Astrophysics Seminar

A NEW EQUATION OF STATE FOR CORE COLLAPSE SUPERNOVA AND NEUTRON STARS

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To describe compact matter--be it in dense nuclear matter, supernovae or neutron stars--an equation of state (EoS) is needed to relate the physics of the state variables. The EoS determines whether the SN remnant ends as a neutron star or black hole. In a neutron star, it determines the mass-radius relationship, composition, cool-down time and impacts the dynamics of neutron star mergers. Today, only a few hadronic EoSs are available which cover large enough density, temperature, and electron fraction ranges to be succient for use in core-collapse supernovae simulations. These EoSs are usually in the form of a multi-dimensional table with three independent variables (i.e. , density, temperature, and Ye). The two most commonly used in astrophysical simulations are the Lattimer & Swesty (LS91) and the H. Shen (Shen98). Over the last several years much progress has been made on the supernova EoS. Recent neutron star observations constraining the maximum mass have been made as well as restricting the mass-radius relationship. A rst order phase transition to a Quark Gluon Plasma has been explored as well as its impact on the supernova explosion mechanism. Based upon newest constraints we have developed a new Notre Dame Livermore (NDL) EoS for both supernova and neutron star simulations. In this talk I will highlight this work by contrasting it with the existing EoS tables of Shen and Lattimer & Swesty.

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