

Competing Frustrations in Rare-Earth Magnets: New Routes to Quantum Spin Liquids

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Quantum spin liquids represent a fascinating class of quantum states characterized by strong quantum entanglement, topological order, and fractional excitations. Rare-earth magnets have recently emerged as a promising platform for realizing such states owing to their strong spin-orbit coupling, highly anisotropic magnetic interactions, and inherent magnetic frustration.

In this talk, we present our recent theoretical studies on rare-earth magnetic systems, focusing on the interplay between geometric frustration and frustration arising from competing bond-dependent interactions. We show how these competing ingredients suppress magnetic ordering, generate unconventional spin correlations, and provide different routes to realizing quantum spin liquids. The coexistence of multiple sources of frustration not only enriches the phase behavior but also offers a unique platform for exploring emergent quantum phenomena beyond conventional paradigms.

We discuss several representative rare-earth compounds in which these ideas manifest themselves and demonstrate how they can serve as promising quantum-spin-liquid candidates. These studies have opened up new families of candidate materials and provide guiding principles for the design of correlated quantum matter. Our results highlight rare-earth magnets as a versatile platform for uncovering novel quantum phases and functionalities driven by competing frustrations.

This work has been carried out in collaboration with Kiyu Fukui, Seong-Hoon Jang, Manodip Routh, and Lingzhi Zhang.