



Contribution ID: 336

Type: **Oral**

Multi-PeV Signals from a New Astrophysical Neutrino Flux Beyond the Glashow Resonance

Thursday 10 August 2017 16:15 (15 minutes)

The IceCube neutrino discovery was punctuated by three showers with $E_\nu \sim 1\text{--}2$ PeV. Interest is intense in possible fluxes at higher energies, though a marked lack of $E_\nu \sim 6$ PeV Glashow resonance events implies a spectrum that is soft and/or cutoff below \sim few PeV. However, IceCube recently reported a through-going track event depositing 2.6 ± 0.3 PeV. A muon depositing so much energy can imply $E_{\nu_\mu} \sim 10$ PeV. We show that extending the soft $E_\nu^{-2.6}$ spectral fit from TeV-PeV data is unlikely to yield such an event. Alternatively, a tau can deposit this much energy, though requiring $E_{\nu_\tau} \sim 10\times$ higher. We find that either scenario hints at a new flux, with the hierarchy of ν_μ and ν_τ energies suggesting a window into astrophysical neutrinos at $E_\nu \sim 100$ PeV if a tau. We address implications, including for ultrahigh-energy cosmic-ray and neutrino origins.

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Session Classification: Neutrinos

Track Classification: Neutrinos (astrophysical, atmospheric)