ELECTRON ACCELERATION DURING RECONNECTION EVENTS

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

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EMMA STOHLMAN[1,2]

MENTORS: NARGES AHMADI[1], FREDERICK WILDER[1], ROBERT ERGUN[1]

(1) Laboratory for Atmospheric and Space Physics, University of Colorado Boulder
(2) Department of Physics, Illinois Institute of Technology

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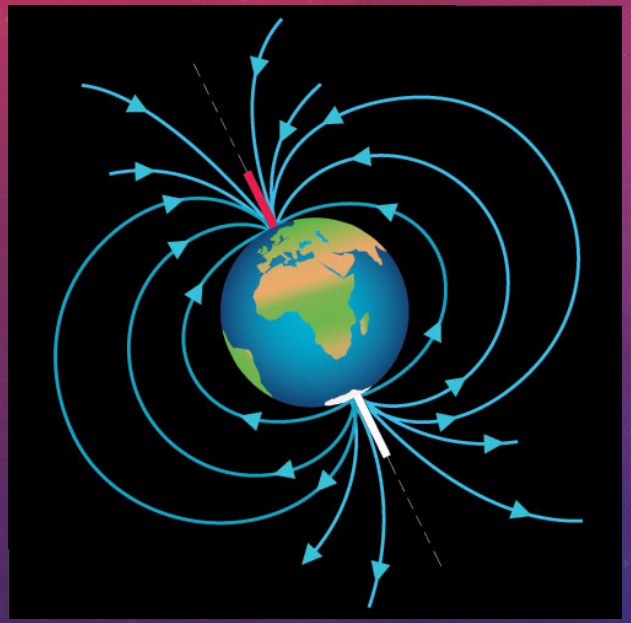
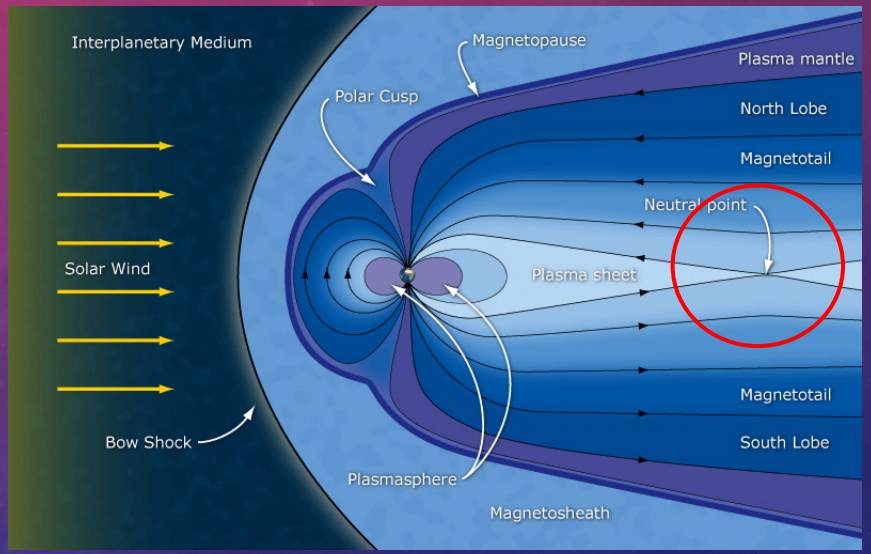
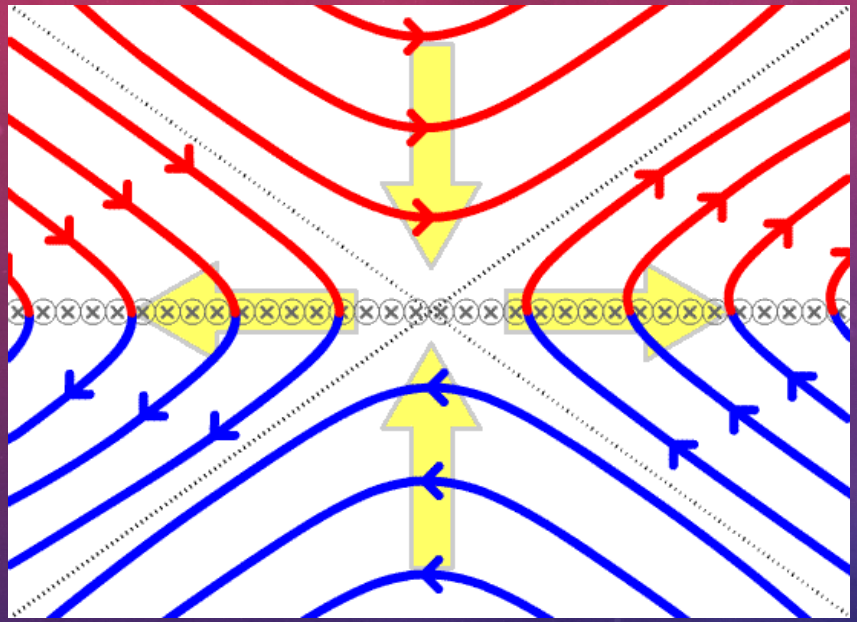
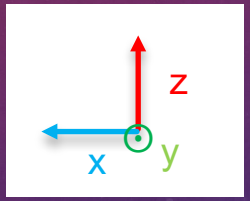
EARTH'S MAGNETOTAIL

