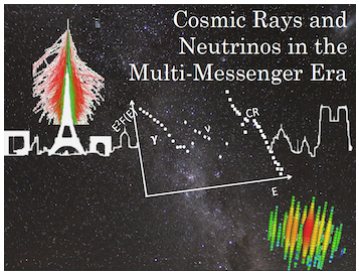

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Searching for Neutrino Emission from Compact Binary Mergers with IceCube

The advent of gravitational wave and neutrino astronomy has led to an exciting era of multi-messenger astronomy. Identifying high-energy neutrino emission from compact binary mergers could shed light on the sources of high-energy neutrino emission as well as particle acceleration mechanisms in these compact binary systems. The LIGO-Virgo Collaboration (LVC) has reported a total of 67 compact binary merger candidates throughout its first three observing runs. We present a search for high-energy neutrino emission from each merger reported by LVC using the IceCube neutrino observatory.

In this work we use an unbinned maximum likelihood method to test for spatial and temporal correlation of IceCube neutrino candidates with the GW candidates reported by LVC. We test for neutrino correlations within a ±500s time window centered around the GW merger time. The test statistic is the log-likelihood ratio weighted by a spatial weight derived from the GW localization uncertainty. A p-value describing the probability that the neutrinos on the sky are consistent with the GW source is computed for each GW candidate independently.

Figure 2 shows the final p value distribution for all of the 67 GW candidates we tested. No statistically significant neutrino correlations are observed and thus we set upper limits on the time-integrated neutrino flux from each GW candidate as well as setting limits on the isotropic equivalent energy, E_{iso} emitted in high-energy neutrinos.

Figure 3 shows our upper limits on E_{iso} as a function of the distance to the GW candidate. We see that the upper limits on E_{iso} follow roughly an r^2 scaling as expected from geometric arguments.

Note that LVC recently published their second GW catalog, GWTC-2, in which they reported 39 events from the first half of the O3 run. This work does not include the new events reported in this catalog and also contains some events that are no longer considered GW candidates in the new catalog. We are currently working on updating our results using the new catalog. Additional analyses searching for neutrino emission are currently in progress. One analysis searches for neutrino emission on longer time scales. There are also two analyses searching for neutrino emission with different data samples, namely cascade type events and lower energy neutrino events. For more details on this analysis, see the published paper in ApJL, DOI: 10.3847/2041-8213/ab9d24

Related session

Multi-messenger

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