# T 61: Methods of astroparticle physics IV

Time: Wednesday 16:30–18:45 Location: L-3.001

T 61.1 Wed 16:30 L-3.001

**The characterization of PMTs for the AugerPrime Upgrade of the Pierre Auger Observatory*** — •Simon Strotmann and Julian Rautenberg for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

The Surface Detector (SD) of the Pierre Auger Observatory will be upgraded through the addition of a 4 $m^2$ scintillator detector on top of each station to further improve the sensitivity of the surface array. A PMT with expected high linearity was chosen in order to meet the requirements of measuring the scintillator's signals over a high dynamic range.
A batch test facility, built to verify that the gain and linearity requirements for operation in the field are met by each PMT, will be presented. The validation of the test facility on the first 80 PMTs recieved as well as the progress on the characterization of the remaining PMTs for the upgrade as well as additional measurements of the spectral and spatial quantum efficiency of selected PMTs will be shown.
** Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1).*

T 61.2 Wed 16:45 L-3.001

**Measurement of luminescence in South Pole ice** — •Anna Pollmann for the IceCube-Collaboration — Universität Wuppertal

The IceCube neutrino observatory uses 1km3 of the natural Antarctic ice near the geographic South Pole as optical detection medium. When charged particles, such as particles produced in neutrino interactions, pass through the ice with relativistic speed, Cherenkov light is emitted. This is detected by IceCube's optical modules and from all these signals a particle signature is reconstructed. A new kind of signature can be detected using light emission from luminescence. This detection channel enables searches for exotic particles (states) which do not emit Cherenkov light and currently cannot be probed by neutrino detectors. For the measurements at IceCube, a 1.7km deep hole was used which vertically overlaps with the glacial ice layers found in the IceCube volume over a range of 350 m. The experiment as well as the measurement results are presented. The impact of the results, which enable new kind of searches for new physics with neutrino telescopes, are discussed.

T 61.3 Wed 17:00 L-3.001

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

One of the crucial parts of the hybrid detection method used at the Pierre Auger Observatory is the absolute calibration of the fluorescence telescopes. Since it determines the energy range of the Observatory, high accuracy is required. The previous calibration method was carried out infrequently, due to its difficulty and high demand of manpower. To address this, the new XY-Scanner calibration system has been developed. It consists of a small lambertian light source, which is scanned spatially across the front of the telescope and emits short light pulses at several known locations.
To calibrate the telescope based on these light pulses an exact measurement of the number of photons emitted in each pulse is needed. For this purpose, a calibration test bench was designed, which combines the measurements of a calibrated photodiode and a PMT was designed. The setup and operation of this bench will be the main subject of this talk. Using it, an uncertainty of less than 4% could be achieved with potential for further reductions in the near future.
** Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1).*

T 61.4 Wed 17:15 L-3.001

**Characterizing the response of a liquid xenon time projection chamber to α-particles** — •Dominick Cichon, Guillaume Eurin, Florian Jörg, Teresa Marrodán Undagoitia, and Natascha Rupp — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Liquid xenon (LXe) time projection chambers (TPCs) are at the forefront of the search for new physics, especially regarding the hunt for particle dark matter. In such detectors, $^{222}$Rn and its daughters often belong to the major sources of background encountered. The $\alpha$-decays of the chain provide a way to both estimate rates of radon-related background and to study its distribution within the detector. However, at the time of writing, only a scarce amount of data on certain important $\alpha$-particle response parameters, such as signal yields in LXe, is available.

In this talk, measurements of $\alpha$-particle light and charge yields at different electric field strengths are presented. They complement the currently available data and were made with a small-scale LXe TPC. It was necessary to attenuate the scintillation light seen by the TPC's photosensors, as they would saturate otherwise. For this purpose, auxilliary measurements of the transmittance of polytetrafluoroethylene (PTFE), a common material in xenon TPCs, for LXe scintillation light (175 nm) were conducted and are also presented here. They make the construction of attenuators with well-defined reduction factors possible and also help future detectors, such as DARWIN, with optimizing TPC design in terms of PTFE material budget.

T 61.5 Wed 17:30 L-3.001

**Construction and commissioning of new IACT telescopes for IceAct/IceCube** — •Yuriy Popovych[1], Jan Audehm[2], Thomas Bretz[2], Giang Do[2], Adrianna García[2], Florian Rehbein[2], Merlin Schaufel[1], and Christopher Wiebusch[1] for the IceCube-Collaboration — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]III. Physikalisches Institut A, RWTH Aachen University

The IceAct Imaging Air Cherenkov Telescopes (IACTs) are used to observe cosmic-ray air-showers and work hereby as a veto detector for the IceCube Neutrino Observatory. The hybrid observation with IceCube allows cross-calibrating the energy-threshold and energy-scale of the surface detector IceTop as well as the directional reconstruction of the in-ice detector. In January 2019, two telescopes were installed at the South Pole and successfully integrated into IceCube data-taking. As an upgrade for these existing telescopes, new telescopes will be produced. To ensure high instrument reliability, each of the telescopes has to be tested individually simulating the harsh conditions at the South Pole. This talk will report on the status and testing results of the production of the new telescopes.

