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Ballistic Graphene Josephson Junctions from the Short to the Long Junction Regimes: Part I- Governing Energy Scales of the Short and Long Junctions. IVAN BORZENETS, University of Tokyo, FRANCOIS AMET, Appalachian State University, CHUNG TING KE, ANNE DRAELOS, MING-TSO WEI, ANDREW SEREDINSKI, Duke University, KENJI WATANABE, TAKASHI TANIGUCHI, National Institute for Materials Science, YURIY BOMZE, Duke University, MICHIHISA YAMAMOTO, SEIGO TARUCHA, University of Tokyo, GLEB FINKELSTEIN, Duke University — We examine the behavior of the critical current, in ballistic Josephson junctions made of encapsulated graphene/boron-nitride heterostructures. The temperature dependence of the critical current allows us to identify and observe the crossover from the short to the long junction regimes. (The operational regime of a junction is defined by the ratio of the superconducting coherence length ξ to the junction length L). For each regime we extract the governing energy scales, which are found to be consistent with theory. In the short regime, the energy is consistent with the expected superconducting gap Δ. While in the long regime, the governing energy δE is independent of the carrier density and proportional to the level spacing of the ballistic cavity, as determined from Fabry-Perot oscillations of the junction normal resistance. However, in the intermediate regime, we find that junctions behave as if in the long regime, but with δE (which is typically a function of L) rescaled as L$\rightarrow$L+ξ.

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