HK 32: Struktur und Dynamik von Kernen

Zeit: Mittwoch 16:30–19:00 Raum: HZ 5

Gruppenbericht HK 32.1 Mi 16:30 HZ 5

Photoneninduzierte γ-γ Koinzidenzmessungen mit dem γ^3-Setup an HIγS* — •B. Löher[1,2], T. Aumann[4,7], J. Beller[4], C. Bernards[5], N. Cooper[5], V. Derya[3], M. Duchêne[4], J. Endres[3], A. Hennig[3], J. Isaak[1,2], J. Kelley[6,8], M. Knörzer[4], N. Pietralla[4], C. Romig[4], D. Savran[1,2], M. Scheck[4], H. Scheit[4], J. Silva[1,2], W. Tornow[8], H. Weller[8], V. Werner[5] und A. Zilges[3] — [1]ExtreMe Matter Institute EMMI and Research Division, Darmstadt — [2]FIAS, Frankfurt — [3]Institut für Kernphysik, Universität zu Köln — [4]Institut für Kernphysik, TU Darmstadt — [5]WNSL, Yale University, New Haven, USA — [6]Department of Physics, NCSU, USA — [7]GSI Helmholtzzentrum für Schwerionenforschung — [8]Department of Physics, Duke University, TUNL, USA

Ein neuer experimenteller Aufbau bestehend aus HPGe- und $LaBr_3$-Detektoren wurde an der High Intensity γ-ray Source (HIγS) installiert [1]. Die Kombination des mono-energetischen Photonenstrahls von HIγS mit der Methode der γ-γ-Koinzidenzen ermöglicht erstmals die direkte Beobachtung von Zerfallskaskaden in Kernresonanzfluoreszenz-Experimenten. Die besonders hohe Sensitivität erlaubt die Untersuchung des Zerfallsverhaltens von Spin = 1, 2 Zuständen mit geringer Intensität unterhalb der Teilchenschwellen. Ein Überblick über den neuen Aufbau, sowie die Ergebnisse des Experiments am Kern ^{140}Ce werden präsentiert und mit QPM Rechnungen verglichen.

* Supported by the Alliance Program of the Helmholtz Association (HA216/EMMI), the DFG (SFB 634 and ZI 510/4-2).

[1] B. Löher *et al.*, Nucl. Instr. Meth. A 723 (2013) 136–142

HK 32.2 Mi 17:00 HZ 5

Probing the shell closure at $N = 32$ by mass measurements of neutron-rich potassium isotopes — •M. Rosenbusch for the ISOLTRAP-Collaboration — Ernst-Moritz-Arndt-Universität Greifswald

The Penning-trap mass spectrometer ISOLTRAP at ISOLDE/CERN has been set up for precision mass measurements of short-lived nuclides and has been continuously improved for accessing more exotic nuclides. A crucial step forward has been made with the installation of a multi-reflection time-of-flight mass separator (MR-ToF MS), which enables high-resolution mass separation of contaminated ions, resulting, e.g., in the measurement of ^{82}Zn [1]. More recently, mass measurements have been performed directly in the MR-ToF MS instead of using a Penning trap. This paved the way for the mass determination of ^{53,54}Ca [2], which would not have succeeded in ISOLTRAP's Penning traps. The obtained two-neutron separation energies (S_{2n}) unambiguously confirm a shell closure at $N = 32$, indicated earlier by measurements of the excitation energies of the first 2^+ state in ^{52}Ca [3]. In addition, with the MR-ToF MS at ISOLTRAP the masses of ^{52}K and ^{53}K have been determined for the first time. With a half-life of only 30 ms, ^{53}K is the shortest-lived nuclide ever investigated at ISOLTRAP. The data are currently under evaluation. In this contribution, the new S_{2n} values will be presented and the crossing of the neutron shell closure at $N = 32$ for potassium will be discussed. [1] R. N. Wolf *et al.*, Phys. Rev. Lett. 110, 041101 (2013);[2] F. Wienholtz *et al.*, Nature 498, 346-349 (2013);[3] A. Huck *et al.*, Phys. Rev. C 31, 2226 (1985)

HK 32.3 Mi 17:15 HZ 5

Medium-Mass and Heavy Nuclei from Chiral NN+3N Hamiltonians — •Sven Binder, Joachim Langhammer, Angelo Calci, and Robert Roth — TU Darmstadt

We present ab initio calculations of nuclear binding energies using chiral two- plus three-nucleon Hamiltonians evolved consistently with the similarity renormalization group. We use coupled-cluster theory at the singles and doubles excitations level in combination with a non-iterative treatment of triples excitations in order to obtain accurate solutions of the many-body problem. We explore different chiral two- and three-nucleon interactions and the systematics of ground-state energies up to 132-Sn. These calculations open the door to ab initio calculations in the regime of heavy nuclei and demonstrate the predictive power of chiral Hamiltonians.

