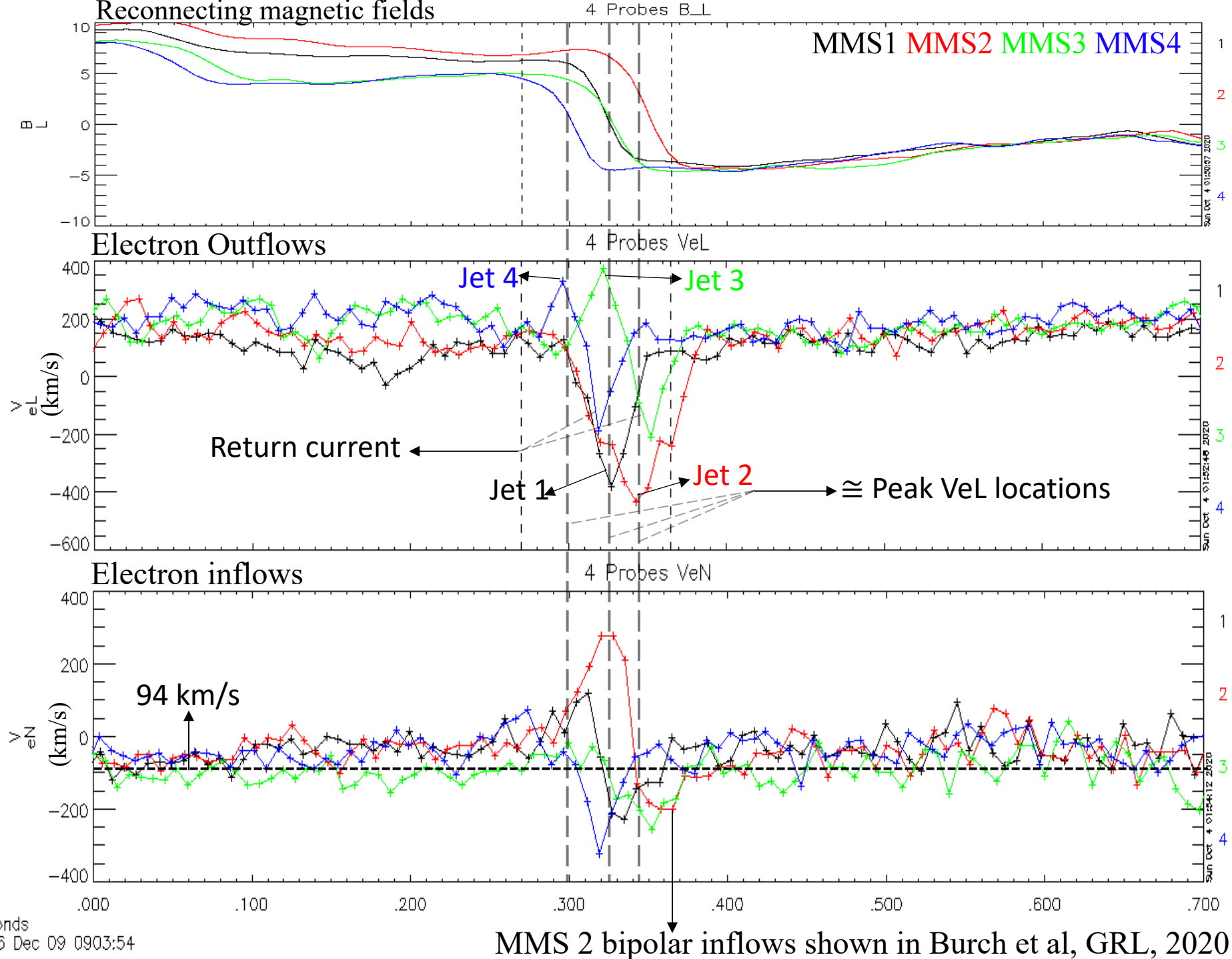


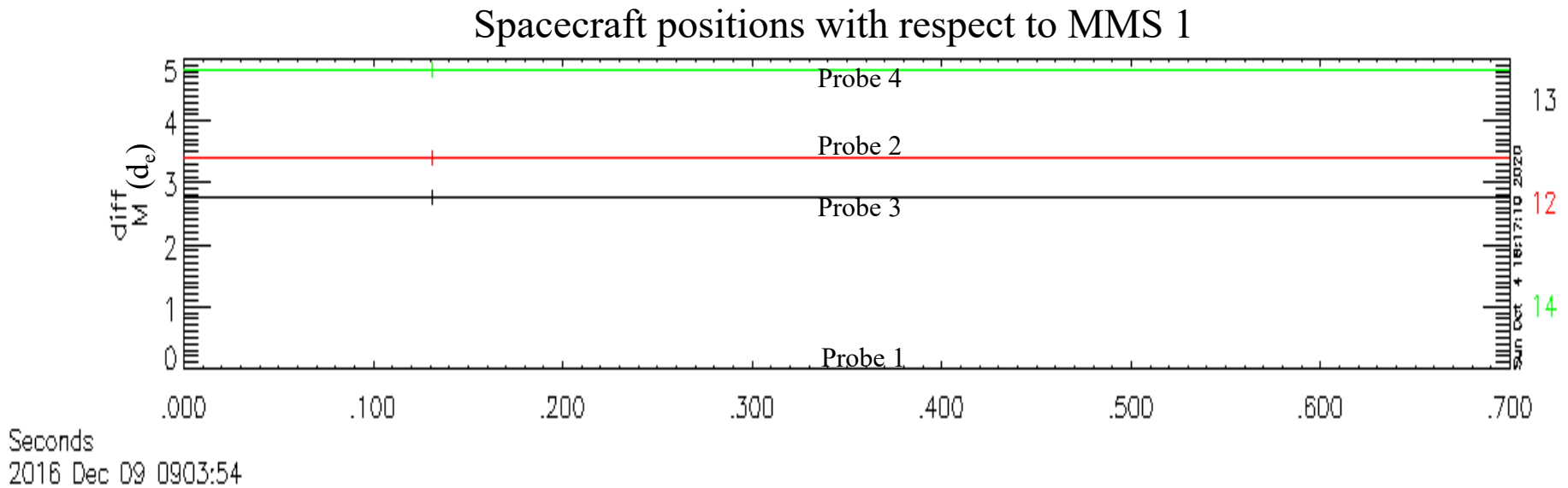
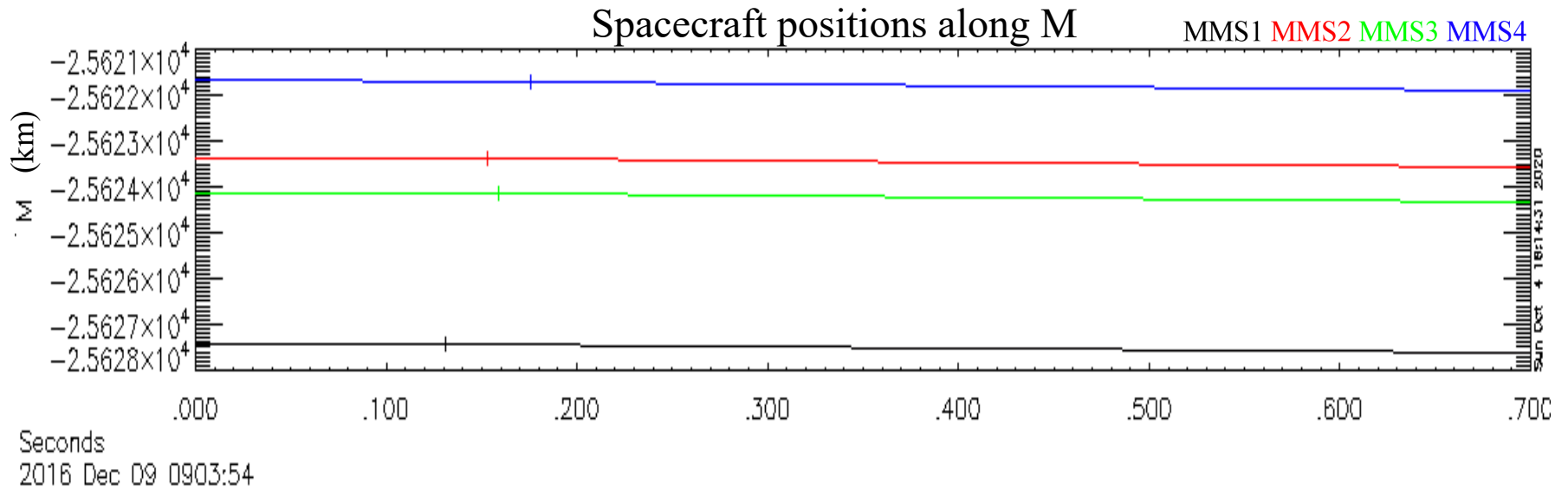
On the short-scale spatial variability of electron inflows in electron-only magnetic reconnection in the turbulent magnetosheath observed by MMS

