HK 37: Instrumentation und Anwendungen I

Zeit: Donnerstag 16:30–19:00 Raum: 2C

Gruppenbericht HK 37.1 Do 16:30 2C

PENeLOPE, ein UCN-Speicher mit supraleitenden Magneten zur Messung der Neutronenlebensdauer — •Stefan Materne, Beatrice Franke, Erwin Gutsmiedel, Joachim Hartmann, Axel Müller, Stephan Paul und Rüdiger Picker — TU München

Die Lebensdauer des freien Neutrons τ_n bietet Zugang zu fundamentalen Parametern der schwachen Wechselwirkung und geht zudem entscheidend in kosmologische Modelle ein. Die jüngste Messung weicht um etwa 6σ von dem derzeitigen PDG-Wert von $885,7\,\mathrm{s}(\pm 0,8\,\mathrm{s})$ ab. Zur Klärung dieser Diskrepanz ist an der TU München ein Experiment mit einer supraleitenden Magnetspeicherfalle für ultrakalte Neutronen (UCN) in Planung. Die UCN werden in einem bis zu 2 T starken Multipolfeld und nach oben durch die Gravitationskraft gefangen. Dies erlaubt zusätzlich die Extraktion und den Nachweis der Zerfallsprotonen und somit eine direkte Messung der Neutronenzerfälle. Die angestrebte Genauigkeit der Lebensdauermessung von etwa 0, 1 s verlangt hohe Speicherzeiten sowie eine genaue Kenntnis systematischer Fehler, wie sie zum Beispiel aus Neutronenverlust durch Spinflip und von höherenergetischen UCN resultieren. Das Neutronenspektrum wird durch Verwendung von Absorbern gereinigt. Das große Speichervolumen von 800 l und die erwartet hohe UCN-Dichte am FRMII oder am PSI liefern die geforderte Statistik bei mehr als 10^7 Neutronen pro Füllung. Der Vortrag behandelt den geplanten Aufbau sowie Testmessungen zu Absorbereigenschaften bei tiefen Temperaturen, die an der Neutronenquelle ILL in Grenoble durchgeführt wurden.

Gefördert von MLL, BMBF und der Exzellenzinitiative EXC 153.

HK 37.2 Do 17:00 2C

Aufbau und Produktion der Drahtelektrode für das KATRIN-Experiment — •Michael Zacher, Volker Hannen, Björn Hillen, Raphael Jöhren, Hans-Werner Ortjohann, Matthias Prall, Martina Reinhardt und Christian Weinheimer für die KATRIN-Kollaboration — Institut für Kernphysik, Universität Münster

Die Neutrinomasse ist ein wichtiger Parameter sowohl in der Kosmologie und Astrophysik als auch in der Teilchenphysik. Mit dem **KA**rlsruher **TRI**tium **N**eutrinomassen-Experiment ist eine direkte, modellunabhängige Massenbestimmung für das Elektronneutrino im Sub-eV-Bereich möglich, indem der Endpunktbereich des Tritium-Betazerfalls mit hoher Präzision vermessen wird. Das Hauptspektrometer des KATRIN-Experiments arbeitet nach dem Prinzip des MAC-E-Filters. Das Spektrometer besteht im Wesentlichen aus einem 23 m langen und 10 m durchmessenden Ultrahochvakuumtank, der mit einer zweilagigen inneren Drahtelektrode ausgestattet ist. Diese dient zum einen zur Feinjustage der elektrischen Felder im Tank und zum anderen zur Abschirmung von Untergrundelektronen, welche etwa durch kosmische Strahlung aus der Tankwand gelöst werden. Die 240 Drahtmodule mit ihren etwa 23000 Drähten werden in Münster unter Reinraumbedingungen gefertigt, vermessen und für den Transport nach Karlsruhe vorbereitet. Der Vortrag wird einen Überblick über die Drahtelektrode, den Produktionsprozess und die Qualitätssicherung geben.

Dieses Projekt wird durch das BMBF gefördert unter Kennzeichen 05CK5MA/0.

HK 37.3 Do 17:15 2C

Measurement of transverse emittance at the source of spin-polarized electrons at the S-DALINAC* — •Christian Eckardt[1], Wolfgang Ackermann[2], Roman Barday[1], Uwe Bonnes[1], Ralf Eichhorn[1], Joachim Enders[1], Christoph Hessler[1], Wolfgang F.O. Müller[2], Oleksandr Patalakha[1], Markus Platz[1], Yuliya Poltoratska[1], Wolfgang Rick[1], Bastian Steiner[2], and Thomas Weiland[2] — [1]Institut für Kernphysik, TU Darmstadt — [2]Institut für Theorie Elektromagnetischer Felder, TU Darmstadt

A new injector concept for 100 keV spin-polarized electrons (SPIN) at the S-DALINAC has been developed. The transverse emittance was measured for beam characterization. The emittance is a quantity concerning the quality of the beam, describing the phase space area. Determination of the emittance requires measurement of the beam profile and knowledge of the focal length of a beam focussing device.

