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Propagation Characteristics of Parallel Propagating Waves in a Relativistic Magnetized Electron Plasma

Waseem Khan[1], M Ali[2], Ayesha Kanwal[2], Huzaifa Bilal[2], Tajammal H. Khokhar[2] and Yousaf Habib[3]
[1]Department of Physical Electronics, Faculty of Science, Masaryk University, Kotlářská 2, Brno 611 37, Czech Republic
[2]School of Natural Sciences (SNS), National University of Sciences and Technology (NUST), Islamabad 44000, Pakistan
Department of Mathematics, COMSATS University Islamabad, Lahore Campus, Lahore, Pakistan
email (speaker):mas.gcu@gmail.com

Propagation characteristics (propagation regions and cutoffs) of parallel propagating modes (Langmuir, right- and left-handed circularly polarized waves) are studied for relativistic, weakly relativistic and non-relativistic magnetized electron plasma using the kinetic model. The dispersion relation for parallel propagating modes in relativistic electron plasma is investigated by employing the Maxwell–Boltzmann–Jüttner distribution function and the final dispersion relation obtained is more general since no approximation is used. As the integrals in the relativistic dispersion relation cannot be done analytically so these integrals have been solved with the numerical quadrature approach. For $\eta \leq 1$ (ratio of rest mass energy to thermal energy), the increase in the effective mass of electrons will result in a change in the mass-dependent quantities (plasma frequency, electron cyclotron frequency, electron sound velocity, etc.) which in turn significantly affect the propagation characteristics of parallel propagating modes. It is observed that the propagation region for these parallel propagating modes decreases, and cutoff points are shifted to lower values when we consider a relativistic plasma environment. Moreover, a low-density and high-temperature plasma is more transparent as compared with a high-density and low-temperature plasma for these modes.

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