P. S. Pyakurel, T. D. Phan, M. A. Shay, J. L. Burch, D. J. Gershman, B. L. Giles, R. B. Torbert, R. E. Ergun, R. J. Strangeway, C. T. Russell

2020 FALL SWT
Science Splinter: Magnetic Reconnection I



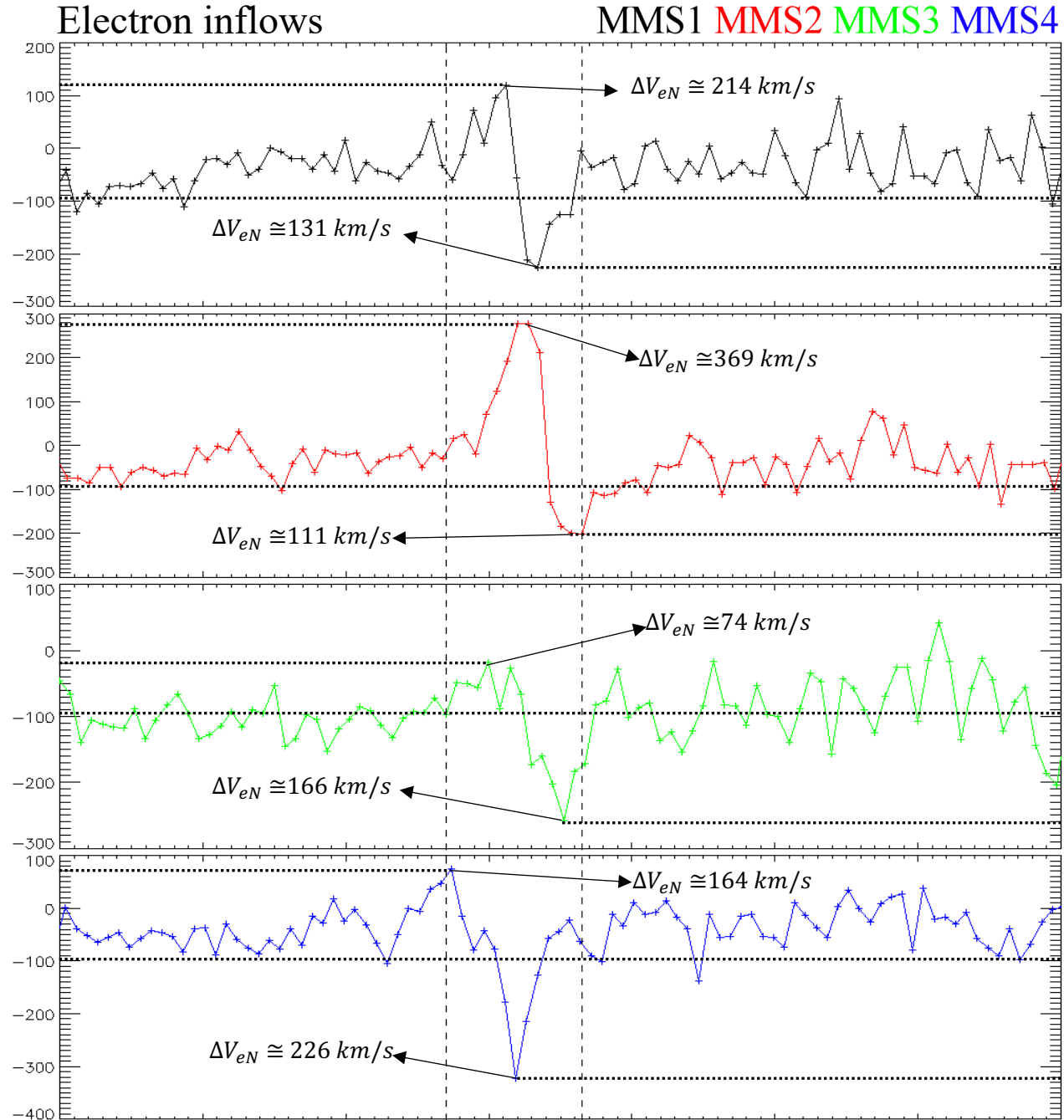
Position of spacecraft in the out-of-plane direction



