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Constraints on the Population of Common Sources of Gravitational Waves and High-Energy Neutrinos with IceCube During the Third Observing Run of the LIGO and Virgo Detectors

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The discovery of joint sources of high-energy neutrinos and gravitational waves has been a primary target for the LIGO, Virgo, KAGRA, and IceCube observatories. The joint detection of high-energy neutrinos and gravitational waves would provide insight into cosmic processes, such as progenitor dynamics and outflows. The joint detection of multiple cosmic messengers can also elevate the significance of the observation when some or all of the constituent messengers are sub-threshold, not significant enough to declare their detection individually. Leveraging data from the LIGO, Virgo, and IceCube observatories, we conducted an archival investigation of sub-threshold multi-messenger events. Complementing previous analyses, we used minimal assumptions to search for common sources of sub-threshold gravitational-wave and high-energy neutrino candidates during the third observing run (O3) of the Advanced LIGO and Advanced Virgo detectors. Our search did not identify significant joint sources. We therefore derive constraints on the rate density of joint sources for each compact binary merger population as a function of the energy emitted in neutrinos. Only a fraction of the gravitational-wave sources emit neutrinos, if the neutrino emission is isotropic and has high bolometric energy ($> 10^{52}$ to 10^{54} erg).

Collaboration(s)

IceCube

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