Ballistic graphene Andreev interferometers

Asmaul Smitha Rashid, Le Yi, Nitin Samarth, Régis Melin, and Morteza Kayyalha

Abstract: Multiterminal Josephson Junctions (JJs) have emerged as a rich platform for studying emergent phenomena, including non-trivial current-phase relations, topological phases, and Floquet-Andreev states. In this work, we investigate the nonequilibrium population of Andreev bound states (ABSs) in a voltage-biased, three-terminal graphene Andreev interferometer. We fabricate three-terminal Andreev interferometers on hBN/graphene/hBN van der Waals heterostructures, which are edge-contacted by Ti (10nm)/Al (80 nm) electrodes. We select graphene as the material of choice because graphene shows ballistic transport and gate tunability of superconducting coupling. Furthermore, graphene's ballistic nature allows for the formation of long-lived Andreev resonances in contrast to diffusive JJs, where resonances are often short-lived.. These findings pave to way towards the study of nonequilibrium quantum transport for future applications in cryogenic electronics and superconducting qubits.