HK 10: Structure and Dynamics of Nuclei II

Time: Monday 16:30–18:00 Location: SCH/A215

Group Report HK 10.1 Mon 16:30 SCH/A215

Collinear laser spectroscopy at NSCL/FRIB — •Kristian König[1,2], Ronald Garcia-Ruiz[3], Kei Minamisono[2], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Facility for Rare Isotope Beams, Michigan State University, USA — [3]Massachusetts Institute of Technology, USA

The National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University was recently upgraded to the Facility for Rare Isotope Beams (FRIB). With in-flight fragmentation, rare isotope beams from all over the nuclear chart can be produced and investigated, e.g., with collinear laser spectroscopy at the BECOLA setup. In this talk, we will summarize the latest results on Nickel, Scandium and Silicon that gave new insights in the nuclear structure at the neutron shell closures at $N = 20$ and 28. Furthermore, the investigation of the nuclear charge radius of mirror nuclei allowed us to constrain L, the slope parameter of the nuclear equation of state. Our result is consistent with results derived from the dipole polarizability and neutron star mergers. The capabilities of BECOLA in the FRIB era will be discussed as well as the status of the currently ongoing upgrade that will allow us to perform the more sensitive collinear resonance ionization spectroscopy with particle detection (RISE). This work was supported in part by US NSF Grant No. PHY-21-11185 and DOE Office of Science Award No. DE-SC0000661, DE-SC0021176 and DE-SC0021179 and by the DFG – Project-Id 279384907*SFB 1245.

HK 10.2 Mon 17:00 SCH/A215

The Charge Radius of ^{26,26m}Al and its implication for CKM unitarity — •Peter Plattner — Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany

For the COLLAPS and IGISOL collaborations.

In the study of atomic nuclei, nuclear charge radii provide intriguing physics insights into the evolution of nuclear structure far away from stability. Furthermore, charge radii have been used as experimental input for the determination of V_{ud} of the CKM quark mixing matrix from superallowed nuclear β-decays. In the Standard Model of particle physics, the CKM matrix is predicted to be unitary but recent reviews of the matrix values show a 2.2σ deviation for one of its unitarity tests.

This contribution will present the recent work of combined measurements of the charge radii of ^{26,26m}Al by means of Collinear Laser Spectroscopy (CLS) at the COLLAPS experiment/ISOLDE and at the IGISOL facility/Jyvaskyla, Finland. CLS takes advantage of the interaction between the atomic nucleus and its surrounding electrons giving rise to the hyperfine structure. Thus, properties of nuclear ground states and long-lived isomers, including nuclear charge radii, can be inferred from measured hyperfine spectra. Prior to the present work, the charge radius of the superallowed β emitter ^{26m}Al was not known experimentally but was extrapolated to evaluate the isospin symmetry breaking (ISB) correction required for the determination of V_{ud}.

The present measurements reveal a charge radius of ^{26m}Al which differs by more than 4 standard deviations from the value assumed in previous ISB calculations.

HK 10.3 Mon 17:15 SCH/A215

^{83m}Kr N-line spectrum measurement at KATRIN — Matthias Böttcher[1], Moritz Machatschek[2], Magnus Schlösser[2], and •Jaroslav Storek[2] for the KATRIN-Collaboration — [1]Institute of Nuclear Physics, University of Münster — [2]Institute for Astroparticle Physics, Karlsruhe Institute of Technology

The ^{83m}Kr conversion electrons are used for calibration purposes of different (astro-)particle physics experiments due to the narrow ^{83m}Kr line widths and short ^{83m}Kr half-life. In the KArlsruhe TRItium Neutrino experiment (KATRIN), that currently provides the best neutrino mass upper limit of 0.8 eV/c^2 (90% C. L.) in the field of direct neutrino-mass measurements, several systematic uncertainties are studied by a shape distortion of the quasi monoenergetic ^{83m}Kr spectrum. This creates high demands on precise knowledge of the undistorted spectrum.

In KATRIN we use the 32 keV N-lines lying in the high energy region of the spectrum including the weaker N_1 line. In this talk, results of a dedicated measurement of the ^{83m}Kr electron N-spectrum with emphasis on N_1 line position and width conducted at unprecedented precision at KATRIN will be presented.

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HK 10.4 Mon 17:30 SCH/A215

Implementation of silicon photomultipliers to detect single photons — •Imke Lopp[1], Laura Renth[1], Bernhard Maass[2], Patrick Müller[1], Julian Palmes[1], Julien Spahn[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Argonne National Laboratory, Chicago, IL, USA

Precise and sensitive measurements in collinear laser spectroscopy require detectors with a high detection efficiency for single photons. At the same time, the dark count rate of the detector and the generated background, e.g., from scattered light, should be as low as possible. Common systems use a combination of mirrors or lenses and photomultiplier tubes.

We investigated whether silicon photodiodes (SiPMs) are suitable for this application. Due to their square detection area, the photodiodes can be better arranged to cover the optimal detection area than photomultiplier tubes with their circular detection area. Collinear laser spectroscopy on $^{12}C^{4+}$ and Sr^+ ions was used to compare the detectors in the UV and optical region, respectively. Funded by BMBF, contract 05P21RDFN1.

HK 10.5 Mon 17:45 SCH/A215

Collinear Laser Spectroscopy on Neutron Rich Palladium — •Laura Renth for the ATLANTIS-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

Collinear laser spectroscopy gives access to isotope shifts and hyperfine parameters at high precision. From this, nuclear charge radii, nuclear magnetic and electric moments and nuclear spins can be determined. The LASPEC beamline, originally designed for collinear laser spectroscopy at FAIR, has been connected to the Californium Rare Isotope Breeder Upgrade (CARIBU) and is now the central part of ATLANTIS (**A**rgonne **T**andem hall **LA**ser bemli**N**e for a**T**om and **I**on **S**pectroscopy). Results from its commissioning and a first physics run on neutron-rich palladium isotopes will be presented. Short-lived Pd ions were delivered from CARIBU and neutralized to a fast atomic beam. Laser fluorescence spectroscopy was performed on the isotopes $^{110,112-116}$Pd. Spectra of all stable isotopes (even $^{102-110}$Pd and ^{105}Pd) were taken for reference with ions delivered by a laser-ablation ion source. Further measurements will be performed on products of the CARIBU successor nuCARIBU.

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