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Quantum interference of edge supercurrents in a two-dimensional topological insulator[1] GRIGORY TKACHOV, PABLO BURSET, BJOERN TRAUZETTEL, EWELINA HANKIEWICZ, Wurzburg University — Josephson weak links made of two-dimensional topological insulators (TIs) exhibit magnetic oscillations of the supercurrent that are reminiscent of those in superconducting quantum interference devices. We propose a microscopic theory of such a TI SQUID effect [1]. The key ingredient of our model is the exact treatment of the influence of an external magnetic field on the edge supercurrents. We show that this influence has the form of a 1D Doppler effect that describes the flux-controlled interference of the edge currents with superimposed suppression of Andreev reflection. Both long and short junctions are discussed. In particular, for long junctions the theory shows a temperature-driven crossover from the normal Φ_0-periodic SQUID pattern to a 2 Φ_0- quasiperiodic pattern consisting of a series of alternating even and odd peaks (where Φ_0=ch/2e is the magnetic flux quantum). The predicted even-odd effect is the signature of gapless (protected) Andreev bound states with a sawtooth dependence on the magnetic flux. Our findings may shed some light on the recently observed even-odd interference pattern in InAs/GaSb-based TI Josephson junctions, suggesting new operation regimes for nano-SQUIDs.

[1] G. Tkachov, P. Burset, B. Trauzettel, and E.M. Hankiewicz, arXiv:1409.7301.

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