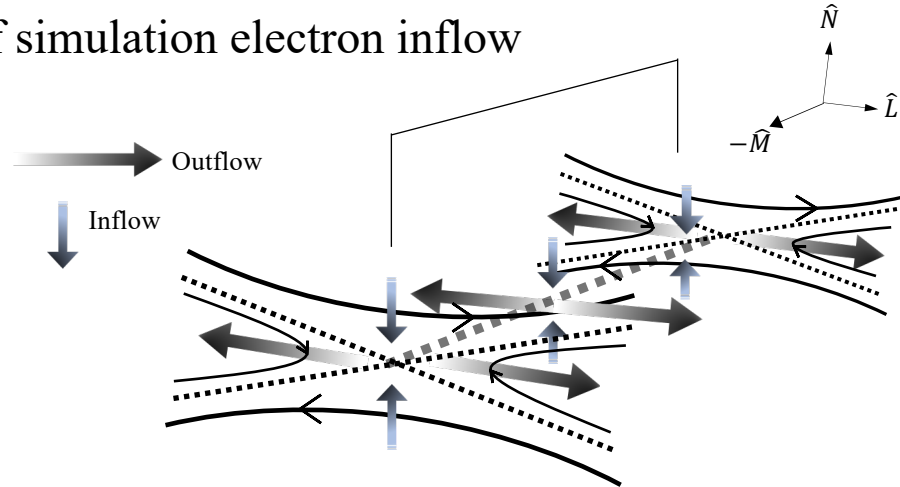
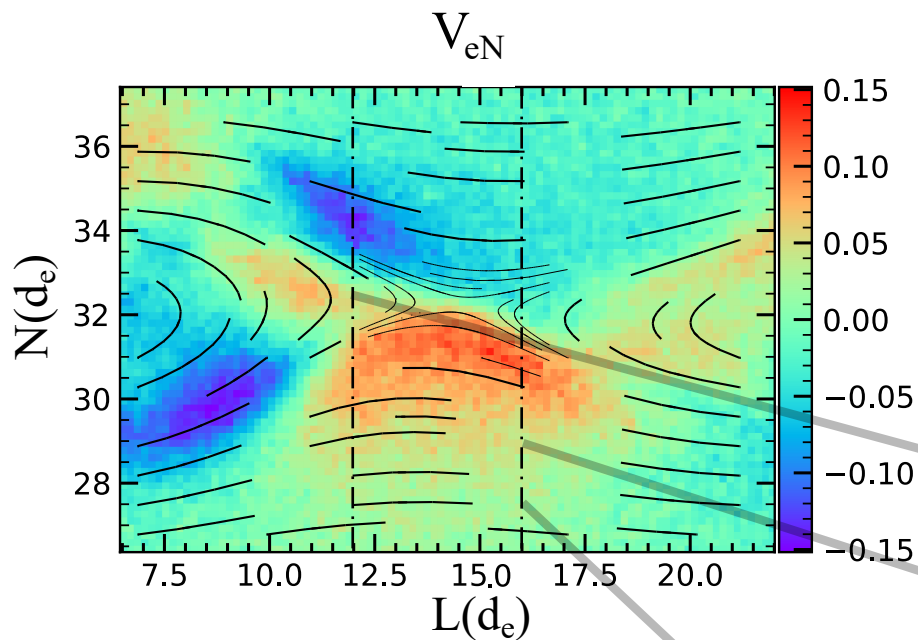
Spacecraft separation within $5d_e$

