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Quantum Bottleneck in Chaotic Inflation and in the subsequent Reheating

It has been long since chaotic inflation has explained the inflationary epoch of the early Universe. Although it has explained the particle creation mechanism via parametric resonance in the reheating region, it has not been employed to study the backreaction of particle creation in the inflationary phase.

In the present work, we take the minimal model of chaotic inflation and show that the backreaction of particle creation works against the phenomenon of inflation itself as it does not allow for any possibility of having the right initial conditions to meet the slow roll conditions with the prescribed sixty number of e-foldings.

To circumvent this situation, we bring in quantum mechanical restriction owing to Heisenberg's uncertainty principle in the process of distributing particles in the configuration space. This creates a bottleneck effect that inhibits the energy flow from the inflaton field restricting creation of particles.

Our numerical simulation shows that this bottleneck effect operates not only in the inflationary epoch but also in most part of the subsequent reheating phase. We find sufficient reheating and the energy density of the created particles attains a peak value of $\rho_r = 1.13 \times 10^{55}$ GeV^4, which corresponds to a reheating temperature of $T_r = 2.38 \times 10^{13}$ GeV. The inflationary era lasts for 8.15×10^{-37} sec whereas the subsequent reheating period spans over a time of 3.10×10^{-34} sec.

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