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New modelling for hybrid stars with an elastic quark core

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Current anisotropic star models often overlook the effects of shear modulus and phase transitions. In our study, we propose a new anisotropic model for hybrid stars with an elastic quark matter core and a fluid nuclear matter envelope with a sharp phase transition in between. We incorporate the effects of shear deformation characterized by the shear modulus into the structural equations of anisotropic stars by extending the framework established by Karlovini and Samuelsson (2003). Using this approach, we calculate the anisotropic parameter, , numerically to analyze the impact on the mass-radius relation and the internal structure of hybrid stars. Additionally, we develop a new analytical model for anisotropy, as other phenomenological models cannot describe the internal structure well. The accuracy of our new model is lower than 10%, indicating that the provided analytical form of σ_0 is valid across a broad parameter space.

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