T 37: Astroteilchenphysik: Methoden II

Zeit: Dienstag 16:00–18:30 Raum: S12

T 37.1 Di 16:00 S12

Efficiency determination of the Wavelength shifting Optical Module (WOM) for IceCube — •John Rack-Helleis, Peter Peiffer, Sebastian Böser, and Florian Thomas for the IceCube-Collaboration — Johannes Gutenberg Universität Mainz

The Wavelength shifting Optical Module (WOM) consists of a cylindrical tube coated in wavelength shifting paint with photomultiplier tubes(PMT) optically attached at each end.

Light hitting the surface of the tube is absorbed, shifted towards larger wavelengths and guided to the PMT via total internal reflection within the walls of the tube.

This design ensures a significantly larger photo detection area compared to the PMT alone. At the same time the noise, which scales with the detection area of the given PMT, is not increased. Additionally this detector is sensitive to light in the UV range, making it well suited for the detection of Cherenkov light.

This makes the WOM a very promising candidate for future extensions of the IceCube Neutrino Observatory at the South Pole.

In this talk I will present the current status of modeling and understanding the light propagation and detection efficiency of the WOM.

T 37.2 Di 16:15 S12

The eyes of XENONnT: Qualification tests of 494 photomultiplier tubes — •Luisa Hötzsch and Oliver Wack for the XENON-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg

The next phase of the XENON dark matter experiments will be the XENONnT detector. Utilizing in total 8.4 tonnes of xenon in a dual-phase liquid xenon time projection chamber, its aim is to increase the sensitivity for direct dark matter detection by one order of magnitude to probe new regions of the parameter space.

The scintillation light induced in liquid or gaseous xenon by particle interactions will be detected with 494 photomultiplier tubes (PMTs). The Hamamatsu R11410 tub has been chosen for its high quantum efficiency and low intrinsic radioactivity to maximize the detector's sensitivity. Applying the knowledge gained during testing and operation of the previous detector, XENON1T, the characteristics and performance of the PMTs for XENONnT have been studied and tested extensively. The general testing procedures and the results of the testing campaign will be presented in this talk.

T 37.3 Di 16:30 S12

Setup of a batch test facility for the characterization of photomultipliers for the AugerPrime Upgrade of the Pierre Auger Observatory* — •Simon Strotmann — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

With the surface detector upgrade of the Pierre Auger Observatory, the precision of the primary particle mass composition measurement will be further improved by mounting additional 4 m^2 scintillator detectors on top of the existing surface detector stations. A PMT with expected high linearity was chosen in order to meet the requirements measuring the signal of the scintillator within a high dynamic range. The presentation will focus on the development and design of the batch test facility located at the University of Wuppertal built for the characterization of these PMTs. The setup enables the determination of the relevant quantities of the PMT such as gain and linearity in order to meet the required specifications for operation at the observatory.

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T 37.4 Di 16:45 S12

PMT characterization for the IceCube mDOM — •Jonas Reubelt, Judith Schneider, Daniel Runze, and Martin Majewski for the IceCube-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

In context of the planned IceCube Upgrade new kinds of optical modules are developed. One of them is the multi-PMT Digital Optical Module (mDOM) containing 24 three-inch photomultiplier tubes (PMTs). In order to fully utilize the advantages of the multi-PMT concept, the performance of different PMT models is investigated. The results of extensive characterization of the two most promising candidates are presented.

T 37.5 Di 17:00 S12

PMT characterization for the multi-PMT Digital Optical Module of the IceCube-Upgrade — •Martin Antonio Unland Elorrieta, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

In the framework of a planned upgrade of the IceCube Neutrino Observatory and a next-generation neutrino telescope at the South Pole, new optical modules are being developed, which are expected to significantly increase the detector sensitivity. One such concept is the multi-PMT Digital Optical Module (mDOM) which features 24 photomultipliers (PMTs) inside a pressure vessel pointing in all directions. This design provides o.a. an almost uniform angular acceptance, an increased effective area and the possibility of using local coincidences between PMTs of the same module. Since the PMTs are the main detection device of the module, a good understanding of their performance is essential. We present current results regarding PMT characterization and measurement techniques.

T 37.6 Di 17:15 S12

Development of a test bench for the quality control of photomultipliers for the IceCube-Upgrade — •Robert Joppe, Martin Rongen, Mareike Profe, Lutz Deriks, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen

For the IceCube-Upgrade a new light sensor (mDOM) is developed, which consists of multiple photomultipliers (PMTs). Each PMT has to be tested and characterized prior to assembly of the modules. We construct a test bench to identify defective units, calibrate gain, transit time, noise rates, photon detection efficiency and reject PMTs which emit light from the dynode system or the base. Design challenges are the large number of PMTs to be tested simultaneously, within a tight schedule, at Antarctic temperatures and over a wide wavelength range.

