

第 36 回 素粒子・宇宙セミナー

日時: 2026 年 7 月 9 日 (木) 16:00 ~ 17:30

場所: 教育学部 E215B (物理セミナー室)

講演者

飛岡幸作 (フロリダ大学 准教授)

題目

Big Bang Nucleosynthesis: Advances in Hadronic Injection and New Bounds on Heavy QCD Axions

概要

Big Bang Nucleosynthesis (BBN) provides a powerful probe of hadronic injection from new physics that modifies the neutron-to-proton ratio, thanks to the precisely measured primordial helium-4 abundance. In this talk, I apply this probe to long-lived particles, specifically heavy QCD axions which are well-motivated candidates that can address the strong CP problem and predominantly decay into hadrons. We compute the axion-induced modification of the neutron-to-proton ratio and derive robust upper bounds on the axion lifetime, as short as 0.017 seconds, well before 1 second, the onset of BBN.

While motivated by the axion study, we also make several significant and broadly applicable advances in the treatment of hadronic injection during BBN. These include new or updated hadronic cross sections, scattering processes involving energetic neutral kaons (KL), and the effects of secondary hadrons. Neglecting these effects can lead to significant misestimates of the primordial helium-4 abundance. In addition, we derive a semi-analytic solution that allows us to estimate theoretical uncertainties and demonstrate the robustness of our bounds.

