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Instability of the Electroweak Vacuum in Starobinsky Inflation

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We study the stability of the electroweak vacuum during and after the Starobinsky inflation, assuming the existence of the non-minimal Higgs coupling to the Ricci scalar. In the Starobinsky inflation, there exists R2 term (with R being the Ricci scalar), which modifies the evolution equation of the Higgs field. We consider the case that the non-minimal coupling is sizable so that the quantum fluctuation of the Higgs field is suppressed and that the Higgs amplitude is settled near the origin during the inflation. In such a case, the Higgs amplitude may be amplified in the preheating epoch after inflation because of the parametric resonance due to the non-minimal coupling. We perform a detailed analysis of the evolution of the Higgs field in the preheating epoch by a numerical lattice simulation and derive an upper bound on the non-minimal coupling constant ξ in order to realize the electroweak vacuum in the present universe. We find that the upper bound on ξ in the Starobinsky inflation model is more stringent than that in conventional inflation models without the R2 term.

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