HK 51: Instrumentation XII

Zeit: Donnerstag 16:45–19:00 Raum: F 072

HK 51.1 Do 16:45 F 072

Set up of a Condensed Krypton Source for the KATRIN experiment — •Stephan Dyba for the KATRIN-Collaboration — Institut für Kernphysik, Uni Münster

With the KATRIN (**KA**rlsruhe **TRI**tium **N**eutrino) experiment the endpoint region of the tritium beta decay will be measured to determine the electron-neutrino mass with a sensitivity of 0.2 eV/c^2 (90% C.L.). For the high precision which is needed to achieve the sub-eV range a MAC-E filter type spectrometer is used to analyze the electron energy by applying an electrostatic retardation potential in combination with a magnetic guiding field.

An important tool for the spatially resolved calibration of the transmission function of the KATRIN main spectrometer is the Condensed Krypton Source. This source uses a sub-monolayer ^{83m}Kr frost on a HOPG surface to generate monoenergetic conversion electrons which are guided along the magnetic field lines through the MAC-E filter onto the detector. To obtain a full coverage of all detector pixels the HOPG is moveable within the magnetic flux tube.

In this talk an overview of the system, its installation at KIT and first performance tests will be given.

This work is supported by BMBF under contract number 05A14PMA.

HK 51.2 Do 17:00 F 072

Developments for the Super-FRS Ion Catcher at the Low-Energy Branch at FAIR — •Ivan Miskun for the FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany

At the Low-Energy Branch (LEB) of the Super-FRS at FAIR exotic nuclei will be produced at relativistic energies, separated in-flight, stopped and thermalized in cryogenic gas-filled stopping cell (CSC), and delivered to the high precision experiments MATS and LaSpec. The prototype of this CSC has been developed and successfully commissioned as part of the FRS Ion Catcher experiment at GSI. It provides areal densities up to ~ 6.3 mg/cm^2 with total efficiencies of ~ 30 %. Short extraction times of ~ 25 ms and high rate capabilities (10^4 ions of interest per second without efficiency losses) enable an access to very exotic and short-lived nuclei.

Furthermore, the design of a next-generation CSC for the LEB has been developed. The new design will incorporate a number of novel concepts, which will provide significant further improvement of the performance parameters (5 times faster extraction times, 5 times higher areal densities, three orders of magnitude higher rate capabilities, etc.). As part of the design studies for this new CSC the operation of stopping cell at extremely high electrical field strengths has been tested with the present prototype. Also, the use of collision-induced dissociation in the RFQ beamline for the breakup of adducts and as an additional separation method has been investigated.

HK 51.3 Do 17:15 F 072

Upgrade of the TRIGA Mainz UCN D source — •Jan Kahlenberg[1], Marcus Beck[1], Christopher Geppert[2], Werner Heil[1], Jan Karch[1], Sergei Karpuk[2], Tobias Reich[2], Kim Ross[1], Christian Siemensen[2], Yuri Sobolev[2], and Norbert Trautmann[2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz

The upgrade of the ultra-cold neutron (UCN) source at beamport D of TRIGA Mainz has been successfully performed. A ^{58}NiMo-coated nose has led to an UCN yield increase of factor 3.5. Consequently, a UCN density of 8.5 UCN/cm^3 in a standardised volume of 32 l has been reached.

This talk presents the main results of the September and November 2016 beam times. The results convincingly prove the source's high performance and its suitability for UCN measurements at TRIGA Mainz. Supported by the PRISMA cluster of excellence, the neutron lifetime experiment τSPECT will profit from the increased UCN yield.

HK 51.4 Do 17:30 F 072

A Magnetically Driven Piston Pump for High-Purity Xenon Experiments — •Axel Buss, Christian Huhmann, Denny Schulte, Christian Weinheimer, Hans-Werner Ortjohann, Michael Murra, and Alexander Figuth — Institut für Kernphysik, Münster

In this talk, a new pump is presented which was designed for xenon gas recirculation in cooperation with the nEXO group at Stanford University and the nEXO/XENON group at Rensselaer Polytechnic Institute. It was built to meet the vast requirements of high-purity experiments like XENON1T, in terms of purity, performance and reliability. This is achieved by using a reciprocating compressor type with a magnetically driven piston. Even in a case of failure, the hermetically sealed design ensures cleanness of the pump medium at all times. Therefore the pump can be used for other applications where intrinsic safety and purity are necessary.

