Axion hot dark matter bound, reliably

Friday, 17 February 2023 12:30 (20 minutes)

Axions originally emerged as low-energy remnants of the Peccei-Quinn solution to the strong CP problem. They also unavoidably contribute to the energy density of the Universe, quantified via the effective number of relativistic degrees of freedom (AXXXX), which is constrained by cosmic microwave background experiments. In the talk, I will discuss the main axion-thermalization channel in the early universe at temperatures below that of the QCD phase transition, namely the axion-pion scattering, within the 2-flavor chiral perturbation theory (ChPT). Based on the leading order (LO) ChPT, the bound on the axion mass from AXXXX is found to be approximately below the eV scale. However, considering the impact of NLO corrections, I will show that the perturbative chiral expansion breaks down for temperatures above 70 MeV, making the LO analysis not reliable. I will also discuss how to extend the EFT validity via unitarization techniques up to the deconfinement temperature, providing a reliable determination of the relic density of thermal axions decoupling after the QCD phase transition.

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