Supernova Explosions: The Role of Hyperon Matter

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Abstract

Supernova explosions are spectacular astronomical events. At the same time, the understanding of the final journey of a massive star after its fuel has been exhausted is a challenging problem. The outcome of it is a core collapse supernova and the residue may take the form of either a neutron star or a black hole. The core collapse supernova explosion mechanism is being investigated over the last five decades. Still, the detailed theory of a successful supernova explosion is beyond our reach. In most core collapse supernova simulations, the shock stalls after traversing a few hundred kilometers. It is not yet understood whether dimension of the problem or microphysics such as equation of state of dense matter and neutrino physics is responsible for a successful core collapse supernova explosion. The shock revival by neutrino heating, after hundreds of milliseconds, was investigated in understanding a successful core collapse supernova explosion. On the other hand, novel phases of dense matter such as hyperon, quark or Bose condensates of pions and kaons might be formed just after the bounce of the Fe core. Here I discuss our newly constructed hyperon equation of state (EoS) for core-collapse supernova simulations and neutron stars. This is the first supernova EoS involving hyperons which is compatible with the recently measured 2 $M_\odot$ neutron star. Finally I describe the role of hyperon matter on the supernova explosion and neutrino signal.