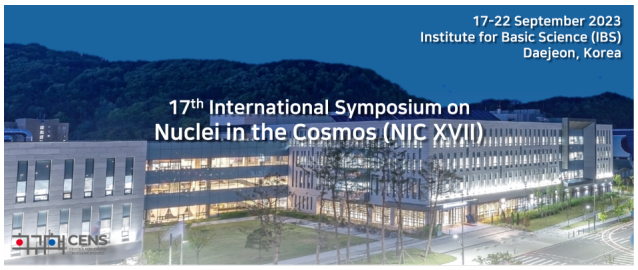

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Supernova equation of state and neutrino-nucleon reaction rates based on bare nuclear forces

Thursday, 21 September 2023 11:45 (15 minutes)

The equation of state (EOS) for dense matter is one of the crucial ingredients in numerical simulations for astrophysical phenomena, such as core-collapse supernovae, cooling of nascent proto-neutron stars, and binary neutron star mergers. While considerable efforts have been devoted to understanding the dense-matter EOS from terrestrial experiments, astrophysical observations, and theoretical calculations, the nuclear EOS still remains rather uncertain. In particular, since the properties of dense nuclear matter appearing in those simulations are governed by the repulsion of nuclear forces, it should be described with a nuclear Hamiltonian composed of realistic nuclear potentials. In the above situation, we have recently constructed a new nuclear EOS based on the variational many-body theory with realistic nuclear forces (AV18 + UIX) [1], and the resultant EOS table is available on the Web [2] for the use in various astrophysical simulations.
In this presentation, we will discuss the properties of our nuclear EOS and its applications to core-collapse simulations starting from several progenitor models to investigate the EOS effects on the mechanism of successful and failed core-collapse supernova explosions. Furthermore, we will report on the newly obtained neutrino-nucleon reaction rates in supernova matter with the consistent variational method, which is an extension of the present EOS.

[1] H. Togashi, K. Nakazato, Y. Takehara, S. Yamamuro, H. Suzuki, and M. Takano, Nucl. Phys. A 961 (2017) 78.
[2] http://www.np.phys.waseda.ac.jp/EOS/

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