Super-resolution microscopy of cold atoms in an optical lattice

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Super-resolution microscopy has revolutionized the fields of chemistry and biology by resolving features at the molecular level. In atomic physics, such a scheme can be applied to reveal the atomic wavefunction and to perform quantum control. Here we demonstrate super-resolution imaging based on nonlinear response of atoms to an optical pumping pulse [1]. With this technique the atomic density distribution can be imaged with a full-width-at-half-maximum resolution of 32(4) nm and a localization precision below 500 pm. The short optical pumping pulse of 1.4 μs enables us to resolve fast atomic dynamics within a single lattice site. A byproduct of our scheme is the emergence of moiré patterns on the atomic cloud, which we show to be immensely magnified images of the atomic density in the lattice.

[1] Super-resolution microscopy of cold atoms in an optical lattice, Mickey McDonald, Jonathan Trisnadi, Kai-Xuan Yao, Cheng Chin, ArXiv:1807.02906