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Multi-Energy and Multi-Sample Searches for IceCube Neutrinos from LIGO/Virgo/KAGRA Gravitational Wave Events

The IceCube Neutrino Observatory at the South Pole detects neutrinos of astrophysical origin via their interactions with ice. The main array is optimized for the detection of neutrinos with energies above 1 TeV. A much smaller infill array, known as IceCube DeepCore, extends the sensitivity down to a few GeV. Neutrinos observed in both parts of the detector are used for astrophysical-source searches with multiple messengers. We present two analyses that follow up archival gravitational wave (GW) events from runs O1 through O3 of LIGO/Virgo/KAGRA. The first analysis uses two neutrino datasets: one with high-energy tracks and another consisting of low-energy tracks and cascades. These two neutrino datasets were previously used independently to follow-up GW events. In the analysis presented here, a combined likelihood search is performed using both datasets to search for neutrinos coincident with the GW events across a wide energy range, from a few GeV to several PeV. The second analysis, for the first time, uses a neutrino-induced cascade sample with events of energy above 1 TeV for searches of coincident neutrino-GW emission. We present results from both analyses and discuss prospects for conducting these analyses in real time.

Collaboration(s)

IceCube

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