Detecting Solitary Waves in Earth's Magnetosphere
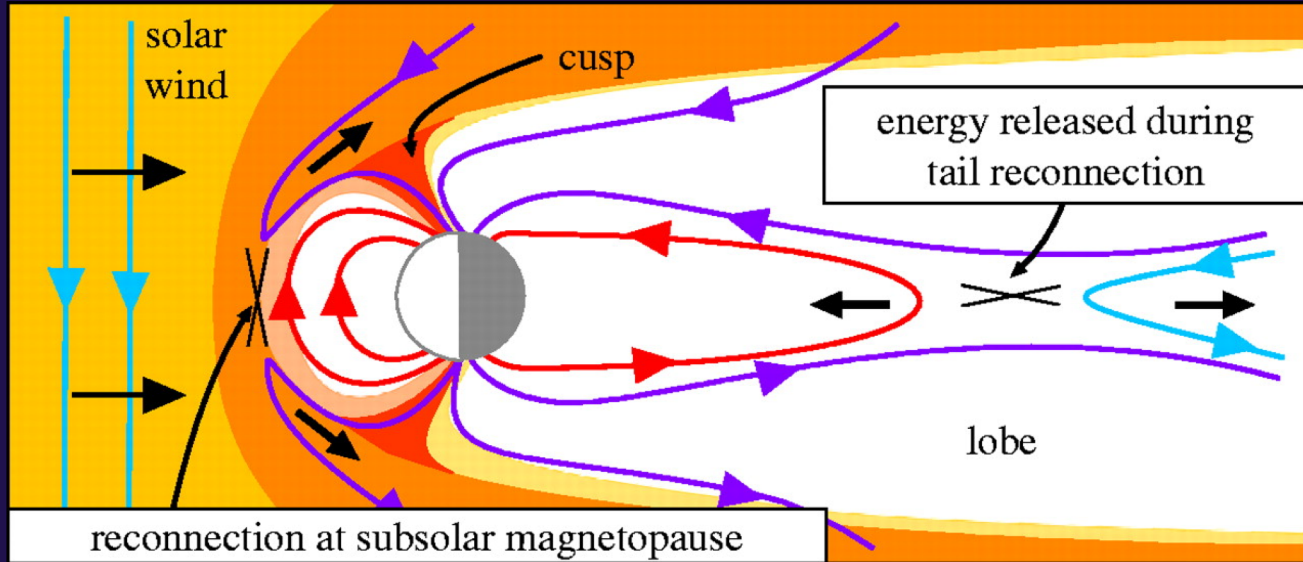
Shaniya Jarrett
Mentored by David Malaspina
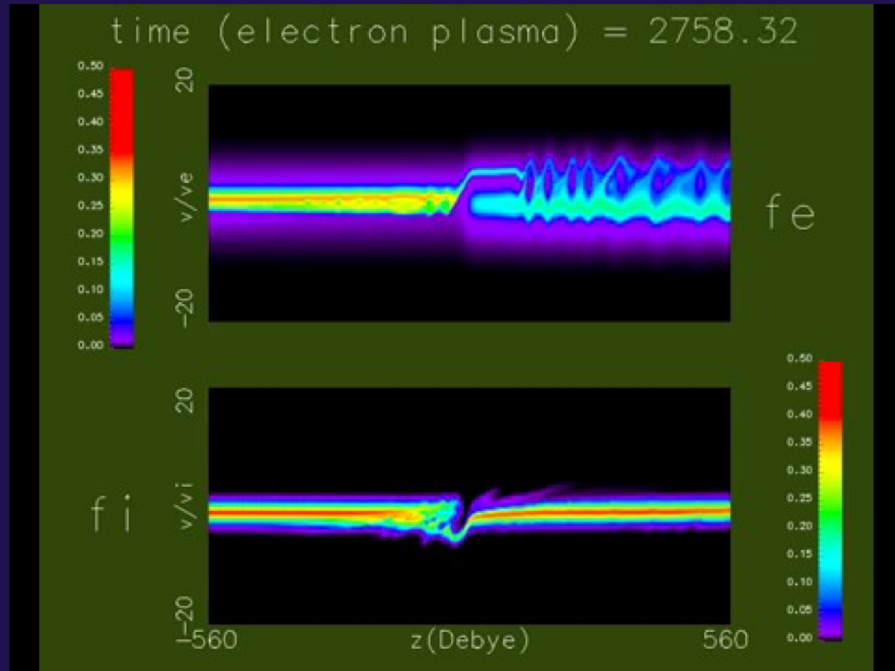