

**R008-08**

**C 会場 : 11/26 PM2 (14:50-16:20)**

**15:05~15:20:00**

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## **Electron Confinement and Associated Acceleration at Quasi-Perpendicular Shocks**

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Diffusive shock acceleration (DSA) is widely recognized as the primary mechanism responsible for generating high-energy particles in supernova remnant shocks. However, it struggles with the so-called injection problem, as DSA can't accelerate low-energy particles efficiently. One promising solution is stochastic shock drift acceleration (SSDA), which relies on high-frequency whistler waves to both confine and energize electrons near the shock. While many simulations have confirmed the presence of such waves upstream of quasi-perpendicular shocks (e.g., Matsukiyo et al., 2011; Guo et al., 2014), the precise mechanisms underlying their generation remain unclear.

To address this gap, our work investigates how shock parameters determine the local electron distribution and trigger wave instabilities. We first develop a realistic electron velocity distribution model by applying Liouville mapping with assumed upstream and downstream electron distributions under a steady magnetic field profile. To account for non-adiabatic effects, pitch-angle diffusion is incorporated. This modeling framework captures critical kinetic features—such as loss-cone distributions—that provide the necessary free energy for wave excitation. Based on these distributions, we perform a linear stability analysis using a semi-analytical method capable of handling arbitrary velocity distributions. This approach enables us to evaluate the growth and damping rates of wave modes and identify the contributions of individual resonance conditions.

Applying this framework to the parameters of Earth's bow shock, our model reveals two self-generated upstream instabilities: the parallel and oblique whistler modes. Both are driven by loss-cone electron distributions and propagate toward the shock, facilitating particle confinement and acceleration. The oblique whistler mode survives longer in diffusion process, suggesting it may play a dominant role. Interestingly, diffusion not only damps existing instabilities but also leads to the emergence of new ones, resulting in a sequence of instabilities that collectively enhance electron confinement.

To identify the shock conditions favorable for the generation of oblique whistler waves, we perform a comprehensive parameter survey. The results indicate that the Alfvén Mach number in the de Hoffmann – Teller frame, is a critical control parameter, with larger values promoting wave growth—consistent with observational findings. Additionally, high electron beta conditions also promote instability growth. These results establish a direct link between shock parameters and wave generation, supporting the view that high Mach number, quasi-perpendicular shocks are favorable for electrons confinement and acceleration.