Quantum Metastable States in Graphene-based Josephson Junctions

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Recently, supercurrents have been measured in graphene-based Josephson junctions. These devices consist of two parallel superconducting leads deposited onto single- and few-layer graphene flakes. Superconductivity in the undoped graphene is induced in the areas near the superconducting leads due to the superconducting proximity effect. The dependence of the critical current on the external magnetic field has a Fraunhofer-like pattern showing a uniformly distributed tunneling current and Shapiro steps appear in the current-voltage measurement when the devices are irradiated with microwaves. These effects clearly demonstrate the Josephson effects. We are motivated by these results to investigate the existence of metastable quantum states like those in conventional current-biased Josephson junctions. We propose to add a shunting capacitor in parallel in order to lower the plasma frequency to a detectable range. We have made 2- to 4-layer graphene flakes via the mechanical exfoliation technique and fabricated devices using electron-beam lithography. We explore metastable states using spectroscopy which consists of measuring switching events while irradiating with microwaves. We report on our results of these experiments.