Naturalness and Higgs inflation

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The observed value of the Higgs mass indicates that the Higgs potential becomes small and flat at the scale around 10^{17} GeV. Having this fact in mind, we reconsider the Higgs inflation scenario proposed by Bezrukov and Shaposhnikov. It turns out that the non-minimal coupling ξ of the Higgs-squared to the Ricci scalar can be smaller than ten. For example, $\xi = 7$ corresponds to the tensor-to-scalar ratio $r \simeq 0.2$, which is consistent with the recent observation by BICEP2.

We then consider the Higgs portal Z2 scalar model as the minimal extension of the Standard Model (SM) to incorporate the dark matter. We find that the dark matter mass is bounded to be lighter than 1000 GeV within the framework that the Higgs inflation occurs above the SM cutoff Λ. We can further fix the dark matter mass to be $400\mathrm{GeV} < m_{DM} < 470\mathrm{GeV}$ if we impose that Λ is at the string scale 10^{17}GeV and that the Higgs potential becomes flat around Λ. This prediction is testable by the dark matter detection experiments in the near future. In this framework, the dark matter and top quark masses are strongly correlated, which is also testable.

References:

[1] Y. Hamada, H. Kawai, K. Oda,*"Predictions on mass of Higgs portal scalar dark matter from Higgs inflation and flat potential"*, arXiv:1404.6141 [hep-ph].

[2] Y. Hamada, H. Kawai, K. Oda, S. C. Park, *"Higgs inflation still alive"*, arXiv:1403.5043 [hep-ph].

[3] Y. Hamada, H. Kawai, K. Oda*,"Minimal Higgs inflation"*, PTEP 2014 (2014) 023B02.

[4] Y. Hamada, H. Kawai, K. Oda, *"Bare Higgs mass at Planck scale"*, Phys. Rev. D87 (2013) 5, 053009