Low frequency Compressional modes in degenerate semiconductor plasmas

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Properties of low frequency compressional electromagnetic wave pulse in a magnetized semiconductor hole-electron plasma, are investigated. The quantum mechanical effects such as Fermi pressure, quantum tunneling and exchange-correlation potential of inertialess electrons, inertial holes and stationary charged ion particulates are considered in the presence of the magnetic field. A new type of dispersion relation is derived for low-frequency compressional waves by employing quantum magneto-hydrodynamic model and Maxwell equations; the dispersion relation is then analyzed for parallel, perpendicular and oblique propagation of compressional electromagnetic wave pulse to the external magnetic field direction. We have analyzed the obtained dispersion relations numerically, for different semiconductor plasma such as GaAs, GaSb and, GaN, the graphs shows that the frequency of compressional electromagnetic wave pulse decreases with increase of electron-hole density concentration, whereas the frequency increases with the increase of angle of propagation compressional electromagnetic wave pulse. Our results are applicable to understanding the dynamics of semiconductor plasma to produce high power, high band-width devices in contrast to the existing gas plasma devices.

Keywords: degenerate semiconductor plasma, quantum mechanical effects, compression electromagnetic wave, gas plasma device.

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