



Contribution ID: 57

Type: Poster

Precision Deuterium in Big Bang Nucleosynthesis: the Critical Role of Nuclear Reactions

Tuesday, 6 September 2022 19:34 (2 minutes)

Big Bang Nucleosynthesis (BBN) accounts for the cosmic origin of the lightest elements, and deuterium (D/H) plays a key role in probing the physics of the early universe. The simplicity of BBN theory allows for few-percent-level precision of D/H prediction, which is not normally possible in nuclear astrophysics. Under such precision, the comparison between predicted and observed primordial D/H not only provides a crucial test of the standard cosmology but also hints at new physics. The push to further improve this precision brings its own challenges and rewards: sharpening the power of BBN constraints on new physics.

The nuclear uncertainties of deuterium destruction reactions now block our way to a better D/H prediction. The reactions $d(p, \gamma)^3\text{He}$, $d(d, n)^3\text{He}$, and $d(d, p)t$ are known to dominate the D/H theory error budget. Recent cross section measurements from LUNA significantly reduced the uncertainty of $d(p, \gamma)^3\text{He}$, and the state-of-the-art D/H theory error is $\sim 3\%$. However, this excellent theory uncertainty still falls behind the observed counterpart; precision measurements of the primordial D/H from high redshift quasar absorption systems in the past several years have contributed to an impressive $\sim 1\%$ error. The future improvement of D/H prediction relies on new precision measurements of $d(d, n)^3\text{He}$ and $d(d, p)t$ at BBN energies. Moreover, *ab initio* theory cross section for $d(p, \gamma)^3\text{He}$ mismatches the precise LUNA data while agreeing with other datasets outside the BBN range. Additional theory study for $d(p, \gamma)^3\text{He}$ cross section is also needed to understand such a puzzling discrepancy.

Primary author: YEH, Tsung-Han (University of Illinois Urbana-Champaign)

Presenter: YEH, Tsung-Han (University of Illinois Urbana-Champaign)

Session Classification: Poster session