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Light and heavy clusters in warm stellar matter

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At densities below the nuclear saturation density and not too high temperatures (T<20 MeV), core-collapse supernova matter is unstable with respect to density fluctuations such that inhomogeneous structures develop and clusters can appear. Light (deuterons, tritons, helions, α-particles), and heavy (pasta phases) nuclei can be expected. Their appearance can modify the neutrino transport, which will have consequences in the dynamical evolution of supernovae and the cooling of proto-neutron stars. In this talk, light and heavy clusters are calculated for warm stellar matter in the framework of relativistic mean-field models, in the single-nucleus approximation. The clusters abundances are determined from the minimization of the free energy. In-medium effects of light cluster properties are included by introducing an explicit binding energy shift analytically calculated in the Thomas-Fermi approximation, and the coupling constants are fixed by imposing that the virial limit at low density is recovered. The resulting light cluster abundances come out to be in reasonable agreement with constraints at higher density coming from heavy ion collision data. Some comparisons with microscopic calculations are also shown.

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