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Dimensional Crossover Induced Topological Hall Effect in a Magnetic Topological Insulator[1] CHANG LIU, YUNYI ZANG, WEI RUAN, YAN GONG, KE HE, XUCUN MA, QIKUN XUE, YAYU WANG, Tsinghua Univ, STATE KEY LABORATORY OF LOW DIMENSIONAL QUANTUM PHYSICS TEAM, COLLABORATIVE INNOVATION CENTER OF QUANTUM MATTER TEAM — The realization of quantum anomalous Hall effect in magnetic topological insulators (TIs) unambiguously proves the intrinsic mechanism of anomalous Hall effect (AHE) associated with the Berry curvature in momentum space. The real space configuration of the local moments in magnetic TIs may also have unique topological properties. The entanglement of momentum and real space topology in magnetic TI can lead to novel quantum phenomena, such as the emergence of skyrmions. Here we report experimental investigations of Mn-doped Bi_2Te_3 TI films with accurately controlled thickness grown by molecular beam epitaxy. We found that films thicker than 5 quintuple-layer (QL) exhibit the usual AHE as commonly observed in magnetic TIs. When the thickness is reduced to 4 QL, however, characteristic features associated with the topological Hall effect (THE) emerge. More surprisingly, the THE vanishes again when the film thickness is further reduced to 3 QL. Theoretical calculations demonstrate that the coupling between the top and bottom surface states at the dimensional crossover regime leads to magnetic skyrmion structure that is responsible for the THE.

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