19BG044, 19BU002, 19BU005, 19BU012 BL-1, Laser-ARPES

Half-Magnetic Topological Insulator with Magnetization-Induced Dirac Gap at a Selected Surface

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Keywords: axion-insulator, $MnBi_8Te_{13}$, angle-resolved photoemission spectroscopy, magnetic topological materials.

The recent discovery of the intrinsic magnetic topological insulator (TI) $MnBi_2Te_4$ and $MnBi_2Te_4/(Bi_2Te_3)_n$ (n=1,2,3,…) have boosted exciting possibilities of producing exotic quantum phenomena by engineering topology and magnetism at the atomic scale [1-4]. Such magnetic TIs are promised to host two exotic quantum phenomena: the “quantum anomalous Hall effect” and the “axion insulating state” [5, 6]. The former has integer-quantized surface Hall resistivity, while the later might present Half-quantized surface resistivity. However, partially because of the lack of a suitable material, it is still not clear if the Half-quantized surface resistivity can be observed in transport measurement, lacking the direct proof of the “axion insulating state”.

In this study, we performed a μ-Laser-angle-resolved photoemission spectroscopy (μ-Laser-ARPES) on an intrinsic ferromagnetic TI, $MnBi_2Te_4$-$(Bi_2Te_3)_3$ ($MnBi_8Te_{13}$), and demonstrated that $MnBi_8Te_{13}$ can be an ideal platform to explore and manipulate the exotic half-quantized surface resistivity. The energy bands show a Dirac gap at the magnetic $MnBi_2Te_4$ layer but gapless Dirac cone at its nonmagnetic Bi_2Te_3 layers in the opposite side. Remarkably, the magnetic Dirac gap (~ 28 meV) decreases monotonically with increasing temperature and closes right at the Curie temperature (as shown in Figure 1), smoking-gun evidence of magnetization-induced topological surface gap among all known magnetic topological materials.

(This work has been published in *Physical Review X* **11**, 011039 (2021))

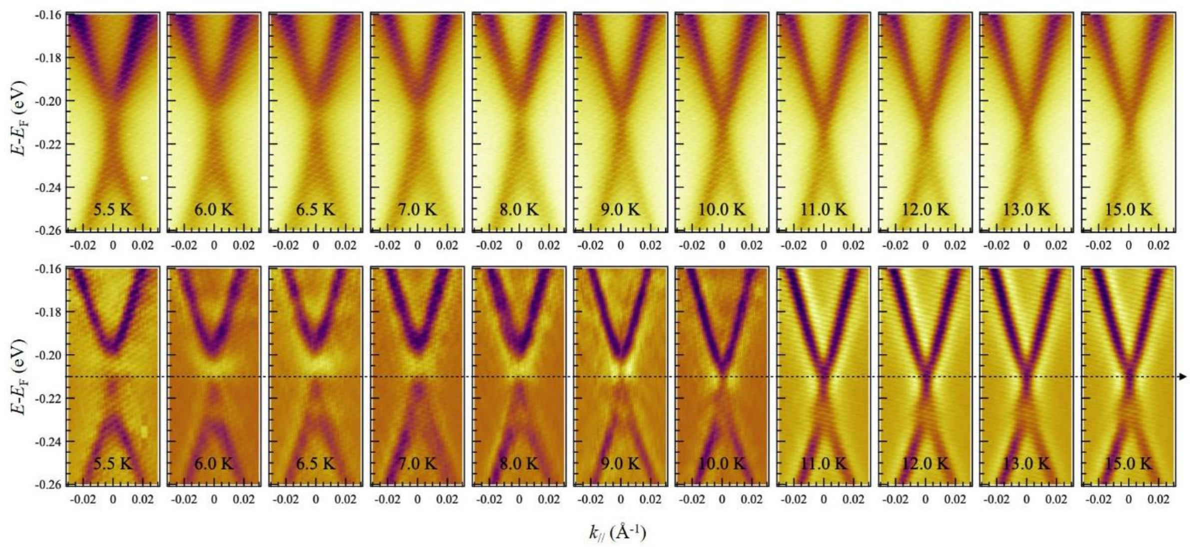

FIGURE 1. ARPES results of the Dirac gap evolution with temperature at the magnetic $MnBi_2Te_4$ layer of $MnBi_8Te_{13}$. Spectra

are shown in the form of original ARPES spectra (top row) and 2D curvature spectra (bottom row). Black dashed line indicates the position of gapless Dirac point.

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