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Formation of Hard Power-laws in the Energetic Particle Spectra Resulting from Relativistic Magnetic Reconnection FAN GUO, HUI LI, WILLIAM DAUGHTON, YI-HSIN LIU, Los Alamos Natl Lab, XIAOCAN LI, University of Alabama in Huntsville — Using fully kinetic simulations, we demonstrate that magnetic reconnection in relativistic plasmas is highly efficient at accelerating particles through a first-order Fermi process resulting from the curvature drift of particles in the direction of the electric field induced by the relativistic flows. This mechanism gives to the formation of hard power-law spectra in parameter regimes where the energy density in the reconnecting field exceeds the rest mass energy density and when the system size is sufficiently large. The power law slope approaches "-1" for closed systems and gets softer when particle loss from the acceleration region is included. A simple analytic model is proposed which explains these key features and predicts a general condition under which hard power-law spectra will be generated from magnetic reconnection. We demonstrate that both continuous inflow and Fermi-type acceleration lead to the power-law distributions. Finally, we discuss the role of particle anisotropy in particle acceleration during magnetic reconnection. The work shows that hard power-law distributions are a common feature in relativistic magnetic reconnection region, which may be important for explaining the high-energy emissions in systems like pulsars, jets from black holes, and gamma-ray bursts.

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