Einladung
zum Laser- und Quantenoptikseminar

Freitag, 14.06.2019, um 10:00 Uhr
Raum 46-387/388

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Momentum-space atom correlations in a Mott insulator

Measuring the full distribution of individual quantum particles has emerged as a central approach to characterize many-body ground-states and many-body dynamics by means of correlation functions. Over the past decade, various platforms, from trapped ions and superconducting circuits to arrays of cold atoms, have investigated strongly interacting matter through position-space and/or spin-resolved correlations. In this talk we will present a complementary approach that consists in measuring the momentum-space correlations between single particles. This is achieved by detecting individual metastable Helium-4 atoms in three dimensions and in the far-field regime of expansion, when released from an optical lattice. Firstly, we benchmark our technique with quantum Monte-Carlo calculations and we map the finite-temperature phase diagram of the 3D Bose-Hubbard Hamiltonian. Secondly, we measure the two-body and three-body correlations deep in the Mott regime, finding a perfectly contrasted bunching whose periodicity reproduces the reciprocal lattice. By investigating quantitatively the two-body correlation function, we show that the momentum-space correlations of a Mott insulator deep in the insulating regime is that of a many-body ground-state with a Gaussian density operator. Finally, in the Mott regime with increasing tunnelling, we extract the spectral weight of the quasi-particles. On approaching the transition towards a superfluid, the momentum spread of the spectral weight is found to decrease as a result of the increased mobility of the quasi-particles in the lattice. A comparison with perturbative many-body theories shows a qualitative agreement but also quantitative discrepancies.

Der Gast wird betreut von Prof. Dr. H. Ott
GÄSTE SIND HERZLICH WILLKOMMEN!