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# 2D Full Particle-In-Cell Simulation on a High Beta Collisionless Shock and Particle Acceleration

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High beta and relatively low Mach number shocks are commonly present in a vriety of space and astrophysical environments, like the earth's bow shock, the heliospheric termination shock (effective beta is rather high due to the presense of pickup ions), galaxy cluster merger shocks, etc. Even such high beta shocks show some evidences that high energy particles are possibly accelerated there. Voyager 2 spacecraft revealed that the fluxes of non-thermal electrons and ions (the latter are called as termination shock particles) are enhanced at the crossings of the termination shock. Radio synchrotron emissions from relics of galaxy cluster mergers imply the presence of relativistic electrons accelerated in the merger shocks. In this study we perform two-dimensional full particle-in-cell simulation to discuss structure of the shock as well as the acceleration process of electrons. The one-dimensional simulations performed in the past showed that under the high beta and relatively low Mach number conditions the shock is more or less laminar and time stationary and electron acceleration occurs through the so-called shock drift mechanism. Here, we reveal that two-dimensional structure of the shock is highly complex even for such a high beta and a low Mach number and further that some electrons are accelerated to high energy but their acceleration mechanism appears not to be so simple as that reproduced in one-dimensional simulations.

Keywords: collisionless shock, numerical simulation, particle acceleration