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Fully kinetic PIC simulations of particle acceleration and non-Maxwellian distribution functions due to current sheets in solar wind turbulence

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Turbulence is ubiquitous in solar system plasmas like those of the solar wind and Earth's magnetosheath. Current sheets can be formed out of this turbulence, and eventually magnetic reconnection can take place in them, a process that converts magnetic into particle kinetic energy. This interplay between turbulence and current sheet formation has been extensively analyzed with MHD and hybrid-kinetic models. Those models cover all the range between large Alfvénic scales down to ion-kinetic scales. The consequences of current sheet formation in plasma turbulence that includes electron dynamics has, however, received comparatively less attention. For this sake we carry out 2.5D fully kinetic Particle-in-Cell simulations of kinetic plasma turbulence including both ion and electron spectral ranges. In order to further assess the electron kinetic effects, we also compare our results with hybrid-kinetic simulations including electron inertia in the generalized Ohm's law. We analyze and discuss the electron and ion energization processes in the current sheets and magnetic islands formed in the turbulence. We focus on the electron and ion distribution functions formed in and around those current sheets and their stability properties that are relevant for the micro-instabilities feeding back into the turbulence cascade. We also compare pitch angle distributions and non-Maxwellian features such as heat fluxes with recent in-situ solar wind observations, which demonstrated local particle acceleration processes in reconnecting solar wind current sheets [Khabarova et al., ApJ, 2020].