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Electron-hole interference in graphene[1] ATIKUR RAHMAN, JANICE WYNN GUIKEMA, SOO HYUNG LEE, NINA MARKOVIC, Johns Hopkins University — The crystal symmetry of graphene gives rise to massless Dirac low-energy quasiparticles which are described by a two-component spinor that has contributions from two interpenetrating sublattices. As a result, the electron and hole states are interconnected, in sharp contrast to conventional semiconductors. Through the Aharonov-Bohm effect, we demonstrate that the electrons and holes in graphene exhibit quantum interference with each other. Our device is made of a graphene ring in contact with gold leads. A top gate on one arm of the ring independently controls the carrier type and concentration in that arm, while the back gate acts on both arms. We observe clear Aharonov-Bohm oscillations (overall visibility $\sim$10%) in the magnetoresistance when the charge carriers are holes in one arm and electrons in the other arm. This indicates phase coherence between the electrons and holes in the two arms of the interferometer. Phase coherence is further substantiated by our observations of $T^{-1/2}$ temperature dependence of the oscillation amplitude.

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