T 17: Methods of astroparticle physics I

Time: Monday 16:30–18:00 Location: H-HS XVII

T 17.1 Mon 16:30 H-HS XVII

A multi-PMT Optical Module for the IceCube Upgrade — •Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

The IceCube Upgrade will add about 700 new advanced optical sensors to the current detector, thereby expanding its capabilities both at low and high neutrino energies. A large fraction of the upgrade modules will be multi-PMT Digital Optical Modules, mDOMs, each featuring 24 three-inch class photomultiplier tubes (PMTs) pointing uniformly in all directions. Together, the 24 PMTs provide an effective photosensitive area more than twice than that of the current IceCube optical module. The main mDOM design challenges arise from the constraints on the module size and power needed for the 24-channel high-voltage and readout systems, as well as the extreme environmental conditions in the deep ice at South Pole. This contribution presents an overview of the module design and the current development status.

T 17.2 Mon 16:45 H-HS XVII

Design and commissioning of a PMT testing facility for the IceCube Upgrade mDOM PMTs — •Lasse Halve, Robert Joppe, Martin Rongen, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Upgrade will extend the current IceCube Neutrino Observatory with seven additional strings of instrumentation. More than 400 multiple-PMT Digital Optical Modules [mDOM], with 24 3" Photomultiplier Tubes [PMT] each, will be deployed. All 10.000 new PMTs need to be tested for compliance with manufacturer requirements and calibrated before integration into the final modules. We present the design and commissioning of a modular test facility that allows testing ~100 PMTs at once at polar temperatures.

T 17.3 Mon 17:00 H-HS XVII

Design and commissioning of a test bench for the quality control of photomultipliers for the IceCube-Upgrade — •Robert Joppe, Lasse Halve, Martin Rongen, and Christopher Wiebusch — III. Physikalisches Institut RWTH Aachen University

A new light sensor [mDOM] housing 24 photomulipliers is developed for the IceCube Upgrade. A total of ~10.000 PMTs 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 17.4 Mon 17:15 H-HS XVII

Determination of the influence of magnetic fields on 3-inch PMTs — •Ken Ueberholz, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

The neutrino telescope IceCube uses Cherenkov light of secondary charged particles to detect neutrino interactions with the molecules of the ice. This light is detected by Digital Optical Modules (DOMs) each consisting of one large 10-inch photomultiplier tube (PMT) inside a glass pressure vessel. Magnetic fields have been found to have an impact on PMT properties such a timing precision and gain, therefore the PMTs are shielded by means of a *mu-metal* caging.

The upcoming IceCube Upgrade will introduce the mDOM to IceCube, a multi Digital Optical Module using 24 smaller 3-inch PMTs. For PMTs as small as 3-inch the influence of the Earth magnetic field was found to be weaker, so the mDOM is not foreseen to feature magnetic shielding.

In this work we investigated in more detail the impact of magnetic fields on PMT and output signal parameters as a function of orientation and strength of the field.

T 17.5 Mon 17:30 H-HS XVII

Development of a Harness for the IceCube mDOM — •Jelena Petereit for the IceCube-Collaboration — Bergische Universität Wuppertal

The primary scientific goals of the planned upgrade of the IceCube Neutrino Observatory are to investigate neutrino oscillations at low energies and to further increase the sensitivity of the existing detector. This upgrade will include new photon detectors called mDOMs. They will have a different shape than the previously used DOMs in order to increase the photo-sensitive area by housing multiple PMTs. In order to preserve a maximum photon detection efficiency, a harness needs to be developed which integrates the mDOM modules mechanically onto strings. Different harness designs, which include different ways of attaching the mDOMs to the harness, have been tested and the results will be presented.

T 17.6 Mon 17:45 H-HS XVII

Determination of scintillation parameters of the mDOM glass pressure vessel for background simulations — •Markus Dittmer, Martin Unland, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

The IceCube neutrino observatory is the world's largest neutrino telescope instrumenting 1 km^3 of Antarctic glacial ice. When charged particles traverse the transparent detector medium, Cherenkov light is produced which is detected by optical modules consisting of PMTs housed in glass pressure vessels. The investigated Vitrovex glass vessels will be used for the mDOM within the IceCube Upgrade. The glass contains trace amounts of radioactive isotopes, such as ^{40}K. The respective decays cause background signals by scintillation and Cherenkov photons. Since the optical activity of the deep glacier ice is very low, the light produced by the modules themselves represents the dominant background source. In order to fully characterize the background expected for mDOMs and its influence on the signal processing of real events, scintillation parameters have to be investigated thoroughly. This contribution presents results from measurements and Geant4 simulations of the scintillation yield for γ and α-particles.