HK 41: Structure and Dynamics of Nuclei VII

Time: Wednesday 15:45–17:15 Location: SCH/A118

Group Report HK 41.1 Wed 15:45 SCH/A118

Lifetime measurements via the coincidence Doppler-shift attenuation method in Cologne — •Anna Bohn, Christina Deke, Felix Heim, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

A powerful tool to determine nuclear level lifetimes in the sub-picosecond regime is the coincidence Doppler-shift attenuation method (DSAM) [1,2]. The target is positioned inside the combined particle-γ detector array SONIC@HORUS [3]. This allows reconstruction of the complete reaction kinematics for each event. Therefore, feeding contributions from higher lying states to the transition of interest are eliminated and specific transitions can be precisely selected. Hence, lifetimes of several dozens of excited states can be determined from a single experiment, using that the emission-angle dependent Doppler-shift of the deexciting γ-ray energy is linked to the attenuation time of the recoiling nucleus. Systematic studies were performed along isotopic chains [4-6], including Zr, Ru, Sn, and Te. Recent results obtained via the DSA method and by spectroscopy benefitting from coincidence measurements will be presented.

Supported by the DFG (ZI-510/9-1).

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

HK 41.2 Wed 16:15 SCH/A118

Nuclear Structure Studies from Mass Spectrometry of Isomeric States — •Lukas Nies — CERN, Switzerland — University of Greifswald, Germany

The nuclear binding energy arises from various effects that govern a nuclei's properties. Different nucleon configurations within nuclear isomers lead to modified binding energies, often resulting in mass differences of tens to hundreds of kilo-electronvolts. These isomeric excitation energies can be directly accessed by measuring the difference in atomic masses of ground and isomeric states. Here, we present such measurements performed with the ISOLTRAP mass spectrometer located at ISOLDE/CERN. By evaluating the excitation energies of neutron-deficient indium isotopes down to the shell closure at N=50 against state-of-the-art shell model, DFT, and ab initio calculations, we contrast the performance of these theories applied to several nuclear properties. We further present evidence for shape-coexistences close to N=50 through the precise excitation energy measurement of the $(1/2)^+$ state in zinc-79, supported by accurate large-scale shell model calculations.

HK 41.3 Wed 16:30 SCH/A118

Lifetime measurement of excited states in ^{116}Xe — •Casper-David Lakenbrink[1], Marcel Beckers[1], Andrey Blazhev[1], Felix Dunkel[1], Arwin Esmaylzadeh[1], Christoph Fransen[1], Jan Jolie[1], Lisa Kornwebel[1], Claus Müller-Gatermann[2], and Franziskus v. Spee[1] — [1]IKP, Universität zu Köln, Deutschland — [2]Physics Division, Argonne National Laboratory, IL , USA

In the Sn, Te and Xe isotope chains, previous experiments showed a drop for the $B_{4/2} = B(E2; 4_1^+ \to 2_1^+)/B(E2; 2_1^+ \to 0_1^+)$ ratio of nuclei with mass $A \leq 114$. If this is caused by a shell effect, as is expected, the drop should correspond to the neutron number rather than the mass number and would be expected to happen at ^{116}Xe already. Transition strengths in ^{116}Xe have only once been measured using singles spectra, possibly suffering from undetected feeding. Thus, lifetimes in ^{116}Xe were evaluated using $\gamma\gamma$-coincidence data from a recoil-distance Doppler-shift experiment to investigate transition strengths without the need for assumptions on feeding. Excited states in ^{116}Xe were populated in the fusion-evaporation reaction ^{102}Pd(^{16}O,2n)^{116}Xe at the FN-tandem accelerator at the Institute for Nuclear Physics, University of Cologne. Lifetimes of the $2_1^+, 4_1^+$ and 6_1^+ states were evaluated using the differential decay-curve method as well as the lifetime of the 7_1^- state using simulations of spectra considering Doppler-shift attenuation effects. The corresponding B(E2), B(E1) values were calculated. We will present the results and compare these to a previous measurement as well as IBM1 calculations. This work was supported by the DFG, grant Nos. FR 3276/2-1 and DE 1516/5-1.

