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Plasmons and Coulomb drag in Dirac/Schroedinger hybrid electron systems[1] ALESSANDRO PRINCIPI, MATTEO CARREGA, NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, I-56126 Pisa, Italy, REZA ASGARI, School of Physics, Institute for Research in Fundamental Sciences (IPM), Tehran 19395-5531, Iran, VITTORIO PELLEGRINI, MARCO POLINI, NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, I-56126 Pisa, Italy — We show that the plasmon spectrum of an ordinary two-dimensional electron gas (2DEG) hosted in a GaAs heterostructure is significantly modified when a graphene sheet is placed on the surface of the semiconductor in close proximity to the 2DEG. Long-range Coulomb interactions between massive electrons and massless Dirac fermions lead to a new set of optical and acoustic intra-subband plasmons. Here we compute the dispersion of these coupled modes within the Random Phase Approximation, providing analytical expressions in the long-wavelength limit that shed light on their dependence on the Dirac velocity and Dirac-fermion density. We also evaluate the resistivity in a Coulomb-drag transport setup. These Dirac/Schroedinger hybrid electron systems are experimentally feasible and open new research opportunities for fundamental studies of electron-electron interaction effects in two spatial dimensions.

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