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On the stability of rotating spherical fluid shells

ABSTRACT:

Spherical energy shells in General Relativity tend to collapse due to gravitational effects and/or due to tension effects. Shell stabilization may be achieved by modifying the gravitational properties of the background spacetime. Thus, gravastars consist of stiff matter shells with an interior de Sitter space with repulsive gravitational properties and an exterior Schwarzschild spacetime which balances the interior repulsive gravity leading to a stable stiff matter shell. Similar stabilization effects may be achieved by considering rotation shells. Here we study the stability of slowly rotating fluid shells. We show that the angular velocity of the shell has stabilizing properties analogous to the repulsive de Sitter gravity of the interior of a gravastar. We thus use the Israel junction conditions and the fluid equation of state of the rotating shell to construct the dynamical equations that determine the evolution of the rotating shell radius. These dynamical equations depend on the parameters of the background spacetime and on the angular velocity of the shell. Assuming a rotating interior and a Schwarzschild exterior spacetime we show that the angular velocity of the shell has interesting stabilizing properties on the evolution of its radius R. Thus rotating matter (or vacuum) shells can imitate black holes while avoiding the presence of a singularity and without the presence of an interior de Sitter space.

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