

Novel Phenomenon of the Hartle-Hawking wave function

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Abstract:

We find a novel phenomenon in the solution to the Wheeler-DeWitt equation by solving numerically the equation with the Hartle-Hawking wave function as a boundary condition. In the slow-roll limit, as expected, the numerical solution gives the most dominant steepest-descent that describes the probability distribution for the initial condition of a universe. The probability is consistent with the Euclidean computations, and the overall shape of the wave function is consistent with analytical approximations. On the other hand, in the non-slow-roll limit, an unexpected novel phenomenon appears in the oscillatory regime corresponding to a classical domain of the solution: interferences among the propagating modes along the metric direction and the field direction. Especially, in some circumstances, the probability of the oscillatory regime becomes even greater than that of the steepest-descent. Possible interpretations and conceptual issues of this phenomenon are discussed.