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How to define the interplay between different instabilities excited within the foot of a supercritical shock : 2D PIC simulations

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In supercritical shocks a substantial fraction of ions is reflected at the steep shock ramp. The beam of reflected ions carries a considerable amount of energy and momentum. As a consequence, different plasma populations can co-exist within the same foot region, which constitutes a source of micro-instabilities excited by the relative drifts between incoming ions, reflected ions, and electrons across the ambient magnetic field $\mathbf{B_o}$. With the help of a spectral periodic 2D PIC code, we investigate the resulting micro-turbulence. Three different waves with different frequency/wave number ranges can be excited simultaneously: Bernstein waves and whistler waves near the lower-hybrid frequency as well as the electron cyclotron frequency. The present work is a 2D extension of a previous analysis (Muschietti et Lembege, Ann. Geophys. 2017) and allows to self-consistently include the mutual interaction between the different instabilities/waves which propagate in different directions with respect to $\mathbf{B_o}$ and are at different stages of their respective linear/nonlinear phases. In order to clarify their intricate synergies, a new filtering procedure (low or high pass filter of a given wave number range) has been developed. Taking thus advantage of the spectral nature of the code, we can include/exclude at will the impact of a given instability on the other ones. We have performed several times the simulation with exactly the same initial conditions yet with different filtering ranges. The procedure allows us to illuminate the role played by each instability in the scenario when all are included. Recent results will be presented.