All parts have been carefully selected to minimize impurities and radioactive background, with the aim to reduce radon emanation below the level of commercially available pumps. At present the prototype in Münster is capable of pumping more than 100 slpm of argon at a differential pressure of 1 bar. Planned upgrades will enhance the performance further.

This project is supported by BMBF under contract 05A14PM1.

HK 51.5 Do 17:45 F 072

The Gas-Jet Target for MAGIX at MESA — •S. Grieser, D. Bonaventura, C. Hargens, A.-K. Hergemöller, B. Hetz, L. Lessmann, C. Westphälinger, and A. Khoukaz for the MAGIX-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The MAGIX experiment (MESA Gas Internal target eXperiment) will be located in the energy-recovering sector of the future electron accelerator MESA (Mainz Energy-recovering Superconducting Accelerator) at the University of Mainz. There, energies up to 105 MeV with a beam current of 1 mA can be achieved. MAGIX is a fixed-target experiment with high luminosity of $10^{35}\,\frac{\mathrm{cm}^2}{\mathrm{s}}$, which will consist of a gas-jet target and a multi-purpose spectrometer. The experiment focuses on investigations to verify the Standard Model of particle physics. Thereby, the main interest is the search for dark photons and precision measurements of fundamental constants, e.g. the proton radius. The gas-jet target was designed and built up at the University of Münster. Gas targets continuously provide target material with constant density (e.g. $10^{19}\,\frac{\mathrm{atoms}}{\mathrm{cm}^2}$ directly behind the nozzle). This gas-jet target offers the possibility to be operated also in a cluster-jet mode. This can be realized by changing the pressure and temperature of the gas at the nozzle. Currently, first measurements for the characterization of the target are done. This includes a construction of a Mach-Zehnder interferometer, which is used to determine the thickness distribution and the shape of the gas-jet. The target design and the results on the beam properties will be presented. Supported by HGS-HIRe.

HK 51.6 Do 18:00 F 072

Commissioning of a detection system for forward emitted XUV photons at the ESR — M. Bussmann[3], A. Buss[6], C. Egelkamp[6], L. Eidam[9], V. Hannen[6], Z. Huang[10], D. Kiefer[4], S. Klammes[4], Th. Kühl[1,2,5], M. Löser[3], X. Ma[10], W. Nörtershäuser[1,5,7], H.-W. Ortjohann[6], R. Sánchez Alarcon[1], M. Siebold[3], Th. Stöhlker[1,2,8], J. Ullmann[6], J. Vollbrecht[6], Th. Walther[4], H. Wang[10], Ch. Weinheimer[6], D. Winters[1], and •D. Winzen[6] — [1]GSI, Darmstadt — [2]Helmholtz-Institut Jena — [3]Helmholtz-Zentrum Dresden-Rossendorf — [4]Institut für Angewandte Physik, TU Darmstadt — [5]Institut für Kernchemie, Uni Mainz — [6]Institut für Kernphysik, Uni Münster — [7]Institut für Kernphysik, TU Darmstadt — [8]Institut für Optik und Quantenelektronik, Uni Jena — [9]Institut für Theorie Elektromagnetischer Felder, TU Darmstadt — [10]Institute of Modern Physics, Chinese Academy of Sciences

The Institut für Kernphysik in Münster developed an XUV-photon detection system for laser spectroscopy measurements at the ESR. In a test beam time for laser cooling with $^{12}C^{3+}$-ions at $\beta \approx 0.47$, the $^2S_{1/2} - {}^2P_{1/2}$ transition was investigated to commission the system. The detector features a movable cathode plate which is brought into the vicinity of the beam to collect forward emitted Doppler shifted photons ($\lambda_{\mathrm{lab}} \approx 93$ nm). The photons produce mostly low energetic (<3 eV) secondary electrons which are electromagnetically guided onto an MCP detector. First results of the beam time will be presented. This work is supported by BMBF under contract number 05P15PMFAA.

