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Dissipation-driven quantum phase transition in superconductor-graphene systems[1] ROMAN LUTCHYN, VICTOR GALITSKI, University of Maryland, GIL REFAEL, California Institute of Technology, SANKAR DAS SARMA, University of Maryland — We show that a system of Josephson junctions coupled via low-resistance tunneling contacts to graphene substrate(s) may effectively operate as a current switching device. The effect is based on the dissipation-driven superconductor-to-insulator quantum phase transition, which happens due to the interplay of the Josephson effect and Coulomb blockade. Coupling to a graphene substrate with gapless excitations further enhances charge fluctuations favoring superconductivity. The effect is shown to scale exponentially with the Fermi energy in graphene, which can be controlled by the gate voltage. We develop a theory, which quantitatively describes the quantum phase transition in a two-dimensional Josephson junction array, but it is expected to provide a reliable qualitative description for one-dimensional systems as well. We argue that the local effect of dissipation-induced enhancement of superconductivity is very robust and a similar sharp crossover should be present in finite Josephson junction chains.

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