ABSTRACT

Using relativistic Vlasov-Maxwell equations, a general expression for the conductivity tensor is derived in spherical polar coordinates. Modes of ultra relativistic electron plasma embedded in a strong magnetic field are investigated for perpendicular propagation. For this purpose, an ultra-relativistic Maxwellian distribution function is employed to derive different modes for strong magnetic field limit. In particular, the dispersion relations for the ordinary mode and the extraordinary mode (O-mode and X-mode) are obtained. Graphs of these dispersion relations and of the imaginary part of the frequency are drawn for some arbitrary values of the parameters. It is observed that the damping rate increases gradually, reaches some maximum point and then decreases for larger wavenumbers. Further, increasing the strength of the magnetic field lowers the maximum value of the damping rate.

Bernstein mode for a relativistic degenerate electron plasma is also investigated. By employing Fermi-Dirac distribution function a generalized dispersion relation for the Bernstein mode is obtained. Two cases i.e., non-relativistic and ultra-relativistic are discussed. The dispersion relations obtained are graphically presented for some specific values of the parameters depicting how the propagation characteristics of Bernstein waves as well as the Upper Hybrid oscillations are modified with the increase in plasma number density.