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*Spin conductance and spin conductivity in topological insulators: analysis of Kubo-like terms*

We investigate spin transport in $2$-dimensional insulators, with the long-term goal of establishing whether any of the transport coefficients corresponds to the Fu-Kane-Mele index which characterizes $2d$ time-reversal-symmetric topological insulators. Inspired by the Kubo theory of charge transport, and by using a proper definition of the spin current operator [Phys. Rev. Lett. 96, 076604 (2006)], we define the Kubo-like spin conductance $G_K^{s_z}$ and spin conductivity $\sigma_K^{s_z}$. We prove that for any gapped, periodic, near-sighted discrete Hamiltonian, the above quantities are mathematically well-defined and the equality $G_K^{s_z} = \sigma_K^{s_z}$ holds true. Moreover, we argue that the physically relevant condition to obtain the equality above is the vanishing of the mesoscopic average of the spin-torque response, which holds true under our hypotheses on the Hamiltonian operator. This vanishing condition might be relevant in view of further extensions of the result, e.g. to ergodic random discrete Hamiltonians or to Schrödinger operators on the continuum. A central role in the proof is played by the trace per unit volume and by two generalizations of the trace, the principal value trace and its directional version. This talk is based on joint work with Gianluca Panati (La Sapienza, Roma) and Clément Tauber (ETH, Zürich).