Energy conversion pathways inside Kelvin-Helmholtz vortices

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Abstract

The Kelvin–Helmholtz instability (KHI) is a shear-driven phenomenon that generates a chain of vortices, located along the shear layer. As these vortices grow, they interact and fragment, eventually leading to turbulence and the dissipation of kinetic energy. The exact pathway through which KHI moves and converts energy across scales remains still elusive. Using cutting-edge MMS spacecraft data, we explore energy conversion pathways in KHI at Earth's magnetopause. At ion scales, compressional waves and enhanced energy conversion between flow and thermal energy are observed inside vortices, associated with both local non-thermal features and perpendicular temperature anisotropies. Conversely, at the boundaries, enhanced magnetic fluctuations are associated with peaks in the ion agyrotropy. Our findings provide insights into how shear flow energy is ultimately dissipated into heat, shedding light on the complex dynamics of KHI-driven turbulence.

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