

Non-extensive statistics solution to the cosmological lithium problem

Tuesday, 27 June 2017 11:50 (20 minutes)

Big Bang nucleosynthesis (BBN) theory predicts the abundances of the light elements D, ^3He , ^4He and ^7Li produced in the early universe. The primordial abundances of D and ^4He inferred from observational data are in good agreement with predictions, however, the BBN theory overestimates the primordial ^7Li abundance by about a factor of three. This is the so-called 'cosmological lithium problem'. Solutions to this problem using conventional

astrophysics and nuclear physics have not been successful over the past few decades, probably indicating the presence of new physics during the era of BBN. We have investigated the impact on BBN predictions of adopting a generalized distribution to describe the velocities of nucleons in the framework of Tsallis non-extensive statistics. This generalized velocity distribution is characterized by a parameter q , and reduces to the usually assumed Maxwell-Boltzmann distribution for $q = 1$. We find excellent agreement between predicted and observed primordial abundances of D, ^4He and ^7Li for $1.069 \leq q \leq 1.082$, suggesting a new solution to the cosmological lithium problem. We encourage studies to examine sources for departures from classical thermodynamics during the BBN era so as to assess the viability of this mechanism. Furthermore, the implications of non-extensive statistics in

other astrophysical environments should be explored as this may offer new insight into stellar nucleosynthesis.

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Session Classification: Session 2 (Chair: K. I. Hahn)