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Plasma particles acceleration and electron heating due to kinetic Alfven waves in Jupiter's equatorial plasma sheet

Shabbir A. Khan, Kiran Batool
National Centre for Physics, Islamabad Pakistan
e-mail (speaker): sakhan@ncp.edu.pk

In-situ measurements of Alfvenic activity in the Jovian plasma reveal that strong particle acceleration and heating due to Alfven waves take place which have various effects on navigation satellites in a magntoactive environment, weather patterns of planets and moons, dynamics of solar wind, and so on. Observations show that Afvenic disturbances and wave-particle interaction of Alfven waves occur at various temporal and spatial scales and believed to accelerate electrons with energies ranging from several keV to MeV scales [1]. One of such examples is the precipitation of energetic electrons which generates auroral footprints of the Jupiter's moons (Io and Ganymede). To explain the particles' energization and acceleration, the contribution of electric fields coming from kinetic Alfven waves is important.

In Jupiter's magnetospheric plasma including Jupiter's equatorial plasma sheet & auroral zones, Ganymede's footprint tail aurora, Io plasma torus and Io-Jupiter fluxtube, it is believed that the electron Landau damping of kinetic Alfven waves is one of the key mechanisms of conversion of the field energy into plasma particle acceleration [2-5]. We have used the plasma kinetic model to analyse the Poynting flux for kinetic Alfven waves in the Jupiter's equatorial plasma sheet using typical parameters. Starting from the standard dielectric tensor in the linearized Vlasov-Maxwell system to describe wave dispersion and polarization properties, the energy transferred by the waves to the plasma is expressed in terms of Poynting flux for Alfven waves which gradually decreases with distance. The electron heating associated with kinetic Alfven waves is analysed by using the drift-kinetic equation under the cold ion approximation. The kinetic dissipation of Alfven waves along the background magnetic field lines as a consequence of wave-particle resonant interaction is discussed. The result shows that the energy transferred to electrons in unit time is proportional to the electron Landau damping rate and the field strength. Preliminary parametric analysis of Poynting flux and electron heating under certain conditions will also be presented.

References

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