HK 13: Structure and Dynamics of Nuclei IV

Zeit: Montag 16:30–18:30 Raum: S1/01 A04

Gruppenbericht HK 13.1 Mo 16:30 S1/01 A04

A systematic fast-timing study of even-even nuclei in the well deformed A 170-180 region. — •J. Jolie[1], J.M. Régis[1], M. Dannhoff[1], R.B. Gerst[1], V. Karayonchev[1], C. Müller-Gattermann[1], M. Rudigier[1,2], N. Saed-Samii[1], S. Stegemann[1], and A. Blazhev[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Department of Physics, University of Surrey

At the Cologne Tandem accelerator we are performing a systematic study of lifetimes in the ground state bands of well deformed even-even nuclei in order to increase the precision of the ns-ps lifetimes and to solve inconsistencies in the literature. The measurements are done using Orange spectrometers, LaBr3(Ce) scintillators and Ge detectors. The data are analyzed using the slope and the generalized centroid difference method. The latter allows the measurement of lifetimes down to 5 ps [1]. First results on Yb, Hf and W isotopes will be presented.

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[1] J.M. Régis et al. Nucl. Instr. and Meth. in Phys. Res. A 726, 191 (2013)

HK 13.2 Mo 17:00 S1/01 A04

Lifetime measurements in ^{170}Yb using the Generalized Centroid Difference Method — •Vasil Karayonchev, Jean-Marc Régis, Jan Jolie, Moritz Dannhoff, Nima Saed-Samii, and Andrey Blazhev — Institute of Nuclear Physics, University of Cologne, Cologne, Germany

An experiment using the electronic $\gamma-\gamma$ "fast-timing" technique was performed at the 10MV Tandem Van-De-Graaff accelerator of the Institute for Nuclear Physics, Cologne in order to measure lifetimes of the yrast states in ^{170}Yb. The lifetime of the first 2^+ state was determined using the slope method, which means by fitting an exponential decay to the "slope" seen in the energy-gated time-difference spectra. The value of $\tau = 2.201(57)$ ns is in good agreement with the lifetimes measured using other techniques. The lifetimes of the first 4^+ and the 6^+ states are determined for the first time. They are in the ps range and were measured using the generalized centroid difference method, an extension of the well-known centroid-shift method and developed for fast-timing arrays. The derived reduced transition probabilities $B(E2)$ values are compared with calculations done using the confined beta soft model and show good agreement within the experimental uncertainties.

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HK 13.3 Mo 17:15 S1/01 A04

Fast-timing lifetime measurement of ^{178,180}Hf — •Johannes Wiederhold[1], Ralph Kern[1], Volker Werner[1], Norbert Pietralla[1], Nico Marginean[2], Raluca Marginean[2], Cristina Roxana Nita[2], Sorin Pascu[2], Dorel Bucurescu[2], Dan Mihai Filipescu[2], Nicoleta Florea[2], Dan Gabriel Ghita[2], Constantin Mihai[2], Razvan Lica[2], Patrick Regan[3], Robert Carroll[3], Terver Daniel[3], Laila Gurgi[3], Ralitsa Ilieva[3,4], Nathan Cooper[4], and Farheen Naqvi[4] — [1]IKP, TU-Darmstadt — [2]IFIN-HH, Bucharest — [3]Physics Department at Surrey — [4]Yale University

Deformed nuclei in the rare earth region should show a saturation of the $B(E2;0_1^+ \rightarrow 2_1^+)$-transition strength near the mid-shell. Recent measurements of lifetimes of W-isotopes show discrepancies to literature values and seem to maximize the $B(E2)$-strength off mid-shell. An analog investigation is done on Hf-isotopes. The lifetimes $\tau(2_1^+)$ of ^{178}Hf and ^{180}Hf have been measured using fast electronic scintillation timing (FEST) at the 9 MV tandem accelerator of the IFIN-HH near Bucharest. Excited States of ^{180}Hf were populated via coulomb excitation and of ^{178}Hf via β^+-decay following the reaction ^{174}Yb(^{7}Li,3n)^{178}Ta. Because the target of ^{180}Hf was contaminated by 5% of ^{178}Hf and both isotopes have nearly the same transition energies ($\Delta E \leq 1$ keV) for the $4_1^+ \rightarrow 2_1^+$- and $2_1^+ \rightarrow 0_{gs}^+$-transitions, a correction has to be applied using the lifetime of the 2_1^+-state of ^{178}Hf. Preliminary results for these lifetimes will be presented. This work was supported by the DFG under the Grant No. SFB 634 and the U.S. DOE Grant No. DE-FG02-91ER40609.

HK 13.4 Mo 17:30 S1/01 A04

Quadrupole collectivity in ^{138,140,142}Xe — •Corinna Henrich, Thorsten Kroell, and Stoyanka Ilieva for the IS411 and EXILL-FATIMA-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

The region around the doubly magic nucleus ^{132}Sn is of special interest as both single-particle and mean-field approaches can be applied by theory. In order to gain further understanding on the nuclear structure in this region, a 'safe' Coulomb excitation experiment was carried out at REX-ISOLDE (CERN, Geneva) using the MINIBALL spectrometer (IS411 campaign). As only a small center-of-mass range on the particle detector was accessible, the sensitivity on the quadrupole moments of the first 2^+ and 4^+ state using just that data is relatively small. Therefore, additional information provided by the direct lifetime measurement at ILL (Grenoble, France) using the EXILL&FATIMA spectrometer was crucial for the analysis. The final results of the analysis along with a comparison to predictions of several theoretical models is presented.

