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Origin of the different energetic ion populations in the quasi-perpendicular Ion Foreshock: 2D Full-particle simulation

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The foreshock region is located upstream of the terrestrial bow shock and is characterized by energetic backstreaming particles (electrons and ions) issued from the shock and by an important wave activity as observed by many space missions. In order to analyse the foreshock region, a curved shock is simulated with the help of a $2-D$ full particle (PIC) code, where full curvature and time of flight effects, and where both electrons and ions dynamics are fully described by a self consistent approach. The analysis is presently restricted to the quasi-perpendicular angular range defined by $45^\circ \leq \theta_{Bn} \leq 90^\circ$, where θ_{Bn} is the angle between the shock normal and the upstream magnetostatic field, and we focus only on the ion foreshock. In a good agreement with experimental data, present preliminary results evidence two distinct ion populations collimated along the interplanetary magnetic field (IMF): (i) the *Field-Aligned Beam* population (hereafter named "FAB") and (ii) the *gyro-phase bunch* population (hereafter named "GPB") which differ from each other by their gyrotropic or non-gyrotropic behavior, respectively. Additionally, the "FAB" population is observed at the edge of the ion foreshock and near the curved shock front, while the "'GPB" population is observed deeper in the foreshock and further from the shock front. The analysis shows that no pitch angle scattering mechanism needs to be invoked to account for the generation of the "GPB", but rather additional criteria are necessary namely: the interaction time Δt_{int} of backstreaming ions with the shock front and their downstream penetration depth. These criteria allow to evidence that (i) the "FAB" population corresponds to particles which move back and forth between the upstream edge of the front and the overshoot, and are characterized by a quite large Δt_{int} (covering several local gyro-periods, $4 \leq \tau_{ci} \leq 12$). In contrast, (ii) the "GPB" ions have suffered a very short interaction time (i.e. $\Delta t_{int} < 1\tau_{ci}$) and escaped into the upstream region with a parallel velocity slightly higher than the "FAB" population. Finally, we observe that the "FAB" population may have different origins, and come even from the downstream region (i.e. so called "leaked" ions), although all "GPB" particles seem to be produced by the electrostatic field built up at the shock front and are emitted in a burst-like mode rather than in continuous way.