Wave-particle(proton) interaction in Bastille shock event

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From several hours before the arrivals of interplanetary shocks (IPSs), fluxes of non-thermal particles (more than several ~ several tens of keV) often show smooth increases toward the maxima occuring near the shock fronts. This type of events, known as ESP (energetic storm particle) since the time of IGY, is now considered as the in situ evidence of diffusive shock acceleration (DSA) process: While the DSA process is regarded as one of the most important processes for astrophysical particle acceleration, in situ study of it has been possible only with these ESP events as well as diffusive ion events in the foreshock region of the earth's bow shock.

According to the standard Lee's theory(1983) of ESP events, substantial energy exchange through the quasi-linear wave-particle interaction process is expected to occur in the upstream region of the IPS. While the quasi-linear process should depend on the shock parameters (e.g., the shock angle and Mach number), only limited information on such parameter dependence has been available so far.

On the solar surface, a large flare/CME event (know as the Bastille event) happend in 14 July 2000. In this presenteation we treat the ESP event associated with the IPS arrived at 1AU ~ 28 hours after the flare/CME on the sun. (This shock is one of the fastest shock observed directly. The local shock propagation speed is estimated as ~1100km/s in observer frame and ~530km/s in upstream plasma frame. The shock angle is caluculated to be ~48 degree.) Both fluxes of high energy proton (100keV-several MeV) and the MHD wave intensities in the resonant frequency regime with these protons showed the gradual increases for several hours toward the arrival of the IPS. Using the detailed magnetic field data of Geotail (X=25Re,Y=6.8Re,Z=-1.6Re) as well as the high energy proton data of SOHO(X=203Re,Y=-68Re,Z=12Re), we study the wave-particle interaction in upstream region of this IPS.