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A Density Functional Equation of State for Supernova Simulations with 3-body forces and Quark Gluon Plasma[1] GRANT J. MATHEWS, MATTHEW MEIXNER, J. POCAHONTAS OLSON, UND, NGUYEN Q. LAN, HNUE, HOLISTER E. DALHED, LLNL — We present an updated and improved equation of state (which we call the NDL EoS) for use in neutron-star structure and core-collapse supernova simulations. This EoS is begins with a framework originally developed by Bowers & Wilson, but there are numerous changes. Among them are: (1) a reformulation in the context of density functional theory; (2) the possibility of the formation of material with a net proton excess ($Y_e > 0.5$); (3) an improved treatment of the nuclear statistical equilibrium and the transition to heavy nuclei as the density approaches nuclear matter density; (4) an improved treatment of the effects of pions in the regime above nuclear matter density including the incorporation of all the known mesonic and baryonic states at high temperature; (5) the effects of 3-body nuclear forces at high densities; and (6) the possibility of a first-order or crossover transition to a QCD chiral symmetry restoration and deconfinement phase at densities above nuclear matter density. This paper details the physics of, and constraints on, this new EoS and describes its implementation in numerical simulations. We show comparisons of this EoS with other equations of state commonly used in supernova collapse simulations.

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