HK 45: Instrumentation IX

Time: Thursday 16:15–17:45 Location: PHIL B 302

HK 45.1 Thu 16:15 PHIL B 302

Development and Characterization of the CBM Neutron Calorimeter (NCAL) — •Dachi Okropiridze[1,2], Dieter Grzonka[2,3], and James Ritman[2,1,3] for the CBM-Collaboration — [1]Ruhr-Universitat Bochum (RUB), Bochum, Germany — [2]GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt, Germany — [3]Forschungszentrum Julich (FZJ), IKP-1, Julich, Germany

The Neutron Calorimeter (NCAL) is proposed as a neutral spectator detector for the Compressed Baryonic Matter (CBM) experiment at FAIR. Located downstream of the Forward Spectator Detector (FSD), the NCAL detects spectator neutrons at small polar angles, thereby improving centrality determination and reaction-plane reconstruction. Furthermore, it enables a complementary physics program for elementary reactions with final-state neutrons.

The detector design features thick plastic scintillator modules with photomultiplier readout. Two prototypes have been constructed and characterized using minimum-ionizing particles and radioactive sources. A scintillator-based veto detector was developed for charged-particle rejection. We report on response measurements performed with quasi-monoenergetic neutron beams at the UJV Rez cyclotron, evaluating neutron detection efficiency and energy resolution.

Additionally, NCAL prototypes were tested in the mCBM experiment at GSI. Integrated into a DiRICH-based data acquisition system, the detector's rate capability and stability were investigated under realistic beam conditions.

HK 45.2 Thu 16:30 PHIL B 302

Thermal Neutron Detection with Lithium-Silica Glass in Proton Therapy — •Kim Tabea Giebenhain[1], Anna Becker[2,3], Lara Dippel[1,3], Markel Fix-Martinez[2,3], Hans-Georg Zaunick[1,3], Dzmitry Kazlou[1], Kilian-Simon Baumann[2,3], Ulrich Weber[2,3], Klemens Zink[2,3], and Kai-Thomas Brinkmann[1,3] — [1]2nd Physics Institute, Justus Liebig University, Giessen, Germany — [2]TH Mittelhessen University of Applied Sciences, Giessen, Germany — [3]LOEWE Research Cluster for Advanced Medical Physics in Imaging an Therapy (ADMIT)

Neutron detection is an important topic in IonBeam Therapy, specifically when irradiating patients with ultra high dose rates (also knownas FLASH). At cyclotron-based facilities, these dose rates can only be reached at the highest energies without a degrader. which necessitates range modulators and thick absorbers to ensure conformal tumor coverage in clinical ranges. These absorbers can increase the amount of produced neutrons significantly. To reliably assess the neutron amount, efficient neutron detectors are needed to benchmark Monte-Carlo simulations which are used for dosimetric assessment. This work presents the findings of a scintillation-based thermal neutron detector, consisting of Lithium-silica glass and a photomultiplier tube. The detector has been tested at an Americium-Beryllium neutron source and for different absorbers at the Marburg IonBeam Therapy center.

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HK 45.3 Thu 16:45 PHIL B 302

Normalization detectors for the neutron lifetime experiment tauSPECT — •Viktoria Ermuth[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

The τSPECT experiment measures the free neutron lifetime by confining ultracold neutrons (UCN) with magnetic field gradients and counting the remaining neutrons after varying storage times. There are statistical and systematic changes over time in the yield and energy of the neutrons produced by the pulsed UCN source that can lead to systematic uncertainties. Therefore, the amount of UCNs filled into the trap during each filling cycle has to be monitored. A neutron detector has been built and installed in the experiment beamline to monitor the flux of UCNs during the filling process. The charged particles resulting from the neutron capture reaction ^{10}B (n,α)^{7}Li cause scintillation in a ^{10}B-coated ZnS:Ag layer. This light is detected by silicon photomultipliers coupled in coincidence to the scintillator. A second version suited for a larger beamline diameter and with some design improvements is currently under development. Since the two detectors will be at different heights on the UCN path, this will also give an insight into the UCN energy spectrum.

This talk will show the detector*s design, results of measurements, as well as the progress for the improved version.

