Microwave transport in HgTe topological insulators

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Research on helical edge states in 2D topological insulators is motivated by exotic fundamental physics, prospects for robust topological quantum computation and novel spinorbitronics. However, topological transport is often visible only on short distances. On larger distances, microwave transport offers powerful tools to investigate the origin of this fragility, or to dynamically enhance topological signatures by exploiting the high mobility of edge states with respect to bulk carriers.
In this talk, we report on microwave transport in HgTe 2D topological insulators [1, 2]. Via microwave capacitance spectroscopy, we highlight the response of the edges which host very mobile carriers, while bulk carriers are present as puddles but are drastically slowed down in the gap. This suggests that edge states can be selectively addressed on timescales over which bulk carriers are frozen. In a second study [3], we measure the velocity of edge states in both the quantum Hall and quantum spin Hall regime. The low observed velocities again point towards the prominent role of charge puddles in the topological gap.

References

[1] M.C. Dartiailh et al., Phys. Rev. Lett., 124 (2020) 076802
[2] A. Gourmelon et al., Phys. Rev. Res., 2 (2020) 043383
[3] A. Gourmelon et al., in preparation (2023)

Figures

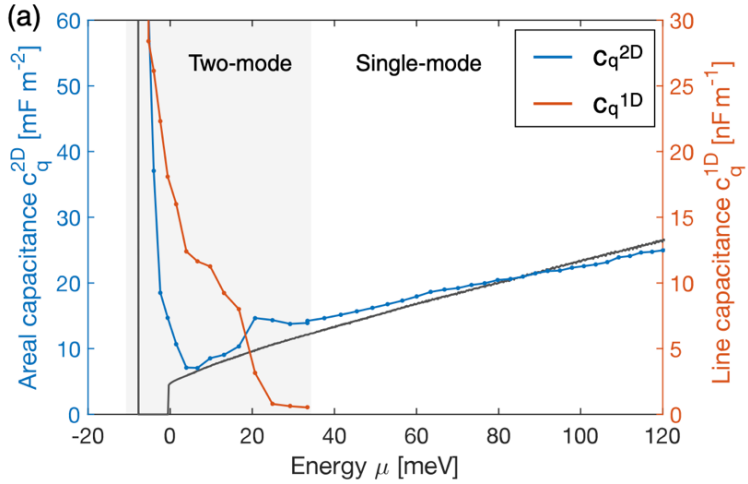

Figure 1: Measured edge and bulk quantum capacitance of a HgTe 2D topological insulator