The Cosmological Out of Time Ordered Correlators (OTOC)

Abstract

The out-of-time-ordered correlation (OTOC) function is an important new probe in quantum field theory which is treated as a significant measure of random quantum correlations. In this paper, using for the first time the slogan “Cosmology meets Condensed Matter Physics”, we demonstrate a formalism to compute the Cosmological OTOC during the stochastic particle production during inflation and reheating following the canonical quantization technique. In this computation, two dynamical time scales are involved—out of them, at one time scale, the cosmological perturbation variable, and for the other, the canonically conjugate momentum, is defined, which is the strict requirement to define the time scale-separated quantum operators for OTOC and is perfectly consistent with the general definition of OTOC. Most importantly, using the present formalism, not only one can study the quantum correlation during stochastic inflation and reheating, but can also study quantum correlation for any random events in Cosmology. We have studied the possibility of having three different types of correlators, which quantifies the random quantum correlation function out-of-equilibrium. We have also studied the classical limit of the OTOC and checked the consistency with the large time limiting behaviour of the correlation. Finally, we prove that the normalized version of OTOC is completely independent of the choice of the preferred definition of the cosmological perturbation variable.