Signatures of van Hove singularity probed by the supercurrent in a graphene – hBN superlattice

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If a graphene layer is placed on top of hexagonal boron nitride such that their crystallographic axes are almost aligned, a Moiré superlattice forms. The resulting periodic potential modifies deeply the graphene band-structure, manifesting by the appearance of new Dirac peaks together with van Hove singularities at energies low enough to be reached with standard electrostatic gating. In this work, we investigate the Josephson effect in such a superlattice and find signature of its specific band-structure on the supercurrent and its distribution across the junction.

The sample is a Josephson junction in the long and diffusive regime, such that the product of the critical current I_c and of the normal state resistance R_n is expected to depend on the Thouless energy and thus on the density of states (DOS). In this regard, we find that our measurements are consistent with the DOS expected in such a system.

By measuring the interference pattern of the critical current as a function of the perpendicular magnetic field, we show as well that the current distribution depends on the gate voltage, exhibiting edge current at the van Hove singularity. This demonstrates that, while the current is suppressed in the bulk due to the strong reduction of the Fermi velocity associated to the divergence of the DOS, it is not the case in the edges. This result brings an additional light on previous studies reporting edge current for vanishing density of states at the charge neutrality point.

[1] Zhu et al. Edge currents shunt the insulating bulk in gapped graphene. Nat. Commun. **8**, 14552 (2017)

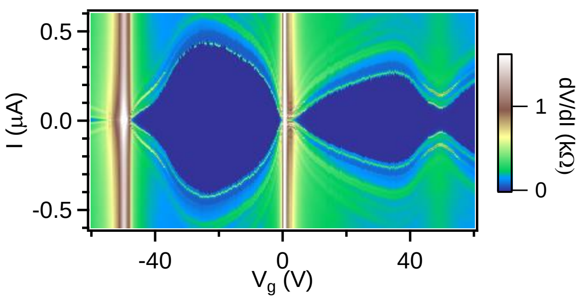

Figure 1: Differential resistance as a function of bias current I and gate voltage Vg, at zero magnetic field. The dark blue region corresponds to the superconducting state, its boundaries thus yields the critical current I_c.