Parallel Propagating Waves in Weakly Magnetized Relativistic Electron Plasma

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The parallel propagating waves (Langmuir, R and L waves) are studies in different plasma environments by choosing the different values of $\eta = (mc^2/k_BT)$ since the value of η will decide whether we are in a relativistic $(\eta < 1)$, weakly relativistic $(\eta \gg 1)$ or non-relativistic $(\eta > 1)$ plasma. To study the density effects on the dispersion curves, we use different values of $\left(\omega_{pe}^2/\omega_{ce}^2\right)$. The dispersion relations of these waves are derived under a weak magnetic field limit for a fully relativistic plasma environment. The analytical solution of the integrals in the dispersion relations is not possible, so we use a numerical quadrature approach for their solution. We analyze the parallel propagating (Langmuir, R- and L-waves) waves in relativistic and weakly relativistic plasma environments and compare the results with the ones we found for a nonrelativistic environment. We observe that due to the relativistic effects, the cutoff point for these modes shifted to the lower values of frequency; as a result, the propagation region increases. The cutoff points of R- and L-waves shifted to further lower values in high-density plasma compared to low density. When we increase the plasma density for the same value of η, R- and L-waves shift to further lower values of frequency and this effect is more prominent in the nonrelativistic environment.

References:

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