T 79: Methods in Astroparticle Physics III

Time: Thursday 16:15–18:15 Location: VG 3.101

T 79.1 Thu 16:15 VG 3.101

Measuring Infrared Light Emission in Xenon — •Kai Böse for the XENON-Collaboration — Max-Planck-Institut für Kernphysik

Xenon is an ideal target for searching for rare events such as dark matter or neutrinoless double-beta decay. Several experiments utilize its ultraviolet scintillation to study interactions with nuclei and electrons. However, it is also known that xenon emits infrared light, which has been less extensively studied. Our group at MPIK Heidelberg has begun investigating the IR component in xenon interactions using infrared-sensitive photomultiplier tubes for future rare event search applications.

T 79.2 Thu 16:30 VG 3.101

Developing a cryogenic heat pump for liquid xenon radon removal systems — •Philipp Schulte, Lutz Althüser, Robert Braun, Hannah Ginkel, Volker Hannen, Christian Huhmann, David Koke, Patrick Unkhoff, Daniel Wenz, and Christian Weinheimer — Institute for Nuclear Physics, University of Münster

Future liquid xenon (LXe) dark matter detectors require a detector background 10 times smaller than the solar neutrino background. Achieving this requires reducing the 222Rn concentration in LXe to <0.1 μBq/kg - corresponding to less than one 222Rn atom in 160 mol xenon. The ERC project "LowRad" aims to develop the next generation of radon and krypton removal technology using cryogenic distillation. By exploiting the different vapour pressures of xenon and radon, radon is removed through repeated evaporation and condensation in a large surface area distillation column with partial reflux. To reach this low radon concentration, the throughput flow of the column must increase, as higher flow rates remove more radon per time, lowering its concentration in the detector. This requires scaling up from 65 kg/h (XENONnT) to $\sim$750 kg/h, with O(20) kW of heating and cooling power for the evaporation and reliquification. Therefore, an additional heat pump circuit using xenon as the working medium is being developed to lower the cooling requirement to the thermodynamic input of the heat pump. This talk will explain the working principle of cryogenic distillation and the heat pump, as well as the results from its development. Acknowledging the support of the ERC AdG project "LowRad" (101055063).

T 79.3 Thu 16:45 VG 3.101

Commissioning of ALMOND, a mobile neutron detector for LNGS — •Felix Kratzmeier[1], Melih Solmaz[1,2], Klaus Eitel[1], Alfredo Davide Ferella[3,4], Francesco Pompa[1,3], Kathrin Valerius[1], and Denis Tcherniakhovski[5] — [1]Karlsruhe Institute of Technology, Institute for Astroparticle Physics — [2]Heidelberg University, Kirchhoff Institute for Physics — [3]University of L'Aquila, Department of Physics and Chemistry — [4]INFN-Laboratori Nazionali del Gran Sasso — [5]Karlsruhe Institute of Technology, Institute for Data Processing and Electronics

ALMOND is a mobile low-flux neutron spectrometer for the LNGS underground laboratory based on a plastic scintillator array surrounded by Gd foils. It has been designed and built at KIT as a stand-alone system. In this talk, we will present the commissioning of the detector system at KIT including MC simulations of its performance, as well as first data taken underground at LNGS.

T 79.4 Thu 17:00 VG 3.101

ALMOND: An LNGS Mobile Neutron Detector — •Melih Solmaz[1,2], Klaus Eitel[2], Alfredo Davide Ferella[3,4], Felix Kratzmeier[2], Francesco Pompa[2,3], and Kathrin Valerius[2] — [1]Heidelberg University, Kirchhoff Institute for Physics — [2]Karlsruhe Institute of Technology, Institute for Astroparticle Physics — [3]University of L'Aquila, Department of Physics and Chemistry — [4]INFN-Laboratori Nazionali del Gran Sasso

Environmental neutrons introduce a source of background to rare event searches, such as dark matter direct searches, neutrinoless double beta decay experiments and in cross section measurements for nuclear astrophysics, which take place in deep underground laboratories. The flux and spectrum of the ambient neutrons vary greatly with time and location. ALMOND is a mobile low-flux neutron spectrometer conceived for the LNGS underground laboratory. In this talk, we will present an overview of the design and construction of ALMOND as well as the calibration measurements performed at KIT and in Frascati, Italy. This project is supported by the German Federal Ministry of Education and Research (BMBF) under the grant number 05A21VK1. We acknowledge the support by S. Loreti and his colleagues from the Frascati Neutron Generator (FNG) facility.

