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# The Inflationary Butterfly Effect: Non-Perturbative Dynamics From Small-Scale Features

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For the first time, we investigate the non-perturbative dynamics of single field inflation with a departure from slow-roll. Using simulations, we find that oscillatory features in the potential can drastically alter the course of inflation, with major phenomenological implications. In certain cases, the entire Universe gets trapped in a forever inflating de Sitter state. In others, only some regions get stuck in a false vacuum, offering an alternative channel for primordial black hole formation. Analogous to the flap of a butterfly, these results show that small-scale phenomena can have profound consequences on the evolution of the entire Universe. This demonstrates the necessity of a non-perturbative approach in the exploration of the small-scale physics of inflation, particularly in the regime relevant for gravitational-wave astronomy. Additionally, we compare our fully nonlinear lattice power spectra with perturbative 1-loop calculations.

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