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Thin-Film Magnetization Dynamics on the Surface of a Topological Insulator

YAROSLAV TSERKOVNYAK, UCLA

We theoretically study the magnetization dynamics of a thin ferromagnetic film exchange coupled with a surface of a strong three-dimensional topological insulator. We focus on the role of electronic zero modes imprinted by domain walls (DWs) or other topological textures in the magnetic film. Thermodynamically reciprocal hydrodynamic equations of motion are derived for the DW responding to electronic spin torques, on the one hand, and fictitious electromotive forces in the electronic chiral mode fomented by the DW, on the other. An experimental realization illustrating this physics is proposed based on a ferromagnetic strip, which cuts the topological insulator surface into two gapless regions. In the presence of a ferromagnetic DW, a chiral mode transverse to the magnetic strip acts as a dissipative interconnect, which is itself a dynamic object that controls (and, inversely, responds to) the magnetization dynamics.