Naturalness of 126 GeV Higgs Boson and meV Dark Energy

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Natural understanding of the hierarchical structure of the universe is becoming more and more important after the discovery of the 126 GeV Higgs boson and precise observations of CMB spectrum. In this talk, I will discuss two important separate, but may-be deeply related issues, the naturalness of the EW scale and a possible origin of dark energy in the history of the universe.

We will first propose an alternative solution to the hierarchy problem of the electroweak scale against much larger energy scales. Based on the naturalness and the stability of the Higgs vacuum analysis, we propose a model that the EW scale is dynamically generated through B-L (baryon number minus lepton number) gauge interactions that is spontaneously broken at the TeV scale.

Then, we discuss naturalness of the dark energy at present universe. We show how the vacuum fluctuations generated during and before the inflation evolve in the history of the universe until today. In particular we consider two different models. The first is an ordinary universe: inflation, radiation-dominant (RD) and matter-dominant (MD) eras. In this case, the energy density of the generated fluctuations is proportional to $H_I^2H^2$ and very small compared to the present critical density, as expected. The equation of state (EOS) of the vacuum fluctuations is given by w=0 and w=1/3 in the RD and MD eras. In the second model we assume another inflation era with Planck scale Hubble constant ($H_I = M_{PI}$) before the ordinary inflation starts. In this case, the behavior of vacuum fluctuation is very different and EOS is given by w= -1/3.

References:

[1] H. Aoki and S. Iso, PRD86 (2012) 013001

[2] S. Iso, N. Okada and Y. Orikasa, PLB676 (2009) 81, PRD80 (2009) 115007

[3] S. Iso and Y. Orikasa, PTEP 2013 (2013) 023B08

[4] M. Hashimoto, S. Iso and Y. Orikasa, PRD89 (2014) 016019, PRD89 (2014) 056010

[5] H. Aoki, S. Iso and Y. Sekino, hep-th/1402.6900 , to appear in PRD