T 38: Methods of astroparticle physics II

Time: Tuesday 17:00–18:30 Location: L-3.001

T 38.1 Tue 17:00 L-3.001

LOM: An optical module for IceCube-Gen2 — •Anna Weatherburn, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Münster

IceCube-Gen2 will further the research done by IceCube and the IceCube Upgrade into cosmic high energy neutrinos. The next generation of IceCube will attempt to identify the sources responsible for these cosmic high energy neutrinos, extend the energy spectrum of measured neutrinos and take measurements of the neutrino flavour ratio. For this high-energy array upgrade, about 10,000 additional optical sensors on 120 strings will be installed, thereby extending its size to about 8 km3. The optical module technology for Gen2 is currently under development, and one of the most promising candidates is the LOM (or Long Optical Module). The LOM design consists of many small photomultipliers (PMTs), similarly to the mDOM (multi-PMT Digital Optical Module) used in the IceCube Upgrade. However the diameter will be reduced in order to substantially reduce the cost and time of drilling to place the optical modules. The particular design of the LOM will be determined through simulations and consideration of the practicalities of design features. An overview of the current status of simulations and optimisation studies of the optical properties of the new module will be given.

T 38.2 Tue 17:15 L-3.001

Development of a Wavelength-shifting Optical Module for STRAW-b — •Maximilian Bubeck, Lucas Sebastian Binn, John Rack-Helleis, Anna Vocke geb. Steuer, Sebastian Böser, Lutz Köpke, and Diego Salgado Llamas — JGU Mainz

The Wavelength-shifting Optical Module (WOM) is a photosensor that detects UV light with a very high signal-to-noise ratio. The WOM consists of a quartz-glass tube coated with a wavelength-shifting paint, which absorbs light in the UV range and re-emits it in the visible spectrum. Two photo-multiplier tubes (PMTs) attached to the ends of the light-guiding tube detect the shifted photons. We are currently assembling a prototype that will soon be deployed in STRAW-b, an experiment in the Cascadia Basin at a depth of 2600 m, to measure the noise rate in a deep sea environment. Designed to withstand extreme pressures, the WOM is surrounded by a pressure housing. To reduce photon losses, the space between the pressure vessel and the inner tube is filled with hydrogel, which offers a similar refractive index as water. The PMTs are optically and mechanically connected to the inner tube using UV-curing adhesive. To fulfill the requirements for a deployment in the deep sea, the final WOM will need to pass multiple vibration and pressure tests.

T 38.3 Tue 17:30 L-3.001

Development of SiPM based light sensors for large neutrino detectors — David Blum, •Marc Breisch, Jessica Eck, Tobias Heinz, Tobias Lachenmaier, Neha Lad, Axel Müller, Tobias Sterr, and Alexander Tietzsch — Physikalisches Institut, Eberhard Karls Universität Tübingen

For future neutrino experiments (like THEIA) the usage of either large photomultiplier tubes (PMTs) or completely new detector technologies like Large Area Picosecond Photodetectors (LAPPDs) are under consideration. To improve the granulation of the detector and thus the reconstruction a new approach based on SiPM and scintillators was investigated. The scintillator in this design has a surface which is larger than the SiPM and acts as an active lightguide to increase the sensitive area. A custom ray-tracing simulation was used to determine the shape and size of the scintillator to optimise its light collection. This talk will present the results of the simulation, the scintillator design and its experimental validation as well as the first test of an array setup. This work is supported by the BMBF (05H18VTRD2).

T 38.4 Tue 17:45 L-3.001

The Efficiency of the Wavelength-shifting Optical Module (WOM) for IceCube — •John Rack-Helleis, Sebastian Böser, Anna Vocke geb. Steuer, Lutz Köpke, Max Bubeck, Florian Thomas, and Lucas Sebastian Binn for the IceCube-Collaboration — JGU Mainz

The Wavelength-shifting Optical Module is a novel photosensor developed for the IceCube neutrino telescope at the South Pole. It combines the technology of light guiding and wavelengthshifting to achieve a large detection area, high sensitivity in the UV range as well as an improved signal-to-noise ratio. The WOM will be deployed and tested in the IceCube Upgrade, scheduled for 2021. Recent results on the modules photon propagation efficiency and its main contributors will be presented. The state of the understanding of theoretical and experimental efficiency is shown.

T 38.5 Tue 18:00 L-3.001

Performance of the UV Calibration Device for the SPICEcore hole — •Jannes Brostean-Kaiser — DESY Zeuthen

IceCube, the biggest neutrino detector in the world, will be upgraded in 2022. For this upgrade and the planned enlarged detector, IceCube-Gen2, new optical modules have been developed. One of these optical modules, the WOM, uses wavelength-shifting and light-guiding techniques to measure Cherenkov photons in the UV-range. To understand the efficiency of this new module the absorption and scattering lengths of UV-light in the South Pole ice have to be measured. The measurement was done in two campaigns (2018/19 and 2019/20) in the SpiceCore hole, a 1751 m deep hole near the IceCube array drilled for glaciology studies and filled with Estisol. To measure the ice properties a calibration device was lowered into the hole and emit UV light. A UV-sensitive detector inside the probe measures the UV photons that are scattered back. From the time distribution of these scattered photons the scattering and absorption lengths can be deduced. The design of the probe will be presented, as well as its performance during the two measurement campaign, and the results from the 2018/19 campaign and preliminary results from the 2019/20 campaign.

T 38.6 Tue 18:15 L-3.001

Ultra-fast ray tracing for the Wavelength-shifting Optical Module — •Florian Thomas, John Rack-Helleis, Sebastian Böser, and Elmar Schömer — Johannes Gutenberg-Universität Mainz

The Wavelength-shifting Optical Module (WOM) is a novel UV-sensitive light sensor for neutrino experiments. It consists of a cylindrical tube coated with wavelength shifting paint, light concentrators and photomultiplier tubes (PMTs). UV light striking the surface of the tube is absorbed, shifted towards longer wavelengths and guided to the PMT by total internal reflection. The simulation models the photon propagation within the tube wall and light concentrator and includes the simulation of photon interactions with the tube material, such as scattering and absorption. The simulation algorithm is based on a ray tracing approach and has been implemented for CUDA-enabled GPUs. It reaches a throughput of several million photons per second, which is three orders of magnitude faster than previous attempts using commercial software. The excellent simulation performance enabled the application in a fit to experimental data.