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The formation of power-law energy spectrum in 3D low-beta magnetic reconnection[1] FAN GUO, XIAOCAN LI, HUI LI, ADAM STANIER, PATRICK KILIAN, Los Alamos National Laboratory — Magnetic reconnection has been proposed as a theory for explaining particle acceleration in solar flares. However, previous kinetic simulations of non-relativistic reconnection have not been able to obtain a power-law energy spectrum, which is a key observational feature of particle distribution. Here we present results from 3D fully kinetic particle-in-cell simulations of reconnection in the non-relativistic low-beta regime. We show that a clear power-law energy spectrum can form and sustain extensively during the simulation. Comparing with 2D simulations, where high-energy particles are trapped deep in magnetic islands, 3D simulations enable stronger acceleration for high-energy particles due to stochastic magnetic field lines and wave-particle scattering of high-energy particles. These effects lead to a nearly constant acceleration rate for particles at different energies. The power-law index is a balance of particle acceleration and particle escape from major acceleration region. This study clarifies the formation condition of power-law energy spectrum in a reconnection layer and has important implication for understanding particle energization during solar flares.

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