A wire scanner unit consisting of two 50 μm diameter tungsten wires is used for the beam-profile measurement. Data analysis is performed by fitting a gaussian model distribution to estimate the 1σ beam radius. Each determined beam width is correlated to the corresponding focal length of a magnetic lens, and a parabola fit is applied to calculate the parameters of the σ-matrix. The square root of the determinant of the σ-matrix defines the emittance. The results of the calculation are presented and the emittance is compared to theoretical estimates.

*Supported by DFG through SFB 634.

HK 37.4 Do 17:30 2C

Production of ultra-cold neutrons with a solid deuterium converter at a test facility at the TRIGA reactor in Mainz — •Andreas Frei[1], Igor Altarev[1], Erwin Gutsmiedl[1], Gabriele Hampel[2], F. Joachim Hartmann[1], Werner Heil[3], Jens Volker Kratz[2], Thorsten Lauer[2], Stephan Paul[1], Youri Pokotilovski[4], Youri Sobolev[3], Markus Urban[1], and Norbert Wiehl[2] — [1]Physik Department E18, Technische Universität München — [2]Institut für Kernchemie, Universität Mainz — [3]Institut für Physik, Universität Mainz — [4]Joint Institute for Nuclear Research, Dubna, Russia

A test facility for the production of ultra-cold neutrons (UCN) with a solid D_2-converter (volume $\leq 200\,\mathrm{cm}^3$) at the TRIGA reactor in Mainz has been taken into operation. This facility serves as a prototype for a strong UCN source at the FRM-II, as well as an apparatus, where different parameters involved with the production of UCN, their transport and storage can be investigated. During the last year many of these parameters concerning UCN production have been measured. The results of these measurements are in good conformance with theoretical calculations and numerical simulations. This talk will give an overview of the experimental results of these measurements. This project was supported by the Maier-Leibnitz-Laboratorium (MLL) and the Cluster of Excellence Exc153 "Origin and Structure of the Universe".

HK 37.5 Do 17:45 2C

A Low-Temperature Proton Detector for a Neutron Lifetime Experiment — •Axel Reimer Müller, Igor Altarev, Heinz Angerer, Stefan Materne, Joachim Hartmann, Stephan Paul, and Rüdiger Picker — E18, Technische Universität München

The neutron lifetime τ_n is a quantity very important for fundamental physics and cosmology. The new experiment PENeLOPE (Precision Experiment on the Neutron Lifetime Operating with Proton Extraction) shall determine τ_n with a precision nearly one order of magnitude better than previous experiments. In this experiment neutrons will be stored in a magneto-gravitational trap. To measure the time distribution of the decay protons is a substantial part of the experiment. We plan to build a large-area scintillation counter to detect the protons. A thin CsI layer on a UV-transparent light guide will be read out with large-area avalanche photodiodes (LAAPD). The detector arrangement has to work at cryogenic temperatures. Extensive investigations were performed to prove the feasibility of the set-up. In addition to the temperature dependent light output of CsI, we measured the LAAPD gain at temperatures down to 25 K. In contrast to an earlier experiment, which noticed a sharp decrease in the LAAPD gain at 50 K, we observed constant gain down to the lowest temperatures for two different kinds of LAAPD. First results where achieved with evaporated thin-film scintillators. A possible detector scheme was established after light-collection studies from the CsI layer to the LAAPD with the ray-tracing program FRED. This work is supported by the German BMBF, by DFG and by the Cluster of Excellence EXC 153.

HK 37.6 Do 18:00 2C

Performance study of a time-of-flight detector for Isochronous Mass Spectrometry — •Benjamin Fabian[1,2], Fritz Bosch[2], Timo Dickel[1], Hans Geissel[1,2], Christophor Kozhuharov[2], Ronja Knoebel[2], Natalia Kuzminchuk[1,2], Sergey Litvinov[2], Yuri Litvinov[2], Martin Petrick[1], Wolfgang Plass[1], Christoph Scheidenberger[1,2], Baohua Sun[2], Martin Winkler[2], and Helmut Weick[2] — [1]II. Physikalisches Institut, Gie{\ss}en, Germany — [2]GSI, Darmstadt, Germany

Isochronous Mass Spectrometry as performed at the FRS-ESR facility at GSI can be used to measure masses of exotic nuclei with lifetimes as short as tens of microseconds. For the measurement of the revolution frequencies for a few ions, a time-of-flight detector is used. Secondary electrons released from a thin CsI coated carbon foil at every passage of the ion through the detector are transported to micro-channel-plates (MCP) by electric and magnetic fields. In order to increase the detection efficiency and the timing characteristics, offline and online experiments have been performed. The experimental results have been compared to simulations. Clear evidence for improved detection efficiency at different magnet field have been found. All stages in the detection process from the creation of secondary electrons, their transport to the MCP to the detection in MCPs have been investigated, The comparison shows that the only weak point of the measurement method is the high count rate required. This knowledge can now be used for the developement of a TOF detector for IMS at the CR at FAIR.

