HK 7: Instrumentation II

Zeit: Montag 16:45–18:45 Raum: F 073

Gruppenbericht HK 7.1 Mo 16:45 F 073

Measurements with neutrons and photons at nELBE — •Roland Beyer[1], Mirco Dietz[1,2], Axel Frotscher[1,2], Joachim Görres[3], Arnd R. Junghans[1], Toni Kögler[1,2], Ralf Nolte[4], Uwe Oberlack[5], Elisa Pirovano[1,6], Arjan Plompen[6], Rene Reifarth[7], Ronald Schwengner[1], Sebastian Urlass[1,2], and Andreas Wagner[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Dresden, Germany — [2]Technische Universität, Dresden, Germany — [3]University of Notre Dame, Notre Dame, IN, USA — [4]Physikalisch Technische Bundesanstalt, Braunschweig, Germany — [5]Johannes Gutenberg Universität, Mainz, Germany — [6]EC Joint Research Centre, Geel, Belgium — [7]Goethe Universität, Frankfurt, Germany

The neutron time-of-flight facility nELBE at Helmholtz-Zentrum Dresden-Rossendorf features the first photo-neutron source at a superconducting electron accelerator, which provides a very precise time structure, high repetition rate and favorable background conditions due to the low instantaneous flux and the absence of any moderating materials. The neutron energy spectrum ranges from about 100 keV up to 10 MeV. The resulting very flexible beam properties at nELBE enable a broad range of nuclear physics experiments. Examples for the versatility of nELBE will be presented: Total neutron cross section measurements to look for unknown nuclear levels relevant for the astrophysical s-process, determination of the photon angular distribution after inelastic neutron scattering, determination of the detector response of a Dark Matter detector based on liquid Xe, or determination of the neutron induced fission cross section of ^{242}Pu.

HK 7.2 Mo 17:15 F 073

High spatial resolution in thermal neutron detection: from CASCADE to BASTARD — •Markus Köhli[1,2], Martin Klein[2], Tim Wagner[1], Fabian P. Schmidt[1], Jochen Kaminski[1], Klaus Desch[1], and Ulrich Schmidt[2] — [1]Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn — [2]Physikalisches Institut, Universität Heidelberg, Im Neuenheimer Feld 226, 69120 Heidelberg

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 and are comprised of one or more layers of Boron-10. The CASCADE detector, developed in Heidelberg for the purposes of Spin Echo spectroscopy, features high spatial and time resolution. The system 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. This multi-layer setup increases the detection efficiency of a single entity while still allowing to precisely determine the time-of-flight. The Spin Echo spectrometers at the FRM II run such new generation systems. This talk will discuss the characteristics of the system explicitly on the basis of the CASCADE detector at RESEDA. Furthermore we open up the perspective to the novel neutron detection systems, which are now currently under development at the Physikalisches Insitut in Bonn using the actual state-of-the-art readout electronics.

HK 7.3 Mo 17:30 F 073

Entwicklung eines Szintillationstriggers auf Basis von SiPMs für einen Neutronendetektor — •Fabian Schmidt, Markus Köhli, Tim Wagner, Jochen Kaminski und Klaus Desch — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

Als Folge der Helium-3-Krise steigt die Nachfrage nach Neutronendetektoren auf Basis von alternativen Konvertern. Aus diesem Grund existiert ein großes Interesse an neuen Technologien auf Basis von Bor-10. In Bonn wurde mit der Entwicklung neuer Neutronendetektoren begonnen, mit dem Ziel die räumliche Auflösung durch eine zeitaufgelöste Spurrekonstruktion um mindestens eine Größenordnung zu verbessern. Unter Verwendung dünner Borkarbidschichten werden zwei Detektoren entwickelt. Einer dieser Detektoren setzt den Fokus auf eine hohe Granularität bei gleichzeitig hohen Raten, der andere auf eine sehr hohe räumliche Auflösung. Letzterer arbeitet auf Basis der Zeitprojektionskammer (TPC) mit Borkarbidschichten in einem Gasvolumen. Da Neutronen durch Bor-10 in zwei antiparallel emittierte Ionen konvertiert werden, kann eines in einer Spurdriftkammer zur Ortsbestimmung verwendet werden, das andere dient zur Generierung des Zeitstempels. Als Auslesesystem wird ein Timepix mit Micromegas Gasverstärkungsstufe eingesetzt, welches mit Pixeln von $55 \times 55\,\mu$m^2 eine präzise Spurmessung erlaubt. Das zur Rekonstruktion nötige Zeitsignal liefert ein schneller Szintillationstrigger. Dieser wird über einen Lichtleiter mit Silizium-Photomultipliern (SiPM) ausgelesen. In diesem Vortrag wird die Entwicklung eines solchen Szintillationstriggers zur Detektion von einzelnen Ionen dargestellt.

