Neutrino Opacities in Proto-Neutron Stars with Quark Matter

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Abstract

The presence of quark matter in proto-neutron stars (PNSs) may have an observable impact on post-supernova neutrino emission. The essential microphysical ingredients that govern the macrophysical evolution of the PNS during the first 100 s of its evolution are the equation of state of dense matter and its associated neutrino opacity. Recently, we have demonstrated that the presence of quarks could lead to metastable PNSs. In addition, the temperature along adiabats in a star containing quarks is much smaller than stars without quarks, which could lead to significantly lower core temperatures (PLB 486, (2000) 239). In this work, we calculate neutrino opacities and diffusion coefficients for the Standard Model neutral and charged current interactions in the dense matter encountered under varying conditions of temperature and neutrino fraction. We compare results for the cases with and without superfluidity in order to qualitatively understand the full evolution of a PNS with quark matter.

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