HK 21: Structure and Dynamics of Nuclei IV

Time: Tuesday 17:00–18:45 Location: SCH/A215

Group Report HK 21.1 Tue 17:00 SCH/A215

Recent Highlights of the DESPEC Experiment at FAIR Phase-0 — •Nicolas Hubbard for the DESPEC-Collaboration — Institut für Kernphysik, Technische Universitität Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschug, Darmstadt, Germany — Helmholtz Forschungsakademie Hessen für FAIR (HFHF) GSI Campus Darmstadt, Darmstadt, Germany

The DESPEC (DEcay SPECtroscopy) experiment is part of the NUSTAR pillar of FAIR and involves the measurement of decay properties of exotic radioisotopes far away from the valley of stability, in order to understand the nuclear force and the origin of the elements. This group report will report on the recent activities during 2022 of the DESPEC collaboration, including recent technical developments and preliminary results from two physics experiments performed at GSI in Darmstadt as part of the FAIR Phase-0 programme: The study of isomeric and beta decays of the $N = 126$ Nuclei ^{202}Os and ^{203}Ir, and the investigation of the β-strength crossing $N = 126$ and the formation of the 3rd r-process abundance peak via total absorption spectroscopy

HK 21.2 Tue 17:30 SCH/A215

Nuclear shell structure studies in the vicinity of doubly magic ^{100}Sn and ^{132}Sn — •Michał Mikołajczuk[1,2] and Magdalena Górska-Ott[2] — [1]Faculty of Physics, University of Warsaw, Poland — [2]GSI, Darmstadt, Germany

In the field of nuclear structure physics, the neighborhood of doubly magic nuclei such as ^{100}Sn and ^{132}Sn remains one of the most intriguing regions along the Segrè chart. Over the last few decades many experimental efforts were made to acquire data neccessary to describe and understand shell structure evolution in the aforementioned regions. Based on experimental data, the state-of-the-art shell model calculations provide further insight into the properties of nuclear structure, broadening our understanding of nucleon-nucleon interaction. This presentation will discuss results of employing well established interactions such as JUN45 [1], Gross-Frenkel [2] and MHJ [3], to neutron closed shell nuclei, namely ^{98}Cd, ^{130}Cd, ^{96}Pd, ^{128}Pd. Calculation results are compared with up to date available experimental data and validity of the used models and obtained conclusions will be discussed.

[1] M. Honma et al., PRC80, 064323 (2009).
[2] R. Gross and A.Frenkel, Nucl. Phys. A267, 85 (1976).
[3] M. Hjorth-Jensen et al., Phys. Repts, 267 (1995).

HK 21.3 Tue 17:45 SCH/A215

Investigation of shape coexistence in ^{116}Te via lifetime measurements — •Franziskus v. Spee[1], Marcel Beckers[1], Andrey Blazhev[1], Arwin Esmaylzadeh[1], Felix Dunkel[1], Christoph Fransen[1], Jan Jolie[1], Lisa Kornwebel[1], Casper-David Lakenbrink[1], and Claus Müller-Gatermann[2] — [1]Institut für Kernphysik, Cologne, Germany — [2]Physics Division, Argonne National Laboratory, Argonne, Illinois, USA

In mid-shell Te isotopes, hints for shape coexistence have been found [1]. However, experimental evidence is scarce, since experiments on neutron-deficient Te isotopes are challenging. Experimental data on transition strengths in ^{116}Te could give further insight. Therefore, a recoil distance Doppler shift experiment was performed to investigate transition strengths between low-lying states in ^{116}Te at the FN-Tandem accelerator facility of the IKP Cologne. To populate low-lying, low-spin states, the reaction ^{112}Sn(^{12}C,^{8}Be)^{116}Te was used. The γ rays were detected in coincidence with α particles stemming from the decay of ^{8}Be. To detect the α particles, silicon particle detectors were used. These were covered with aluminum foil that prevented any heavier ions to penetrate the detector. This results in very clean γ spectra even though the cross section for the reaction of interest is rather low. This allowed for the first-time determination of lifetimes of low-lying off-yrast states. This work was supported by the Deutsche Forschungsgemeinschaft (DFG) under contract numbers FR 3276/2-1 and DE 1516/5-1.

[1] P. Garrett *et al.*, Prog. Part. Nucl. Phys. **124** (2022) 103931.

