HK 26: Structure and Dynamics of Nuclei VII

Time: Wednesday 14:00–15:30 Location: HS 2 Physik

Group Report HK 26.1 Wed 14:00 HS 2 Physik

State-of-the-art nuclear structure studies with the recoil distance Doppler-shift technique — •Christoph Fransen[1], Andrey Blazhev[1], Felix Dunkel[1], Arwin Esmaylzadeh[1], Carina Heymer[1], Jan Jolie[1], Casper-David Lakenbrink[1], Claus Müller-Gatermann[2], Richard Novak[1], Franziskus von Spee[1], Nigel Warr[1], and Michael Weinert[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Argonne National Laboratory, Illinios, USA

Absolute transition strengths between excited states yield fundamental information on nuclear structure and can be determined from level lifetimes. The recoil distance Doppler-shift (RDDS) technique employing so-called plunger devices provides a valuable method for the determination of lifetimes in the picosecond range and has been in the focus of our Cologne group since many years. Here, we will present our latest developments of the RDDS technique with respect to the application with very different experimental conditions and the required detection techniques to identify the reaction products. We will also discuss new results from RDDS measurements of our group in tellurium isotopes close to neutron midshell where the data give hints for shape coexistence. Furthermore, we will give an overview of our recent lifetime measurements in neutron-deficient nuclei in the $A = 170$ region. In these nuclei, a $B(E2)$ anomaly was already found for the lowest yrast states. Our new results allow to test different state-of-the-art nuclear model approaches aiming for an understanding of this anomaly also towards higher yrast states.

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HK 26.2 Wed 14:30 HS 2 Physik

Study of the spin-flip orbitals in N = 83 isotones with lifetime measurement via (n, gamma) reactions — •zhiqiang chen[1], kathrin wimmer[1], elisa maria gandolfo[1], martha reece[1], wiktor poklepa[1], caterina michelagnoli[2], jean michel daugas[2], lorenzo domenichetti[2], and zhihuan li[3] — [1]GSI, Darmstadt, Germany — [2]ILL, Grenoble, France — [3]PKU, Beijing, China

The spin-orbit (SO) splitting is closely linked to nuclear shell gaps and magic numbers. This splitting can be significantly reduced in exotic nuclei with extreme N/Z ratios, a phenomenon that remains poorly understood. The energies of the spin-flip $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals above the $N = 82$ shell closure are still not well established. Astonishingly, even in nuclei close to stability the $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals are not well characterized.

To achieve a comprehensive understanding of the SO splitting between the $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals in $N = 83$ isotones, a thermal neutron capture experiment was conducted at the Institut Laue-Langevin (ILL), Grenoble. γ-rays from (n, γ) reaction were measured using a new HPGe array, comprising eight FIPPS Clover and eight IFIN-HH Clover detectors. Properties of the $\nu p_{1/2}$ and $\nu p_{3/2}$ orbitals in $^{139}Ba_{83}$ and $^{141}Ce_{83}$ will be characterized by deriving the $B(M1; 1/2^- \rightarrow 3/2^-)$ values. This involves determining the mixing ratio $\delta(M1/E2)$ through γ-γ angular correlations and the lifetimes of the $1/2^-$ states using the Gamma Ray Induced Doppler Shift Attenuation method. In this talk, I will present some preliminary results on the lifetime measurements of low-lying states in $^{139}Ba_{83}$ and $^{141}Ce_{83}$.

HK 26.3 Wed 14:45 HS 2 Physik

Lifetime determination and level-scheme reconstruction in ^{104}Ru using particle-γ coincidences — •Anna Bohn, Elias Binger, Tobias Langel, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The Cologne particle-γ detector array SONIC@HORUS [1] is a powerful tool for nuclear structure investigations. It enables the measurement of p-γ and p-γ-γ coincidences, providing full reaction kinematics while excluding feeding contributions from higher-lying states. This capability makes it an ideal setup for the (p,p'γ) Coincidence Doppler-Shift Attenuation Method (CDSAM) [2,3], enabling lifetime measurements in the sub-picosecond regime, as well as level-scheme reconstruction. Several CDSAM experiments on stable even-even isotopes along the A $\approx$ 100 mass region have been performed at the University of Cologne in recent years [4-6]. Results obtained on ^{104}Ru via p-γ and p-γ-γ coincidence analysis will be presented in this contribution.

