T 97: Experimental techniques in astroparticle physics IV

Time: Thursday 16:00–18:30 Location: Tv

T 97.1 Thu 16:00 Tv

Characterization of Wavelength Shifters for Rare-Event Search Experiments at Low Temperatures — •Andreas Leonhardt[1], Gabriela R. Araujo[2], Patrick Krause[1], Laszlo Papp[1], Tina R. Pollmann[3], Stefan Schönert[1], and Andreas Ulrich[1] — [1]Physik Department, Technische Universität München, Garching, Germany — [2]Physik-Institut, Universität Zürich, Zurich, Switzerland — [3]Nikhef National Institute for Subatomic Physic, University of Amsterdam, Amsterdam, Netherlands

Rare-event search experiments commonly use liquid argon (LAr) as target or instrumented shielding medium. Particle interactions in LAr produce vacuum-ultraviolet (VUV) light flashes with a peak at 128 nm. To enable commercially available photodetectors to detect the scintillation light, it has to be shifted to longer wavelengths. The characterization of wavelength shifting materials is difficult due to the low LAr scintillation wavelength that requires VUV optics in vacuum, and due to the low temperatures the sample must have so that the results are relevant to operation in LAr. We present the wavelength-shifting efficiencies of common wavelength-shifters measured at 128 nm excitation, and the custom fluorometer built to make these measurements. The fluorometer consists of a high-intensity deuterium light source coupled to a VUV monochromator and vacuum-tight sample chamber. Both the wavelength-integrated and wavelength-resolved fluorescence yield can be measured. We also describe an ongoing upgrade of the setup that will enable the samples to be cooled to LAr temperature.

T 97.2 Thu 16:15 Tv

Towards Detecting Terrestrial Gamma-Ray Flashes with the Pierre Auger Observatory — •Martin Schimassek, Darko Veberič, and Ralph Engel for the Pierre Auger-Collaboration — Karlsruhe Institute of Technology

Terrestrial gamma-ray flashes (TGFs) are short bursts of MeV gamma-rays originating from within thunderstorms. TGFs were discovered by satellite experiments nearly two decades ago. To this day the detection of the same phenomena on the ground still remains challenging. The attenuation of gamma-rays near the ground is large, thus limiting the detection range. In addition, the statistics is very limited, as covering sufficiently large areas with sensitive instruments is expensive.

However, cosmic-ray observatories, like the Pierre Auger Observatory, have sensitive detectors deployed over large areas opening up the possibility of observing these events. For cosmic-ray observatories, the difficulty in measuring TGFs is the design of the data-taking system that is not targeted towards working in thunderstorm conditions and detecting long lasting gamma-ray emission.

In this contribution, we summarize the current abilities of the Pierre Auger Observatory to take data during thunderstorms and comment on the observations of candidate events obtained so far. Additionally, we highlight the possibilities for future improvements both on the existing hardware and on the upgraded electronics that is currently deployed.

T 97.3 Thu 16:30 Tv

Performance analysis of new PMTs and light guide systems at the Fluorescence Detector of the Pierre Auger Observatory — •Urs Grosse-Rhode for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal, Deutschland

The Fluorescence Telescopes at the Pierre Auger Observatory are used to measure the fluorescence light produced by extensive air showers. Each camera of the telescopes consists of 440 PMTs in the focal plane of a 12m* mirror. To study the performance of a new generation of PMTs, one camera has been partially equipped with two new PMT types and an new light guide system. Different PMT types and their performances will be compared. The analysis uses a reference calibration executed at the camera and laser shots which are fired into the atmosphere at low inclination passing by the telescopes. Also the recently launched Aeolus satellite introduced a new opportunity, providing laser shots into the Observatorys field of view, which trigger the Fluorescence Telescopes. An overview of the used methods for the fluorescence detectors performance analysis as well as results from the aeolus analysis will be presented. *Gefördert durch die BMBF Verbundforschung Astroteilchenphysik(Vorhaben 05A17PX1)

T 97.4 Thu 16:45 Tv

Absolute calibration of the light source for the end-to-end calibration of the Fluorescence Detector of the Pierre Auger Observatory* — •Tobias Heibges — Bergische Universität Wuppertal, Gaußstraße 20 42119, Wuppertal, Deutschland

The accuracy of the cosmic ray energy reconstruction by the Fluorescence Detectors is the most crucial part of the hybrid detection method used at the Pierre Auger Observatory. Because of this the absolute calibration of the Fluorescence Telescopes is vitally important, since it determines the energy scale of the Observatory. The previous calibration method was carried out infrequently, due to its difficulty and high manpower requirements. To address this issue, a new XY-Scanner calibration system is being installed. It consists of a small isotropic light source, which is scanned across the front of the telescope and emits short light pulses at several known locations.

