

# Landau damping and kinetic instability in non-Maxwellian highly electronegative multi-species plasma

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**Abstract** The effect of two negative ions on the Landau damping and stellar solar wind driven instability is analyzed using kinetic theory for the Lorentzian plasmas. It is investigated that the dispersion relations, damping rates and instability growths are appreciably modified in the presence of Generalized Lorentzian or kappa distributed function and additional negative ion in our plasma system. A quantitative measurement of the threshold value of the streaming velocity is also determined to estimate the condition of the growing instability.

**Keywords** Multi-species plasma · Kinetic theory · Landau damping · Kappa distribution

## 1 Introduction

This decade the study of multi-specie and multi-ion plasmas has caught great attention of scientists due to its number of applications in many fields of theoretical as well as experimental (laboratory and space) physics. Now a days the role of multi-ion plasmas is not worth hidden from any one, such plasmas are used extensively in the material

processing which is helping in the improvement of many physical as well as chemical properties of various materials (Lieberman and Lichtenberg 2005). Presently, plasma is acting as a polymerizing agent in the materials to study the chemical composition and potential interaction films based on plasma polymerized surfaces (Scotti et al. 2011; Punzón-Quijorna et al. 2011). A large amount of plasma sources have crucial role in many biology related applications today (Léveillé and Coulombe 2006). The multi-ion plasma discharges have wide range of applications in the technological progress all around us. The plasma discharges of different ions are commonly used in the treatment of rough surfaces of polymer (Bhoj and Kushner 2008). Many scientists have discovered the ways analytically as well as by simulation to improve the electrical properties of the conducting materials with the radio frequency aided discharges of multi-component plasmas (Lazzaroni et al. 2012a, 2012b; Liu et al. 2010; Mustafa and Hashim 2010; Jandieri et al. 2011). The coupled plasma reactors either inductively or capacitively, are studied on the based on the many Kinetic and Fluid simulation models, having discharge form of many component plasmas (Lee et al. 2006). The afterglows of Oxygen-Helium plasmas discharges are useful in the etching of thin organic films (James et al. 2000).

In space the multi-ions are in abundance and availability of single ion is almost impossible, so study of multi-species plasmas is always a hot area in space plasmas. Recently, Hybrid Vlasov-Maxwell simulations are used (Perone et al. 2013) to study the kinetic phenomenon in Helium electron Hydrogen (He-e-H) plasma to determine the non-Maxwellian distribution of turbulent solar wind due to stress magnetic field and anisotropy of the temperature. The interstellar environment always has some amount of dust particles and these dust particles have very important

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