Electron inflow features

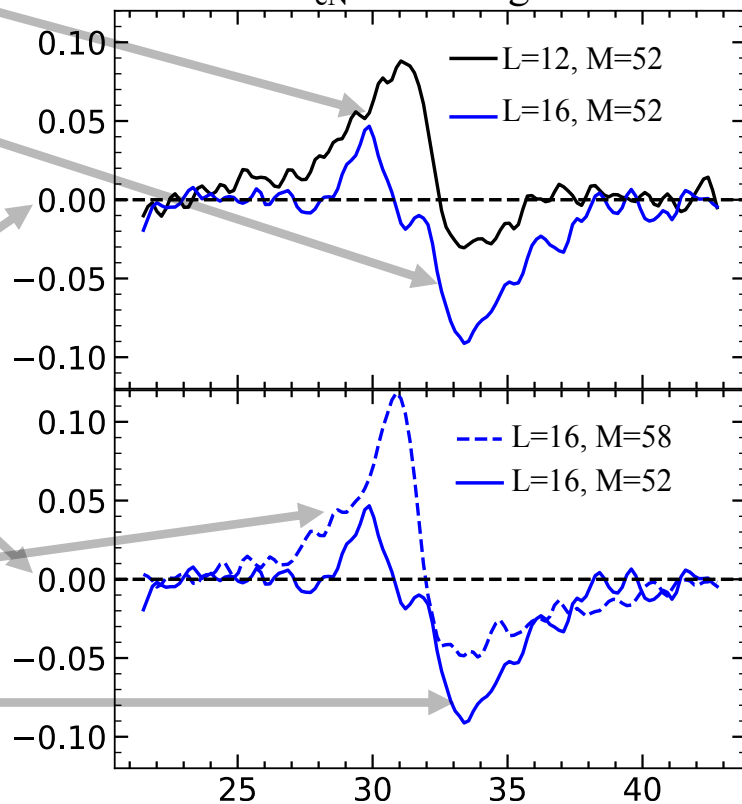
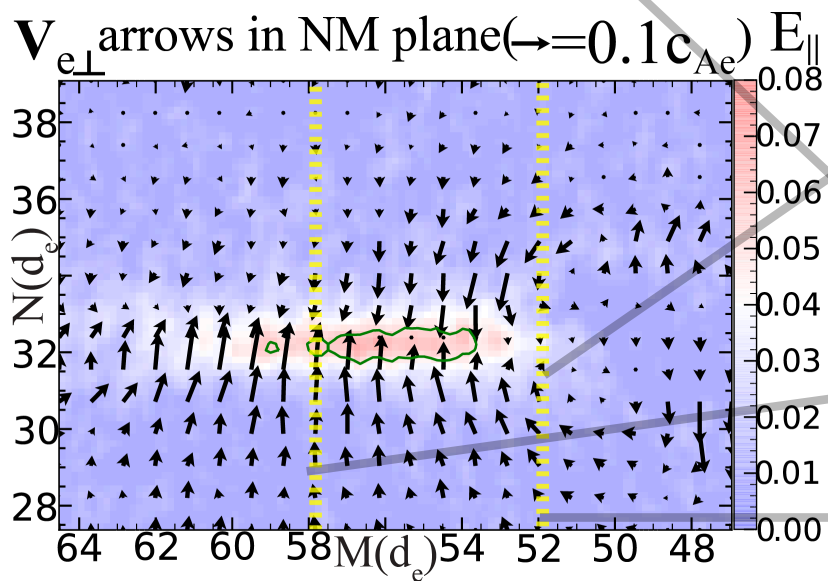
- Asymmetric V_{eN} observed in all spacecraft.
- In MMS 2 and 3, we find that on either side of the inflow region, the inflow V_{eN} differs by at least twice the amplitude.
- Between MMS 2 and MMS (3,4), the asymmetric inflow feature switches.
- The largest measured ΔV_{eN} is about 369 km/s and smallest is about 74 km/s.
- The electron Alfvén speed is about 1000 km/s. Normalized to this speed, we have $\Delta V_{eN, max} \cong 0.37$ and $\Delta V_{eN, min} \cong 0.074$.