T 37.7 Di 17:30 S12

Characterisation of PMTs for the FlashCam Project — Stefan Eschbach, •Oleg Kalekin, and Johannes Schumann — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

The FlashCam project aims to build a camera for the Middle Size Telescopes of the Cherenkov Telescope Array Project. The 1758 pixel camera consists of 1.5-inch Hamamatsu PMTs of type R12992-100. A subset of 400 PMTs was characterised at Erlangen Centre for Astroparticle Physics. Tested parameters were Quantum Efficiency (QE), afterpulsing, gain, transit time spread, rise time and width of single photoelectron pulses. All these parameters are in agreement with specifications. However, for some PMTs a strong inhomogeneity of QE over photocathode was found.

T 37.8 Di 17:45 S12

Evaluierung der Sensitivität von SALLA Prototypantennen für das großflächige Radio Upgrade des Pierre Auger Observatoriums — •Markus Nowak — Institut für Kernphysik, Karlsruher Institut für Technologie

In Luftschauern, verursacht durch ultrahochenergetische kosmische Strahlung, werden neben den erzeugten Teilchen auch Radiopulse emittiert. Wie bereits einige Radioantennenfeld-Experimente gezeigt haben, ist es möglich, mit diesen Pulsen den Radio-Fußabdruck des Schauers am Boden zu rekonstruieren. Dieser Radio-Fußabdruck bietet eine weitere Möglichkeit um Eigenschaften wie die Energie oder die Masse des primären Teilchens zu bestimmen. Von besonderem Interesse sind stark geneigte Luftschauer, da sie einen sehr großen Radio-Fußabdruck hinterlassen, wohingegen die elektromagnetische Teilchenkomponente dieser Schauer verschwindend gering wird.

Für das Pierre Auger Observatorium wird ein großflächiges Radio-Upgrade durchgeführt, um diese stark geneigten Schauer messen zu können. Ziel ist es, die durch das Observatorium durchgeführte Messung der Massenkomposition kosmischer Strahlung, auf große Zenitwinkel auszudehnen. Im bereits erfolgreich arbeitenden Auger Engineering Radio Array (AERA) sind hierfür unter anderem Prototypstationen mit short aperiodic loaded loop (SALLA)-Antennen aufgebaut worden. In dieser Präsentation wird die Eignung dieser Antennen für ein großflächiges Radioantennenfeld im Vergleich zu den anderen An-

tennentypen in AERA untersucht.

T 37.9 Di 18:00 S12

Towards an improved radio detection technique for the measurement of air showers — •Aswathi Balagopal V., Andreas Haungs, Thomas Huber, Tim Huege, Donghwa Kang, Agnieszka Leszcynska, Marie Oehler, Max Renschler, and Frank G. Schröder for the IceCube-Collaboration — Karlsruhe Institue of Technology, Karlsruhe, Germany

Radio detection of air showers has continually grown and developed since the past few decades. It is already proven to be an effective method for extracting information of air showers and their properties. Existing experiments measuring such air showers mostly operate in the frequency range of 30-80 MHz, and have successfully measured cosmic rays with energies well above 50 PeV. In this talk, I will present the recent results which show how the optimization of the frequency range of operation can enable us to improve the signal-to-noise ratio, and thereby lower the energy threshold of detection. This optimization is universal, and can pave the way for an improved performance of all future radio air-shower arrays.

T 37.10 Di 18:15 S12

GRANDProto300, a pathfinder for autonomous radio detection of UHECRs — •Anne Zilles — Institut d'Astrophysique de Paris, Paris, France

GRANDProto300, acting as a pathfinder for the future Giant Radio Array for Neutrino Detection (GRAND), is planned as an array of 300 antennas deployed over $\sim 300\,\mathrm{km}^2$. Its main goal is to demonstrate the viability of detection principle of GRAND: from radio data alone, to trigger on nearly horizontal air showers, separate the signal from the background, and reconstruct the properties of the primary particles with a precision similar to standard techniques used for cosmic-ray detection. With 10^5 detected CR events above $10^{7.5}$ GeV already in the first year, GRANDProto300 is placed in a privileged position to study the transition between Galactic and extragalactic cosmic rays. With the extension by a ground array of particle detectors, hybrid detection will allow an independent measurement of the electromagnetic and muonic component of the shower. In this contribution we will present the science goals, preliminary design, performance goals and current status of the GRANDProto300 project.