Particle simulation of collisionless shocks with a shock-rest-frame model. II

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Particle-in-cell (PIC) simulations are one of essential approaches to solve full kinetic processes in shock waves in collisionless plasmas. There are several different methods for exciting collisionless shocks in numerical simulations of plasmas. The magnetic piston method and the injection method are widely used in full particle simulations. In these methods, an excited shock wave propagates toward the upstream region. Therefore, it is necessary to take a very long simulation domain in the propagation direction of the shock wave in order to study a long-time evolution of the excited shock wave. This makes it difficult to perform multidimensional simulations even with a current supercomputer. In the present study, we first attempt to perform a full particle simulation of a collisionless shock in the shock rest frame: the collisionless shock is excited by using another method called the “relaxation method& #39;& #39; which was used in the previous hybrid code simulations [M. M. Leroy, et al., GRL, 1981; JGR, 1982]. In this method, the initial upstream and downstream states are determined based on the shock jump conditions for a two-fluid plasma consisting of electrons and ions with the equal density and the equal bulk velocity. We varied upstream and downstream quantities in order to study detailed properties of excited shocks.