T 12: Astroteilchenphysik: Methoden I

Zeit: Montag 16:00–18:30 Raum: S12

T 12.1 Mo 16:00 S12

Surface scans of inverted coaxial HPGe detctors for the LEGEND collaboration — •Andreas Zschocke for the LEGEND-Collaboration — Physikalisches Institut, Universität Tübingen

The LEGEND collaboration plans to search for the neutrinoless double beta decay ($0\nu\beta\beta$) with up to 200 kg of enriched germanium detectors. The sensitivity of this experiment relies strongly on the suppression and discrimination of background events. Inverted coaxial high purity Germanium detectors provide excellent pulse shape discrimination (PSD) properties and large masses, which make them a promising candidate for $0\nu\beta\beta$ searches. However, events originating near the passivated surface of these detectors can induce background at the region of interest which are not distinguishable with standard PSD methods. Therefore a detailed understanding of the shape of background events near the surfaces is crucial. This talk will present results of dedicated surface scans of an inverted coaxial detector with a collimated alpha source and focus on the pulse shape discrimination of those surface events.

This work has been supported by the German Federal Ministry for Education and Research (BMBF)

T 12.2 Mo 16:15 S12

Superconductive cryogenic detectors for rare event searches — •Elizabeth Mondragón[1], Stephan Geprägs[3], Luca M. Pattavina[1], Federica Petricca[2], Stefan Schönert[1,2], Raimund Strauss[1], Andreas Erhart[1], Angelina Kinast[1], Alexander Langenkämper[1], Tobias Ortmann[1], and Walter Potzel[1] — [1]Physik-Department, Technische Universität München, Garching — [2]Max-Planck-Institut für Physik, München — [3]Walther-Meißner-Institut für Tieftemperaturforschung, Garching

We present first results obtained with novel cryogenic detectors coated with a thin Nb superconductive film. The smaller band gap of superconductors (meV) allows an improved light collection and enlarges the light absorption to the infrared. The detectors are equipped with transition edge sensors made from a superconducting W film operated in the steep transition to normal conduction. Detectors of this type are particularly suited as cryogenic light detectors for rare event searches that use phonon-light event-by-event particle discrimination, such as for the CRESST direct dark matter experiment. Further, we discuss the potential of superconducting bulk detectors. Such devices offer the possibility to discriminate particle interactions by the different decay times of phonons and quasiparticles down to low energies (below 100 eV). This technology is highly suited for direct dark matter searches like CRESST and for detecting coherent neutrino nucleus scattering like in the nuCLEUS experiment. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) and the German Research Foundation (DFG) via the SFB1258.

T 12.3 Mo 16:30 S12

Preparing the FAMOUS telescope for the observation of fluorescence light from extensive air-showers — •Adrianna García[1], Thomas Bretz[1], Paulo Ferreira[1], Thomas Hebbeker[1], Julian Kemp[1], Tobias Pan[1], Christine Peters[1], Merlin Schaufel[2], and Johannes Schumacher[1] — [1]III. Physikalisches Institut A, RWTH Aachen University — [2]III. Physikalisches Institut B, RWTH Aachen University

The First Auger Multi-pixel photon counter camera for the Observation of Ultra-high energy cosmic-ray air-showers (FAMOUS) is a telescope developed at the RWTH Aachen University. Its main goal is to measure photons produced in Extensive Air Showers generated from the interaction of Cosmic Rays (CRs) with the Earth's atmosphere.

The Data Acquisition system (DAQ) currently used by FAMOUS is suitable to measure Cherenkov photons. Now we evaluate its capability to detect also fluorescence light which will give information about the energy and the arrival direction of the primary CRs.

Experiments and analysis techniques have been developed in order to study the possibility of detecting both Cherenkov and fluorescence light with the current DAQ.

