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ANHARMONIC EFFECTS ON THE SQUEEZING OF AXION PERTURBATIONS

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It is well known in cosmology that the history of the Universe undergoes a period of quasi exponential expansion. The fluctuations of the inflaton field are believed to have a quantum origin, however the CMB sky we observe today is classical. Therefore the questions whether the initial perturbations have a quantum or classical origin and how to discriminate them arise. Actually inflation itself provides an explanation for the "classicalization" of the originally quantum perturbations. They are squeezed due to the fast expansion of the universe. A squeezed state is a special quantum state for which one variable is allowed to have an arbitrarily small uncertainty, while its conjugate counterpart has a very big uncertainty correspondingly. This is indeed the most quantum state we could think about, however, from an observational point of view, it is indistinguishable from a classical phase-space distribution. In this talk, I will present the evolution in time of the perturbations of axion-like particles, introducing the notion of Bogoliubov coefficients and squeezing parameters. I will also present the link between these mathematical notions and physical observables, in order to address the question about the observability of the quantum nature of these perturbations. Moreover I will study the modification of the squeezing parameters due to anharmonic effects. An exponential increase in the Bogoliubov coefficients, i.e. in the average energy density of the perturbations, is observed.

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