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Engineering Subwavelength Optical Landscapes using Stroboscopic Techniques[1] TSZ-CHUN TSUI, SARTHAK SUBHANKAR, YANG WANG, STEVE ROLSTON, JAMES PORTO, Joint Quantum Institute, National Institute of Standards and Technology and the University of Maryland, College Park
— In cold-atom experiments, the wavelength of the laser field involved usually sets a limit on the size of structures that can be resolved. To beat the diffraction limit, we exploit the non-linear optical response of a three-level system coupled to two light fields to create ultra-narrow barriers with widths less than $\frac{\lambda}{50}$. These delta-like barriers allow us to create lattices with a lattice spacing of $\frac{\lambda}{2N}$ stroboscopically, where N are integers. We also demonstrate a new imaging technique for probing the wavefunction of atoms trapped in optical lattices with a spatial resolution of $\frac{\lambda}{50}$ and a sub-microsecond temporal resolution, thereby introducing super-resolution microscopy to the field of cold-atom systems. With this technique, we study the static and dynamic properties of wavefunctions of atoms in different potential landscapes.

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