# T 82: Neutrino Astronomy IV

Time: Thursday 16:15–18:00 Location: KS H C

T 82.1 Thu 16:15 KS H C

**Simulation of the atmospheric neutrino production height with CORSIKA 8** — •Tim Schönauer — TU Dortmund, Dortmund, Germany

Atmospheric neutrinos are produced in cosmic-ray air showers. Yet the neutrino production height remains largely unexplored, although it exhibits significant seasonal and regional variability, especially in polar atmospheres where the density profile undergoes strong annual modulation. To investigate the production height of neutrinos, air-shower simulations were carried out using CORSIKA 8, the recently developed C++-based successor to the established CORSIKA framework. Its architecture enabled controlled variation of physical parameters and allowed detailed comparisons with legacy simulations, providing a basis for validation and for identifying deviations introduced by the modernized implementation. The production heights of atmospheric neutrinos were simulated for summer and winter atmospheric profiles at the South Pole and other geographical locations. The resulting distributions quantified the magnitude and energy dependence of seasonal shifts in the neutrino production region and provide refined input for analyses sensitive to atmospheric model uncertainties in present and future neutrino observatories.

T 82.2 Thu 16:30 KS H C

**Water Properties Studies with atmospheric muons in the ORCA/ARCA KM3NeT detector** — •Evi Sakkou for the KM3NET-ERLANGEN-Collaboration — Erlangen Centre for Astroparticle Physics (ECAP), Friedrich-Alexander-Universität Erlangen-Nürnberg, Nikolaus-Fiebiger-Str. 2, 91058 Erlangen, Germany

The KM3NeT detector is an underwater neutrino observatory that detects atmospheric neutrinos in a range of energies. ORCA and ARCA detectors rely on precise knowledge of the optical properties of the surrounding water helping to enhance neutrino event reconstruction. In this study, we use atmospheric muons to study the water attenuation length. To this end we compare the light yield of muons between data and Monte Carlo simulations generated with different true values of the water attenuation length.

T 82.3 Thu 16:45 KS H C

**Unfolding the Electron Neutrino Spectrum** — •Lene Van Rootselaar and Lukas Liland for the IceCube-Collaboration — TU Dortmund, Dortmund, Germany

The IceCube Neutrino Observatory, a cubic-kilometre detector located in the Antarctic ice at the South Pole, provides unique sensitivity to neutrinos over energies spanning from the GeV to the PeV scale. In this energy regime, the observed neutrino flux is expected to arise from a combination of conventional atmospheric neutrinos produced in pion and kaon decays, a possible prompt atmospheric contribution from charmed hadron decays, and an astrophysical component of extragalactic origin. Disentangling these contributions, in particular in the transition region where the prompt flux may become relevant, is essential for advancing our understanding of high-energy particle interactions in the atmosphere.

This contribution describes the current status of an analysis aimed at determining the electron neutrino energy spectrum in IceCube in the range from roughly 1 TeV to 4 PeV using a cascade event sample. A spectral unfolding technique is used to infer the neutrino energy distribution while minimizing dependence on assumed flux models. Ongoing studies of the detector response, Monte Carlo validation, and the impact of systematic uncertainties will be presented.

T 82.4 Thu 17:00 KS H C

**Atmospheric tau neutrino appearance analysis with 11 years of IceCube DeepCore data** — •Sol Benkel for the IceCube-Collaboration — DESY Zeuthen

DeepCore, a region of the IceCube Neutrino Observatory with denser instrumentation, enables the detection of atmospheric neutrinos between 5 and 150 GeV, where a strong tau neutrino signal has been observed. DeepCore has continually provided high precision measurements of atmospheric neutrino oscillations, repeatedly setting world-leading results. In this talk, I present the design and current progress of a new analysis strategy for atmospheric tau neutrino appearance using 11 years of IceCube DeepCore data. This strategy explores new metrics by which high resolution neutrino events can be isolated from the analysis sample, thus potentially improving the sensitivity to measure muon to tau neutrino oscillations. Rather than applying cuts, which would discard low-purity data, these metrics will only bin the data, thus isolating high-quality events while preserving the statistical power of the full dataset. With this approach, we expect to increase sensitivity to the signatures of $\nu_\tau$ appearance from $\nu_\mu$ oscillation, as this binning strategy would provide enhanced discrimination against the background from other cascade events.