HK 41.4 Wed 16:45 SCH/A118

First direct lifetime determination of the 2_1^+ state of ^{210}Pb — •C. M. Nickel[1], M. Beckers[2], D. Bittner[2], A. Blazhev[2], A. Esmaylzadeh[2], B. Falk[2], C. Fransen[2], J. Garbe[2], L. Gerhard[2], K. Geusen[2], A. Goldkuhle[2], K. E. Ide[1], P. R. John[1], J. Jolie[2], V. Karayonchev[2], R. Kern[1], E. Kleis[2], L. Klöckner[2], M. Ley[2], N. Pietralla[1], G. Rainovski[3], F. Spee[2], M. Steffan[2], T. Stetz[1], V. Werner[1], and J. Wiederhold[1] — [1]TU Darmstadt — [2]U Cologne — [3]U Sofia

The investigation of transitions from the 2_1^+ to the g.s. in nuclei close to the doubly-magic ^{208}Pb allows to constrain parameters from nuclear models, e.g. the effective charges of the shell model. Nuclei containing two valence nucleons, like ^{210}Pb, are of particular importance [1], as their fundamental excitations form the low-lying nuclear states. The 2_1^+ state of ^{210}Pb was directly populated in a two neutron transfer reaction at the 10 MV FN Tandem Accelerator at the IKP of the University of Cologne. Its lifetime was measured using the Cologne plunger device and the RDDS method. The gamma radiation was detected with HPGe detectors and the back-scattered beam-like particles with silicon detectors. Corrections for contaminants were performed and, thus, for the first time the lifetime of the 2_1^+ state of ^{210}Pb was directly determined, being consistent with, but considerably more precise than, the only existing literature value obtained from triton scattering [2].

[1] D. Kocheva et al., Eur. Phys. J. A 53, 175 (2017).
[2] C. Ellegaard et al., Nucl. Phys. A 162, 1 (1971).
*Supported by the BMBF under Grant No. 05P21RDCI2.

HK 41.5 Wed 17:00 SCH/A118

Evolution of the first mixed-symmetry 2^+ state in the N=80 isotones — •T Stetz[1], R Zidarova[1], R Kern[1], V Werner[1], N Pietralla[1], T Abraham[2], U Ahmed[1], G Colucci[2], K Hadyńska-Klek[2], K E Ide[2], G Jaworski[2], M Kisieliński[2], M Komorowska[2], M Kowalczyk[1], M Liliana Cortes[2], P Napiorkowski[1], C Nickel[2], M Palacz[3], G Rainovski[2], J Samorajczyk-Pyśk[2], J Srebrny[3], M Stoyanova[2], A Trzcińska[2], K Wrzosek-Lipska[2], and B Zalewski[1] — [1]TU Darmstadt — [2]HIL Warsaw — [3]U Sofia

The evolution of the first mixed-symmetry 2^+ state in the N=80 isotones from ^{132}Te to ^{142}Sm has been of great interest for the past two decades [1,2,3,4,5]. A recent CoulEx experiment to investigate the M1 strength of the $2^+_{\mathrm{ms},1} \to 2_1^+$ transition of ^{142}Sm has been performed at HIE-ISOLDE [6]. A complementary experiment to determine the multipole mixing ratio of the aforementioned transition was conducted at the HIL in Warsaw in 2021. Combined, these experiments will expand the understanding of the first mixed-symmetry 2^+ state in this isotonic chain.

[1] M. Danchev *et al.*, Phys. Rev. C **84** (2011) 061306(R)
[2] T. Ahn *et al.*, Phys. Lett. B **679** (2009) 1
[3] N. Pietralla *et al.*, Phys. Rev. C **58** (1998) 796
[4] G. Rainovski *et al.*, Phys. Rev. Lett. **96** (2006) 122501
[5] R. Kern *et al.*, Phys. Rev. C **102** (2020) 041304(R)
[6] R. Kern *et al.*, J. Phys.: Conf. Ser. **1555** (2020) 012027
*Supported by BMBF 05P18RDCIA-TP1 and 05P21RDCI2-TP1