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Wave-Particle Interaction in Kinetic Alfven Waves

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In this talk I will introduce the wave-particle interaction in kinetic Alfven waves (KAW). KAW is the shear Alfven wave modified by the short wavelength effects, and it can be created when an obliquely propagating shear Alfven wave is affected by the electron temperature and inertia such that a non-zero parallel electric field arises within the wave itself due to the local charge separation [1]. It is because the parallel component of its perturbed electric field can play an important role in accelerating and heating plasma particles that KAW has been a very interesting topic for discussion extensively in the fields of laboratory, space, and astrophysical plasmas since the pioneering theoretical work of Hasegawa and Chen in 1975 [2].
The wave-particle interaction in KAWs depends sensitively on the plasma β parameter, that is, the ratio of thermal to magnetic pressures [3]. In the parameter regime of $1>\beta>m_e/m_i$ (the mass ratio of electron to ion), the weak ion Landau damping leads to ions heat and the wave weakly damped [4]. In the parameter regime of $\beta\sim m_e/m_i$, the strong electron Landau damping will lead to efficient electron heat and restrain strongly the growth of the wave [5]. And in the parameter regime of $\beta< m_e/m_i$, the wave can grow into strong nonlinear stages and form local nonlinear structures such as solitary KAW [6], or dissipative nonlinear KAW with a local shock-like structure [7], and the latter can play an important role in the acceleration of energetic electrons [8].

Keywords: Space plasma; wave-particle interaction; kinetic Alfven wave; particle energization.

References

[1] R. L. Lysak and W. Lotko, *J. Geophys. Res*., **101**, 5085 (1996) and D. J. Wu, *Commun. Theor. Phys.*, **39**, 457 (2003).
[2] A. Hasegawa and L. Cheng, *Phys. Rev. Lett*., **35**, 370 (1975).
[3] D. J. Wu, G. L. Huang, and D. Y. Wang, *Phys. Plasmas*, **3**, 2879 (1996).
[4] A. Hasegawa and L. Cheng, *Phys. Fluids*, **19**, 1924 (1976).
[5] D. J. Wu and C. Fang, *ApJ*, **511**, 958 (1999) and *ApJ*, **596**, 656 (2003).
[6] D. J. Wu, D. Y. Wang, and C. G. Falthammar, *Phys. Plasmas*, **2**, 4476 (1995).
[7] D. J. Wu, *Phys. Rev. E*, **67**, 027402 (2003) and *Phys. Plasmas*, **10**, 1364 (2003).
[8] D. J. Wu and J. K. Chao, *Phys. Plasmas*, **10**, 3787 (2003) and *J. Geophys. Res.*, **109**, A06211 (2004).