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Late vacuum choice and slow roll approximation

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Abstract

In the transition between inflation and reheating, the curvature scalar typically undergoes oscillations which have significant impact on the density of gravitationally produced particles.
The commonly used adiabatic vacuum prescription for the extraction of produced particle spectra becomes a non-reliable definition of vacuum in the regimes for which this oscillatory behavior is important.
In this work, we study particle production for a scalar field non-minimally coupled to gravity, taking into account the complete dynamics of spacetime during inflation and reheating.
We derive an approximation for the solution to the mode equation during the slow-roll of the inflaton and analyze the importance of Ricci scalar oscillations in the resulting spectra.
Additionally, we propose a prescription for the vacuum that allows to safely extrapolate the result to the present, given that the test field interacts only gravitationally.
Lastly, we calculate the abundance of dark matter this mechanism yields and compare it to observations.

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