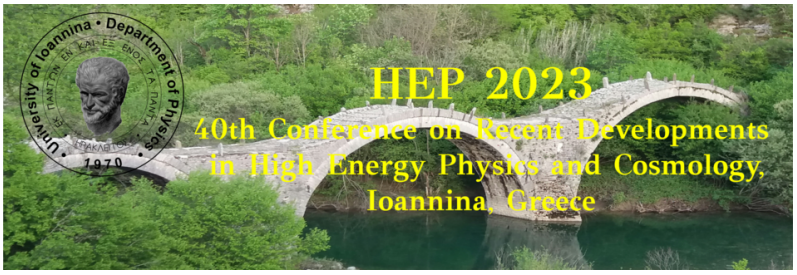

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Entanglement and expansion

Friday, 7 April 2023 12:00 (30 minutes)

I discuss the entanglement entropy resulting from tracing out local degrees of freedom of quantum harmonic systems, which include free scalar field theory as a continuum limit. It is known that the entanglement entropy of such a system in its ground state is dominated by an area law term. This peculiar feature resembles the famous property of black hole entropy. I summarize the calculation of entanglement entropy for a quantum scalar field in an expanding universe. When field modes become superhorizon during inflation they evolve to increasingly squeezed states. This causes the entanglement entropy to grow continuously as successive modes cross the horizon. The resulting entropy is proportional to the total duration of inflation. It is preserved during a subsequent era of radiation or matter domination, and thus it may be relevant for today's universe. The squeezing of the states of the field modes results in the appearance of a volume term in the entanglement entropy, in violation of the pure area law for a quantum field in its ground state in a static background. These features are demonstrated in a toy model of a scalar field in 1+1 dimensions. Preliminary results in 3+1 dimensions are also presented.

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