Fabry-Perot Oscillations in Dual-gated Graphene Josephson Junctions

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Abstract: Exploring emergent superconducting phenomena such as chiral Andreev modes and parafermions requires the development of materials and devices that facilitate ballistic transport and gate tunability of the emergent properties. Here, we report on the high-quality dual graphite gated ballistic graphene JJs. The dual graphite gating ensures the high quality of our devices by lowering the bulk disorder, thereby enabling the observation of early four-fold degeneracy breaking of the lowest Landau level at relatively low magnetic fields, e.g., ~ 2.5 T. In these devices, we observe a Fabry-Perot (FP) cavity, and explore the gate tunability of the cavity length and the temperature dependence of the critical current under different FP resonance conditions. Finally, we study multiple Andreev reflections in the intermediate to long junction limit. Our results pave the way towards the future exploration of elusive Majorana and parafermion states in ultraclean JJs for quantum computation purposes.