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Simulations of turbulent relaxation in solar wind plasma and the role of reconnection

D. Burgess (1), C. Haynes (1), and E. Camporeale (2)

(1) Queen Mary University of London, Astronomy Unit, London E1 4NS, UK, (2) Applied Mathematics and Plasma Physics, Los Alamos National Laboratory, USA

We present results from two-dimensional fully-kinetic Particle-in-Cell (PIC) simulations of decaying electromagnetic fluctuations. The computational box is such that wavelengths ranging from electron to ion gyroradii are resolved. The parameters used are realistic for the solar wind, and the ion to electron mass ratio is physical. The simulations study the regime of cascade from scales from close to the ion scale to electron scales. We firstly analyse the simulation results in the light of the Vlasov linear theory. The dispersion curves of lightly damped modes in this regime suggest that a linear mechanism could be responsible for the observed steepening of power spectra at electron scales, but a straightforward identification of turbulent fluctuations as an ensemble of linear modes is not possible. In contrast to dissipation mechanisms based on linear modes, magnetic reconnection offers a different route to particle heating and energization at small scales. We show that reconnection events do occur during the simulations of turbulent relaxation, and we illustrate the signatures of electron heating for these events. We also investigate the role of controlling parameters for the effectiveness of reconnection in the dissipation process.