# T 47: Experimental techniques in astroparticle physics II

Time: Tuesday 16:00–18:30 Location: Tv

T 47.1 Tue 16:00 Tv

**Studies on the hole ice characterization with mDOM LED flashers in IceCube Upgrade** — •Cristian Jesús Lozano Mariscal and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, WWU Münster

For the upgrade of the IceCube neutrino telescope seven additional strings equipped with new optical modules will be installed in the center of DeepCore, the current low energy extension of the detector. The upgrade is not only aimed at extending IceCube's capabilities to detect low-energy neutrinos, but also to improve the current calibration of the existing IceCube detector by installing new calibration equipment. One such device consists of up to twelve LEDs which are built into the optical sensors and generate nanoseconds-long flashes of light. One goal is to characterize the dust column that forms when the hole ice refreezes after the module is deployed, which is currently one of the largest sources of systematic uncertainty in IceCube. The talk presents initial studies on the dust column characterization using the LEDs in the mDOM module, one of the major optical sensors of IceCube Upgrade.

T 47.2 Tue 16:15 Tv

**Geant4 studies on the impact of the harness on the sensitivity of the mDOM** — •Moritz Schlechtriem, Alexander Kappes, and Lew Classen for the IceCube-Collaboration — Institut für Kernphysik, WWU Münster, Münster

The IceCube neutrino telescope at the South Pole uses optical sensors to detect Cherenkov radiation emitted by charged secondary particles produced in neutrino interactions. For a precise reconstruction of the neutrino properties, a detailed characterization of the detector performance is mandatory. With seven additional closely spaced strings, the IceCube Upgrade will not only significantly enhance IceCube's capabilities at low energies but also improve the calibration of the detector at all energies. More than half of its sensors will be multi-PMT Digital Optical Modules (mDOMs). The mDOM features a more than doubled effective photosensitive area compared to the sensors in the current detector as well as intrinsic directional sensitivity and nearly isotropic acceptance. In this paper, the impact of the mDOM harness on the photon sensitivity of the module is investigated using a detailed Geant4 simulation of the module.

T 47.3 Tue 16:30 Tv

**The wavelength-shifting optical module (WOM) - first prototype** — •Sebastian Böser for the IceCube-Collaboration — PRISMA+ / Institut für Physik, Johannes Gutenberg-Universität, Staudinger Weg 7, 55099 Mainz

The sensitivity and energy threshold of neutrino telescopes is mainly driven by the deployed photocathode area. The wavelength-shifting optical module (WOM) uses a novel approach to enhance the photon collection area while keeping the noise rate constant. Combining wavelength-shifting and light-guiding techniques, abundantly generated UV photons in the Cherenkov process are converted in a coated tube and guided to conventional PMTs at the ends. With a conversion efficiency of close to 100%, the efficiency is dominated by absorption and scattering processes in propagation. On quartz tubes with 55mm diameter photon collection efficiencies of 40% can be achieved over length larger than 60cm length.

I will report on the design and performance of a first prototype that was developed in the context of the STRAWb mission to explore the Cascadian basin as a neutrino telescope site. First in-situ results from the prototype deployed at a depth of 2539m will be presented.

T 47.4 Tue 16:45 Tv

**Optimization and decision-making for the outer pressure vessel of the IceCube-Upgrade WOM** — •Nick Jannis Schmeisser for the IceCube-Collaboration — Bergische Universität Wuppertal (BUW), FK 4 - Astroparticle Physics, Gaußstr. 20, 42119 Wuppertal

In 2023/24 the IceCube Neutrino Observatory is going to be enhanced by the IceCube Upgrade. Therefore over 700 new photosensors are planned to be deployed in addition to the old IceCube detector. This deployment will contain the Wavelength-shifting Optical Module (WOM) among other sensors. The WOM's goal is to achieve a large photosensitive area combined with an improved signal to noise ratio and UV-sensitivity via wavelength shifting and light guiding techniques. A combination of wavelength-shifting dies allows to effectively capture photons below 400nm that are abundantly generated in the Cherenkov process and reemit them close to the peak sensitivity of PMTs at 450nm. The lower edge of the sensitivity is typically given by the housing of the module. To reach this goal the pressure vessel of the WOM needs to fulfill different requirements for example to ensure most of the photons hitting the sensitive area get detected. Also the pressure resistance needs to be taken into account so that the WOM resists the pressure inside the ice. This presentation discusses these key points in the development of the pressure vessel. Especially the decision-making on which glass to use while considering the transmission in the critical sensitive area between 250 nm and 400 nm is going to be presented.

