MAR12-2011-001014

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Nanomechanical Field-Effect Magnetometry in Graphene[1]

JAMES HONE, Columbia University

This presentation will describe our studies of graphene nanomechanical resonators in the quantum Hall (QH) regime. We observe strong magneto-mechanical coupling to de Haas-van Alphen oscillations of magnetization, resulting in oscillatory frequency shifts of up to 1 MHz. This response is over two orders of magnitude larger than the expected response in a "standard" torque magnetometry framework. Instead, we find that the electric field-effect modulation of the magnetic energy provides a gradient force without a magnetic field gradient. Modeling of the effect produces excellent agreement with experiment, using only the disorder as a free parameter. We further use this novel mechanism to quantify the many-body exchange interaction of broken-symmetry QH states. This new mechanism may prove to be a useful tool for magnetic studies across low-dimensional materials and in sensing applications.

[1]The author acknowledges support from Air Force Office of Scientific Research Grant No. MURI FA955009-1-0705