HK 37.7 Do 18:15 2C

Latest Results and New Developments From the FRS Ion-Catcher Project at GSI — •Martin Petrick for the FRS Ion-Catcher-Collaboration — JLU, Gießen

A key element of the Low-Energy-Branch (LEB) of the FAIR-facility will be the energy buncher and the stopping cell for in-flight separated exotic nuclei. This device will provide high quality beams of short-lived nuclei for high precision experiments such as decay spectroscopy, direct mass measurements and laser-spectroscopy. In an on-line experiment with a beam of 280 MeV/u, projectiles were produced by fragmentation of a ^{58}Ni-beam in an aluminium target, stopped in a helium-filled gas cell and extracted with a few eV through an RF-quadrupole ion distribution system, which guided the ions to a silicon surface barrier detector and a time-of-flight mass spectrometer. In the experiment the efficiency of the setup, molecule -and adduct-formation in the gas and extraction times from the gas cell were investigated. As a proof-of-principle the half-life of ^{54}Co was determined.
As a second generation stopping cell, a cryogenic device is under development for the LEB. Its benefit is the smaller dimension in longitudional beam direction due to larger gas density. According to the use of cryogenic gas compared with ion catchers driven at room temperature, the diffusion losses decrease and a higher efficiency is therefor expected. In this presentation an overview on the experiment, its results and the new developements will be given.

HK 37.8 Do 18:30 2C

Simulations and test results of slowed down beams project — •Plamen Boutachkov[1], Magdalena Górska[1], Jürgen Gerl[1], Hans Geissel[1], Ivan Kojouharov[1], Wolfgang Koenig[1], Alvarez Marcos A. G.[2], Chiara Nociforo[1], Marcin Pomorski[3], Wawrzyniec Prokopowicz[1], Henning Schaffner[1], and Helmut Weick[1] — [1]Gesellschaft für Schwerionenforschung, — [2]Seville University, Seville, Spain — [3]Warsaw University, Warsaw, Poland

The availability of radioactive beams has opened new opportunities for the investigation of exotic drip-line nuclei. The NUSTAR/HISPEC slowed down beam project[1] at GSI/FAIR is dedicated to rare isotopes with energies of 10 MeV/u and less. These fragments will be used for spectroscopy and reactions studies at HISPEC. The slowed down setup will utilize a thick degrader positioned after the FRS/Super FRS separators at GSI/FAIR, followed by transmission detectors for energy and trajectory reconstruction. A feasibility study and a test experiment at the FRS were performed. In a follow up measurement at the UNILAC accelerator a 40 μm silicon DSSD detectors equipped with fast preamplifiers were tested. These detectors are considered for fragment tracking at the future slow down beam setup. The results from the test experiments and comparison to the simulations will be presented.
[1] http://www-linux.gsi.de/ ˜wwwnustar/tech_report/09-hispec_despec.pdf * Supported by the MEC, Spain, project FPA2006-13807-C02-01

HK 37.9 Do 18:45 2C

A new cryogenic gas-filled stopping chamber for SHIPTRAP — •Sergey Eliseev, Michael Block, Frank Herfurth, H.-Jürgen Kluge, and Gleb Vorobjev — GSI, Darmstadt, Germany

The SHIPTRAP facility at GSI Darmstadt is a unique Penning trap mass spectrometer designed to perform high precision mass measurements [1] on transuranium nuclides produced in fusion-evaporation reactions at the velocity filter SHIP [2].

A crucial element of SHIPTRAP is a gas-filled stopping chamber [3], which transforms a fast ion beam of a few MeV/u from SHIP into a thermally cooled ion beam. Detailed experimental investigations of the gas-filled stopping chamber [4] have revealed bottle necks, which limit the efficiency of SHIPTRAP. In order to improve the SHIPTRAP a novel cryogenic gas-filled stopping chamber has been designed and is presently under construction. The operation at liquid nitrogen temperature results in enhanced stopping and extraction performance. For example, ion losses due to ion diffusion - a significant loss process in the present room temperature chamber - will be substantially reduced. In addition, an influence of impurities on the performance of the chamber will be drastically reduced. All these modifications will allow us to increase the total efficiency of SHIPTRAP by factor of 4-5.

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