Contribution ID: **953** Type: **Talk**

Constraining the contribution of Seyfert galaxies to the astrophysical neutrino flux using NGC 1068 as a benchmark

Tuesday 22 July 2025 16:05 (15 minutes)

IceCube recently reported evidence for TeV neutrino emission from several nearby Seyfert galaxies, with the highest significance found for NGC 1068. The absence of TeV gamma rays suggests neutrino production in the AGN corona, which is opaque to high-energy photons. Assuming stochastic proton acceleration, we model the neutrino emission of a Seyfert galaxy as a function of its intrinsic X-ray luminosity, considering both photohadronic and hadronuclear interactions. We fit the resulting neutrino spectrum for NGC 1068 to public IceCube data and find that our model provides a good fit to the data while remaining consistent with Fermi-LAT gamma-ray constraints. Using this as a benchmark, we apply our model to a sample of nearby Seyfert galaxies and a simulated source population based on the X-ray luminosity function of AGNs. We go beyond previous work by modelling the details of individual sources, considering both nearby X-ray observations and the broader population in a consistent way. We find that Seyfert galaxies could contribute significantly to the diffuse neutrino flux in the 1-10 TeV range. However, if all Seyferts were as efficient as NGC 1068, their combined flux would exceed current upper limits at TeV energies by more than 3σ, suggesting that NGC 1068 is an unusually powerful neutrino source.

Collaboration(s)

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Session Classification: NU

Track Classification: Neutrino Astronomy & Physics