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SIGNATURES OF TEMPERATURE DRIVEN ANTIFERROMAGNETIC TRANSITION IN THE ELECTRONIC STRUCTURE OF TOPOLOGICAL INSULATOR $MnBi_2Te_4$

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A combination of magnetic and topological orders in novel quantum materials has unlocked an intriguing research area in condensed matter physics. Breaking of time reversal symmetry (TRS) in 3D topological insulators (TI) has been recently proposed to be the way to realize the quantum anomalous Hall effect (QAHE) [1]. When TRS is broken via exchange interaction the topological surface states (TSS) are no longer protected and a gap opens at the Dirac point (DP) [2]. This leads to the creation of chiral 1D edge states with quantized Hall resistance. Magnetism can be induced into TIs in the following ways: doping with magnetic atoms, via a proximity effect, magnetic extension of TI crystal structure or the creation of intrinsic magnetic TI [3]. To this date, the most common way and the only one with experimentally observed QAHE [1] is doping of 3D TI $(Bi,Sb)_2(Te,Se)_3$ with magnetic 3d or 4f elements. However, the highest observed critical temperature required for QAHE has been limited to 1 K which could be caused by the arbitrary localisation of magnetic atoms. The temperature of the TI transition to the QAHE regime is expected to be related to the size of the band gap at the DP and the TI's magnetic ordering temperature [3]. Therefore, the recently discovered intrinsic antiferromagnetic (AFM) TI $MnBi_2Te_4$ (MBT) [4] has a great potential to show a high-temperature QAHE.

Indeed, it was shown that MBT is characterised by a high Neel temperature (T_N) and a large band gap at the DP in comparison with magnetically doped TIs. The material has a layered structure and consists of septuple layer blocks [Te-Bi-Te-Mn-Te-Bi-Te] stacked along the *c* axis and separated by van der Waals gaps. From magnetic measurements it was shown that MBT exhibits an A-type AFM ordering with an easy axis perpendicular to the layers, i.e. parallel to *c* [4]. According to theoretical calculations and direct magnetic measurements T_N of MBT is about 25 K. Below T_N theory predicts an opening of a giant band gap of ~80 meV at the DP in case of A-type AFM ordering. Experimentally such order gaps for MBT have been reported in [4]. However, several recent experiments propose small gap (< 20 meV) [5] which is explained in terms of a deviation of the surface magnetic ordering from the bulk. These deviations are suggested to be caused by reconstruction processes and sensitivity to surrounding environments. This inconsistency of results indicates the possibility of a complex space-varying magnetic structure in MBT. Therefore, a more detailed investigation of the system's evolution processes in respect to the emerged magnetic state is required.

With this intension here we will present a detailed study of the electronic structure in paramagnetic (PM) and AFM phases in MBT by means Laser-based angle resolved photoemission spectroscopy [6]. We demonstrate that both the bulk conduction band (BCB) states and the topological surface state (TSS) spectral weight are affected by the emerged magnetism. These findings will be discussed as an evedance pointed to the interplay between magnetism with bulk and topological surface states. The observed temperature-dependent effects in MBT may be used as an experimental fingerprint for the presence of magnetism and may guide the future analysis of ARPES spectra in magnetic topological insulators.

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