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Vlasov simulations of nonlinear electrostatic waves

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Collisionless magnetic reconnection requires the violation of ideal MHD by various kinetic-scale effects. Recent research has highlighted the potential importance of wave-particle interactions by showing that Vlasov simulations of unstable ion-acoustic waves predict an anomalous resistivity that can be significantly higher in the nonlinear regime than the quasi-linear estimate. Here, we investigate the dependence on the initial electron drift velocity of the current driven ion-acoustic instability and its resulting anomalous resistivity. We examine the properties of statistical ensembles Vlasov simulations with real mass ratio for a range of drift velocities and for electron to ion temperature ratios relevant to both solar and magnetospheric physics. We show that the ion-acoustic anomalous resistivity depends nonlinearly on the electron drift velocity for the low temperature ratios examined, in contrast to the linear dependence predicted by theory and commonly assumed in models of magnetic reconnection. We examine the dependence of resistivity on the electron to ion temperature ratios. An anomalous resistivity model consistent with our results could be important for simulations of magnetic reconnection in astrophysical plasmas.