IQ ST | INTEGRATED QUANTUM SCIENCE AND TECHNOLOGY

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Invitation to IQST Seminar

on Tuesday, May 29th, 2018, 2pm
Ulm University
N25, Room 4413
Albert-Einstein-Allee 11

Alexander Glaetzle
Clarendon Laboratory, University of Oxford

Quantum Spin Lenses with Rydberg dressed atoms

Ultra-cold atoms in optical lattices are one of the most promising platform for quantum simulation and computing where scalability in terms of system sizes as well as interaction control and at the same time control and detection of individual qubits have already been demonstrated. By enhancing ultra-cold atoms with strong, long-range interactions mediated by Rydberg states, it is possible to address challenges from realizing fundamentally new states of matter to the implementation of adiabatic quantum computing and novel atom-light interfaces representing new quantum technologies.

In this seminar, I will first given an introduction to Rydberg atoms and review our recent work on realizing a broad class of lattice spin-1/2 models with cold alkali atoms stored in optical or magnetic trap arrays, to implement Abelian U(1) and Z2 gauge theories in a series of geometries [1-2]. In the second part of this talk I will propose and discuss linear and nonlinear 'quantum spin-lenses' and their physical realization with cold atoms. I will discuss application as a novel quantum atom-light interface, where incident photonic qubits are sequentially stored in an atomic array, and focused to a quantum register of spatially localized spin-qubits. More generally, we will discuss the design of non-linear spin-lenses, adding finite range (repulsive) spin-spin interactions to the spin-lens Hamiltonian. Thus, focusing dynamics will be conditional to the number of initial spin excitations, and an initial quantum superposition state of delocalized spins will be mapped to superposition of spatial spin patterns. [3]

References

[1] Designing Frustrated Quantum Magnets with Rydberg Atoms:
A. Glätzle, M. Dalmonte, R. Nath, C. Gross, I. Bloch, P. Zoller,
Phys. Rev. Lett. 114, 173002 (2015)

[2] Simulating Quantum Spin Models using Rydberg-Excited Atomic Ensembles in Magnetic Microtraps:
S. Whitlock, A. Glätzle, P. Hannaford,
J. Phys. B: At. Mol. Opt. Phys. 50, 074001 (2017)

[3] Quantum Spin Lenses in Atomic Arrays:
A. Glätzle, K. Ender, D. S. Wild, S. Choi, H. Pichler, M. D. Lukin, P. Zoller,
Phys. Rev. X 7, 031049 (2017)

Host: Prof. Dr. Tommaso Calarco, Institute for Complex Quantum Systems, Ulm University