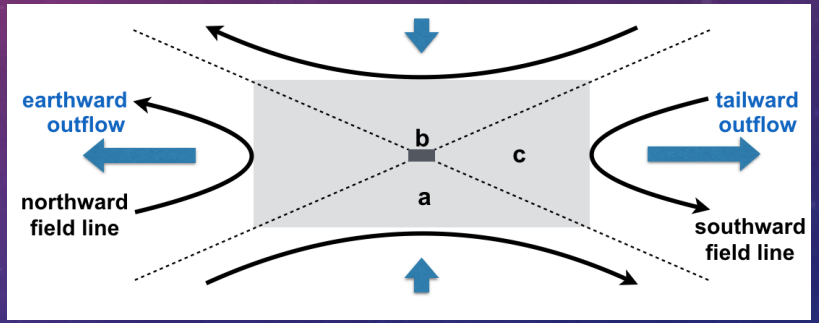


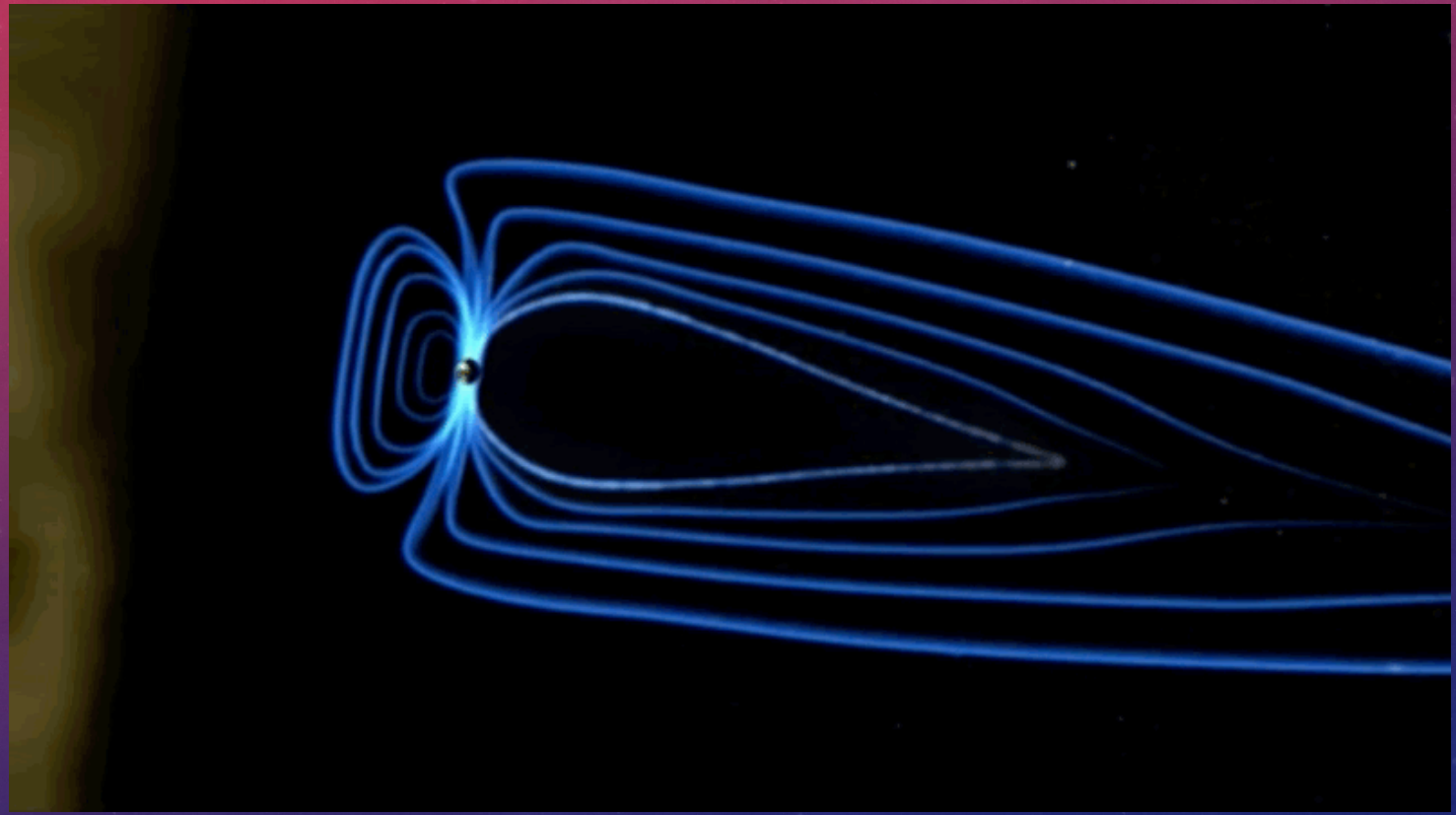


RECONNECTIONS

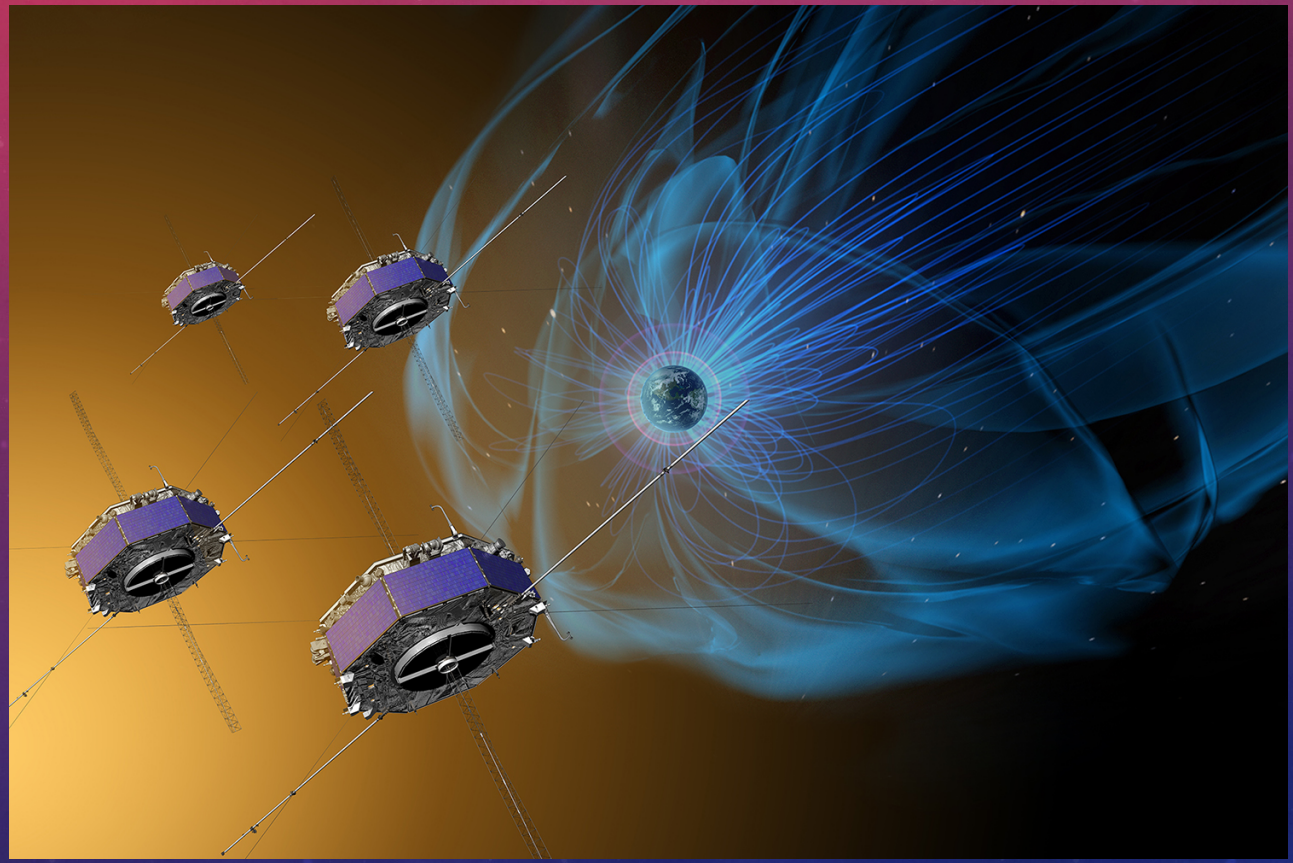








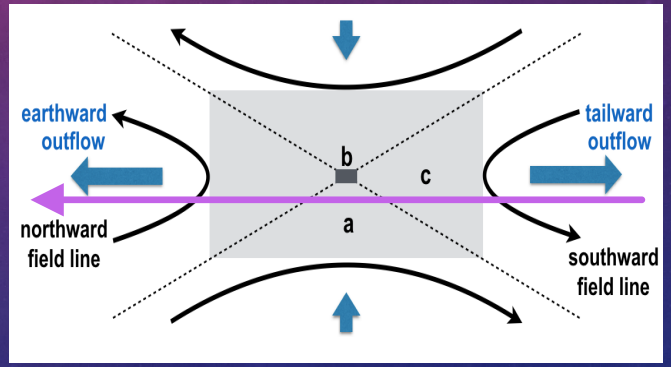
MAGNETOSPHERIC MULTISCALE MISSION (MMS)

