# MAGNETIC RECONNECTION IN THE KELVIN-HELMHOLTZ INSTABILITY

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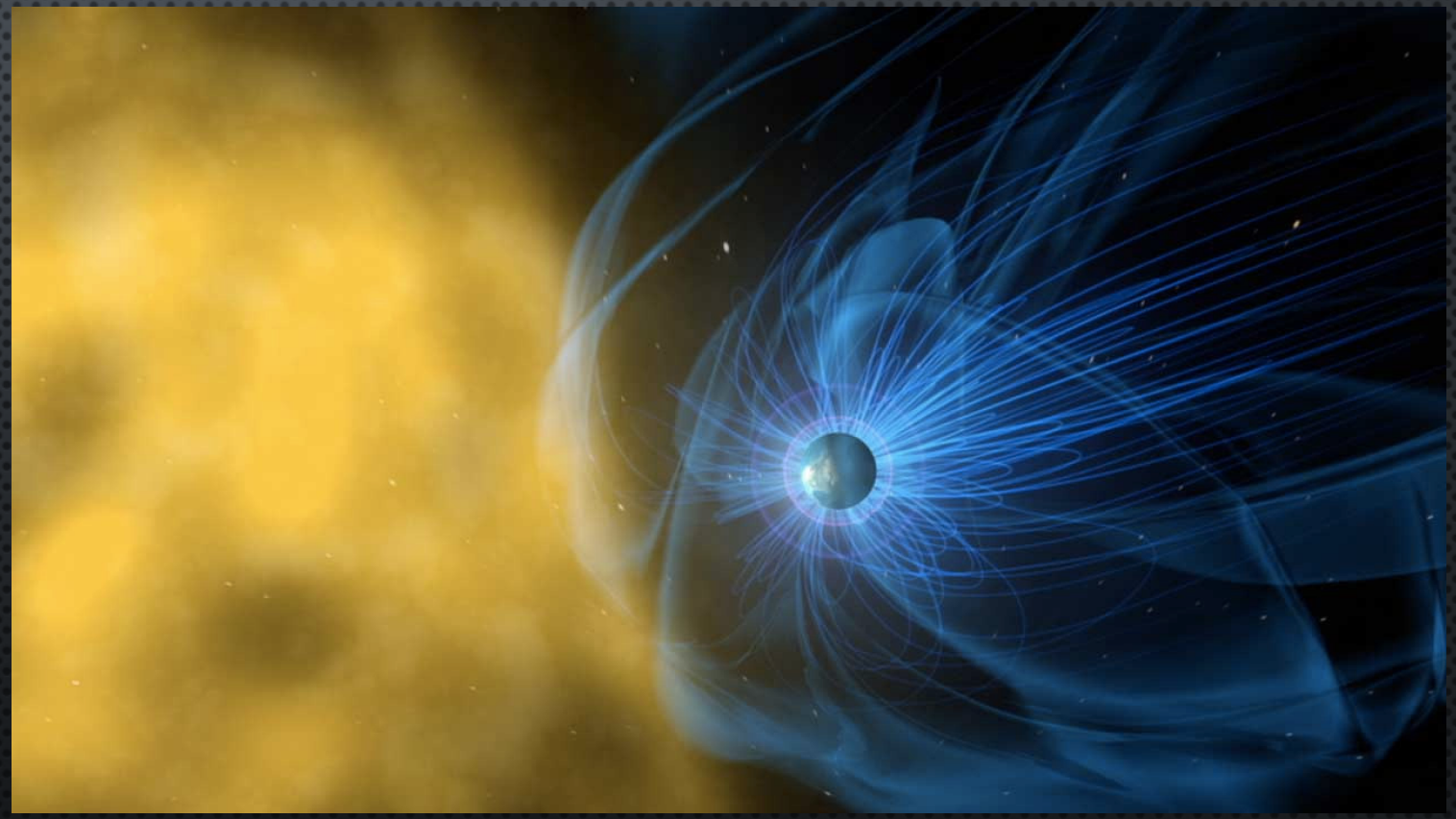
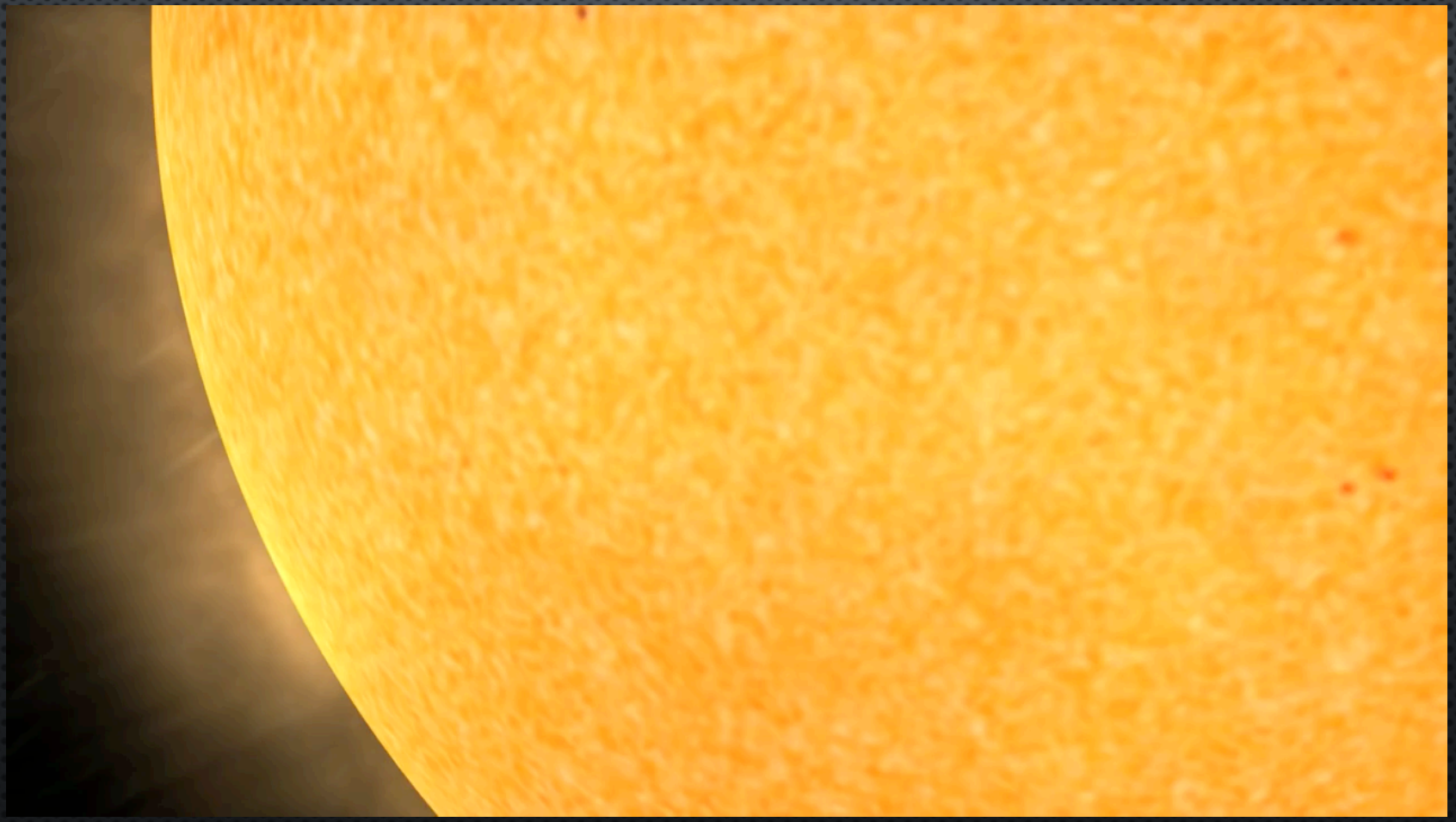
# INTRODUCTION

- What are we looking at
  - Reconnection from KHI
- Why
  - Better understand plasma
  - See how matter and energy are transferred
- What did we find
  - Less reconnection further down the flanks