T 79.5 Thu 17:15 VG 3.101

Status of the IceAct Telescopes above the IceCube Neutrino Observatory — •Lars Heuermann, Lars Marten, Andreas Nöll, Sönke Schwirn, and Chistopher Wiebusch — RWTH Aachen - III. physikalisches Institut B, Aachen, Germany

IceAct is an array of Imaging Air Cherenkov Telescopes on the ice surface above the IceCube Neutrino Observatory. Each telescope features a SiPM-based 61-pixel camera and Fresnel lens-based optics, resulting in a 12-degree field of view. The design is optimized to be operated in harsh environments, particularly at the South Pole. The setup will consist of a station of seven telescopes in a so-called fly's eye configuration, increasing the field of view to 36°, and an additional telescope 200m apart for stereoscopic observations. Three of the eight telescopes are currently taking data. Another two have been shipped and are being prepared for data taking starting in 2025. In this talk we will review the status of the installation, recent analysis results, and report on the ongoing upgrade.

T 79.6 Thu 17:30 VG 3.101

Development of a Dataset for Hybrid Cosmic-Ray Measurements using IceAct, IceTop, and IceCube — •Sönke Schwirn, Shuyang Deng, Lasse Düser, Jonas Häussler, Lars Heuermann, Lars Marten, Philipp Soldin, Julian Vogt, and Christopher Wiebusch — RWTH Aachen - III. Physikalisches Institut B, Aachen, Germany

IceAct is an array of Imaging Air-Cherenkov Telescopes stationed at the South Pole as part of the IceCube Neutrino Observatory. One of its main goals is the hybrid detection of cosmic-ray induced air showers. We combine the shower development as measured with IceAct, the surface component as measured with IceTop, and TeV muons as measured deep in the ice with IceCube. For this, accurate and robust event synchronization and matching is required to combine these complementary measurements. Furthermore, it is necessary to precisely align the geometric orientation of the IceAct telescopes for an analysis of these events. In this talk, we will present a new data processing for a hybrid dataset including an improved event matching and its application to updated geometric alignment. Finally, we present a graph convolutional network for event reconstruction.

T 79.7 Thu 17:45 VG 3.101

Analysis of AERA measurements for optimizing the lightning interferometer at the Pierre Auger Observatory* — •Melanie Joan Weitz for the Pierre-Auger-Collaboration — Bergische Universität Wuppertal, Wuppertal, Germany

The Pierre Auger Observatory has detected downward terrestrial gamma-ray flashes with its water Cherenkov detectors. A key to understanding this high-energy radiation in thunderstorms is to combine such measurements with those of lightning processes in their earliest stages. The introduced lightning interferometer is a detector currently under construction for imaging lightning propagation in 3D based on radio interferometry. With eleven modified Auger Engineering Radio Array (AERA) stations and their bandwidth range from $30-80$ MHz the necessary precision can be provided.
One step towards the lightning interferometer data acquisition is to investigate the existing AERA measurements for lightning signal traces and to study their properties. We will present their signal characteristics measured with AERA stations using external lightning information. This allows the optimization of the signal dynamical range for the modified stations.

Supported by BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A23PX1)

T 79.8 Thu 18:00 VG 3.101

A test system for the AERA/RD beacon 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 des Departments Physik, Universität Siegen

Precise timing is crucial in the radio detection of cosmic-ray-induced air showers, as it enables an accurate reconstruction of X_{max} through radio interferometry. GPS receivers such as those used for time synchronization in AERA/RD at the Pierre Auger Observatory cannot achieve sub-ns accuracy. To correct these inaccuracies, AERA exploits a beacon system that transmits sine waves to provide timing corrections. We are developing a test system based on the White Rabbit (WR) technology to evaluate the accuracy and scalability of the beacon. This system can tackle new challenges associated with the upgrade from AERA to RD. WR delivers precise timing in the sub-ns range over a distance up to several kilometers via fiber optic cables and serves as a reference signal for data acquisition at multiple radio stations. The recorded data is analyzed offline using interferometric signal processing techniques to assess the stability of the beacon signal. Sub-ns accuracy has been achieved in our initial tests on a short baseline. Future plans to scale the system are outlined in this contribution.