Big bang nucleosynthesis and dark matter

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In usual cosmology, an effect of cold dark matter (DM) on big bang nucleosynthesis (BBN) through the expansion rate of the universe is negligible. However, a possibility of cooling of background photon through an interaction with axion, which is a possible DM candidate, between the BBN and cosmological recombination was suggested recently [1,2]. In this case, the baryon to photon number ratio can be smaller in BBN epoch than standard BBN case. A theoretical prediction of primordial ^{7}Li abundance can then be rather consistent with observations of metal-poor old stars [3], although theoretical and observational deuterium abundances are different from each other. We stress that the observational constraint on (D+^{3}He)/H abundance ratio is broken if the possible photon cooling happens [4]. We then investigate a hybrid model with both axions and long-lived radiatively decaying particles. In this model we demonstrate that the ^{7}Li abundance can be consistent with observations without destroying the important concordance of deuterium abundance [4].

Reference

[1] O. Erken, P. Sikivie, H. Tam and Q. Yang, Phys. Rev. Lett. **108**, 061304 (2012).
[2] O. Erken, P. Sikivie, H. Tam and Q. Yang, Phys. Rev. D **85**, 063520 (2012).
[3] L. Sbordone, P. Bonifacio, E. Caffau, H.-G. Ludwig, N. T. Behara, J. I. G. Hernandez, M. Steffen and R. Cayrel *et al.*, Astron. Astrophys. **522**, A26 (2010).
[4] M. Kusakabe, A. B. Balantekin, T. Kajino and Y. Pehlivan, arXiv:1202.5603 [astro-ph.CO].