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قسم

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بالرسالة صفحات

لم ترد بالأصل

HOSSAM MAGHRABY

Tanta University
Faculty of Science
Physics Department

ON THE THEORY OF CURRENT INSTABILITIES IN PLASMA

A Thesis

Submitted for the Degree of Doctor of Philosophy of Science -Physics

(Plasma Physics)

By

Eman Nabil Mohamed El-Siragy

M. Sc. Tanta University

2003

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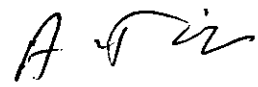

Prof. Dr. A. Tawfik

CONTENTS

Acknowledgment

I wish to take this opportunity to thank **Prof. Dr. A. Tawfik,** Head of Physics Department, Faculty of Science, Tanta University for his encouragements and helpful advice.

I am deeply indebted to thank **Prof. Dr. F. M. El-Mekawy**, Professor of Laser Physics, Department of Physics, Faculty of Science, Tanta University for his sincere guidance and valuable remarks during his supervision throughout the study and preparation of this thesis.

I am obliged to **Prof. Dr. Sh. M. Khalil**, Professor of Theoretical Plasma Physics, Atomic Energy Authority, Cairo, for suggesting the point of research, supervision, his kind assistance throughout the work and fruitful discussion.

Abstract

The main work in this thesis is to study and investigate the excitation of current Buneman's instability (electron-ion two stream instability) which takes place in plasma due to the relative motion of electrons and ions. We consider a different plasma temperature regimes, i.e., isothermal ($T_e \simeq T_i$) and nonisothermal ($T_e >> T_i$ or $T_e << T_i$) plasmas. Also, we consider different plasma states, i.e., and unmagnetized and magnetized; collisionless and collisional; homogeneous and inhomogeneous plasmas; without and with applied external electric field.

A linear, quasilinear and nonlinear dispersion relations are derived and solved in 1-D to obtain the frequencies and growth rate of instability under the conditions when the current velocity is slightly exceeds the instability threshold velocity ($\Delta u = u - u_{cr} << u_{cr}$). Conditions of excitation of current Buneman's instability are also obtained. The possibility of instability depression is discussed for different plasma temperature regimes. External magnetic or electric fields, plasma inhomogeneity, ratio of electron to ion temperature (T_e / T_i) are found to play a crucial roll via the saturation of such instability.

Chapter 1

INTRODUCTION

1.1 Plasma Instabilities

Plasma instabilities have become of increasing importance not only in plasma physics but also in plasma technology, plasma engineering, and in the construction of plasma devices for thermonuclear power and other purposes [1,2].

Also, plasma instabilities analysis play a central role in the investigation of collisionless heating mechanisms, collisionless shock transitions, anomalous transport phenomena, nonlinear plasma phenomena and confinement problems (see, e.g. [3,4]).

It is known that, plasma is characterized by a large number of parameters (e.g. density, temperature, degree of ionization, potentials, chemical composition, etc.) which may vary by many order of magnitudes, also, by a high degree of freedom. The great range of variation of plasma parameters leads to different physical situations, which are important in the study of plasma instabilities.

Terminology and nomenclature of plasma instabilities (see, e.g. [5,6]) are confusing and sometimes it is a problem to identify instability. Some authors give the names according to a certain mechanism producing the instability (collision induced instability-without saying which instabilities is excited by collision; ionization instability, parametric instability, rotation induced instability, etc.) and others give names according to phenomenological

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