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Creating effective vector potentials with light[1]

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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 date this has focused mostly on the real-space potential that the atoms experience for example, multiple-well traps or optical lattice potentials. Here we 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 an effective vector potential. This work was performed in collaboration with Y.-J. Lin, R. L. Compton, A. R. Perry, W. D. Phillips and J. V. Porto.

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