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Step-wise switching of anomalous Hall effect in a topological insulator[1] LUKAS ZHAO, ZHIYI CHEN, INNA KORZHOVSKA, SHIHUA ZHAO, LIA KRUSIN-ELBAUM, CCNY - CUNY, MARCIN KONCZYKOWSKI, Ecole Polytechnique — Surfaces of three-dimensional (3D) topological insulators (TIs) have emerged as one of the most remarkable states of condensed quantum matter where exotic charge and spin phases of Dirac particles could arise. The main challenge to finding these phases comes from a non-vanishing conductivity of the bulk. Recently we have demonstrated that we can access 2D surface transport and reach the charge neutrality point (CNP) by compensating intrinsically p-type TIs using high energy electron beams, and increase bulk resistivity by orders of magnitude. Here we report a discovery of anomalous Hall signal (AHE) at the CNP in Bi_2Te_3 of unprecedented appearance; it shows regions of plateaus on sweeping the temperature, where Hall resistivity is flat in temperature, and has sharp (nearly discontinuous) 'steps' in-between the plateaus. The height of the steps increases on cooling, consistently following the ratio of 1:3 with each step. We will show by electrostatically tuning gated structures how this macroscopic switching of spins evolves in the vicinity of CNP and discuss the phenomenon of step-wise AHE in the context of charge inhomogeneities (puddles) and correlations between the localized bulk spins and Dirac spins.

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