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Direct evidence of secondary reconnection inside filamentary currents of magnetic flux ropes in magnetic reconnection

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Magnetic reconnection is a fundamental plasma process, by which magnetic energy is explosively released in the current sheet to energize charged particles and to create bi-directional Alfvénic plasma jets. Numerical simulations predicted that evolution of reconnecting current sheet was dominated by formation and interaction of magnetic flux ropes, which finally leads to turbulence. Accordingly, most volume of the reconnecting current sheet is occupied by the ropes and energy dissipation primarily occurs along their edges via the rope coalescence. As essential elements of the reconnecting current sheet, how these ropes evolve itself is unresolved. Here, we present, for the first time, direct evidence of secondary reconnection in the filamentary currents within the ropes. The observations of cross-scale energy transfer and reconnection inside the ropes show us a new picture that energy conversion occurs at a huge region rather than just at primary reconnection site.