HK 25: Structure and Dynamics of Nuclei V

Zeit: Dienstag 16:30–17:45 Raum: HZO 80

Gruppenbericht HK 25.1 Di 16:30 HZO 80

Investigation of Z-Yield Distributions of Fission Fragments using Calorimetric Low Temperature Detectors — •Santwana Dubey[1,2], Artur Echler[1,2], Peter Egelhof[1,2], Patrick Grabitz[1,2], Manfred Mutterer[1], Werner Lauterfeld[2], Aurelien Blanc[3], Ulli Köster[3], Saskia Kraft-Bermuth[4], Pascal Scholz[4], Shawn Bishop[5], Jose Gomez[5], and Friedrich Gönnenwein[6] — [1]GSI Darmstadt, Germany — [2]Univ. Mainz, Germany — [3]ILL, Grenoble, France — [4]Univ. Giessen, Germany — [5]TU München, Germany — [6]Univ. Tübingen, Germany

The investigation of isotopic yields of fission fragments is important for our understanding of fission process and for applications in reactor physics. The new concept of calorimetric low-temperature detectors (CLTDs) which provides fundamental advantages over ionization-mediated detectors was applied for the first time for the investigation of isotopic yields at the LOHENGRIN recoil separator, at the ILL Grenoble, using the degrader method. For ^{239}Pu and ^{241}Pu targets, the present method allowed for the first time direct nuclear charge yield measurements in the mass region approaching symmetry (up to A=112 for ^{241}Pu and up to A=113 for ^{239}Pu), and in the heavy mass region (A=128-137 for ^{239}Pu), where new data for masses inaccessible with gamma-spectroscopy could be obtained. Of particular interest was the behaviour of proton even-odd staggering in the transition region to symmetry which provides, insight in the fission mode. Furthermore, precise yields of ^{92}Rb and ^{96}Y for ^{235}U, ^{239}Pu and ^{241}Pu targets were determined, which are relevant for the reactor neutrino anomaly.

HK 25.2 Di 17:00 HZO 80

Towards a precise energy determination of the ^{229}Th nuclear clock transition — •Benedict Seiferle, Lars von der Wense, and Peter G. Thirolf — LMU München, Am Coulombwall 1, 85748 Garching

The first isomeric excited nuclear state of ^{229}Th (denoted with ^{229m}Th) exhibits the lowest excitation energy in nuclear physics which has been measured indirectly to be 7.8(5) eV. The uniquely low transition energy which corresponds to a wavelength of approximately 160 nm makes it possible to drive the transition with lasers. This in turn may pave the way for a long list of interesting applications (such as a nuclear optical clock) which has so far been hindered by the rather large uncertainty in the reported energy value. In this talk an experimental scheme is presented that uses internal conversion electrons which are mitted in the ground-state decay of ^{229m}Th [1,2] and first results are shown. With these measurements a precise and direct determination of the excitation energy is in reach.

[1] L. v.d. Wense et al., Nature 533, 47-51 (2016).
[2] B. Seiferle et al., PRL 118, 042501 (2017).
This work was supported by the European Union's Horizon 2020 research and innovation programme under grant agreement 664732 "nuClock" & by DFG Grant No. Th956/3-2.

HK 25.3 Di 17:15 HZO 80

Reduced transition probabilities for the gamma decay of the 7.8 eV isomer in ^{229}Th — •Adriana Pálffy[1] and Nikolay Minkov[1,2] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Institute of Nuclear Research and Nuclear Energy, Sofia, Bulgaria

The ^{229}Th actinide isotope has a 3/2 isomeric state lying only 7.8 eV above the ground state. This extremely small energy renders for the first time a nuclear transition accessible to vacuum ultraviolet lasers. Novel applications such as a nuclear frequency standard with unprecedented accuracy based on this transition are anticipated.

In this work we predict the reduced magnetic dipole and electric quadrupole transition probabilities for the radiative decay of the ^{229}Th 7.8 eV isomer to the ground state within a detailed nuclear-structure model approach. We show that the presence and decay of this isomer can only be accounted for by the Coriolis mixing emerging from a remarkably fine interplay between the coherent quadrupole-octupole motion of the nuclear core and the single-nucleon motion within a reflection-asymmetric deformed potential [1]. The predicted magnetic dipole transition probability which determines the radiative lifetime of the isomer is considerably smaller than presently estimated. The so-far disregarded electric quadrupole component may have non-negligible contributions to the internal conversion channel. These findings support new directions in the experimental search of the ^{229}Th transition frequency for the development of a future nuclear frequency standard.
[1] N. Minkov and A. Pálffy, Phys. Rev. Lett. **118**, 212501 (2017).

HK 25.4 Di 17:30 HZO 80

Hunting for the long-lived isomer 188Hf — I Kulikov[1], •K Blaum[7], Y Litvinov[1], T Stöhlker[1], B Sun[6], P Walker[2], P Woods[8], T Yamaguchi[3], and Y Zhang[4,5] — [1]GSI, Germany — [2]University of Surrey, UK — [3]Saitama University, Japan — [4]Institute of Modern Physics, China — [5]Chinese Academy of Sciences — [6]Beihang University, China — [7]MPI Heildelberg, Germany — [8]Edinburgh University, UK

Isomers are long-lived nuclear states with nuclear properties different from the corresponding ground state formed by the same numbers of protons and neutrons. They can give a key information about nuclear structure, heavy-element nucleosynthesis and limits to particle stability. High-K isomers are predicted to coexist with well-deformed collective oblate rotation [1]. Significant contributions to this research field have already been made by GSI with the successful identification of isomers in exotic nuclei, using projectile-fragmentation reaction, A/q and Z selection in the FRS and the final isomer identification in the storage ring ESR. For instance, 183mHf, 184m2Hf and 186mHf isomers were discovered along with their excitation energies and half-life measurement [2]. The observation of 188Hf and confirmation of previous isomers is one of goals of the new experiment at the Experimental Storage Ring at GSI. The details of the experiment and the present status of preparations will be presented. References: [1]- G.D. Dracoulis et al., Rep. Prog. Phys. 79(2016) 076301. [2]- M.W. Reed et al., Phys. Rev. C 86 (2012) 054321.