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Generation of a Synthetic Vector Potential in Ultra-Cold Neutral Rubidium

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Abstract:

Ultra cold atoms are remarkable systems with a truly unprecedented level of experimental control. One application of this control is to engineer the systems hamiltonian. To date this engineering 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, while leaving the real-space potential largely unchanged. We couple different internal states of rubidium 87 via a momentum-selective Raman transition and load our system into the resulting adiabatic eigenstates. The resulting effective hamiltonian acquires a term analogous to the electromagnetic vector potential. We verify the induction of this gauge field by decomposing a BEC loaded into the dressed state into is bare components. In addition, we show that by changing a spatially uniform vector potential in time the BEC is accelerated by the resulting synthetic electric field.