HK 37: Structure and Dynamics of Nuclei VII

Time: Wednesday 16:30–18:30 Location: J-HS E

Group Report HK 37.1 Wed 16:30 J-HS E

Study of electromagnetic transition rates in the N=126 isotones 210-Po, 211-At and 213-Fr. — •Jan Jolie[1], Vasil Karayonchev[1], Lisa Kornwebel[1], Diana Kocheva[2], Andrey Blazhev[1], Arwin Esmaylzadeh[1], Lukas Knafla[1], Jean-Marc Régis[1], Georgi Rainovski[2], and Pieter Van Isacker[3] — [1]IKP, Universität zu Köln, Zülpicher Str. 77, 50937 Köln — [2]Faculty of Physics, St. KlimenOhridski University of Sofia, 1164 Sofia, Bulgaria — [3]GANIL, Bd. Henri Becquerel BP55027, 14076 Caen, France

Lifetimes of excited states in 210-Po, 211-At and 213-Fr were measured at the FN Tandem accelerator of the Institute for Nuclear Physics, University of Cologne. The nuclei of interest were populated using two-proton transfer reactions and fusion-evaporation reactions. The lifetimes were obtained using the Doppler Shift Attenuation (DSA) and the Recoil Distance Doppler Shift (RDDS) methods and using the electronic gamma-gamma fast timing technique. The experimental electromagnetic transition rates are compared to shell-model calculations, using the modified Kuo-Herling interaction in a multi-j model space. For 211-At they are also compared to a semi-empirical calculation for three particles in a single j=9/2 shell.

HK 37.2 Wed 17:00 J-HS E

Nuclear Isovector Valence-shell Excitation of ^{202,204}Hg — •Ralph Kern[1], Robert Stegmann[1], Norbert Pietralla[1], Georgi Rainovski[2], Mike P. Carpenter[3], Robert V. F. Janssens[4,5], Marc Lettmann[1], Oliver Möller[1], Thomas Möller[1], Christian Stahl[1], Volker Werner[1], and Shaofei Zhu[3] — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]Faculty of Physics, University of Sofia St. Kliment Ohridski, Sofia, Bulgaria — [3]Physics Division, ANL, Argonne, IL, USA — [4]Department of Physics and Astronomy, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA — [5]Triangle Universities Nuclear Laboratory, Duke University, Dunham, NC, USA

In the framework of the IBM-2, a class of excited states is predicted, where the collective valence-neutron and proton motions are out of phase. These so-called mixed-symmetry states (MSS) represent a rare physics case in which the interplay between nuclear collectivity, shell structure, and isospin degrees of freedom can be studied. MSS were observed in nuclei near shell closures in the $A = 90, 130$ mass regions, and recently near the doubly-magic ^{208}Pb [1]. To extend the knowledge about this data in the $A = 208$ mass region, projectile Coulomb excitation experiments with stable Hg ion beams were performed at the ATLAS facility at Argonne National Laboratory [2,3].

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[1] D. Kocheva *et al.*, Phys. Rev. C **93**, 011303(R) (2016).
[2] R. Stegmann *et al.*, Phys. Lett. B **770**, 77 (2017).
[3] R. Kern *et al.*, Phys. Rev. C **99**, 011303(R) (2019).

HK 37.3 Wed 17:15 J-HS E

Lifetime of the 4_1^+ state in ^{212}Po using the fast timng technique — •Martin von Tresckow for the IFIN-HH-212Po-Collaboration — TU Darmstadt

The isotope ^{212}Po has two protons and neutrons more than the doubly magical nucleus ^{208}Pb and it can anticipated that this nucleus can be well described by the nuclear shell-model. However, experimental lifetimes of excited states don't agree well with predictions from the shell model. The nucleus has rather a mixture between shell-model and cluster configurations. The B(E2) value of the 4_1^+ state is an important puzzle piece to solve the question about the structure of ^{212}Po but previous attempts to measure this value had very large errors which did not allow for any conclusion.

In November 2019, we performed an experiment at the Tandem accelerator of IFIN-HH in Magurele, Romania, to determine the lifetime applying the fast timing technique. We used the α transfer between a ^{10}B beam and a ^{208}Pb target to investigate the unstable isotope ^{212}Po. The γ-rays were detected by ROSPHERE consisting of 15 Ge CLOVER detectors, 10 $LaBr_3$(Ce) detectors and 6 solar cell detectors at backward angles to measure the beam like products.

For the fast timing technique applying the centroid shift method, the precise determination of prompt time response is crucial. A novel method has been tested in this experiment to determine the time response at low energies using the internal activity of the $LaBr_3$(Ce) crystals. This method will be presented, as well as preliminary results from the data analysis.