T 82.5 Thu 17:15 KS H C

**Studying the Diffuse Supernova Neutrino Background with JUNO** — •Tim Charissé[1,2], George Parker[2], David Maksimović[2], Marcel Büchner[2], Oliver Pilarczyk[2], Arshak Jafar[2], Manuel Böhles[2], Daniela Fetzer[2], Elena Winiker[2], and Michael Wurm[2] — [1]Helmholtzzentrum für Schwerionenforschung, Planckstrasse 1, D-64291 Darmstadt, Germany — [2]Johannes Gutenberg-Universität Mainz, Institute of Physics and EC PRISMA+

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kton liquid scintillator detector situated in Southern China that started data taking in August 2025. Its large fiducial volume together with low radiopurity and high photocoverage results in excellent energy resolution. While JUNOs main physics goal is the determination of the neutrino mass ordering and precision measurement of neutrino oscillation parameters, it is also able to detect core-collapse Supernova (CCSN) neutrinos. Apart from directly observing these neutrinos in the rare event of a close-by CCSNe, JUNO also aims to measure the so-called Diffuse Supernova Neutrino Background (DSNB). This predicted isotropic flux consisting of remnant neutrinos from all CCSNe that happened in the visible universe is yet to be observed. Its measurement will offer insides into CSSNe, Astrophysics and Cosmology. Current efforts towards a detection of the DSNB with JUNO will be presented in this talk.

T 82.6 Thu 17:30 KS H C

**Machine Learning for DSNB Detection in JUNO: Utilizing Spatial-Temporal PMT Hit Patterns for Background Suppression** — •David Maksimovic[1], Michael Wurm[1], Daniel Tobias Schmid[1], and Dhaval J. Ajana[2] — [1]Johannes Gutenberg-University — [2]Florida State University

The detection of the Diffuse Supernova Neutrino Background (DSNB) poses a significant challenge in neutrino astronomy, primarily due to backgrounds mimicking the extremely rare antineutrino events via Inverse Beta Decay (IBD) . The Jiangmen Underground Neutrino Observatory (JUNO) uses a liquid scintillator to detect these neutrinos in the 12 to 30 MeV range. There, especially Neutral-Current (NC) interactions of atmospheric neutrinos dominate the predicted DSNB signal by 1-2 orders of magnitude. In this talk, we present a comparative study of ML discrimination algorithms, ranging from 3D Convolutional Neural Networks (3D CNNs), LSTMs and Convolutional LSTMs (ConvLSTMS) and utilizing Fourier Transformations. These techniques analyze time-sequenced data from photomultiplier tube (PMT) hit patterns to capture the spatial-temporal dynamics of particle interactions. Here we present the resulting background reduction capabilities for JUNO.

T 82.7 Thu 17:45 KS H C

**Charm Contributions to Multi-Messenger Emissions in Dense AGN Environments*** — •Vladimir Kiselev[1,2], Julia Becker Tjus[1,2,3], Rikard Enberg[4], and Julien Dörner[1,2] — [1]Theoretical Physics IV: Plasma Astroparticle Physics, Ruhr University Bochum — [2]RAPP Center, Bochum — [3]Department of Space, Earth and Environment, Chalmers University of Technology, Gothenburg, Sweden — [4]Department of Physics and Astronomy, Uppsala University, Sweden

Active galactic nuclei (AGN) are compelling sites for high-energy neutrino production, yet the balance between light-meson ($\pi, K$) and charm-hadron channels in dense, magnetised environments remains unresolved. We present a simulation-driven framework that couples a version of CRPropa designed for the AGN/jet environment with a Hadronic Interaction Module for $pp$ interactions with secondary tag-

ging. Inclusive energy-differential cross sections $d\sigma/dx_E$ are computed and tabulated using chromo with Sibyll 2.3d, enabling consistent propagation from cosmic-ray injection to neutrino yields on finely sampled energy grids. By comparing decay, synchrotron, hadronic, and adiabatic timescales, regimes are identified in which $\pi/K$ channels can be suppressed while short-lived charm hadrons remain effectively prompt and can contribute significantly to the neutrino signal. The analysis points to coronae and dense jet substructures as potential "charm factories" within realistic acceleration limits. Validation of these qualitative indications using the framework through the spectral shape and flavour composition to isolate charm contributions is ongoing. *Supported by DFG (SFB 1491)