HK 10: Accelerators and Instrumentation II

Time: Monday 14:00–16:00 Location: H-ZO 90

Group Report HK 10.1 Mo 14:00 H-ZO 90

PENeLOPE: progress towards a new precise neutron lifetime measurement — •Rüdiger Picker, Igor Altarev, Beatrice Franke, Erwin Gutsmiedl, Joachim Hartmann, Stefan Materne, Axel Müller, Stephan Paul, Rainer Stoepler, and Christian Tietze — Technische Universität München, Physik Department

The neutron lifetime τ_n allows access to fundamental parameters of the weak interaction. Therefore, a precise knowledge of τ_n provides direct tests of the Standard Model of particle physics. Moreover, a precise knowledge of the neutron lifetime is important for astrophysical models. However, recent results disagree with the PDG value of 885.7 ± 0.8 s by roughly 6σ. To resolve this discrepancy, we are developing an experiment with a superconducting magnetic trap for ultracold neutrons (UCN) at Technische Universität München. The UCN will be trapped in a multipole field with a flux density of up to 2 T and will be additionally bound to the top by gravitation. This makes extraction and detection of the decay protons possible and allows a direct measurement of the neutron decay rate. The envisaged precision of $\Delta\tau_n < 0.1$ s demands very long storage lifetimes and a good handle on systematic effects.. Several measures are taken to avoid these effects or investigate their influence on the extracted lifetime value extensively. The big storage volume of around 700 dm^3 and the expected high neutron flux of the UCN source at the FRMII give more than 10^7 neutrons per filling of the storage volume. The talk will report on the measurement principle and the current status of the setup. Supported by MLL, DPG and the excellence initiative EXC 153.

HK 10.2 Mo 14:30 H-ZO 90

On the release of 83mKr — •Makhsud Rasulbaev[1], Reiner Vianden[1], Karl Maier[1], Henrik Arlinghaus[2], Marcus Beck[2], Tim Schäfer[2], Christian Weinheimer[2], and Miroslav Zboril[2] for the KATRIN-Collaboration — [1]HISKP der Universität Bonn, Bonn, Germany — [2]Institut für Kernphysik der Universität Münster, Münster, Germany

The mono-energetic electrons with the kinetic energy of 17.8 keV from ^{83m}Kr ($t_{1/2} = 1.83$ h), daughter isotope of ^{83}Rb decay, are exploited for the calibration and monitoring of the main spectrometer voltage in the KATRIN experiment, which of utmost importance for the long term stability of the measurements. Until now there were problems with the release of ^{83m}Kr out of ^{83}Rb source. It was investigated how heating of the *Rb* source, following vacuum evacuation of the volume can improve the release of ^{83m}Kr.

HK 10.3 Mo 14:45 H-ZO 90

Further development of the precision HV divider for the KATRIN experiment — •Stephan Bauer, Frank Hochschulz, Stephan Rosendahl, Matthias Prall, and Christian Weinheimer for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

To determine the mass of the $\overline{\nu_e}$ with a sub-eV sensitivity the KATRIN-(KArlsruhe TRItium Neutrino-) experiment measures the tritium β spectrum in the endpoint region using a MAC-E type spectrometer. To reach the desired sensitivity the retarding potential of the MAC-E-filter of −18.6 kV must be monitored with a precision of 3 ppm. For that purpose a precision high voltage divider for voltages of up to 30 kV was developed in cooperation with the PTB (Physikalisch-Technische Bundesanstalt) Braunschweig. This first divider has been proven to deliver the necessary accuracy and stability.

For redundancy reasons and as a replacement during the calibration periods a second high voltage divider was developed based upon the experience gained from the first divider. The main goal of the development of the second divider was the improvement of the longterm stability and to expand the possible field of application to other experiments. In this talk the improvements of the second divider are shown along with calibration results obtained at the PTB.

This project is supported by BMBF under contract number 05A08PM1.

HK 10.4 Mo 15:00 H-ZO 90

A large-area low-temperature proton detector for the neutron lifetime experiment PENeLOPE — •Christian Tietze, Igor Altarev, Heinz Angerer, Beatrice Franke, Erwin Gutsmiedl, Joachim Hartmann, Stefan Materne, Axel Reimer Mueller, Stephan Paul, and Rüdiger Picker — Physik-Department, Technische Universität München

The neutron lifetime τ_n is a quantity very important for fundamental physics and cosmology. The new experiment PENeLOPE shall determine τ_n by trapping ultra-cold neutrons in a magnetic multipole field and by gravitation. Their lifetime will be determined precisely by both, counting the remaining neutrons after one storage period and online measurements of the time distribution of the decay protons. It is planned to use a scintillation counter as proton detector; it shall consist of a thin CsI layer evaporated on a UV-transparent light guide. The signals will be read out with large-area avalanche photodiodes (LAAPDs). As the whole arrangement is situated next to superconducting coils of PENeLOPE, the detector has to work at high magnetic fields and cryogenic temperatures. Extensive investigations were performed to prove the feasibility of the setup. The gain of two different types of LAAPDs was measured down to 25 K and found to be nearly constant. Additionally, the temperature dependent light output of CsI was measured as well as its behaviour after exposition to humid air. The talk will cover further developments of the detector concept as well as its integration into the PENeLOPE cryostat. This work is supported by MLL, DFG and by the Cluster of Excellence EXC 153.

