2018 Proposal Flux Plots

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1 IceCube Flux Measurements

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 [1]:

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

The second is their measurement of the all-flavor astrophysical neutrino spectrum using four years of cascades [2]:

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

Their most recent *peer-reviewed* result is their combined-likelihood analysis, which utilizes both tracks and cascades [3]:

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

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:

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

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

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

References

[1] 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.
URL `https://pos.sissa.it/cgi-bin/reader/contribution.cgi?id=PoS(ICRC2017)1005`

[2] 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.
URL `https://pos.sissa.it/cgi-bin/reader/contribution.cgi?id=PoS(ICRC2017)968`

[3] M. G. Aartsen, et al., A combined maximum-likelihood analysis of the high-energy astrophysical neutrino flux measured with IceCube, Astrophys. J. 809 (1) (2015) 98. `arXiv:1507.03991`, `doi:10.1088/0004-637X/809/1/98`.