HK 70: Instrumentation XX

Zeit: Freitag 14:00–16:00 Raum: S1/01 A3

Gruppenbericht HK 70.1 Fr 14:00 S1/01 A3

The neutron lifetime experiment PENeLOPE — •Wolfgang Schreyer[1], Dominic Gaisbauer[1], Joachim Hartmann[1], Igor Konorov[1], Stephan Paul[1], Rüdiger Picker[2], Dominik Steffen[3], Rainer Stoepler[1], and Christian Tietze[1] — [1]Technische Universität München, Garching, Germany — [2]TRIUMF, Vancouver, Canada — [3]CERN, Geneva, Switzerland

The neutron lifetime $\tau_n = 880.3 \pm 1.1$ s is an important parameter in the Standard Model of particle physics and in Big Bang cosmology. Several systematic corrections of previously published results reduced the PDG world average by several σ in the last years and call for a new experiment with complementary systematics.

The experiment PENeLOPE, currently under construction at the Physik-Department of Technische Universität München, aims to determine the neutron lifetime with a precision of 0.1 s. It will trap ultra-cold neutrons in a magneto-gravitational trap using a large superconducting magnet and will measure their lifetime by both neutron counting and online proton detection.

This presentation will give an overview over the latest developments of the experiment, especially magnet construction, the ultra-cold neutron polarization system, and the proton detector.

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

HK 70.2 Fr 14:30 S1/01 A3

Low Energy Proton Detector Using APDs for the PENeLOPE Experiment — •Dominic Gaisbauer[1], Joachim Hartmann[1], Igor Konorov[1], Stephan Paul[1], Rüdiger Picker[2], Wolfgang Schreyer[1], Dominik Steffen[3], Rainer Stoepler[1], and Christian Tietze[1] — [1]Technische Universität München, Garching, Germany — [2]TRIUMF, Vancouver, Canada — [3]CERN, Geneva, Switzerland

PENeLOPE is a neutron lifetime measurement at the Technische Universität München aiming to achieve a precision of 0.1 s. The detector for PENeLOPE consists of about 1250 Avalanche Photodiodes (APDs) with a total active area of 1225 cm^2. The detector and electronics will be operated at a high electrostatic potential of -30 kV, and a magnetic field of 0.6 T. This includes shaper, preamplifier, ADC and FPGA stage. In addition the APDs will be cooled to 77 K. The 1250 APDs are divided into 14 groups of 96 channels, including spares. Each group is processed by one FPGA card which reads out the 12-bit ADCs with 1 MSps. A new firmware was developed for the detector including a self-triggering readout with continuous pedestal calculation and configurable signal detection. The data transmission and configuration is done via the Switched Enabeling Protocol (SEP). It is a time-division multiplexing low layer protocol which provides determined latency for time critical messages, IPBus, and JTAG interfaces. The network has a n:1 topology and thereby reduces the number of optical links.

HK 70.3 Fr 14:45 S1/01 A3

Spatial Resolution of a GEM-TPC Detector* — •Martin Berger — TU München, 85748 Garching, Germany

With the use of GEM foils instead of conventional MWPCs for the electrons amplification in a TPC one can overcome the rate limitations introduced by the gating grid by exploiting the intrinsic ion backflow suppression of the GEM foils. In order to validate the feasibility of such a GEM-TPC, a prototype detector with a drift length of 728 mm and a radius of 308 mm and a total of 10254 electronic channels, was built as an upgrade for the FOPI experiment at GSI (Darmstadt, Germany) to improve the acceptance, PID capabilities and vertex resolution of FOPI. After commissioning, a large statistics of cosmic muon tracks and beam-target reactions have been collected and the obtained tracks in the TPC have been used to improve the tracking algorithms. During the track finding and fitting procedure a clustering algorithm which takes into account the track topology as well as the full 3D spatial information is employed. The clustering algorithm, the cluster error calculation as well as correction algorithms and the tracking resolution will be discussed in this contribution.

*Supported by BMBF, TUM Graduate School and Excellence Cluster "Universe".

