Magnetic topology and flow pattern signatures of reconnection in the turbulent magnetosheath

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Abstract

The Earth's magnetosheath is a plasma region rich in various physical processes that operate across a broad range of overlapping spatial and temporal scales. This complexity makes it challenging to disentagle and study a particular process. In this work, we take advantage of the unprecedented high-resolution multipoint measurements of the Magnetospheric Multiscale (MMS) mission to investigate the topological changes of the magnetic field and plasma flow at reconnection sites in the magnetosheath. For this purpose, we use the database of Stawarz et al. 2022 (https://doi.org/10.1063/5.0071106), consisting of more than two hundred reconnecting current sheets. We estimate the characteristic length scales parallel and perpendicular to the background magnetic field to evaluate how the thickness of the current sheets evolves in turbulence reconnection. We identified very thin current sheets below the ion inertial scale, suggesting that thin current sheets are essential for electron-only magnetic reconnection in the collisionless magnetosheath turbulence. Also, we show that the collocating maxima of current density, vorticity and magnetic field curvature together with the minima of the perpendicular length scale, can be used to find reconnection sites in plasma turbulence.

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