3D PIC Simulation: Features of simulation electron inflow



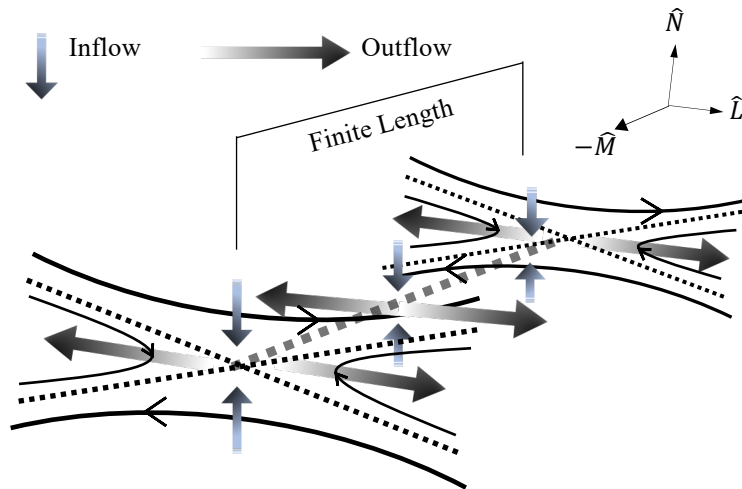
Comparison to MMS observations
 V_{eN} cuts along N



Remarks

- Observations of bipolar and asymmetric inflows in MMS spacecraft.
- Spacecraft separation was at most $5 d_e$ in the out-of-plane direction(M).
- Even though the spacecraft separations were only a few electron inertial lengths (d_e), the inflow velocity amplitudes among the spacecraft are very different.
- MMS inflow velocities range from $0.07 - 0.4 C_{Ae}$.
- Simulation inflow velocities range from $0.02 - 0.1 C_{Ae}$.
- Asymmetric V_{eN} comes about naturally in simulations.
- Like MMS observations, the 3D PIC simulation show that the inflow velocity profiles at different locations in the downstream regions and in the out-of-plane (X-line extent) direction can be very different within such short distances (few d_e 's).

Simulation: Finite Length Electron-Only Reconnection



Particle-In-Cell (PIC) Simulation Setup

1. Force-free initial condition with real mass ratio and $\beta \sim 3$.
2. No initial perturbation, reconnection onset due to PIC noise.
3. Real mass ratio $m_i/m_e = 1836$
4. Guide field asymptotes to the reconnecting field of 1.0 outside the current sheet
5. The initial current sheet consists solely of electron current with ions as a neutralizing background
6. All figures normalized to electron units: Lengths to electron inertial length (d_e), time to inverse electron cyclotron frequency (Ω_{ce}^{-1}), velocity to electron Alfvén speed (c_{Ae})