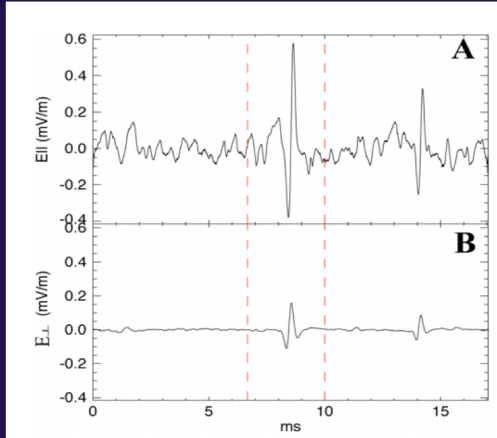
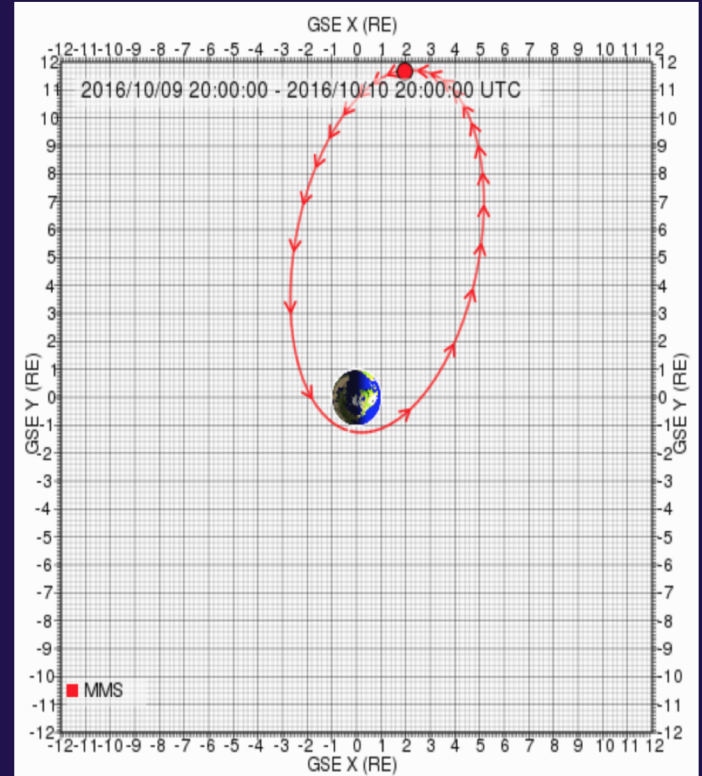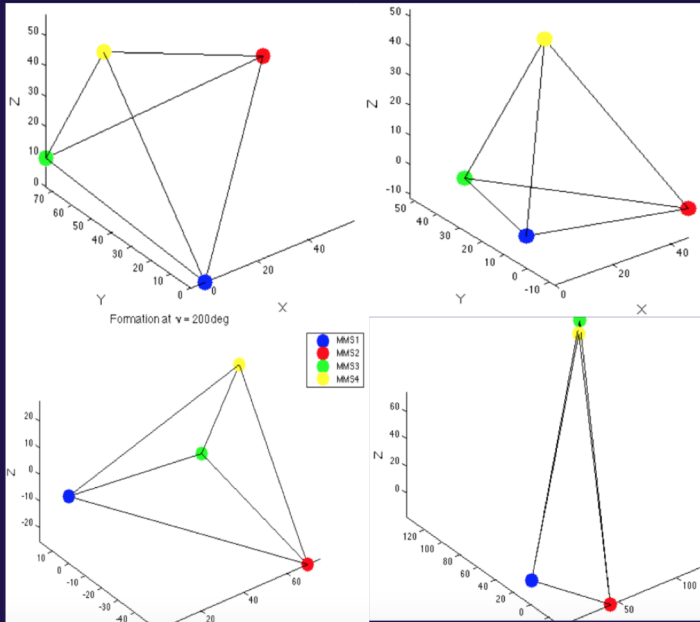Laboratory for Atmospheric and Space Physics
University of Colorado Boulder

