
The magnetosheath as a turbulent dynamo laboratory

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Abstract

Space plasma turbulence encompasses a large variety of energy transfer, transport and conversion processes. This study explores, for the first time, the small-scale turbulent dynamo, which amplifies magnetic fields at the expense of kinetic energy on scales comparable to or smaller than the characteristic scales of flow gradients in 3D plasma turbulence within the magnetosheath. Specifically, this study investigates the anticipated stretching of the magnetic field due to velocity gradients, the impact of compressions, and the simultaneous occurrence of pressure anisotropy instabilities. MMS observations reveal that magnetosheath data display the anticipated signatures of small-scale turbulent dynamo activity. Our findings indicate that the terrestrial magnetosheath, with the available high-resolution, multi-point plasma and field measurements, has the potential to serve as the first space-based testbed for validating turbulent dynamo theories and simulations.

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