Contribution ID: **85** Contribution code: **P#37** Type: **Poster**

Exploring Neutrino-GW Correlations: Navigating Challenges Envisioning the ET Era

Tuesday 7 May 2024 18:07 (1 minute)

In this era of multi-messenger astronomy, we have been able to detect common sources of gravitational waves (GW) and photons. However, there is still a missing correlation between GW and neutrino sources. The scenarios involving binary mergers have been particularly favoured for a long time. However, no evidence has been found yet. The aim of our research is to contribute to this aspect. We are looking into the sub-threshold GW candidate selections from the LIGO-Virgo-KAGRA collaboration, and searching for sub-TeV neutrino counterparts using IceCube data. This improves our understanding about the threshold for GW detection. This might also improve the significance and localisation of the sub-threshold GW candidates. We report on the current status of the ongoing work. In addition, we will adapt our analysis techniques involving the next generation GW and neutrino detectors. The Einstein Telescope (ET) will have significantly improved sensitivity for high- and low frequency GW, a better sky localisation and a larger distance horizon. As a result of that, it will detect 100s of BNS events per day, which will need to be followed up with neutrinos. However, we are yet to identify the analysis pipelines and data brokers which will help us to follow up such a huge number of GW candidates within a short time window in real-time. Therefore, the motivation of this work is also to identify prospective solutions so that we are prepared as we enter the ET era.

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Session Classification: Posters

Track Classification: Observational Science Board (OSB)