Overview
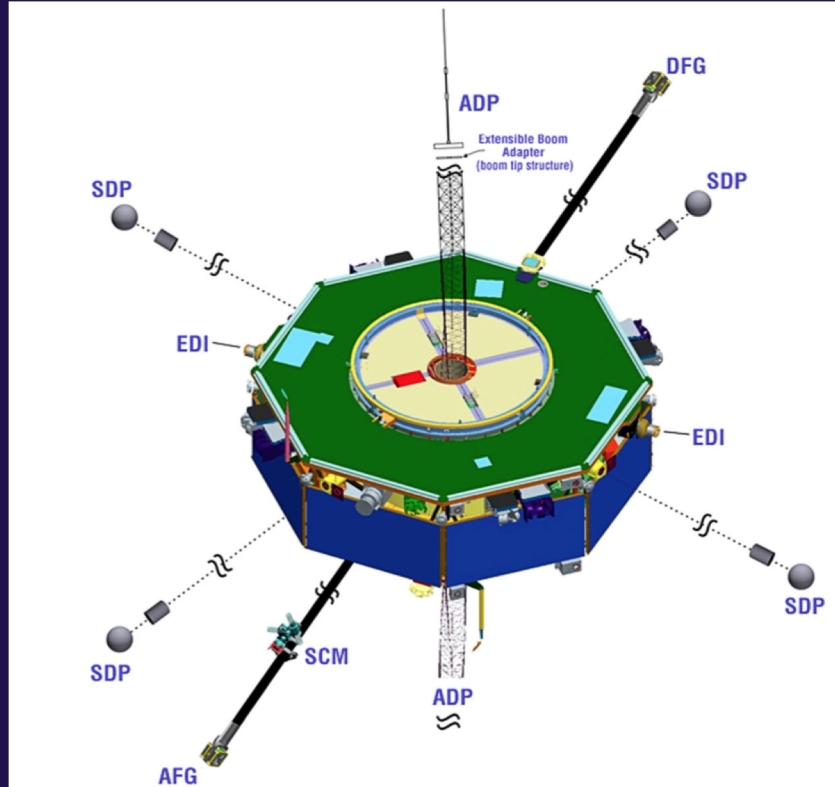
More on Solitary Waves

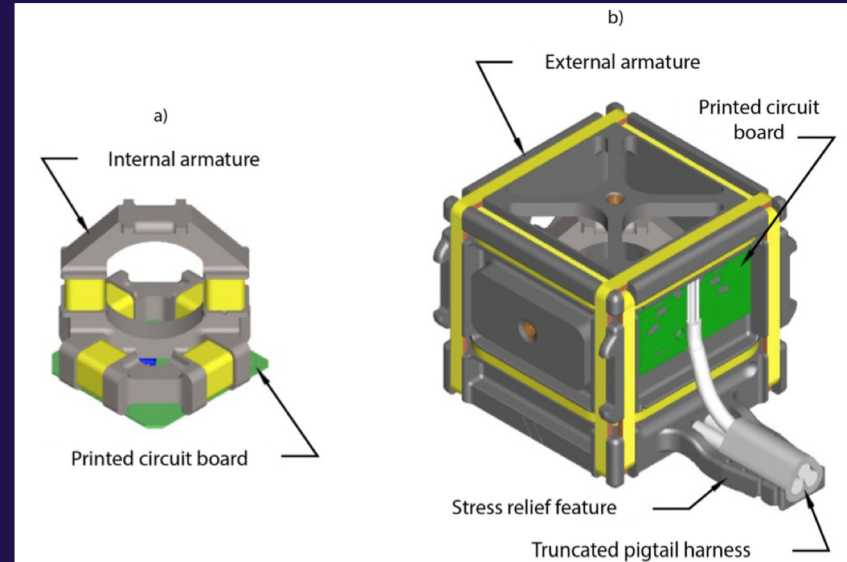[1D Vlasov simulation courtesy of: David Newman

