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Hot and Dense Neutron-Rich Matter in Supernovae and Neutron Star Mergers[1]

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The equation of state, transport and linear response properties of hot and dense neutron-rich matter created in core-collapse supernovae and neutron star mergers directly affect the observable electromagnetic, neutrino, and gravitational wave signals as well as the possibility for r-process nucleosynthesis in the ejected matter. In this talk I will describe recent progress in constructing a thermodynamic equation of state of nuclear matter based on the low-energy realization of QCD, chiral effective field theory, which incorporates realistic microphysics such as multi-pion exchange processes and three-body forces. Bulk properties of zero-temperature symmetric nuclear matter around saturation density are shown to be well described without additional fine tuning, as are selected thermodynamic observables. Constraints from microscopic many-body theory on farther-reaching phenomenological mean field models are explored, and first efforts toward the description of consistent neutrino response in neutron-rich matter from chiral effective field theory is presented.

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