Probing Axion/Boson Stars with Optomechanical Sensing[1]
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The focus of dark matter research has shifted to "ultralight" (sub-MeV) candidates in recent years due to the inability of other experiments to detect heavier particles. One proposed method of increasing detection reach is to use optomechanical force sensing. In this project, we consider whether optomechanical force sensing could be used to search for axion-like particles (ALPs) in gravitationally bound boson stars in the Milky Way. We consider two scenarios for boson stars: a star centered around the sun and a star virialized to the galaxy. We model these boson stars using a variational ansatz and determine the density of each at the earth and the approximate collision rate. To determine the force an ALP would exert on this sensor, we assume ALPs couple to the standard model via a Yukawa coupling to neutrons. Considering constraints on coupling strength from BBN allows us to place an upper limit on the force we could hope to observe. We search the available parameter space and conclude that current optomechanical force sensing technologies could be used to look for ALPs in boson stars.

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