MMS and its Orbit
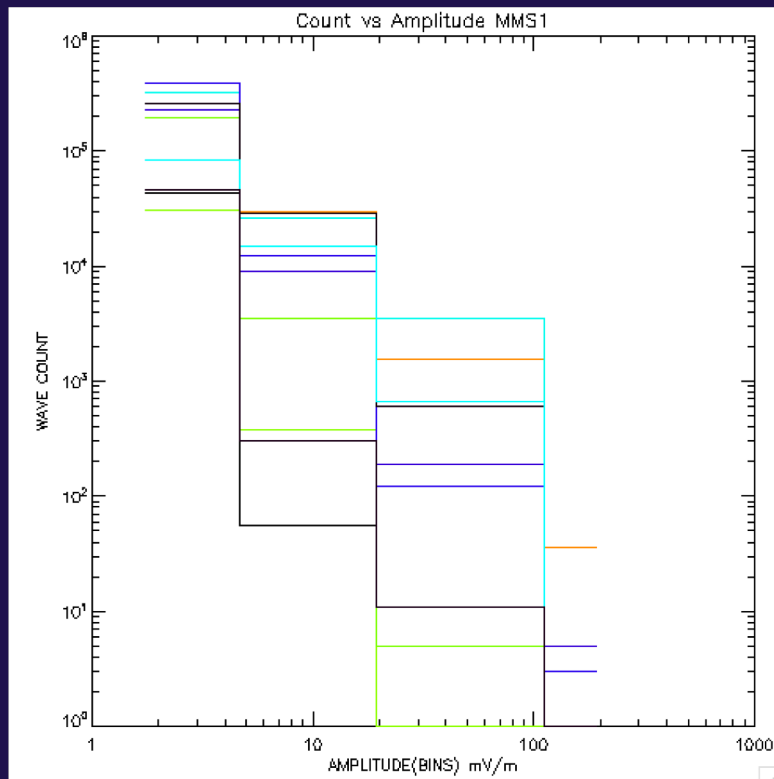
Spacecraft Instruments

$$\vec{\nabla} \times \vec{B} = \mu_0 J$$

Understanding the basics

- Histogram of four amplitude categories

- Represented with logarithmic scale
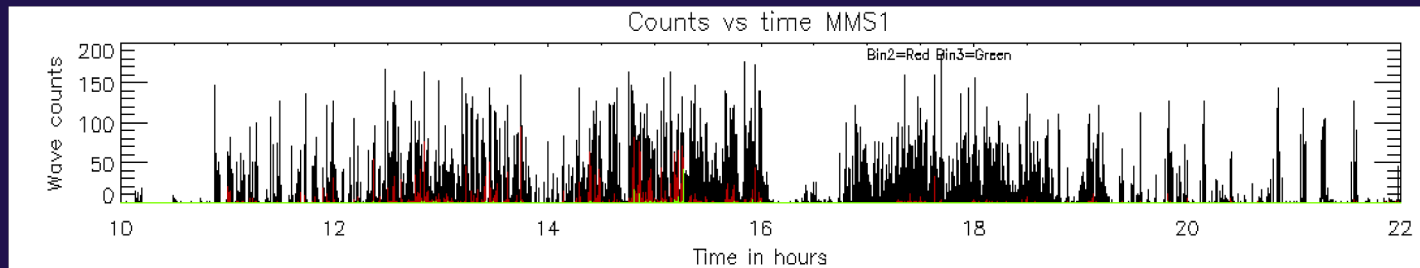
- Spans over 10 days