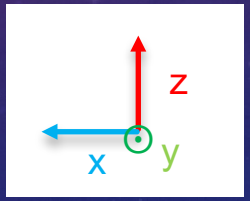


HALLMARKS OF RECONNECTION

- 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

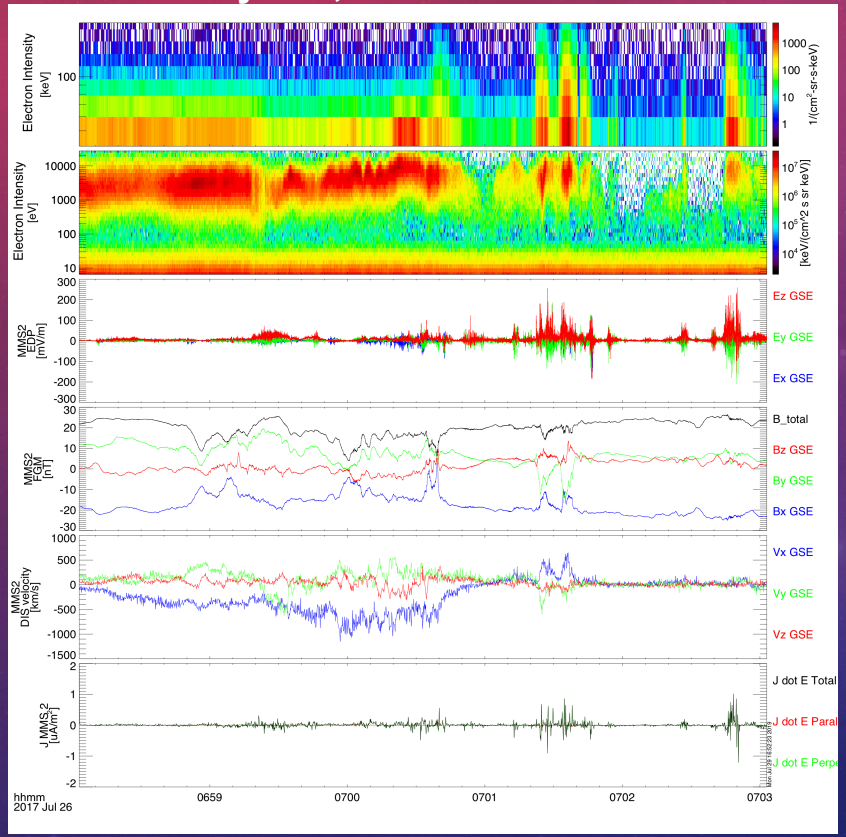
$$-\frac{\partial u}{\partial t} = \nabla \cdot \mathbf{S} + \mathbf{J} \cdot \mathbf{E}$$





