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Relic Supernova Neutrinos and the Nuclear Equation of State¹

GRANT MATHEWS, University of Notre Dame, JUN HIDAKA, TOSHITAKA KAJINO, NAOJ — Understanding the mechanism of core-collapse supernova explosions requires knowledge of the nuclear equation of state (EoS). Recent multidimensional numerical simulations indicate that explosions are possible. Nevertheless, it is not yet fully understood which equation of state is realized in the proto-neutron star formed during the SNe explosion. We examine the EoS dependence of the neutrino emission from failed supernovae (fSNe) as a probe of the properties of the nuclear EoS due to its influence on the relic supernova neutrino spectrum. We consider a variety of astrophysical scenarios, which include different progenitor masses for a successful explosion, the cosmological star formation rate, starbursts, quiescent star formation, and the metallicity dependence of the initial mass function. We find a robust EoS dependence, and we highlight the usefulness of future neutrino detectors to distinguish the nuclear EoS.

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