HK 45.4 Thu 17:00 PHIL B 302

Development of a BaF - Plastic Phoswich Detector for Particle Identification in Mixed Fields — •Lara Dippel[1,2], Anna Becker[2,3], Kilian Simon Baumann[2,3], Kai-Thomas Brinkmann[1,2], Kim Tabea Giebenhain[1], Dzmitry Kazlou[1], Markel Fix Martinez[2,3], Uli Weber[2,3], Hans-Georg Zaunick[1,2], and Klemens Zink[2,3] — [1]2nd Physics Institute, Justus Liebig University Giessen, Germany — [2]LOEWE Research Cluster for Advanced Medical Physics in Imaging and Therapy (ADMIT) — [3]TH Mittelhessen University of Applied Sciences, Giessen, Germany

This work presents the development of a Phoswich detector for fast neutron detection and particle discrimination in mixed radiation fields. The detector consists of a Barium Fluoride (BaF) crystal optically coupled to a thin plastic scintillator. Measurements were performed at the Marburg Ion Beam Therapy Center, where a water phantom was irradiated with 300 MeV/u carbon ions. Particle discrimination and identification were achieved using pulse shape discrimination (PSD) techniques, allowing the relative abundances of particles produced in the irradiation to be extracted. The measurement setup was replicated in a Geant4 simulation to validate the particle identification and to compare the relative particle yields. This work is part of the ADMIT consortium under Project Part A, which focuses on estimating spectral neutron fluxes for flash therapy in tumor treatment applications. This project is financed with funds of LOEWE - Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz, Förderlinie 2: LOEWE-Schwerpunkte.

HK 45.5 Thu 17:15 PHIL B 302

Portable standalone n/γ detector based on RedPitaya board — •Dzmitry Kazlou, Roman Bergert, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — 2nd Institute of Experimental Physics, Justus-Liebig-University, Giessen, Germany

A portable neutron/γ detector was developed leveraging the open-source RedPitaya platform (Xilinx Zynq-7010/7020 SoC) as a compact data acquisition system based on a 125 MS/s 14-bit ADC, combining low-cost and easily accessible components. A custom open source SiPM bias board was used to eliminates the need for an external high-voltage supply. Dedicated fast broad-band preamplifiers have been developed for the Hamamatsu S14160-6050 and S14160-3010 silicon photomultipliers, providing a dual-channel readout with an extended dynamic range. The commercially available EJ-276D plastic scintillator was chosen as the detector material due to its well-performing pulse shape discrimination (PSD) capability, enabling efficient separation of fast neutrons from γ-rays.

The detector was calibrated with standard γ-sources (^{137}Cs, ^{22}Na, ^{207}Bi) and characterized in mixed neutron/γ fields from known AmBe, ^{252}Cf, and RaBe sources, after which it was tested in a high-energy neutron field with γ background. The proton beam measurements were performed to obtain the proton light-yield quenching factor, which is necessary for the subsequent unfolding of the neutron spectrum. The resulting portable device is highly suited for radiation monitoring, dosimetry, and applications requiring simultaneous identification of neutrons and γ-quanta.

HK 45.6 Thu 17:30 PHIL B 302

A spatially resolving detector for ultracold neutrons — •Konrad Franz[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

Ultracold neutrons (UCNs) are neutrons with a kinetic energy of around 100 neV. Their defining property is that they can be confined by material vessels and magnetic field gradients. This allows for long observation times and thereby precision measurements of fundamental neutron properties. Spatial resolution is often desirable in UCN experiments, as it provides information about the energy and phase space distribution of the probed ensemble. The presented detector design consists of a sandwich structure. In a ^{10}B conversion layer neutrons generate energetic ions through the ^{10}B (n, α) reaction. In the subsequent scintillation layer light is released which is then guided onto an array of silicon photomultipliers by a 3D printed light guide. This setup is well suited for in-situ detection of UCNs in strong magnetic fields and compatible with vacuum environments. In a first test beam time, a detector prototype was compared to a commercial UCN detector and its spatial resolution was evaluated. This talk will present the detector setup as well as the test beam time results. Furthermore, its use case for tackling systematic effects in the latest generation of precision neutron lifetime experiments will be highlighted at the example of the τSPECT experiment.