Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Synthetic magnetic fields in strained graphene-like optical lattices

BINBIN TIAN, University of Pittsburgh, MANUEL ENDRES, Max-Planck-Institut für Quantenoptik, DAVID PEKKER, University of Pittsburgh — Integer and fractional quantum hall effects are an area in which ultra cold atoms experiments could address long-standing problems of many-body physics. However there is a missing experimental ingredient: a good way to make "synthetic magnetic fields" for the neutral atoms that does not heat the atoms too quickly. Here we present a proposal for a solution by appealing to the physics of graphene. The motion of electrons in graphene is described by the Dirac equation. In the presence of strain the Dirac equation becomes modified as if there is a local magnetic field. We propose to use three laser beams to create a graphene-like optical lattice for ultra cold atoms. By mis-aligning the beams, we can encode a strain into the optical lattice and hence synthesize a uniform "magnetic" field. Using a tight binding model, we show that the synthetic magnetic field results in the formation of distinct Landau levels. These levels will persist in presence of a trap potential. The Landau levels can be detected using spectroscopic methods, like Bragg spectroscopy, or alternatively "kick" methods, like Bloch oscillations.

Binbin Tian
University of Pittsburgh

Date submitted: 13 Nov 2014 Electronic form version 1.4