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Electron acceleration in the foot region of a quasi-perpendicular shock

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We have carried out a three-dimensional simulation of a quasi-perpendicular shock. The full mass ratio M/m=1840 was taken for this simulation, and we can access cross-scale coupling processes in the shock transition though only one ion inertia length square was allocated to the shock plane. In this simulation, efficient production of non-thermal electrons is observed. As reported by Shinohara and Fujimoto (2011), complicated wave activity is found at the most front end of the shock foot region. Comparing with results of 1-D and 2-D simulations with the same parameters, we found that both non-thermal electrons and wave activity emerge only in the 3-D simulation. Detailed analysis of accelerated electron trajectories shows that the acceleration efficiency depends on the phase of the shock self-reformation. Accelerated electrons are keep staying in the foot region due to the scattering by the electromagnetic field fluctuation. The final stage of acceleration at the lamp region occurs during the steepen phase of the self-reformation. The electron acceleration is observed in higher mass ratio runs. We will discuss physics of electron acceleration mechanism and its relation with three-dimensional behavior of the shock transition region.

Keywords: quasi-perpendicular shock, electron acceleration