HK 81: Instrumentation

Zeit: Donnerstag 16:45–19:00 Raum: WIL-A221

Gruppenbericht HK 81.1 Do 16:45 WIL-A221

On-Line Commissioning of the Cryogenic Stopping Cell for the (Super-)FRS at the FRS Ion Catcher — •Moritz Pascal Reiter for the FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Giessen, Giessen, Germany

At the FRS projectile and fission fragments are produced at relativistic energies, separated in-flight, range-bunched, slowed-down and thermalized in the FRS Ion Catcher, a cryogenic stopping cell (CSC), from which they are extracted with kinetic energies of a few eV. A multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) is used as a diagnostic tool for the extracted ions, to remove isobaric contaminants and to perform direct mass measurements of the projectile and fission fragments. The achieved clean beam may be delivered to further experiments, for example mass-selected decay spectroscopy. The FRS Ion Catcher serves as a test facility for the Low-Energy-Branch of the Super-FRS at FAIR, where the CSC and the MR-TOF-MS will be key devices for experiments with very neutron rich fission fragments.

In October 2011 and July/August 2012, the CSC and the MR-TOF-MS were commissioned on-line at the FRS Ion Catcher at GSI. For the first time, a stopping cell for exotic nuclei was operated on-line at cryogenic temperatures. Using a gas density almost two times higher than ever reached before for a stopping cell with RF ion repelling structures, various projectile fragments were thermalized and extracted with high efficiencies and short extraction times. For the first time, direct mass measurements of short-lived nuclei were performed with an MR-TOF-MS, among them the nuclide 213Rn with a half-life of only 20 ms.

HK 81.2 Do 17:15 WIL-A221

The Neutron Distribution System of the new Ultra-Cold Neutron Source at the FRM II — •Stephan Wlokka[1], Andreas Frei[1], Peter Fierlinger[2], Stephan Paul[2], and Peter Geltenbort[3] — [1]Forschungsneutronenquelle Heinz Maier-Leibnitz (FRM II), Technische Universität München, Lichtenbergstraße 1, D-85747 Garching — [2]Physik Department, Technische Universität München, James-Franck-Straße 1, D-85748 Garching — [3]Institut Laue-Langevin, BP 156, 6, rue Jules Horowitz, 38042 Grenoble Cedex 9, France

Ultra-cold neutrons (UCN) are neutrons which are totally reflected from a given material surface. Typical energies of UCN are below 300 neV and velocities below 8 m/s. Thus they can be stored in material or magnetic bottles for several hundreds of seconds. As such, UCN are excellent laboratories to study fundamental parameters, e.g. the free neutron lifetime or the electric dipole moment of the neutron.

The new UCN source foreseen at the FRM II will deliver high UCN densities to four experimental areas. Hence a mechanism to distribute as many UCN as possible to these areas is needed. We have developed a high efficiency UCN switch for this purpose.

This talk reports about a series of measurements conducted with this switch. There have been three types of measurements, testing the transmission, storage and surface properties of the switch.

This work was funded by the DFG Excellenz-Cluster EXC153 "Origin and Structure of the Universe" and the Maier-Leibnitz-Laboratorium (MLL) of the TU and LMU Munich.

HK 81.3 Do 17:30 WIL-A221

A powerful source for ultracold neutrons at TRIGA Mainz: latest results — Markus Beck[1], Klaus Eberhardt[2], Gabriele Hampel[2], Werner Heil[1], •Jan Peter Karch[1], Robin Kieser[1], Christian Plonka-Spehr[2], Tobias Reich[2], Iouri Sobolev[1], and Norbert Trautmann[2] — [1]Institut für Physik, Universität Mainz — [2]Institut für Kernchemie, Universität Mainz

Ultracold neutrons (UCN) are a powerful tool for addressing many fascinating questions in particle physics, nuclear physics, and astronomy. UCNs offer unique opportunities for investigating the properties of the free neutron, such as its lifetime, with exceptionally high precision. In order to tackle the obvious count rate limitations, super-thermal UCN sources are now under construction at different places worldwide.

Within PRISMA cluster of excellence the existing UCN source at TRIGA Mainz will be upgraded in its performance to reach very high UCN number densities. The talk gives an overview on the present optimization work at the pulsable UCN source at beamport D, measures to improve the UCN yield and future plans to establish a user facility at TRIGA Mainz.

HK 81.4 Do 17:45 WIL-A221

On-line coupling of the TRIGA-SPEC facility at the research reactor TRIGA Mainz — •Dennis Renisch for the TRIGA-SPEC-Collaboration — Institut für Kernchemie, Johannes Gutenberg-Universität, Mainz, Germany

To determine ground-state properties of exotic nuclides, the TRIGA-SPEC experiment at the TRIGA Mainz research reactor was recently installed. It includes the Penning-trap mass spectrometer TRIGA-TRAP and the collinear laser spectroscopy setup TRIGA-LASER. Nuclides of interest are produced via neutron-induced fission of suitable actinoide isotopes, thermalized in a gas-filled volume and transported with a gas-jet system to an on-line ion source. Ionization of the fission products occurs inside a hot cavity of the ion source, which is heated by electron bombardment to temperatures of about 2000°C. The ion beam is extracted by a high potential difference and mass separated by a 90° dipole magnet. Afterwards, the ion beam is injected into an RF-cooler/buncher and finally decelerated by a pulsed drift tube so that the ions can be captured in a Penning trap. The efficiencies of the different parts of the beamline were tested recently and the latest results about the performance will be presented.

