BIG BANG NUCLEOSYNTHESIS AND LEPTON NUMBER ASYMMETRY IN THE UNIVERSE

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Recently it has been reported that there may be a discrepancy between big bang nucleosynthesis theory and observations (BBN crisis) (Hata *et al.*, 1995). One way to solve the discrepancy might be to adopt some modifications of standard physics used in SBBN (Kawasaki *et al.*, 1997). We show that BBN predictions agree with the primordial abundances of light elements, ^{4}He, D, ^{3}He and ^{7}Li inferred from the observational data if the electron neutrino has a net chemical potential ξ_{ν_e} due to lepton asymmetry (Kohri *et al.*, 1997). We study BBN with the effects of the neutrino degeneracy in details using Monte Carlo simulation and make a likelihood analysis using the most recent data. We estimate that $\xi_{\nu_e} = 0.043^{+0.040}_{-0.040}$(95% C.L.) and $\Omega_b h^2 = 0.015\ ^{+0.006}_{-0.003}$ (95% C.L.) adopting the presolar Deuterium abundance as the primordial values. If we adopted the low D abundance which is obtained by the observation of the high redshift QSO absorption systems, $\xi_{\nu_e} = 0.060^{+0.034}_{-0.042}$(95% C.L.) and $\Omega_b h^2 = 0.020\ ^{+0.006}_{-0.004}$. The estimated chemical potential of ν_e is about 10^{-5} eV which is much smaller than experiments can detect (~ 1 eV). In other words, BBN gives the most stringent constraint on the chemical potential of ν_e.

References

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