Thermodynamic instabilities in compact stars

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We investigate the possible thermodynamic instability in a warm and dense nuclear medium where a phase transition from nucleonic matter to resonance-dominated Δ-matter can take place. Such a phase transition is characterized by both mechanical instability (fluctuations on the baryon density) and by chemical-diffusive instability (fluctuations on the isospin concentration) in asymmetric nuclear matter [1]. Similarly to the liquid-gas phase transition, the nucleonic and the Δ-matter phase have a different isospin density in the mixed phase. In the liquid-gas phase transition, the process of producing a larger neutron excess in the gas phase is referred to as isospin fractionation. A similar effects can occur in the nucleon-Δ matter phase transition due essentially to a Δ^- excess in the Δ-matter phase in asymmetric nuclear matter [2]. In this context we also discuss the relevance of Δ-isobar and hyperon degrees of freedom in the bulk properties of the cold neutron stars and in the protoneutron stars at fixed entropy per baryon, in the presence and in the absence of trapped neutrinos.

References

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[2] A. Drago, A. Lavagno, B.D. Metzger, G. Pagliara, Phys. Rev. D **93** (2016) 103001.