RECONNECTION EVENTS

July 26th, 2017 06:58 Event



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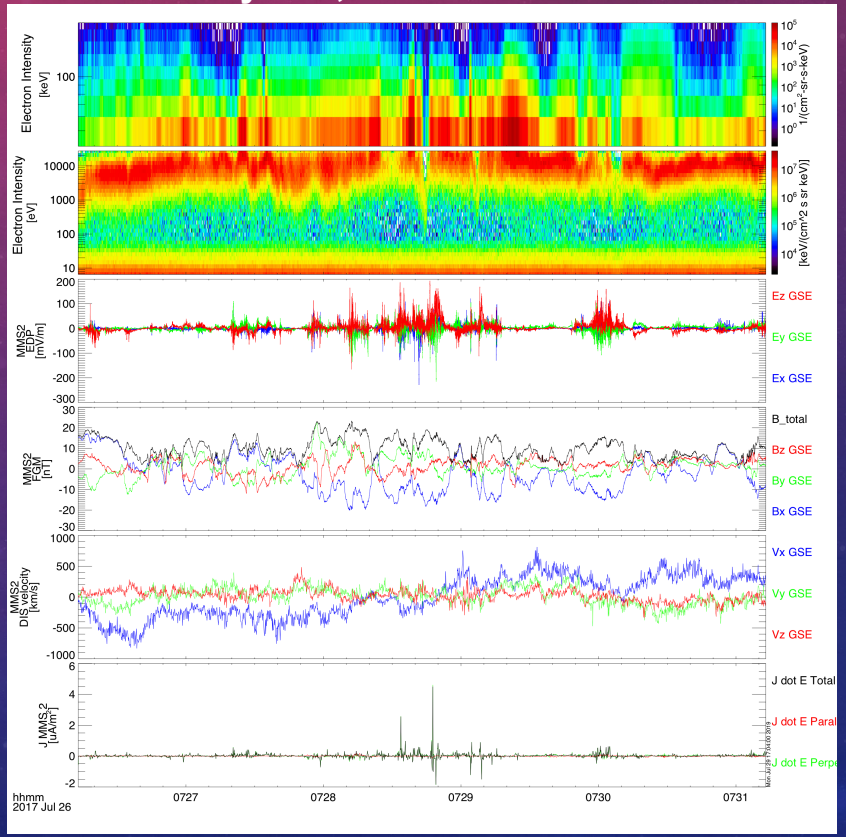

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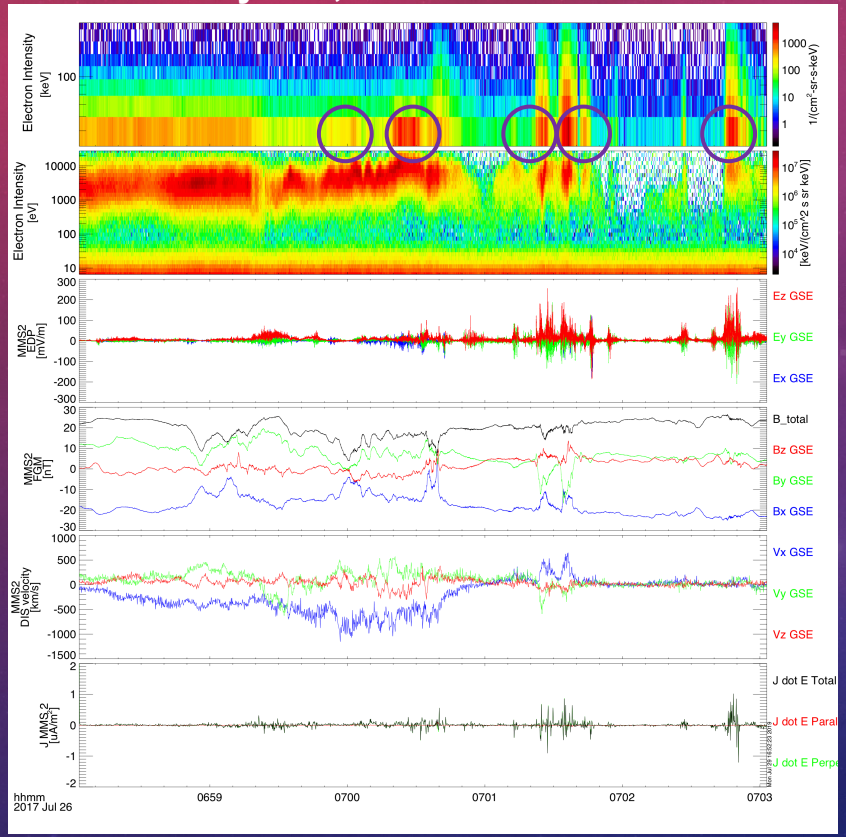

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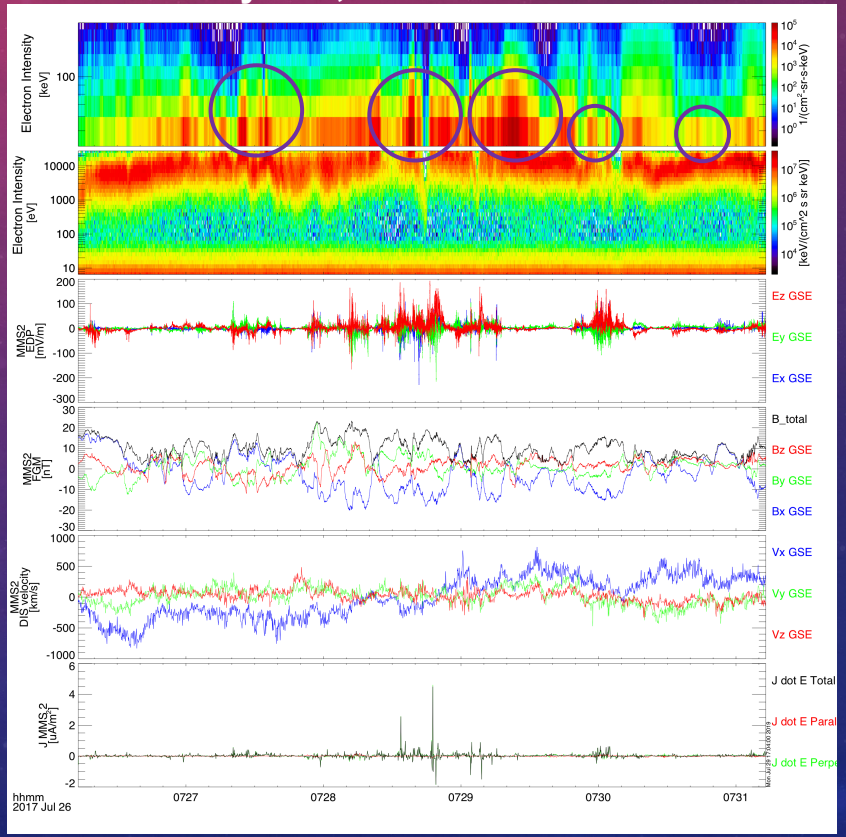

