

高ベータ無衝突衝撃波の2次元構造と粒子加速に関するフル粒子計算 2D Full Particle-In-Cell Simulation on a High Beta Collisionless Shock and Particle Acceleration

松清 修一^{1*}; 松本 洋介²

MATSUKIYO, Shuichi^{1*}; MATSUMOTO, Yosuke²

¹九州大学, ²千葉大学

¹Kyushu University, ²Chiba University

High beta and relatively low Mach number shocks are commonly present in a variety of space and astrophysical environments, like the earth's bow shock, the heliospheric termination shock (effective beta is rather high due to the presence 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.

キーワード: 無衝突衝撃波, 数値実験, 粒子加速

Keywords: collisionless shock, numerical simulation, particle acceleration