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74

Unveiling quantum phase transitions efficiently using machine learning and quantum computing

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The classification of phase transitions is a central and challenging problem in condensed matter physics. Over the past few years, numerous computational techniques have been developed to address this issue. However, there is a classical bottleneck that prevents analyses of systems with more than hundreds of particles. In this work, we propose a framework to identify quantum phase transitions by applying classical shadows (1) and unsupervised machine learning to the axial next-nearest neighbor Ising (ANNNI) model, which serves as our benchmark, and extend the analysis to the Kitaev-Heisenberg model. All results rely on a few qubits; however, the classical shadows process allows our analysis to scale logarithmically with the number of qubits, enabling a scalable and efficient framework for the study of phase transitions in many-body systems

Palavras-chave: Quantum Computing; Classical Shadows; Many body.

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