IQ ST | INTEGRATED QUANTUM SCIENCE AND TECHNOLOGY

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Invitation to IQST Seminar

on Thursday, December 13th, 10am
University of Stuttgart
Seminar room 3.123, Pfaffenwaldring 57

Dr. Guillaume Salomon

Max-Planck-Institut für Quantenoptik

Quantum gas microscopy of the doped Fermi-Hubbard model

The interplay between magnetism and doping is at the origin of exotic strongly correlated electronic phases and can lead to novel forms of magnetic ordering. One example is the emergence of incommensurate spin-density waves with a wave vector that does not match the reciprocal lattice. In one dimension this effect is a hallmark of Luttinger liquid theory, which also describes the low energy physics of the Hubbard model. Here we use a quantum simulator based on ultracold fermions in an optical lattice to directly observe such incommensurate spin correlations in doped and spin-imbalanced Hubbard chains using fully spin and density resolved quantum gas microscopy. Doping is found to induce a linear change of the spin-density wave vector in excellent agreement with Luttinger theory predictions. For non-zero polarization we observe a decrease of the wave vector with magnetization as expected from the Heisenberg model in a magnetic field. We trace the microscopic origin of these incommensurate correlations to holes, doublons and excess spins which act as delocalized domain walls for the antiferromagnetic order.
When inducing interchain coupling we measure fundamentally different spin correlations around doublons suppressing incommensurate magnetism at our finite temperature in the 2D regime. We observe in 2D a direct local correlation between the presence of mobile doublons and reduced antiferromagnetism, a striking feature predicted for magnetic polarons, agreeing well with a simple string picture. These works represent first steps towards microscopic studies of the intriguing phases of the doped Fermi-Hubbard model.

Host: Prof. Dr. Tilman Pfau, 5. Physikalisches Institut, Universität Stuttgart