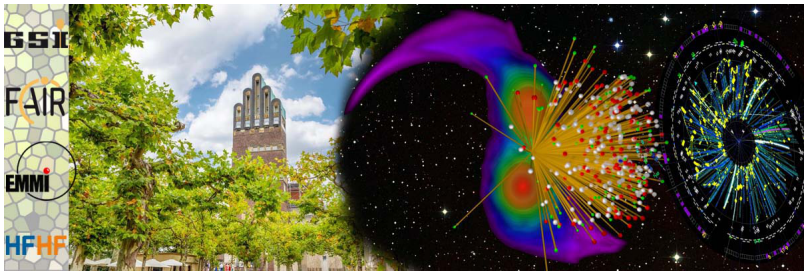

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New Equation of State for Supernova and Binary Neutron Star Merger Simulations

Wednesday, 20 September 2023 10:16 (3 minutes)

Recently, we constructed a new equation of state (EoS) table including the Bose-Einstein condensate of negatively charged kaons for core collapse supernova and binary neutron star merger simulations. The nuclear statistical equilibrium model including excluded volume effects was used to describe the matter below the saturation density whereas the uniform matter composed of neutrons, protons, electrons and K^- condensate at higher densities was treated in the relativistic hadron field theory with density dependent couplings. The equation of state table was generated for a wide range of density (10^{-12} to ~ 1 fm^{-3}), positive charge fraction (0.01 to 0.60) and temperature (0.1 to 158.48 MeV). As soon as the threshold condition of the Bose-Einstein condensate was reached, electrons were replaced by the negatively charged kaons in the condensate. The impact of antikaon condensate was investigated on different thermodynamic quantities. The charge neutral and beta-equilibrated matter with the condensate made the EoS softer compared to that without the condensate resulting in the reduction of the maximum neutron star mass but it was above the 2 solar mass benchmark. This softening in the EoS might be attributed to the equal number of neutrons and protons after the appearance of the condensate. This implies zero symmetry energy contribution in the EoS. It would be worth investigating the impacts of the antikaon condensate on the evolution of core collapse supernovae and binary neutron star mergers particularly on the ejected matter and nucleosynthesis in binary neutron mergers.

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