Disturbance of the front region of magnetic reconnection outflow jets due to the lower-hybrid drift instability

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Magnetic reconnection is a key process in collisionless plasmas that converts magnetic energy to plasma kinetic energies through changes in the magnetic field topology. The energy conversion in this process is believed to cause various explosive phenomena in space such as auroral substorms in the Earth’s magnetosphere and solar flares. Here, a 3D fully kinetic simulation shows that the lower-hybrid drift instability (LHDI) disturbs the front of magnetic reconnection outflow jets and additionally causes the energy dissipation. The peak energy dissipation at the jet fronts is comparable to the values seen near the center of the reconnection region where the topology change during reconnection occurs, indicating that the LHDI turbulence has a substantial effect on the energetics of reconnection. The result is well consistent with a disturbance observed at the dipolarization front (DF) in the Earth’s magnetotail by the Magnetospheric Multiscale (MMS) mission. A fully kinetic dispersion relation solver, validated by the MMS observations, further predicts that the disturbance of the reconnection jet front could occur over different parameter regimes in space plasmas including the Earth’s DF and solar flares.