EXCITATION OF WAVES AND SCATTERING PHENOMENA IN PLASMAS

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TO

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ABSTRACT

In the present thesis, the author has studied the nonlinear excitation of electrostatic waves in a collisionless plasma by high power Gaussian electromagnetic beams. This excitation is provided on account of the additional coupling between the electrostatic waves in the plasma and electromagnetic Gaussian beam as a result of the modified background density by d.c. component of ponderomotive force. Specifically, the excitation of an electrostatic upper hybrid wave, electrostatic lower hybrid wave and ion-cyclotron wave by the electromagnetic wave in the ordinary mode has been investigated. Within the WKB and paraxial approximation, the technique developed by Akhmanov et al. (1968) and Sodha et al. (1976) has been used for studying the actual magnitude of the excited waves taking into proper account of diffraction effects due to finite beam size. The excited electrostatic waves after Landau damping may lead to enhanced heating of the plasma. But the second possibility of enhanced Raman/Brillouin scattering by the interaction of the excited electrostatic waves with the electromagnetic beam has also been studies in detail.

The excitation of the electrostatic waves by the beating of two electromagnetic beams at the difference frequency e.g. the excitation of an ion-acoustic wave by two whistlers, excitation of an electrostatic ion-cyclotron

wave by two electromagnetic beams (in ordinary mode) and mode conversion has also been studied in detail.

The growth of a radially symmetrical ripple (superimposed on a Gaussian laser beam) in a collisionless unmagnetised plasma has been studied. The growth of the ripple is found to be comparable to the growth rate of filamentation instability in plasma. The effect of width and position of the ripple on its growth rate has been studied explicitly. The effect of the presence of the ripple on the excitation of plasma wave has also been studied.

The transient setting of ponderomotive nonlinearity in a collisionless magnetoplasma has been studied in the presence of a circularly polarised electromagnetic beam propagating along the static magnetic field. The phenomenon of moving focii, generation of electron plasma pulse and second harmonic has been studied in detail.

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