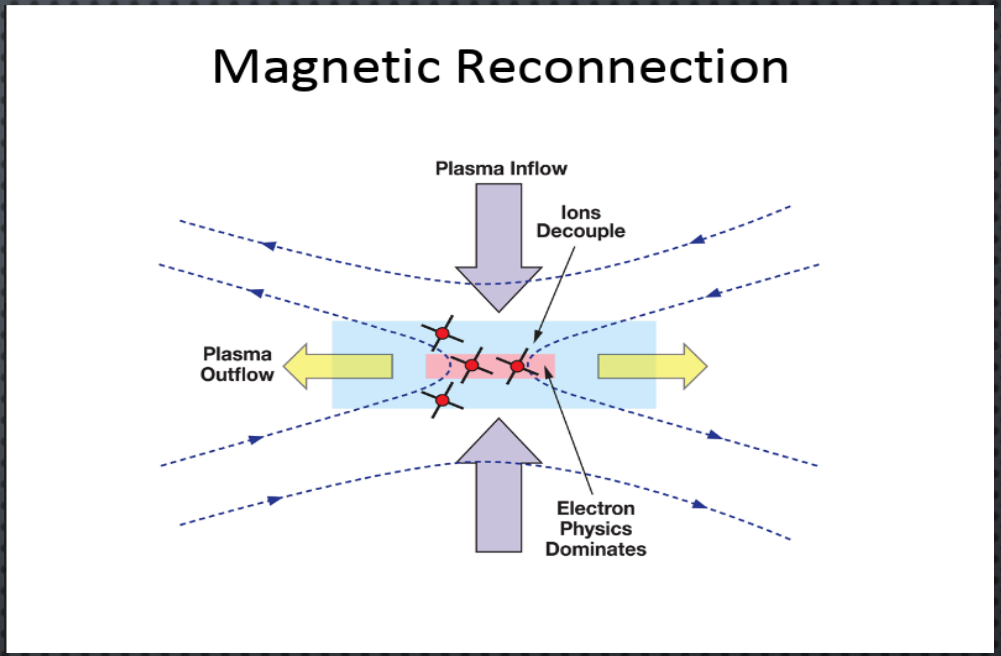


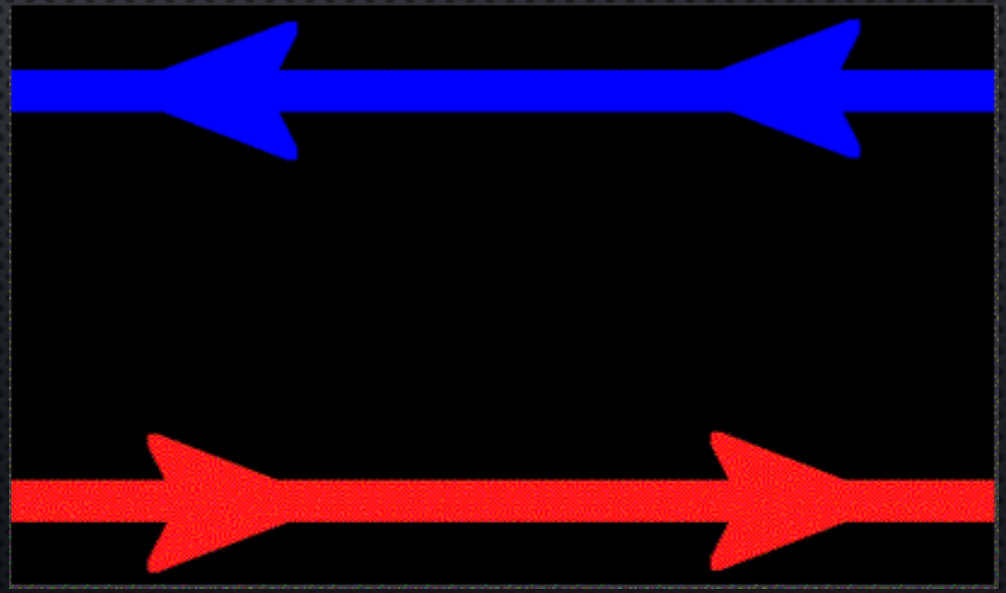
# INTRODUCTION TO THE MAGNETOPAUSE



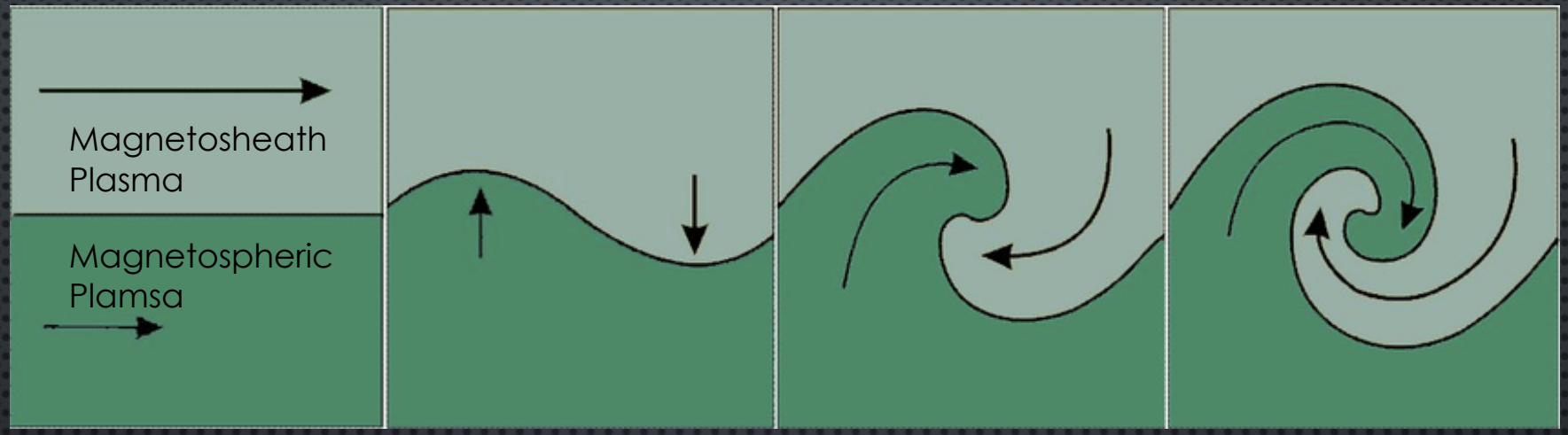
# MAGNETIC RECONNECTION

- PLASMA PROCESS
- HAPPENS WHEN OPPOSINGLY DIRECTED FIELDS ARE PINCHED TOGETHER
- CONVERTS ENERGY FROM MAGNETIC TO KINETIC OR THERMAL
- IONS/ELECS CAN JET OUT

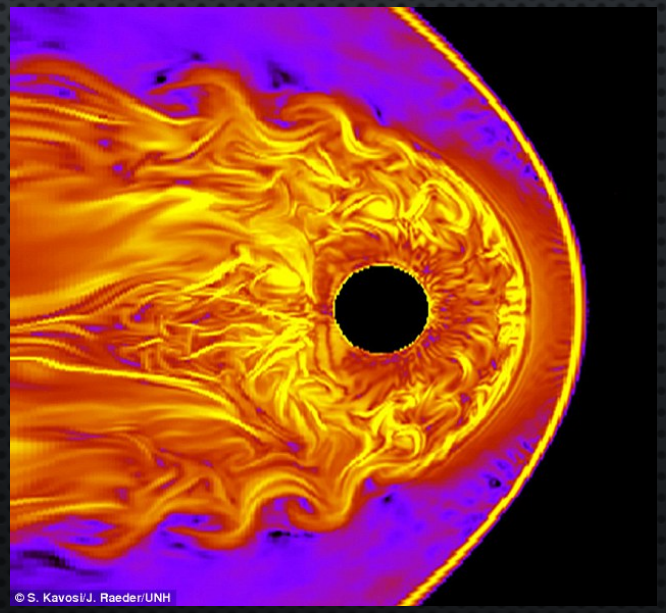


# KELVIN-HELMHOLTZ INSTABILITY ON THE FLANKS

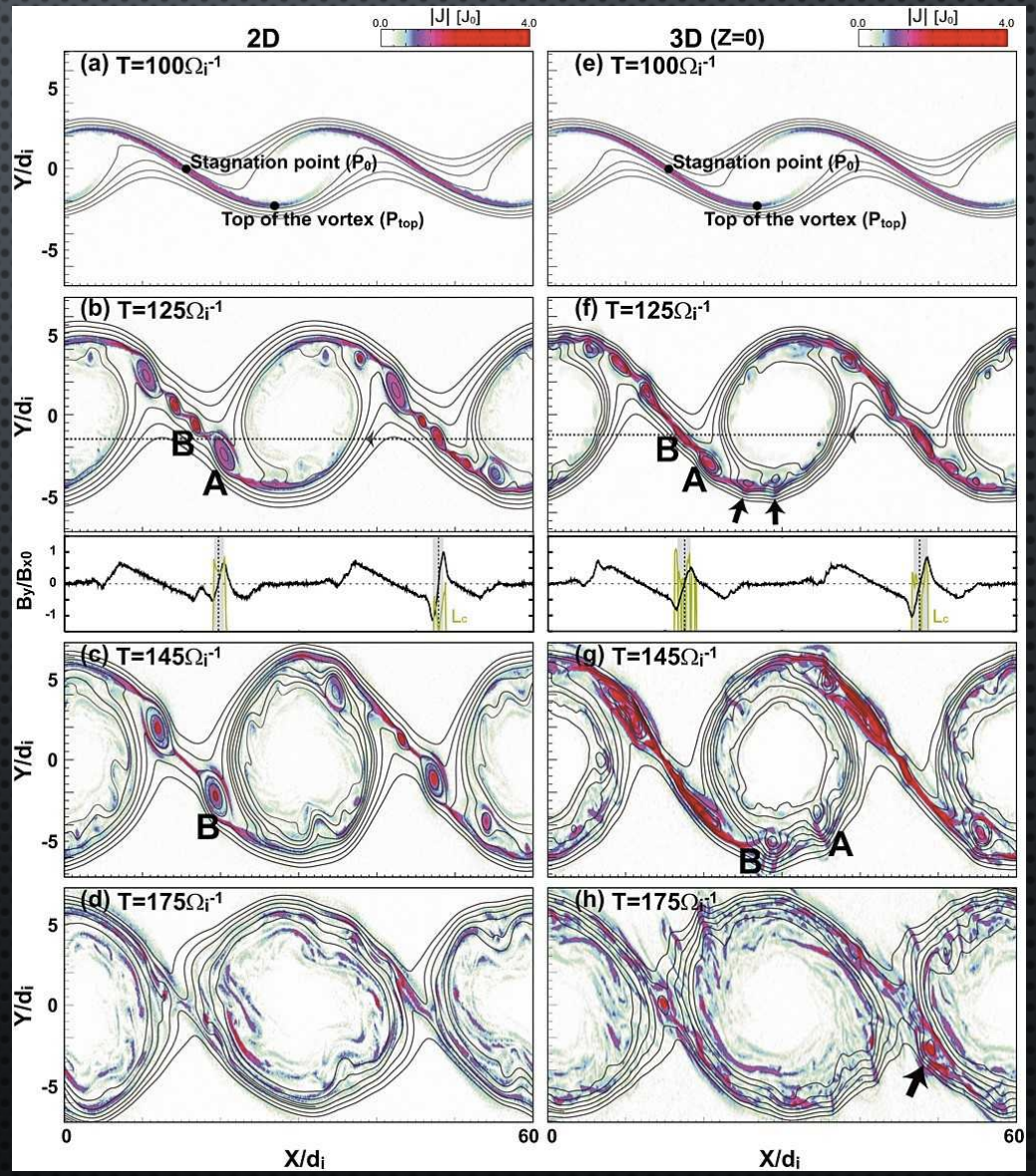



- Forms at a fluid boundary
- Flow shear at the boundary
- Rolls into wave-like structures
- Happens along the flank magnetopause
- Shocked solar wind and magnetospheric plasma



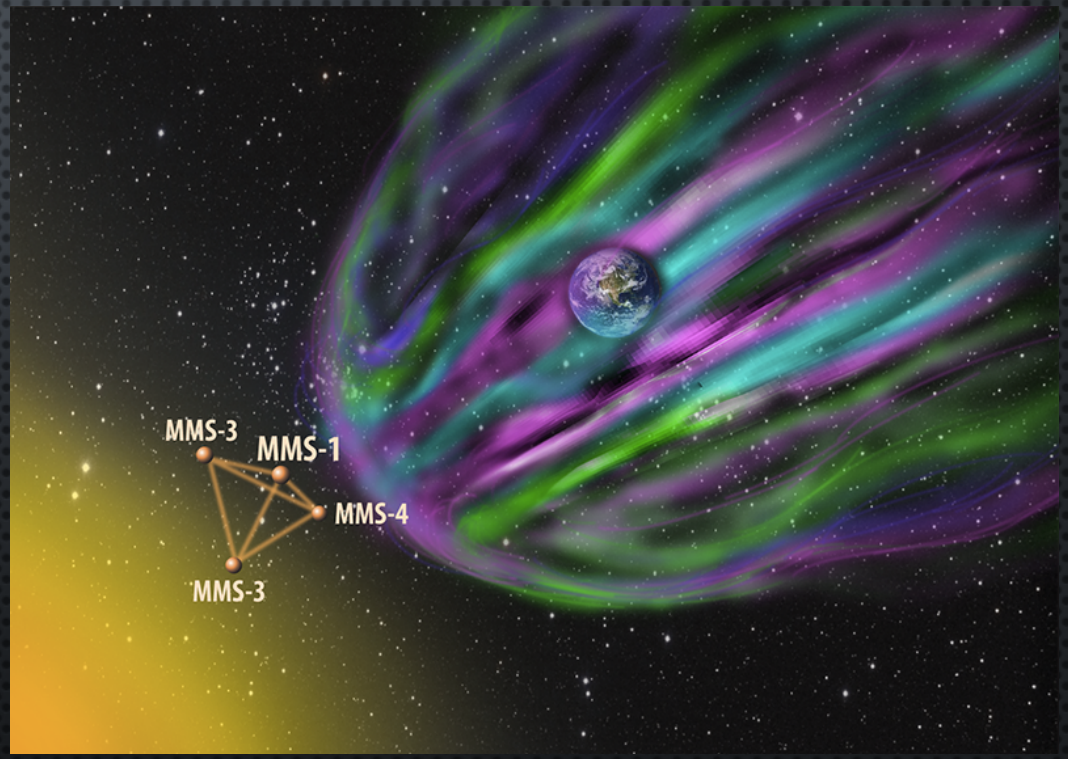
# RECONNECTION COULD HAPPEN THERE

- SIMULATIONS SHOW THAT RECONNECTION COULD HAPPEN IN VORTICES (NAKAMURA ET AL., 2013)
- PREDICTS THAT AS THE KHI BECOMES MORE ROLLED UP, WE WILL GET MORE RECONNECTION