T 47.5 Tue 17:00 Tv

**Performance of the IceAct Imaging Air Cherenkov Telescopes at the South Pole** — •Franziska Maria Tischbein[1], Thomas Bretz[2], Giang Do[2], Frank Maslowski[2], Yuriy Popovych[1], Florian Rehbein[2], Merlin Schaufel[1], and Christopher Wiebusch[1] for the IceCube-Collaboration — [1]RWTH Aachen University - Physics Institute III B, Aachen, Germany — [2]RWTH Aachen University - Physics Institute III A, Aachen, Germany

IceAct telescopes are compact Imaging Air Cherenkov Telescopes (IACTs) that are used to observe cosmic-ray showers in coincidence with the IceCube Neutrino Observatory. With a hybrid observation it is possible to calibrate the surface and in-ice components of IceCube. Furthermore, the primary particle identification of IceTop can be improved and potentially a veto for atmospheric neutrinos in IceCube can be provided. In January 2019, two new IceAct telescopes, with different camera and DAQ design, were installed at a distance of 220m close to the center of the IceTop surface array. This talk will present the different steps to understand the data and compare the performances of the telescopes in this configuration.

T 47.6 Tue 17:15 Tv

**IceAct Project status - SiPM based Imaging Air-Cherenkov Telescopes for IceCube** — •Merlin Schaufel[2], Thomas Bretz[1], Giang Do[1], Frank Maslowski[1], Yuriy Popovych[2], Florian Rehbein[1], Jonas Reimann[2], Franziska Tischbein[2], and Christopher Wiebusch[2] for the IceCube-Collaboration — [1]RWTH Aachen University - Physics Institute III A, Aachen, Germany — [2]RWTH Aachen University - Physics Institute III B, Aachen, Germany

IceAct is a proposed surface array of cost-effective Imaging Air-Cherenkov telescopes above IceCube for the hybrid detection of Air-Showers. Starting January 2019, two IceAct telescope demonstrators featuring 61 SiPM pixels and improved optics operate in the center of the IceTop surface detector at the geographic South Pole. Combining information from these telescopes and IceCube, it is possible to test the performance in primary particle discrimination, energy calibration, and veto capabilities. We present the status and prospects of the project and first results from coincident and stereoscopic data taken during the antarctic winter 2019/2020.

T 47.7 Tue 17:30 Tv

**Application of graph neural networks to classification and reconstruction tasks in KM3NeT** — •Daniel Guderian and Alexander Kappes for the KM3NeT-Collaboration — WWU Münster

The KM3NeT neutrino telescope consists of a network of large-volume Cherenkov detectors at the bottom of the Mediterranean Sea, destined to search for neutrino interactions in water. With its two different sites, ORCA and ARCA, specializing in lower and higher neutrino energies, respectively, it aims at studying physics spanning from the determination of the neutrino mass hierarchy to detection of neutrinos from astrophysical objects. Currently under construction, data from the first deployed detector units, each holding 18 optical modules for the Cherenkov light detection, is available for analysis.

This talk presents results from studies on event classification and reconstruction for the ORCA detector, consisting of four detector units, based on graph neural networks.

