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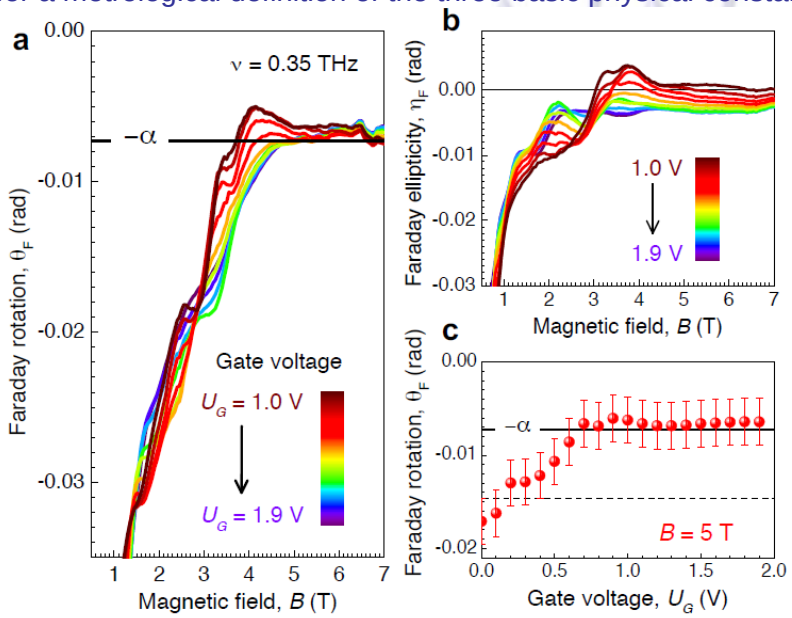
Universal Faraday rotation in topological insulators

Topological insulators are materials which are insulating in the bulk and which reveal conducting surface/edge states. These states are topologically protected against non-magnetic scattering due to their chiral nature. The electrodynamics of topological insulators is described by modified Maxwell's equations, which contain additional terms that couple an electric field to a magnetization and a magnetic field to a polarization of the medium, such that the coupling coefficient is quantized in odd multiples of e2/2hc per surface. The new term leads to universal values of Faraday rotation angle equal to the fine structure constant $\alpha \approx 1/137$ rad when a linearly polarized THz radiation passes through the two surfaces of a topological insulator. These experiments may potentially be used for a metrological definition of the three basic physical constants.



Quantized THz Faraday rotation of Dirac fermions.
a, Faraday rotation and **b**, Faraday ellipticity in a HgTe topological insulator as a function of external magnetic field for different gate voltages (color-coded). The horizontal solid line in a indicates the universal Faraday rotation angle $\alpha \approx 1/137$ rad. **c**, Gate voltage dependence of the Faraday rotation in a magnetic field of 5 T.

[1] In cooperation with: V. Dziom, A. Shuvaev, A. Pimenov, G. V. Astakhov, G. Tkachov, E. M. Hankiewicz, C. Brüne, H. Buhmann, L. W. Molenkamp, N. N. Mikhailov, Z. D. Kvon.

18. November 2016, 14:00 Uhr

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