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Unraveling the global behavior of equation of state by explicit finite nuclei constraints

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We obtain posterior distribution of equations of state (EOSs) across a broad range of density by imposing explicitly the constraints from precisely measured fundamental properties of finite nuclei, in combination with experimental data from heavy-ion collisions and astrophysical observations of radius, tidal deformability and minimum-maximum mass of neutron stars. The acquired EOSs exhibit a distinct behavior compared to those usually obtained by imposing the finite nuclei constraints implicitly through empirical values of selected key parameters describing symmetric nuclear matter and symmetry energy in the vicinity of saturation densities. The explicit treatment of finite nuclei constraints yields softer EOSs at low densities which eventually become stiffer to meet the maximum mass criteria. The radius measurements derived from NICER and HESS J1731-347 exhibit favorable agreement with the posterior distribution of radius determined through our explicitly constrained EOSs. The Kullback-Leibler divergence has been used to perform a quantitative comparison of the distributions of the EOSs resulting from implicit and explicit finite nuclei constraints.

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