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Modified Hybrid Inflation, Reheating and Electroweak Vacuum stability

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We propose a modification to the standard hybrid inflation model \cite{Linde:1993cn}, that connects a successful hybrid inflation scenario to the standard model Higgs sector, via the electroweak vacuum stability. The proposed model results in an effective inflation potential of a hilltop-type, with both the trans-Planckian and sub-Planckian inflation regimes consistent with the recent Planck/BICEP combined results. Reheating via the inflation sector decays to right-handed neutrinos is considered. An upper bound on the reheating temperature $T_R \leq\sim 2 \times 10^{11}$ (1×10^{13}) GeV, for large˜(small) field inflation, will suppress contributions from one-loop quantum corrections to the inflation potential. This may push the neutrino Yukawa couplings to be $calO(1)$ and affect the vacuum stability.

We show that the couplings of the SM Higgs to the inflation sector can guarantee the electroweak vacuum stability up to the Planck scale. The so-called hybrid Higgs-inflaton model leads to a positive correction for the Higgs quartic coupling at a threshold scale, which is shown to have a very significant effect in stabilizing the electroweak vacuum. We find that even with $calO(1)$ neutrino Yukawa couplings, threshold corrections leave the SM vacuum stability intact.

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