

Lefschetz-thimble analysis of the Lorentzian IKKT matrix model around saddle point configurations

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The type IIB matrix model is a promising candidate for a nonperturbative definition of superstring theory. The Lorentzian version, however, is not well defined as it is, and it was recently proposed to introduce a Lorentz invariant mass term in the action as an IR regulator. Depending on the sign of this term, we either have a model that is truly Lorentzian or one that is comparable to the Euclidean model. In this work we numerically investigate the purely Lorentzian case using Lefschetz thimble method. Our investigation of the simplest $N = 2$ bosonic case confirms certain surprising properties of the model predicted from the analytical calculations like divergence of the partition function, phase transition etc. We claim that these features are truly Lorentzian in nature. We also discuss the impact of this statement in the possible emergence of $(3+1)D$ expanding space-time.

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