Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Circle of crossings and Berry curvatures in 2D topological insulators[1] MARIUS RADU, YULI LYANDA-GELLER, Department of Physics and Astronomy, Purdue University — HgTe forms a two-dimensional topological insulator when sandwiched between CdTe barriers for a HgTe layer wider than the critical thickness. We derive single-particle and two-particle interaction Hamiltonians describing physics of these compounds by using $\mathbf{k}\ \mathbf{p}$ theory and extended Kane model. We include contributions from upper conduction bands with orbital states of p-symmetry that bring about the terms describing lack of inversion symmetry in host semiconductors. A crucial ingredient is hetero-interface contribution to intrinsic spin-orbit interactions that drives significant anticrossing gaps in spectra at zero wavevector, but results in a circle of spectral crossings at finite wavevectors. Single-particle Hamiltonian and two-particle Hamiltonian contain important spin-dependent terms. The spin-dependent interaction couples orbital motion of one particle with evolution of spin of the other particle. Such particle-particle interactions do not conserve spin and lower the symmetry of exchange interactions, leading, e.g., to Dzyaloshinskii-Moriya exchange term. We study the effects of new interactions on Berry curvature and spin-Hall conductance.

[1]This research was supported by the U.S. Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering under Award DE-SC0010544

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Date submitted: 06 Nov 2015 Electronic form version 1.4