Contribution ID: **45** Type: **Poster**

Nucleosynthesis and Kilonova in Neutron Star Mergers: Impact of Nuclear Matter Properties

Monday 16 September 2024 20:15 (20 minutes)

Matter expelled from binary neutron star (BNS) mergers can harbor r-process nucleosynthesis and power a Kilonova (KN). Both the elemental yields and the KN transient are intimately related to the astrophysical conditions of the merger ejecta, which in turn indirectly depend on the equation of state (EOS) describing the nuclear matter inside the NS. In particular, the merger evolution is influenced by the nuclear matter properties that characterize the EOS around and above nuclear saturation density.

We consider the outcome of a set of BNS merger simulations employing different finite-temperature nuclear EOSs, obtained from Skyrme-type interaction models. We study the ejecta using a nuclear reaction network coupled with a semi-analytic KN model.

The final elemental abundances and the associated KN light curves are found to be non-trivially influenced by the nuclear matter properties used to parametrize the EOS, specifically the incompressibility and the nucleon effective mass at saturation density. A major role is played by the overall amount of each ejecta component, highlighting the strong degeneracy that intervenes between the merger outcome and the behaviour of the intrinsic nuclear matter.

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Session Classification: Poster Session