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(U*) (POS-26) Gravitational Stability of Black Hole Mimickers

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The classical black hole is one of the most extreme and scientifically rich products of classical general relativity. However, it has predictions which still leave some uncomfortable; these primarily being the nature of the event horizon and the mass singularity. This has led to the development of alternative black hole 'mimicking'models which correct for these singularities and retain the observed properties of black holes without requiring modifications to general relativity.
One of these mimickers is the 'gravastar'; a dense spherical mass distribution constructed of a cold gravitational condensate, colloquially called dark matter, inside a thin perfect-fluid shell. The density of the gravastar varies and the sizes for which it exhibits black hole properties are unknown. It has also been shown that such a stellar configuration can exist in thermodynamic equilibrium while correcting the information paradox. However, to replace the classical black hole as the end-product of gravitational collapse, as is currently accepted, an analysis of its dynamical stability is required. By perturbing the shell from gravitational equilibrium –as also occurs during mass accretion, binary coalescence, and other black hole events –its dynamical stability can be discussed. If such a body could reach harmonic behaviour around equilibrium without collapsing to a classical black hole, or alternatively leading to stellar explosion, then it would suitably describe black hole behaviour while correcting for their singularities.
In this work we sought exactly this. By thoroughly investigating the equations of motion of the thin shell, we determined the mass sequences for which a stable gravastar can exist as well as their dynamical stability to a first order perturbation theory. We found that although such a configuration does indeed have black hole mimicking equilibrium forms, they are dynamically unstable and thus not expected to exist in nature.

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