Linear magnetoresistance in disordered magnetically doped topological insulator Bi$_2$Te$_3$ INNA KORZHOVSKA, LUKAS ZHAO, ZHIYI CHEN, MILAN BEGLIARBEEKOV, HAIMING DENG, City College of New York-CUNY, SIMONE RAOUX, IBM Research - Yorktown Hts, LIA KRUSIN-ELBAUM, City College of New York-CUNY — First-principle calculations predict that certain topological insulators (TIs) can turn ferromagnetic (ferro-TIs) when doped with magnetic ions such as Fe or Cr. These ferro-TIs support anomalous Hall effect (AHE) that becomes quantized in the thin film limit. In the absence of disorder, doping with vanadium (SP = 0.7 eV per V, comparable to Fe) is not expected to produce a ferro-TI due to the position of vanadium 3D bands. Here we show that disorder introduced by doping vanadium into Bi$_2$Te$_3$ thin films has three remarkable effects: (i) it shows unusual AHE as seen in the hysteretic behavior of Hall conductance that does not scale with magnetization M, (ii) it forms a donor band that turns conductivity type from p- to n- and turns R vs. T from metallic to semiconducting-like, and (iii) it results in a large region below 100 K that has negative linear magnetoresistance (MR) in high magnetic fields. A large positive linear MR was observed in silver chalcogenides Ag$_{2+d}$Se and Ag$_{2+d}$Te, consistent with the predicted quantum linear MR in disordered semimetals. We will discuss this mechanism in a TI, including the MR sign reversal arising from frustrated magnetic doping. * Supported in part by NSF-DMR-1122594, NSF-DMR-1312483-MWN, and DOD-W911NF-13-1-0159

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