The Relationship Between Electron-Only Magnetic Reconnection and Turbulence in Earth’s Magnetosheath

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The Earth’s magnetosheath is filled with small-scale current sheets arising from turbulent dynamics in the plasma. Previous observations and simulations have provided evidence that such current sheets can be sites for magnetic reconnection. Recently, observations from the Magnetospheric Multiscale (MMS) mission have revealed that a novel form of “electron-only” reconnection can occur at these small-scale, turbulence-driven current sheets, in which ions do not appear to couple to the reconnected magnetic field to form ion jets. The presence of electron-only reconnection may facilitate dissipation of the turbulence, thereby influencing the partition of energy between ions and electrons, and can alter the nonlinear dynamics of the turbulence itself. In this study, we perform a survey of turbulent intervals in the Earth’s magnetosheath as observed by MMS in order to determine how common magnetic reconnection is in the turbulent magnetosheath and how it impacts the small-scale turbulent dynamics. The magnetic correlation length, which dictates the length of the turbulent current sheets, is short enough in most of the examined intervals for reduced or absent ion jets to occur. Magnetic reconnection is found to be a common feature within these intervals, with a significant fraction of reconnecting current sheets showing evidence of sub-Alfvénic ion jets and super-Alfvénic electron jets, consistent with electron-only reconnection. Moreover, a subset of the intervals exhibit...
changes in the behavior of the small-scale magnetic power spectra, which may be related to the reconnecting current sheets. The results of the survey are compared with recent theoretical work on electron-only reconnection in turbulent plasmas.