A Multi-Component Model for the Observed Astrophysical Neutrinos

The recent IceCube measurements has opened a new window on the universe but their interpretation remainings still an issue. Various interesting problems are present: i) no confirmed point sources have been detected, ii) there is a tension between the spectra suggested by throughgoing muons and High Energy Starging Events, iii) it is not clear if a Galactic component of high energy neutrinos is present; iiii) a very energetic tracks of 4.5 PeV, implying a proton energy greater than 100 PeV, has been detected, opening questions on which sources are the ideal candidates to accelerate neutrinos up to this energy. We propose a multi-component model for the observed diffuse neutrino flux, including the residual atmospheric backgrounds, a Galactic contribution (such as from cosmic ray interactions with gas), an extra-galactic contribution from pp interactions (such as from starburst galaxies) and a hard extragalatic contribution from photo-hadronic interactions at the highest energies (such as from Tidal Disruption Events or Active Galactic Nuclei). We demonstrate that this model can address the key problems of astrophysical neutrino data discussed above. We perform the analysis based on the observed events instead of the unfolded fluxes by computing the probability distributions for the event type and reconstructed neutrino energy. As a consequence, we give the probability to belong to each of these astrophysical components on an event-to-event basis.