SCALAR PERTURBATIONS OF GRAVASTAR MODEL IN THE PRESENCE OF GLOBAL MONOPOLE

Abstract:

This study presents a comprehensive theoretical and phenomenological investigation of gravastars threaded by a global monopole within the framework of teleparallel f(T) gravity. The model unites two intriguing ingredients a topological global monopole and a dark energy driven interior capped by a thin shell governed by a stiff-matter equation of state. Employing the Israel junction conditions, the dynamics of the shell are analyzed and a sufficient condition for its stability is established. Moving from structure to observation, the optical signatures of the configuration are characterized through complementary approaches: the deflection angle is obtained via both the Gauss–Bonnet topological method and the analytical Hamilton–Jacobi formalism, while the equatorial shadow is reconstructed using ray-tracing techniques. By casting the null-geodesic equations as an initial-value problem and integrating them numerically, photon trajectories are traced, the surrounding photon sphere is revealed, and the full 3D shadow is constructed incorporating observer inclination and relativistic effects to forge a direct link with high-resolution interferometric imaging. Finally, the dynamical stability of the gravastar is probed through scalar-field perturbations, with quasinormal modes computed using the third-order WKB approximation. The effective potential exhibits a single peak with asymptotic decay the hallmark of a stable configuration and the consistently negative imaginary frequencies across a range of monopole parameters η confirm stability. Crucially, the predicted ring-down overtones fall within the detection windows of LISA and the Einstein Telescope, establishing a concrete phenomenological bridge between the model and the next generation of gravitational-wave observations.