HK 27: Instrumentation IX

Zeit: Dienstag 16:30–18:30 Raum: Audimax H1

Gruppenbericht HK 27.1 Di 16:30 Audimax H1

Status of the KATRIN experiment and preparation for tritium measurements — •Jan David Behrens — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie (KIT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

The **KA**rlsruhe **TRI**tium **N**eutrino experiment aims to determine the mass of the electron antineutrino with a sensitivity of $0.2\,\mathrm{eV}/c^2$ (90% C.L.). The measurement of the shape of the tritium β-spectrum facilitates a model-independent investigation of the absolute neutrino mass scale. The setup consists of a 70 m long beam line that magnetically guides electrons from a gaseous, windowless tritium source to a silicon detector. The energy analysis of the electrons takes place in an electrostatic spectrometer (MAC-E filter) with an energy resolution of about 1 eV. In preparation for tritium data-taking, a measurement campaign was carried out with gaseous and condensed $^{83\mathrm{m}}$Kr sources in the main beam line. Due to its narrow conversion electron lines this krypton isotope is ideally suited to investigate the performance of the MAC-E filter and overall system stability. These measurements allow us to investigate the experiment's reponse function, the beam line alignment and simulation models which are vital analysis ingredients.

The talk gives an overview about the current status of the experiment, focusing on the results of the recent data-taking period with gaseous and condensed krypton sources. This project is supported by BMBF project 05A17VK2, the Helmholtz Society and the Young Investigators Group (YIG) VH-NG-1055.

Gruppenbericht HK 27.2 Di 17:00 Audimax H1

Accurate High Voltage measurements based on laser spectroscopy — •Kristian König[1], Christopher Geppert[2], Phillip Imgram[1], Jörg Krämer[1], Bernhard Maass[1], Johann Meisner[3], Ernst Wilhelm Otten[4], Stephan Passon[3], Tim Ratajczyk[1], Johannes Ullmann[1,5], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz — [3]Physikalisch-Technische Bundesanstalt, Braunschweig — [4]Institut für Physik, Johannes Gutenberg-Universität Mainz — [5]Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The ALIVE experiment at the TU Darmstadt is a collinear laser spectroscopy setup that has been developed for the measurement of high voltages in the range of 10 to 100 kV with highest precision and accuracy. Here, ions with a well-known mass and transition frequency are accelerated with the voltage that has to be measured and their Doppler shift is examined precisely with laser spectroscopic methods. An accuracy of at least 1 ppm is targeted which is of interest for metrology as well as applications like, e.g. the KATRIN experiment. We will present the results we achieved with ^{40}Ca^{+} ions where the well-known $4S_{1/2} \rightarrow 4P_{3/2}$ and the $3D_{3/2} \rightarrow 4P_{3/2}$ transitions were used to identify the ion velocities before and after the acceleration which are already in the 5 ppm level. To improve this uncertainty, indium ions from a liquid metal ion source and an alternative pump and probe approach will be used in the next stage.

HK 27.3 Di 17:30 Audimax H1

Commissioning measurements of the CKrS with KATRIN — •Mariia Fedkevych — WWU Münster, Deutschland

The KArlsruhe TRItium Neutrino Experiment (KATRIN) is a model-independent measurement of the neutrino mass from the kinematics of tritium β-decay, aiming for a sensitivity of $0.2\ eV/c^2$ (90% C.L.). It uses an electrostatic spectrometer working in MAC-E-filter mode to analyze energies of beta-electrons generated in a windowless gaseous tritium source (WGTS). The experiment uses several sources for absolute energy calibration, monitoring and precise determination of the transmission function of the spectrometer. One of them is the ***Condensed Krypton Source*** (*CKrS*) developed in Münster which utilizes nearly monoenergetic conversion electrons from an adsorbed $^{83\mathrm{m}}$Kr layer on a graphite (HOPG) substrate. The substrate with the frozen $^{83\mathrm{m}}$Kr layer can be moved mechanically over the complete flux tube area at its position in the KATRIN beamline and therefore allows for per-pixel calibration of the KATRIN focal plane detector (FPD). The cleanliness of the substrate and the quality of the frozen radioactive films are crucial for the stability and reproducibility of the conversion electron spectrum and both are monitored by means of laser ellipsometry.

