Ion Acceleration Processes Under the Effects of the Shock Front Rippling and Nonstationarity for a Supercritical Perpendicular Shock

B. LEMBEGE[1], Z. YANG[1,2] and Q. LU[2]
[1]*LATMOS-IPSL-UVSQ-CNRS, Quartier des Garennes, 78280 Guyancourt (France)*
[2]*School of Earth and Space Sciences, USTC, Hefei, Anhui 230026 (P. R. of China)*

Both simulations results and experimental measurements (recently from CLUSTER mission) have clearly evidenced that the front of a supercritical quasiperpendicular shock is non-stationary. Different processes are presently proposed to be responsible for this nonstationarity. One well accepted process of non-stationarity has been identified as due to the self-reformation of the shock front fed by the accumulation of reflected ions in front of the ramp. This self-reformation leads to a strong change both in amplitude and in the spatial width of the overshoot, the ramp and the foot. Recent 1D test particle simulations based on shell/Maxwellian ion upstream distributions interacting with fields components issued from PIC simulation, have shown that this self reformation has a strong impact on the Shock Drift Acceleration (SSA) and Shock Drift Acceleration (SDA) mechanisms which contribute to the formation of energetic ions. More precisely: (i) SDA alone is dominant as the ramp width is broad (overshoot amplitude low); (ii) both SSA and SDA contribute as ramp width is narrow (overshoot amplitude high); (iii) SDA process is more efficient (higher energy gain) than SSA; (iv) according to the time of the encounter with the shock front, two types of SSA (mono and multiple bounce) ions can be identified, and their occurrence depends on the radius V-shell of the upstream distribution; (v) the density of reflected ions (including both SSA and SDA) varies with a period equal to that of the self reformation; and (vi) energetic ions (both SDA and SSA) are not issued from the wings (as for a stationary shock) but also from the core of the upstream distribution.

The present work will summarize these recent results which will be completed by corresponding energy spectra for each population. In extenso, recent results obtained from 2-D test particles simulations will be presented illustrating the impact of the shock front rippling on each population in terms of both (a) individual ion trajectory analysis and (b) statistical approach.