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Overtaking Collision Of Fast Moving Ion Acoustic Kinetic Alfven Waves

Kuldeep Singh[1] , Nimardeep Kaur[1] and N.S. Saini[1]
[1]Department of Physics, Guru Nanak Dev University
e-mail: singh.kdeep07@gmail.com

Over the past many years the variety of nonlinear structures, Alfven waves and the magnetoacoustic waves (slow and fast) are the basic wave modes in the magnetohydrodynamic (MHD) systems in which Alfvén waves are the low frequency waves (below the ion cyclotron frequency) which play a central role in many laboratory, cosmic as well as fusion plasmas where the plasma β is typically much smaller than the electron to ion mass ratio. The observational data of Freja Satellite showed that the auroral low-frequency turbulence is dominated by the strong electromagnetic spikes, which resembles the solitary structures and can be interpreted as SKAWs. Also, the data from the Freja and the FAST Satellites [1] have revealed a clear signature of solitary Alfvénic structures i.e., density cavities in the auroral zone of the Earth's ionosphere. Dispersive effects of Alfvén waves related to the electron inertial length have gained a great deal of attention, which ranges from around 50 m in the topside ionosphere to several kilometers in the magnetosphere. Dispersive Alfvén waves basically are the shear Alfvén waves that can be created when either the electron temperature or the electron inertia affects the obliquely propagating shear Alfvén waves. The resulting dispersive Alfvén waves often referred to as kinetic Alfvén wave. Kinetic Alfven waves arise when the perpendicular wavelength of ordinary Alfven wave is comparable to the ion Larmor radius. Kinetic Alfven waves play an important role in transporting energy in various space and astrophysical plasma environments [2], coronal plasma heating [3], plasma transport in magnetopause as well as in heating Tokamak plasmas [4], thus heating the plasma to fusion temperatures. Thus, it is very important to study the dynamics of kinetic Alfven waves in order to understand various energy transport mechanisms in plasmas. The propagation and interaction of multi-solitons are important phenomena in plasma physics. They interact elastically and owing to this reason, the amplitudes of solitons do not change; however each soliton gets a phase shift. In the present work, we have investigated the propagation of ion acoustic kinetic Alfven waves in a low β plasma. In this regard, Korteweg de Vries equation is derived and discussed using the plasma parameters that are typically found in solar corona. The interaction of fast IAKAWs is explored by using the Hirota bilinear formalism [5], which admits multi-soliton solutions. It is observed that the values of the propagation vectors determine the interaction of solitary waves. It is pertinent to mention here that this solution describes two solitons travelling in the same direction and the soliton interaction takes place when the faster solitary wave overtakes the slower solitary wave. It is further noted that the amplitude of the respective solitary waves remain unchanged after the interaction, however, they do experience a phase shift. This study may also be helpful in understanding various non-linear coherent structures in space and astrophysical plasma environments e.g., Saturn's magnetosphere, pulsar magnetosphere, solar wind etc.

References

[1] J. S. Makela et al., Geophys. Res. Lett. **103**, 9391 (1998)
[2] J. W. Belcher and L. Davis Jr, *J. Geophys. Res.* **76**, p 3534, (1971).
[3] A. Hussain, Z. Iqbal, G. Brodin and G. Murtza, *Phys. Lett. A.* **377**, p 2131, (2013).
[4] L. C. Lee, J. R. Johnson and Z. W. Ma, *J. Geophys. Res.* **99**, p 17405, (1994).
[5] K. Singh et al., Phys. Plasmas 25, 033705, (2018)