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Sensitivity of the Cherenkov Telescope Array to emission from the gamma-ray counterparts of neutrino events

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Astrophysical sources capable of hadronic acceleration to relativistic energies have long been believed to be sources of high-energy astrophysical neutrinos. The lack of significant indication of point sources in the long-exposure neutrino sky map may point to a large population of faint, steady sources or flaring objects as the origin of the diffuse flux. The spatially and temporaly correlated observations of the flaring gamma-ray blazar TXS 0506+056 and a high-energy neutrino detected by IceCube are the most compelling evidence for a high-energy neutrino point source so far.
We investigate the detection probability for the VHE gamma-ray counterparts to neutrino sources from the populations simulated by the FIRESONG software to resemble the diffuse astrophysical neutrino flux measured by IceCube. For different zenith angles and geomagnetic field configurations we scan over parameters describing the populations –luminosity and density (density rate) for steady (flaring) objects. For steady sources following both flat and star formation rate redshift evolution the populations with $\rho \geq 10^{-7} Mpc^{-3}$ and $L < 10^{53} erg/yr$ are detected for 30 minutes of observation for the baseline CTA layout. The difference in detectability of sources between CTA-N and CTA-S for the average magnetic field is not large. We investigate the effect of higher night sky background and the reduced CTA Phase-I layout on the detection probability. For the blazar flares resembling the neutrino flare of TXS 0506+056 in 2014-2015, CTA will detect more than 40% of the sources in 30 minutes of observation. We propose the optimal strategy for the follow-up observations of neutrino alerts from IceCube.

Keywords

neutrino alerts; gamma-ray counterparts; follow-up observations

Collaboration

CTA

other Collaboration

Subcategory

Future projects

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