

Quantum tunneling, decoherence and the beginning of the Universe from Lefschetz thimble real-time simulations

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Monte Carlo simulations of quantum time-evolution based on the real-time path integral have been thought to be extremely difficult since it involves a phase factor $\exp(iS)$ in the integrand, which causes a severe sign problem. We apply the Lefschetz thimble method with various new techniques to such systems. In this talk, I would like to discuss a new understanding of quantum tunneling and quantum decoherence that arises as complex saddle point configurations. I would also like to discuss how one can apply this method to investigate the beginning of the universe based on quantum gravity.

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