Past Data:
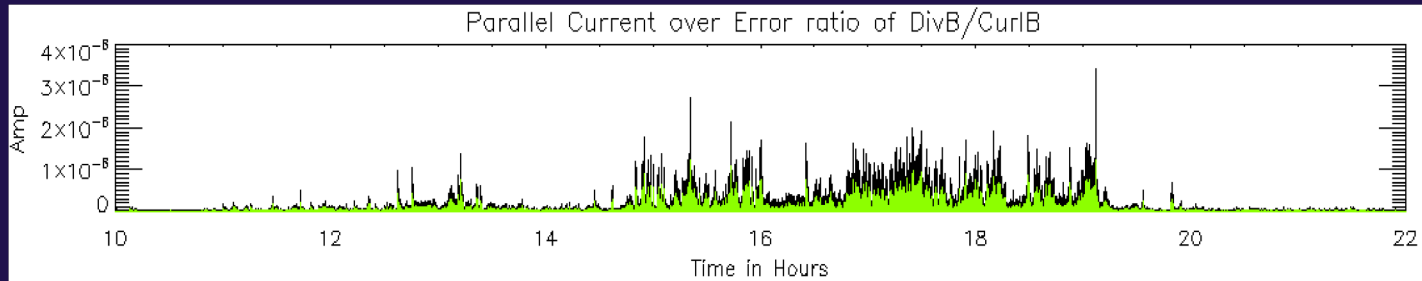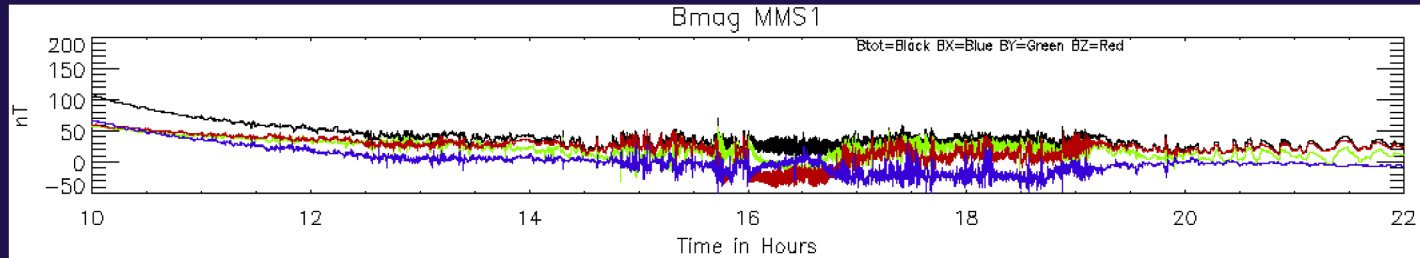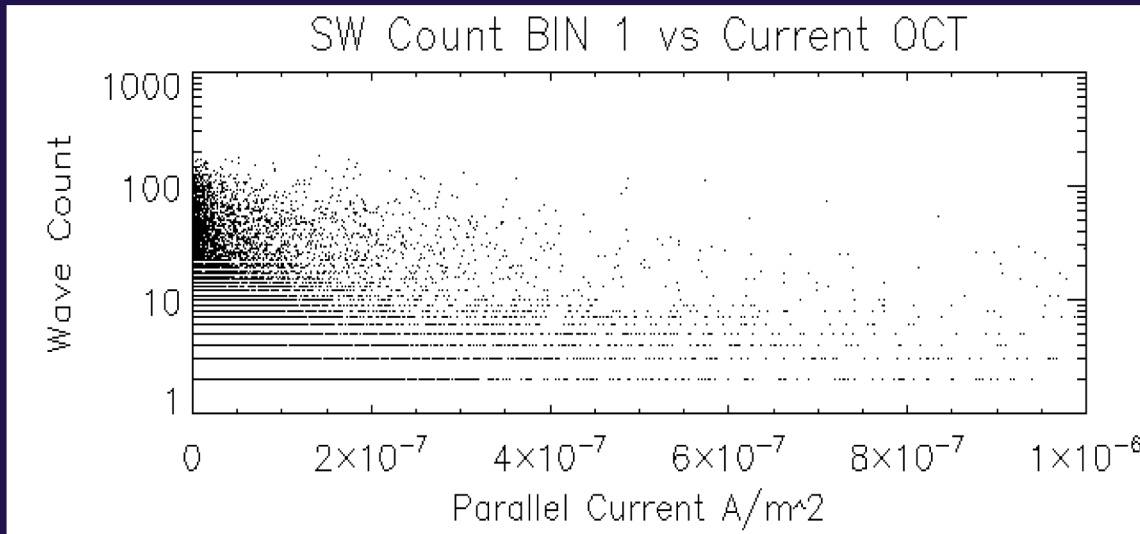## Looking at Currents and Waves

