Supercurrent through Monolayer and Multilayer Graphene

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We have theoretically studied the critical current through superconductor-graphene-superconductor junction using tunneling approximation and diagramatic technique[1]. In our theory, electron transfer between superconductors and graphene is treated by tunnel Hamiltonian and the critical current through the junction is calculated by perturbative expansion with respect to the tunneling matrix elements. In this paper, we present our recent development on this topic. We especially pay attention to the differences between tunneling through A- and B-sublattice of graphene. We report the following new results: i) the vanishing density of states at Dirac point in monolayer graphene leads to peculiar temperature dependence of critical current, ii) the critical current of bilayer system oscillates as a function of temperature and junction length, which indicates the existence of intrinsic interference effects in bilayer systems. We also investigate the correspondence of our theoretical results to those obtained by experiments.

1. M. Hayashi, A. Kanda, H. Yoshioka, J. Phys.: Conf. Ser., **248** (2010) 012002.