



Contribution ID: 116

Type: parallel talk

High-Scale Axions without Isocurvature from Inflationary Dynamics

Monday 9 May 2016 14:45 (15 minutes)

Observable primordial tensor modes in the cosmic microwave background (CMB) would point to a high scale of inflation H_I . If the scale of Peccei-Quinn (PQ) breaking f_a is greater than $\frac{H_I}{2\pi}$, CMB constraints on isocurvature naively rule out QCD axion dark matter. This assumes the potential of the axion is unmodified during inflation. We revisit models where inflationary dynamics modify the axion potential and discuss how isocurvature bounds can be relaxed. We find that models that rely solely on a larger PQ-breaking scale during inflation require late-time dilution of the axion abundance. Even then, f_a must be below the grand unification scale. Models that have enhanced explicit breaking of the PQ symmetry during inflation may allow f_a close to the Planck scale. Avoiding disruption of inflationary dynamics provides important limits on the parameter space.

Summary

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Session Classification: Cosmology & Astroparticle