Comparing the Two
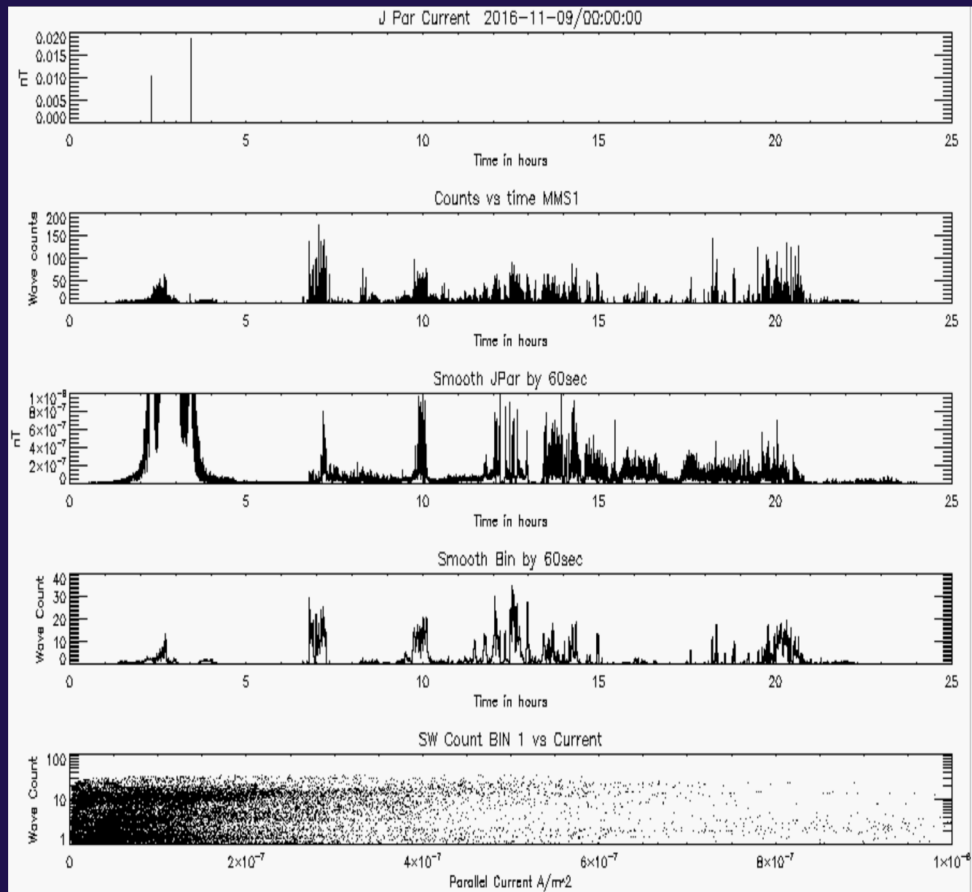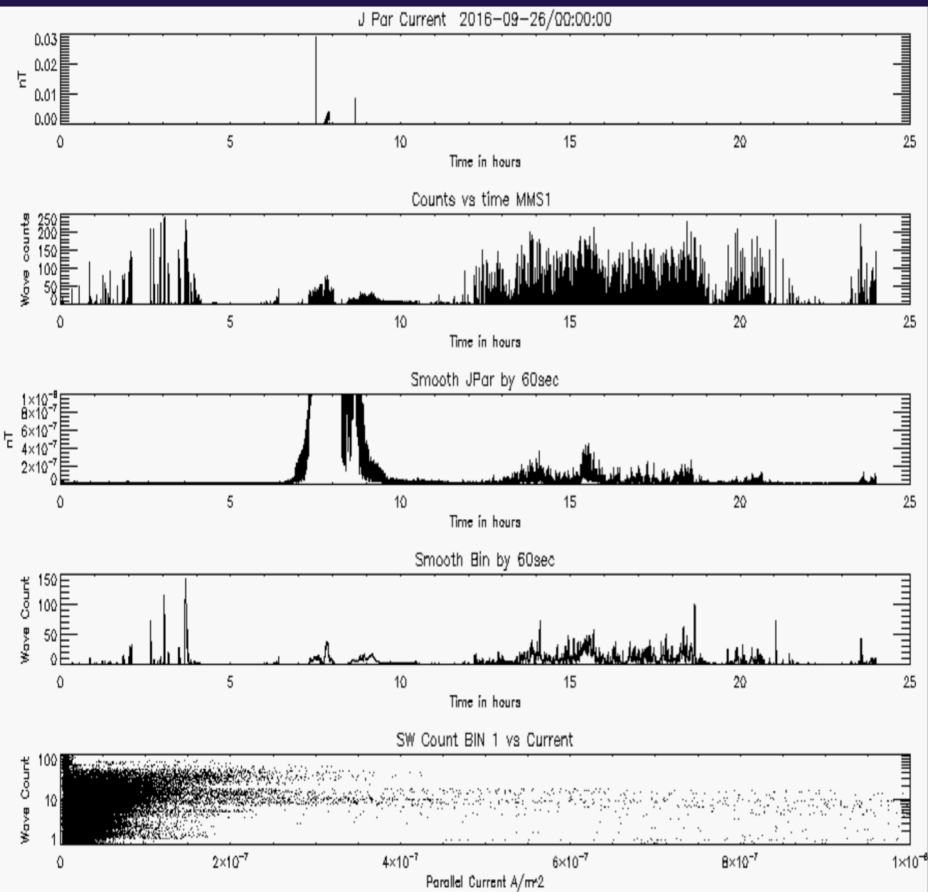
Initial Future Plans

