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Physikalisches Kolloquium — Physics Colloquium

Einladung — **Invitation**

Monday, 02 December 2019

Lecture Hall N24/H13, 16:15

Coffee and cookies will be served in front of the lecture hall from 16:00

Quantum dynamics in strongly correlated one-dimensional Bose gases

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Quantum many-body systems exhibiting strong correlations give rise to fascinating novel phenomena in physics. In recent years, dilute atomic gases prepared at temperatures close to absolute zero and confined to optical lattice potentials have opened exciting new routes for detailed studies of paradigmatic many-body Hamiltonians with unprecedented parameter control. Apart from exploring associated quantum phases and phase transitions, ultracold atoms allow us to explore these systems also far out-of-equilibrium and trace their coherent many-body dynamics in real time.

In our experiments, we have studied phenomena in the dynamics of strongly correlated bosonic quantum gases confined to a one-dimensional (1D) geometry, with focus on two different model systems. We have realized 1D Hubbard chains by adding an additional lattice potential and have studied correlated tunnelling dynamics when the many-body system is suddenly exposed to a strong force [1,2]. This allowed us to observe how interacting quantum particles prepared in the Mott-insulating phase tunnel through multiple wells of the lattice potential in a situation where a single particle cannot move at all [3]. Our studies further comprise the coherent evolution of an interacting superfluid that exhibits Bloch-oscillations modulated by interaction-driven collapse and revival dynamics [4]. In a certain parameter regime, the transition to quantum chaotic behaviour can be observed. The second system of interest constitutes a uniform Luttinger liquid with highly tunable interactions. Building on investigations of its collective excitations [5], we have probed the dynamics of a strongly coupled impurity atom injected into the liquid and have found an intriguing Bloch-oscillation type motion induced in the correlated system in the absence of an imprinted lattice structure [6].

References:
[1]F. Meinert et al., *Phys. Rev. Lett. **111**, 053003 (2013).
[2]O. Jürgensen et al., *Phys. Rev. Lett. **113**, 193003 (2014).
[3]F. Meinert et al., *Science **344**, 1259-1262 (2014).
[4]F. Meinert et al., *Phys. Rev. Lett. **112**, 193003 (2014).
[5]F. Meinert et al., Phys. Rev. Lett. **115**, 085301 (2015).
[6]F. Meinert et al., Science 356, 945 (2017).

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