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From Matrices to Spacetime: Probing Symmetry Breaking in the Type IIB Matrix Model

One of the significant challenges in superstring theory is understanding how the extra dimensions of space might shrink down to sizes we cannot see - something called dynamical compactification. The type IIB matrix model is a robust mathematical framework that aims to describe this process in ten dimensions. In this model, space itself is expected to emerge from the behavior of large matrices, which can break the original symmetry of the model. However, studying this model is extremely difficult because of a technical issue known as the sign problem, which arises from complex numbers in the calculations. The complex Langevin method has recently shown success in dealing with this challenge. In this work, we apply this method to explore whether the symmetry in the model is spontaneously broken. Our findings suggest that the complex part of the model plays a key role in triggering this symmetry breaking, helping us understand how space and its structure might emerge from fundamental theory.

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None

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