T 87: Neutrinos III

Time: Wednesday 17:30–19:00 Location: POT/0051

T 87.1 Wed 17:30 POT/0051

The Taishan Antineutrino Observatory — •Hans Theodor Josef Steiger — Cluster of Excellence PRISMA+, Detector Laboratory, Mainz, Germany — Experimental Particle and Astroparticle Physics, Johannes Gutenberg University, Mainz, Germany

The TAO (Taishan Antineutrino Observatory) detector is aiming for a measurement of the reactor neutrino spectrum at very low distances (<30m) to the core with a groundbreaking resolution better than 2 % at 1 MeV. The TAO experiment will realize the unprecedented neutrino detection rate of about 2000 per day, which is approximately 30 times the rate in the JUNO main detector. In order to achieve its goals, TAO is relying on yet to be developed, cutting-edge technology, both in photosensor and liquid scintillator (LS) development which is expected to have an impact on future neutrino and Dark Matter detectors. In this talk TAO's design, physics prospects as well as the status of its construction will be presented, together with a short excursion into its rich R&D program with a special focus on the German contribution to the development of the novel gadolinium-loaded liquid scintillator. This work is supported by the Cluster of Excellence PRISMA+ at the Johannes Gutenberg University in Mainz and the DFG research unit JUNO.

T 87.2 Wed 17:45 POT/0051

Event Reconstruction in JUNO-TAO using Deep Learning — •Vidhya Thara Hariharan, Daniel Bick, Caren Hagner, and Rosmarie Wirth for the University of Hamburg-Collaboration — University of Hamburg

he primary goal of JUNO is to resolve the neutrino mass hierarchy using precision spectral measurements of reactor antineutrino oscillations. To achieve this goal a precise knowledge of the unoscillated reactor spectrum is required in order to constrain its fine structure. To account for this, Taishan Antineutrino Observatory (TAO), a ton-level, high energy resolution liquid scintillator detector with a baseline of about 30 m, is set up as a reference detector to JUNO. The 20% increase in the coverage of photosensors, the replacement of Photomultiplier Tubes (PMTs) with Silicon Photomultiplier (SiPM) tiles, the smaller dimension and the operating temperature at -50°C, would enable TAO to achieve a yield of 4,500p.e./MeV. Consequently TAO will achieve an energy resolution better than 2% @ 1 MeV.

The ability to accurately reconstruct reactor antineutrino events in TAO is of great importance for providing a model-independent reference spectrum for JUNO. This work aims to demonstrate the general applicability of Graph Neural Network (GNN) for event reconstruction in TAO. The dataset for model training and validation are Monte Carlo samples generated from the official TAO offline software. The network is trained on the features that are obtained from the information collected by SiPMs to predict the vertices and energy. The resolutions obtained from the model are presented in the talk.

T 87.3 Wed 18:00 POT/0051

Calibration of the JUNO pre-detector OSIRIS — •Moritz Cornelius Vollbrecht[1,2], Livia Ludhova[1,2], Runxuan Liu[1,2], Anita Meraviglia[2,3], Nikhil Mohan[2,3], Luca Pelicci[1,2], Mariam Rifai[1,2], Apeksha Singhal[2,3], and Tobias Richard Sterr[4] — [1]Forschungszentrum Jülich GmbH, Institut für Kernphysik IKP-2, Jülich, Germany — [2]III. Physikalisches Institut B, RWTH Aachen University, Aachen, Germany — [3]GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany — [4]Physikalisches Institut, Eberhard Karls Universität Tübingen, Tübingen, Germany

The 20-kton liquid scintillator detector (LS) of the Jiangmen Underground Neutrino Observatory (JUNO) experiment, currently under construction in southern China, has a huge potential for insights in several fields of particle physics. To achieve its many goals, stringent radiopurity requirements have to be fulfilled. In order to ensure these limits, the Online Scintillator Internal Radioactivity Investigation System (OSIRIS) was designed as a pre-detector for JUNO. During the months-long filling of JUNO, OSIRIS will closely assess the radiopurity of purified LS batches to allow fast countermeasures in case of contaminations. In OSIRIS, an array of 76 Large Photomultiplier Tubes (LPMTs) instruments a water-shielded 20-ton LS target. An Automatic Calibration Unit (ACU) from the Daya Bay experiment is used for the calibration of event and vertex reconstruction as well as LPMT timing and charge responses. A separate laser system is used for redundant LPMT timing and charge calibration. This presentation will summarize the current status of the calibration strategy of OSIRIS.

T 87.4 Wed 18:15 POT/0051

Tau appearance with KM3NeT/ORCA — •Nicole Geisselbrecht for the ANTARES-KM3NET-ERLANGEN-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

KM3NeT/ORCA is a water Cherenkov detector currently under construction in the Mediterranean Sea. It is optimised for the detection of atmospheric neutrinos with the main goal of determining the neutrino mass ordering.
Even though atmospheric neutrinos are produced as electron or muon neutrinos and thus initially do not contain tau neutrinos, these are expected to appear at Earth due to neutrino oscillations. In KM3NeT/ORCA, tau neutrinos can't be identified on an event-by-event basis but rather as a statistical excess of shower-like events. This measurement will allow KM3NeT/ORCA to measure the tau neutrino flux normalisation factor and provide insights into the unitarity of the PMNS matrix and hence the validity of the standard three-flavour neutrino oscillation model. This talk will cover the status of the tau appearance analysis with an early sub-array of KM3NeT/ORCA.

T 87.5 Wed 18:30 POT/0051

Search for quantum gravity effects with neutrino telescopes — •Alba Domi for the ANTARES-KM3NET-ERLANGEN-Collaboration — ECAP, Erlangen, Germany

The Standard Model of particle physics and General Relativity are expected to merge into a new theory of Quantum Gravity (QG) at energies approaching the Planck scale. However, none of the proposed QG approaches has been validated to date. In this context, several signatures of QG effects in accessible energy regimes, known as "Windows on Quantum Gravity", have been postulated. In particular, quantum decoherence (QD) or QG-induced violation of Lorentz invariance (LIV), could cause modifications in neutrino oscillation patterns accessible to observation with neutrino telescopes. Moreover, the phenomenon of QD will provide new possibilities to investigate the neutrino nature as a Dirac or Majorana particle, as well as to trace possible violations of CPT symmetry in neutrino oscillations. Such a phenomenon represents a totally new scenario where to test the real nature of neutrinos. This talk reviews the efforts made in neutrino physics to search for QD and LIV effects and their implications in terms of QG models.

T 87.6 Wed 18:45 POT/0051

Neutrino Generator Comparisons GiBUU/GENIE in KM3NeT — •Johannes Schumann for the ANTARES-KM3NET-ERLANGEN-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg

The KM3NeT neutrino telescope is currently being deployed in the Mediterranean Sea. The detector comprises a three-dimensional array of digital optical modules, which detect faint Cherenkov light signals from secondary particles of neutrino interactions. Simulations of the neutrino interactions play an important role for the interpretation of the measurements and are performed by so-called neutrino generators, which employ different approximations in order to achieve a numerical solution with reasonable computing resources. This contribution describes the comparison between GENIE, the neutrino generator used by KM3NeT and the GiBUU generator. The comparisons are performed at the level of systematic uncertainties and their impact on sensitivity estimates.