HK 15: Structure and Dynamics of Nuclei I

Time: Tuesday 16:30–18:30 Location: H4

Group Report HK 15.1 Tue 16:30 H4

Recent results from the FRS Ion Catcher — •Gabriella Kripkó-Koncz for the FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany

The atomic masses of exotic nuclei provide key information for the understanding of nuclear structure and astrophysics. The FRS Ion Catcher experiments at the FRagment Separator FRS at GSI enable high precision mass measurements or isobar and isomer separation with thermalized projectile and fission fragments by combining a Cryogenic Stopping Cell (CSC) and a Multiple-Reflection Time-Of-Flight Mass Spectrometer (MR-TOF-MS). Incorporating several novel and unique concepts, the MR-TOF-MS enables the highest performance, such as a mass resolving powers at FWHM of up to 1,000,000 and relative mass accuracies down to $1.7 \cdot 10^{-8}$.

Mass and half-life measurements of projectile fragments in the vicinity of ^{100}Sn were performed, including the first mass measurement of the ^{101}In ground state and the discovery of a new isomeric state in ^{97}Ag. A novel technique for measuring half-lives and decay branching ratios was developed and demonstrated experimentally. These results including the most recent experiments, recent technical upgrades, and the status of the next-generation CSC for the Low-Energy-Branch of the Super-FRS at FAIR will be presented.

Group Report HK 15.2 Tue 17:00 H4

DSAM lifetime measurements using particle-γ coincidences at SONIC@HORUS — •Sarah Prill, Anna Bohn, Christina Deke, Felix Heim, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, 50937 Köln, Germany

The Doppler-shift attenuation method (DSAM) has been used in recent years to successfully determine lifetimes of excited low-spin states of various nuclei in the sub-picosecond range [1,2]. Especially by the use of particle-γ coincidence data taken at the SONIC@HORUS spectrometer in Cologne [3], the direct selection of levels via their excitation energy is possible. This greatly reduces background and eliminates feeding from levels of higher energies, as well as gives complete knowledge over the reaction kinematics. This contribution will give an overview of the method and show recent results from experiments on Ru, Sn [2] and Te isotopes. Additionally, a complementary approach to the conventional DSA technique to extract lifetimes from weak transitions and excited states with low statistics will be presented. A first estimation of its feasibility is discussed.

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[1] A. Hennig *et al.*, Nucl. Instr. and Meth. A **794** (2015) 717.
[2] M. Spieker *et al.*, Phys. Rev. C **97** (2018) 054319
[3] S. G. Pickstone *et al.*, Nucl. Instr. and Meth. A **875** (2017) 104.

HK 15.3 Tue 17:30 H4

High-precision mass measurements in the direct vicinity of the doubly magic ^{100}Sn(N=Z=50) at ISOLDE/CERN — •Jonas Karthein for the ISOLTRAP-Collaboration — CERN, 1211 Geneva, Switzerland — Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany — present address: Massachusetts Institute of Technology, Cambridge, MA 02139, USA

This contribution reports on high-precision mass measurements of $^{99-101}$In isotopes and isomers with the ISOLTRAP mass spectrometer at ISOLDE/CERN. Applying the Multi-Reflection Time-of-Flight (MRToF) method, the masses of ^{99}In and ^{100}In (the β-decay daughter of ^{100}Sn) were measured for the first time with high precision. Additionally, the recently implemented Phase-Imaging Ion-Cyclotron-Resonance (PI-ICR) technique [S. Eliseev et al. PRL 110 (2013) 082501] will be discussed in the context of these measurements. This revolutionary Penning-trap mass spectrometry technique allowed for the first time a direct mass determination of both the ground and the isomeric states of ^{101}In in a Penning trap with resolving powers exceeding m/Δm > 5*10^5 in only 62 ms phase-accumulation time. Our mass spectrometry results, recently accepted for publication in *Nature Physics*, will be compared with pioneering *ab-initio* many-body calculations in this heavy mass region. The 100-fold improvement in the precision of the ^{100}In mass value highlights a discrepancy in the so-far published atomic mass values of ^{100}Sn, which could previously only be derived from β-decay results.

HK 15.4 Tue 17:45 H4

Nuclear structure investigations on $^{253-255}$Es by laser resonance ionization spectroscopy — •Steven Nothhelfer — Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany — Helmholtz-Institut Mainz, 55099 Mainz, Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

Experimental data on the hyperfine structure splittings and isotope shifts of spectral lines in transuranium elements are required to reveal valuable information about the structure of their atomic nuclei. In this talk we will present results of laser resonance ionization spectroscopy performed on the rare isotopes $^{253-255}$Es at the RISIKO mass separator in Mainz. With small sample sizes ranging down to fg, the prominent 351.5 nm ground-state transition was measured in all three Es isotopes, and four additional ground-state transitions were measured in ^{254}Es. Hyperfine structure analysis resulted in spin values of $I(^{254}\mathrm{Es}) = 7$ and $I(^{255}\mathrm{Es}) = 7/2$. From the extracted coupling constants, nuclear magnetic dipole moments as well as spectroscopic electric quadrupole moments were derived. The literature value of the nuclear magnetic dipole moment for ^{254}Es obtained from the angular anisotropy of ^{254}Es α-radiation deviates from our more precise value of this quantity.

HK 15.5 Tue 18:00 H4

Precision calculation of deuteron form factors in chiral effective field theory — Arseniy A. Filin[1], •Daniel Möller[1], Vadim Baru[1,2,3], Evgeny Epelbaum[1], Hermann Krebs[1], and Patrick Reinert[1] — [1]Ruhr-Universität Bochum, Fakultät für Physik und Astronomie, Institut für Theoretische Physik II, D-44780 Bochum, Germany — [2]Institute for Theoretical and Experimental Physics, B. Cheremushkinskaya 25, 117218 Moscow, Russia — [3]P.N. Lebedev Physical Institute of the Russian Academy of Sciences, 119991, Leninskiy Prospect 53, Moscow, Russia

We employ the precise two-nucleon potentials worked out to fifth order in chiral effective field theory to perform high-accuracy calculations of the deuteron form factors. The corresponding electromagnetic charge and current operators are derived and regularized consistently with the potentials. The single-nucleon contributions to these operators are expressed in terms of the proton and neutron form factors, for which up-to-date empirical parametrizations are employed. The short-range two-nucleon operators contain undetermined parameters which are fixed from the deuteron static moments and/or the world data of deuteron form factors, allowing for different kinds of predictions. A comprehensive error analysis is carried out, including a Bayesian analysis of the uncertainty stemming from the truncation of the chiral expansion.

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HK 15.6 Tue 18:15 H4

Systematic treatment of hypernuclear data and application to the hypertriton — •Philipp Eckert, Josef Pochodzalla, Patrick Achenbach, Marcell Steinen, Pascal Klag, and Julian Geratz for the A1-Collaboration — JGU Mainz, Germany

A new database is under construction to offer a complete collection of published information on hypernuclei. A key aspect is the combination of measurements to average values in a systematic manner together with a proper treatment of errors. The focus lies on lifetimes, Lambda binding energies and excitations of hypernuclei.

The capability of the database will be demonstrated for the case of the hypertriton.

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