HK 3: Instrumentation I

Time: Monday 16:45–18:15 Location: HBR 19: C 1

Group Report HK 3.1 Mon 16:45 HBR 19: C 1

The Surrounding Background Tagger for the SHiP Experiment at CERN — •Horst Fischer for the SHiP-SBT-Collaboration — Albert-Ludwigs-Universität Freiburg

The Search for Hidden Particles (SHiP) experiment is an ambitious initiative designed as a dedicated proton beam dump facility located in the ECN3 cavern at CERN. The overall goal of this experiment is to explore the realm of long-lived, neutral, feebly interacting particles outside the Standard Model, produced by the collision of 400 GeV/c protons with a robust heavy metal target. Over a 15-year time span, the SHiP experiment aims to accumulate an impressive 6x10^20 protons on target, employing a sophisticated detector setup strategically designed to suppress potential background to virtually negligible levels. The Surrounding Background Tagger (SBT) will be a cornerstone of background suppression. It is designed to reject background by detecting charged particles that either enter the Hidden Sector vacuum decay vessel from external sources or arise from deep inelastic interactions within the vacuum vessel walls. To this end the SBT detector encloses ae expansive 50-meter-long decay vessel utilizing liquid scintillator (LAB-PPO) filled cells. Light capture is facilitated by Wavelength shifting Optical Modules (WOMs) made of PMMA and that are coated with a wavelength shifting dye and equipped with silicon photomultipliers. In 2023, a four-cell prototype detector was developed for a test beam campaign at CERN. We will report on the results of the test beam exposure and, as well as the ongoing R&D work.

HK 3.2 Mon 17:15 HBR 19: C 1

Testbeam Readout and Slow Control of 4-cell Prototype for the SHiP SBT — •Tim Molzberger for the SHiP-SBT-Collaboration — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, 79104 Freiburg, Germany

The Search for Hidden Particles (SHiP) is a proposed next-generation beam dump experiment at CERN to scan for previously undiscovered long-lived and feebly interacting neutral particles beyond the Standard Model. This task requires unprecedented efficiency in background rejection by multiple veto detectors like the surrounding background tagger (SBT). We present the developments for the readout and the slow control of the latest SBT prototype testbeam at CERN in October 2023. The readout features silicon photomultipliers for photodetection and ASICs for signal amplification and shaping. A group of controller boards powers and controls the configuration of this readout, which is one element of the low cost slow control developed for this testbeam. The slow control further features sensors to monitor the orientation and position of the prototype and dedicated software to organize all activities and store data.

HK 3.3 Mon 17:30 HBR 19: C 1

Improved Design of a Compact Scintillating-Fiber Detector for Space Applications — •Liesa Eckert[1], Peter Hinderberger[1], Martin J. Losekamm[1], Luise Meyer-Hetling[1], Stephan Paul[1], Thomas Pöschl[2], and Sebastian Rückerl[3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]CERN, Geneva, Switzerland — [3]School of Engineering and Design, Technical University of Munich, Ottobrunn, Germany

We aim to measure the charged nuclear component of the space radiation environment with compact detectors composed of scintillating-plastic fibers read out by silicon photomultipliers. With different detector versions, we study the radiation spectrum's composition for the determination of astronaut radiation exposures with the RadMap Telescope and aim to measure the antiproton flux in Earth's radiation belts with the upcoming AFIS mission. For the latter, we are currently updating the detector design of the RadMap Telescope to achieve better performance and higher mechanical stability, and to reduce the production effort. We plan to test the improved design as part of the In-Orbit Verification Experiment 1 (IOV-1), a technology demonstration experiment on the International Space Station. In this talk, I will present the improvements we made in the past year with respect to the design of the RadMap Telescope, as well as the difficulties we dealt with during development and production. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 3.4 Mon 17:45 HBR 19: C 1

Advancements in Compact Scintillation Detector "RUBIK " for Tracking of Space Radiation — Roman Bergert, •Hartmut Schotte, Niclas Friedler, Hans-Georg Zaunick, and Kait-Thomas Brinkmann — II. Physics Institute, Justus-Liebig-University Giessen

A segmented scintillation detector designed for use in radiation tracking within the space environment is discussed. The detector utilizes single unity polyvinyl toluene (PVT) based cubes as the sensitive detector volume, ensuring a compact and efficient tracking system. Addressing the challenges posed by power consumption, volume, and weight constraints specific to the mission requirements is a pivotal aspect of the detector design. We present the results of our first prototype, emphasizing its performance in the context of the specified mission parameters. Notably, discussions center around the detector's capabilities under diverse stress factors, such as temperature cycles and vacuum conditions, criticalconsiderations for its application in space. The implications of the detector's performance in meeting the specified requirements, offering insights gained from the initial prototype. Lessons learned from its behavior under different environmental stresses contribute to the refinement of the detector concept, guiding the development of subsequent prototypes. The progress made in tailoring the detector for optimal performance in the challenging conditions of space environments, setting the stage for further advancements for the final design choice is summarized.

HK 3.5 Mon 18:00 HBR 19: C 1

Development of a cost effective PET-like system utilizing organic scintillators and SIPMs to be used for particle tracking — •Esther Constanze Wais, Nadia Böhle, Mario Fink, Thomas Held, Fritz-Herbert Heinsius, Matthias Steinke, and Ulrich Wiedner — Experimentalphysik 1, Ruhr-Universität Bochum, Bochum, Deutschland

Although PET has established itself as a reliable tool in medical applications over the last 20 years, industrial applications have so far been limited. The reason for this are the high costs of constructing a detector on the scale required for industrial purposes. A cost-effective detector has been built. The detector uses long (1000 mm × 20 mm × 20 mm) organic scintillator rods instead of small inorganic scintillator crystals, significantly reducing material and readout costs compared to a conventional detector.

The scintillation light gets detected by SiPMs. Since no SiPMs with the required dimensions were available, four SiPMs are connected in a 'hybrid circuit' to form a SiPM array of the required size. The goal of the measurements is to investigate the behavior of granular matter in rotary kilns or grate systems in order to test simulations calculations. These calculations will be used in order to make rotary kilns and grate systems more efficient.

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