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Stimulated Brillouin scattering of an electromagnetic wave by an acoustic-like mode in multi-ion species plasmas

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Abstract. Using an hydrodynamical model, analytical investigation of the stimulated Brillouin scattering of an electromagnetic wave by an acoustic-like mode has been done in a multi-ion species plasma. The acoustic-like mode is a new mode which propagates in a multi-ion plasma only. The non-linear dispersion relation and the growth rate of the excited modes are derived. The non-linearity arises through the motion of ions which is introduced through ponderomotive force. It is found that the growth rate can be controlled by several parameters like charge number, mass, density and temperature of the ions.

Keywords. Stimulated Brillouin scattering; acoustic-like mode; multi-ion species plasma.

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1. Introduction

Multi-ion species plasma exists in space as well as in laboratory plasmas (Dash *et al* 1984; Sharma *et al* 1986; Milic and Krstic 1987). Many aspects of this complex physical system have received significant attention in the literature (Milic and Krstic 1987). In the vast majority of studies of multi-species plasma, attention is focussed to those aspects of their behaviour which are determined by the specificities of the individual atoms of the species present.

Hansen (1976) extended Monto Carlo calculations to the physically important case, where two ionic species are present, e.g. $H^+ - He^{++}$ mixtures, the corresponding model is the two component plasma in which he considered a mixture of N_1 ions of charge $Z_1 e$ and N_2 ions of charge $Z_2 e$. Dash *et al* (1984) considered a two-ion species magnetoplasma where ions are more energetic than the electrons. They applied their result in the plasma sphere where proton is the dominant ion-species, with 2–5% of He^{++} and O^{++} ions (Hoffman *et al* 1974). Sharma *et al* (1986) obtained a new analytical solution for an ion-acoustic soliton in a two-ion species plasma where the multiple ionization of the ion-species was also discussed. For a pure single ion case the amplitude is independent of the multiplicity of ionization. However, in the presence of different types of ions, it depends on Z_1 and Z_2.

Heating of plasmas by using ordinary electromagnetic waves has been studied extensively both theoretically and experimentally (Tripathi and Sharma 1988). In a single species plasma anomalous ion heating as observed by Hendel and Flick (1973) may occur via parametric instabilities excited by relative electron-ion motion. Ions can also be heated directly when one of the parametrical decay waves is a low-frequency wave (Tripathi and Sharma 1988). Ion heating using excitation of low-frequency waves