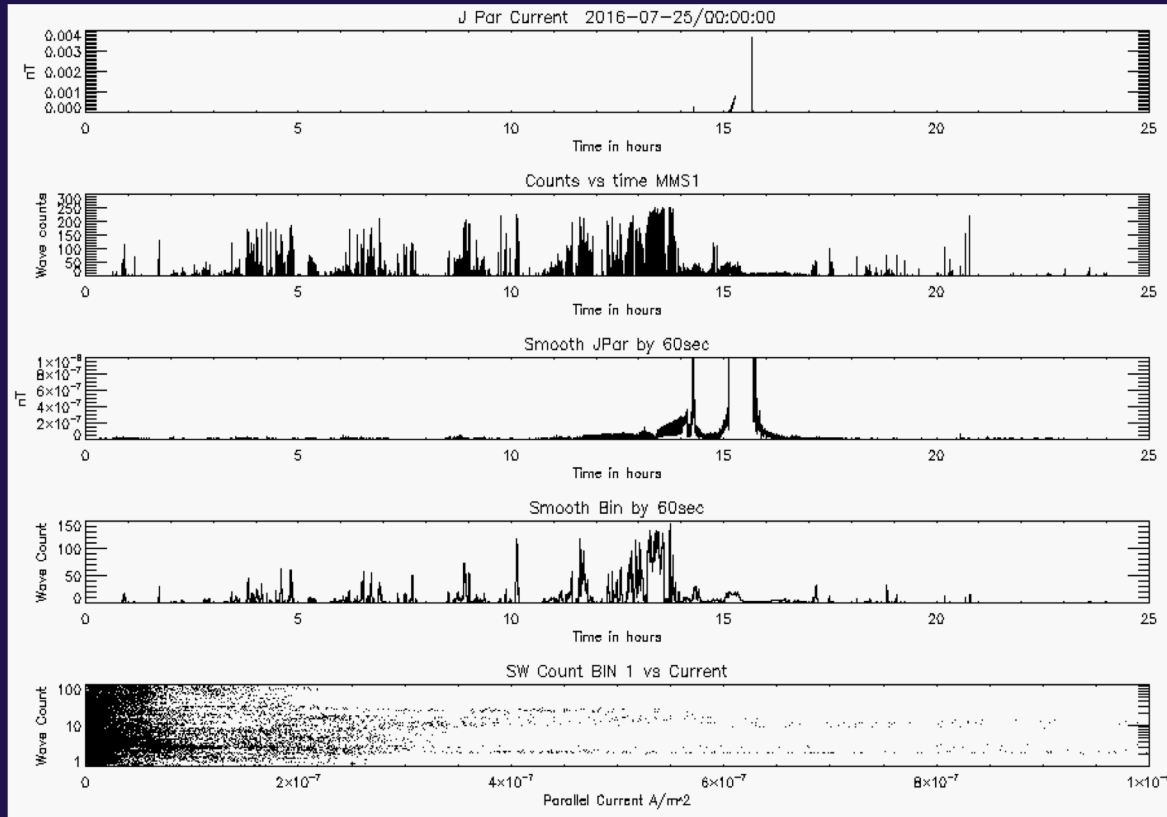SW Count BIN 1 vs Current OCT

- Left off looking for pattern

- Work on problem solving
    -Interpolate
    -Smooth

Solving Problem #1

Issues with the Current

New Data:
Creating the Maps

Solving Problem #2

```
Step=.5
Max=20
Npts=80

x_array=(dindgen(Npts)/Npts*(Max/step)-Max)
y_array=(dindgen(Npts)/Npts*(Max/step)-Max)
z_arrayCount=dblarr(Npts,Npts)
z_array=dblarr(Npts,Npts)

interpolateX=interpol(OrbitX, OrbitT , data1.x)
interpolateY=interpol(OrbitY, OrbitT, data1.x)