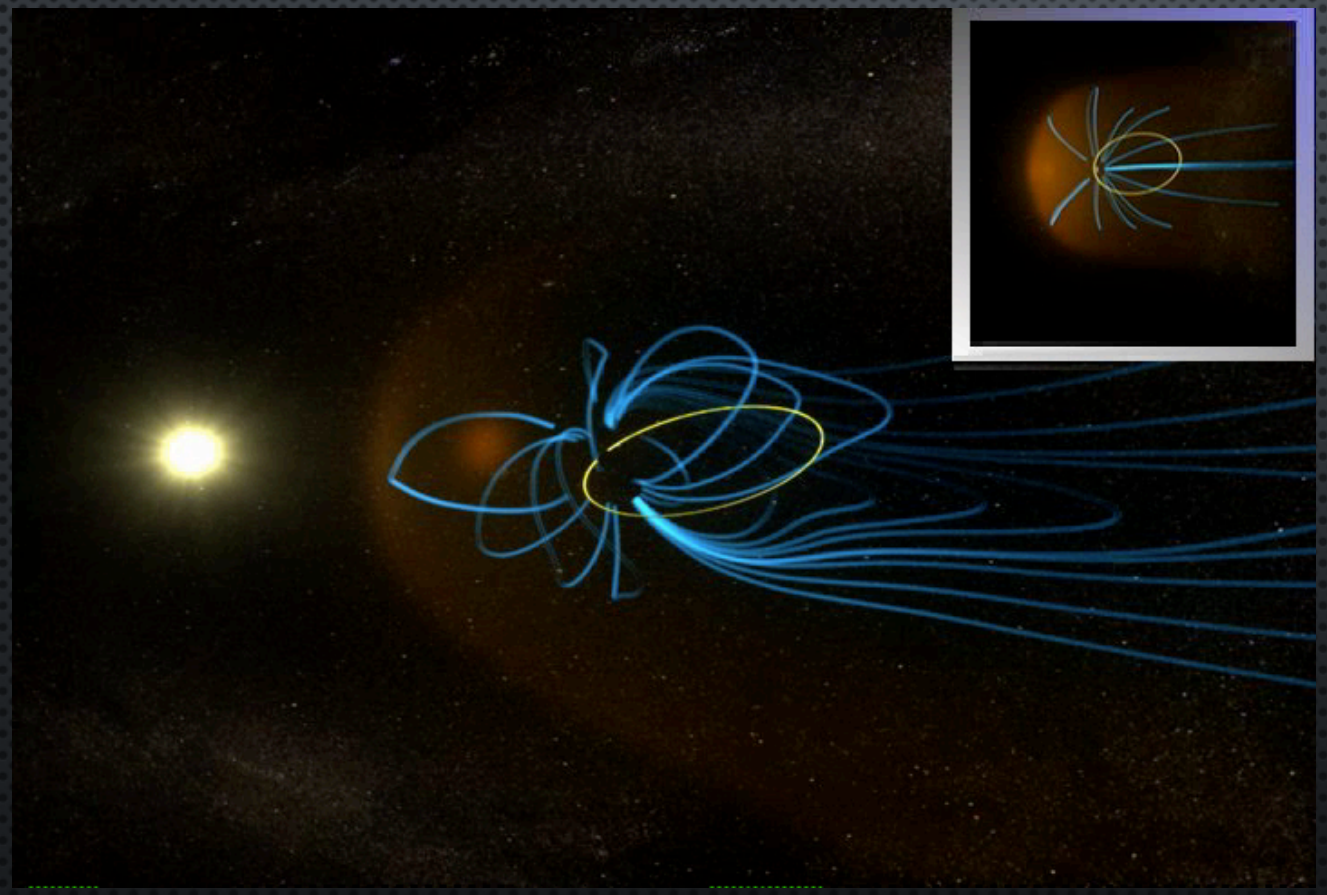


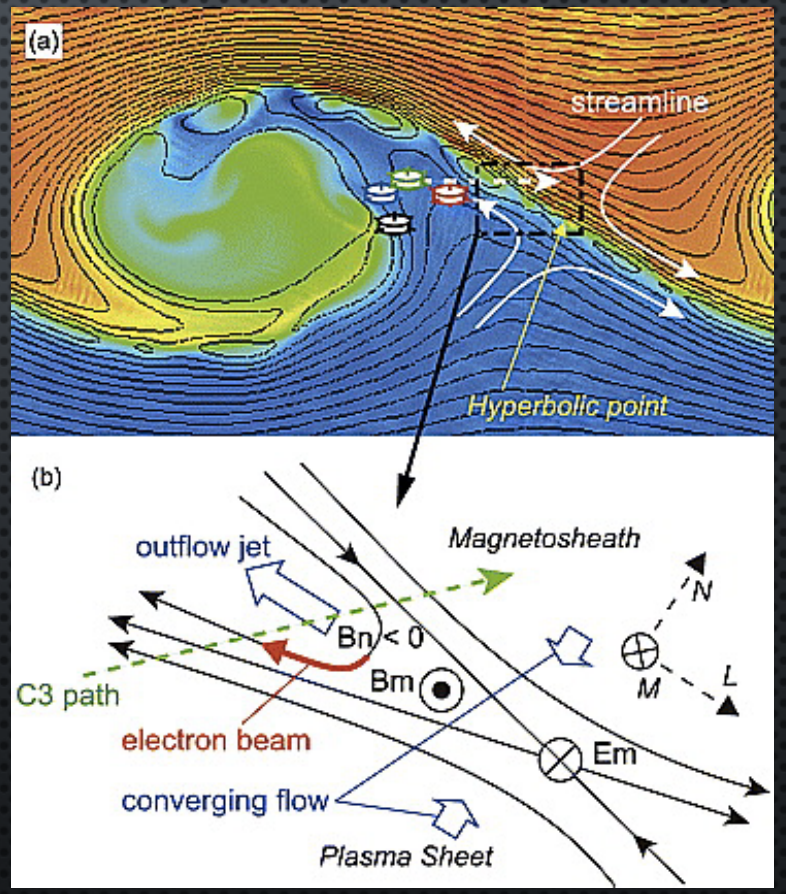
# MAGNETOSPHERIC MULTISCALE MISSION (MMS)

- Launched in 2015
- Designed to study reconnection
- Orbit through magnetopause
- Tetrahedral formation to get 3D derivatives of fields



