Interference, diffraction, and diode effects in superconducting arrays based on $Bi_{0.8}Sb_{1.2}Te_3$ topological insulator

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Abstract
t is a well known phenomenon in optics that spectroscopic resolution of a diffraction grating is much better compared to an interference device having just two slits, as in the Young's famous double-slit experiment. On the other hand, it is well known that a classical superconducting quantum interference device (SQUID) is analogous to the optical double-slit experiment. Here we report experiments and present a model describing a superconducting analogue to the diffraction grating, namely an array of superconducting islands positioned on a topological insulator (TI) film Bi0.8Sb1.2Te3 [1]. Previously, the proximity effect has been studied extensively on epitaxial topological films which are not intrinsic, due to unintentional doping, such as Bi_2Se_3 [2]. Here we are able to induce a strong proximity superconductivity into an epitaxial film of an intrinsic topological insulator. In the limit of extremely weak field, of the order of one vortex per the entire ar ray, such devices exhibit a critical current peak that is much sharper than the analogous peak of an ordinary SQUID. Because of this, such arrays can be used as sensitive absolute magnetic field sensors. An important finding is that, due to the inherent asymmetry of such ar rays, the device also acts as a superconducting diode.[3]

References

[1] Hlevyack, J.A. et al. Massive Suppression of Proximity Pairing in Topological (Bi1−xSbx)2Te3 Films on Niobium. Phys. Rev. Lett. 124, 236402 (2020).
[2] Flototto, D. et al. Superconducting pairing of topological surface states in bismuth selenide films on niobium. Science Advances 4, 7214 (2018).
[3] Xiangyu Song et al., https://arxiv.org/pdf/2209.14266.pdf

Figures

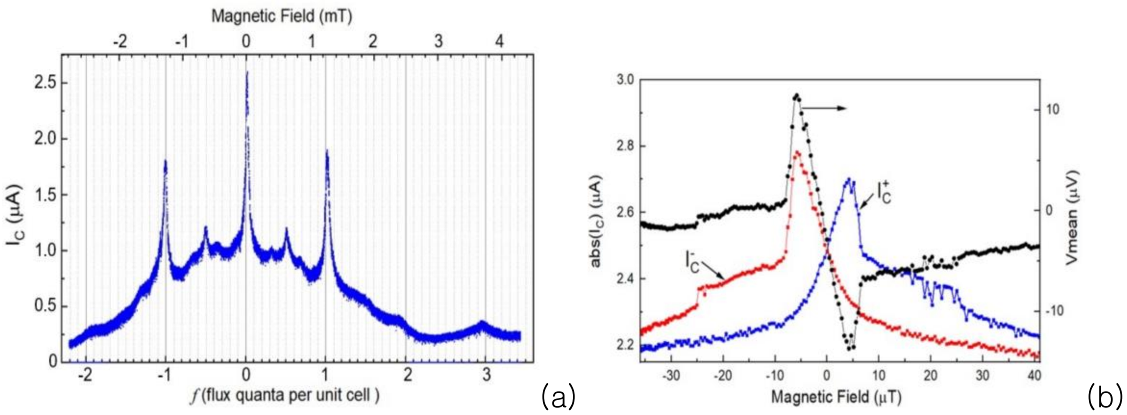

Figure 1: (a) Critical current versus the normalized flux per unit cell, f . The critical current shows sharp peaks coinciding with integer values of f. The peak f = 2 is suppressed more than n=0 and n=3. (b) Mean voltage, critical current on positive and negative branches plotted as a function of magnetic field.