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Giant anisotropic magneto-resistance in the magnetic topological insulator $\mathbf{Cr}_x\mathbf{(Bi,Sb)}_{2-x}\mathbf{Te}_3$ ABHINAV KANDALA, ANTHONY RICHARDELLA, CHAOXING LIU, NITIN SAMARTH, Pennsylvania State University — We report the observation of a giant anisotropic magneto-resistance (GAMR) effect in the magnetic topological insulator $Cr_x(Bi,Sb)_{2-x}Te_3$ as an external field (and the magnetization M) is rotated from out-of-plane (azimuthal angle $\theta = 0°$) to in-plane ($\theta = 0°$)). While the rotation of a magnetic field in-plane produces a weak, conventional anisotropic magnetoresistance (AMR) that follows the standard angular dependence (AMR $\sim \cos^2\phi$, where ϕ is the angle between M and the current density J), the GAMR is much larger in magnitude and deviates from the standard $\cos^2\theta$, dependence. We explain the observed GAMR through a quantum magnetic phase transition from an "imperfect" quantum anomalous Hall (QAH) insulator to a trivial ferromagnetic semiconductor as the magnetization is tilted from out-of-plane to in-plane. We expect the GAMR to become stronger in the ideal QAH regime where edge state conduction dominates over bulk conduction, thus providing a route toward proof-of-concept ferromagnetic topological insulator transistors and magnetic field sensors. Funded by DARPA.

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