Progress toward a Lithium-based quantum gas microscope

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Neutral atoms have taken ground as a compelling platform for both analog and digital quantum simulation. They bring several advantages such as long lifetimes, naturally identical qubits, and inherent scalability. Optical lattice based tunneling gates are expected to enhance the toolkit of simulation experiments to realise hybrid quantum hardware. This approach combines the power of Hubbard simulations with the programmability of quantum gates, utilising the inherent fermion exchange statistics of cold atoms. Here we present our progress towards a new lithium quantum gas microscope. Our goal is to gain full control over the motion of the atoms in an optical lattice by employing an optical superlattice and single site addressing to create gates. We aim for fast cycle times and robust preparation of deeply degenerate gases using a single-chamber design with a high-power optical lattice directly loaded from a MOT.

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