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Collapse of Axion Stars

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Abstract

Axion stars, gravitationally bound states of low-energy axions, described by a field theory with potential energy $f^2m^2(1 - Cos(A/f))$ have
a maximum mass allowed by gravitational stability. Weakly bound states obtaining this maximum mass have sufficiently large radii such that they are dilute, and as a result, they are well described by a leading-order expansion of the axion potential. Heavier states are susceptible to gravitational collapse. Inclusion of higher-order interactions, present in the full potential, can give qualitatively different results in the analysis of collapsing heavy states, as compared to the leading-order expansion. In this work, we find that collapsing axion stars are stabilized by repulsive interactions present in the full potential, providing evidence that such objects do not form black holes. These dense configurations, which are the endpoints of collapse, have extremely high binding energy, and as a result, quickly decay through number changing interactions.

Summary

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