Supported by the DFG (ZI 510/9-2).

[1] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875** (2017) 104.
[2] A. Hennig *et al.*, Nucl. Instr. Meth. A **794** (2015) 171.
[3] M. Spieker *et al.*, Phys. Rev. C **97** (2018) 054319.
[4] A. Hennig *et al.*, Phys. Rev. C **92** (2015) 064317.
[5] S. Prill *et al.*, Phys. Conf. Ser. **1643** (2020) 012157.
[6] S. Prill *et al.*, Phys. Rev. C **105** (2022) 034319.

HK 26.4 Wed 15:00 HS 2 Physik

First measurement of the lifetime of the 2_1^+ state of ^{200}Pt — •C.M. Nickel[1], V. Werner[1], P.R. John[1], U. Ahmed[1], C. Costache[2], K.E. Ide[1], N.M. Mărginean[2], H. Mayr[1], C. Mihai[2], R.E. Mihai[2,3], N. Pietralla[1], T. Stetz[1], A. Weber[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]IFIN-HH, Bucharest-Măgurele — [3]IEAP, CTU Prague

The W, Os, Pt and Hg isotopes exhibit shape transitions between oblate, prolate, γ-soft and spherical nuclei [1]. The neutron-rich Pt isotopes transition from γ-softness towards sphericity, as indicated by the energy ratio $R_{4/2}$, when approaching the neutron-shell closure at $N = 126$. In the vicinity of shell closures, quadrupole collectivity is expected to decrease and, hence, the $B(E2; 2_1^+ \rightarrow 0_1^+)$ transition strength which is inversely proportional to the lifetime of the 2_1^+ state. ^{200}Pt is the lightest neutron-rich Pt isotope without a known $B(E2; 2_1^+ \rightarrow 0_1^+)$ value and could sit at the transitional point between a γ-soft and a spherical shape. Therefore, the ^{198}Pt(^{18}O,^{16}O)^{200}Pt* two-neutron transfer reaction was studied in a recoil-distance Doppler-shift experiment at the IFIN-HH in Bucharest-Măgurele using the ROSPHERE array equipped with 25 HPGe detectors and the SORCERER particle detector. Correcting for contaminants as well as taking de-orientation into account, allowed the application of the differential decay curve method to determine the lifetime of 2_1^+ state of ^{200}Pt for the first time. The analysis and resulting $B(E2; 2_1^+ \rightarrow 0_1^+)$ value will be presented.

[1] Z. Podolyák *et al.*, Phys. Rev. C **79** 031305 (2009).

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HK 26.5 Wed 15:15 HS 2 Physik

Fast timing@nu-Ball2 fission campaign: first results for the neutron-rich Kr isotopes — •Julia Fischer[1], Andrey Blazhev[1], Jan Jolie[1], Andi Messingschlager[2], Sorin Pascu[3], Martin von Tresckow[2], Nigel Warr[1,4], and Jonathan Wilson[5] for the nu-Ball2 N-SI-120-Collaboration — [1]IKP Cologne — [2]TU Darmstadt — [3]U Surrey — [4]Oliver Lodge Laboratory Liverpool — [5]IJCLab Orsay

Neutron-rich Kr isotopes have been shown to undergo a moderate evolution of collective structure and have been recently studied in two complementary campaigns [1,2]. To further address the nuclear structure, these nuclei were also studied at IJCLab Orsay as part of the Nuball2 fission campaign in 2022, produced by the fast-neutron-induced fission reaction ^{238}U(n,f). The measurement was performed with the nu-Ball2 spectrometer, a hybrid γ-spectrometer equipped with HPGe and $LaBr_3$(Ce) detectors, which provide excellent energy and timing resolution, respectively. In comparison to the first fission campaign in 2018, nu-Ball1, a number of improvements on the spectrometer and the beamline were made, in particular the tripling of the $LaBr_3$(Ce) coincidence efficiency (from 0.7% to 2.1%). First preliminary results of lifetimes in neutron-rich Kr will be presented as well as compared with 5DCH and mapped IBM calculations [2].*Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) grant 05P21PKFN1.

[1] R.-B. Gerst et al., PRC 102, 064323 (2020).
[2] R.-B. Gerst et al., PRC 105, 024302 (2022).