Statistical Study of Energy Transport and Conversion in Electron Diffusion Regions at Earth's Dayside Magnetopause

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Abstract

The electron diffusion region (EDR) is a key region for magnetic reconnection, but the typical energy transport and conversion in EDRs is still not well understood. In this work, we perform a statistical study of 80 previously published near X-line events identified at the dayside magnetopause in Magnetospheric Multiscale data. We find 44 events that clearly present all commonly accepted EDR signatures and use this database to investigate energy flux partition and energy conversion. We find that energy partition is changed inside EDRs, with a 71%–29% allocation of particle energy flux density between electrons and ions respectively. The electron enthalpy flux density is found to dominate locally at all EDRs and is predominantly oriented in the out-of-plane direction, perpendicular to the reconnecting magnetic field. We also examine the transition from electron- to ion-dominated energy flux partition further from the EDR, finding this typically occurs at scales of the order of the ion inertial length, larger than the typical EDR size. We then investigate energy conversion and transport and highlight complex processes, with potential non-steady-state energy accumulation and release near the EDR. We discuss the implications of our results for reconnection energy conversion, and for magnetopause dynamics in general.

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