HK 10.5 Mo 15:15 H-ZO 90

A high Resolution Phoswich detector: LaBr3(Ce) coupled with LaCl3(Ce) — •Mariano Carmona Gallardo[1], Jose Antonio Briz Monago[1], Olof Tengblad[1], Manuela Turrion Nieves[1], Vincent Gugliermina[1], and Bilal El Bakkari[2] — [1]IEM-CSIC, Madrid, Spain — [2]Dep. of Physics, Rabat, Marocco

The gamma calorimeter CALIFA which is to surround the Target position of the R3B experiments at FAIR is to detect high energy gammas and protons emitted in Nuclear Reactions at Relativistic Energies.

In the design of CALIFA's forward cap an innovative solution using two scintillating crystals stacked together one after the other in a so called Phoswich configuration is being considered. Simulations show that the gamma deposit most of the energy in the vicinity of the first impact and this with high probability happens already in a few cm of material. Combining two materials one could thus distinguish at what depth the impact happens; use a first short crystal of a high resolution material followed by a longer piece of a less expensive material. The second layer is used to fully absorb the gamma energy or in the case of first hit in the second layer to veto that specific event.

For protons, two layers detector is also useful in order to determine the initial energy. It is possible to determine the initial energy by the energy loss in two shorter crystals.

We report here on results that has been obtained with a Phoswich detector made from 30 mm long LaBr3(:Ce) stacked with 50 mm long LaCl3(:Ce) crystals in a cylindrical configuration of 20 mm diameter.

HK 10.6 Mo 15:30 H-ZO 90

Development of a Time-of-Flight Detector System for Isochronous Mass Spectrometry at FAIR — •Natalia Kuzminchuk[1,2], Hans Geissel[1,2], Ronja Knöbel[1,2], Christophor Kozhuharov[2], Serguei Litvinov[2], Yuri Litvinov[2], Wolfgang Plass[1,2], Christoph Scheidenberger[1,2], Baohua Sun[2], and Helmut Weick[2] — [1]Justus-Liebig Universität Gießen, Germany — [2]GSI, Darmstadt, Germany

At the FAIR facility, the projectile fragment separator Super-FRS will provide beams of exotic nuclei with unprecedented intensity. The new Collector Ring (CR) is optimized to accept the large-emittance secondary beams provided by the Super-FRS. High-precision mass measurements of exotic nuclei with life times as short as a few tens of microseconds will be performed with Isochronous Mass Spectrometry (IMS) at the CR.

For these measurements a dual detector system is under development. In the detectors, ions passing a thin carbon foil release secondary electrons, which are transported to microchannel plates by electric and magnetic fields. The time dispersion in the electron flight due to the velocity spread of the secondary emission electrons and the initial spatial distribution on the foil was investigated. The influence of the MCP dead time on the rate capability of the detectors was examined. An initial design of a new detector will be presented, which incorporates corresponding improvements in timing performance, rate capability and includes position-sensitive detection for beam tracking.

HK 10.7 Mo 15:45 H-ZO 90

A Multiple-Reflection Time-of-Flight Isobar Separator and Mass Spectrometer (MR-TOF-MS) for the LEB at FAIR
— •Timo Dickel[1], Wolfgang R. Plass[1,2], Arno Becker[1], Ulrich Czok[1], Hans Geissel[1,2], Christian Jesch[1], Martin Petrick[1], Christoph Scheidenberger[1,2], André Simon[1], and Mikhail I. Yavor[3] — [1]Justus-Liebig-Universität Gießen — [2]GSI, Darmstadt — [3]Inst. for Analytical Instrum., Russian Academy of Sci., St. Petersburg

At the LEB of the Super-FRS at FAIR, precision measurements of very short-lived nuclei will be performed. For these experiments (MATS, LASPEC), the nuclei have to be stopped, cooled, separated and measured fast and efficiently. To achieve this goal, a multi-purpose, non-scanning mass spectrometer with single-ion sensitivity, a multiple-reflection time-of-flight mass spectrometer, has been developed.

It will be positioned behind the gas-filled stopping cell at the LEB, where it can be used as a broadband mass spectrometer, an isobar separator or a high-precision mass spectrometer. The broadband mode will be used for optimization of the range and range-compression in the Super-FRS and the stopping and extraction from the gas cell. Isobaric contamination that is produced by secondary reactions in the degraders or by charge-exchange reactions in the gas cell can be orders of magnitude larger than the ions of interest. To remove these ions, the isobar separator mode is required, in which up to 10^7 isobaric ions/s can be handled. The high-precision mode enables measurements with an accuracy of 10^{-6} to 10^{-7} in about 2 ms. In this contribution the basic characteristics and performance of the device will be presented.