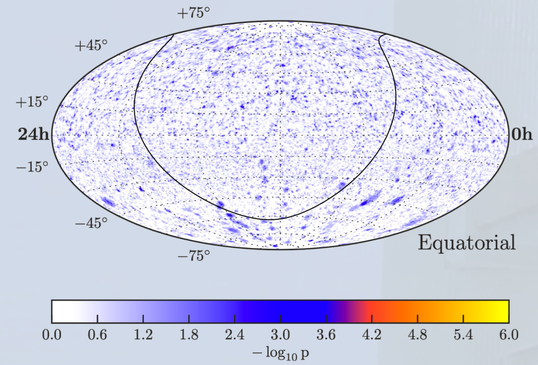
Are the neutrinos observed by IceCube originating from our local Universe? Probably Not! (1911.11809)

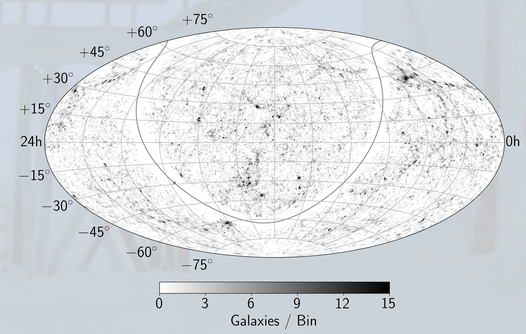
Étienne Bourbeau and Steve Sclafani , for the IceCube Collaboration
etienne.bourbeau@icecube.wisc.edu

ν-Searches with the IceCube Detector



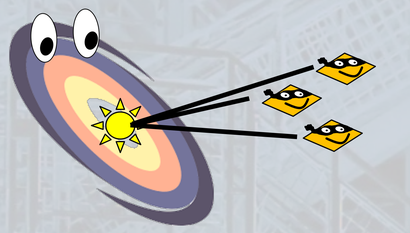
- IceCube detects a **diffuse flux** of astrophysical neutrinos [1]
- Seven-Year Point Source Sample: Selection of **high-resolution, through-going track events** in IceCube. [2]
- No galactic sources found [3]. Next likely region: the **Local Universe (z<0.03)**

The Local Universe seen by 2MRS



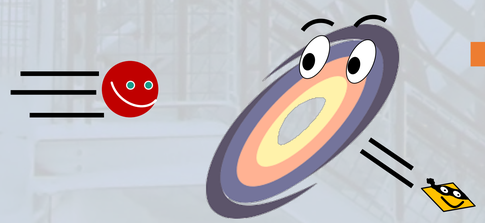
- Vast survey of galaxies with redshift measurements [4]
- Unbiased in luminosity for redshift z=0.03
- Used as a **proxy for matter distribution**

Low-luminosity neutrino sources within galaxies in the Local Universe? [5]



What Could Possibly Create Neutrinos in the Local Universe?

We perform likelihood searches comparing hypothesis with the expected Test Statistic distribution of randomly scrambled neutrinos or neutrino clusters



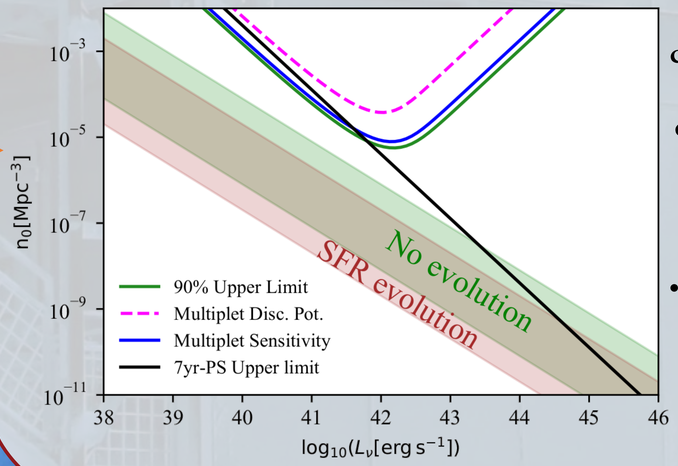
Ultra-High Energy Cosmic Rays colliding with Matter from the Local Universe?

The Multiplet Search

$$\ln \mathcal{L}(N_a) = \sum_{i=1}^{N_m} \ln\left(\frac{N_a}{N_m} S_i + \left(1 - \frac{N_a}{N_m}\right) \mathcal{B}_i(\delta_i)\right)$$

S_i : Density of 2MRS objects

B_i : Uniform background fluctuation



Testing if sub-significant clusters of neutrinos from the 7yr-PS correlate with the distribution of 2MRS objects

No significant signal ☹

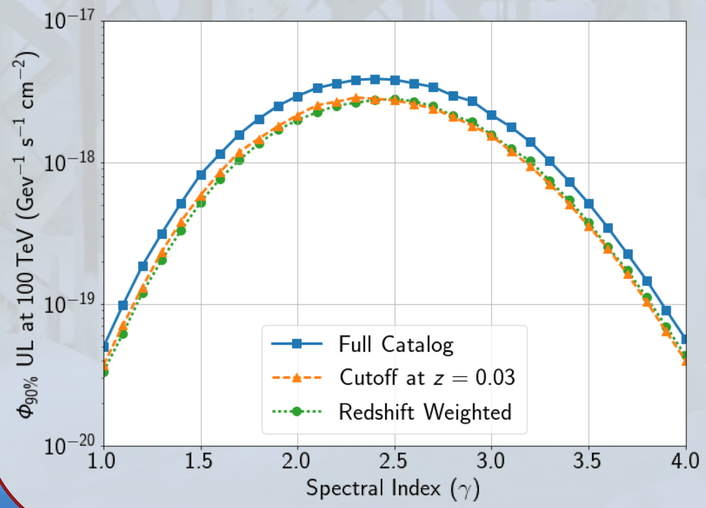
- we calculate a limit on the density of low neutrino luminosity sources within the local universe.

The Template Search

$$\ln \mathcal{L}(N_s) = \sum_{i=1}^{N} \ln\left(\frac{N_s}{N} S_i(x_i, \sigma_i, E_i) + \left(1 - \frac{N_s}{N}\right) \mathcal{B}_i(\delta_i, E_i)\right)$$

S_i : Simulated neutrinos emitted from 2MRS objects

B_i : Declination + energy dependent background



Testing if individual neutrinos from the 7yr-PS correlate with the distribution of 2MRS objects

No significant signal ☹

- we calculate a limit on the contribution of UHECR interactions in the Local Universe to the IceCube flux

VILLUM FONDEN

References

[1] M. G. Aartsen et al. [IceCube Collaboration], Science, no. 342, 1242856 (2013) [arXiv:1311.5238]
[2] M. G. Aartsen et al. [IceCube Collaboration], Astrophys. J. 835, no. 2, 151 (2017) [arXiv:1609.04981]
[3] M. G. Aartsen et al. [IceCube Collaboration], Astrophys. J. 849, 67 (2017) [arXiv: 1707.03416]
[4] J.P Huchra et al. Astrophys. J. Suppl. 199, 2, 26 (2012) [arXiv: 1108.0669]
[5] P. Mertsch, M. Rameez and I. Tamborra, JCAP 1703, no. 03, 011 (2017) [arXiv:1612.07311]