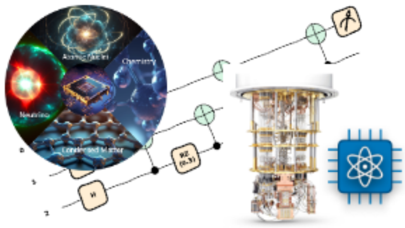

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Quantum Circuit Optimization with Differentiable Projected Entangled Pair States for Ground State Preparation

Thursday, November 20, 2025 11:15 AM (45 minutes)

The interplay between quantum computers and tensor networks have been increasingly popular, and can provide pathways to overcome difficult problems inherent to quantum algorithms, such as preparing relevant initial states for further computations. In this work, we utilize tensor networks to optimize quantum circuits for ground state preparation. Specifically, we employ differentiable Projected Entangled Pair States (PEPS) across various topologies to simulate and optimize parameterized quantum circuits for model Hamiltonians. Our approach enables the preparation of ground states with high energy accuracy, even for large qubit systems and connectivities that are beyond one dimension. Furthermore, by analyzing the energy landscape around the optimized parameters, we demonstrate that PEPS-based optimization may help mitigate the barren plateau phenomenon by providing a warm-start initialization with enhanced gradient magnitudes. Finally, we examined the classical simulation costs of this strategy and identified cases where quantum computers exhibit favorable scaling. We believe this work pushes the potential of quantum computing by leveraging classical pre-processing for both NISQ experiments and FT algorithms and helps to identify which tasks are best suited for classical or quantum resources.

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