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Hubble tension with an extra radiation and neutrino degeneracy

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The standard Lambda CDM cosmological model now seems to face some puzzles. One of the most serious problems is the so-called Hubble tension; the values of the Hubble constant obtained by local measurements look inconsistent with that inferred from CMB. Although introducing extra radiations $\Delta N_{\rm eff}$ such as hot axions or sterile neutrinos appears to be promising, such extra radiations increase the Helium mass fraction synthesized by Big Bang Nucleosynthesis (BBN). To cancel such an increment, positive electron neutrino asymmetry ξ_e may be also needed. By analysing the data from Planck, baryon acoustic oscillation (BAO), BBN and type-Ia supernovae, we evaluate the possibility of the non-zero lepton asymmetry and extra radiations.

Summary

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