T 47.8 Tue 17:45 Tv

**Liquid Scintillator Light Response Nonlinearity Determination in the Context of the JUNO Experiment** — •Konstantin Schweizer[1], Lothar Oberauer[1], Raphael Stock[1], David Dörflinger[1], Ulrike Fahrendholz[1], Julia Sawatzki[1], Sebastian Zwickel[1], Matthias Mayer[1], Hans Steiger[2], Andreas Steiger[1], and Ludwig Wallner[1] — [1]Technische Universität München (TUM), Physik-Department, James-Franck-Str., 85748 Garching, Deutschland — [2]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität (JGU) Mainz, 55099 Mainz, Deutschland

Many current and future neutrino experiments use liquid scintillators as their target material. The energy information of the neutrino interaction is one of the most important observed quantities. However the light yield of charged particles depositing energy in the scintillator follows a nonlinear behaviour. This talk will show the importance of the knowledge of the scintillator nonlinearity for neutrino experiments, in particular for the JUNO experiment which aims to determine the neutrino mass ordering. An experiment has been set up to measure the nonlinearity of the light yield of low energy electron events with a low threshold of approximately 10 keV. The talk will present recent developments and the current status of the experiment. This work is supported by the DFG Research Unit "JUNO" (FOR 2319).

T 47.9 Tue 18:00 Tv

**Calibrating OSIRIS: A 20-ton radioactivity monitor for JUNO** — •Alexandre Sébastien Göttel[1,2], Philipp Kampmann[1], Runxuan Liu[1,2], Livia Ludhova[1,2], Luca Pelicci[1,2], Mariam Rifai[1,2], Giulio Settanta[1], and Cornelius Vollbrecht[1,2] — [1]Forschungszentrum Jülich - Institute for Nuclear Physics, IKP-2, Jülich, Germany — [2]RWTH Aachen University - Physics Institute III B, Aachen, Germany

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator reactor neutrino experiment being built in the Guangdong province in China. JUNO is a multi-purpose experiment with a wide range of applications in neutrino physics, ranging from a mass-hierarchy determination to solar, geo, and atmospheric neutrino measurements, to detecting supernovae, etc.. For many of these applications it is imperative to closely monitor the radiopurity of the liquid scintillator during the several months it will take to fill the detector. The Online Scintillator Internal Radioactivity Investigation System (OSIRIS), a 20-ton liquid scintillator detector, is being developed for this purpose and will be built in Jiangmen in 2021. In order for the OSIRIS pre-detector to achieve its goals a rigorous calibration is necessary. This calibration will consist of the lowering of radioactive sources, as well as a fast-pulsed LED, directly inside of the liquid scintillator using a fully automated and sealed calibration unit which was previously used in the Daya Bay experiment. In this talk the methods used for this calibration are discussed, as well as how they were optimized beforehand using a GEANT4-based Monte Carlo simulation.

T 47.10 Tue 18:15 Tv

**Radon Monitoring in gaseous Nitrogen used for the Filling of the Central Detector of JUNO and OSIRIS** — •Hans Steiger[1,2], Lothar Oberauer[1], Matthias Raphael Stock[1], and Philipp Landgraf[1] — [1]Physik-Department, Technische Universität München (TUM), James-Franck-Straße 1, 85748 Garching bei München — [2]Cluster of Excellence PRISMA+, Johannes Gutenberg University Mainz (JGU), Staudingerweg 9, D-55128 Mainz

The planned JUNO (Jiangmen Underground Neutrino Observatory) Detector will use 20 kt of liquid scintillator (LS) based on LAB (Linear AlkylBenzene) as neutrino target within an acrylic sphere with a diameter of 35.4 m. For the filling of this sphere as well as for the filling of OSIRIS (Online Scintillator Internal Radioactivity Investigation System) with LS pressurized nitrogen will be used. To avoid a contamination of the LS with $^{222}$Rn, its content in the nitrogen gas will be monitored. In this talk the status of a prototype radon monitoring system based on a large volume (50 l) proportional chamber operated in pure nitrogen will be presented as well as pulse shape analysis techniques applied for efficient background reduction. This work is supported by the DFG research unit "JUNO" (FOR2319) and the Maier-Leibnitz-Laboratorium (MLL).