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Dense Axion Stars ABHISHEK MOHAPATRA, ERIC BRAATEN, HONG ZHANG, Ohio State University — If the dark matter consists of axions, gravity can cause them to coalesce into axion stars, which are stable gravitationally bound Bose-Einstein condensates of axions. In the previously known axion stars, gravity and the attractive force between pairs of axions are balanced by the kinetic pressure. If the axion mass energy is $mc^2 = 10^{-4}$ eV, these dilute axion stars have a maximum mass of about $10^{-14} M_\odot$. We point out that there are also dense axion stars in which gravity is balanced by the mean-field pressure of the axion condensate. We study axion stars using the leading term in a systematically improvable approximation to the effective potential of the nonrelativistic effective field theory for axions. Using the Thomas-Fermi approximation in which the kinetic pressure is neglected, we find a sequence of new branches of axion stars in which gravity is balanced by the mean-field interaction energy of the axion condensate. If $mc^2 = 10^{-4}4$ eV, the first branch of these dense axion stars has mass ranging from about $10^{-11} M_\odot$ toabout $M_\odot$.

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