T 61.6 Wed 17:45 L-3.001

**Results of SiPM Pixel Tests in the MAGIC IACT Camera** — •Alexander Hahn[1,2], Antonios Dettlaff[1], David Fink[1], Daniel Mazin[1,3], Razmik Mirzoyan[1], and Masahiro Teshima[1,3] — [1]Max-Planck-Institut für Physik, München, Deutschland — [2]Physik-Department, Technische Universität München, München, Deutschland — [3]Institute for Cosmic Ray Research, the University of Tokyo, Tokyo, Japan

Large size Imaging Atmospheric Cherenkov Telescopes (IACTs), such as MAGIC, H.E.S.S. or VERITAS, currently in operation or such as LST of CTA in commissioning, are relying on photomultiplier tubes (PMTs) as their primary light detectors. Smaller IACTs (such as FACT or ASTRI) have shown that they can operate with Silicon photomultipliers (SiPMs) instead. However, there is no conclusive study yet whether SiPMs might be also suitable light detectors for large size IACTs. Our group at the Max Planck Institute for Physics built several SiPM based prototype detector modules and installed them to one of the MAGIC telescopes. We operated them since a couple of years in parallel with the existing scientific PMT based camera allowing for a multi-year in-situ comparison of SiPMs and PMTs inside an operational telescope. Here we present a direct performance comparison between SiPM-based and existing PMT-based detector modules being operated in parallel inside the MAGIC imaging camera.

T 61.7 Wed 18:00 L-3.001

**Status of the Imaging Air-Cherenkov Telescopes HAWC's Eye at the HAWC Gamma-Ray Observatory** — •Giang Do[1], Jan Audehm[1], Thomas Bretz[1], Florian Rehbein[1], Merlin Schaufel[2], and Adrianna García[1] — [1]III. Physics Institute 3A, RWTH Aachen, Germany — [2]III. Physics Institute 3B, RWTH Aachen, Germany

The imaging air-Cherenkov telescope HAWC's Eye has been developed in order to improve the energy and angular resolution of extensive air shower arrays. Hybrid observations can improve the reconstruction of the air shower by combining the ground-based detectors and the air-Cherenkov telescopes. The combination of both techniques allows to measure not only the fraction of the shower at ground level but also the shower development. In summer 2017, the first telescope prototype featuring a 50 cm Fresnel lens and a camera with 61 silicon photomultipliers (SiPMs) was commissioned at the site of the High-Altitude Water Cherenkov Gamma-Ray Observatory (HAWC) located in the state of Puebla, Mexico. For the first time, hybrid data was recorded. By using the shower reconstruction of HAWC, the telescope was characterized and calibrated without simulations. In October 2019, two telescopes with upgraded hexagonal light collectors and a new type of SiPMs were successfully installed and operated in stereo mode, promising a better performance. Based on first measurements, the performance of the improved telescopes is evaluated.

T 61.8 Wed 18:15 L-3.001

**Parameterisation of the angular acceptance of KM3NeT PMTs** — •Johannes Schumann for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

The KM3NeT neutrino telescope is currently being built in the depths of the Mediterranean Sea. The detector consists of a three-dimensional array of digital optical modules, housing 31 photomultiplier tubes (PMT) each. A detailed simulation of the experiment is required in order to perform precision measurements of neutrino interactions. The PMT properties are substantial input for the detector response model. In this talk, the in-situ measurement of the angular acceptance based on Cherenkov light emitted by Potassium-40 decays in the sea water is discussed. A comparison of this measurement and the corresponding simulations, as well as a parameterisation for the PMT angular acceptance will be presented.

T 61.9 Wed 18:30 L-3.001

**Status Update from the PMT Mass Testing Container System for JUNO** — •Alexander Tietzsch[1], David Blum[1], Marc Breisch[1], Jessica Eck[1], Caren Hagner[2], Tobias Heinz[1], Tobias Lachenmaier[1], Neha Lad[1], David Meyhöfer[2], Axel Müller[1], Henning Rebber[2], Tobias Sterr[1], and Björn Wonsak[2] — [1]Physikalisches Institut, Eberhard Karls Universität Tübingen — [2]Institut für Experimentalphysik, Universität Hamburg

The Jiangmen Underground Neutrino Observatory (JUNO) experiment will be one of the coming neutrino oscillation experiments starting in the next years. To reach its main goal of determining the neutrino mass hierarchy from the oscillation pattern, a high energy resolution of 3% @ 1 MeV is required, for whose realization up to 20'000 20-inch photomultiplier tubes (PMTs) are intended to be used in JUNO. All of these PMTs have to fulfil dedicated quality requirements for several key characteristics (dark rate, PDE, peak-to-valley ratio etc.), for which a PMT mass testing facility using commercial shipping containers has been developed and is running successfully for more than 2 years now. With this system, so far more than 12'000 PMTs have been tested and characterized. This talk will give an update on the system, the progress in PMT testing and data analysis of tested PMTs and will discuss current statistics and questions related to the PMT characterization for JUNO. This work is supported by the Deutsche Forschungsgemeinschaft.