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A Nanoplasmonic Lattice for Quantum Simulation with Cold Atoms MICHAEL GULLANS, Department of Physics, Harvard University, DARRICK CHANG, TOBIAS TIECKE, JEFF THOMPSON, IGNACIO CIRAC, PETER ZOLLER, MIKHAIL LUKIN — Optical lattices formed from interfering laser beams are a powerful tool for quantum simulation with cold atoms. However, this approach faces limitations in achieving low enough temperatures to observe many proposed strongly-correlated states. We discuss a scheme for generating an optical lattice by illuminating a two- dimensional array of metallic nanospheres near their surface plasmon resonance. The lattice spacing is set by the spacing between adjacent spheres and can be much smaller than a wavelength for small enough spheres. We describe an adiabatic loading procedure starting from a Bose-Einstein condensate. We estimate the trap lifetime including the van der Waals attraction with the sphere. We discuss two applications of this system to quantum simulation. First, the subwavelength lattice spacing and trapping pushes the optical lattice dynamics into a new range of energy scales for the Hubbard model by as much as two orders of magnitude compared to traditional optical lattices. Second, subwavelength separations result in strong radiative coupling between atoms and nanoparticles. This strong coupling can be used to engineer long range interactions between atoms that are dissipative by nature; thereby allowing the system to be driven into correlated many-body states in steady state.

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