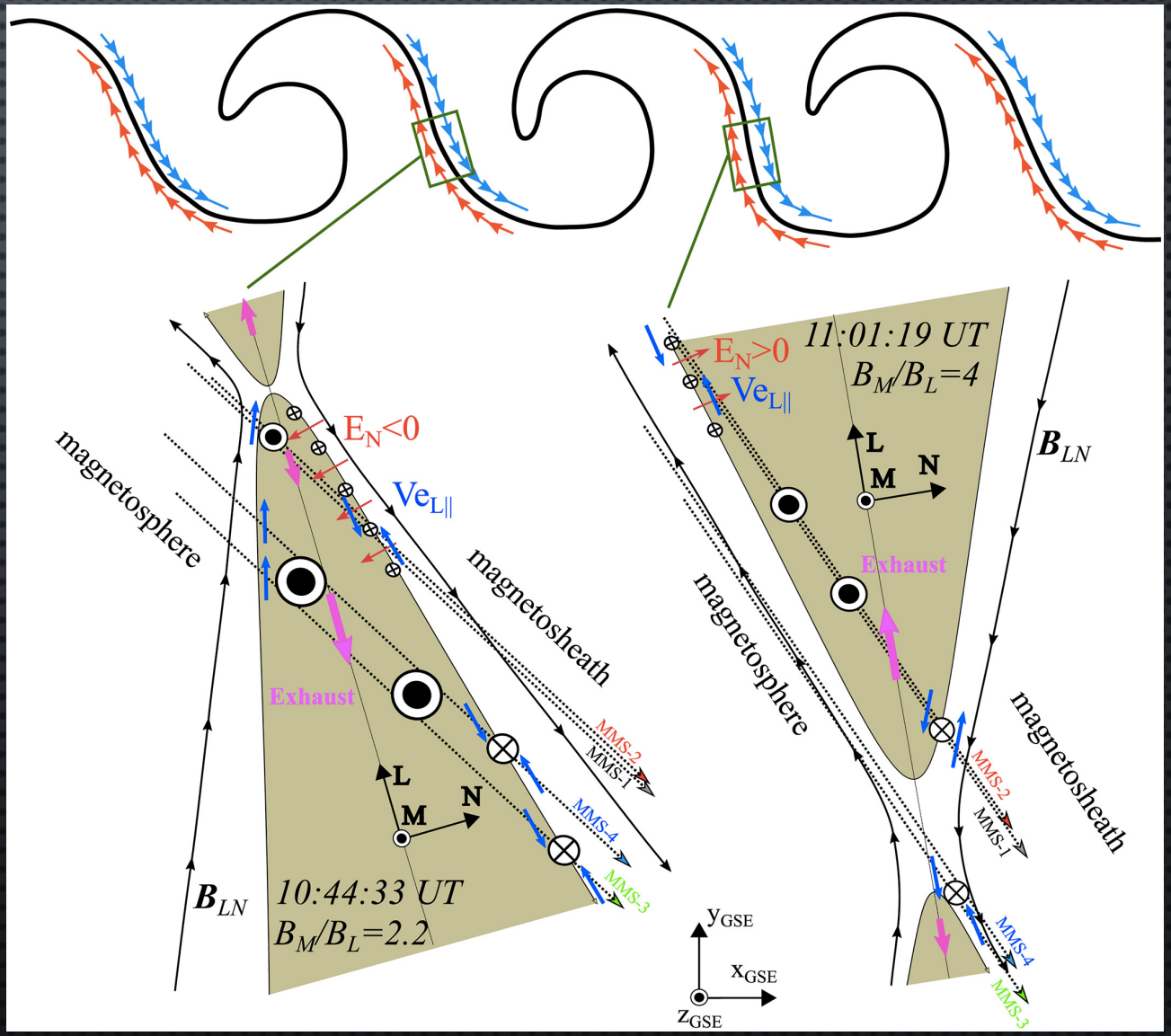
# MMS CONTINUED



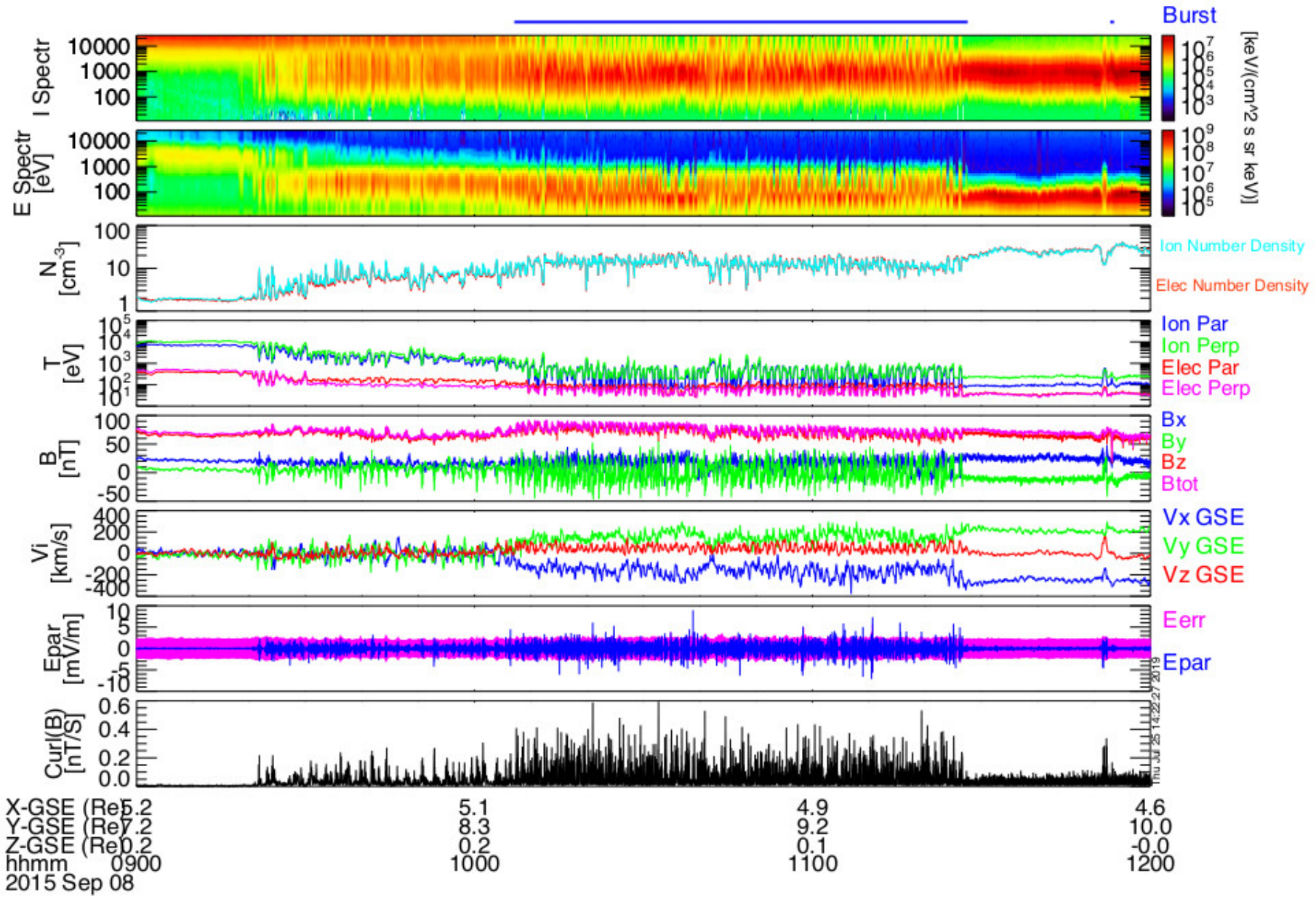


# SEPTEMBER 8, 2015

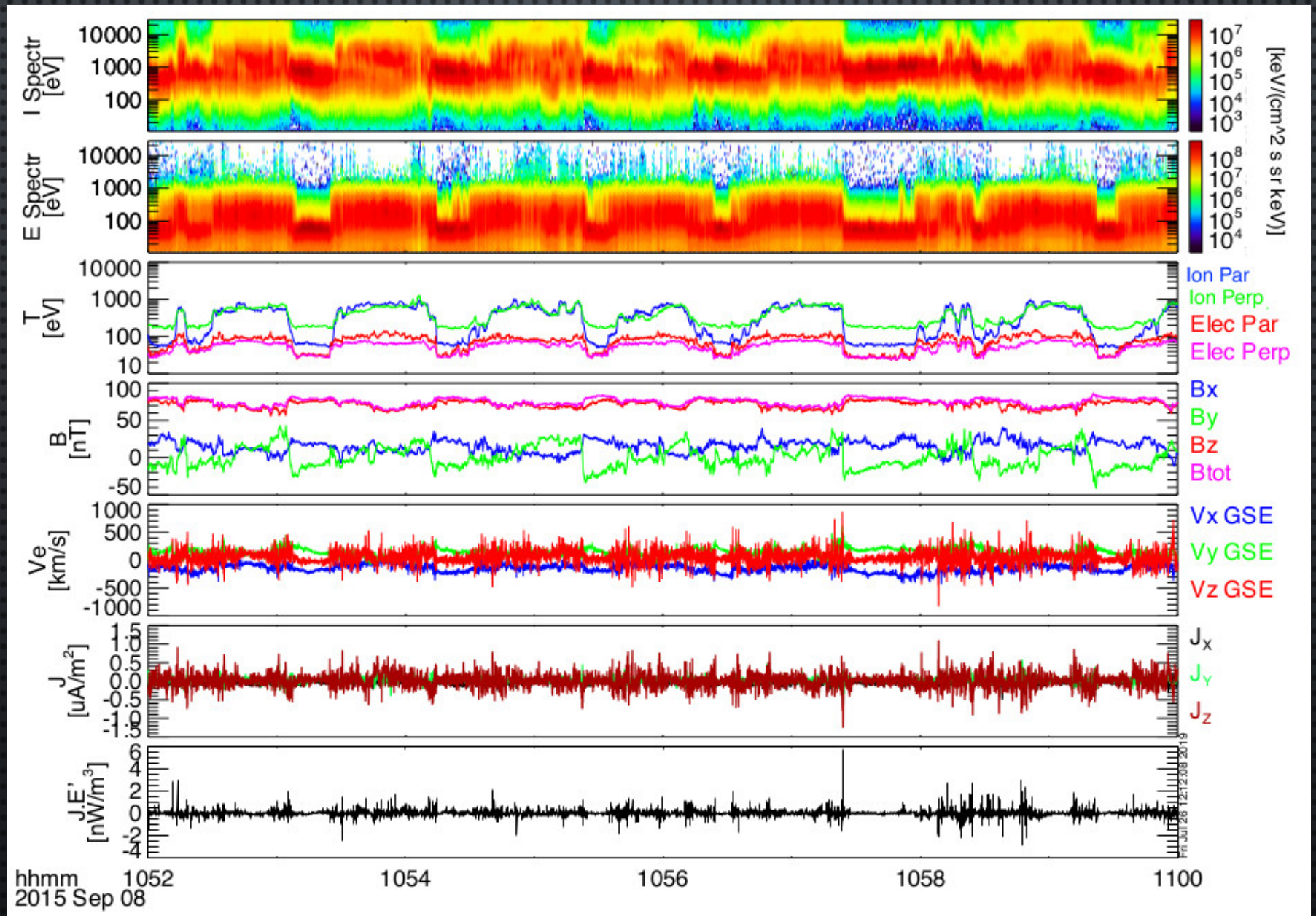
- SUPER FAMOUS KHI EVENT
- EXTENSIVELY STUDIED
- OBSERVED LOTS OF RECONNECTION AND JETS