HK 21.4 Tue 18:00 SCH/A215

Exploring the isoscalar - isovector symmetries in 94Ru, 95Rh, 94Pd and 96Pd nuclei by means of lifetime measurements — •Biswarup Das for the DESPEC-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH - Darmstadt, Germany

The nuclei of interest were produced in the projectile fragmentation of a 850 MeV/nucleon 124Xe beam impinging on a 4 g/cm2 9Be target, as the first of a series of commissioning *FAIR-0* experiments with the DESPEC experimental setup at the GSI- FAIR facility in Germany. The isomeric state of 94Pd and 96Pd were populated directly, whereas the β-decay of 95Pd populates the isomeric states of 94Ru and 95Rh. The nuclei were implanted on an active stopper, AIDA, and the γ-rays of interest were detected using the six triple cluster HPGe detectors as well as 36 LaBr3(Ce) detectors of the FAst Timing Detector Array (FATIMA). Direct lifetime measurements via γ- γ coincidences using FATIMA has been applied to determine the lifetimes for the yrast states below the isomer of the mentioned nuclei. The Generalised Centroid Difference (GCD) method was implemented for the lifetimes residing in the picosend regime. The transition rates were obtained from the measured lifetimes and the BE(2) values were compared with the standard shell model calculations. With the remeasured 96Pd lifetimes the new results for the 94Ru nucleus was successfully described using the $\Delta\nu$=2 seniority admixture allowed in the fpg model space using the Jun-45 interaction , on the other hand a large anomaly from the seniority scheme was found for the 95Rh.

HK 21.5 Tue 18:15 SCH/A215

Structural investigation of neutron-deficient ^{168}W — •Christoph Fransen[1], Lisa Kornwebel[1], Kalle Auranen[2], Marcel Beckers[1], Mike Carpenter[3], Tuomas Grahn[2], Paul Greenlees[2], Rauno Julin[2], Jan Jolie[1], Filip G. Kondev[3], Casper-David Lakenbrink[1], Claus Müller-Gatermann[1,3], Darek Seweryniak[3], Franziskus von Spee[1], Nigel Warr[1], and Shaofei Zhu[3] — [1]IKP, Univ. of Cologne, Germany — [2]JYFL, Jyväskylä, Finland — [3]Argonne Natl. Lab, Illinois, USA

In several neutron deficient nuclei in the A=180 region both shape coexistence and rapid shape transitions were identified. Further, $B(E2;4_1^+ \rightarrow 2_1^+)/B(E2;2_1^+ \rightarrow 0_1^+) = B_{4/2}$ ratios < 1 were found in some neutron deficient Os–W–Pt nuclei far from closed shells. This cannot be explained with any collective model. Shape coexistence could be an explanation, but there are no such cases known so far. Older data [1] yield that ^{168}W is just at the transition point from "normal" collectivity to the "island" of nuclei with $B_{4/2} < 1$. However, these data might suffer from assumptions on side feeding of the related states. Therefore, and to learn on the structural evolution within the yrast band of ^{168}W, we performed an experiment with the recoil distance Doppler-shift technique on ^{168}W at Argonne National Laboratory with the GAMMASPHERE spectrometer to determine transition strengths from level lifetimes using $\gamma\gamma$ coincidences. We present these data with respect to rapid shell evolution in this region.

Supported by the DFG, grant Nos. FR 3276/2-1 and DE 1516/5-1.

[1] G.D. Dracoulis et al. Phys. Rev. C 29, 1576 (1984)

HK 21.6 Tue 18:30 SCH/A215

Isomer and excited-state lifetimes around ^{190}W * — •Sultan Alhomaidhi[1,2], E. Sahin[1,2], V. Werner[1], P.H. Regan[3], J. Jolie[4], N. Pietralla[1], and J. Gerl[2] — [1]IKP, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]U Surrey, UK — [4]IKP, U Köln, Germany

In March 2021, the DESPEC experiment S452 was performed at GSI. The focus of the experiment was to measure the lifetimes and energies of exited states of neutron-rich isotopes in the A∼190 mass region, to probe a predicted [1,2] prolate-oblate shape transition. The experimental setting allowed us to investigate the single-particle structures of isomers and connect their decays to the shape evolution. The main nuclei of interest, ^{189}Ta and ^{190}W, were populated by the fragmentation of a ^{208}Pb primary beam impinging on a ^{9}Be target. The cocktail beam was separated and identified using FRS to implant the nuclei of interest in AIDA. The γ rays from the implanted ions were detected by 36 $LaBr_3$(Ce) detectors of FATIMA and 2 EUROBALL cluster detectors, surrounding AIDA. Data obtained in this experiment is analyzed on an event-by-event basis, for which the analysis is in progress. An overview of the DESPEC setup, the analysis procedures and preliminary results of the isomeric lifetime of ^{189}Ta and the B(E2) strength of the first 2^+state of ^{190}W will be presented in the conference.

[1] J. Jolie et al., Phys. Rev. Lett. 89, 182502 (2002).

[2] J. Jolie and A. Linnemann, Phys. Rev. C 68, 031301(R), (2003).
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