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Quantum Phase Transition of An Ising System Coupled to a Nuclear Spin Bath RYAN MCKENZIE, University of British Columbia — The rare earth insulating magnet $LiHoF_4$ is often considered to be the quintessential (dipolar coupled) magnetic quantum Ising system. At low temperatures, upon application of a magnetic field transverse to the easy axis of the crystal, it undergoes a phase transition between ferromagnetic and paramagnetic states. However, neutron scattering experiments indicate this quantum phase transition is forestalled by the strong hyperfine coupling of each holmium ion's electronic spin to its nuclear spin. This spin bath environment appears to gap the crystal's excitation spectrum at its quantum critical point. This is relevant for the development of quantum computation, in which the coupling of a network of qubits to its environment must be mitigated or controlled in order to carry out meaningful computations. We show that the quantum phase transition in $LiHoF_4$ is preserved despite the presence of the nuclear spin bath, with spectral weight being transferred to a lower energy electronuclear mode that softens to zero at the quantum critical point. Hence, $LiHoF_4$ is indeed a paragon of a quantum Ising system in a transverse magnetic field.

Ryan McKenzie
University of British Columbia

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