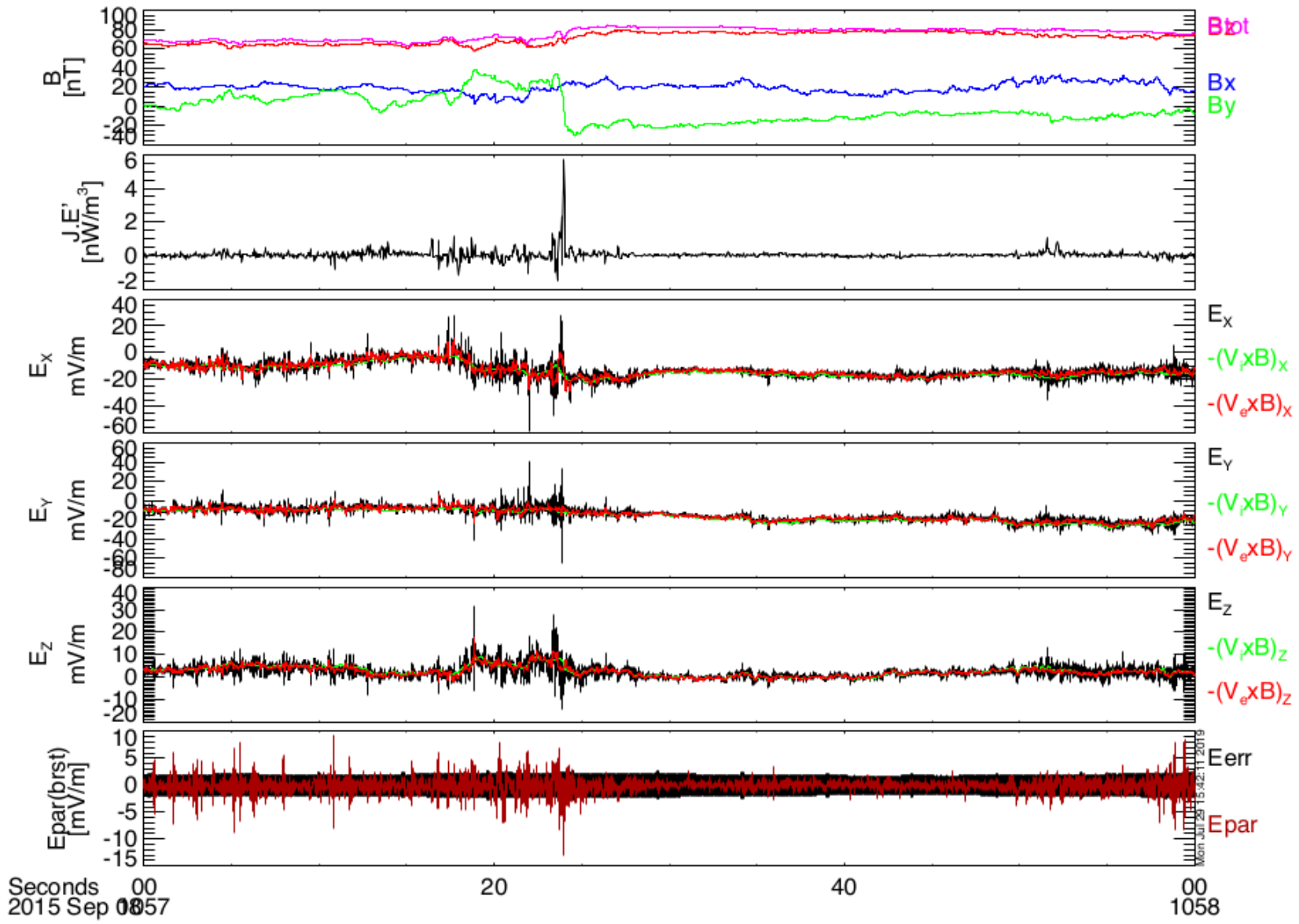
# OVERVIEW DATA



# ZOOM IN FURTHER

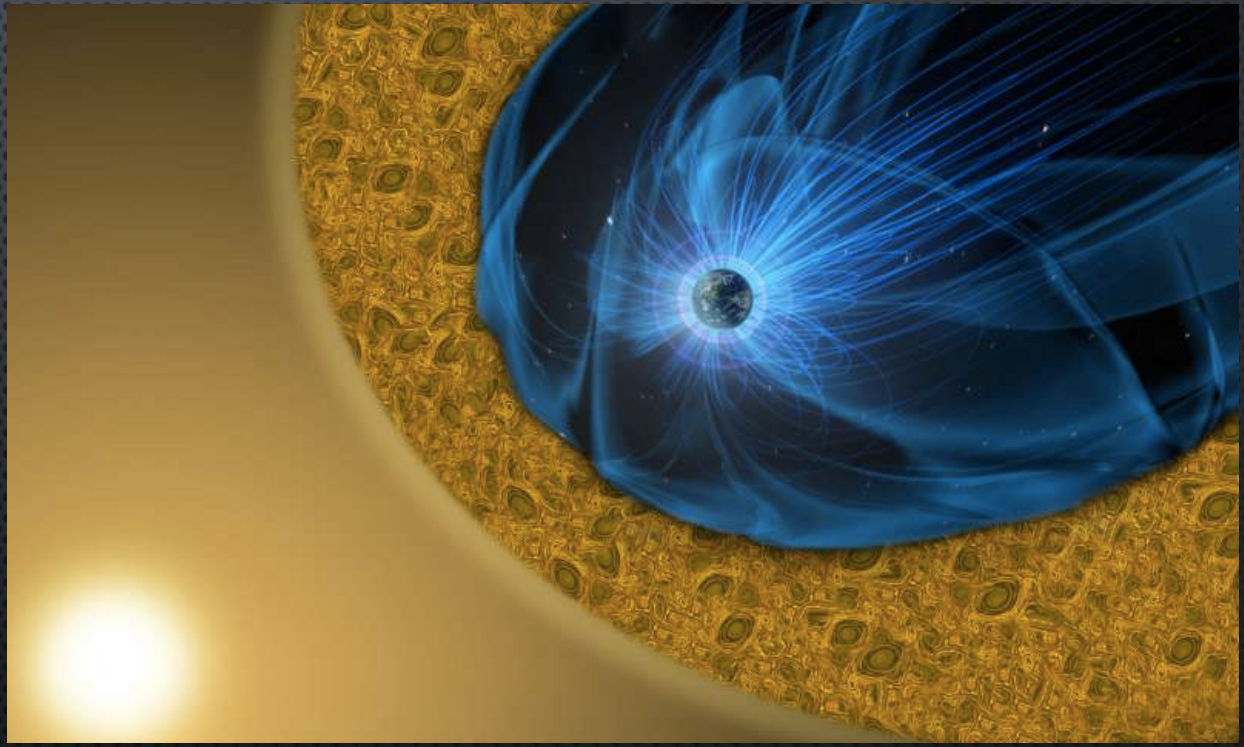


# FURTHER STILL

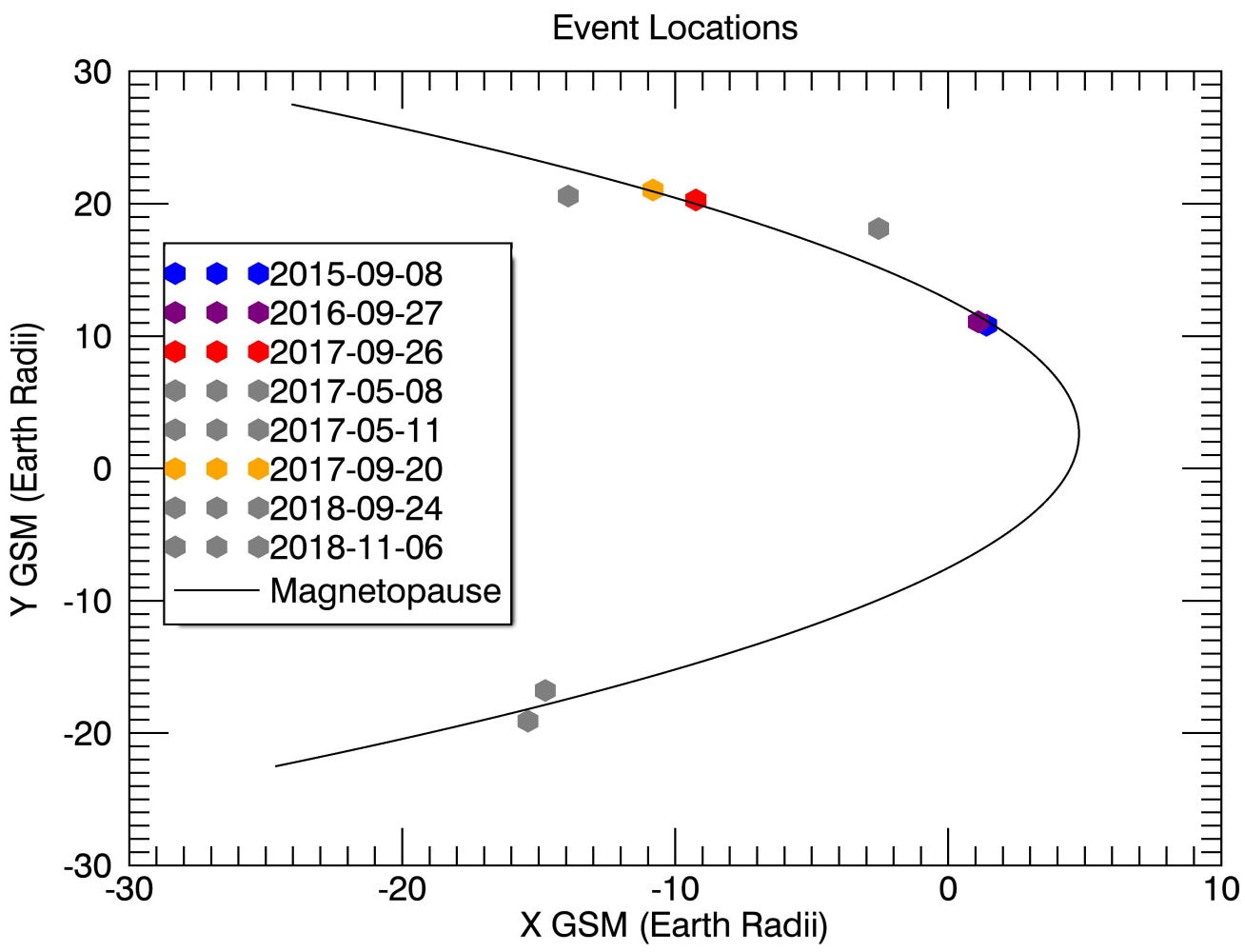


# WHAT HAPPENS ELSEWHERE

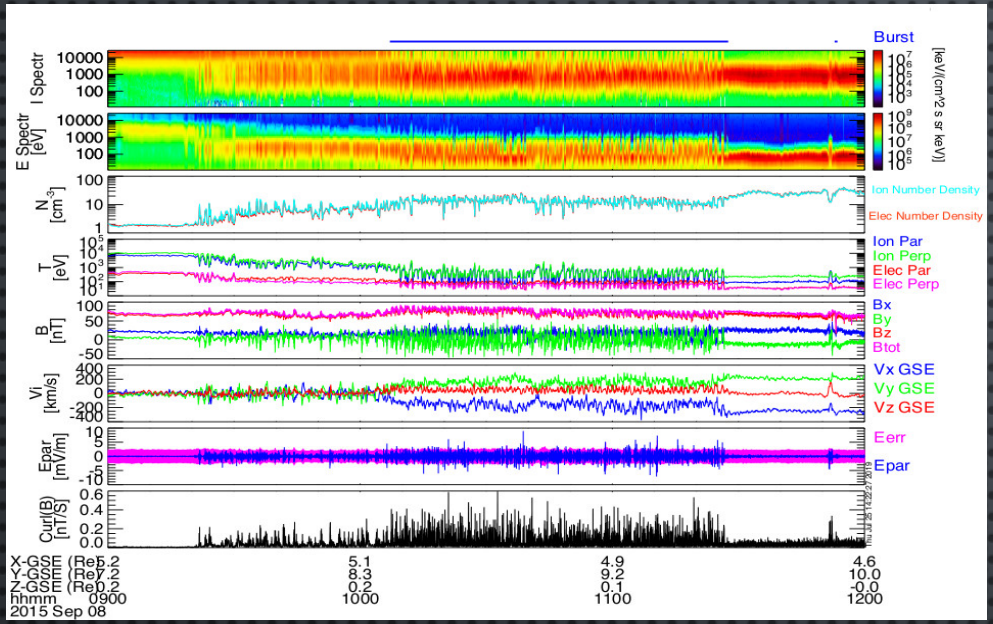
- EVENT HAPPENED AT A POINT IN THE MAGNETOPAUSE
- HOW IS IT DIFFERENT ELSEWHERE
- KHI IS MORE ROLLED UP AND COMPLEX