HK 70.4 Fr 15:00 S1/01 A3

Charge transfer in Gas Electron Multipliers — •Jonathan Ottnad, Markus Ball, and Bernhard Ketzer for the CBELSA/TAPS-Collaboration — HISKP, Bonn University, Nussallee 14-16, D-53115 Bonn

The operation of a Time Projection Chamber at high event rates requires an amplification structure which minimizes the backdrift of ions into the drift volume and at the same time maintains a good energy and spatial resolution. This can be achieved with the implementation of Gas Electron Multipliers (GEM), offering a continuous readout, a stable operation with sufficient charge amplification and an intrinsic suppression of the ions flowing back into the drift volume.

In order to optimize the operation parameters of a GEM based readout, various GEM geometries and different electric field settings inside a multi-GEM stack have been studied experimentally. The transfer efficiencies of electrons and ions have been measured and compared to the results of a microscopic simulation. An effective parametrization of the transfer efficiency is presented. It describes the charge transfer as a function of geometric parameters and the applied electric fields. From this, predictions for the transfer efficiency of electrons and the ion backflow suppression for a given GEM geometry and set of fields become possible.

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HK 70.5 Fr 15:15 S1/01 A3

Investigation of the energy spectra of a hybrid GEM-MicroMegas detector — •Matthias Liebtrau, Viktor Ratza, Markus Ball, and Bernhard Ketzer for the ALICE-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn University

In the context of the upgrade of the LHC during the second long shutdown the interaction rate of the ALICE experiment will be increased up to 50 kHz for Pb-Pb collisions. As a consequence, a continuous operation of the Time Projection Chamber will be required. To handle the expected increase of space charge distortions the currently installed multi wire proportional counter (MWPC) charge amplification system has to be replaced. Micropattern gaseous detectors (MPGDs) offer a way to suppress the backdrift of ions to the drift volume to a tolerable level. At the same time, however, a good energy resolution of the detector has to be maintained. As an alternative to the 4-GEM baseline solution, a hybrid detector consisting of 2 GEMs and a Micromegas stage has been investigated.

Both ion backflow and energy resolution were studied systematically with a small (10×10) cm^2 detector. An ion backflow as low as 0.6% was achieved. A background under the photopeak, if not taken into account in the fit model, was found to systematically bias the energy resolution towards larger values. Methods to suppress the background as well as to fully include it in the fit model were developed. The results show that the hybrid detector fulfills the requirements concerning ion backflow and energy resolution.

HK 70.6 Fr 15:30 S1/01 A3

The CASCADE Project - On the Phase Front of Neutron Detection — •Markus Köhli and Ulrich Schmidt — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Germany

By alerts on the future Helium supply critical to perspectives of the European Spallation Source the run on substitutional technologies started. Most of the solutions could be adapted from developments of particle physics. We report on the CASCADE Project - a novel detection system, which has been developed for the purposes of neutron spin echo spectroscopy. It features 2D spatially resolved detection of thermal neutrons at high rates. The CASCADE detector is comprised of a stack of solid Boron-10 coated Gas Electron Multiplier (GEM) foils, which serve both as a neutron converter and as an amplifier for the primary ionization deposited in the standard Argon-CO2 counting gas environment. This multi-layer setup increases the detection efficiency of a single entity. For the application in MIEZE spin echo techniques, which use the coherence of a fast oscillating neutron interference pattern as an observable, the signal of the charge traversing the stack is detected to identify the very thin conversion layer of about 1 mum. This allows to precisely determine the time-of-flight. Here we literally sit on the phase front of neutron detection. The RESEDA and MIRA Spectrometers at the FRM II run such new generation systems. This talk will discuss the characteristics of the system, challenges and perspectives, explicitly on the basis of the CASCADE detector at RESEDA.

HK 70.7 Fr 15:45 S1/01 A3

Monte Carlo simulations for the JEDI polarimeter at COSY
— •Paul Maanen for the JEDI-Collaboration — III. Physikalisches Institut B, RWTH Aachen

New CP violating sources could manifest as permanent electric dipole moments (EDM). So far, no direct measurement of a charged hadron's EDM has been achieved. The goal of the JEDI (Juelich Electric Dipole moment Investigations) collaboration is to measure the EDM of light nuclei (p,d, ^{3}He). In the current concept the signal is vertical polarisation build-up, measured via counting rate asymmetries scattering on a carbon target. Because the effect is very small, great care has to be taken designing the polarimeter. To study the detector performance the geometry of the candidate detector layout has been implemented in Geant4. This talk gives an overview of the planned detector concept and discusses some results of simulation studies, including comparison of simulation results to experimental data.