D. Winzen thanks HGS-HIRe for FAIR for funding his scholarship.

HK 51.7 Do 18:15 F 072

First results of a high-precision high-voltage measurement based on collinear laser spectroscopy — •Kristian König[1], Christopher Geppert[2], Phillip Imgram[1], Jörg Krämer[1], Bernhard Maass[1], Ernst Otten[3], Tim Ratajczyk[1], Johannes Ullmann[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz — [3]Institut für Physik, Johannes Gutenberg-Universität Mainz

Many physics experiments depend on accurate high-voltage measurements to determine for example the exact retardation potential of an electron spectrometer as in the KATRIN experiment or the acceleration voltage of the ions at ISOL facilities. Until now only precision high-voltage dividers can be used to measure voltages up to 65 kV with an accuracy of 1 ppm. However, these dividers need frequent calibration and cross-checking and the direct traceability is not given. We will report on the status of the ALIVE experiment at the TU Darmstadt which aims to measure high voltages using collinear laser spectroscopy and which has the potential to provide a high-voltage standard and hence, a calibration source for precision high-voltage dividers on the 1 ppm level.

HK 51.8 Do 18:30 F 072

An Improved Charge Exchange Cell for Collinear Laser Spectroscopy — •Felix Sommer[1], Peter Müller[2], Jason Clark[2], Jörg Krämer[1], Bernhard Maass[1], Rodolfo Sanchez[3], Guy Savard[2], and Wilfried Nörtershäuser[1] — [1]IKP, TU Darmstadt, DE — [2]ANL, Chicago, USA — [3]GSI, Darmstadt, DE

Collinear laser spectroscopy (CLS) provides the opportunity to extract nuclear charge radii and magnetic dipole as well as electric quadrupole moments in a nuclear-model independent way. CLS utilizes the reduction of velocity spread via acceleration with a DC high-voltage potential of typically a few 10 kV. The isotopes of interest have to exhibit electronic transitions which are accessible with laser systems and sensitive to changes of nuclear charge radii. If these are not available from the ionic ground state, charge exchange can provide access to suitable atomic transitions.

We present an updated design of a charge exchange cell for CLS, that can hold acceleration potentials up to 30 kV and operate at temperatures above 430 °C to allow for charge exchange with magnesium vapor. The cell is developed in Darmstadt and will be used at Argonne National Laboratory (ANL), where the CAlifornium Rare Isotope Breeder Upgrade (CARIBU) opens up new possibilities for in-flight laser spectroscopy of short lived isotopes, especially in the region beyond the sudden deformation at N=60 and Z>38.

This work is supported by the U.S. DOE, Office of Science, Office of Nuclear Physics, under contract DE-AC02-06CH1135, and by the Deutsche Forschungsgemeinschaft through Grant SFB 1245.

HK 51.9 Do 18:45 F 072

Production of polarized molecules — •Hani M. Awwad — HHU, Düsseldorf, Deutschland

The payoff for a breakthrough in nuclear fusion energy would be massive, because it could provide an almost endless supply of clean energy. However research has proven to be incredibly complicated and expensive. One way of significantly reducing size and cost of the fusion devices could be the use of polarized fuel, which is known to increase the cross section of fusion reactions by 50%. Furthermore the plasma could be more easily controlled, as emission directions of fusion products can be manipulated.

This is just one reason for the growing interest in polarized molecules. In the discussed experiment (supported by DFG/RSF grant BU 2227) an atomic beam source produces polarized atoms, which then recombine to polarized molecules in a storage cell. Next the polarization of the molecules is measured in a Lamb-Shift polarimeter. Another interesting aspect is the temperature dependence of their rotational states. J=0 molecules can possibly be frozen out and stored for later use. One way to make use of them is to build polarized targets e.g. for storage rings or laser acceleration of polarized protons.

Generally understanding the nuclear spin can grant new insights in chemical reactions and may also find more applications in biology or medicine.