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Questions on calculation of primordial power spectrum with large spikes: the resonance model case

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Inflationary models predicting a scale-dependent large amplification of the density perturbations have recently attracted a lot of attention because the amplified perturbations can seed a sizable amount of primordial black holes (PBHs) and stochastic background of gravitational waves (GWs). While the power spectra in these models are computed based on the linear equation of motion, it is not obvious whether loop corrections are negligible when such a large amplification occurs during inflation.
In this talk, I will discuss our paper, arXiv:2211.02586, in which we use the in-in formalism and calculate the one-loop scalar power spectrum numerically and analytically in an illustrative model where the density perturbations are resonantly amplified due to oscillatory features in the inflaton potential. Our calculation is technically new in that the amplified perturbations are numerically taken into account in the in-in formalism for the first time. With the calculation results, I will show that, for the typical parameter space leading to the O(10^7) amplification of the power spectrum for a sufficient PBH production in the oscillatory feature models, the one-loop power spectrum dominates over the tree-level one, indicating the breakdown of the perturbation theory.

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