

Lattice formulation of axion inflation: application to preheating

Tuesday, 23 June 2020 10:00 (1 hour)

Zoom meeting: <https://cern.zoom.us/j/7930190483> (password: see email)

Format: 40 minutes talk + 20 min discussion

Virtual Axion Institute: The discussion on this talk can be continued in Daniel's virtual guest office. <https://mattermost.web.cern.ch/axions/channels/daniel-figueroa>

Abstract: I will present a lattice formulation of an interaction $\phi F\tilde{F}$ between an axion and a $U(1)$ gauge sector, with the following properties: it reproduces the continuum theory up to $\mathcal{O}(dx_\mu^2)$, it preserves exact gauge invariance and shift symmetry on the lattice, and it is suitable for self-consistent expansion of the Universe. I will discuss an implicit method to solve the lattice equations of motion, which preserves the relevant system constraints down to arbitrary (tunable) precision. We then apply our formalism to study the last e-folds of axion-inflation with quadratic potential, and the preheating stage following afterwards. We fully account for the inhomogeneity and non-linearity of the system, including the gauge field contribution to the expansion rate of the Universe and its backreaction into the axion dynamics. We characterize in detail, as a function of the coupling, the energy transfer from the axion to the gauge field, identifying two coupling regimes: sub- and super-critical, depending on whether the final energy fraction stored in the gauge field is below or above $\sim 50\%$ of the total energy. The Universe is very efficiently reheated for super-critical couplings, reassuring previous results with less advanced lattice techniques.

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Session Classification: Gauge fields