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On the Hierarchy Problem and the Cosmological Constant Problem in the Standard Model

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I argue that the SM in the Higgs phase does not suffer form a hierarchy problem" and that similarly thecosmological constant problem" resolves itself if we understand the SM as a low energy effective theory emerging from a cut-off medium at the Planck scale. We discuss these issues under the condition of a stable Higgs vacuum, which allows to extend the SM up to the Planck length. The bare Higgs boson mass then changes sign below the Planck scale, such the the SM in the early universe is in the symmetric phase. The cut-off enhanced Higgs mass term as well as the quartically enhanced cosmological constant term trigger the inflation of the early universe. Reheating follows by the heavy Higgses decaying predominantly into top–anti-top pairs, which at this stage are effectively massless. The coefficients of the shift between bare and renormalized Higgs mass as well as of the shift between bare and renormalized vacuum energy density exhibit close-by zeros at about 10^{15} GeV. The scale dependent Higgs mass counter term is negative in the Higgs phase (low energy), which triggers the electroweak phase transition, and changes sign at the transition point after which is is large positive, which turns the system into the symmetric phase at high energies. Obviously, the SM Higgs system initially provides a huge \textbf{dark energy} density and the resulting inflation is taming the originally huge cosmological constant to the small value observed today, whatever its initial value was, provided it was large enough to trigger inflation. While laboratory experiments can access physics of the broken phase only, the symmetric phase above the Higgs transition point is accessible though physics of the early universe as it manifests in cosmological observations. The main unsolved problem remains the origin of dark matter.

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