The source was recently installed at the KATRIN Cryogenic Pumping Section (CPS) and was successfully used in the KATRIN commissioning measurements in the summer 2017. Measurements regarding characterization of the source and spectroscopy with the CKrS are presented. This work is supported under BMBF contract 05A17PM3.

HK 27.4 Di 17:45 Audimax H1

Construction of the resonant position sensitive Schottky cavity — •Dmytro Dmytriiev[1], Shahab Sanjari[1], Yuri Litvinov[1], and Thomas Stohlker[1,2,3] — [1]GSI, Plankstrasse 1, 64291 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH Branch Office Helmholtz Institute Jena Fröbelstieg 3, 07743 Jena, Germany — [3]Friedrich Schiller University Jena 07737 Jena

Resonant Schottky cavities are sensitive beam monitors. They are very useful for the beam diagnostics in the storage rings. In addition to their applications in measurements of the beam parameters they also can be used in non-destructive in-ring decay studies of radioactive ion beams. And position sensitive Schottky cavities enhance precision in the isochronous mass measurement technique.

The goal of this work is to create and test position sensitive cavity based on previous simulations and theoretical calculations. These cavities will allow measurement of a particle horizontal position using monopole mode in an elliptic geometry. This information can be further analyzed to increase the performance in isochronous mass spectrometry. A brief description of the detector and its application in mass and lifetime measurements will be provided in this contribution.

HK 27.5 Di 18:00 Audimax H1

Development of the next-generation cryogenic stopping cell for the Super-FRS — •Daler Amanbayev[1], Samuel Ayet San Andres[1,2], Timo Dickel[1,2], Hans Geissel[1,2], Ivan Miskun[1], Wolfgang R. Plass[1,2], Ann-Kathrin Rink[1], and Christoph Scheidenberger[1,2] — [1]II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

A novel cryogenic gas-filled stopping cell (CSC) is being developed for the Low-Energy Branch (LEB) of the Super-FRS Ion Catcher at FAIR. The CSC will thermalize exotic nuclei produced in the Super-FRS at relativistic energies, and make them available to the high-precision experiments MATS and LaSpec.

A prototype of the CSC – commissioned as a part of the FRS Ion Catcher experiment at GSI – has already enabled an access to short-lived exotic nuclei, providing high areal densities of up to 6.3 mg/cm^2, short extraction times of 25 ms, high rate capabilities of more than 10^4 ions of interest per second and total efficiencies of 30%.

The current design of the future CSC introduces a number of novel concepts that yield in a five-fold increase in areal densities (30 mg/cm^2), five times faster extraction (5 ms), and 10^8 ions per second rate-capability without compromising the efficiency.

The major design features of the future CSC are presented (e.g. RF carpets) with the emphasis on the cryogenic system, that relies on electrically driven cryocoolers. To optimize the cryogenic system, the multiphysics simulations – static and dynamic – were performed.

HK 27.6 Di 18:15 Audimax H1

High-resolution spectrometer in the R^{3}B setup — •Sunji Kim, Thomas Aumann, and Heiko Scheit for the R3B-Collaboration — TU Darmstadt, Darmstadt, Germany

The international research facility FAIR is under construction for research on the nature of matter and the evolution of the universe. Among the four pillars of physics experiments at FAIR, NUSTAR Physics has a branch of R^{3}B to develop a versatile reaction setup for kinematical complete measurements.

In the planned R^{3}B setup, the High-resolution spectrometer (HRS) is one major part for the high-resolution measurement to obtain a relative momentum resolution of $\Delta p/p \sim 10^{-4}$ with high beam energies at around 1 A GeV of medium and heavy mass nuclei. In knockout reactions and quasi-free scattering, the orbital angular momentum of the recoiling fragment can be deduced from the momentum distribution by comparison with the calculated ones. Here, to distinguish the momentum distributions for different orbital angular momenta, around 20-30 MeV/c momentum resolution in σ in the laboratory frame is needed, corresponding to $\Delta p/p \sim 10^{-4}$. Therefore, the HRS, consisting of quadrupole triplets, dipoles, and tracking detectors, is being developed by simulations, and the status will be shown in the presentation.

This work is supported by the BMBF under contract number 05P15RDFN1 and the GSI-TU Darmstadt cooperation agreement.