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Investigation of electromagnetic oscillations and their instabilities in a nonuniform quantum electron-positron magnetoplasma interacting with a short pulse laser

M Asgharzadeh and H Zahed

Physics Department, Sahand University of Technology, 51335-1996, Tabriz, Iran

Email: zahed@sut.ac.ir

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Abstract

In this article, we investigated electromagnetic oscillations in a quantum nonuniform electron-positron magnetoplasma interacting with a short pulse laser, in low frequency approximation, in two parallel and perpendicular directions. According to our investigations, the waves in the parallel direction are affected by ponderomotive force, vigorously. Quantum corrections cause the magnitude of this force to change and accordingly, cause the magnitude of phase and group velocities of the waves, as well as, their instability to change. In the parallel direction, initial quantities of number density and streaming velocity affect the waves directly, but the magnetic field affects these waves through the ponderomotive force, indirectly. As well, absorption of the laser pulse causes the plasma waves to grow in the laser direction and damp in the opposite direction. While, the amplification of the laser causes the waves to damp in the laser direction and grow in the opposite direction. In the perpendicular direction, the waves are influenced by the transverse gradient of initial quantities of number density, streaming velocity and external magnetic, in addition to their amounts, while these gradients don't have any effect on the parallel waves. Likewise, we investigate the behavior of the waves for different values of the transverse gradients. So that we indicate that the presence of each of gradients can completely change the behavior of the waves. As well, the investigations indicated that the presence of the transverse gradient of the initial density or streaming velocity couldn't create the electromagnetic waves in the perpendicular direction but, the transverse gradient of the magnetic field could initiate these waves.

Keywords: electron-positron plasma, electromagnetic waves, laser-plasma interaction, wave instability, quantum plasma

For full article, refer to the Persian section