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Gate-tunable control from diffusive to ballistic proximity superconducting regime in a long graphene Josephson junction S DUBEY, Nel Institute, Grenoble, France, Z HAN, Nel Institute, Grenoble, France; Physics department, Columbia University, NY, USA, B WEN, Physics department, Columbia University, NY, USA, H GOTO, Nel Institute, Grenoble, France, C DEAN, Physics department, Columbia University, NY, USA, V BOUCHIAT, Nel Institute, Grenoble, France — We study a wide and long graphene Josephson junction, where the graphene is 1D-contacted by NbN electrodes and encapsulated between two boron nitride flakes. Additional normal-metal side-electrodes enable a non-invasive measurement of the voltage drop (4W) across the junction. Both below and above transition parameters of the superconducting state (critical current and temperature), a gate-dependent zero-voltage state between these normal contacts is observed. This indicates the dual nature of the zero-voltage as the junction can be either in a normal ballistic regime or in a proximity superconducting state. Measuring the 4W voltage as a function of the current bias, temperature, gate voltage and magnetic field enable to build phase-diagram for both the diffusive/ballistic states and normal/superconducting states, defining a gate-controlled transition from ballistic to diffusive Josephson junction. A diffusive intermediate state is found close to the charge neutrality point, while ballistic regime is found both at high electron and hole doping regimes. The temperature dependence of the critical current provides a second and independent measurement of diffusivity in the proximity Josephson junction. It is found to be strongly affected by the diffusive/ballistic regime.

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