An ion scale magnetic structure with rapidly inflowing electrons was observed just prior to an EDR encounter [1] by MMS on July 11th 2017. Enhanced Hall magnetic field, velocity reversal, parallel heating, and large amplitude electrostatic waves are indicative of a violent mixing interaction at a sharp boundary near the reconnection separatrix. We investigate the nature of this boundary via multi-spacecraft timing, de Hoffmann Teller frame jump conditions, and dissipation in the form of J·E. Violent mixing between reconnection inflow and outflow appear coupled to compression of the separatrix.

**EVENT OVERVIEW**

- **P** ~ parallel to **B**
- **Q** ~ **E x B** direction
- **R** ~ Normal to layer

**PARALLEL MIXING IN SECOND CROSSING**

- Fast electron beam consistent with magnetic shear accompanied by high frequency beam-mode waves
- High amplitude Buneman spikes similar to mixing signatures in previous separatrix observations

**INFLOW STRUCTURE**

- LMN coordinates defined based on reconnection event, PQR redefined for separatrix structure
- Second crossing exhibits magnetic pileup, high amplitude wave activity, and apparent coupling between lower hybrid drift waves and parallel mixing

**OHM’S LAW AND DISSIPATION**

- Generalized Ohm’s Law assuming small inertial term:
  \[ E + v \times B = \nabla \cdot p_e - \nabla \cdot \mathbf{J}_e + \eta \mathbf{J} \]
- Compute \( \mathbf{J} \) using curlometer technique, compare with \( v \)
- \( \mathbf{E}_e \) does not meet frozen in condition. Pressure gradient is in +R direction, so cannot make up the remainder.
- \( \mathbf{J}_e \) dissipation shown likely oscillatory – curlometer \( \mathbf{J} \) not reliable at higher frequencies
- \( \mathbf{J}_e \) overall negative contribution, possibly related to thinning of the separatrix

**DISCONTINUITY ANALYSIS**

**DE HOFFMANN TELLER FRAME**

- Change to frame with no motional \( E \)
  \[ E \times B = 0 \]
  \[ \mathbf{v}_{HT} = \mathbf{n} \times (\mathbf{v}_1 \times \mathbf{B}_1) / |\mathbf{B}_1| \cdot \mathbf{n} \]
- de Hoffmann Teller frame is well defined and quasi-2D
- Structure has the form of a slow shock, but reversed from Petschek orientation [2], with the inflow as the fast population

**JUMP CONDITIONS / WALÉN RELATION NOT SATISFIED**

- Is tangential velocity \( (V_t) \) consistent with Alfvén speed?
  \[ V_t = \sqrt{V_{Ti}^2 - V_{Ni}^2} \]
- Assumed steady-state and diagonal pressure tensor
- Failure of tests implies non-ideal or time-evolving behavior at the boundary

**SUMMARY**

Magnetic pileup is observed along the separatrix of a confirmed magnetic reconnection site. Strong electrostatic waves with velocities both parallel and perpendicular to the magnetic field are found concurrent with parallel heating of electrons, ion velocity rotation, and a density cavity expected in the reconnection separatrix. Parallel modes are indicative of rapid thermalization of an anti-parallel electron beam. Coplanarity of \( B \) and \( v \) are consistent with a (reversed) slow shock model, but jump conditions are not satisfied. Likely, the failure of these tests relates to the active compression and non-ideal activity at the boundary, also indicated by unusual generalized Ohm’s Law balance and an overall negative \( J \cdot E \).

**REFERENCES**