HK 32.4 Mi 17:30 HZ 5

Lebensdauermessung tiefliegender, langlebiger Isomere und γ-Spektroskopie in ^{100}Rh — •Matthias Dewald, Andrey Blazhev und Jan Jolie — IKP, Universität zu Köln

Im vergangenen Jahr wurde ein Experiment zur Untersuchung von ^{100}Rh am HORUS Spektrometer des Kölner Tandembeschleunigers durchgeführt. Erzeugt wurde der Kern über die Reaktion ^{100}Ru(p,nγ)^{100}Rh mit gepulstem Protonenstrahl mit einer Energie von 8 MeV. Im Fokus der Messung stand die Überprüfung von Lebensdauern tiefliegnder isomerer Zustände im Nanosekundenbereich. Die Messung dieser Lebensdauern erfolgte mit Hilfe der Pulsung, deren Zeitauflösung 4 ns betrug, sowie dem Zeitsignal der Germaniumdetektoren des Spektrometers. Um γ-Übergänge unterhalb 100 keV gut auflösen zu können, wurde zusätzlich ein Germaniumdetektor in das Spektrometer integriert, der für Röntgen- und niederenergetische γ-Strahlung ausgelegt ist. Desweiteren sollte aufgrund der guten Statistik über γ-γ-Koinzidenzmatrizen das Anregungsspektrum von ^{100}Rh unterhalb 2 MeV systematisch überprüft und gegebenenfalls ergänzt werden. Das Experiment, sowie Ergebnisse der laufenden Auswertung werden präsentiert.

HK 32.5 Mi 17:45 HZ 5

Fission properties of the BCPM energy–density functional — •Samuel Andrea Giuliani[1,2] and Luis Miguel Robledo[2] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 2, D–64289 Darmstadt — [2]Departamento de Física Teórica (Módulo 15), Universidad Autónoma de Madrid, E–28049 Madrid, Spain

Fission dynamics properties of the Barcelona–Catania–Paris–Madrid energy density functional are explored with mean–field techniques. Potential energy surfaces as well as collective inertias relevant in the fission process are computed for several nuclei where experimental data exist. Inner and outer barrier heights as well as fission isomer excitation energies are reproduced quite well in all the cases. The spontaneous fission half–lives t_{sf} are also computed using the standard semiclassical approach and the results are compared with the experimental data. The experimental trend with mass number is reasonably well reproduced over a range of 27 orders of magnitude. However, the theoretical predictions suffer from large uncertainties when the quantities that enter the spontaneous fission half–life formula are varied. Modifications of only a few per cent in the pairing correlation strengths strongly modify the collective inertias with a large impact on the spontaneous fission lifetimes in all the nuclei considered. Encouraged by the quite satisfactory description of the trend of fission properties with mass number, we explore the fission properties of the even-even uranium isotope chain from ^{226}U to ^{282}U. Very large lifetimes are found beyond A = 256 with a peak at neutron number N = 184.

HK 32.6 Mi 18:00 HZ 5

Preparations for an optical access to the lowest nuclear excitation in ^{229}Th * — •Lars v.d.Wense[1], Benedict Seiferle[1], Peter Thirolf[1], and Mustapha Laatiaoui[2] — [1]Ludwig-Maximilians-Universität München — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH

The isomeric lowest excited nuclear level of ^{229}Th has been indirectly measured to be 7.6 ± 0.5 eV (163 ± 11 nm)[1]. In order to improve the accuracy as prerequisite of an all-optical control, ^{229m}Th is populated via a 2% decay branch in the α decay of ^{233}U. The Thorium ions are extracted and cooled with the help of a buffer gas stopping cell and an RFQ-cooler. In order to suppress accompanying α decay chain products other than ^{229}Th, a quadrupole mass spectrometer (QMS) is used, performance and extraction efficiency measurements were performed. Following the QMS, the Thorium isomers will be collected on a 50 μm micro electrode. The decay of these isomers can then be detected using deep UV optics [2], presently in the phase of preparation and adjustment. Newest results will be presented.