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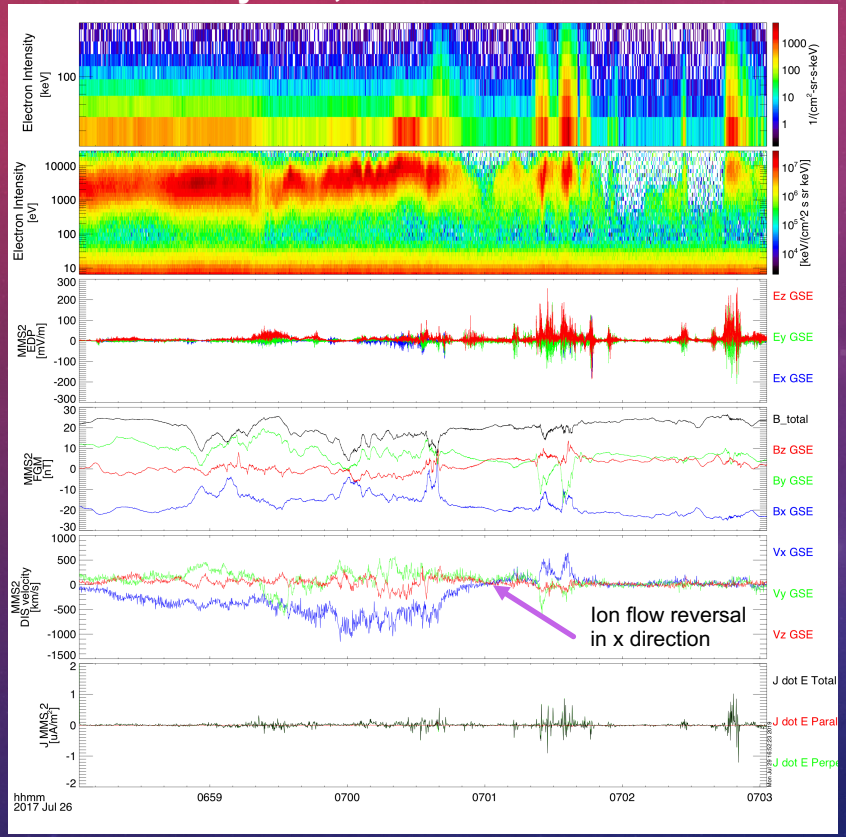

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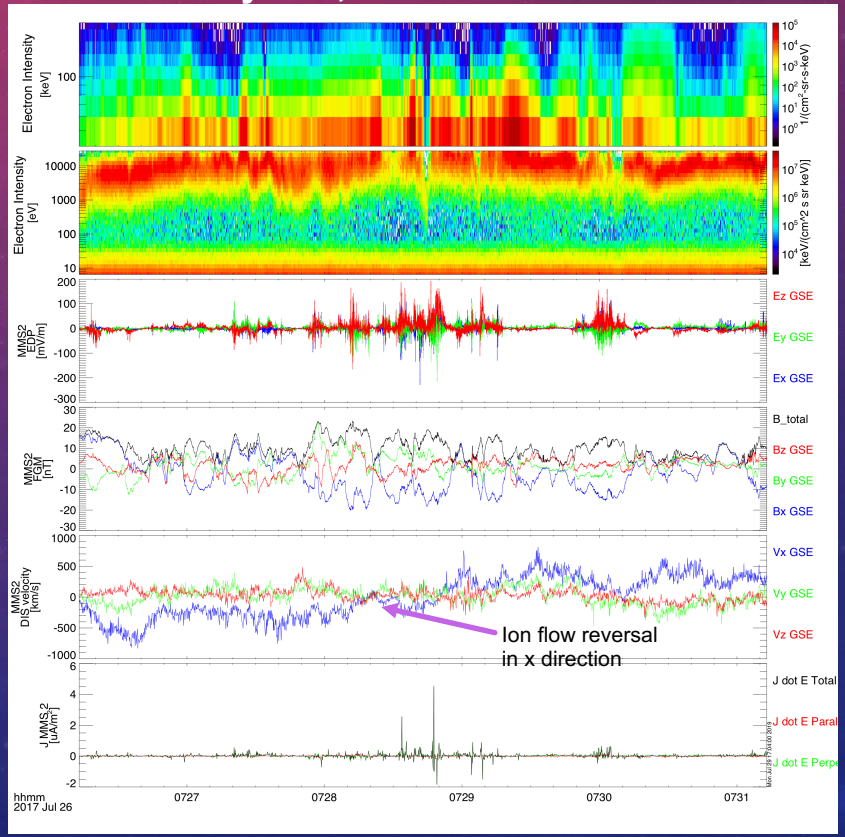