To calibrate the telescope with these light pulses, an exact measurement of the emitted intensity and angular profile of each pulse is needed. For this purpose a calibration test bench was designed, combining the measurements of a calibrated photo-diode and a photomultiplier tube. With the addition of precision rotation and translation stages it now also allows for angular profile measurements. An uncertainty of $< 4\%$ has been achieved with potential for further reductionsin the near future. The setup, operation and analysis of data takenfrom this bench are the main focus of this talk.

Supported by the BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1 und 05A20PX1).

T 97.5 Thu 17:00 Tv

Absolute energy calibration of the Fluorescence Detectors at the Pierre Auger Observatory with a roving laser system* — •Alina Nasr Esfahani for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstr. 20, Wuppertal, Germany

The Fluorescence Detector (FD) of the Pierre Auger Observatory provides a nearly model independent measurement of the energy of primary cosmic rays. This FD energy measurement is used to calibrate the energy reconstruction of the Surface Detector. The precision of the FD energy calibration therefore factors into the systematic uncertainties of practically all scientific results from the Observatory. A precise calibration can be achieved by firing a laser with known energy output in front of the FD telescopes. The advantage of such a method is that the camera response to the laser closely mimics its response to a real cosmic ray shower in a way which can not be duplicated by other calibration techniques. Thorough work has been put into the design of the system and its components. The important aspects of mean energy, wavelength and stability have been tested with simulations. Special care has also been given with regard to the de-polarization of the beam to ensure a reliable correlation between output energy and directional light yield. Additionally a telescope mount is used to steer the laser to allow for inclined shots. This talk will focus on the design requirements of a roving laser system and outline plans for measurement campaigns.
**Supported by the BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A20PX1).*

T 97.6 Thu 17:15 Tv

Calibration of the Auger Radio Detector using the Galactic Emission — •Max Büsken for the Pierre Auger-Collaboration — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

The Pierre Auger Observatory is the largest ground-based experiment for the detection of cosmic rays up to the highest energies. These cosmic rays initiate extensive air showers, whose properties are measured by several different detectors. Among other things there is particular interest in determining the mass composition of the primary particles. New radio antennas will be installed on each of the surface detector stations as part of the AugerPrime upgrade. This will expand mass composition studies to air showers with high inclinations of zenith angles beyond 70°.

An absolute calibration of the deployed antennas is necessary in order to exploit the maximum potential of the new radio detector. In this talk I will explain the procedure to apply the absolute calibration by using the most dominant background signal, which is the emission by our own galaxy, the Milky Way. The comparison of noise traces in

the antennas with the expected background signal from simulations allows for the determination of frequency dependent calibration factors. The treatment of sources of uncertainties will be presented in this talk as well.

T 97.7 Thu 17:30 Tv

A simulation study for application of the Forward Folding Method to data of the Radio Detector of AugerPrime — •Sara Martinelli for the Pierre Auger-Collaboration — Institute for Astroparticle Physics, Karlsruhe Institute of Technology

The Radio Detector of AugerPrime - the Pierre Auger Observatory's upgrade - will allow to increase the sky coverage for composition sensitive measurements of showers having energies up to 10^{20} eV. Combining the radiation energy estimated through the radio-event reconstruction and the muon number obtained through the Auger water-Cherenkov detector array will enable the mass composition studies for inclined showers beyond 60°.

My presentation will address the so-called *Forward Folding*, a 3D electric-field vector reconstruction-method for radio signals, which is based on the fit of the voltage traces by an analytic signal model. The application of the previously developed method will be evaluated for inclined showers in the 30-80 MHz frequency band. During the talk, the potential improvement of the estimation of the uncertainties on the radiation energy obtainable by employing *Forward Folding* will be discussed, too. The latter, strongly relies on the recovery of the vertical component of the electric-field, which is typically most affected by noise.