HK 81.5 Do 18:00 WIL-A221

CoTEx 2.0 - Coil tests for the neutron lifetime experiment PENeLOPE — •Dominic Gaisbauer for the PENeLOPE-Collaboration — Technische Universität München, München, Deutschland

PENeLOPE is an experiment with ultra cold neutrons (UCN) for determining their lifetime in a magneto-gravitational trap with special designed superconducting coils developed at the Technische Universität München. It is designed to have a precision of up to 'pm 0.1s.Due to their unique characteristics all coils for the trap have to be trained and tested in a preliminary experiment called CoTEx 2.0 before they can be inserted into PENeLOPE. The talk will highlight the results of the first prototype coil tests and the three coils delivered in January 2013. A short overview of CoTEx in general and the slow control and quench detection of CoTEx will also be presented.

This project is supported by the Deutsche Forschungsgemeinschaft, the Maier-Leibnitz-Laboratorium Garching and the Cluster of Excellence "Origin and Structure of the Universe".

HK 81.6 Do 18:15 WIL-A221

High Precision Neutron Polarisation with Supermirrors — •Christine Klauser[1,2], Thierry Bigault[1], Peter Böni[3], Pilar Guimerá Millán[1], Martin Schneider[4], and Torsten Soldner[1] — [1]Institut Laue-Langevin, Grenoble, France — [2]Atominstitut, Technische Universität Wien, Austria — [3]Physikdepartment E21, Technische Universität München, Germany — [4]SwissNeutronics AG, Brühlstrasse 28, CH-5313 Klingnau, Switzerland

Absolute measurements of correlation coefficients in neutron beta decay are presently limited to a relative accuracy in the order of 10^{-3} by systematics and statistics. Next-generation instruments aim for 10^{-4} accuracy, implying a 10^{-4} accuracy for the polarization of a large cold neutron beam. State-of-the-art polarizing super mirrors in the X-SM geometry deliver about 99.7% polarization only. This limitation of the performance is caused by depolarization by the supermirrors themselves. We present a systematic study of depolarizing effects in polarizing supermirrors. The highly sensitive Opaque Test Bench based on 3He spin filters is used as diagnostic tool. We have studied depolarization in both reflection and transmission for different supermirrors, varying in material and supermirror factor m, and investigated the relationship to magnetizing field, incidence angle and wavelength. The results of this study have been used to push the polarisation of the X-SM geometry to 99.970(3), combining a FeSi mirror and a CoTi bender.

HK 81.7 Do 18:30 WIL-A221

An angular selective electron gun for the KATRIN experiment — •Michael Zacher, Hans-Werner Ortjohann, Nicholas Steinbrink, Lorenz Josten, Volker Hannen, Christian Weinheimer, and Daniel Winzen for the KATRIN-Collaboration — West-

fälische Wilhelms-Universität, Münster

The **KA**rlsruhe **TRI**tium **N**eutrino experiment aims for a measurement of the electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (95% C.L.) by analysing the endpoint region of the tritium β-decay. The main spectrometer (MAC-E filter type, 23m length) is one of the central parts of the experiment, featuring an energy resolution of Δ E<1 eV. For commissioning of the spectrometer a well defined electron source is needed that allows to determine the transmission characteristics and compare the electromagnetic properties to simulations. For this purpose an angular selective electron gun was developed.

A pulsed UV-Laser produces electrons via the photo-electric effect, which are then accelerated electro-statically in a magnetic field. It features a small energy spread, a sharp selectable emission angle and covers the whole magnetic flux tube of KATRIN. By that, the characteristics of the spectrometer can be investigated with high precision. The time structure of the electron pulses allows time of flight measurements, offering enhanced sensitivity. The talk will give an overview about the e-gun design and its properties.

This project is funded by the BMBF under contract number 05A11PM2.

HK 81.8 Do 18:45 WIL-A221

Novel laser ellipsometry method for the KATRIN condensed ^{83m}Kr source — •Miroslav Zbořil for the KATRIN-Collaboration — Institut für Kernphysik, Uni Münster

One of the systematic effects in the neutrino mass experiment KATRIN are the fluctuations of the electric retarding potential which is experienced by the tritium β electrons on their path through the spectrometer. For the purpose of long-term monitoring of the energy scale stability several calibration electron sources will be utilised at KATRIN. One of them is the condensed ^{83m}Kr source based on a frozen ^{83m}Kr film on a HOPG backing at about 20 K. The isomeric state decays via a cascade of highly converted transitions, yielding conversion electron lines with energies ranging from 7.5 keV to 32.1 keV, useful for the energy calibration. The cleanliness of the HOPG backing is crucial as any adsorption of residual gas would shift the kinetic energy of the conversion electrons. The backing is cleaned via laser ablation and resistive heating. The cleanliness is checked via a novel method of laser ellipsometry where the polarisation analysis takes place directly in ultrahigh vacuum. The polarisation analysis is realised by an analyser and light detector at 90 K embedded in the cold baffle. This method allows to determine film thicknesses with a resolution of better than an atomic monolayer. As a byproduct it can be also used to determine the indices of refraction of condensed krypton and of the HOPG backing.

The main features of the calibration source will be reviewed and the results of test measurements will be presented. The project is supported by BMBF under contract number 05A11PM2.