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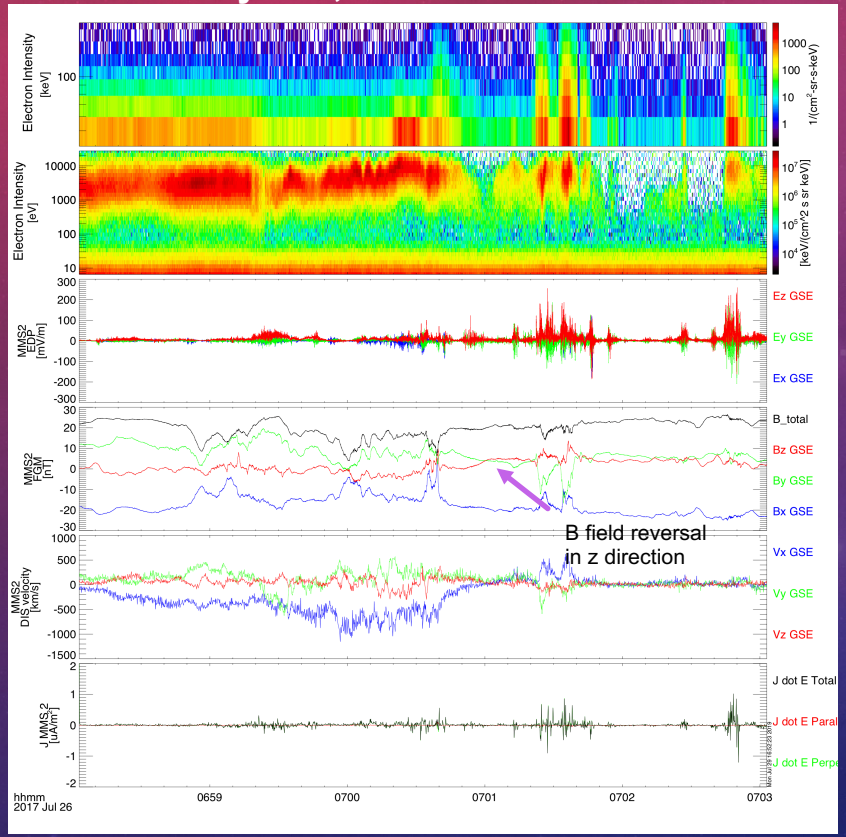

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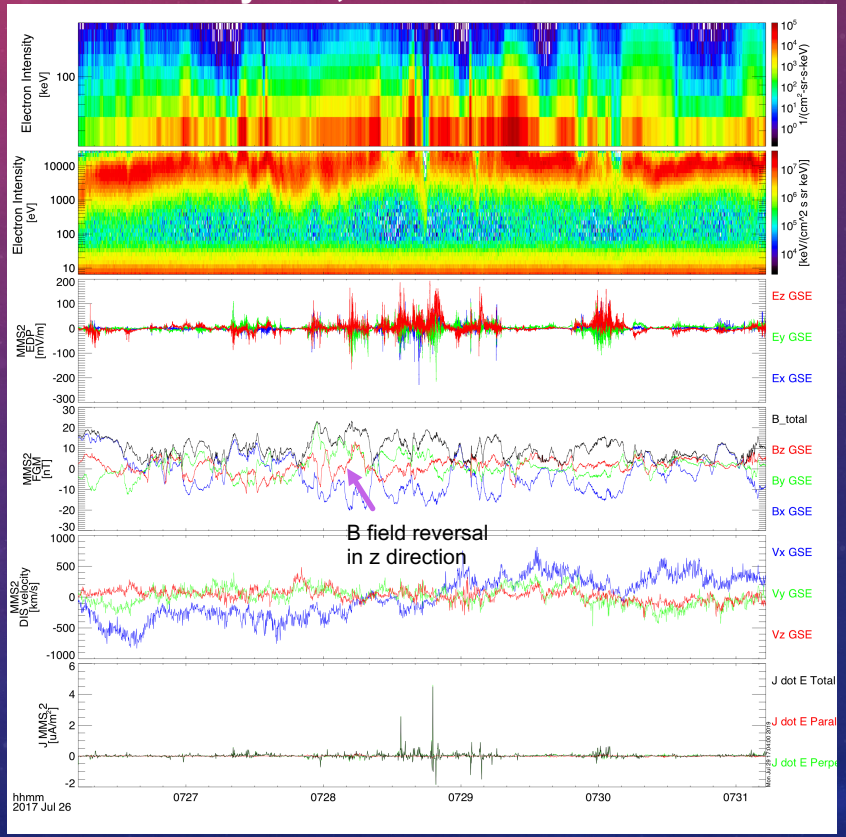
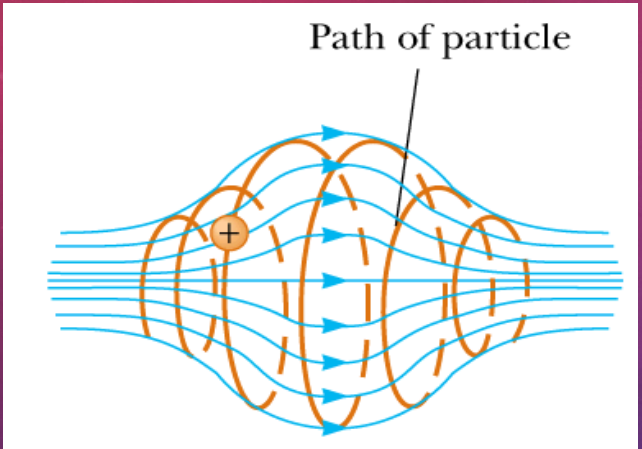
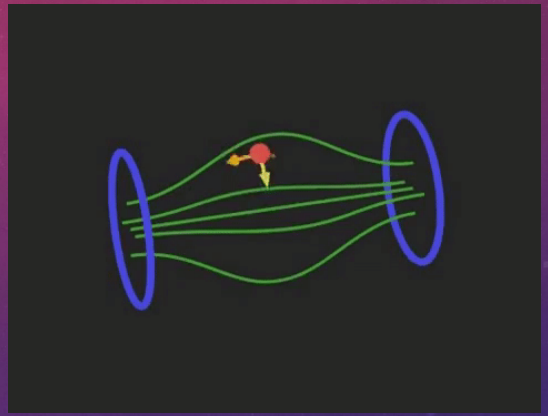


