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Evaluating cosmic coincidences in the context of astrophysical source populations

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The multi-messenger era is now well underway, with high-energy neutrinos providing a unique opportunity to study particle acceleration. Recent reports describe possible coincident detections of single IceCube neutrinos with both a flaring blazar and a tidal disruption event. While compelling, these sources cannot be considered in isolation. I will present various strategies to put these associations into the context of the relevant astrophysical source populations. Firstly, we can use the non-observation of point sources in IceCube searches to place constraints on the high-level properties of the unknown source population. In particular, current measurements disfavour populations of rare and bright sources. Secondly, multi-messenger simulations of proposed populations and their transient behaviour can be used to evaluate the probability of chance coincident detections in a principled manner. Finally, these simulations can also be harnessed to predict the contribution to the overall neutrino flux that is consistent with an assumed source-neutrino association. I will demonstrate the application of these methods, using the proposed detections as a case study. The results raise further questions for the bigger picture of neutrino astrophysics.

Keywords

Neutrinos; blazars; Tidal disruption events; Source detection; Population; Simulation; Inference; Statistics

Collaboration

other Collaboration

Subcategory

Theoretical Methods

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