ELECTRON ACCELERATION DURING RECONNECTION EVENTS

OBSERVATIONS OF TURBULENCE AND LARGE ELECTRIC FIELDS ASSOCIATED WITH MAGNETIC RECONNECTION IN EARTH’S MAGNETOTAIL

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EARTH’S MAGNETOTAIL
RECONNECTIONS
MAGNETOSPHERIC MULTISCALE MISSION (MMS)
HALLMARKS OF RECONNECTION

- Electron acceleration to energies higher than 100 keV
- Turbulence
- Spikes of J dot E
- Ion flow reversal in x direction
- Magnetic field reversal in z direction

\[- \frac{\partial u}{\partial t} = \nabla \cdot \mathbf{S} + \mathbf{J} \cdot \mathbf{E}\]
RECONNECTION EVENTS

July 26th, 2017 06:58 Event

July 26th, 2017 07:26 Event
July 26th, 2017 06:58 Event

Ion flow reversal in x direction

July 26th, 2017 07:26 Event

Ion flow reversal in x direction
RECONNECTION EVENTS

July 26th, 2017 06:58 Event

July 26th, 2017 07:26 Event

B field reversal in z direction
MAGNETIC MIRRORING

Magnetic moment
\[ \mu = \frac{1}{2} m v^2_\perp \frac{1}{B} \]

Pitch angle
\[ \theta = \sin^{-1} \left( \frac{v_\perp}{v_0} \right) \]

Kinetic energy
\[ E_k = \frac{1}{2} m \left( v^2_\perp + v^2_\parallel \right) \]

Trapped electrons
\[ \frac{\pi}{2} > |\theta| > \sin^{-1} \left( \frac{B_0}{B_1} \right) \]
SPEED OF MAGNETIC HOLES

July 26th, 2017 06:58 Event

2599.7920 km/s
Max correlation: 0.99833

July 26th, 2017 07:26 Event

1783.5461 km/s
Max correlation: 0.86330867
PLASMA PARAMETERS

July 26th, 2017 06:58 Event

- e- gyroradius: 4.67361 km
- e- gyrofrequency: 671.676 Hz
- Ion gyroradius: 220.113 km

July 26th, 2017 07:26 Event

- e- gyroradius: 24.6117 km
- e- gyrofrequency: 264.352 Hz
- Ion gyroradius: 580.034 km
• 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

• Looking forward, future studies will focus on identifying specific mechanisms behind acceleration
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