HK 66: Structure and Dynamics of Nuclei 13

Time: Thursday 17:00–18:45 Location: T/SR19

HK 66.1 Thu 17:00 T/SR19

Microscopic description of nuclear fission properties in the superheavy region — •Samuel Andrea Giuliani[1,2], Gabriel Martinez-Pinedo[1], and Luis Miguel Robledo[2] — [1]Institut für Kernphysik (Theoriezentrum), Technische Universität Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [2]Departamento de Física Teorica, Universidad Autónoma de Madrid, E-28049 Madrid, Spain

In previous studies the fission properties of the Barcelona-Catania-Paris-Madrid energy-density functional were compared with available experimental data. Given its encouraging results, we explored the fission properties of nuclei in the superheavy region ($92 \leq Z \leq 120$ and $158 \leq N \leq 202$). Potential energy surfaces as well as collective inertias relevant to the fission process are obtained within a mean-field approach. Spontaneous fission half-lives are computed using the semiclassical Wentzel-Kramers-Brillouin formalism. As tracks of possible magic numbers in the superheavy region, combinations of neutron and proton number leading to an enhanced stability against the spontaneous fission process are discussed. The agreement with other theoretical models is also studied. This work was supported by the Helmholtz Association through the Nuclear Astrophysics Virtual Institute (VH-VI-417) and the Bundesministerium für Bildung und Forschung (BMBF) No. 06DA7047I

HK 66.2 Thu 17:15 T/SR19

Study of fission barriers in neutron-rich nuclei using the (p,2p) reaction: Status of SAMURAI-Experiment NP1306 SAMURAI14 — •Sebastian Reichert for the NP1306-SAMURAI14-Collaboration — TU Munich

Violent stellar processes are currently assumed to be a major origin of the elements beyond iron and their abundances. The conditions during stellar explosions lead to the so called r- process in which the rapid capture of neutrons and subsequent β decays form heavier elements. This extension of the nuclei stops at the point when the repulsive Coulomb energy induces fission. Its recycling is one key aspect to describe the macroscopic structure of the r-process and the well known elemental abundance pattern. The RIBF at RIKEN is able to provide such neutron rich heavy element beams and a first test with the primary beam 238U was performed to understand the response of the SAMURAI spectrometer and detectors for heavy beams. The final goal is the definition of the fission barrier height with a resolution of 1 MeV (in sigma) using the missing mass method using (p,2p) reactions in inverse kinematics. Supported by DFG Cluster of excellence: "Origin and structure of the Universe"

HK 66.3 Thu 17:30 T/SR19

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

The isomeric lowest excited nuclear level of ^{229}Th has been indirectly measured to be 7.6±0.5 eV (163±11 nm)[1]. This low transition energy, compared to energies typically involved in nuclear processes, would allow for the application of laser-spectroscopic methods. Also considering the isomeric lifetime of the excited state (estimated to be 10^3 to 10^4 s), which leads to an extremely sharp linewidth of $\Delta\omega/\omega \sim 10^{-20}$, the isomer becomes a strong candidate for a nuclear-based frequency standard. In order to directly detect the isomeric ground-state decay and improve the accuracy of its energy as a prerequisite for 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. Following the QMS, the Thorium isomeric decay is expected to be detectable. Internal conversion as well as photonic decay is probed via different detection techniques [2]. Latest 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).
* Supported by DFG Grant TH956/3-1.

HK 66.4 Thu 17:45 T/SR19

Gamma-ray spectroscopy of neutron-rich actinides after multi-nucleon transfer reactions — •Andreas Vogt[1], Benedikt Birkenbach[1], Lorenzo Corradi[2], Peter Reiter[1], and Suzana Szilner[3] for the LNL 11.22-Collaboration — [1]IKP, Universität zu Köln — [2]INFN - LNL, Italy — [3]IRB Zagreb, Croatia

Excited states in neutron-rich actinide Th and U nuclei were investigated after multi-nucleon transfer reactions employing the AGATA demonstrator and PRISMA setup at LNL (INFN, Italy). A primary 1 GeV ^{136}Xe beam hitting a ^{238}U target was used to produce the nuclei of interest in the actinide region. Beam-like reaction products in the Xe-region were identified and selected by the magnetic spectrometer PRISMA. Hence, fission fragments can be discriminated against surviving nuclei, DANTE-MCPs were installed within the target chamber to exploit kinematic coincidences between the binary reaction products which allows for clean conditions for in-beam γ-ray spectroscopy. Coincident γ-rays from excited states in beam- and target-like particles were measured with the position-sensitive AGATA HPGe detectors. An improved Doppler correction for both beam- and target-like nuclei is based on the novel γ-ray tracking technique. An extension of the ground-state rotational band in ^{240}U and insights into n-rich Th isotopes were achieved. Based on relative cross-section distributions for various reaction channels, perspectives and limitations for the production of the hard-to-reach neutron-rich isotopes with this experimental method will be presented. Supported by the German BMBF (05P12PKFNE TP4), ENSAR-TNA03, BCGS.