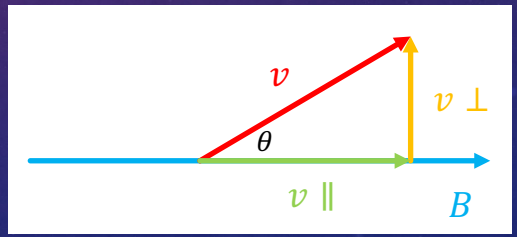
MAGNETIC MIRRORING





Magnetic moment $\mu = \frac{\frac{1}{2}mv^2\perp}{B}$

Pitch angle $\theta = sin^{-1}(\frac{v\perp}{v_0})$



Kinetic energy $E_k = \frac{1}{2}m(v_\perp^2 + v_\parallel^2)$

Trapped electrons $\frac{\pi}{2} > |\theta| > sin^{-1}(\frac{B_0}{B_1})$

RECONNECTION EVENTS

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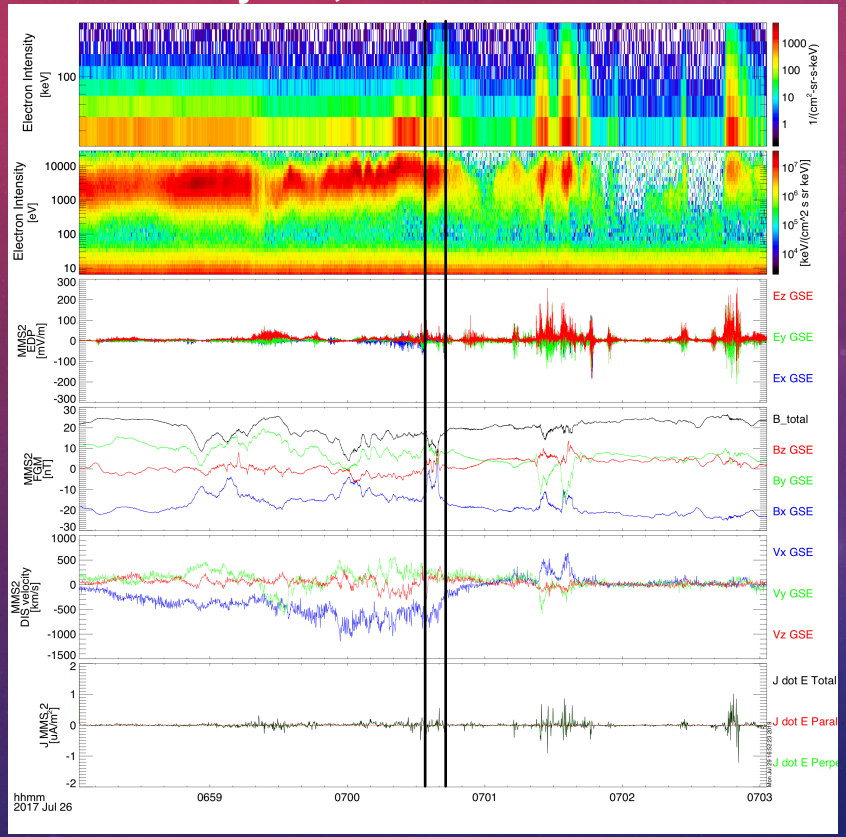

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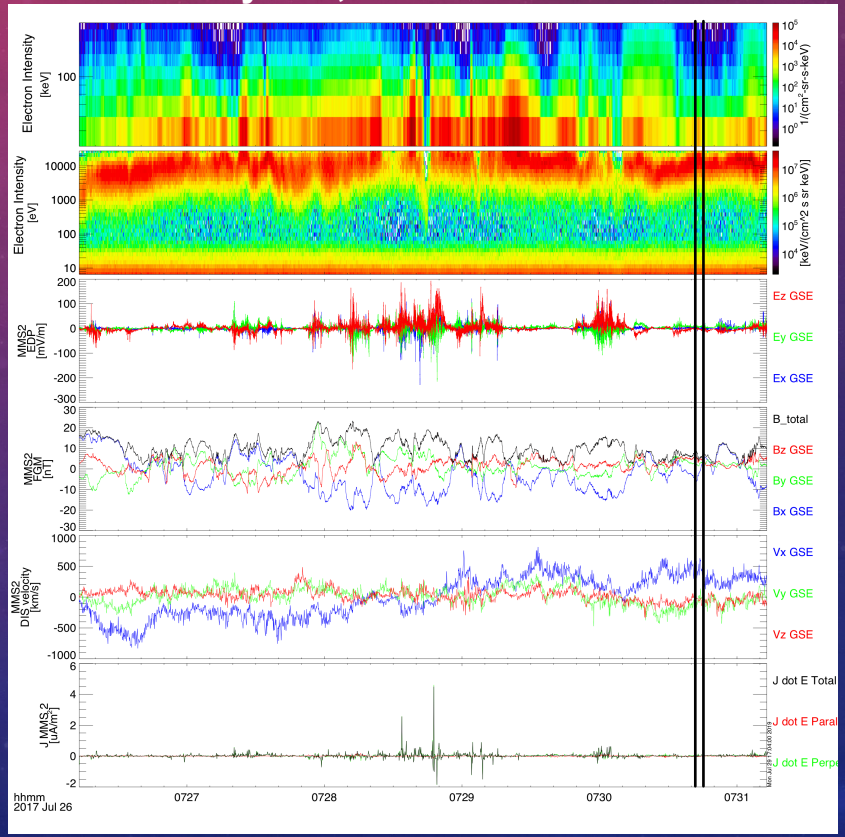

