Can a Varying Higgs VEV Solve the Cosmic Lithium Problem?

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Abstract

The discrepancy between the observationally inferred primordial ^{7}Li abundance and the theoretical prediction of Standard Big Bang Nucleosynthesis (SBBN) remains one of the longstanding unsolved problems in modern cosmology. In addition, recent spectroscopic observations of metal-poor extra-galactic systems have reported a lower primordial 4He abundance than previously reported from observations of metal-poor field stars in the Milky Way. This new 4He abundance constraint appears to be inconsistent with the standard model of elementary particles and fields, which describes the breaking of lepton and baryon symmetries in the early Universe.

We have recently proposed [1] that a time-varying Higgs field may provide a unified resolution to these discrepancies involving the primordial abundances of ^{7}Li and ^{4}He. Elementary particles and nuclei acquire their masses through their coupling to the Higgs field. Consequently, the Higgs vacuum expectation value (VEV) determines the Fermi constant as well as the electron and quark masses. Any deviation of the Higgs VEV from its present-day value in the early Universe would modify electroweak and strong interactions, thereby affecting proton–neutron conversion rates and many thermonuclear reaction rates that play the critical roles in BBN of the light elements.

In this talk, we present a detailed analysis of these effects on BBN and investigate whether concordance can be achieved among the observed primordial abundances of the light elements D, ^{4}He, and ^{7}Li, cosmological constraints from cosmic microwave background (CMB) fluctuations and anisotropies, and the underlying framework of particle physics.

[1] H. Feng, Y. Luo, T. Kajino, B. Sun, and T. Shima;
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