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Reformation at low-Mach-number perpendicular shocks

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Large-scale two-dimensional full particle-in-cell simulations are carried out for studying periodic self-reformation of super-critical perpendicular shocks. It is confirmed that the structure and dynamics of shocks are affected by the coupling between ripples and microinstabilities at the shock front. The shock reformation is absent when electromagnetic instabilities such as the modified two-stream instability are dominant at the shock foot. Electromagnetic whistler mode waves excited by the modified two-stream instability couples with the shock-front ripples, resulting in strong scattering of reflected ions at the shock front. On the other hand, the shock reformation is persistent when there is no microinstabilities or electrostatic instabilities are dominant at the shock foot. However, the reformation period is modified essentially due to the shock-front ripples because reflected ions are less scattered at the shock front.

Keywords: shock waves, particle simulation, cross-scale coupling, instability