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Three-Dimensional Network of Filamentary Currents and Super-Thermal Electrons during Magnetotail Magnetic Reconnection

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Magnetic reconnection is a fundamental plasma process by which magnetic field lines on two sides of the current sheet flow inward to yield an X-line topology. It is responsible for producing energetic electrons in explosive phenomena in space, astrophysical, and laboratorial plasmas. The X-line region is supposed to be the important place for generating energetic electrons. However, how these energetic electrons are generated in such a limited region is still poorly understood. Here, using Magnetospheric multiscale mission data acquired in Earth's magnetotail, we present direct evidence of super-thermal electrons up to 300 keV inside an X-line region, and the electrons display a power-law spectrum with an index of about 8.0. Concurrently, three-dimensional network of dynamic filamentary currents in electron scale is observed and leads to electromagnetic turbulence therein. The observations indicate that the electrons are effectively accelerated while the X-line region evolves into turbulence with a complex filamentary current network.

References:

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