

Particle Acceleration and Shock Structures in a Shock-Shock Interaction: 1D full-PIC simulation

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Shock-shock interactions occur on various places in space and the interaction can produce high energy particles. For example, two or multiple coronal mass ejections (CME) are released from the Sun sometimes [Li et al., 2011]. In this situation, the preceding shock produces seed particles and the following shocks re-accelerate the seed particles. A CME driven shock can also collide with the Earth's bow shock [Hietala et al., 2011]. This study reported that ions are accelerated by the first Fermi acceleration between the two shocks before the collision. An electron acceleration through an interplanetary-Earth's bow shock interaction was also reported [Terasawa et al., 1997]. The detailed comprehension, however, is still missing due to only few studies.

Recently, we have performed one-dimensional full PIC simulations to investigate a shock-shock interaction in which two quasi-perpendicular and super-critical shocks collide head-on. In this case, only electrons are accelerated between the two shocks (Fermi acceleration) before the two shocks collide [Nakanotani et al., 2017].

We discuss the case of two quasi-parallel shocks. In the present case, ions can go back upstream and are accelerated between the two shocks as electrons in the case of quasi-perpendicular shocks. The pressure of those energetic ions between the two shocks are comparable with the pressure in the downstream of the shocks. It has a potential to alter the shock structure.

Keywords: collisionless shock, shock-shock interaction, particle acceleration