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Variational study of the supernova equation of state with realistic nuclear forces HAJIME TOGASHI, RIKEN, YUTA TAKEHARA, SACHIKO YAMAMURO, KEN'ICHIRO NAKAZATO, HIDEYUKI SUZUKI, Tokyo University of Science, KOHSUKE SUMIYOSHI, Numazu College of Technology, MASATOSHI TAKANO, Waseda University — We construct a new nuclear equation of state (EOS) for numerical simulations of core-collapse supernovae (SNe) with the realistic nuclear forces. For this purpose, we first constructed the EOS for uniform matter based on the Argonne v18 two-body potential and the Urbana IX three-body potential with the cluster variational method. The obtained free energies agree well with those by the more sophisticated Fermi Hypernetted Chain variational method. The symmetry energy of our EOS is smaller than that of the Shen EOS, and masses and radii of neutron stars with the present EOS are consistent with the observational data. In order to complete the SN-EOS, we are constructing an EOS for non-uniform matter in the Thomas-Fermi approximation. The thermodynamic quantities obtained so far are quite reasonable, and the phase diagrams of nuclear matter are similar to those of the Shen EOS. To our knowledge, this is the first SN-EOS based on the bare nuclear forces. In this talk, we systematically compare the thermodynamic quantities of the present EOS with those of the Shen EOS. Furthermore, as the first step of the application to SN simulations, we will examine the properties of central core from the collapse of a progenitor with our EOS.

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