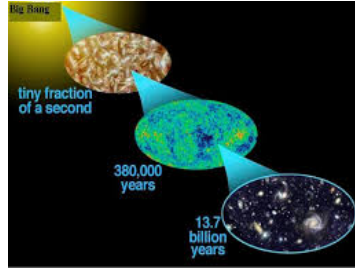


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Particle Production and Semiclassical Validity in Two-mode Squeezed Vacuum state of an Oscillatory Quantize Scalar Field in FRW Universe

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Abstract

An approximate solution to the semiclassical Einstein equation is obtained in two-mode squeezed vacuum (TMSV ($|\xi, 2\rangle$)) state formalism perturbatively and is found to obey the same power-law expansion as that of classical Einstein equation. However, the semiclassical gravity shows a significant difference that the Hubble constant does not oscillate, in contrast with the oscillatory behavior observed in classical gravity, for a specific choice of squeezing angle. This coherently oscillating scalar field in the TMSV state suffers from the phenomenon of nonclassical particle creation due to the quantum fluctuation of the scalar field in the expanding background cosmology. We also analyzed the validity of the semiclassical theory in TMSV state and finally examined the nonclassicality of the above state in the oscillatory phase of a massive scalar field.

Keywords: Scalar Field, Two-mode Squeezed Vacuum State, FRW Universe, Semiclassical Approximation to gravity, quantum fluctuation, particle creation.

Primary author(s) : RATHORE, Meghna (MNIT)

Presenter(s) : RATHORE, Meghna (MNIT)