HK 59: Struktur und Dynamik von Kernen

Zeit: Freitag 11:00–13:00 Raum: P 4

Gruppenbericht HK 59.1 Fr 11:00 P 4

^{270}Ds und seine Zerfallsprodukte — •Dieter Ackermann für die SHIP-Ds270-Kollaboration — GSI Helmholtzzentrum für Schwerionenforschung Darmstadt, Germany

Im Jahr 2000 wurden in der Reaktion ^{64}Ni + ^{207}Pb am Geschwindigkeitsfilter SHIP der GSI erstmals das Isotop ^{270}Ds und seine Zerfallsprodukte ^{266}Hs und ^{262}Sg mit dem zusätzlichen Nachweis des K-Isomers ^{270m}Ds beobachtet. In einem zweiten Experiment in 2010 wurden zu den 8 Zerfallsketten aus der ersten Untersuchung weitere 25 Zerfallsketten detektiert. Dabei konnten erstmals Spontanspaltung von ^{266}Hs und ein α-Zerfallszweig für ^{262}Sg nachgewiesen werden. Letzterer stellt das fehlende Bindeglied zu ^{258}Rf und ^{254}No dar. Für ^{254}No wurde vor kurzem eine präzise Massemessung am Penningfallenaufbau SHIPTRAP durchgeführt. Dadurch konnte über Q_α-Werte eine experimentelle Masse für ^{270}Ds ermittelt werden. Des Weiteren wurde für ^{266}Hs ein α-Zerfall mit einer um nahezu zwei Größenordnungen längeren Zerfallszeit von 105 ms und einer um etwa 200 keV höheren α-Zerfallsenergie beobachtet, der dem Zerfall des K-Isomers ^{266m}Hs zugeschrieben wird.

HK 59.2 Fr 11:30 P 4

Towards In-Trap-Spectroscopy at MATS/FAIR — •Christine Weber, Jasmin Moazzami-Fallah, Peter Müller, Jurek Szerypo, and Peter Thirolf — Fakultät für Physik, LMU - München, 85748 Garching

A novel in-trap spectroscopy setup is developed at MLL-TRAP/Garching to be implemented in the future MATS facility at FAIR/GSI. It combines the high-resolution purification capabilities of a Penning trap with a customized detector trap setup, providing both, storage and detection. In this way, decay-spectroscopy experiments of purified nuclides, free from any background or scattering effects, will become feasible. Here, the main trapping electrodes are replaced by position-sensitive Si-strip detectors and emitted electrons are efficiently guided by the strong field of the trap magnet towards distant electron detectors. Possible experiments are conversion-electron spectroscopy and intrap α-decay experiments of heavy actinides. Moreover, a coincident detection of an α decay with an electron detection allows to reconstruct the original positions of electron clouds initiated by shake-off as well as from subsequent conversion decay. Via this decay length, the half-lives of excited (2^+) states populated by α decay can be derived in a unique type of recoil-distance method. In this presentation, possible physics experiments and the design of the setup are presented.

[*] Supported by the BMBF (06ML9148), DFG (HA 1101/14-1), and MLL.

HK 59.3 Fr 11:45 P 4

Double-beta transition Q-value and direct mass measurements with TRIGA-TRAP — •Christian Smorra for the TRIGA-SPEC-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg — Institut für Kernchemie, Johannes Gutenberg-Universität, Fritz-Strassmann-Weg 2, D-55128 Mainz — Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität, Philosophenweg 12, D-69120 Heidelberg

Neutrinoless double-beta transitions are difficult to observe due to their long half-lives. In case of neutrinoless double-electron capture, a resonant enhancement of the decay rate by several orders of magnitude occurs if the energy levels of initial and final state are degenerate in energy. In order to search for nuclides undergoing a resonantly-enhanced double-electron capture the Q-values of the transitions in ^{106}Cd, ^{108}Cd, and ^{184}Os were determined by the double-Penning trap mass spectrometer TRIGA-TRAP with a precision better than 1 keV. The double-beta decay Q-value of ^{110}Pd was investigated as well. The recent results will be presented.

HK 59.4 Fr 12:00 P 4

Multi-Coincidence Spectroscopy of SHE using TASISpec — •Lise-Lotte Andersson for the TASISpec-Collaboration — Helmholtz-Institut Mainz

The isotope ^{253}No was produced in the two neutron evaporation channel using the ^{48}Ca + ^{207}Pb reaction. The structure of both mother and daughter nuclei was studied with TASISpec [1], a compact spectroscopy set-up placed in the focal plane of the gas-filled separator TASCA at GSI, Darmstadt. TASISpec allows for multi-coincidence spectroscopy including correlations between implanted nuclei, α particles, electrons, X- and γ rays. For example, electron lines originating from internal conversion can, for the very first time, be observed in the Si-strip box detectors at the same time as γ-rays are observed in the surrounding Ge detectors. This is a unique strength of TASISpec, which here provides the possibility to determine the multipolarities of these transitions, using conversion coefficient systematics.

