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Plasmonics in Quantum Plasmas with two Species of Free Charge Particles[1] MODJTABA MOAIED, Plasma Nanoscience @ Complex Systems, School of Physics, The University of Sydney, Australia, KOSTYA OSTRIKOV, Plasma Nanoscience Centre Australia, CSIRO Materials Science and Engineering, Australia — The field of quantum plasma nanoscience is increasing and motivated by its potential applications in modern technology (e.g. metallic and semiconductor nanostructures including metallic nanoparticles, nano-plasmonic devices, quantum dots, thin metal films, quantum well, etc.). The collective oscillations in quantum plasmas have been studied by many theoretical and experimental works. In most of them, plasmonics were investigated in metallic structures and those are collective oscillations of conduction electrons in quantum plasmas with one species of free charge particles. In this work, plasmonics in semiconductors with two types of free charge carriers are investigated taking into account the collision between free charge carriers and lattice. The spectra and damping of plasmonic are analytically and numerically obtained in three referred types of plasmons: (1) Volume or Bulk Plasmons, (2) Surface Plasmon Polaritons, and (3) Localised Surface Plasmons. It shows that weakly damped plasmonics propagate in highly doped semiconductors (e.g., by electron density $n_e \gg 10^{15}\,\mathrm{cm}^{-3}$ in a N-type Silicon at room temperature) and the energy of plasmonics in semiconductors is significant smaller than that in metals (i.e., in THz renge).

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