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# Constraining Palatini gravity with GR-independent equations of state for neutron stars

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# Abstract

We demonstrate how to construct GR-independent equations of state for a neutron star from the information available in the literature. We emphasize the importance of using theory-based principles instead of relying solely on astrophysical observables and General Relativity. We propose a set of equations of state based on first microscopic principles, including chiral perturbation theory and perturbation theory in quantum chromodynamics. Interpolation methods are employed with assumptions on the thermodynamic stability and causality in the intermediate region. These equations of state are then used to constrain quadratic Palatini $f(mathcal R)$ gravity, indicating that its free parameter can at most lie within the range around $-6.47 lesssim beta lesssim 1.99$ km$^2$. Additionally, we briefly discuss the problem of phase transitions and twin stars.

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