QUANTUM SEMINARS

Physics Dept. Theory Section
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SOLVING PROBLEMS IN COSMOLOGY AND QUANTUM GENERAL RELATIVITY USING COLLAPSE MODELS

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Abstract

The success of the inflationary paradigm rests on its ability to explain the observed classicality of primordial quantum fluctuations despite their quantum origin. Squeezing of primordial cosmological inhomogeneities along with the mechanism of decoherence accounts for many aspects of this quantum to classical transition, although it remains a matter of debate as to whether this is sufficient to explain the issue of realization of a single outcome from a quantum ensemble given that the universe is a closed system. Apart from decoherence there have been attempts to resolve this issue through Continuous Spontaneous Localization (CSL), which is a stochastic nonlinear modification of the non-relativistic Schrodinger equation. In this talk, I shall revisit one such recently proposed working model of classicalization by spontaneous collapse to look for possible modifications to scalar and tensor power spectra and their implications. I shall show that it can potentially change the consistency relation of single-field models and a precise measurement of tensor spectral tilt and its running could serve as a test of such dynamics in the early universe.

Apart from the quantum measurement problem, two of the big puzzles of theoretical physics are the following: (i) There is apparently no time evolution in the dynamics of quantum general relativity, because the allowed quantum states must obey the Hamiltonian constraint. (ii) The observed value of the cosmological constant is exceedingly small, compared to its natural value, creating a serious fine-tuning problem. In this talk, I shall also discuss a novel proposal to show how the three problems help solve each other.