Evidence and analysis of ion/electron foreshocks for a curved shock in Subcritical regime: 2D self-consistent PIC simulations

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Since early 2D PIC full self-consistent quasi-perpendicular simulations of the foreshock region [Savoini et Lembege, 2001] performed for a supercritical regime, different efforts have been invested later on to analyze the foreshock region. Previous 2D PIC simulations have succeeded in recovering both the local electron distribution [Savoini and Lembege, 2001] and the ion distribution [Savoini et al., 2013] in good agreement with the in-situ experimental data. These studies have retrieved both kinds of distributions and have analyzed in detail how these local distributions vary versus (i) the local angle $\Theta_{Bn}$ to the curved shock (defined between the normal of the shock front and the upstream interplanetary magnetic field) and (ii) the distance from the shock front, in order to identify in detail the different acceleration mechanisms at work at the curved front and supporting these local ion and electron distributions within the foreshock region [Savoini and Lembege, 2001, 2015; Savoini et al., 2013]. This last point can only be accessible to a self-consistent approach (where ion and electron scales are fully included) as in 2D PIC simulations.

Then, the present work is an extension of the previous analyses listed above for a curved (quasi-perpendicular) shock applied now in a subcritical regime. This work is performed thanks to a new 2D parallel PIC code (SMILEI) which is highly optimized and allows much higher statistics. The main characteristics of the curved front microstructures, its time dynamics, and preliminary results on local distribution functions obtained for both electrons and ions in this new Mach regime will be presented.

