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Bayesian analysis of nontrivial features in the speed of sound inside neutron stars in light of astrophysical and pQCD constraints

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Functional forms of the neutron star Equation of State (EoS) are required to extract the viable EoS band from neutron star observations. Realistic nuclear EoSs, containing deconfined quarks or hyperons, present nontrivial features in the speed of sound such as bumps, kinks, and plateaus. Using modified Gaussian processes to model EoSs with nontrivial features, we show in a fully Bayesian analysis incorporating measurements from X-ray sources, gravitational wave observations, and perturbative QCD results that these features are compatible with current constraints. We find nontrivial behavior in the EoS plays a role in understanding the possible phase structure of neutron stars at densities around 2 $n_{\rm sat}$ [1]. Lastly, we perform a large-scale systematic analysis of the impact of perturbative QCD constraints when they are applied beyond the maximal central densities realized in realistic neutron star EoSs.

[1] D. Mroczek et al, arXiv:2302.07978

Category

Theory

Collaboration (if applicable)

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