HK 66.5 Thu 18:00 T/SR19

Femtoscopy measurements in a p($T = 3.5$ GeV) + Nb system* — •Oliver Arnold for the HADES-Collaboration — Physik Department E12 and Excellence Cluster "Universe", Technische Universität München, 85748 Garching, Germany

In the 1950s, Hanburry-Brown and Twiss realized that there is a chance that photons are correlated after their emission from a light emitting astrophysical object like a star. They constructed a formalism, which allowed them to determine the angular size of the object by measuring the correlation signal between the emitted photons. Independently of this discovery, Goldhaber *et al.* measured later on an angular correlation for like-sign pion pairs in nuclear physics.

We use the technique of two-particle correlations in a femtoscopy measurement of proton and Lambda pairs, which were produced in proton-niobium collisions and detected with HADES, where the proton had a kinetic beam energy of 3.5 GeV. This allows us to extract the region of homogeneity for proton-lambda pairs and additionally study their interaction. For comparisons of the source size we constructed also the correlation functions of proton and pion pairs and measured the k_T dependence of the source. Our measurements allow us also to confront the experimental data with predictions of theoretical transport model calculations (UrQMD) to gain information about the emission dynamics of the particles.

*supported by BMBF(05P12WOGHH), Excellence Cluster "Universe" and FIAS/HGS-HIRe

HK 66.6 Thu 18:15 T/SR19

Untersuchung der neutronenarmen Kerne ^{178,180}Pt — •Christoph Fransen[1], Claus Müller-Gatermann[1], Thomas Braunroth[1], Alfred Dewald[1], Tuomas Grahn[2], Jan Jolie[1], Peter Jones[3], Rauno Julin[2], Julia Litzinger[1], Rick D. Smit[3], Mathis Wiedeking[3] und Karl-Oskar Zell[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Dept. of Physics, University of Jyväskylä, Finnland — [3]iThemba LABS, Faure/Kapstadt, Südafrika

Verschiedenste Kernmodelle wie das IBM, das General Collective Model, mikroskopische Rechnungen zu Energiedichte-Funktionalen und eine "beyond-mean-field" Beschreibung sagen eine oblat-prolate Formkoexistenz in neutronenarmen Kernen um $A = 180$ vorher. Es handelt sich um prolate Intruderzustände aus Protonenanregungen über den Schalenabschluss in Koexistenz mit fast-sphärischen oder leicht oblaten Zuständen. Andererseits zeigen die tiefliegendenen Banden von ^{176,178}Os Merkmale der X(5)-Symmetrie. Dies motiviert die Frage, inwieweit die oben genannten Modelle in dieser Region mit stark variierenden Kernstrukturen ein schlüssiges Bild liefern können. In diesem Beitrag werden erste Ergebnisse von Experimenten zur Bestimmung absoluter Übergangsstärken aus Zustandslebensdauern, gemessen mit der Recoil Distance Doppler-Shift Methode, in ^{178,180}Pt vorgestellt. Für diese Kerne lagen bisher unzureichende Daten vor, um die zugrundeliegende Kernstruktur zu identifizieren. Die Messung an ^{178}Pt war dabei das erste Plunger-Experiment am iThemba LABS in Südafrika. Gefördert durch die DFG, Fördernr. FR 3276/1-1, DE 1516/3-1 und die EU, Projekt ENSAR im Seventh Framework Programme.

HK 66.7 Thu 18:30 T/SR19

Recent results from the Penning-trap mass spectrometer ISOLTRAP — •Dinko Atanasov for the ISOLTRAP-Collaboration — Max-Planck Institute for Nuclear Physics, Heidelberg, Germany — IMPRS-PTFS, Heidelberg, Germany

ISOLTRAP is an experiment dedicated to precision Penning-trap mass measurements of radioactive nuclides produced by the ISOLDE facility at CERN. In this contribution we will present the results of recent ISOLTRAP measurements performed after the restart of the physics program at ISOLDE in 2014. The unique combination of four traps allowed the study of the neutron-rich $^{129-131}$Cd isotopes. Their masses are of great importance to model the astrophysical r-process, as the ^{130}Cd isotope is a major *waiting point* isotope. Furthermore, ISOLTRAP assisted in measuring the hyperfine structure of astatine isotopes in an ongoing in-source laser spectroscopy program. From the hyperfine structure, charge radii and electromagnetic moments can be extracted. Additionally, the nuclear masses of ^{101,102}Sr and ^{101,102}Rb were determined, extending further the investigations of the $A \approx 100$ nuclides in the shape transition region.