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Unconventional superconducting quantum interference in a suspended graphene resonator MONICA ALLEN, DANIYAR NURGALIEV, Harvard University, ANTON AKHMEROV, Delft Technical University, AMIR YACOBY, Harvard University — In a coherent electron cavity, quantum interference of electron waves replaces classical diffusion as a key feature of electronic transport. Here we report novel behavior that emerges by coupling superconducting reservoirs to a Fabry-Perot resonator in bilayer graphene. In this device, a pair of superconducting electrodes is coupled to a suspended graphene membrane and defines a ballistic cavity between the two graphene-electrode interfaces. Tuning the Fermi wavelength in the cavity with a gate electrode moves the system on and off resonance, thus inducing an oscillatory critical current whose period satisfies the Fabry-Perot interference conditions. By varying the magnetic flux through the junction, we explore the rich interplay between superconducting quantum interference and resonant cavity states and demonstrate a non-trivial correspondence between the supercurrent and normal state resistance. To describe our findings, we use a numerical model based on the tight-binding approach and Landauer-Buttiker scattering formalism. These results constitute a departure from the conventional Josephson effect in graphene and motivate exploration of new effects at the intersection of superconductivity and optics-like phenomena.

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