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Exploring Composition of Neutron Star Matter with Astrophysical Observations

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In this work, we perform a Bayesian analysis putting together the available knowledge from the nuclear physics experiments and astrophysical observations to explore the equation of state of supranuclear matter. In particular, we employ a relativistic metamodeling technique to nuclear matter to cover the uncertainties in the parameter space of the saturation properties of nuclear matter, both in the isoscalar and isovector sectors. Then, we investigate if it is possible to reconcile the inferred values of those quantities from observational data with the values obtained from nuclear experiments and compute a joint posterior of these quantities incorporating all the available knowledge. We further probe the fractions of different particle species that the interior of a neutron star may contain, particularly the proton fraction in the core and the consequences of the allowed compositions within our metamodel. We also incorporate the possible emergence of hyperons in the system and the number of ways that the nucleonic metamodel can accommodate hyperons in the neutron star matter. Finally, we calculate the strangeness content in the star and discuss its observational implications.

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