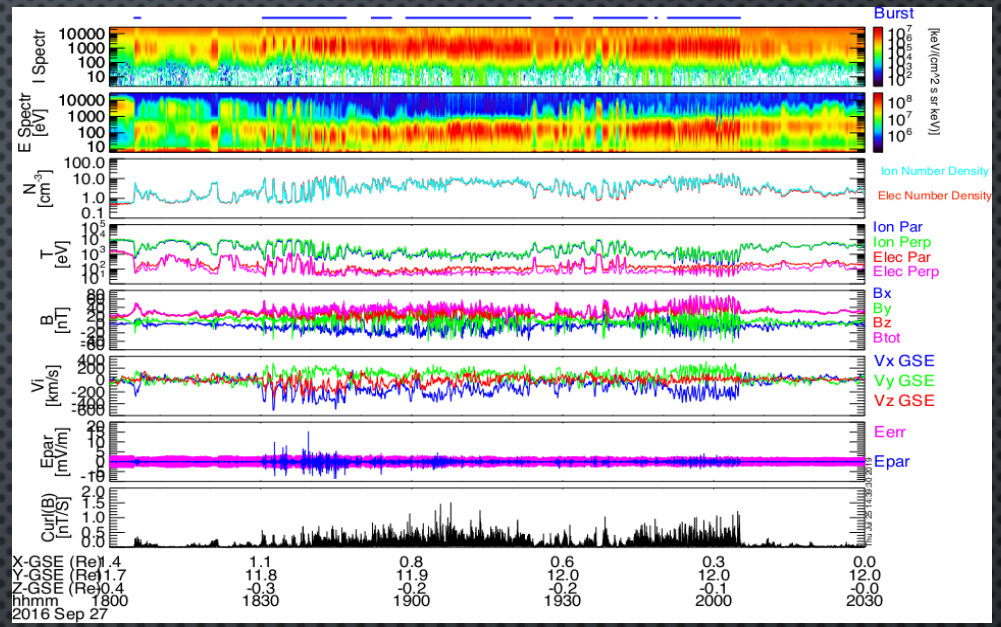


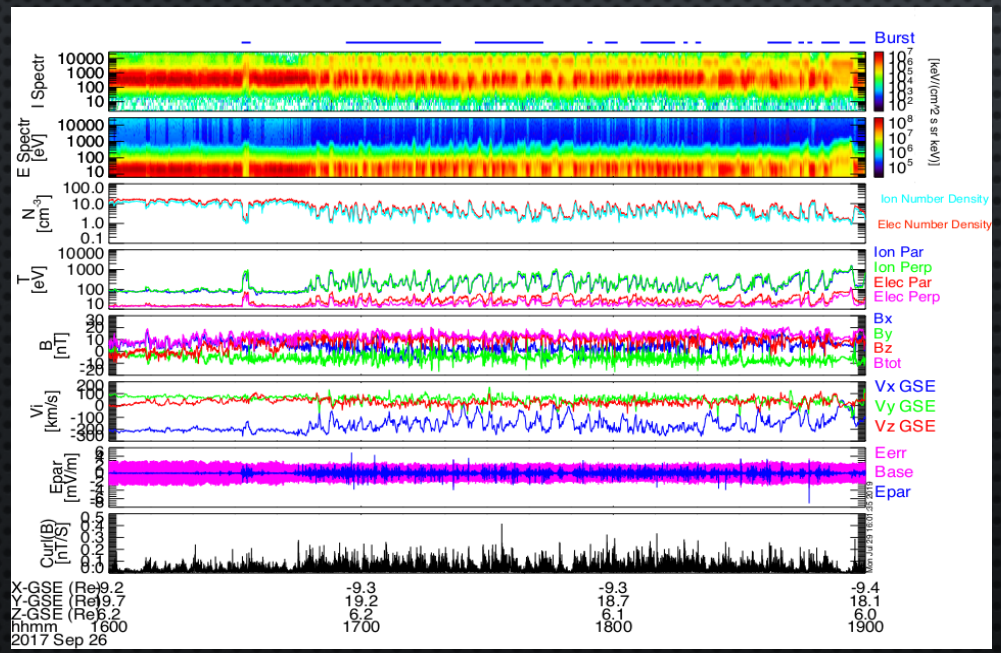
# NEW EVENTS

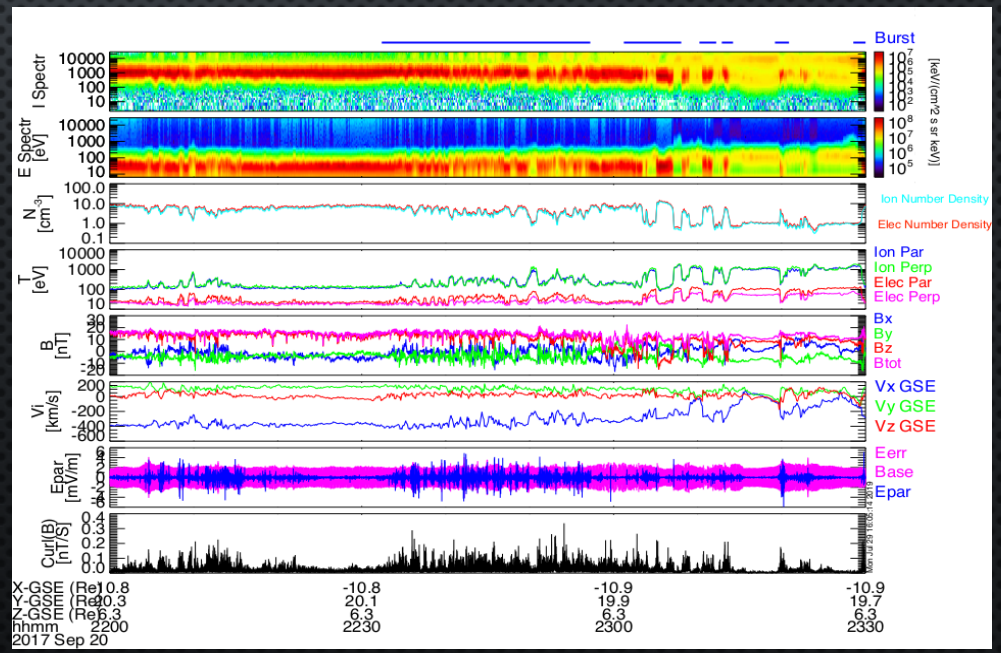

Event Locations
30
20
10
0
-10
-20
-30
-30
-20
-10
0
10
Y GSM (Earth Radii)
X GSM (Earth Radii)
2015-09-08
2016-09-27
2017-09-26
2017-05-08
2017-05-11
2017-09-20
2018-09-24
2018-11-06
Magnetopause

# EVENT OVERVIEWS

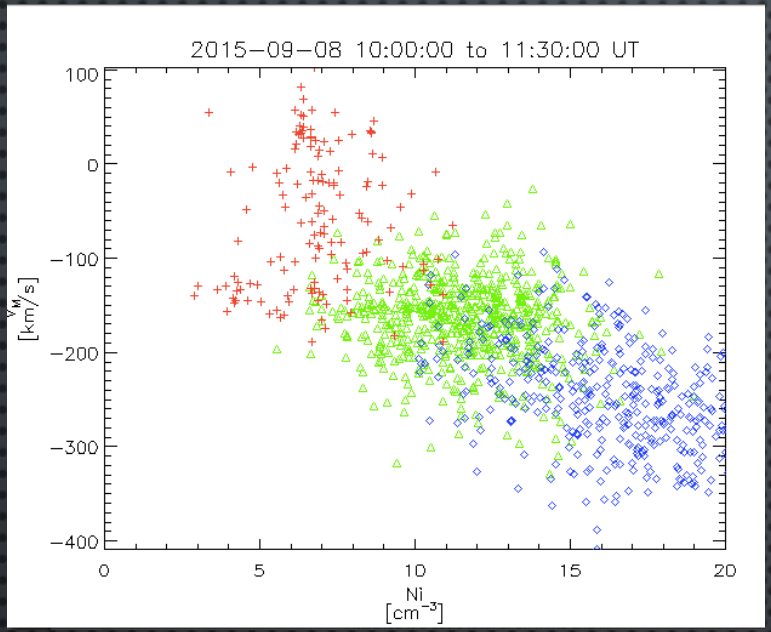


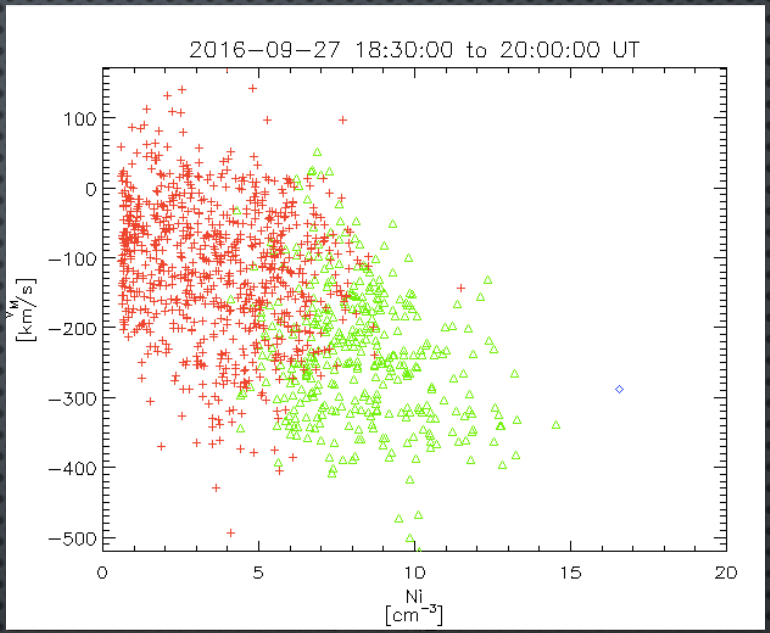



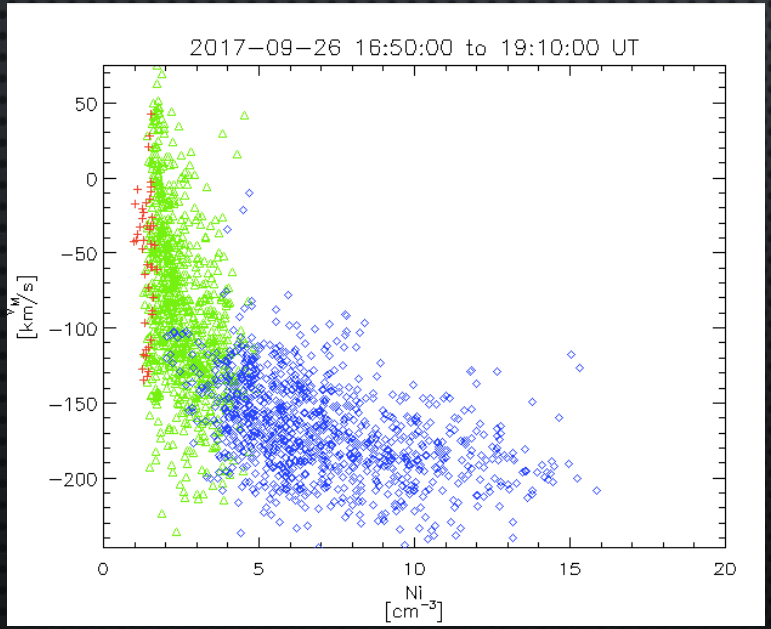



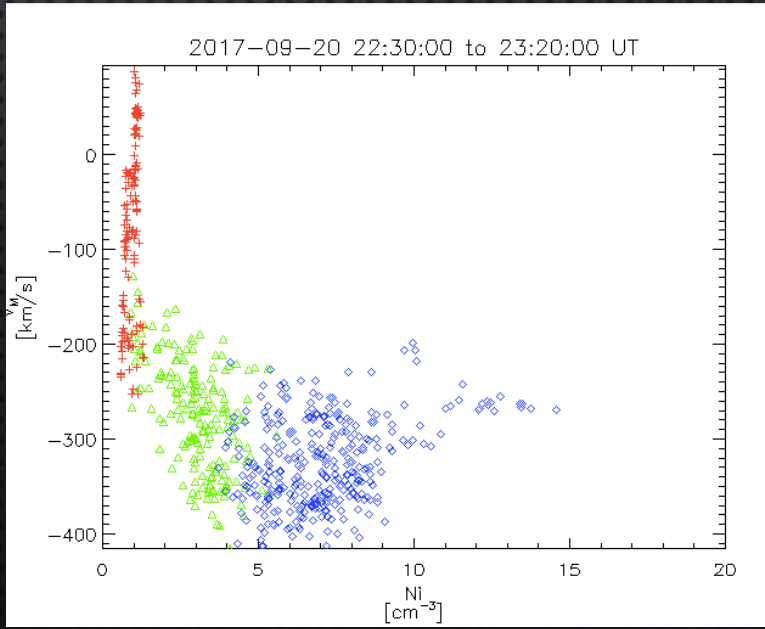



# ROLLUP

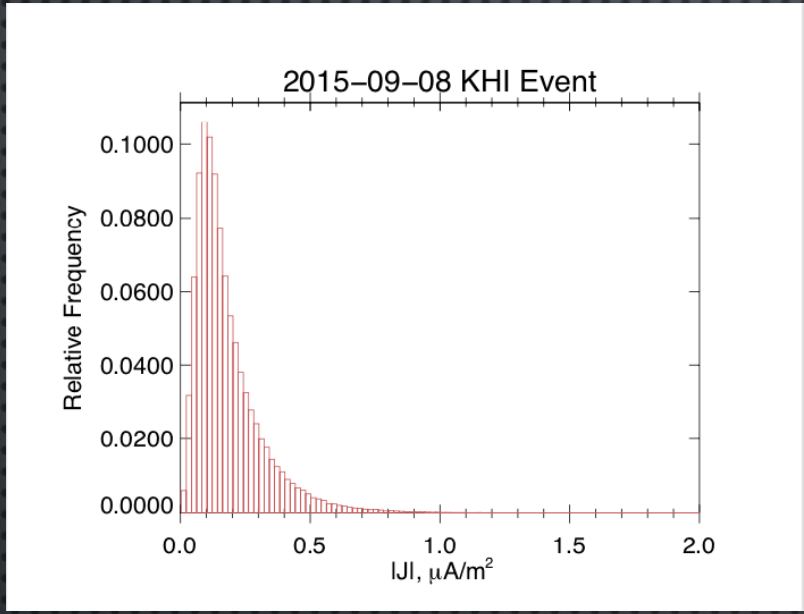

2015−09−08 10:00:00 to 11:30:00 UT
$v_M$ [km/s]
Ni [cm$^{-3}$]

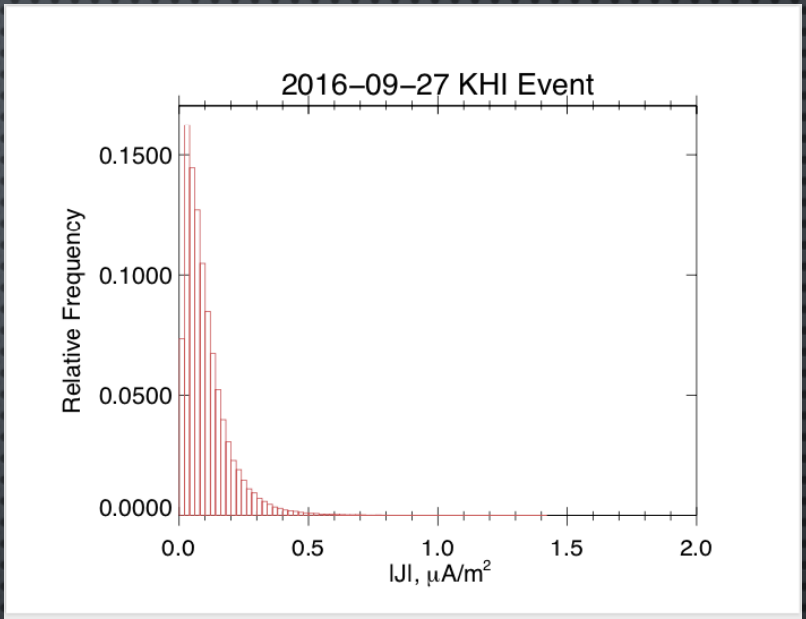

2016−09−27 18:30:00 to 20:00:00 UT
$v_M$ [km/s]
Ni [cm$^{-3}$]

