

Studies on the SJ Vacuum in de Sitter Spacetime

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Abstract

In this talk we discuss the Sorkin-Johnston (SJ) vacuum in de Sitter spacetime for free scalar field theory. For the massless theory we show that the SJ vacuum can neither be obtained from the $O(4)$ invariant Fock vacuum of Allen and Folacci nor from the non-Fock de Sitter invariant vacuum of Kirsten and Garriga. Using a causal set discretisation of a slab of 2d and 4d de Sitter spacetime, we show the causal set SJ vacuum for a range of masses $m \geq 0$ of the free scalar field. While our simulations are limited to a finite volume slab of global de Sitter spacetime, they show good convergence as the volume is increased. We find that the 4d causal set SJ vacuum shows a significant departure from the continuum Motolla-Allen α -vacua. Moreover, the causal set SJ vacuum is well-defined for both the minimally coupled massless $m = 0$ and the conformally coupled massless $m = m_c$ cases. This is at odds with earlier work on the continuum de Sitter SJ vacuum where it was argued that the continuum SJ vacuum is ill-defined for these masses. Our results hint at an important tension between the discrete and continuum behaviour of the SJ vacuum in de Sitter and suggest that the former cannot in general be identified with the Mottola-Allen α -vacua even for $m > 0$.

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