T 36: Methods in Astroparticle Physics II

Time: Tuesday 16:15–17:45 Location: VG 3.101

T 36.1 Tue 16:15 VG 3.101

Characterisation of a SiPM Array in Liquid Xenon — •Vera H. S. Wu[1], Kaixuan Ni[2], Jianyang Qi[2], Haiwen Xu[2], and Yue Ma[2] — [1]Karlsruhe Institute of Technology, Institute for Astroparticle Physics — [2]University of California San Diego

Silicon-photomultipliers (SiPMs) have grown in attention and application among direct dark matter search and neutrino physics experiments due to some advantages compared to the traditional photomultipliers (PMTs). Using the liquid xenon detector R&D setup at the University of California San Diego, we installed 96 Hamamatsu VUV4 SiPMs surrounding a sensitive volume of about one litre, intending to detect sub-keV recoils in liquid xenon for the NUXE experiment. The number of the VUV4 SiPMs used is unprecedented for low-energy liquid xenon experiments. For a few months, we monitored the readout noise level and the gain of individual SiPM in either gaseous or liquid xenon. The gain-to-overvoltage ratio has been stable within months of measurement. We also tested the light collection efficiency (LCE) of the device in liquid xenon, as will be reported in this talk.

We acknowledge the financial support from Karlsruhe House of Young Scientists through a Research Travel Grant to visit and work at UCSD.

T 36.2 Tue 16:30 VG 3.101

Construction and commissioning of a Novel Krypton Concentrator for Next-Generation Dark Matter Experiments — •David Koke, Lutz Althüser, Volker Hannen, Christian Huhmann, Philipp Schulte, Patrick Alexander Unkhoff, Daniel Wenz, and Christian Weinheimer — Universität Münster, Germany

Future large scale dark matter experiments, such as DARWIN and XLZD, require high radiopurity in their liquid xenon detectors to probe WIMPs down to the neutrino fog. Due to the presence of the radioactive man-made isotope Kr-85, maintaining a low krypton concentration is a critical requirement. The LowRad project aims at developing a compact all-in-one xenon purification system for krypton, radon and electronegative impurities in xenon. The system's key components include a distillation column for continuous online removal, requiring a secondary distillation column as a concentrator for the krypton-enriched off-gas to avoid losses of xenon and enable monitoring of the krypton concentration. This novel krypton concentrator has been successfully constructed and commissioned, and underwent initial functionality tests. This talk will present the design and construction of the concentrator, along with the results of the first performance tests, demonstrating its capabilities. These advancements pave the way for achieving the ultra-low backgrounds necessary for future dark matter searches with next generation experiments. This work is supported by the ERC AdG project "LowRad" of C. Weinheimer (No. 101055063).

T 36.3 Tue 16:45 VG 3.101

Local coincidences in the Multi-PMT Digital Optical Module for IceCube Upgrade — •Anna-Sophia Tenbruck and Alexander Kappes for the IceCube-Collaboration — Universität Münster, Institut für Kernphysik

The IceCube Neutrino Observatory will undergo an upgrade during the Antarctic summer of 2025/26 that will significantly improve its sensitivity. Among the newly introduced components is the Multi-PMT Digital Optical Module (mDOM), a detector module equipped with multiple photomultipliers (PMTs) that enables the detection of local coincidences. This capability is particularly useful for applications such as noise suppression. In a comprehensive study conducted as part of a master's thesis, the multiplicity rate of an mDOM was measured in both air and water and compared to a Geant4 toolkit simulation. This presentation will discuss the results, focusing on the comparison between measurements and simulations.

T 36.4 Tue 17:00 VG 3.101

Determination of scintillation properties using alpha spectroscopy for IceCube's optical module — •Ines Bahloul and Alexander Kappes for the IceCube-Collaboration — Universität Münster, Institut für Kernphysik

The main optical background in IceCube's Digital Optical Modules (DOMs) arises from scintillation caused by trace amounts of radioactive isotopes in the glass of the pressure vessel. The current simulation of this background relies, among other factors, on a gamma spectroscopy measurement of the glass. However, this measurement cannot directly quantify radon and radium content. As part of my master's thesis, I aim to enhance this simulation by measuring these quantities with an alpha spectrometer. In this talk, experimental setup, calibration process, and the current progress of this study will be presented.

T 36.5 Tue 17:15 VG 3.101

Broadband Lightning Interferometry at the Pierre Auger Observatory — Markus Cristinziani[1], •Eric-Teunis de Boone[1], Qader Dorosti[1], Stefan Heidbrink[2], Noah Siegemund[1], Waldemar Stroh[2], Jens Winter[2], and Michael Ziolkowski[2] — [1]Experimentelle Astroteilchenphysik, Center for Particle Physics Siegen, Universität Siegen — [2]Elektronikentwicklungslabor der Physik, Universität Siegen

Lightning-related phenomena are known to interact with and influence all detector systems of the Pierre Auger Observatory in Argentina. Notably, the Surface Detector has recorded signals linked to Terrestrial Gamma Flashes (TGFs) which are rare phenomena linked to the initial processes of lightning. Interpreting these signals remains challenging due to the absence of a system capable of providing detailed 3D imaging of lightning propagation. To address this gap, we are developing a state-of-the-art interferometric lightning detection system that enhances the Observatory's unique capabilities for precision research on TGFs. It will consist of radio detectors that have been previously developed for the Auger Engineering Radio Array (AERA), located at strategic positions within the Auger field. This contribution highlights recent hardware developments and the initial large-scale data readouts from the first field installation, demonstrating the system's potential for advancing TGF and lightning research.

T 36.6 Tue 17:30 VG 3.101

Absolute energy calibration of the Fluorescence Telescopes at the Pierre Auger Observatory with a roving laser system* — •Rukije Uzeiroska-Geyik for the Pierre-Auger-Collaboration — ergische Universität Wuppertal, Wuppertal, Germany

The Fluorescence Detector (FD) of the Pierre Auger Observatory provides energy measurements of primary cosmic rays that are largely independent of specific interaction models. The FD energy measurement is crucial for calibrating the energy reconstruction of the Surface Detector. Consequently, the accuracy of the FD energy calibration plays a significant role in the systematic uncertainties associated with nearly all scientific results of the Observatory. To achieve high accuracy in calibration, a laser with a well-defined energy output is going to be fired in front of the FD telescopes. This method has the advantage that the response of the telescope to the laser closely simulates its reaction to an actual cosmic ray air shower, something that is not achievable with other calibration methods.

The system was designed with special attention given to the depolarization of the laser beam to ensure a consistent relationship between energy output and directional light yield. This contribution covers the ongoing development of the mobile laser system and the calibration measurements performed in the laboratory to ensure the highest precision of the in field measurements.

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