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Formation of Power-law Electron Energy Spectra in Three-dimensional Low-β Magnetic Reconnection

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Magnetic reconnection is a primary driver of particle acceleration processes in space and astrophysical plasmas. One of the major unsolved problems in reconnection studies is nonthermal particle acceleration. Here we present results from 3D PIC simulations of low-β magnetic reconnection. We find that a clear power-law energy spectrum with a power-law index 4 can form and persist throughout the 3D simulations. We show that 3D effects such as self-generated turbulence and chaotic magnetic field lines enable the transport of high-energy electrons across the reconnection layer and allow them to access several main acceleration regions. This leads to a sustained and nearly constant acceleration rate for electrons at different energies. We will present the results from simulations with different guide field and discuss the properties of the self-generated turbulence in 3D reconnection (e.g. spectrum and anisotropy). These results are important for understanding particle acceleration during magnetic reconnection in low-β plasmas, such as solar corona and near-Sun solar wind.