Edge currents shunt the insulating bulk in gapped graphene

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It is possible to open an energy gap in the electronic spectrum of graphene by lifting its sublattice symmetry1, with gaps as large as 250meV measured in bilayer graphene2. Interestingly, these gaps rarely lead to a highly insulating state expected at low temperatures. This is usually explained by charge inhomogeneity3. Here we investigated proximity - induced superconductivity in graphene-based Josephson junctions. We find that the supercurrent at the charge neutrality point in gapped graphene propagates along narrow channels near the edges. We also compared normal-state measurements in the Hall bar and Corbino geometries. In the Hall bar geometry, we observed a saturation of the resistivity to values of a few resistance quanta at the neutrality point. In contrast, resistivity at the neutrality point in the edgeless Corbino geometry increases exponentially as the gap is increased, as expected for an ordinary semiconductor. We attribute the metallic-like edge conductance to a non-trivial topology of gapped Dirac spectra.

References

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