Electron acceleration at quasi-perpendicular collisionless shock: One-dimensional PIC simulation

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A collisionless shock is thought to be an efficient accelerator of charged particles in space. At the quasi-perpendicular side of the earth's bow shock, non-thermal electrons are observed in-situ measurements. However, the electron acceleration process has not been unclear due to limited accuracies of instruments.Magnetospheric Multiscale (MMS) spacecraft launched on 2015 enables us to reveal the electron acceleration process in detail. The instruments measure the waves and particles with high time (millisecond) resolution and accuracy.

In this presentation, we perform one-dimensional particle-in-cell (PIC) simulation of a quasi-perpendicular collisionless shock and discuss electron acceleration at the shock, considering a direct comparison with MMS spacecraft data in mind. We will report the results of the runs with the Alfven Mach number 7, the shock angle (the angle between the background magnetic field and the shock normal) 70-80 degrees, and plasma beta 0.3-3, respectively. We evaluate electron distributions both in energy and pitch-angle, and upstream wave spectra, and discuss their temporal as well as spatial variations. Further, highly accelerated electrons are traced back to indentify their origin and acceleration process.

Keywords: electron acceleration, quasi-perpendicular shock, PIC simulation