HK 37.4 Wed 17:30 J-HS E

Photofission on ^{238}U using quasi-monochromatic, polarized γ-rays — •M. Peck[1], J. Enders[1], S.W. Finch[2], A. Göök[3], C.R. Howell[2], A.-L. Katzenmeier[1], A. Oberstedt[4], S. Oberstedt[3], J.A. Silano[5], A.P. Tonchev[5], and W. Tornow[3] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Duke University and TUNL, Durham, USA — [3]European Commission, Joint Research Centre, Geel, Belgium — [4]ELI-NP, Măgurele, Romania — [5]Nuclear and Chemical Sciences Division, LLNL, Livermore, USA

Photofission on actinides using quasi-monochromatic, polarized γ-rays from Laser-Compton-Backscattering (LCB) has been studied recently at Duke University's High-Intensity γ-ray Source (HIγS). Fission-fragment mass and energy distributions as well as polar and azimuthal angular distributions are determined using a position-sensitive twin Frisch-grid ionization chamber. We have investigated the feasibility of measuring prompt fission neutrons using four liquid scintillator detectors. Results for the ^{238}U(γ,f) reaction at incident linear/circular polarized γ-ray energy of 11.2 MeV at a flux of up to 4.0×10^8 γ/s will be presented.

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HK 37.5 Wed 17:45 J-HS E

High-precision mass spectrometry of superheavy elements at SHIPTRAP: latest results, status and outlook. — •Francesca Giacoppo for the SHIPTRAP-Collaboration — GSI Darmstadt — HIM Mainz

During the experimental campaign in summer 2018 the masses of ^{251}No and ^{254}Lr has been directly measured for the first time at the mass spectrometer SHIPTRAP at GSI. In addition, the long-lived, low-lying isomeric states ^{251m}No and ^{254m,255m}Lr have been probed with high accuracy. This was made possible by the first application of the Phase-Imaging Ion-Cyclotron-Resonance (PI-ICR) technique in the region of the heaviest elements. Thus, with its superior mass resolving power and precision, the PI-ICR technique was established as a complementary tool to decay spectroscopy. Furthermore, with its high efficiency the PI-ICR technique allowed a first mass measurement of the ground state of ^{257}Rf, and thereby opened the doorway to the exotic superheavy elements which are characterized by their particularly low production yields.

In the meantime, the SHIPTRAP setup has been prepared for the next beam time scheduled for early 2020. It is planned to look for low-lying states of the Rf isotopes as well as to extend direct high-precision mass spectrometry to even heavier and more exotic nuclides, including Dubnium (Z=105).

In this contribution, an overview on the latest efficiency optimization of SHIPTRAP together with the status of the 2020 campaign will be reviewed.

HK 37.6 Wed 18:00 J-HS E

How well do we know nuclear magnetic moments: The cases of ^{207}Pb and ^{209}Bi — •Wilfried Nörtershäuser[1], Verena Fella[1], Leonid V. Skripnikov[2], Magnus R. Buchner[3], H. Lars Deubner[3], Florian Kraus[3], Alexei F. Privalov[1], Vladimir M. Shabaev[2], and Michael Vogel[1] — [1]TU Darmstadt — [2]St. Petersburg State University — [3]Philipps-Universität Marburg

Tabulated nuclear magnetic moments of stable isotopes are often used as reference values, e.g., in studies of short-lived isotopes. Results from nuclear magnetic resonance measurements are often provided with very high accuracy but are affected with chemical and diamagnetic shifts which are not always well under control. We will report on two extreme cases recently investigated. Motivated by discrepancies between QED calculations and laser spectroscopic investigations on highly charged ions [1], we performed new NMR studies on ^{207}Pb and ^{209}Bi [2] where we found significant discrepancies to the tabulated values [3].

[1] J. Ullmann *et al.*, Nature Comm. **8** 15484 (2017).
[2] L. Skripnikov *et al.*, Phys. Rev. Lett. **120**, 093001 (2018).
[3] N. Stone, Atomic Data Nuclear Data Tables **90**, 75 (2005).

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HK 37.7 Wed 18:15 J-HS E

TDRIV g factor measurement of the 2_1^+ state of ^{18}O — •J. Wiederhold[1], V. Werner[1], C. Fransen[2], C. Müller-Gatermann[2], N. Pietralla[1], M. Beckers[2], M. Berger[1], A. Blazhev[2], A. Dewald[2], A. Goldkuhle[2], P.R. John[1], J. Jolie[2], R. Kern[1], C. Stahl[1], S. Thiel[2], W. Witt[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]IKP, Universität zu Köln

Magnetic dipole moments are an important indicator of the proton neutron wave function composition and therefore the single-particle properties of the investigated excited states. The available experimental data for *sd* shell nuclei can overall be reproduced by shell model calculations, but deviations exist at the edges, i.e. for ^{18}O and ^{38}Ar. To clarify the picture for ^{18}O, a g factor measurement has been performed at the IKP Cologne, employing the electron-configuration-reset time-differential recoil-in-vacuum technique [1]. The technique is based on the traditional TDRIV method, but the excited ions are not stopped but only attenuated in a degrader foil and can be detected by a particle detector. Excited states of ^{18}O were populated by Coulomb excitation on a ^{58}Ni target. The experimental setup consisted of the HORUS detector array in combination with the DARCY plunger device and a double-sided silicon strip detector. The obtained results for the g-factor measurement will be presented.

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[1] A. Stuchbery *et al.*, Phys. Rev. C **71**,047302 (2005).