Second order Fermi acceleration of ions in the earth's foreshock: wave dispersion effects

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It is well known that the second order Fermi acceleration can efficiently operate when there exist multiple electromagnetic waves traveling in two opposing directions. The process has been discussed using turbulence composed of non-dispersive Alfven waves (e.g., Terasawa, 1989; Kuramitsu and Hada, 2000), and has been applied to ion acceleration in the earth's foreshock. However, upstream waves in the earth's foreshock have a wide frequency spectrum extending beyond the ion cyclotron frequency, where the effects of finite wave dispersion cannot be neglected.
In this presentation, we discuss the second order Fermi process by performing test particle simulations, paying particular attention to the effects of finite wave dispersion on the ion acceleration efficiency. We consider the right- and left-hand polarized electromagnetic waves, with both parallel and anti-parallel propagation directions along the background magnetic field. A power-law spectrum of each wave component is assumed. The waves obey the cold plasma dispersion relation. We evaluate the acceleration efficiency as a function of the initial ion kinetic energy. We will discuss implications of our results to Cluster observations (Kis et al., 2004).

Keywords: second order fermi acceleration, particle acceleration and energy diffusion, wave dispersion