T 12.4 Mo 16:45 S12

Production and Testing of Scintillator Surface Detectors for the Pierre Auger Observatory in Aachen — •Julian Kemp, Thomas Bretz, Paulo Ferreira, Adrianna García, Thomas Hebbeker, Tobias Pan, and Christine Peters — III. Physikalisches Institut A, RWTH Aachen University

The Pierre Auger Observatory, located in the Argentinean Pampa, is a hybrid cosmic-ray detector measuring ultrahigh energy cosmic-ray air-showers. It consists of a surface array made up by 1660 water Cherenkov detectors which is overlooked by 27 fluorescence telescopes.

The Pierre Auger Observatory is currently undergoing a major upgrade, AugerPrime, to improve its performance. One main contribution is the installation of an additional scintillator detector on top of each surface detector station. It will allow for a more precise determination of air-shower characteristics, especially its number of muons.

The III. Physikalisches Institut A of the RWTH Aachen University is manufacturing and testing 135 of these Scintillator Surface Detectors. A procedure was developed to validate the performance of each detector individually before shipment.

T 12.5 Mo 17:00 S12

mDOM - a multi-PMT optical module for future IceCube-Extension — •Lew Classen and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

Located in the deep glacial ice of Antarctica IceCube is the World's largest neutrino telescope. Originally designed for the investigation of the neutrino sky on the TeV to PeV energy scale and beyond, the lower energy threshold of its sensitivity range was expanded to $\sim 10\,\mathrm{GeV}$ by the DeepCore extension. Now plans for an upgrade of the detector are maturing that will further enhance IceCube's potential both at low and high energies. Novel optical sensors will have a key role in this. Among the new designs is the so-called mDOM, a multi-PMT Digital Optical Module. Optical modules based on this concept feature an array of several small photomultipliers (PMTs) housed inside a transparent pressure vessel, resulting in several advantages with respect to the conventional single-PMT design, such as a larger sensitive area, a uniform solid angle coverage as well as enhanced intrinsic directional sensitivity. The contribution will introduce the sensor concept and give an overview of the current status of development of the device.

T 12.6 Mo 17:15 S12

A GPU-Based Photon Tracker for the Wavelength shifting Optical Module (WOM) — •Florian Thomas[1], John Rack-Helleis[1], Sebastian Böser[1], and Elmar Schömer[2] for the IceCube-Collaboration — [1]Institute of Physics, Mainz — [2]Institute of Computer Science, Mainz

The Wavelength shifting Optical Module consists of a cylindrical tube coated with wavelength shifting paint and read out by a photomultiplier tube (PMT) optically attached at each end. Light striking the surface of the tube is absorbed, shifted towards longer wavelengths and guided to the PMT by total internal reflection within the walls of the tube.

This talk presents the current status of a high performance photon tracking simulation for the WOM which runs on CUDA-enabled GPUs. A prototype of this simulation processes photons approximately 240 times faster than commercial software, and we have identified opportunities for additional optimization.

T 12.7 Mo 17:30 S12

Simulation of the Optics of the Imaging Air Cherenkov Telescopes IceAct with Geant4 — •Maurice Günder[1], Jan Auffenberg[1], Pascal Backes[1], Thomas Bretz[2], Erik Ganster[1], Merlin Schaufel[1], and Christopher Wiebusch[1] for the IceCube-Collaboration — [1]III. Physikalisches Institut B, RWTH Aachen — [2]III. Physikalisches Institut A, RWTH Aachen

The Imaging Air Cherenkov Telescopes IceAct are proposed to be deployed on the surface above the IceCube Neutrino Observatory at the South Pole. With an SiPM based camera and a field of view of 12°, IceAct is capable to observe Cherenkov light from cosmic ray air showers in order to veto atmospheric muons and neutrinos which are background sources in cosmic neutrino searches of IceCube. Furthermore, IceAct can be used to measure the composition of cosmic rays and improve the calibration of IceCube and IceTop. For these purposes a detailed wavelength dependent simulation of the optics is needed to parametrize the telescopes' response. This simulation is done by Geant4, a general-purpose Monte Carlo simulation platform for the passage of particles through matter. We will present the results of the simulations with respect to detection efficiency, optical effects, and aberrations. The resulting optical response is parametrized in form of lookup tables that allow the efficient simulation of the signal of air showers.

