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Strong coupling between graphene surface plasmon and intersubband transitions

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The strong coupling between the surface plasmon generated on a graphene ribbon and the intersubband transition in a quantum well (QW) is investigated by means of simulations. Scattering matrix and finite element analysis codes have been employed. The optical response of the ribbon and QW is reproduced through the dielectric function. The ribbon transmission spectrum splits in two branches when the frequency of the intersubband transition matches that of the ribbon resonance. The vacuum Rabi splitting is observed in the transmission spectrum even for very low densities in the quantum well, suggesting that the formation of intersubband polaritons is possible even when single QW electrons are interacting with the graphene plasmon mode. This is a consequence of the extreme confinement of the plasmon mode under the graphene ribbon, leading to a very intense field concentration also in the QW. This opens the possibility of exploring the establishment of quantum non-linearities, related to the dependence of the Rabi energy on the number of photons. Beyond interesting fundamental physics at the crossover between vacuum and classical Rabi oscillations, the system could form the basis for novel all-optical functionalities, like bistable switches, photon blockade devices, etc.

Biography

F Pisani achieved his Master's degree in Plasma Physics and started his PhD few months later in the Physics Department in Pisa. He published an article regarding Ultrafast Plasmonics and he is now working on Graphene Plasmonics.

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