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# The Rise and Fall of the Standard-Model Higgs during Kination

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# Abstract


This paper aims at investigating the role played by the Standard-Model Higgs during a phase of kination following inflation. The non-minimal coupling to curvature at high energy scales plays a double role: it stabilises the Higgs quantum fluctuations during inflation and drives them towards the instability scale during kination, when they can classically overcome the potential barrier in its effective potential. Avoiding the instability sets an upper bound on the inflationary scale that depends on the strength of the non-minimal interaction and on the top Yukawa coupling. We find that for all combinations of parameters that allow the presence of a barrier in the effective potential, classical vacuum stability is guaranteed. Thanks to the explosive particle production in the tachyonic phase, the Higgs can be appointed to the role of reheaton field, which sets a lower bound on the inflationary scales $mathcal{H}_{rm inf} gtrsim 10^8 text{ GeV}$. These constraints favour lower masses of the top quark, i.e. higher instability scales, in the range of the current measurements of the top pole mass. We perform our analysis semi-analytically in terms of the one-loop and three-loop running of the Standard-Model Higgs self-coupling and we make use of parametric formulas for studying the (re)heating phase. For a specific choice of $m_t=171.3 text{ GeV}$ we perform an extensive scanning of the parameter space with lattice numerical simulations to identify the stable and unstable regions and to support our analytical arguments.


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