Observations of Turbulence and Large Electric Fields associated with Magnetic Reconnection in Earth's Magnetotail

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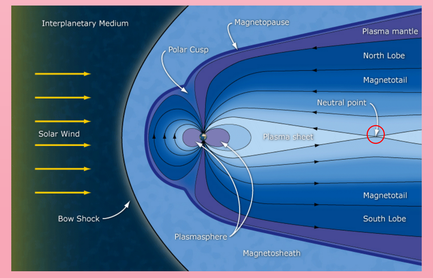
Summary

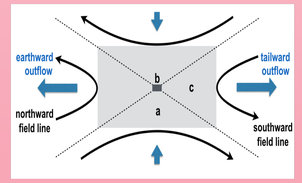
Magnetic trapping is a driving factor of electron acceleration to energies of 100 keV+ during reconnection events in Earth's magnetotail

- Reconnection events are associated with turbulence and electrons accelerated to high energies
- Electrons accelerated to high energies spent enough time in magnetic holes during reconnection events to indicate a strong connection between turbulence and acceleration

Background

- Reconnections of magnetic field lines in Earth's magnetotail can result in the release of magnetic flux and plasma in both Earthward and tailward flows

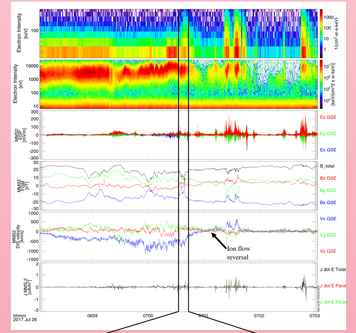


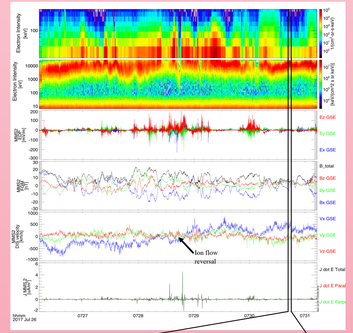


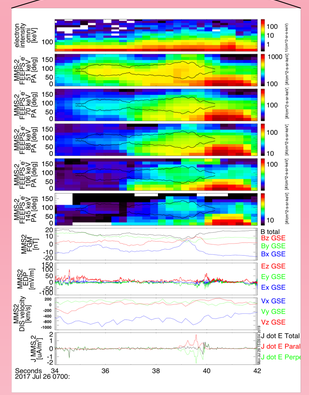
- Observation of the plasma sheet using MMS satellites show large-amplitude electric field pulse, plasma turbulence, and electrons accelerated to energies of 100 keV+
- High resolution MMS measurements are used to examine turbulent regions in detail
- Measurements indicate magnetic trapping is a contributing factor in electron acceleration

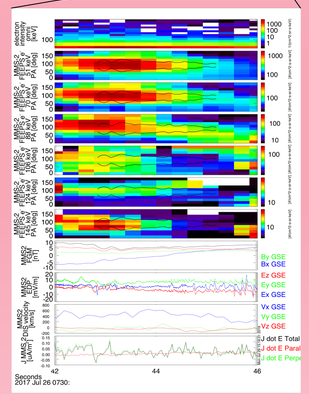
Acceleration Events

- MMS data was used to identify periods of electron acceleration during reconnection events with associated bulk flow reversal and high amplitude electric fields and turbulent magnetic fields
- High resolution MMS measurements were used to calculate the work done on particles by electric fields (J dot E)
- The Pitch Angle Distribution (PAD) of electron acceleration events was calculated and graphed to identify magnetic holes and trapping



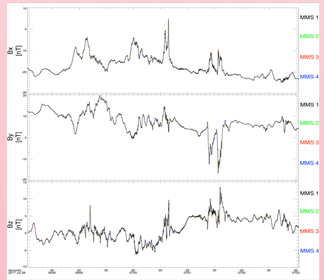




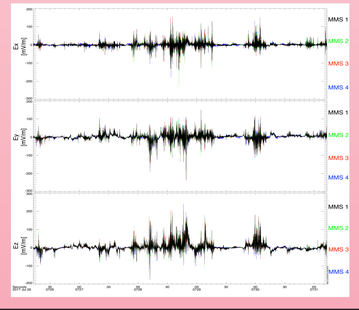


Magnetic Trapping

- High resolution MMS data was used to calculate the speed of magnetic holes, particle gyroradii, inertial length, and gyrofrequencies



- Magnetic hole Speed: 2599.7920 km/s
- Max correlation: 0.99833
- e- gyroradius: 4.67361 km
- e- gyrofrequency: 671.676 Hz
- Ion gyroradius: 220.113 km



- Magnetic hole Speed: 1783.5461 km/s
- Max correlation: 0.86330867
- e- gyroradius: 24.6117 km
- e- gyrofrequency: 264.352 Hz
- Ion gyroradius: 580.034 km

Conclusion

- Magnetic trapping as a result of turbulence is a driving factor of electron acceleration to high energies
- The plasma parameters and speed of the magnetic holes indicates electrons can get trapped and spend sufficient time in magnetic holes for acceleration
- Future studies will focus on identifying specific mechanisms behind acceleration

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