

2018 Proposal Flux Plots

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1 Flux Estimates and Measurements

1.1 Theoretical Predictions

Two very common theoretical predictions for the GZK cosmogenic neutrino flux are those by *Ahlers and Halzen* [1] and by *Kotera et. al.* [2].

1.2 IceCube Measurement

We will utilize three of the most recent IceCube flux measurements. The first is their measurement of the astrophysical muon neutrino spectrum using eight-years of through-going muons [3]:

$$\frac{d\Phi_{\nu+\bar{\nu}}}{dE} = 3 \times (1.01^{+0.26}_{-0.23}) \left(\frac{E}{100 \text{ TeV}} \right)^{-2.19 \pm 0.10} \cdot 10^{-18} \text{ GeV}^{-1} \text{ cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \quad (1)$$

The second is their measurement of the all-flavor astrophysical neutrino spectrum using four years of cascades [4]:

$$\frac{d\Phi_{\nu+\bar{\nu}}}{dE} = 3 \times (1.57^{+0.23}_{-0.22}) \left(\frac{E}{100 \text{ TeV}} \right)^{-2.48 \pm 0.08} \cdot 10^{-18} \text{ GeV}^{-1} \text{ cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \quad (2)$$

Their most recent *peer-reviewed* result is their combined-likelihood analysis, which utilizes both tracks and cascades [5]:

$$\frac{d\Phi_{\nu+\bar{\nu}}}{dE} = (6.7^{+1.1}_{-1.2}) \left(\frac{E}{100 \text{ TeV}} \right)^{-2.50 \pm 0.09} \cdot 10^{-18} \text{ GeV}^{-1} \text{ cm}^{-2} \text{ s}^{-1} \text{ sr}^{-1} \quad (3)$$

It is interesting to note that the spectral index γ in the muon-based measurement is considerably harder than the explicitly all-flavor measurements, but the tension is only $\sim 2\sigma$.

2 Event Number Estimate

To estimate the number of events that would be detected by an experiment, we must complete the following integral:

$$N = \int \left(\frac{dN}{dE dA d\Omega dt} \right) [\Omega A_{eff}] dt dE \quad (4)$$

where we are integrating over a flux model. This can be discretized into a sum over energy bins:

$$N = \Delta t \sum_i \left(\frac{dN}{dE dA d\Omega dt} \right)_i [\Omega A_{eff}]_i \Delta E_i \quad (5)$$

References

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- [2] K. Kotera, D. Allard, A. V. Olinto, Cosmogenic Neutrinos: parameter space and detectability from PeV to ZeV, JCAP 1010 (2010) 013. [arXiv:1009.1382](#), [doi:10.1088/1475-7516/2010/10/013](#).
- [3] C. Haack, C. Wiebusch, the IceCube Collaboration, A measurement of the diffuse astrophysical muon neutrino flux using eight years of icecube data., in: Proceedings of the International Cosmic Ray Conference, Vol. PoS(ICRC2017)1005, 2017.
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- [4] H. Niederhausen, Y. Xu, the IceCube Collaboration, High energy astrophysical neutrino flux measurement using neutrino-induced cascades observed in 4 years of icecube data, in: Proceedings of the International Cosmic Ray Conference, Vol. PoS(ICRC2017)968, 2017.
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