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Comparison of MMS data and virtual simulation data relative to secondary reconnection within a flux rope in the magnetopause

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Recently Øieroset et al. [2016] reported evidence for reconnection between colliding reconnection jets in a compressed current sheet at the center of a magnetic flux rope at Earth's magnetopause. Here, we set up a simulation with parameters similar to those observed: in particular we used the same guide field ratio to the in plane field.
The initial state is a Harris sheet with mass ratio 256 and temperature ratio 10. The domain is 3D with box size 20x15x10 di.
Reconnection is initiated at the two edges of the box by seeding an initial localized x-line. Reconnection starts at the two x-lines by design due to the strong perturbation. The subsequent evolution shows reconnection taking root in the initially seeded x-lines.
Later an instability develops within the flux rope, likely similar to those reported in Lapenta et al. [2015], and secondary reconnection starts in a ring near the center of the flux rope. The analogy with the kink mode of laboratory and solar wind flux ropes[Lapenta et al., 2006] is striking and future work will be needed to investigate if the instability satisfies the Kruskal-Shafranov limit [Shafranov, 1957, Kruskal and Tuck, 1958].
At late times, the primary reconnection site becomes inactive and the secondary reconnection site becomes dominant. In this later stage, agyrotropy and $J \cdot E'$ are stronger in the center. But more strikingly, the ions are outflowing predominantly away from the secondary reconnection site in the central region of the flux rope and the ring near the center where reconnection signatures (agyrotropy and $J \cdot E'$) are strongest. The electron pressure presents several intense loci, identifying where strong electron energization by secondary reconnection takes place.
The results of the simulation are studied producing synthetic virtual satellite diagnostics obtained from the simulation results but with a format similar to in situ spacecraft observations. With these data formats the results can be more readily be compared with the MMS data reported in Øieroset et al. [2016].
References
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