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Dense Axion Stars

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If the dark matter particles are axions, gravity can cause them to coalesce into axion stars, which are stable gravitationally bound systems of axions.

In the previously known solutions for axion stars, gravity and the attractive force between pairs of axions are balanced by the kinetic pressure.

The mass of these dilute axion stars cannot exceed a critical mass, which is about $10^{-14} M_{\odot}$ if the axion mass is 10^{-4}eV .

We study axion stars using a simple approximation to the effective potential of the nonrelativistic effective field theory for axions.

We find a new branch of dense axion stars in which gravity is balanced by the mean-field pressure of the axion Bose-Einstein condensate.

The mass on this branch ranges from about $10^{-20} M_{\odot}$ to about M_{\odot} .

If a dilute axion star with the critical mass accretes additional axions and collapses, it could produce a bosonova, leaving a dense axion star as the remnant.

Summary

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