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# Formation of backstreaming ions into the Foreshock :test-particles based on Two-dimensional PIC simulations

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A curved shock has been analyzed in the whole quasi-perpendicular propagation region ($45° \leq \theta_{Bn} \leq 90°$) in a supercritical regime with the help of a 2D PIC (particle-in-cell) electromagnetic code including self-consistently the shock curvature, the time of flight effects and the ion/electron foreshock region. Based on these 2D PIC simulations, Savoini and Lembege [2015] have discriminated between two distinct populations observed experimentally in the ion foreshock located upstream of the shock itself, namely a population collimated along the IMF, hereafter "FAB" for *Field-Aligned Beam* and a nongyrotropic population, hereafter named "GPB" for *gyro-phase bunched*. This last study has shown that both populations can be generated directly by the macroscopic fields at the shock front itself (i.e. without invoking any local ion instability process), and has confirmed that the shock front is nonstationary

Herein, we use test-particles simulations based on the same curved shock profiles issued from the previous 2D PIC simulations. These simulations evidence the importance of the shock front for both « FAB » and « GPB » populations. More precisely, we show that the ion reflection process is not continuous in time and/or in space (burst-type reflection process), but strongly depends on the local shock front profile met by incoming ions at their hitting time.

These test-particles approaches allow us to investigate in details the roles of the shock curvature and the time variation of the macroscopic field profiles at the front in the ion reflection efficiency.

Several main questions raise up: (i) Where do the ions populating the edge of the ion-foreshock come from? (ii) What is the impact of the $\theta_{Bn}$ angle (i.e. space dependence) and/or of the shock profile variations (i.e. time dependence) on the reflected population?, (iii) How the space charge electric field localized within the shock ramp influences the reflection process ? and (iv) Can different reflection mechanisms be identified ? These different questions will be addressed and discussed in this presentation.