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Unfolding the Muon Neutrino Spectrum with Eleven Years of IceCube Data

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The IceCube Neutrino Observatory, a cubic-kilometre detector embedded in the glacial ice of the South Pole, is designed to detect neutrinos across a broad energy range, from a few GeV to several PeV. This enables precise measurements of the neutrino energy spectrum, comprising the diffuse astrophysical flux, the conventional atmospheric flux from pion and kaon decays, and the not yet detected prompt neutrino flux from charmed hadron decays. Investigating the prompt component, expected to dominate in the crossover region between the other two, is a critical focus for understanding neutrino interactions, atmospheric processes, and cosmic ray composition.

This analysis determines the muon neutrino energy spectrum in the sensitive energy range between 500 GeV and 4 PeV with eleven years of IceCube data. We used an unfolding technique, which allows for model-independent determination and re-bins the observable space to ensure sufficient statistics at the highest energies. In addition to improving the precision of intermediate-energy spectral measurements, it provides the first reconstruction of the muon neutrino flux across five zenith angle bins from 86° to 180°, increasing IceCube' s energy range and enabling comparisons with theoretical models and prior measurements.

Collaboration(s)

IceCube

Author: Ms VAN ROOTSELAAR, Lene (TU Dortmund University)

Co-authors: Dr KARDUM, Leonora (TU Dortmund University); Mr WITTHAUS, Lucas (TU Dortmund University)

Presenter: Ms VAN ROOTSELAAR, Lene (TU Dortmund University)

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