T 97.8 Thu 17:45 Tv

The LEGEND Liquid Argon Monitoring Apparatus (LLAMA) — •Mario Schwarz, Patrick Krause, Laszlo Papp, and Stefan Schönert — Physik-Department, Technische Universität München, Garching

Large volume liquid argon (LAr) scintillation detectors require a precise assessment of key optical parameters for rigid signal predictions and proper data interpretation. Considering neutrinoless double beta decay experiments, both the state-of-the-art GERDA experiment as well as the next-generation LEGEND 200 and 1000 detectors use LAr scintillation light read-out as part of their active veto system. Modeling the LAr veto efficiency requires knowledge of the optical parameters in LAr, which depend on the actual impurity concentrations in the liquid. To this end, a dedicated setup has been designed for in-situ measurements of the light yield, the triplet lifetime and the attenuation length valid for the 128 nm primary emission wavelength. The setup will monitor the LAr in the LEGEND 200 cryostat, where it resides permanently. Ahead of its successful installation in the cryostat, in the scope of a one-time measurement campaign, LLAMA measured optical properties of the LAr in GERDA.

An overview of LLAMA and preliminary results of the measurements in the GERDA cryostat are presented as well as data obtained at TUM. The work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung.

T 97.9 Thu 18:00 Tv

Liquid Argon Purification for LEGEND-200 — •Christoph Vogl[1], Malgorzata Haranczykl[2], Patrick Krause[1], Tomasz Mroz[2], Laszlo Papp[1], Stefan Schönert[1], and Grzegorz Zuzel[2] — [1]Physik Department, Technische Universität München, Garching — [2]Institute of Physics, Jagiellonian University, Krakow, Poland

Experiments searching for rare events frequently use liquid argon (LAr) as scintillating detection medium. The first phase of the Large Enriched Germanium Experiment for Neutrinoless double beta Decay (LEGEND), L200, is currently being commissioned. Up to 200 kg of bare germanium detectors will be deployed in LAr. The LAr will serve as cooling medium as well as passive shielding and will be instrumented to serve as a detector by itself. The instrumentation is composed of light guiding fibers connected to silicon photomultipliers detecting scintillation light. The scintillation properties of LAr are worsened by electronegative impurities in the argon such as oxygen, water and nitrogen due to quenching and absorption processes. To reduce the amount of impurities, a pre-loading liquid-phase argon purification system was designed and is currently being tested and commissioned. In this talk, the current status of the system is presented. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF).

T 97.10 Thu 18:15 Tv

Background Rejection with the Liquid Argon Instrumentation of LEGEND-200 — •Patrick Krause[1], Maria Fomina[2], Konstantin Gusev[2], Jozsef Janiscko-Csathy[1,3], Stefan Schönert[1], Mario Schwarz[1], Egor Shevchik[2], and Christoph Wiesinger[1] — [1]Physik-Department, Technische Universität München, Garching — [2]Joint Institute for Nuclear Research, Dubna, Russia — [3]now at Semilab Semiconductor Physics Laboratory Co. Ltd., Budapest, Hungary

The LEGEND Collaboration aims to develop a phased, ^{76}Ge-based double-beta decay experimental program with discovery potential at a half-life beyond 10^{28} years. The first Phase, LEGEND-200, targets a discovery potential of 10^{27} years by aiming at a background index of $2 \cdot 10^{-4}$ cts/(keV·kg·yr). Based on the success in GERDA a liquid argon (LAr) detector system will be deployed. It will offer secondary event information which will allow the identification of background events. The system utilizes the property of LAr to scintillate upon the interaction with ionizing radiation. The emitted vacuum ultraviolet light is shifted to the optical spectrum and read out by silicon photomultipliers mounted at the end of optical fibers. The design of the LEGEND-200 LAr instrumentation will be presented and discussed with special emphasis on what was learned from the GERDA LAr instrumentation. This work has been supported in part by the BMBF Verbundforschung (05A20WO2).