# QUANTUM OPTICS SEMINAR

**Title:** Towards Simulating the Quantum Magnet

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**Time:** Wednesday, May 28 at 10:15

**Place:** 1525-323

**Abstract:**

Simulating quantum mechanical systems is a hard task since the amount of degrees of freedom scale exponentially with the number of constituents. One could circumvent this difficulty by introducing a quantum simulator based on the idea that systems governed by the same Hamiltonian evolve alike.

I present our system for a feasibility study of a linear chain of magnesium ions. External fields and interactions between the ions are simulated/controlled via rf- and laser-fields respectively. To initialize our system, we cool up to three ions close to the axial-motional ground state $n < 0.05$. To calibrate our operational fidelities, we implemented a geometric phase gate[1] and prepared an entangled Bell state of two ions with a fidelity exceeding 95%. Subsequently, we were able to simulate an adiabatic evolution of two spins described by the Quantum-Ising-Hamiltonian from paramagnetic into ferromagnetic order[2,3] with an fidelity of 95%. We proof that this transition is driven by quantum (not thermal) fluctuations providing us even an entangled state with a lower bound for the fidelity of 70%.

The talk focus on the experimental techniques as well as results gained from the named experiments.

[1] D. Leibfried et al., Nature 422, 412 (2003)
[2] D. Porras and J.I. Cirac, Phys. Rev. Lett. 92, 207901 (2004)
[3] A. Friedenauer, H. Schmitz, J. Glückert et al., arXiv:0802.4072v1 [quant-ph] (2008)

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