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Nongaussianity from Particle Production During Inflation

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In a variety of models the motion of the inflaton may trigger the production of some non-inflaton particles during inflation, for example via parametric resonance or a phase transition. Such models have attracted interest recently for a variety of reasons, including the possibility of slowing the motion of the inflaton on a steep potential. In this review we show that interactions between the produced particles and the inflaton condensate can lead to a qualitatively new mechanism for generating cosmological fluctuations from inflation. We illustrate this effect using a simple prototype model g^2 (\phi-\phi_0)^2\chi^2 for the interaction between the inflaton, \phi, and iso-inflaton, \chi. Such interactions are quite natural in a variety of inflation models from supersymmetry and string theory. Using both lattice field theory simulations and analytical calculations, we study the quantum production of \chi particles and their subsequent rescatterings off the condensate \phi(t), which generates bremsstrahlung radiation of light inflaton fluctuations \delta\phi. This mechanism leads to observable features in the primordial power spectrum. We derive observational constraints on such features and discuss their implications for popular models of inflation, including brane/axion monodromy. Inflationary particle production also leads to a very novel kind of nongaussian signature which may be observable in future missions. We argue that this mechanism provides a simple and well-motivated option to generate large nongaussianity, without fine-tuning the inflationary trajectory or appealing to re-summation of an infinite series of high dimension operators.

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