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Young supernovae sprinkling high energy neutrinos and gamma-rays throughout our universe

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Multiwavelength observations of Supernovae (SNe) have revealed the presence of dense Circumstellar Material (CSM) around their progenitor stars. This CSM is formed due to heavy mass loss that the progenitor stars suffer a few years prior to their death as SNe. High energy protons accelerated in SN explosion interacting with this CSM can produce secondary particles like high energy neutrinos and gamma-rays. We term such SNe as Young Supernova (YSNe) as this interaction generally lasts for about a year after explosion. In this work, we estimate the spectra of high energy neutrinos and gamma rays emitted by different types (IIn, II-P, Ib/c, and IIb/II-L) of YSNe. Type IIn produces the largest neutrino and gamma-ray fluxes, followed by Ib/c and II-P. Telescopes like IceCube (neutrino) and Fermi-LAT (gamma-ray) might detect type IIn upto 10 Mpc, while the remaining types are detectable at smaller distances. The different classes of YSNe can also produce diffuse backgrounds of high energy neutrinos and gamma-rays. The contribution to these diffuse backgrounds is found to be dominated by type IIn YSNe, followed by type II-P and Ib/c YSNe. The diffuse neutrino background from YSNe explains very well the IceCube High Energy Starting Events (HESE). Interestingly, the gamma-ray counterpart to diffuse background do not create tension to the resolved Isotropic Gamma-ray Background (IGRB) measured by Fermi-LAT.

Session

Astroparticle Physics and Cosmology

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