PHYSICS AND ASTRONOMY
COLLOQUIUM

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"Topological States in Graphene-Based Two-Dimensional Electron Systems"

Abstract

The conduction and valence bands of bilayer graphene cross at the material's honeycomb lattice Brillouin-zone corners. The band wavefunctions are conveniently described in a Bloch spin language in which the polar angle characterizes layer polarization and the azimuthal angle is equal to the momentum-dependent interlayer phase difference. The valence band pseudospin of bilayer graphene has a momentum space texture with vorticity equal to two. I will explain why this property makes graphene bilayers particularly susceptible to the formation of low-temperature broken symmetry states that have gaps in their charged excitation spectrum and broken layer inversion symmetry. The broken symmetry state can be viewed as one in which a core is formed in the momentum space vortex, turning the ground state into a type of Chern insulator which has a quantized anomalous Hall effect. I will discuss what we have learned about these states from recent experiments, and also comment on the potential for pseudospin order[1] in other graphene-based two-dimensional electron systems.

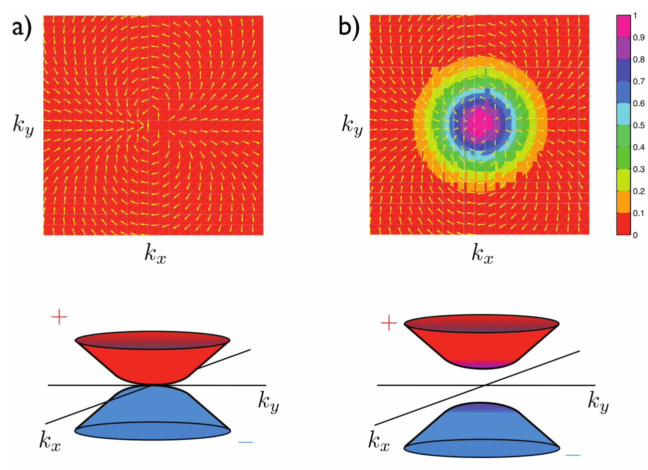

Fig1. Pseudopin orientations and quasiparticle bands for bilayer graphene. In the ordered state the *x-y* components of the quasiparticle pseudospins (yellow arrows) shorten while the polar component (color scale) develops a non-zero value. The quasiparticle energy bands (bottom panels) develop a gap between valence and conduction bands.

1. A.H. MacDonald, Jeil Jung, and Fan Zhang, *Pseudospin Order in Monolayer, Bilayer, and Double Layer Graphene*, Physica Scripta **T146**, 014012 (2012).

Wednesday, March 06, 2013
3:30 p.m.
Bob Wright Centre
Room A104