Synthetic electromagnetic fields created with light

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Ultra cold atoms are remarkable systems with a truly unprecedented level of experimental control and one application of this control is engineering the systems hamiltonian to realize many body systems usually associated with condensed matter physics. To date this has focused mostly on the real-space potential that the atoms experience, for example, multiple-well traps or optical lattice potentials. Here I present our experimental work which tailors the energy-momentum dispersion of the cold atoms. We couple different internal states of rubidium 87 via a momentum-selective Raman transition and load our system into the resulting adiabatic eigenstates.

Using this technique we show the controlled modification of the energy-momentum dispersion leads to synthetic magnetic and electric fields.