Sensitivity of reaction rates in primordial nucleosynthesis to alternative statistics

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Abstract. This study investigates the sensitivity of reaction rates in primordial nucleosynthesis to the application of alternative statistics. We present calculations of reaction rates for leading and sub-leading processes in Big Bang Nucleosynthesis (BBN), by employing Tsallis [1], Kaniadakis [2], and Planck statistics. In current literature, photons are typically assumed to obey the Planck's law. However, alternative approaches have been proposed to address the lithium-7 problem. For instance, Jang et al. [3] apply Tsallis statistics to the photon distribution while retaining the standard Maxwell–Boltzmann (MB) statistics for particle-induced reactions. Conversely, Hou et al. [3] apply Tsallis statistics to the nucleon velocity distribution for particle-induced reactions, assuming the photons to obey the standard Planck law. In view of these two "opposite" scenarios that seemingly resolved the Lithium problem, this research aims to systematically investigate all combinations of alternative statistics for particle- and photon-induced processes in BBN.

References

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