T 71: Exp. Methods AP, PMTs

Time: Wednesday 15:50–17:20 Location: POT/0351

T 71.1 Wed 15:50 POT/0351

Performance Tests of the Acoustic Module for the IceCube Upgrade — •Charlotte Benning, Jan Audehm, Jürgen Borowka, Mia Giang Do, Oliver Gries, Christoph Günther, Dirk Heinen, Adam Rifaie, Joëlle Savelberg, Christopher Wiebusch, and Simon Zierke for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory is a one cubic kilometer particle detector consisting of 5160 Digital Optical Modules located in the ice at the geographic South Pole. During the IceCube Upgrade more than 700 additional modules will be deployed at the center of the existing detector with the purpose of calibrating and enhancing the detectors capabilities. Part of this upgrade will be ten specialized Acoustic Modules which are capable of receiving and transmitting acoustic signals from 5 to 40 kHz. Based on the principle of trilateration, the positions of acoustic and optical modules will be determined from the propagation times of these signals. With this system we aim to achieve an accuracy of a few 10 cm for the geometrical precision of the detector. In this talk the results of performance tests of the acoustic modules in the laboratory and at a local swimming pool are presented.

T 71.2 Wed 16:05 POT/0351

The Design of the Acoustic Module for the IceCube Upgrade — •Adam Rifaie, Jan Audehm, Charlotte Benning, Jürgen Borowka, Mia Giang Do, Oliver Gries, Christoph Günther, Lasse Halve, Dirk Heinen, Joëlle Savelberg, Christopher Wiebusch, and Simon Zierke for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory at the South Pole detects high energy neutrinos from astrophysical sources. With the upcoming IceCube Upgrade, more than 700 detector modules along with calibration devices will be deployed at the central core of IceCube, 2 km deep into the Antarctic ice. Ten Acoustic Modules (AM) will transmit and receive acoustic signals from 5 to 40 kHz. By means of trilateration of the propagation times of these acoustic signals, we determine the positions of the AMs with an accuracy of about 10 cm and thus calibrate the geometry of the detector. The AM consists of acoustic transducer, communication and signal generation power electronics, and receiver electronics, all embedded in a housing, withstanding the pressure in the ice. For the proper measurement of transit times between different modules a dedicated synchronization and timing protocol has to be implemented. This talk presents an overview of the functionality and technical design of the main components and describes the development of appropriate firmware.

T 71.3 Wed 16:20 POT/0351

Status of the implementation of "Event-Generator" in IceCube-Gen2 — •Francisco Javier Vara Carbonell and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik WWU Münster, Münster, Germany

The success of large observatories such as the IceCube neutrino telescope is highly dependent on the accuracy of their reconstruction algorithms. In IceCube, traditional likelihood-based methods are limited by the lookup tables used for calculating the event hypotheses, since their complexity requires them to be simplified. Promising results have recently been obtained with "Event Generator", a generative neural network that can replace such tables and lead to an improvement in reconstruction performance since it does not require simplification. The success of this neural network lies in its design, which, unlike most machine learning applications, is able to explicitly exploit the information domain of IceCube event generation, such as symmetries and detector properties. In this talk, "Event Generator" will be introduced and the current status and future plans for its implementation in IceCube-Gen2 will be presented.

T 71.4 Wed 16:35 POT/0351

Photomultiplier simulation in COMSOL Multiphysics — •Willem Achtermann, Alexander Kappes, and Markus Dittmer for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster, Germany

Photomultiplier tubes (PMTs) are used in water Cherenkov neutrino detectors such as IceCube and KM3NeT. They play a central role in the performance of the detector and therefore a deep understanding of their properties is crucial for the operation and improvement of the experiment. In this talk, I discuss some of the timing parameters, e.g., the transit time (spread) for a PMT, which I investigate using a COMSOL multiphysics simulation. The current state of simulation will be shown and some insights into the working principle of PMTs and simulation results will be given.

T 71.5 Wed 16:50 POT/0351

Characterizing Light Attenuation inside the Wavelength-Shifting Optical Module from Timing Distributions — •Yuriy Popovych, John Rack-Helleis, Martin Rongen, and Sebastian Böser — Johannes Gutenberg-Universität Mainz

The Wavelength Shifting Optical Module (WOM) makes use of wavelength-shifting paint to absorb UV-photons and re-emit them as visible light. These photons are captured via Total Internal Reflection inside a quartz tube and propagate to Photomultipliers at both ends. Due to its design the timing resolution of the WOM does not result not from the sensors, but from the photon propagation inside the tube. Further, one can measure the timing distribution to differentiate between scattering and absorption processes in the light propagation. Characterizing the timing lets us explore new use cases for the WOM-technology.

This talk will describe the modeling and measurement of the timing characteristics of the WOM and a method to deduce absorption and scattering properties of the wavelength-shifter coated WOM tube from it.

T 71.6 Wed 17:05 POT/0351

Investigation of photomultiplier photocathodes with an ellipsometer — •Berit Schlüter and Alexander Kappes — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster, Germany

Photomultiplier tubes (PMTs) are a central component of today's neutrino telescopes such as IceCube and KM3NeT, and an accurate understanding and measurement of their properties is indispensable for further improvement of the detectors. In my talk I focus on the optical properties of the photocathode, which is only a few 10 nanometers thick and will be investigated using an ellipsometer. As part of my master's thesis, I set up the ellipsometer and used it to characterize flat samples. Currently, the setup is being extended for the measurement of curved photocathodes as part of my PhD thesis. This talk presents the idea of the measurement as well as the current status of the work.