

Noise magnetometry with spin qubits: A window into fractionalization and anyonic statistics in magnetic insulators

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Two-dimensional magnetic insulators exhibit a plethora of competing ground states, such as ordered (anti)ferromagnets, quantum spin liquids characterized by topological order and anyonic excitations, and random singlet phases emerging in the presence of disorder and frustration. Single spin qubits, which interact directly with the low-energy spin-excitations of magnetic insulators, can be used as a diagnostic of magnetic ground states. Experimentally tunable parameters, such as qubit level splitting, sample temperature, and qubit-sample distance, can be used to measure spin correlations with energy and wavevector resolution. Such resolution can be exploited to distinguish between fractionalized excitations in spin liquids and spin waves in magnetically ordered states, or to detect anyonic statistics in systems with a finite energy gap.

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