Graham Edge
(University of Toronto)

In-situ fluorescence imaging of a Fermi gas in an optical lattice

Systems of ultracold atoms have proven to be versatile tools for the study of quantum physics. In an optical lattice potential, they can be used to simulate models of condensed matter physics, with parameters such as the interaction energy, chemical potential, and temperature being experimentally tunable. With bosonic Rubidium atoms, recent work has opened the possibility to probe these systems locally at the single atom level, resolving the density distribution of the atoms in the lattice site by site. The extension of site-resolved imaging techniques to the fermionic Alkali atoms has unfortunately proven to be challenging due their less favourable internal atomic structure. I will describe our efforts to realise single atom and single site resolved imaging of fermionic potassium atoms in a cubic lattice with 527 nm spacing. Using EIT cooling, we cool the atoms near the ground state of the lattice while scattering photons at a rate of 5 kHz. Collected the scattered light with a microscope objective allows us to distinguish individual atoms in a sparsely filled trap with an optical resolution of 800 nm. This represents an major step towards the study of correlated states of many fermions at the single particle level.

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Universität Stuttgart, NWZII, Raum 3.123
Pfaffenwaldring 57, 70569 Stuttgart

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