Numerical simulation of instabilities in transition regions of collisionless shocks

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In a transition region of a high Mach number collisionless shock, various kinds of instabilities are generated and contribute to producing turbulence. In particular, specularly reflected ions play some important roles in a foot of a quasi-perpendicular shock. In this study, we perform one dimensional full particle simulations with periodic boundary conditions to discuss instabilities in a system which is composed of electrons, incoming ions, and reflected ions. It is shown that types of instabilities vary depending on parameters upstream of a shock by comparing the results with a linear dispersion relation.