垂直衝撃波における再形成と微視的不安定性

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Reformation and microinstabilities at perpendicular collisionless shocks

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Large-scale two-dimensional (2D) full particle-in-cell (PIC) simulations are carried out for studying the relationship between the dynamics of a perpendicular shock and microinstabilities generated at the shock foot. The structure and dynamics of collisionless shocks are generally determined by Alfven Mach number and plasma beta, while microinstabilities at the shock foot are controlled by the ratio of the upstream bulk velocity to the electron thermal velocity and the ratio of the plasma-to-cyclotron frequency. With a fixed Alfven Mach number and plasma beta, the ratio of the upstream bulk velocity to the electron thermal velocity is given as a function of the ion-to-electron mass ratio. The present 2D full PIC simulations with a relatively low Alfven Mach number (MA ∼ 6) show that the modified two-stream instability is dominant with higher ion-to-electron mass ratios. It is also confirmed that waves propagating downstream are more enhanced at the shock foot near the shock ramp as the mass ratio becomes higher. The result suggests that these waves play a role in the modification of the dynamics of collisionless shocks through the interaction with shock front ripples.