

Probing the Early Universe with Axion Physics

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Axions and axion-like particles are excellent dark matter candidates, spanning a vast range of mass scales from the milli- and micro-eV for the QCD axion, to 10^{-22} eV for ultralight axions, to even lighter candidates that make up the “axiverse”. In some scenarios, inhomogeneities in the axion density lead to the formation of compact structures known as axion “miniclusters” and axion stars. Topological defects in the early universe might also contribute the energy density of axions and generate primordial gravitational waves that can possibly be detected in future experiments. I will first discuss astrophysical and cosmological constraints on axions at either end of this spectrum, using data from the cosmic microwave background anisotropies and the effects of miniclusters on the gravitational microlensing and on direct detection. I will then assess the formation and the evolution of axion stars in various astrophysical regimes.

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