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Interplay between magnetic reconnection and flapping instabilities in the magnetotail: global hybrid-Vlasov simulation of the Earth's magnetosphere

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Magnetic reconnection is a fundamental process in plasma and a major cause of energy conversion and transport by means of magnetic field topology reconfiguration. It takes place in thin plasma sheets, where energy is often explosively converted from the magnetic field to plasma heating and particle energization. Magnetic reconnection in Earth's magnetotail is thought to play a crucial role in geomagnetic storms and substorms, one of the most explosive phenomena in the context of Earth's magnetosphere. Several other current sheet-related processes, such as the ballooning instability, tearing instability, and a variety of flapping instabilities, can occur in the magnetotail, and the interplay between magnetic reconnection and these current sheet instabilities is largely unexplored. In this study, we investigate the interplay between magnetic reconnection and other instabilities taking place in the magnetotail current sheet, using a hybrid-Vlasov simulation that provides a three-dimensional description of the global coupled solar wind-magnetosphere system down to the ion-kinetic scale. In particular, we identify and characterize the flapping instability that develops in the magnetotail midnight sector and we discuss its dynamics in relation to magnetotail magnetic reconnection.