Abstract

In a variety of inflation 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. Particle production during inflation leads to observables in the cosmological fluctuations, such as features in the primordial power spectrum and also nongaussianities. Here we focus on a prototype scenario with inflaton, Œ, and iso-inflaton, Ø, fields interacting during inflation via the coupling g2(Œ-Œ0)2Ø2. Since several previous investigations have hinted at the presence of localized glitches in the observed primordial power spectrum, which are inconsistent with the simplest power-law model, it is interesting to determine the extent to which such anomalies can be explained by this simple and microscopically well-motivated inflation model. Our prototype scenario predicts a bump- like feature in the primordial power spectrum, rather than an oscillatory ringing pattern as has previously been assumed. We discuss the observational constraints on such features using a variety of cosmological data sets. We find that bumps with amplitude as large as O(10scale invariant fluctuations from inflation, corresponding to g2 ¸ 0.01, are allowed on scales relevant for Cosmic Microwave Background experiments. Our results imply an upper limit on the coupling g2 (for a given Œ0) which is crucial for assessing the detectability of the nongaussianity produced by inflationary particle production. We also discuss more complicated features that result from superposing multiple instances of particle production. Finally, we point to a number of microscopic realizations of this scenario in string theory and supersymmetry and discuss the implications of our constraints for the popular brane/axion monodromy inflation models.