An Equation of State for sub-saturation matter of Core Colla pse Supernovæ, proto-Neutron Stars and Neutron Stars

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Abstract

At the end of their life, very massive stars can explode as a Core Collapse Supernova. Then it remains a hot and dense self-gravitating object called proto-Neutron Star that evolves into a cold Neutron Star. Theory currently fails to explain the observed macroscopic properties of Neutron Stars such as their maximal mass. Moreover, the processes that are implied are not sufficiently understood to correctly simulate the dynamics of the Core Collapse Supernova. In order to improve these models, one needs the microscopic behavior of the matter composing the star, which determines the Equation of State. Fully realistic equations of state are not available yet. Indeed, most current simulations are using simplistic Equations of State employing obsolete effective interactions and where sub-saturation matter is described within the single nucleus approximation [1, 2]. EoS models considering the complete nuclei distribution at finite temperature start to be employed [3] but these models employ phenomenological in-vacuum cluster energy functionals and the interaction between the nuclei and the medium is completely neglected. In this presentation, we introduce the general context of Compact Stars, then we discuss the models that are employed for explaining their microscopic composition, and the expected theoretical improvements. These latter essentially concern the development of a realistic equation of state for stellar matter at finite temperature. A special focus is given on the energetic modifications induced by the interaction between the cluster and the medium. Collaboration: F. Gulminelli (LPC, Thesis Supervisor), A. Raduta (NIPNE, Romania), J. Margueron and P. Papakonstantinou (IPNO and IPNL, France)

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