T 12.8 Mo 17:45 S12

Effectivity analysis of a new lightguide design for SiPM pixel in MAGIC — •Alina Nasr Esfahani for the MAGIC-Collaboration — TU Dortmund, LS E5b, Otto-Hahn-Strasse 4a, 44227 Dortmund

MAGIC is a stereocopic system of two Imaging Air Cherenkov Telescopes on La Palma. At the edges of the camera, which uses Photomultiplier Tubes (PMTs), test clusters of silicon photomultipliers (SiPMs) have been installed.

To maximize the surface area of PMTs and SiPMs, collimators are placed on the pixels to guide the cherenkov light produced in particle showers to the sensor surface. Besides the currently used Winston Cones as lightguides for the SIPM Cluster, different lightguide designs have been installed which are cheaper in the production, while retaining the desired performance. In this talk, the performance of the different collimators are compared. Also, a comparison of the arrival times of lightpulses in SiPM und PMT pixels is shown.

T 12.9 Mo 18:00 S12

Comparison and optimization of scintillation detector DAQ systems for the large surface array of IceCube-Gen2 — •Marie Oehler[1], Andreas Haungs[1], Bernd Hoffmann[1], Thomas Huber[1,2], Timo Karg[2], Matt Kauer[3], Marko Kossatz[2], Max Renschler[1], Harald Schieler[1], Karl-Heinz Sulanke[2], Delia Tosi[3], Andreas Weindl[1], and Chris Wendt[3] for the IceCube-Collaboration — [1]KIT, Karlsruhe, Germany — [2]DESY, Zeuthen, Germany — [3]UW, Madison, USA

The IceCube Observatory is a cubic-kilometer neutrino detector installed in the ice at the geographic South Pole. To increase the amount of detected extragalactic neutrinos the upgrade IceCube-Gen2 is under development. Among others, a large surface scintillation detector array is proposed.

Two prototype stations, consisting of seven detectors each, have been installed in the Antarctic Season 2017/2018. These detectors use scintillators, wavelength shifting optical fibers and silicon photomultipliers (SiPM). The stations use different data acquisition (DAQ) systems: The μDAQ system researched, developed and built by UW-Madison and the TAXI system researched, developed and built by KIT and DESY. μDAQ transfers the digitized integrated signals only to minimize the amount of transmitted data. TAXI can transmit the waveforms of the signals additionally and build local triggers for further detectors like radio antennas. In this contribution these two DAQ systems will be compared and an optimized setting for the DAQ system will be presented.

T 12.10 Mo 18:15 S12

Development of a hybrid particle and radio detector DAQ for the IceCube experiment — •Peter Steinmüller[1], Michele Caselle[1], Andreas Haungs[1], Bernd Hoffmann[1], Thomas Huber[1,2], Timo Karg[2], Marko Kossatz[2], Max Renschler[1], Michael Schleicher[1], Frank G. Schröder[1,3], Karl-Heinz Sulanke[2], and Andreas Weindl[1] for the IceCube-Collaboration — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]DESY, Zeuthen, Germany — [3]University of Delaware,Newark, USA

Complementing the in-ice neutrino detector, IceCube features a surface array for the detection of cosmic-ray air showers. A new hybrid detector consisting of particle and radio detectors is at the moment under development as an option to extend the IceCube surface array. While prototypes of the particle detectors are already deployed and operating at the South Pole, the deployment of two prototype radio antennas is scheduled for January 2019. These two antennas will be included in the existing particle detector array and its DAQ. To be able to process radio detector signals with the existing DAQ system (IceTAXI), additional components have to be added to the existing particle DAQ. Special care has been taken since the reconstruction of cosmic-ray properties using the radio signal highly depends on the accuracy of the recorded radio waveform. In this presentation, the hybrid DAQ system will be described in detail focusing on the radio detector electronics. In addition, first results regarding the characterization of the radio electronics as well as first tests with the full setup will be shown.