MAGNETIC HOLES

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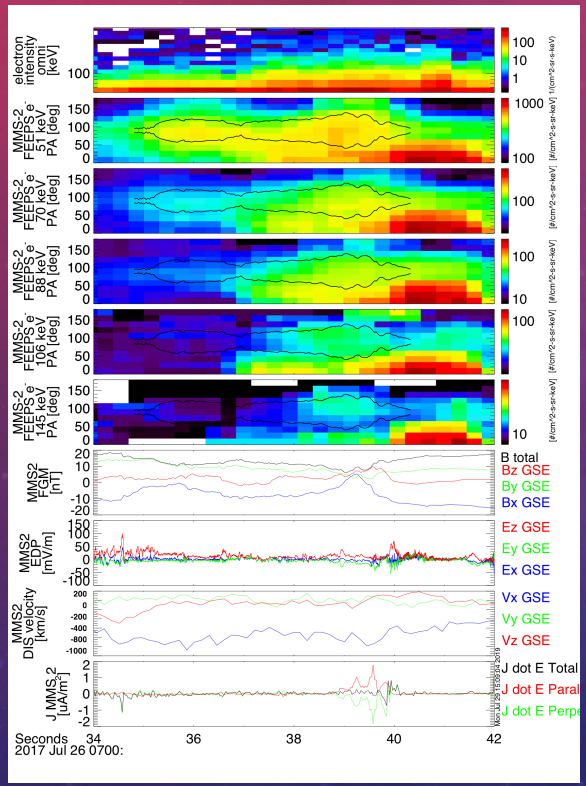

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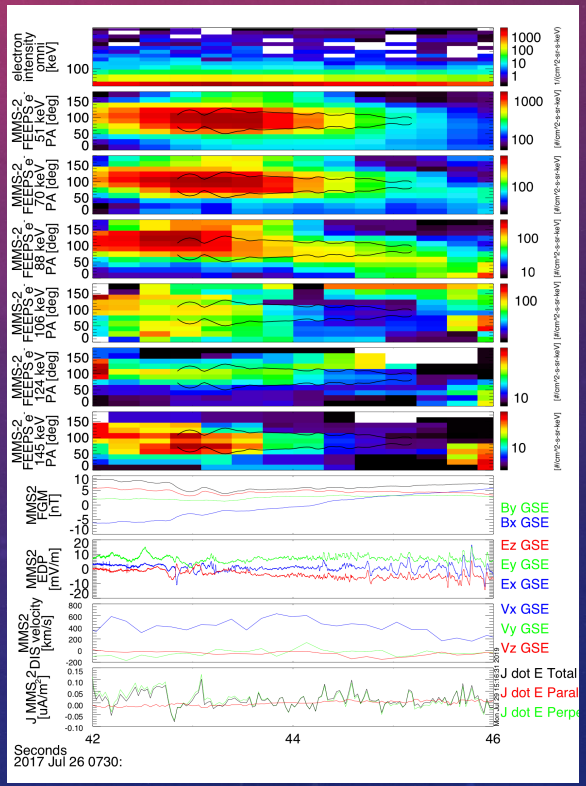

SPEED OF MAGNETIC HOLES

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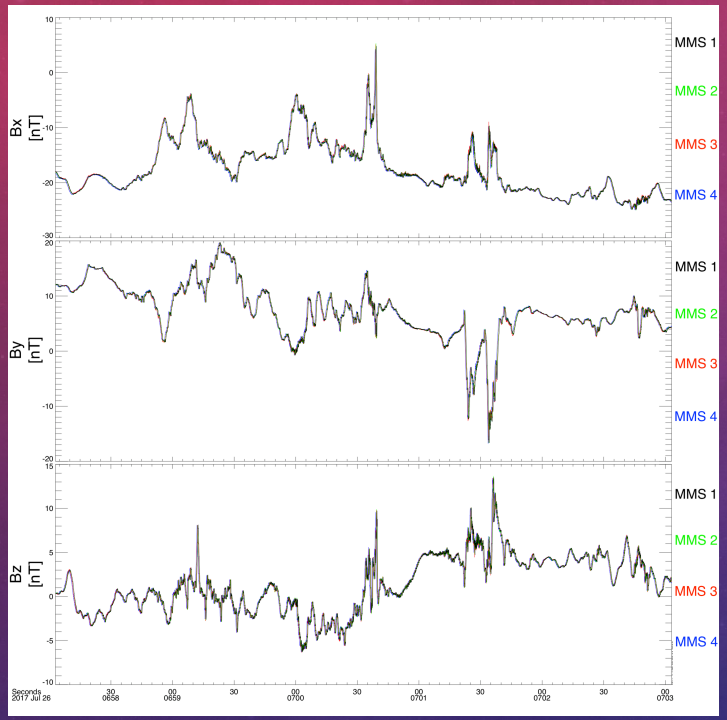

2599.7920 km/s
Max correlation: 0.99833

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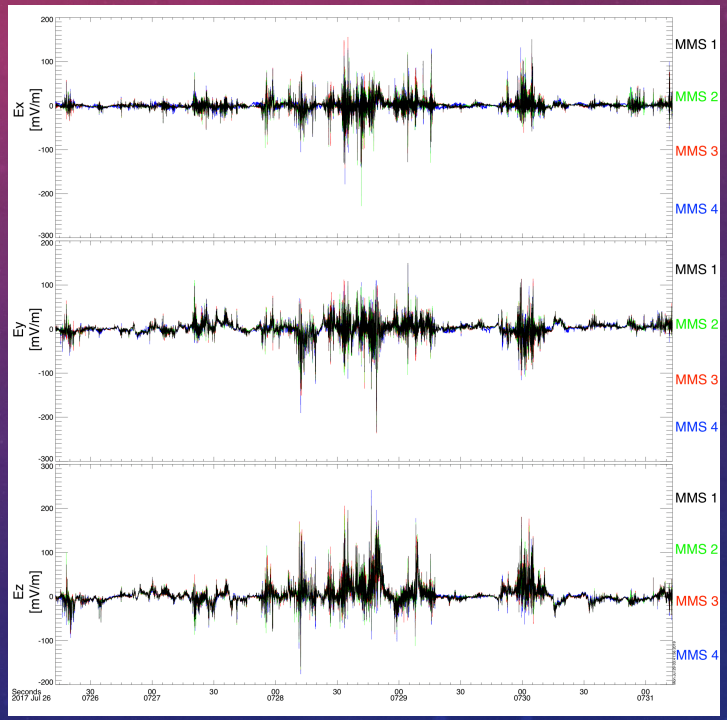

1783.5461 km/s
Max correlation: 0.86330867

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

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

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QUESTIONS?