Astrophys Space Sci
DOI 10.1007/s10509-013-1760-3

ORIGINAL ARTICLE

Effect of ion and electron beam on kinetic Alfven wave in an inhomogeneous magnetic field

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Received: 4 June 2013 / Accepted: 17 December 2013

Abstract Kinetic Alfven waves are examined in the presence of electron and ion beam and an inhomogeneous magnetic field with bi-Maxwellian distribution function. The theory of particle aspect analysis is used to evaluate the trajectories of the charged particles. The expressions for the field-aligned currents, perpendicular currents (with respect to B_0), dispersion relation and growth/damping rate with marginal instability criteria are derived. The effect of electron and ion beam and inhomogeneity of magnetic field are discussed. The results are interpreted for the space plasma parameter appropriate to the auroral acceleration region of the earth's magnetoplasma.

Keywords Kinetic Alfven wave · Ion and electron beam · Auroral currents · Magnetic field inhomogeneity

1 Introduction:

Detection of Alfven wave turbulence has been made by Intercosmos Bulgaria 1300 satellites (Chmyrev et al. 1985, 1989) well as more recently by the Freja satellite (Wahlund et al. 1998) studying the association of auroral particle precipitation and the kinetic Alfven waves. Additional support for their role in auroral phenomena comes from global distribution maps at both low (FAST satellite) and high (Polar satellite) altitudes showing that Alfven waves occur on auroral field lines along the entire auroral oval (Chaston 2004; Chaston et al. 2003; Keiling et al. 2001, 2003, 2005).

Observations from spacecraft traversing the auroral acceleration region have revealed in great detail the microphysics of particle acceleration and the zoo of plasma effects that occur within this region of space (Paschmann et al. 2003).

Kinetic Alfven wave play an important role in energy transport in driving field-aligned currents, particle acceleration and heating, inverted-V structures in magnetosphere-ionosphere coupling, solar flares and the solar wind (Hasegawa 1977; Goertz and Boswell 1979; Goertz 1984; Maghaddam-Taaheri et al. 1989; Huang and Wang 1997). They are also useful in explaining the ultra-low frequency (ULF) emission in the earth's magnetosphere. Field-aligned currents are of great importance in magnetosphere-ionosphere coupling (Agarwal et al. 2011, 2012). Field aligned currents play a fundamental role in the transfer of momentum along the field. They are perhaps of most importance in magnetospheric physics in the study of coupling between regions, where different dynamical conditions prevail but which are threaded by the same field (Southwood and Kivelson 1991). Small-scale Alfvén waves are regularly observed inside large-scale magnetospheric current systems (e.g., review by Stasiewicz et al. 2000, and references therein) and several studies have shown an association with downward current regions (Karlsson et al. 2004; Keiling et al. 2005; Johansson et al. 2004; Wright et al. 2008). They are speculated to play a role in electron acceleration (Chaston et al. 2002; Russell et al. 2013).

Over the last decade it has been established that auroral luminosity is due to the impact of an accelerated electron beam coming towards the ionosphere and at the same event the upcoming ion beam has also been observed towards the

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Published online: 31 December 2013