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Controlled manipulation of light by cooperative response of atoms in an optical lattice[1] STEWART JENKINS, JANNE RUOSTEKOSKI, School of Mathematics, University of Southampton — We show that atoms in an optical lattice can respond cooperatively to incident light [1]. Such a cooperative response can be employed to precisely control and manipulate light on the subwavelength scale. As an illustration, we consider an optical lattice whose atoms are in a Mott-insulator state with precisely one atom per lattice site. The cooperative response of the atoms originates from strong dipole-dipole interactions mediated by scattered electromagnetic fields. As a result of these interactions, the atoms exhibit collective modes of electronic excitation distributed over the lattice. By tailoring the spatial phase profile of the incident light, one can address specific linear combinations of these modes. We demonstrate how the cooperative response can be used to produce optical excitations at isolated sites in the lattice.

[1] S. D. Jenkins and J. Ruostekoski, Phys. Rev. A **86** 031602(R) (2012).

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