Title: Beyond the Ising Model: Kitaev and Gamma Interactions in Co-Based Quantum Chains

Abstract: The one-dimensional (1D) transverse-field Ising model is one of the simplest systems that exhibits a quantum phase transition and a quantum critical point. Realizing such materials has posed a formidable challenge, and only a limited number of solid-state compounds have been shown to host a 1D Ising quantum critical point under a magnetic field. Among the extensively studied 1D Ising-like systems, chains composed of Co^{2+} ions, such as $CoNb_2O_6$ and $BaCo_2V_2O_8$, stand out as two of the most thoroughly investigated examples.

I will present a microscopic theory of the nearest-neighbor spin-exchange interactions to elucidate their roles in the Ising anisotropy and domain-wall excitations in the ordered state. I will show that the ferromagnetic, bond-dependent Kitaev interaction is dominant in these systems, while the conventional Heisenberg exchange is subdominant. The Ising anisotropy and moment pinning arise from the combined effects of the Kitaev and Gamma interactions, both bond-dependent terms. Together, they give rise to rich phenomena beyond the conventional Ising model. A comparison with two-dimensional cobaltates will also be discussed.