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Two-Dimensional Electron Gas with Cold Atoms in Non-Abelian Gauge Potentials INDUBALA SATIJA, Department of Physics, George Mason University, DANIEL DAKIN, Optical Air Data Systems, J. Y. VAISHNAV, CHARLES W. CLARK, Joint Quantum Institute, National Institute of Standards and Technology — Motivated by the possibility of creating non-Abelian fields using cold atoms in optical lattices, we study two-dimensional electron gases in a lattice, subjected to such fields. In the continuum limit, the system characterized by a two-component "magnetic flux" describes a harmonic oscillator existing in two different charge states (mimicking a particle-hole pair). A key feature of the non-Abelian system is a splitting of the Landau energy levels, which broaden into bands. These Landau bands result in a coarse-grained Hofstadter "moth." Furthermore, the bands overlap, leading to effective relativistic effects. Similar features also characterize the corresponding 2D lattice problem when at least one of the components of the magnetic flux is an irrational number. Some unique aspects of the transport properties of the non-Abelian system are the possibility of inducing localization by varying the quasimomentum, and the absence of localization of certain zero-energy states exhibiting a linear dispersion relation. Furthermore, non-Abelian systems provide an interesting localization scenario where the localization transition is accompanied by a transition from relativistic to non-relativistic theory.

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