



## Seminar/Talk

# Simulating spin physics with quantum dot ladders

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The field of analog quantum simulations promises to shed light into some of the most formidable questions of solid-state physics before digital quantum computers reach quantum practicality. In this context, semiconductor gate-defined quantum dots have emerged as an appealing platform for quantum simulations, due to the direct mapping of their Hamiltonian to a Fermi-Hubbard or Heisenberg model, as well as the precise control of onsite energies and nearest-neighbor interactions. Out of all available quantum dot platforms, quantum dot arrays in planar germanium have quickly scaled up in the past years, with device sizes approaching the many-body threshold. In this talk, I will introduce the basic concepts of analog quantum simulators and present two concrete examples, where we use a 4x2 quantum dot ladder in Ge/SiGe to simulate the physical properties of coupled spins in the presence of g-factor variability and different interaction strengths. In our first work, we simulate the dynamics of single-spin excitations (magnons) and two-spin excitations (triplons). Using a methodology that combines digital spin qubit operations for initialization and readout with analog evolution, we are able to reconstruct quantum walk plots for various configurations of exchange couplings. Subsequently, we combine these methods to probe the energy spectrum of spin chains of up to 8 coupled spins by means of many-body interferometry. We observe signatures of a transition between an interaction-dominated (chaotic) and a disorder-dominated (localized) phase. These experiments pave the way for more complex simulations of spin physics with quantum dot arrays.

**Tuesday, December 16, 2025 10:00am - 11:00am**

Mondi Seminar Room 3, Central Building



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