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Visualization of superparamagnetic dynamics in magnetic topological insulators E. LACHMAN, Weizmann Institute of Science, A. F. YOUNG, University of California Santa Barbara, A. RICHARDELLA, The Pennsylvania State University, J. CUPPENS, N. HR, Y. ANAHORY, A. Y MELTZER, Weizmann Institute of Science, A. KANDALA, S. KEMPINGER, The Pennsylvania State University, Y. MYASOEDOV, Weizmann Institute of Science, M. E. HUBER, University of Colorado Denver, N. SAMARTH, The Pennsylvania State University, E. ZELDOV, Weizmann Institute of Science — Magnetically doped topological insulators have recently been shown to host a quantum anomalous Hall (QAH) state at low temperatures. Using scanning nanoSQUID magnetic imaging on a Cr-doped $(Bi,Sb)_2Te_3$ thin film[1], we reveal that the magnetic structure of magnetically doped topological insulators is not ferromagnetic as assumed so far. In fact it is superparamagnetic, formed by weakly interacting magnetic domains. These domains have a characteristic size of a few tens of nanometers, and undergo random reversals which drive the electronic state from one Hall plateau to the other. The superparamagnetic state is metastable, with small energy barriers to relaxation. We observe magnetic relaxation even at 300 mK, evident also in transport measurements. Unexpectedly, magnetic relaxation can also be induced by varying the gate voltage, and we propose a mechanism for the influence of the electronic phase on the magnetic relaxation. We speculate that the dynamic nature of magnetic disorder in QAH systems may contribute to the observed fragility of the QAH state at elevated temperatures. [1] Lachman *et al, arXiv:1506.05114*

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