Upstream wave evolution, particle diffusion and acceleration in the earth's foreshock: One-dimensional PIC simulation

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We have systematically studied wave excitation, particle diffusion and acceleration in the earth's foreshock by making use of quasi-linear theory, test particle simulation, and particle-in-cell (PIC) simulation. In the previous presentation, we reported the preliminary results of one-dimensional PIC simulation of a quasi-parallel shock with Alfven Mach number 6.6 and electron and ion beta 0.5. The field-aligned beam (FAB) ions, backstreaming away from the shock, were generated by the solar wind ions specularly reflected at the shock. They excited Alfvenic waves via resonant beam instability. We also showed the upstream ion distributions as a function of the distance from the shock.

In this presentation, we discuss how the waves excited by the FAB contribute to the particle diffusion and acceleration in their spatial as well as temporal evolutions. We analyze electromagnetic and electrostatic wave spectra in the foreshock region, and discuss the relation between the evolution of wave spectra and the distribution functions of the solar wind plasma and the FAB. Further we will investigate trajectories of highly accelerated particles and discuss the diffusion and acceleration processes of them.

Keywords: earth's foreshock, waves, particle diffusion and acceleration

