Ferromagnetic resonance for spectroscopic investigation of topological surface states

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In most cases, the electronic band structure of a system can only be studied on clean surfaces, e.g., with angle-resolved photoemission electron spectroscopy or scanning tunnelling spectroscopy. Moreover, most applications depend on the interplay between different materials, so the interface has become the crucial factor. We present a spectroscopic tool to study the band structure of an interface, here in the case of a heterostructure comprising topological insulators and a ferromagnetic layer. Since the large spin-to-charge conversion in this hybrid structure might become relevant for future applications [1-2], knowledge of the band structure at the interface of a topological insulator is of particular interest. We use a single ferromagnetic layer, Fig. 1 a), as source and sensor for the angular momentum transferred into an adjacent TI-layer via the spin-pumping mechanism. The dissipation of the angular momentum is based on the spin-to-charge conversion in the topological surface state (TSS), Fig. 1 b). By application of a backgate to a compensated TI [3] fingerprints of the TSS are found, Fig. 1 c).

References

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Figures

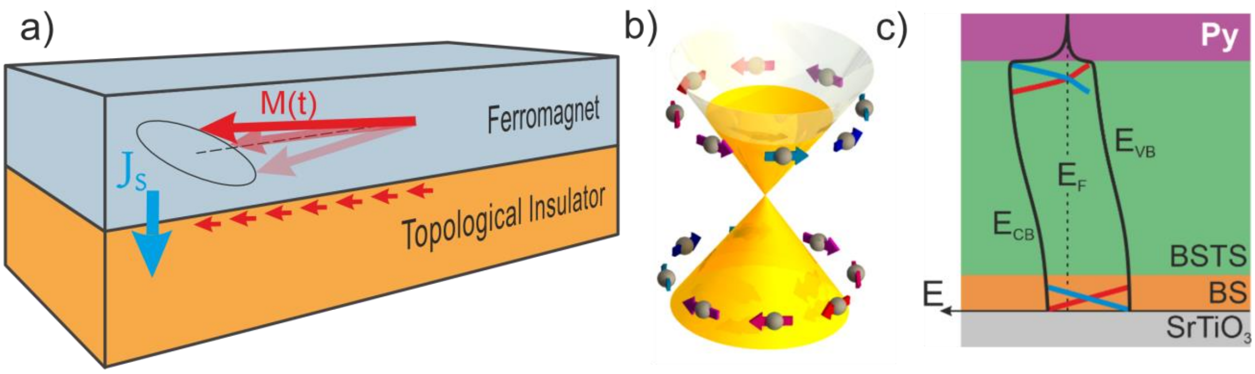

Figure 1: a) FMR-spin-pumping is the basis to investigate a topological surface state in b). The sample structure is a TI comprising a Bi_2Se_3 (BS) seed layer and a $(Bi_{1-x}Sb_x)_2(Te_{1-y}Se_y)_3$ (BSTS) layer, with a ferromagnetic permalloy (NiFe) layer on top. The substrate is $SrTiO_3(111)$, while E_{CB}, E_{VB} are the conduction and valence band energies, and E_F is the Fermi energy.