Impact of the equation of state in core-collapse supernovae

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Neutron stars originate in core-collapse supernovae, which are one of the most energetic events in the universe. In core-collapse supernova simulations, the equation of state is a key ingredient. However, matter at high densities is only poorly constrained and the nuclear equation of state is still not fully understood. Equations of state that are available for supernova simulations differ considerably in their underlying theory as well as nuclear physics input. We investigate the impact of different nuclear matter properties on the equation of state in core-collapse supernovae. To this end, we introduce a range of equations of state based on the Lattimer and Swesty equation of state that vary the nucleon effective mass, incompressibility, symmetry energy, and nuclear saturation point. Larger effective masses lead to lower pressures at nuclear densities and a lower thermal index. This has an important impact on the proto-neutron star contraction and shock evolution.

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