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Comparison between self-consistent 2D full-particle and test-particles simulations to investigate the origin of the Earth's Ion Foreshock.

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Backstreaming ion populations propagating along the interplanetary magnetic field are evidenced upstream of the Terrestrial curved bow shock and form the ion foreshock. Two distinct backstreaming populations have been identified by spacecrafts within the quasi-perpendicular shock region (i.e. for $45^o \leq \theta_{Bn} \leq 90^o$, where θ_{Bn} is the angle between the shock normal and the upstream magnetostatic field): so called (i) field-aligned ion beams (« FAB ») characterized by a gyrotropic distribution, and (ii) gyro-phase bunched ions («GPB »), characterized by a NON gyrotropic distribution. The origin of these backstreaming ions can be analyzed within an « enlarged » upstream region near/around the front with the help of 2D PIC simulation of a curved shock, where full curvature effects, time of flight effects and both electrons and ions dynamics are fully included by a self consistent approach.

Our previous analysis (Savoini et Lembege, 2015) has evidenced that these two populations can be generated directly by the macroscopic fields at the shock front itself (i.e. without invoking any local ion instability process).

Moreover, present complementary test-particule simulations evidence the importance of the shock wave profile for both the « FAB » and « GPB » populations. Such results show that the reflection process is not continuous in time and in space, but strongly depends of the local shock front profile met by incoming ions at their hitting time. Present simulations aim to clarify the respective roles of the shock curvature and the variation of the macroscopic field profiles at the front in the efficiency for reflecting ions which fill-in the ion foreshock.

Results show the following points:

1) The strong dependence of θ_{Bn} on the origin of the backstreaming ions. In particularly, we observe that the foreshock edge is formed by ions coming from high θ_{Bn}.

2) The strong impact of the shock front profile on the ion reflection rate which seems related to the non stationarity of the shock front.

3) Extensively, some local/instantaneous shock front profiles reveal to be very efficient ion reflectors under the combined effects of the (i) front nonstationarity and (ii) the shock front curvature (related to the θ_{Bn} angle), hence an increase of backstreaming ions ratio by a factor of ~ 20.

A comparison between self-consistent and test-particles results will be presented in more details to explain these different points.