Seminar/Talk

From many-body physics to quantum information with atomic and photonic systems

Hannes Pichler
Harvard U

Host: Misha Lemeshko

The realization of fully controlled, coherent many-body quantum systems is an outstanding challenge in science and engineering. Quantum optical systems, such as photons, atoms or atoms-like systems, hold great promises to achieve this goal. With novel tools and functionalities that have been developed in recent years, they allow the realization of quantum simulators, providing insights into strongly correlated quantum systems, as well as the implementation of ideas from quantum information science.In this talk I want to discuss a few examples that highlight how state-of-the-art quantum optical technology can be employed to create highly entangled states of atoms or photons and using them for quantum simulation and computing. In the first part of this talk I will discuss the physics of arrays of individually trapped Rydberg atoms [1] and the associated quantum many-body phenomena. This includes the equilibrium quantum phase diagram in 1D and the universal quantum critical behavior of the various accessible quantum phase transitions, as well as novel non-equilibrium phenomena such as quantum many-body scars. Moreover I show how these systems can be used to naturally encode combinatorial optimization problems and realize quantum annealers [2]. In the second part of this talk I want to focus on atom-photon interfaces and present a novel way to create highly entangled states of photons by sequentially generating and correlating photons using a single quantum emitter in a waveguide QED setting. I will show that using delayed quantum feedback dramatically expands the class of achievable photonic quantum states in such settings and in particular allows to generate states that are universal resources for quantum computation [3]. [1] H. Bernien, S. Schwartz, A. Keesling, H. Levine, A. Omran, H. Pichler, S. Choi, A. S. Zibrov, M. Endres, M. Greiner, V. Vuleti?, and M. D. Lukin, Nature 551, 579 (2017).[2] H. Pichler, S.-T. Wang, L. Z., S. Choi, M. D. Lukin, arxiv:1808.10816, (2018). [3] H. Pichler, S. Choi, P. Zoller, and M. D. Lukin, PNAS 114, 201711003 (2017).

Wednesday, January 9, 2019 10:00am - 11:00am
Mondi Seminar Room 3, Central Building

This invitation is valid as a ticket for the ISTA Shuttle from and to Heiligenstadt Station. Please find a schedule of the ISTA Shuttle on our webpage: https://ista.ac.at/en/campus/how-to-get-here/ The ISTA Shuttle bus is marked ISTA Shuttle (#142) and has the Institute Logo printed on the side.