Kinetic dispersion relation for a relativistic magnetized electron-positron plasma

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We use a kinetic treatment to study the transverse dispersion relation for a magnetized isotropic electron-positron plasma. The explicit linear dispersion relation for transverse waves propagating along a constant background magnetic field is presented, by a correct analytical continuation of the whole complex frequency plane. This dispersion relation is studied numerically for various temperatures. The system presents two branches, the electromagnetic and the Alfvén one. For the low frequency regime, the Alfvén branch has two zones, the normal zone (where frequency increases with wave number) and an anomalous zone (where frequency decreases with wave number). We found that in the anomalous zone of the Alfvén branch the electromagnetic waves are damped, and there is a maximum wave number for which the Alfvén branch is suppressed. We study the dependence of the Alfvén velocity and effective plasma frequency with the temperature.

These results were compared with a fluid model, a kinetic one dimensional model, where the kinetic effects were considered only along the background magnetic field, and a relativistic particle-in-cell simulation, where relativistic effects are taken into account both in the momentum equation for the particles and in the thermal particle distribution function, which is taken as a Maxwell-Boltzmann-Jüttner distribution function.