Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Dissipationless Phonon Hall Viscosity SUK-BUM CHUNG, MAISSAM BARKESHLI, XIAO-LIANG QI, Stanford University — We study the acoustic phonon response of crystals hosting a gapped time-reversal symmetry breaking electronic state. The phonon effective action can in general acquire a dissipationless "Hall" viscosity, which is determined by the adiabatic Berry curvature of the electron wave function. This Hall viscosity endows the system with a characteristic frequency, ω_v; for phonons of frequency ω, it shifts the phonon spectrum by an amount of order $(\omega/\omega_v)^2$ and it mixes the longitudinal and transverse sound waves with a relative amplitude ratio of ω/ω_v and with a phase shift of $\pm\pi/2$, to lowest order in ω/ω_v. We study several examples, including the integer quantum Hall states, the quantum anomalous Hall state in $Hg_{1-y}Mn_yTe$ quantum wells, and a mean-field model for $p_x + ip_y$ superconductors. We discuss situations in which the phonon response is directly related to the gravitational response, for which striking predictions have been made. When the electron-phonon system is viewed as a whole, this provides an example where measurements of Goldstone modes may serve as a probe of adiabatic curvature of the gapped sector of a system.

Xiao-Liang Qi
Stanford University

Date submitted: 11 Nov 2011 Electronic form version 1.4