Stimulated Raman backward scattering in the nonlinear interaction of short laser pulse with a warm underdense transversely magnetized plasma

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Abstarct

Nonlinear Raman backward scattering (RBS) is investigated in the interaction of linearly polarized short laser pulse with a homogenous underdense warm collisionless transversely magnetized plasma. Nonlinear and relativistic effects of electrons beside the role of thermal motions are taken into account in the presence of constant external magnetic field. Growth rate of Raman backward scattering is calculated by solving coupled equations with Fourier transformation. Results are significantly different in comparison with a cold plasma.

Introduction

Stimulated Raman backward and forward scattering (SRS) has long been an issue for inertial confinement fusion. SRS is usually described as a decay of an incident electromagnetic pump wave into a longitudinal electrostatic plasma wave plus another scattered light wave (Stokes/Anti-Stokes) when the plasma density is below the quarter critical density. Scattered wave may propagate in the forward direction backward direction, which are known as forward Raman scattering (RFS) and backward Raman scattering (RBS) respectively [1,2]. In a magnetized plasma, where the direction of the external magnetic field is perpendicular to the direction of laser pulse propagation, plasma wave is the upper hybrid wave which is excited at angular frequency $\omega_{UH} = \sqrt{\omega_p^2 + \omega_c^2}$ in which ω_p is the plasma frequency and ω_c is the electron cyclotron frequency in the external magnetic field B_0 [3,4,5]. In this work, nonlinear and relativistic effects of electrons beside the role of thermal electrons are taken into account in the presence of external magnetic field. Using the wave equation, the continuity equation and the equation of motion for electrons, two coupled equations are extracted for oscillation of electron density and scattered electromagnetic wave. Coupled equations are