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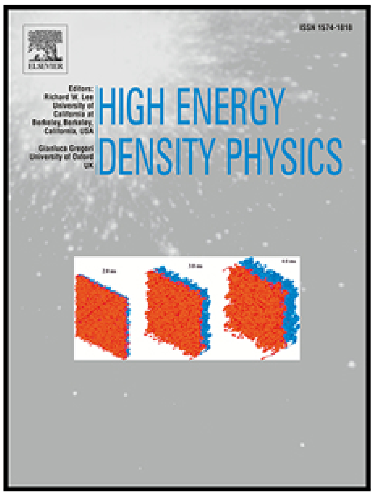

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Interaction of plasma and electromagnetic waves in warm motional plasma: local approximation method

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Abstract

The behavior of short-wavelength electromagnetic waves passing through a warm motional plasma is studied. The velocity and the self-magnetic field of the plasma particles are directed transversely to the direction of wave propagation. Using local approximation method, dielectric tensor and dispersion relation of perpendicular waves are derived employing the Fluid-Maxwell model. The role of temperature in propagation of EM waves, and as a result, in the instability caused by interaction between extraordinary EM waves and modified electron plasma waves is demonstrated. Moreover, the effects of self-magnetic field strength on the instability are illustrated.

Keywords

Relativistic warm plasma; Plasma instabilities; Electromagnetic waves in plasma

1. Introduction

Motion of charged particles affected by electromagnetic fields has been studied in many classic texts[1-3]. In this regard, the behavior of waves propagation in magnetized plasma, such as interaction between electromagnetic waves with plasma oscillations is the subject of many investigations[4-6]. In most of these studies, the focusing field is assumed to be imposed from an external source. While, magnetization from an internal source, the so-called self-magnetization, can be even more important, for example, in passing a relativistic electron beam through a wiggler in some laboratory settings which are candidate for high power radiation sources [7-9], plasma x-ray sources and plasma terahertz [10-11], and electron acceleration by plasma wave [12]. Recently, for the case of cold motional plasma with considering the self-magnetic field, interaction between electromagnetic waves and plasma waves has been investigated, and the instability caused by coupling between EM waves propagating in the direction of plasma motion has been concluded [5]. This investigation can be helpful with regard to the new types of plasma radiation sources such as free electron laser (FEL), cyclotron auto-resonance masers (CARMs), and ion ripple laser to generate tunable coherent radiation, ranging from microwaves to the ultraviolet, via coupling of the excited electromagnetic radiation with a negative-energy of electrostatic waves [13-14].