NUCLEAR EQUATION OF STATE EFFECTS IN STELLAR COLLAPSE: NUCLEOSYNTHESIS

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Understanding the characteristics of dense nuclear matter has remained a significant question in nuclear physics today. A phenomenological model is proposed in which the enrichment of light r-process elements (relative to heavy r-process elements) in metal-poor and extremely-metal-poor stars (EMPs) is found to depend on the stiffness of the nuclear equation of state (EOS). Here, an r-process is assumed in which an explosion scenario is halted due to an accretion-induced collapse and a subsequent failed or partial explosion, followed by partial ejection of r-process material. Nucleosynthsis results in an abundance distribution enriched in the light r-process elements. Initial results suggest that a possible upper limit on the stiffness of the EOS may be constrained by observations, which could complement results of neutron star masses which place lower limits on the EOS stiffness. Additional work is being done to examine neutrino spectra in collapse scenarios and their sensitivity to the EOS. Comparison is made to high-resolution spectroscopic measurements of the logarithmic ratios [Sr/Ba] and [Sr/Fe] for EMPs. The proposed model is not only capable of producing extremes in [Sr/Ba] and [Sr/Eu] at very low metallicity, but it is shown to relate the nuclear equation of state (EOS) to the observed upper limits in [Sr/Ba] and [Sr/Eu]. A softer EOS suggests an enhancement of light r-process elements in the early galaxy. The interplay between the nuclear matter EOS, spectral observations, and neutrino effects will be discussed.