In-situ sub-λ quantum gas microscopy: control and measurement of dense ensemble

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This research project is building a novel quantum simulation apparatus utilizing cold atoms trapped in an optical lattice. Traditional cold atom quantum simulators use a far-field optical method setting the minimum lattice spacing to approximately λ/2, where λ is the wavelength of light.

Our team developped a technique (Doubly dressed state) overcoming this limitation by trapping atoms close to a nanostructured surface, enabling significantly smaller lattice spacing and hence higher energy scales. Many body problem and complex systems, such as two dimensional electron gases in sub-wavelength potentials can then be probed by imaging the atoms evolving in these potentials.

Our trapping technique can be adapted to provide sub-wavelength imaging of the atom cloud. Current work is being carried on this subwavelength imaging scheme. A single wavefunction in a lattice tunneling through nearby sites is being imaged.