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Electron Injection at Quasi-Perpendicular Supernova Remnant Shocks

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Abstract content

Electron injection process at high Mach number collisionless quasiperpendicular shock waves is investigated by means of one-dimensional electromagnetic particle-in-cell simulations. We find that energetic electrons are generated through the following two steps: (1) electrons are accelerated nearly perpendicular to the local magnetic field by shock surfing acceleration at the leading edge of the shock transition region. (2) the preaccelerated electrons are further accelerated by shock drift acceleration. As a result, energetic electrons are preferentially reflected back to the upstream. Shock surfing acceleration provides sufficient energy required for the reflection. Therefore, it is important not only for the energization process by itself, but also for triggering the secondary acceleration process. We also present a theoretical model of the two-step acceleration mechanism based on the simulation results, which can predict the injection efficiency for subsequent diffusive shock acceleration process. We show that the injection efficiency obtained by the present model agrees well with the value obtained by Chandra X-ray observations of SN 1006. At typical supernova remnant shocks, energetic electrons injected by the present mechanism can self-generate upstream Alfven waves, which scatter the energetic electrons themselves.

If this papers is presented for a collaboration, please specify the collaboration

Summary

Reference

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