

## Exploring the Ground States of Higher-Spin Kitaev Models via QR-Accelerated iPEPS simulation

Higher-spin extensions of the Kitaev honeycomb model offer a fertile ground for exploring quantum frustration and topological order beyond the spin-1/2 paradigm. Despite intensive interest, the nature of their ground states remains elusive, particularly in the large-spin regime where semiclassical intuition and entanglement effects intertwine. Accurate simulations in this limit are hindered by steep computational costs.

We build upon our previously established QR-accelerated iPEPS(infinite projected entangled pair states) framework, which achieves one to two orders of magnitude speedup in contraction time compared to conventional approaches, with excellent performance on modern GPU architectures. This enables controlled access to larger bond dimensions, which is crucial to obtain reliable ground state.

The improved efficiency enables simulations of higher-spin Kitaev models at unprecedented scale, laying the groundwork for deeper investigations into their entanglement structure and phase behavior.

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