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Formation of quark matter in protoneutron stars: the burning process and the neutrino emission

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The temporal evolution of a protoneutron star could be schematically divided into two processes, the deleptonization and the cooling, which modify respectively the isospin asymmetry and the temperature of the stellar matter. In turn, the change of these two thermodynamic variables could trigger several possible phase transitions to quark matter before the protoneutron star reaches its cold and catalysed state. We investigate two scenarios: two-flavor color superconducting quark matter [1] and three-flavor absolutely stable quark matter [2]. In particular, an equation of state is provided in both cases which is then implemented in a neutrino diffusion code for the numerical simulation of the first tens of seconds of the evolution of the protoneutron star. Hydrodynamical simulations of the burning of nuclear matter into quark matter will be also presented [2]. In both scenarios, the formation of the quark phase is accompanied by a huge amount of released energy which is then transported out of the star by neutrinos. We finally discuss possible astrophysical consequences of our scenarios in connection with the observed “double” gamma-ray-bursts [3,4].

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