Contribution ID: **21** Type: **Parallel talk**

First Search for High-Energy Neutrino Emission from Galaxy Mergers

Wednesday 16 October 2024 15:00 (15 minutes)

The exact sources of high-energy neutrinos detected by the IceCube neutrino observatory still remain a mystery. For the first time, this work explores the hypothesis that galaxy mergers may serve as sources for these high-energy neutrinos. Galaxy mergers can host very high-energy hadronic and photohadronic processes, which may produce very high-energy neutrinos. We perform an unbinned maximum-likelihood-ratio analysis utilizing the galaxy merger data from six catalogs and 10 years of public IceCube muon-track data to quantify any correlation between these mergers and neutrino events. First, we perform the single source search analysis, which reveals that none of the considered galaxy mergers exhibit a statistically significant correlation with high-energy neutrino events detected by IceCube. Furthermore, we conduct a stacking analysis with three different weighting schemes to understand if these galaxy mergers can contribute significantly to the diffuse flux of high-energy astrophysical neutrinos detected by IceCube. We find that upper limits (at 95% c.l.) of the all flavour high-energy neutrino flux, associated with galaxy mergers considered in this study, at 100 TeV with spectral index $\Gamma = -2$ are 2.57×10^{-18}, 8.51×10^{-19} and 2.36×10^{-18} $\mathrm{GeV}^{-1}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}\,\mathrm{sr}^{-1}$ for the three weighting schemes. This work shows that these selected galaxy mergers do not contribute significantly to the IceCube detected high energy neutrino flux. We hope that in the near future with more data, the search for neutrinos from galaxy mergers can either discover their neutrino production or impose more stringent constraints on the production mechanism of high-energy neutrinos within galaxy mergers.

Track type

Astroparticle Physics

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Session Classification: Parallel - ASP & GW