T 69: Neutrinos, Dark Matter IX

Time: Wednesday 15:50–17:05 Location: POT/0112

T 69.1 Wed 15:50 POT/0112

Reconstruction of atmospheric neutrino events in JUNO using GCNs — •Rosmarie Wirth, Caren Hagner, Daniel Bick, and Vidhya Thara Hariharan — Universitaet Hamburg, Hamburg, Germany

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillation detector, which will be completed in 2023 as the largest of its kind. JUNO aims to determine the neutrino mass ordering with $3\,\sigma$ significance in about 6 years by observing the energy dependent oscillation probabilities of reactor anti-neutrinos.

Due to JUNO's large volume, it provides the opportunity to detect atmospheric neutrino events with lower energies than today's large Cherenkov experiments. This channel could deliver further measurements on the mass ordering, by observing the energy and direction dependent oscillation probabilities.

This talk presents reconstruction methods based on Graph Convolutional Networks (GCNs) to analyze these atmospheric neutrino events in JUNO.

T 69.2 Wed 16:05 POT/0112

Atmospheric neutrino reconstruction for the neutrino mass ordering measurement of JUNO — •Mariam Rifai[1,3], Runxuan Liu[1,3], Livia Ludhova[1,3], Anita Meraviglia[2,3], Nikhil Mohan[2,3], Luca Pelicci[1,3], Apeksha Singhal[1,3], and Cornelius Vollbrecht[1,3] — [1]Forschungszentrum Jülich GmbH, Institut für Kernphysik IKP-2, Jülich, Germany — [2]GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany — [3]III. Physikalisches Institut B, RWTH Aachen University, Aachen, Germany

The Jiangmen Underground Neutrino Observatory (JUNO) is a multipurpose liquid scintillator-based neutrino experiment with a target mass of 20 kt. The detector is currently under construction and expected to be completed by the end of 2023. Its main goal is the determination of the neutrino mass ordering (MO), through a measurement of the oscillation pattern of reactor anti-neutrinos over a 53 km baseline. As the largest liquid-scintillator detector, JUNO will also be able to observe atmospheric neutrinos events in the GeV region and down to sub-GeV. Therefore, the sensitivity of JUNO to the neutrino mass ordering can be enhanced from 3 to at least 4 sigma in 6 years via a combined analysis of reactor anti-neutrinos with atmospheric neutrinos. Such an analysis requires a precise knowledge on the track of atmospheric neutrinos, which is challenging in terms of reconstruction of the isotropic scintillation light emitted in JUNO. To achieve this target performance, a novel track reconstruction technique based on the voxelized distribution of optical photon emissions is being developed. The current status of this method will be presented in this talk.

T 69.3 Wed 16:20 POT/0112

Development of the first Detector Line for the Pacific Ocean Neutrino Experiment — Christian Spannfellner, •Niklas Retza, Elisa Resconi, Chiara Bellenghi, Mariia Sharshunova, and Lea Ginzkey for the P-ONE-Collaboration — Technical University Munich, Physics Department, James-Franck-Str. 1, Garching, Germany

The Pacific Ocean Neutrino Experiment (P-ONE) is a proposed multi-cubic-kilometre neutrino observatory off the coast of Vancouver Island, Canada. P-ONE will be connected to the NEPTUNE observatory, a deep-sea infrastructure in the Northeast Pacific Ocean hosted by Ocean Networks Canada (ONC). The NEPTUNE node at the Cascadia Basin, roughly 200 km offshore of Vancouver Island at a depth of 2660 m, has been probed for its optical properties by two pathfinder experiments, STRAW and STRAW-b, deployed in 2018 and 2020 respectively and was found to be suitable for a neutrino telescope. A first mooring line, called P-ONE-1, is planned to be deployed in 2024. P-ONE-1, consisting of 20 optical and calibration instruments distributed over a total vertical length of around one kilometre, shall serve as a prototype line for the detector, and ultimately be the blueprint for the following detector lines. In this contribution, we will present the design of P-ONE-1 and its optical instruments. The multi-PMT design of the latter allows to cope with the high background rates in the depths of the Northeast Pacific Ocean, while their modular and minimal mechanical design makes them easily scalable in vision of the construction of the full P-ONE detector.

T 69.4 Wed 16:35 POT/0112

DELight: Direct Search Experiment for Light Dark Matter with Superfluid Helium — •Francesco Toschi[1], Klaus Eitel[1], Christian Enss[1,2], Torben Ferber[1], Loredana Gastaldo[2], Felix Kahlhoefer[1], Sebastian Kempf[1], Greta Heine[1], Markus Klute[1], Sebastian Lindemann[3], Marc Schumann[3], Kathrin Valerius[1], and Belina von Krosigk[1] — [1]Karlsruhe Institute of Technology — [2]Heidelberg University — [3]University of Freiburg

The DM-nucleon scattering parameter space of Light Dark Matter (LDM) has been barely experimentally probed, as it requires an energy detection threshold down to a few tens of eV. The "Direct search Experiment for Light dark matter" (DELight) aims at using superfluid helium-4 as target, particularly suited because of its low nuclear mass and radiopurity, while providing both photon and quasiparticle signal channels valuable for event classification. DELight will deploy Magnetic Micro-Calorimeters (MMCs) operating at a temperature of 20 mK, promising high resolution and a threshold of a few eV. With an exposure of only 1 kg×d and an energy threshold of 20 eV, in its first phase DELight will be able to probe unexplored regions of the parameter space for LDM masses below 100 MeV with an expected sensitivity lower than $10^{-39}\,\mathrm{cm}^2$ at 20 MeV.

In this talk we will present the working principle of the detector technologies as well as an overview of the ongoing R&D towards the realization of DELight.

T 69.5 Wed 16:50 POT/0112

Design and Commissioning of the MainzTPC2 — •Constantin Szyszka, Christopher Hils, Jan Lommler, Uwe Oberlack, Daniel Wenz, and Alexander Deisting — Institut für Physik & Exzellenzcluster PRISMA$^+$, Johannes Gutenberg-Universität Mainz

The MainzTPC is an experimental dual-phase xenon time projection chamber (TPC) dedicated to the study of scintillation and ionization processes of liquid xenon for low-energy electronic and nuclear recoils. It features a signal readout with two PMTs and eight APDs, enabling 3D position reconstruction. The TPC also allows to study the influence of the drift field's strength on the scintillation process. Its design has been optimized for the use as primary target in Compton scattering experiments to measure recoil energies in liquid xenon down to 1 keV.

The MainzTPC is being redesigned to accommodate a SiPM array instead of the top PMT and APDs to improve position resolution in x and y. To address known instabilities in the liquid level of the MainzTPC, we aim to improve the level meters and level control by observing the liquid gas interface with commercially available cameras. We report on the status of this work.