Magnetic interaction and magnetic fluctuations in topological insulators with ordered and disordered magnetic adatoms

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In this work using first-principles Green's function approach we study magnetic properties of the magnetic binary topological insulators Bi_2Se_3, Bi_2Te2_3 and Sb_2Te_3 doped with *3d* transition metals, in bulk and at the surface. We analyze the magnetic phase for each dopant, the exchange interaction, the Curie temperature and the Bloch spectral-function. To study the magnetic interaction at the surface we also consider a system consisting of a topological insulator with an array of magnetic adatoms interacting with the electronic surface state. We find that the indirect coupling of the magnetic impurities results in a ferromagnetic ordering of the magnetic moments and is also responsible for the unusual linear dispersion of the surface magnons. Developing a 2D model we analyze the electron-magnon interaction and we observe that it renormalizes the electron energy spectrum. The renormalized spectrum is nonlinear and can be characterized by a negative effective mass of electrons and holes for any $k \neq 0$. We conclude that the electron velocity near the Dirac point depends on the electron-magnon coupling.

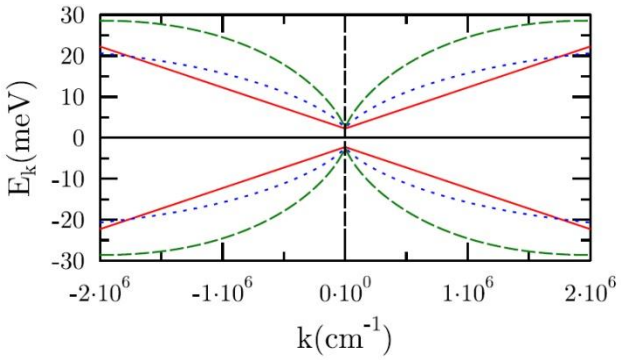

Figure 1. Renormalized electron energy spectrum.

References

[1] Phys. Rev. B 89, 165202 (2014).
[2] Phys. Rev. B 89, 075103 (2014)