Observations of an Electron-only Magnetic Reconnection within a macroscopic Flux Rope in the Magnetotail

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It is widely accepted that flux ropes play important roles in the momentum and energy transport in space plasmas. Recent observations found that magnetic reconnection occurs at the interface between two counter flows around the center of flux ropes. In this presentation, we report a novel observation by MMS that reconnection occurs at the edge of a large-scale flux rope, the cross-section of which was about 2.5 Re. The flux rope was observed at the dusk side in Earth’s magnetotail and was highly oblique with its axis proximity along the $X_{\text{GSM}}$ direction. We found an electron-scale current sheet near the edge of this flux rope. The Hall magnetic and electric field, super-Alfvénic electron outflow, parallel electric field and positive energy dissipation were observed associated with the current sheet. All the above signatures indicate that MMS detected a reconnecting current sheet in the presence of a large guide field. Interestingly, ions were not coupled in this reconnection, akin to the electron-only reconnection observed in the magnetosheath turbulence. We suggest that the electron-scale current sheet was caused by the strong magnetic field perturbation inside the flux rope. This result will shed new lights for understanding the multi-scale coupling associated with flux ropes in space plasmas.