[1,2] for the NeuLAND-SAMURAI-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]RIKEN Nishina Center, Tokyo, Japan — [4]Massachusetts Institute of Technology, Cambridge MA, USA

The ground state of the neutron unbound nucleus ^{26}O is speculated to have a lifetime in the pico-second regime. In order to determine the decay lifetime of the ^{26}O ground state with high sensitivity and precision, a new method has been applied. The experiment was performed in December 2016 at the Superconducting Analyzer for MUlti-particle from RadioIsotope Beams (SAMURAI) at the Radioactive Isotope Beam Factory (RIBF) at RIKEN. A ^{27}F beam was produced in the fragment separator BigRIPS and impinged on a W/Pt target stack where ^{26}O was produced. The ratio of the number of decays happening inside and outside of the target will change according to the lifetime. Thus, the velocity difference between the decay neutrons and the fragment ^{24}O delivers a characteristic spectrum from which the lifetime can be extracted. In the report, the experimental setup and method are introduced and the current analysis status is presented.

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HK 70.3 Thu 16:45 HK-H6

Excited states from eigenvector continuation: the anharmonic oscillator — •Margarida Companys Franzke[1], Alexander Tichai[1,2,3], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Plank Institut für Kernphysik, Heidelberg

Eigenvector continuation (EC) has recently attracted a lot attention in nuclear structure and reactions as a variational resummation tool for many-body expansions. While previous applications focused on ground-state energies, excited states can be accessed on equal footing. This work is dedicated to a detailed understanding of the emergence of excited states from the eigenvector continuation approach. For numerical applications the one-dimensional quartic anharmonic oscillator is investigated, which represents a strongly non-perturbative quantum system where the use of standard perturbation techniques break down. We discuss how different choices for the construction of the EC manifold affect the quality of the EC resummation and investigate in detail the results from EC for excited states compared to results from a full diagonalization as a function of the basis-space size.

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HK 70.4 Thu 17:00 HK-H6

Gamma ray spectroscopy of the neutron-rich ^{94,95,96}Kr* - results from the NuBall and SEASTAR campaigns — Rosa-Belle Gerst, •Andrey Blazhev, and Nigel Warr — Institut für Kerphysik, Universität zu Köln

The isotopic chain of krypton isotopes is home to a variety of nuclear-shape phenomena and has been studied extensively. In recent years, we have studied the neutron-rich isotopes during the SEASTAR campaign at the RIBF at the RIKEN Nishina Center and during the NuBall campaign at the ALTO facility at the IPN Orsay. While the former populated the isotopes of interest via nucleon knockout reactions, the latter used fast-neutron induced fission of ^{238}U. In all three studied nuclei, previously unknown gamma-transitions were observed extending the level schemes [1,2]. A new short-lived isomer was discovered in ^{94}Kr [1]. For ^{95}Kr, the analysis of prompt gamma-radiation with and without coincidence of delayed radiation identified the prompt gamma-rays [2] as either feeding or bypassing the known isomeric state [3]. For ^{96}Kr, the measured new transitions imply the existence of low-lying low-spin non-yrast states [2]. The comparison of the new experimental results with 5DCH and mapped IBM calculations, both using the Gogny D1M interaction, could suggest oblate-prolate shape coexistence in the krypton isotopes already at N=60 [2].

*Supported by the DFG under Grant No. BL 1513/1-1

[1] R.-B Gerst et al., Phys. Rev. C 102, 064323 (2020).
[2] R.-B. Gerst et al., submitted to PRC.
[3] J. Genevey et al., Phys. Rev. C 73, 037308 (2006).

HK 70.5 Thu 17:15 HK-H6

Novel normal ordering framework for heavy nuclei — •Jan Hoppe[1,2], Kai Hebeler[1,2,3], Victoria Durant[4], Johannes Simonis[5], Matthias Heinz[1,2,3], Achim Schwenk[1,2,3], and Alexander Tichai[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Plank Institut für Kernphysik, Heidelberg — [4]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [5]Jülich Supercomputing Centre

The inclusion of three-nucleon (3N) interactions plays a central role in the solution of the nuclear many-body problem, e.g., for the structure of finite nuclei or bulk properties of nuclear matter, but still represents a computational frontier. Normal-ordering (NO) has proven to be a powerful tool to systematically include 3N interactions in an efficient way. However, traditional NO frameworks require the representation of 3N interactions in a large single-particle basis, which typically necessitates a truncation on the 3N matrix elements. While these truncations have only a minor impact up to medium-mass nuclei, their effects become sizable for heavier systems and hence limit the scope of ab initio calculations. We present a novel NO framework that allows to circumvent this drawback by performing the NO directly in the Jacobi basis. We systematically study the convergence behavior of results obtained in this framework and present results for ground-state energies of selected nuclei up to ^{132}Sn. *Funded by the DFG - Project-ID 279384907 - SFB 1245 and by the ERC Grant Agreement No. 101020842.

HK 70.6 Thu 17:30 HK-H6

Electron-Gamma Coincidence Experiments at the S-DALINAC — •Gerhart Steinhilber, Jonny Birkhan, Isabelle Brandherm, Martha Liliana Cortes, Florian Gaffron, Johann Isaak, Igor Jurosevic, Peter von Neumann-Cosel, Florian Niederschuh, Norbert Pietralla, Maxim Singer, and Maximilian Spall — IKP, Technische Universität Darmstadt

Inclusive (e,e') electron scattering is an established tool in nuclear physics that provides insights in nuclear structure with high accuracy because of its pure electromagnetic nature. In (e,e'γ) coincidence experiments, the advantage of inclusive electron scattering is preserved and additional information, for example, γ-decay branchings of PDR/GDR and the interference of longitudinal and transversal

components of low-lying electric dipole excitations are accessible. The existing (e,e') setup at S-DALINAC was extended by a detector array consisting of 6 $LaBr_3$:Ce detectors and successful (e,e'γ) measurements were conducted for the first time since the pioneering (e,e'γ) experiment nearly 40 years ago [1]. In 2021, a first production run was performed using the new (e,e'γ) setup to study the B(M1,$2^+_{ms}\rightarrow 2^+_1$) and B(E2,$2^+_{ms}\rightarrow 0^+_1$) transition strength of the 2^+_{ms} branching in ^{96}Ru [2] measuring γ-decay branchings. This talk will present the new setup and preliminary results of the ^{96}Ru measurement.

Work supported by DFG (GRK 2128)

[1] C. N. Papanicolas et al., Phys. Rev. Lett. 54 (1985).
[2] N. Pietralla et al., Phys. Rev. C 64 (2001).