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Equation of State in the era of new nuclear physics and multimessenger constraints

Over the past decade, a widely rich variety of data pouring in from laboratory experiments as well as astrophysical observations, including the detection of gravitational waves from binary neutron star mergers and the observations of a subsequent electromagnetic signal have raised new challenges in modelling equation of state of dense matter, and in physics in general. In this contribution, I will start with an overview of different types of equation of state modelling in the Bayesian formalism, to demonstrate the impact of different experimental and observational constraints. Further, I will present equations of state at finite temperature obtained with Brussels-Skyrme-on-a-Grid (BSkG) energy density functionals developed at Brussels, which are unified across the crust and core of the neutron star environment. These models have demonstrated remarkable accuracy over the whole nuclear chart on the masses, and fission barriers of nuclei, but at the same time they also satisfy recent astrophysical constraints. I will outline the impact of our calculations at finite temperatures on the composition of the crust in the neutron stars. Our immediate future goal is to apply these equations of state in the simulation of binary neutron star mergers.

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