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The lifetime of Dirac plasmons in graphene[1] ALESSANDRO PRINCIPI, GIOVANNI VIGNALE, Department of Physics and Astronomy, University of Missouri, Columbia, Missouri 65211, USA, MATTEO CARREGA, MARCO POLINI, NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, I-56126 Pisa, Italy — Dirac plasmons in a doped graphene sheet have recently been shown to enable confinement of light to ultrasmall volumes. In this work we calculate the intrinsic lifetime of a Dirac plasmon in a doped graphene sheet by analyzing the role of electron-electron interactions beyond the random phase approximation. The damping mechanism at work is intrinsic since it operates also in disorder-free samples and in the absence of lattice vibrations. We demonstrate that graphene's sublattice-pseudospin degree of freedom suppresses intrinsic plasmon losses with respect to those that occur in ordinary two-dimensional electron liquids. We relate our findings to a microscopic calculation of the homogeneous dynamical conductivity at energies below the single-particle absorption threshold. Finally, we compute the impact of disorder on Dirac plasmon losses and then show that a very reasonable concentration of charged impurities yields a plasmon damping rate which is in good agreement with s-SNOM experimental results.

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