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Variability of the shock front of a perpendicular supercritical shock when approaching realistic conditions: impact on the self reformation process

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The ramp of a collisionless shock front is well known to play a key role in the formation of energetic particles during their interaction and within the intrinsic dynamics of the shock front itself. Different results obtained from different simulations codes (in particular from PIC and hybrid) converge progressively towards a unified view in the behavior of the shock front in particular its nonstationarity. However, most simulations are based on compromise in the use on realistic/nonrealistic plasma parameters (in PIC codes) or on simplifying assumptions and scalings (in Hybrid codes). The features of the shock front of a perpendicular supercritical shock are presently analyzed in details with the help of 1D PIC simulations via a parametric study approaching realistic conditions in terms of mass ratio and of the ratio wpe/wce. Approaching real wpe/wce ratio represents the most difficult task because of computational constraints at present time, which requires high optimization methodology of the used PIC code which has been developed at PRIC and USTC. The main goal is to analyze in time and for different plasma conditions the variability of (i) the spatial scaling of the shock front microstructures, (ii) the overshoot amplitude features, and (iii) the cross shock electric field / potential (CSP) amplitude within the ramp which plays a crucial role (and is sometimes source of controversy in the comparison with experimental data) in dissipation of the shock transition and the particle acceleration. Detailed results which will be presented confirm the validity of previous works (in particular concerning the normalized spatial scaling of electric/magnetic macroscopic fields) based on irrealistic upstream parameters, and in addition that the self-reformation due to the accumulation of reflected ions persists quite well for realistic plasma parameters.