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HK 13.5 Mo 17:45 S1/01 A04

Lifetimes of excited states in neutron-rich Xe isotopes — •Stoyanka Ilieva and Thorsten Kroell for the EXILL-FATIMA-Collaboration — Institut für Kernphysik, TU Darmstadt

The EXILL&FATIMA campaign at ILL, Grenoble is the first prompt-fission γ-ray spectroscopy experiment performed with a mixed array of Ge detectors (EXILL) and fast $LaBr_3$(Ce) scintillators (FATIMA). The lifetimes of excited states, populated by neutron-induced fission of ^{235}U and ^{241}Pu targets, were directly measured. The high-resolution EXILL detector gives us the possibility to identify the nuclides of interest among the large amout of produced fission fragments. Using the generalized centroid difference method [1] to analyse the data from FATIMA we could measure lifetimes down to ≈ 10 ps.

The lifetime of an excited state is a direct measure for the strength (collectivity) of a transition. The properties of the excited states in even-even nuclei can be largely described by quadrupole and octupole degrees of freedom. This contribution will present the current status of the analysis for the neutron-rich even-even ^{138,140,142}Xe isotopes which lie in the vicinity of the double shell closure $Z = 50$ and $N = 82$. Through the direct lifetime measurement we aim to study the evolution of quadrupole and octupole collectivity above ^{132}Sn.

[1] *J.-M. Régis et al., NIM A 763 (2014) 210*

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HK 13.6 Mo 18:00 S1/01 A04

Exited-state lifetimes in neutron-rich Ce isotopes from EXILL&FATIMA — •P. Koseoglou[1], V. Werner[1,2], N. Pietralla[1], I. Stoyanka[1], C. Bernards[2], A. Blanc[3], A.M. Bruce[4], R.B. Cakirli[5], N. Cooper[2], G. de France[6], P. Humby[7], M. Jentschel[3], J. Jolie[8], U. Koester[3], T. Kröll[1], P. Mutti[3], Z. Patel[7], V. Paziy[9], Zs. Podolyak[7], P.H. Regan[7], J.-M. Régis[8], O.J. Roberts[4], N. Saed-Samii[8], G.S. Simpson[10], T. Soldner[3], C.A. Ur[11], W Urban[3], D. Wilmsen[8], and E. Wilson[7] — [1]IKP TU-Darmstadt, Darmstadt, Germany — [2]Yale University, USA — [3]ILL Grenoble, France — [4]University of Brighton, England — [5]MPIK Heidelberg, Germany — [6]GANIL Caen, France — [7]University of Surrey, England — [8]KP University of Cologne, Germany — [9]Universidad Complutense, Spain — [10]PSC Grenoble, France — [11]INFN Legnaro, Italy

235U and 241Pu fission fragments were measured by a mixed spectrometer consisting of high-resolution Ge and fast LaBr3(Ce)-scintillator detectors at the high-flux reactor of the ILL. Prompt γ-ray cascades from the nuclei of interest are selected via Ge-Ge-LaBr3-LaBr3 coincidences. The good energy resolution of the Ge allow precise gates to be set, selecting the cascade, hence, the nucleus of interest. The excellent timing performance of the LaBr3 detectors in combination with the General Centroid Difference method allows the measurement of lifetimes in the ps range in preparation for the FATIMA experiment at FAIR. The first results on neutron-rich Ce isotopes are presented. Supported by HGS-HIRe

HK 13.7 Mo 18:15 S1/01 A04

Lifetime measurements in self-conjugate nuclei ^{44}Ti, ^{48}Cr and ^{52}Fe — •K. Arnswald, P. Reiter, B. Birkenbach, A. Blazhev, T. Braunroth, A. Dewald, C. Fransen, B. Fu, A. Hennig, R. Hirsch, L. Lewandowski, J. Litzinger, C. Müller-Gatermann, D. Rosiak, N. Saed-Samii, D. Schneiders, M. Seidlitz, B. Siebeck, T. Steinbach, A. Vogt, K. Wolf, and K.O. Zell — Institut für Kernphysik, Universität zu Köln

Reduced transition strengths expressed with $B(E2)$ values are sensitive signatures to describe collective excitations of atomic nuclei and are indispensable to understand nuclear shell structures. Along the $N = Z$ line in the $1f_{7/2}$ shell they provide stringent tests of recent shell-model interactions. So far, $B(E2, 2_1^+ \rightarrow 0^+_{\text{g.s.}})$ values for the self-conjugate $^{44}_{22}$Ti, $^{48}_{24}$Cr, $^{52}_{26}$Fe isotopes are known only with considerable errors. Recoil Distance Doppler-Shift (RDDS) experiments were performed employing the Cologne coincidence plunger device to measure lifetimes with high precision in order to deduce model-independent $B(E2)$ values. Excited states in the nuclei of interest were populated with fusion-evaporation reactions. γ rays were detected by an array of 12 HPGe detectors. Precise $B(E2, 2_1^+ \rightarrow 0^+_{\text{g.s.}})$ values are measured to be 204^{+16}_{-14} e^{2}fm^4, 262 ± 3 e^{2}fm^4, and 269 ± 8 e^{2}fm^4 for ^{44}Ti, ^{48}Cr, and ^{52}Fe, respectively. The results are compared to recent shell-model calculations on the basis of GX1A interaction [1]. While the excitation energies are reproduced quite well, the B(E2) values show considerable differences.

[1] M. Honma *et al.* Phys. Rev. C 69, 034335 (2004)