HK 7.4 Mo 17:45 F 073

Neutron measurement with a GridPix — •Tim Wagner, Markus Köhli, Fabian Schmidt, Jochen Kaminski, and Klaus Desch — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

As a result of the Helium-3 crisis the demand for neutron detectors with alternative neutron converters still increases. Thus new technologies using Boron-10 are highly asked for. In Bonn the development a novel neutron detector started which aims to push the limits of spatial resolution by at least one order of magnitude applying time resolved event reconstruction. Using enriched Boron Carbide in thin layers this model sets the focus on very high spatial resolution. The detector is operated like a Time Projection Chamber (TPC) with a Boron layer placed between the drift volume and a scintillator. As the neutron conversion in Boron-10 produces two charged particles emitted back-to-back the light generated by the scintillator is used as a trigger for the track in the detection gas. The TPC will be read out by an array of GridPix - CMOS ASICs with pixels of 55μm $\times$ 55μm and a micromegas gas amplification on top of the chip, which allows to precisely measure the ionization track to the single electron level.

As a first step a prototype using a board with eight GridPix detectors has been built. With this prototype the track of a converted neutron on a GridPix is studied. The setup of the detector and measurements done will be presented in this talk.

HK 7.5 Mo 18:00 F 073

The neutron lifetime experiment PENeLOPE — •Dominic Gaisbauer for the PENeLOPE-Collaboration — TUM Institute for Hadronic Structure and Fundamental Symmetries, Garching, Germany

The neutron lifetime $\tau_{\rm n} = 880.2 \pm 1.0$ 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. The project is supported by the Maier-Leibnitz-Laboratorium (Garching), the Deutsche Forschungsgemeinschaft and the Excellence Cluster "Origin and Structure of the Universe".

HK 7.6 Mo 18:15 F 073

Low Energy Proton Detector Using APDs for the PENeLOPE Experiment — •Joachim Meichelböck for the PENeLOPE-Collaboration — TUM Institute for Hadronic Structure and Fundamental Symmetries, Garching, Germany

PENeLOPE is a neutron lifetime measurement experiment at the Forschungsreaktor Muenchen II aiming to achieve a precision of 0.1 seconds. The detector for PENeLOPE consists of about 1250 Avalanche Photodiodes (APDs) with an total active area of 1225 cm^2. The detector and electronics will be operated at the high electrostatic potential of -30 kV, the magnetic field of 0.6 T. This includes shaper, preamplifier, ADC and FPGA stage. In addition the APDs will be operated at 77 Kelvin. The 1250 APDs are divided into 14 groups of 96 channels each including some spare. Each group is processed by one FPGA card which reads out the 12-bit ADC with 1MSps. Also a complete new firmware was developed for the detector including a self-triggering readout with continuos pedestal calculation and configurable signal detection. The data transmission and configuration is done via the Unified Communication Framework (UCF). It is a time-division multiplexing low layer protocol which provides determind latency for time critical messages, IPBus and JTAG interfaces. The network has a n:1 topology and thereby reducing number of optical links.

HK 7.7 Mo 18:30 F 073

A new Detector Design for Electron Spectroscopy in Neutron Beta Decay — •Christoph Roick[1], Bastian Märkisch[1], Lukas Raffelt[2], Heiko Saul[1,3], and Ulrich Schmidt[2] — [1]Physik-Department ENE, TU München — [2]Physikalisches Institut, Universität Heidelberg — [3]Atominstitut, TU Wien

The upcoming versatile instrument PERC will significantly increase the precision in neutron beta decay studies. This also demands new developments in electron detector design.

In this talk we present a new scintillator based detector setup featuring machine milled light guides, temperature stabilized photomultiplier tubes and a conductive coating. This system can be used for electron spectroscopy or coincident electron-proton-detection. During a recent measurement of the proton asymmetry with Perkeo III, we could prove that a superior performance in light yield at similar spatial homogeniety compared to former detectors with and without coating is achieved.