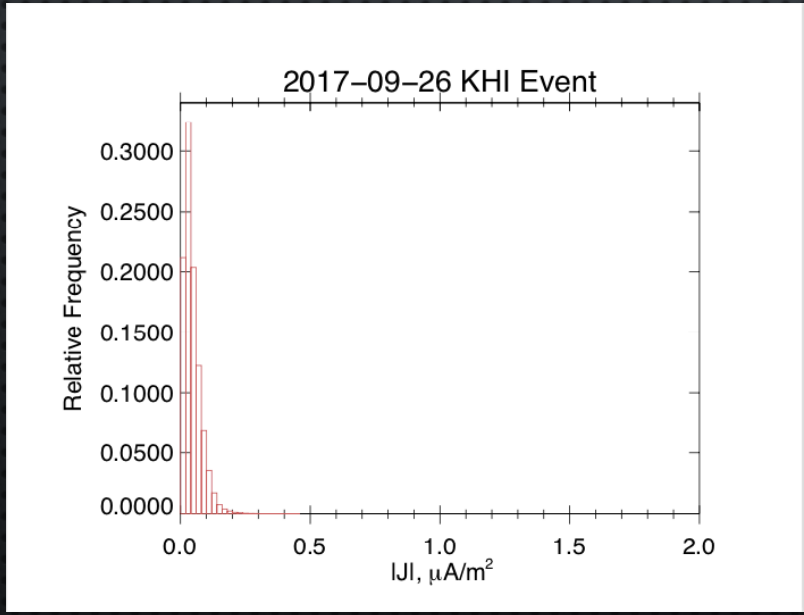

2017−09−26 16:50:00 to 19:10:00 UT
$v_M$ [km/s]
Ni [cm$^{-3}$]

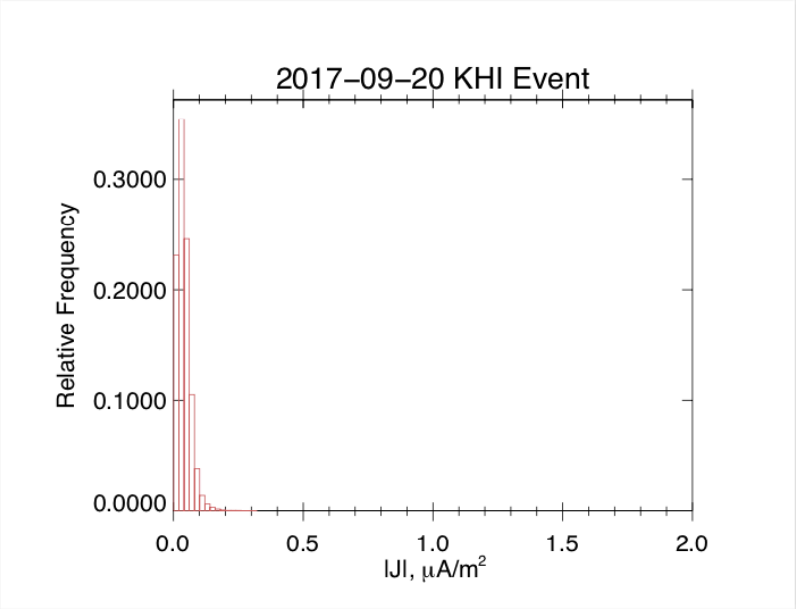

2017−09−20 22:30:00 to 23:20:00 UT
$v_M$ [km/s]
Ni [cm$^{-3}$]

# INCREASED CURRENT FREQUENCIES

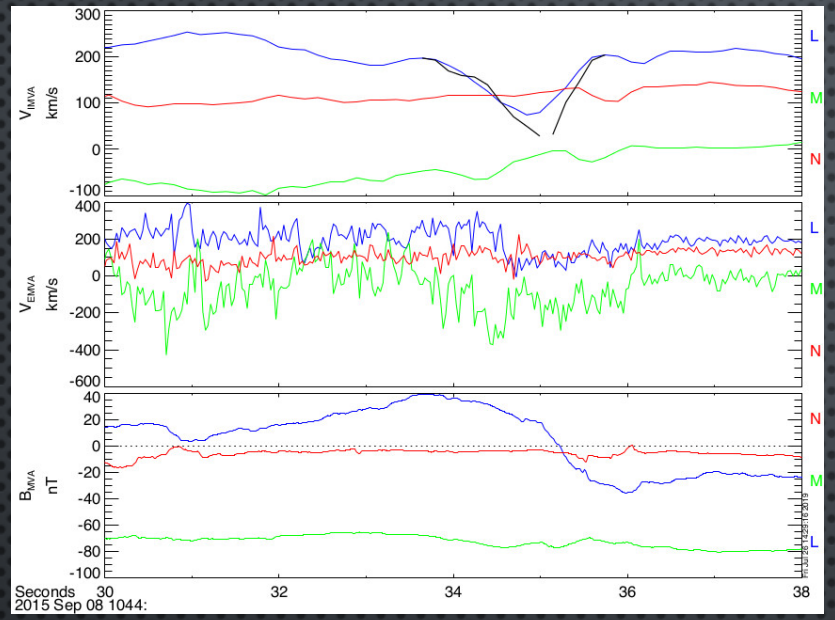


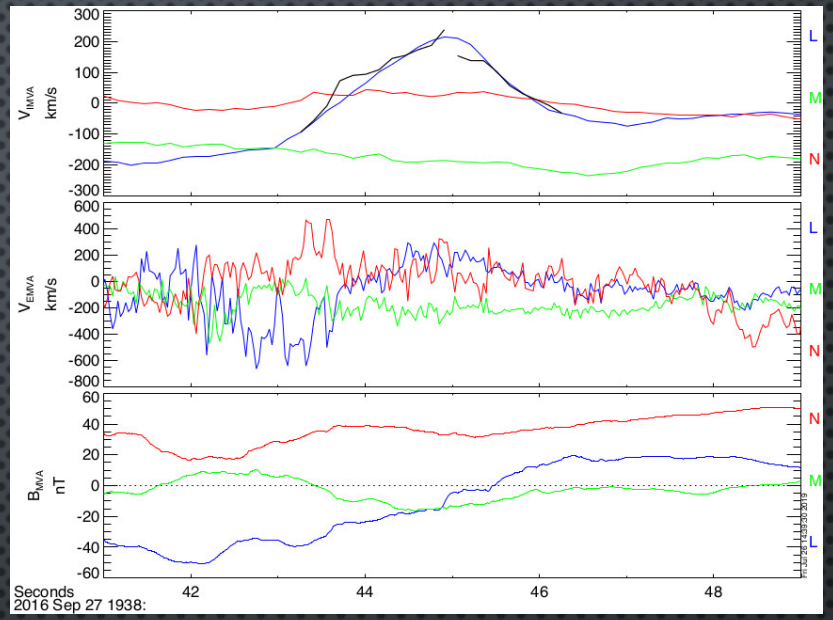



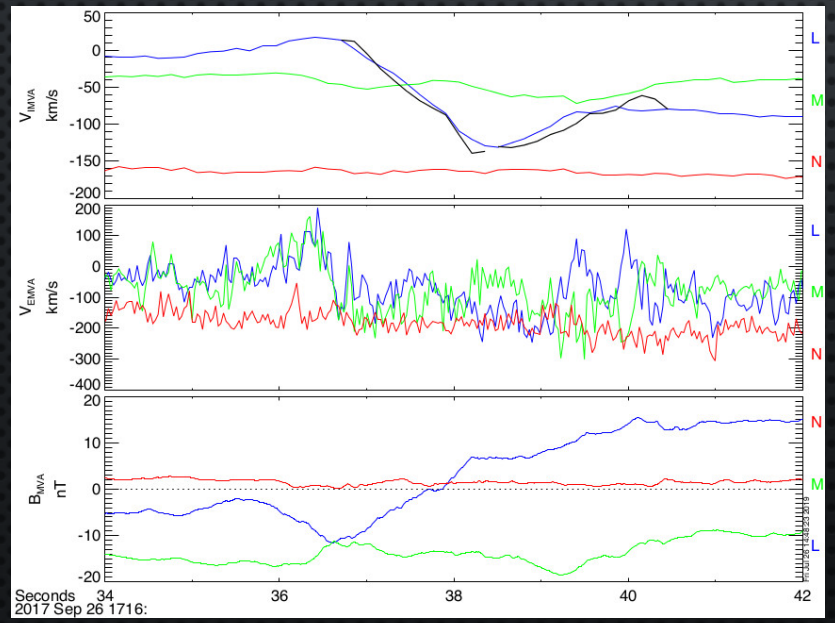



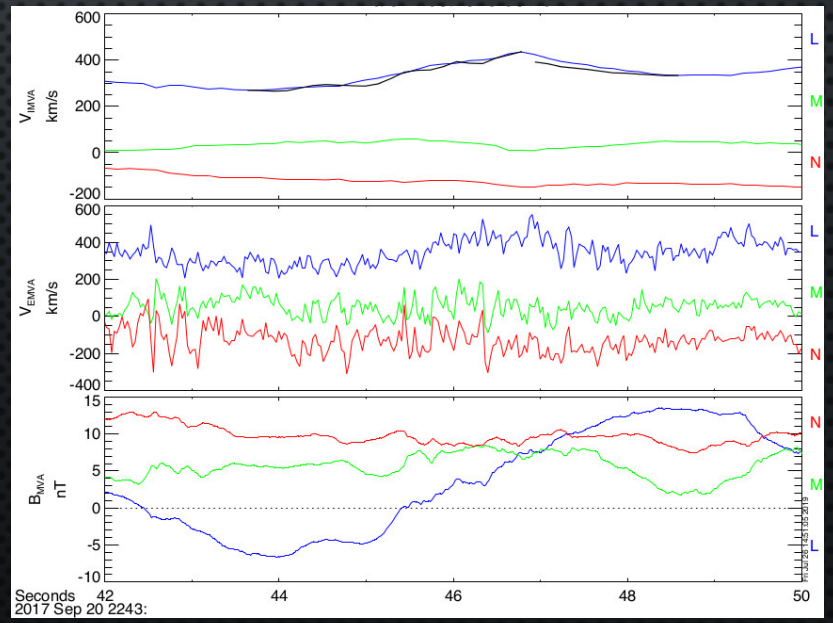



# WALÉN TESTS


$V_{IMVA}$ km/s
$V_{EMVA}$ km/s
$B_{IMVA}$ nT
L
M
N
Seconds
2015 Sep 08 1044:


$V_{IMVA}$ km/s
$V_{EMVA}$ km/s
$B_{IMVA}$ nT
L
M
N
Seconds
2016 Sep 27 1938:

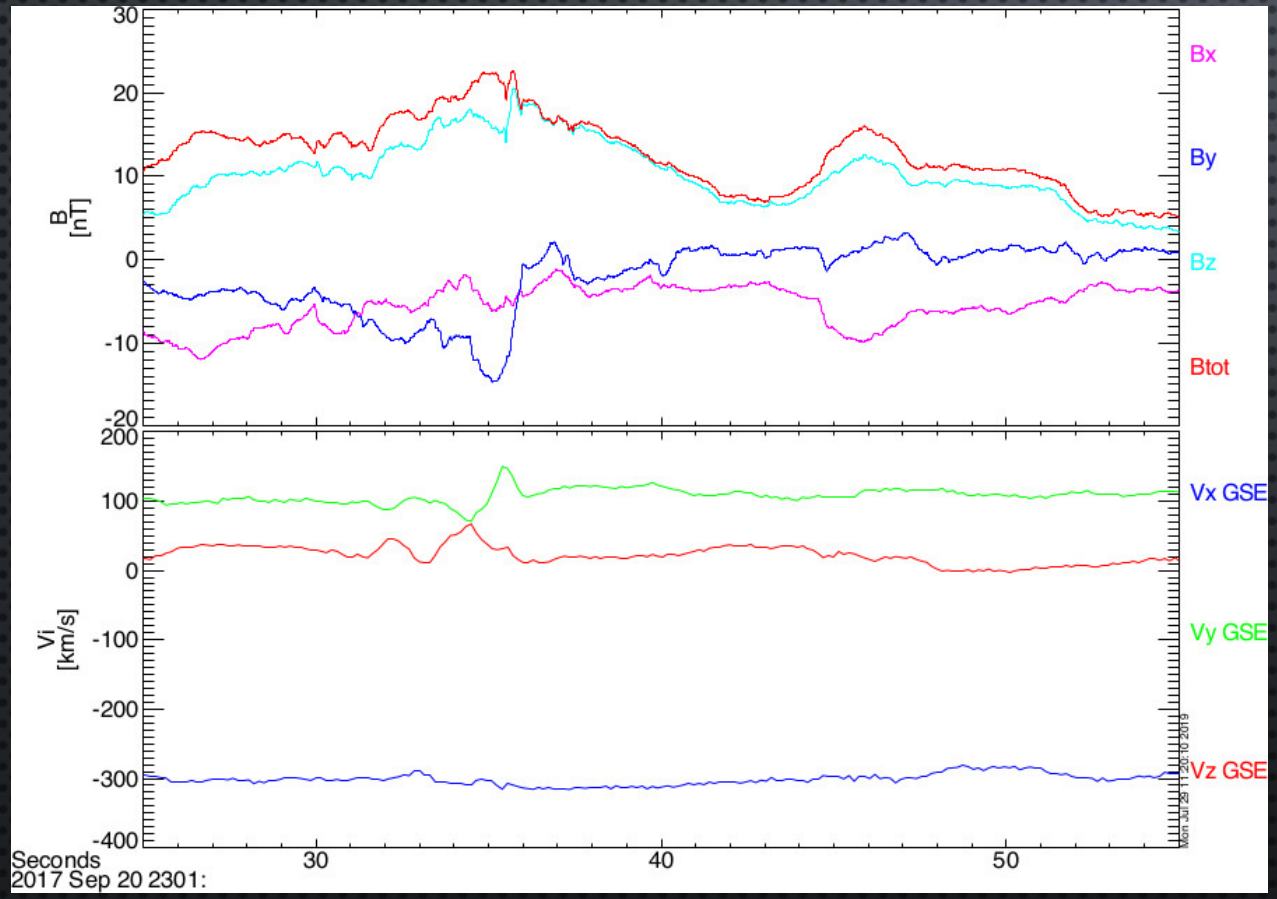

$V_{IMVA}$ km/s
$V_{EMVA}$ km/s
$B_{IMVA}$ nT
L
M
N
Seconds
2017 Sep 26 1716:

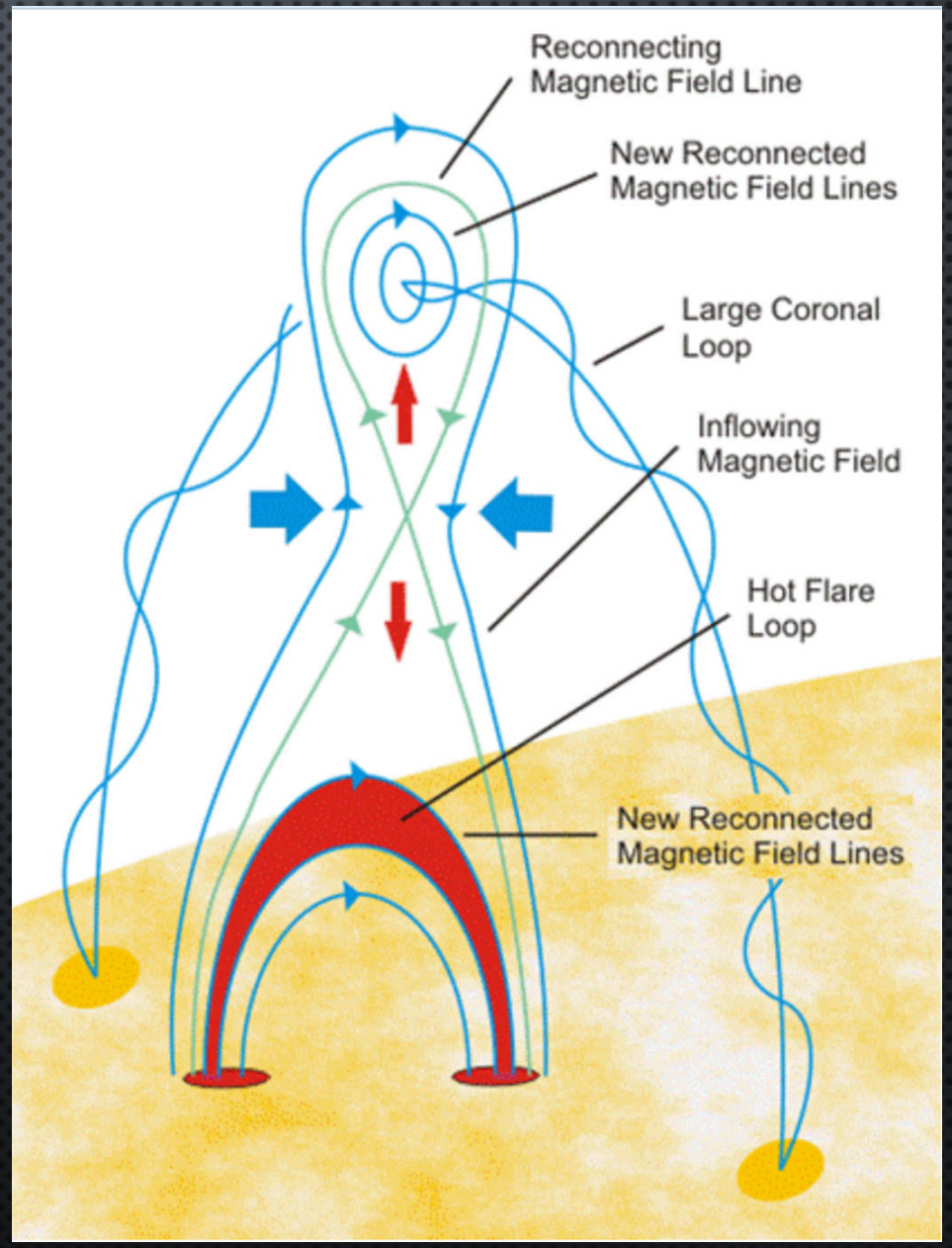

$V_{IMVA}$ km/s
$V_{EMVA}$ km/s
$B_{IMVA}$ nT
L
M
N
Seconds
2017 Sep 20 2243:

# RECONNECTION JET FREQUENCIES

| Event Date | Candidate Current Sheets | Ion Jets Observed | Jets per Period |
|---|---|---|---|
| 9/8/15 | 42 | 22 | 52% |
| 9/27/16 | 31 | 5 | 16.1% |
| 9/26/17 | 33 | 4 | 12.1% |
| 9/20/17 | 20 | 1 | 5% |

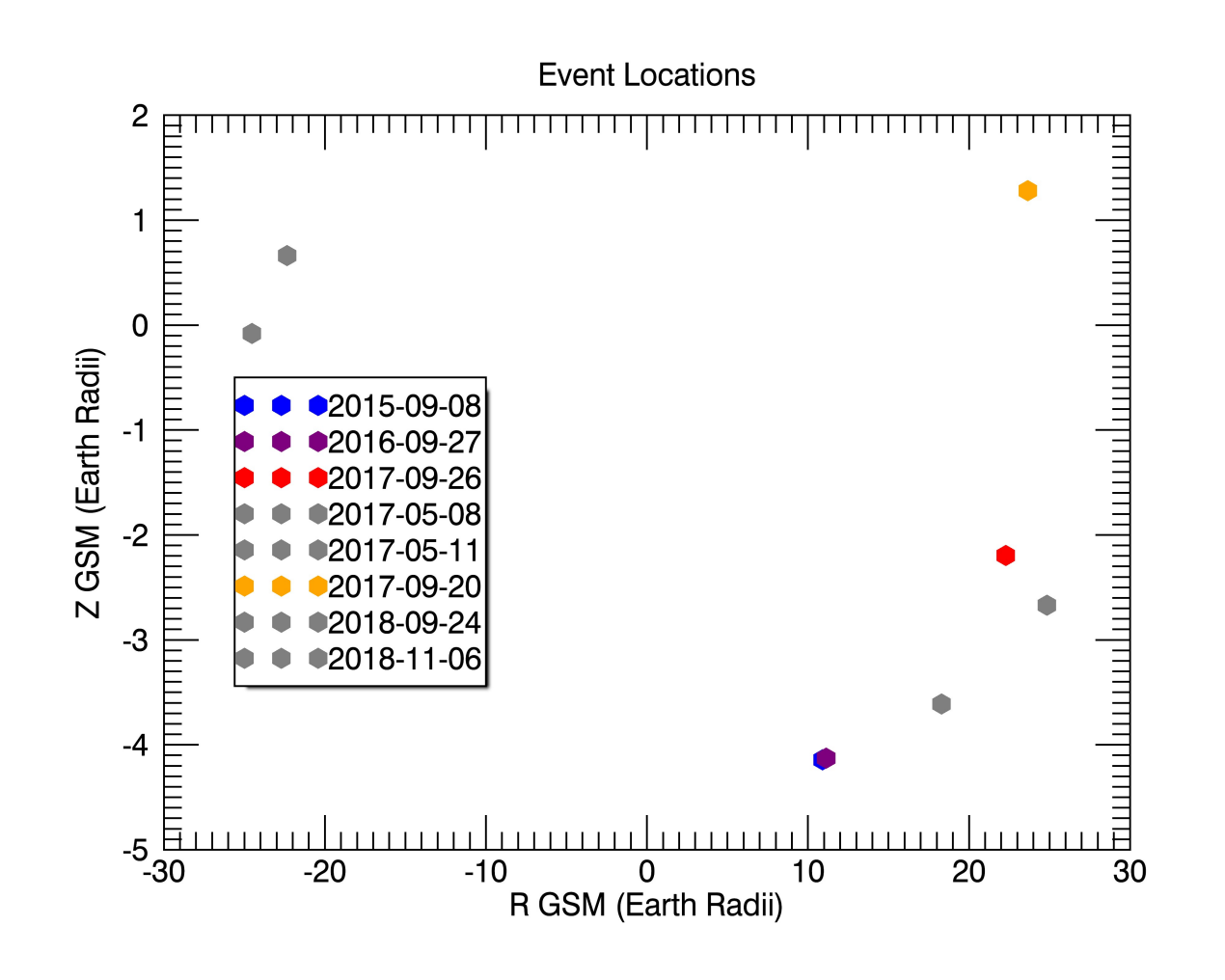
# INTERESTING FIND



# FUTURE WORK

- NOTE THAT FURTHER EVENTS ARE DIFFERENT LATITUDES
- OVERALL WE JUST NEED MORE DIFFERING CASES TO STUDY



# THANK YOU

# ACKNOWLEDGEMENTS

This research was supported by the National Science Foundation REU program, Award #1659878.