# HK 6: Structure and Dynamics of Nuclei II

Zeit: Montag 14:00–16:00 Raum: S1/01 A04

**Gruppenbericht** HK 6.1 Mo 14:00 S1/01 A04

**Beam normal single-spin asymmetry measurements at MAMI**
— •Michaela Thiel for the A1-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

Reaching new precision frontiers in nuclear physics brings up new experimental challenges as well as the demand for more sophisticated theoretical calculations. Especially in parity violating electron scattering experiments the contribution from higher order processes, such as two-photon exchange, is comparable in size with the observed asymmetry $A_{pv}$. Hence, a precise knowledge of this contribution is mandatory to determine the systematic uncertainties.

The beam normal single-spin asymmetry $A_n$ is a direct probe of the imaginary part of the two-photon exchange amplitude in the elastic scattering of transversely polarized electrons from unpolarized nucleons. Up to now, there is significant disagreement between experiment and theory for $^{208}$Pb, which motivates more measurements to study the $Q^2$ and Z dependence. Therefore a new experimental campaign started at the Mainz Microtron (MAMI) using the spectrometer setup of the A1 collaboration. Within three weeks of beam time $A_n$ was measured as a function of $Q^2$ for $^{12}$C. First results for four different 4-momentum transfer values, ranging from 0.02 to 0.05 $(\mathrm{GeV}/c)^2$, will be presented in this talk.

**Gruppenbericht** HK 6.2 Mo 14:30 S1/01 A04

**Direct detection of the thorium-229 isomer: Milestone towards a nuclear clock**
— •L. von der Wense[1], B. Seiferle[1], M. Laatiaoui[2,3], J.B. Neumayr[1], H.J. Maier[1], H.F. Wirth[1], C. Mokry[3,4], J. Runke[2,4], K. Eberhardt[3,4], C.E. Düllmann[2,3,4], N. Trautmann[4], and P.G. Thirolf[1] — [1]Ludwig-Maximilians-University Munich, 85748 Garching — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt — [3]Helmholtz Institute Mainz, 55099 Mainz — [4]Johannes Gutenberg University, 55099 Mainz

In the whole landscape of atomic nuclei, $^{229}$Th possesses the only known transition which by today could allow for the development of a nuclear frequency standard. The corresponding isomeric state has an energy of just 7.8 eV, which is even accessible by laser and frequency-comb technology. The isomer to ground-state transition, however, could not be directly detected within the past 40 years, despite significant efforts. In the presentation the first time unambiguous direct detection of the isomeric transition is described. This detection will allow for the determination of the decay parameters and in this way pave the way for the development of a nuclear clock.[1]

This work was supported by DFG (Th956/3-1) and by EU Horizon 2020 grant agreement no 664732 "nuClock".

[1] L. v.d.Wense, B. Seiferle, M. Laatiaoui and P.G. Thirolf, Eur. Phys. J. A 51, 29 (2015).

HK 6.3 Mo 15:00 S1/01 A04

**Inelastic Form Factor of the He-4 (0+)-Resonance**
— •Simon Kegel — Institut für Kernphysik Universität Mainz, Deutschland

Electron scattering experiments offer a great opportunity to probe nuclear properties and to get deeper insight into nuclear dynamics, because the electromagnetic interaction is well understood.
The MAMI electron accelerator at Mainz, Germany, can reach high beam intensities with electron energies in the range up to 1.5 GeV, thus it is a powerful tool to investigate nuclear dynamics with high statistics and precision. In 2009 an electron scattering experiment was performed by the A1 collaboration at MAMI with the focus on the study of inclusive reactions of light nuclei. The goal of the experiment is to test effective field theories, including phenomenological 3- or 4-body forces in potentials for ab-initio calculations. In the talk a new analysis of the form factor for the He-4 $(0^+)$-resonance will be presented.

HK 6.4 Mo 15:15 S1/01 A04

**Background analysis for the beta-spectrum of the isotope 113Cd in the COBRA experiment**
— •Stephan Platzek for the COBRA-Collaboration — Technische Universität Dresden, Deutschland

The COBRA experiment uses Cadmium-Zinc-Telluride as detector material. This semiconductor contains several isotopes that are candidates for neutrinoless double beta-decay. Due to the natural abundance of the detector material various other isotopes are present as well. One of them is $^{113}$Cd with an abundance of about 12%.

The fourfold forbidden non-unique beta-decay of $^{113}$Cd is a rare process with a half-life of about $8 \cdot 10^{15}$ years. The shape of the spectrum is still topic of scientific discussions because of various forecasts given by theoretical models. The signal related to this decay is by far the most prominent in the COBRA setup causing more than 98% of the total rate.

In this talk potential background components contributing to the $^{113}$Cd beta-spectrum are discussed with the aim to develop a detailed background simulation with the program VENOM (based on Geant4), that includes background sources originating from cosmic activation as well as natural radioactivity and detector specific effects.

HK 6.5 Mo 15:30 S1/01 A04

**Tensor Interaction Studies via High-Momentum Neutron Transfer Reaction, $^{16}$O(p,d), at the FRS**
— •Fabio Farinon for the S436-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany

The contribution of the nuclear tensor force was investigated via the $^{16}$O(p,d) reaction with the FRS at different energies from 400 MeV/u to 1200 MeV/u centered at 0 degrees. Previously, it was measured at lower energies and at angles up to 25 degrees [1]. The measured deuteron spectrum reflects the ground state and various excitation levels of $^{15}$O. The required high momentum resolution was achieved by operating the FRS as a spectrometer in a complete dispersive ion-optical mode, where the resolving powers of the four dipole-magnet stages are added. The object size of the spectrometer was restricted by a stripe target of 1 mm in the dispersive direction. The measured deuteron spectra were compared with extended simulations. The results of cross-section ratios of the low-lying excited states to the ground state reflect the influence of the tensor force which cannot be explained by present mean field calculations.

[1] H.J. Ong et al. Phys. Lett. B 725 (2013) 277.

HK 6.6 Mo 15:45 S1/01 A04

**Using $^{233}$U-doped crystals to access the few-eV isomeric transition in $^{229}$Th**
— •Simon Stellmer, Matthias Schreitl, Georgy A. Kazakov, Johannes H. Sterba, and Thorsten Schumm — Vienna Center for Quantum Science and Technology (VCQ) and Atominstitut, TU Wien, Vienna, Austria

The isotope $^{229}$Th possesses an exceptionally low-lying isomeric state at an energy of only a few eV. While direct laser excitation of the isomer is a tantalizing future prospect, the stage is not yet set for nuclear laser spectroscopy: too little is known about the energy, lifetime, and internal conversion pathways of the isomer. Alternative routes to populate the isomer are needed for further investigations.

We use the alpha decay $^{233}\mathrm{U} \rightarrow {}^{229\mathrm{g,m}}\mathrm{Th}$ to populate the isomer with a probability of 2%. The $^{233}$U is embedded into VUV-transparent crystals, as the isomer transition is expected around 160 nm. The wavelength of the gamma ray, emitted upon de-excitation of the isomer into the ground state, is measured with a spectrometer. Calculations show that the isomer emission will not be obscured by radioluminescence of the crystal.

We will report on the current status of the experiment.