

Strange matter in neutron stars and core-collapse supernovae

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Abstract

Born in core-collapse supernovae, neutron stars contain matter at densities far beyond nuclear saturation. Though recent neutron star mass measurements provide information about the properties of high density nuclear matter, the interior composition of neutron stars is till today not known and possible scenarios range from pure nucleonic matter, to the presence of hyperons, or even quark matter.

I will discuss signals from the possible appearance of hyperons and strange quark matter during the birth of neutron stars in supernova explosions. Special emphasis will be placed on the early post-bounce

appearance of strange quark matter in the proto neutron star interior. It has been shown that in such a case the proto neutron star can collapse to a more compact quark-hadron hybrid star configuration. The collapse can trigger the formation of a shock wave which leads to a successful supernova explosion and leaves an imprint on the neutrino signal. I will discuss these dynamical features, also with respect to their compatibility with the recent measurement of the two solar mass pulsar PSR J1614-2230.

Corresponding publications, see e.g.:

”Signals of the QCD phase transition in core-collapse supernovae” I. Sagert, M. Hempel, G. Pagliara, J. Schaffner-Bielich, T. Fischer, A. Mezzacappa, F.-K. Thielemann, M. Liebendoerfer, Phys. Rev. Lett. 102, 081101 (2009)

”Core-collapse supernova explosions triggered by a quark-hadron phase transition during the early postbounce phase” T. Fischer, I. Sagert, G. Pagliara, M. Hempel, J. Schaffner-Bielich, T. Rauscher, F.-K. Thielemann, R. Kaeppli, G. Martinez-Pinedo, M. Liebendoerfer The Astrophysical Journal Supplement, Volume 194, Issue 2, article id. 39 (2011)

”Strange matter in core-collapse supernova” I. Sagert, T. Fischer, M. Hempel, G. Pagliara, J. Schaffner-Bielich, F.-K. Thielemann, M. Liebendoerfer arXiv:1112.6328