[1] B.R. Beck et al., PRL 98, 142501 (2007).
[2] L. v.d.Wense et al., JINST 8 P03005 (2013).

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HK 32.7 Mi 18:15 HZ 5

Relative μs-Isomerpopulation nach Spaltung in leichten Fragmenten mit $79 \leq A \leq 100$ — •Matthias Rudigier[1], Andrey

Blazhev[1], Jan Jolie[1], Jean-Marc Regis[1], Nigel Warr[1], Christoph Fransen[1], Ulli Köster[2], Thomas Materna[2] und Gary Simpson[3] — [1]Institut für Kernphysik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln, Deutschland — [2]Institut Laue-Langevin, BP 156, 6, rue Jules Horowitz, F-38402 Grenoble CEDEX 9, France — [3]Laboratoire de Physique Subatomic et de Cosmologie, IN2P3-Centre National de la Reserche Scientifique / Universite Joseph Fourier, F-38026 Grenoble, France

In Messungen am Lohengrin Massenseparator des Institute Laue-Langevin, Grenoble, wurden μs-Isomere in leichten Spaltfragmenten der Massengegend $79 \leq A \leq 100$ untersucht. Gemessene Isomerlebensdauern werden vorgestellt. Desweiteren wurde die relative Isomerpopulation nach Spaltung von ^{233}U, ^{235}U und ^{241}Pu, induziert durch thermische Neutronen, gemessen. Diese Daten können Aufschluss über die mittlere Spinverteilung der Fragmente nach der Spalung geben. Die Ergebnisse werden mit Vorhersagen eines statistischen Modells verglichen.

HK 32.8 Mi 18:30 HZ 5

Quadrupole Collectivity in neutron-rich Cd istotopes — •Sabine Bönig[1], Thorsten Kröll[1], Marcus Scheck[1,2], Stoyanka Ilieva[1], and Anna-Lena Hartig[1] for the IS477/IS524-Collaboration — [1]Institut für Kernphysik, TU Darmstadt — [2]University of West Scotland, United Kingdom

The neutron-rich cadmium nuclei with a proton number of Z=48 are some of the most interesting isotopes in nuclear structure physics due to the proximity to the proton and neutron shell closures at Z=50 and N=82 respectively. The transition strength B(E2, $0^+_{gs} \rightarrow 2^+_1$) and quadrupole moment $Q_s(2^+_1)$ in the even neutron-rich isotopes $^{122-128}$Cd was measured in Coulomb excitation experiments with MINIBALL at REX-ISOLDE (CERN). Results of these experiments will pursue the picture of the behaviour of the transition strength towards the neutron shell closure at N=82. A closer insight into the onset of collectivity and the roles played by different orbits can be obtained by the investigation of the odd isotopes. We started this program with the examination of ^{123}Cd where already discrepancies in the level scheme to the literature were evidenced. In this contribution the results of these investigations will be presented. This project is supported by BMBF (No. 06 DA 9036I and No. 05 P12 RDCIA), HIC for FAIR, EU through EURONS (No. 506065) and ENSAR (No. 262010).

HK 32.9 Mi 18:45 HZ 5

Nuclear structure effects in high-energy bremsstrahlung from spin-0 and spin-1/2 nuclei — •Doris Jakubassa-Amundsen — University of Munich, Germany

Bremsstrahlung from relativistic spin-polarized electrons colliding with inert nuclei is calculated by taking into account the nuclear form factors and the kinematical recoil. For the spin-1/2 nuclei additional contributions from the anomalous magnetic moment and the dynamical recoil are considered. Electron bremsstrahlung is described with the help of semirelativistic wavefunctions while nuclear bremsstrahlung, when present, is treated within the Born approximation. The triply differential bremsstrahlung cross section is integrated over the electron scattering angle to study the polarization correlations between the beam electron and the emitted photon. Results are shown for 20-120 MeV electrons colliding with protons, 19F, 64Zn and 89Y. It is also attempted to explain the background in electron spectra from nuclear excitation in terms of bremsstrahlung. As an example the 180 degree spectrum from exciting the giant M2 resonance in 90Zr by 42.7 MeV electrons is analyzed.