Results from experimental studies will be presented together with GEANT4 simulations of the setup and theoretical predictions of the nuclear structure.

[1] L.-L. Andersson et al., Nucl. Instr. Meth. A 622, 164, (2010).

HK 59.5 Fr 12:15 P 4

Entwicklung digitaler Signalverarbeitung zur Untersuchung superschwerer Kerne — •Ron Mändl für die SHIP-Kollaboration — Fachhochschule Frankfurt am Main, Germany — Helmholtz Institut Mainz, Germany

Die Anforderungen an die Datenaufnahmeelektronik für Teilchen- und Photonenzähler sind durch die Form der zu erwartenden Signale definiert. In Experimenten am Geschwindigkeitsfilter SHIP bei GSI für die Synthese und Kernstrukturuntersuchungen von superschweren Kernen sind das Signale von Spaltfragmenten (E $\leq$ 250 MeV), von Reaktionsprodukten (E $\approx$ (10-50) MeV), von α-Teilchen (E $<$ 15 MeV) und von Elektronen (E $\leq$ 1 MeV). Zerfallszeiten im Bereich von μs und die Untersuchung kurzlebiger Isomere machen die Verwendung digitaler Elektronik zur Signalverarbeitung notwendig. Dazu wurden zwei Konfigurationen auf Basis der bei GSI entwickelten digitalen FEBEX ADC-Module mit komplementären Eigenschaften im Vergleich mit einem analogen Aufbau untersucht, die bezüglich der spezifischen Anwendung dem breiten dynamischen Signalbereich Rechnung tragen. Die erste verwendet konventionelle ladungsempfindliche Vorverstärker mit zwei unterschiedlichen, schaltbaren Verstärkungsfaktoren, welche den Amplitudenhub der FEBEX-Module optimal ausnutzen. Sie ist auf hohe Zeitauflösung optimiert. Die zweite, auf hohe Energieauflösung optimierte Konfiguration, verwendet einen hoch integrierten Schaltkreis, den sogenannten APFEL-Chip, der für jeden Eingangskanal zwei bereits geformte Ausgangssignale unterschiedlicher Verstärkung mit 250 ns Integrationszeit anbietet.

HK 59.6 Fr 12:30 P 4

Towards Photofission Studies with highly-brilliant γ beams — •Lorant Csige[1], Dieter Habs[1], Attila Krasznahorkay[2], Janos Gulyas[2], Peter G. Thirolf[1], and Tamas G. Tornyi[2] — [1]Ludwig Maximilians Universität München, Garching, Germany — [2]Inst. Nucl. Res. of Hung. Acad. Scienc. (ATOMKI), Debrecen, Hungary

Using highly brilliant γ beams, which will be soon available at the MEGa-Ray facility (Livermore) and at ELI-NP (Bucharest), a new experimental campaign on photofission studies can be envisaged to study extremely deformed nuclear states of the light actinides and their multiple-humped potential energy surface in a highly-selective way. The experimental technique of these studies is based on the observation of transmission resonances in the prompt fission cross section; the fission decay channel can be expressed as a tunneling process of gateway states in the 2nd and 3rd minimum through the multiple-humped fission barrier. Until now all photofission measurements at sub-barrier energies have been performed with bremsstrahlung photons, where the fission cross-section was folded by the increasing gamma-ray spectrum. Compared to the presently available gamma bandwidth of 100 keV, the soon available improved energy resolution of 1 keV will allow resolving the "isomeric shelf" in the photofission cross-section into underlying predicted individual resonances. Moreover, as a result of the strong spin selectivity of the photo-induced reactions, the states in the 2nd and 3rd minimum can be populated with much larger intensities compared to former methods (light-ion induced reactions), hence a detailed gamma-spectroscopy in these minima will be enabled.

HK 59.7 Fr 12:45 P 4

Preparations for an optical access to the lowest excited nuclear state in ^{229m}Th* — •Lars von der Wense, Peter Thirolf, Dominik Kalb, and Mustapha Laatiaoui — LMU München, Am Coulombwall 1, 85748 Garching

The isomeric lowest excited nuclear level of ^{229}Th has been indirectly measured to be 7.6 ± 0.5 eV (163 ± 11 nm). 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 ^{229m}Th, a quadrupole mass spectrometer (QMS) is under construction, aiming at an optimum mass resolution and transmission efficiency. Following the QMS, the Thorium isomers will be collected on a $40\mu m$ needle tip. The decay of these isomers can then be detected using deep UV optics, presently under construction based on extensive simulations.

* Supported by DFG Cluster of Excellence MAP.