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Stiffness, complexity, cracking and stability of relativistic compacts stars

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Current multi-messenger approach has made it possible to get a much more precise estimation of stellar observables like mass M and radius R of a neutron star which consequently can help us constrain the neutron star equation of state (EOS) like never before. Theoretical stellar models are being refined accordingly. Using Chandrasekhar's variational method, we examine the dynamical stability of a recently proposed modified Tolman VII solution that can accommodate a more realistic neutron star EOS consistent with observational data. We note that the critical value of compactness (M/R) at which instability develops within the configuration decreases with the stiffness increase of the assumed EOS. The critical bound remains below the Buchdahl bound throughout. We further invoke the concepts of 'cracking' and 'complexity' in the stability analysis of an anisotropic stellar configuration. We show that for a static, spherically symmetric, anisotropic distribution of matter with radially decreasing energy density possessing zero 'complexity', the tangential pressure must be greater than the radial pressure at all interior points of a potentially stable stellar configuration.

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