for x_index=0,Npts-1,1 do begin
  for y_index=0,79,1 do begin

  xcheck=where(  (InterpolateX gt x_array[x_index] and InterpolateX lt x_array[x_index]+step) and $
                 (InterpolateY gt y_array[y_index] and InterpolateY lt y_array[y_index]+step) ,h_count)
  if h_count eq 0 then continue

  SW=data1.y[*,0]
  Sum=total(sw[xcheck])

  z_arrayCount[x_index, y_index]+=Sum
  z_array[x_index, y_index]+=h_count

  endfor
endfor
```
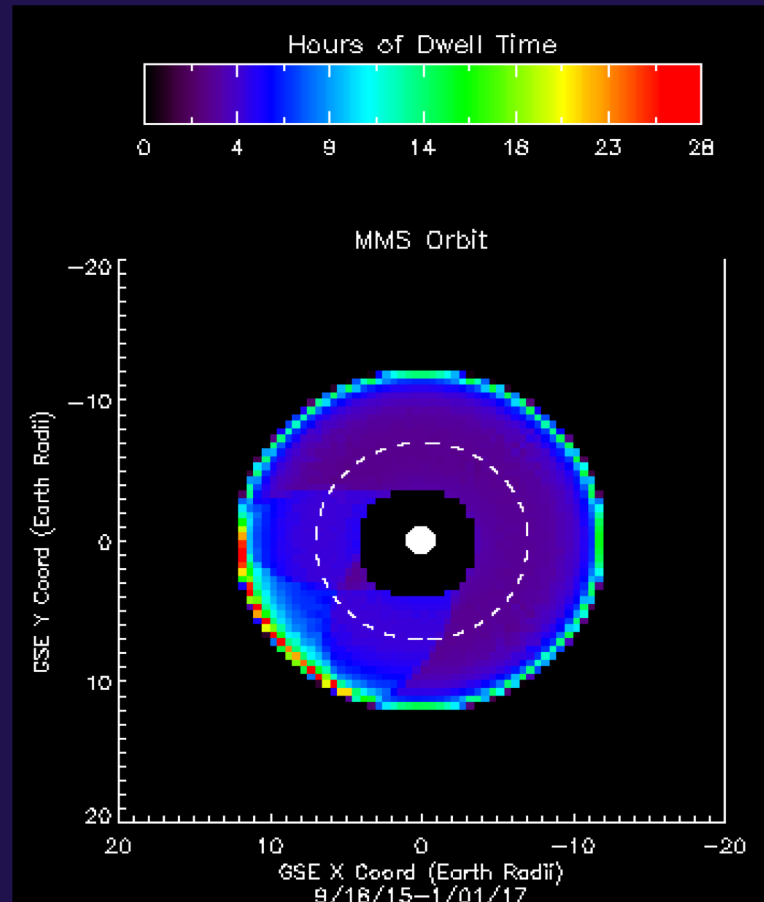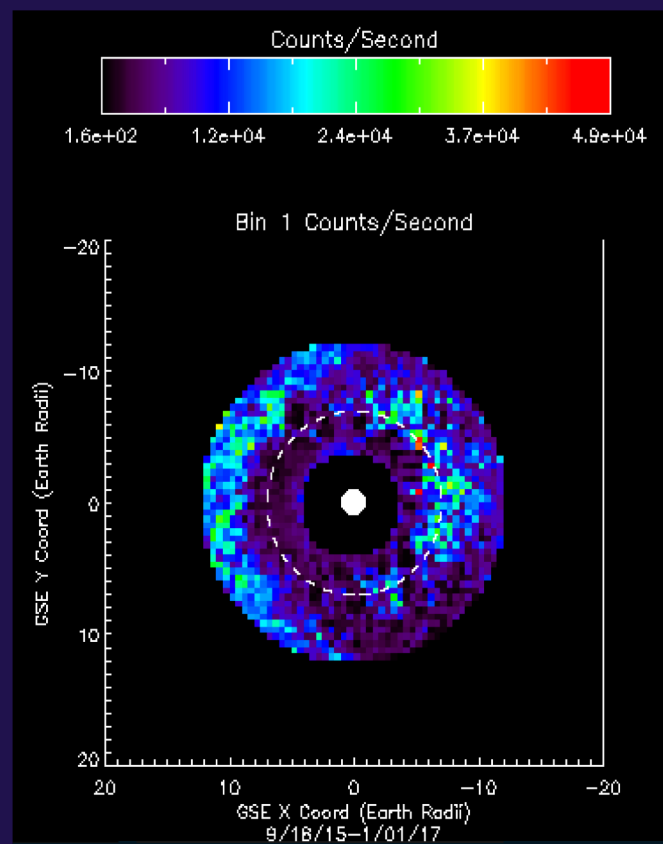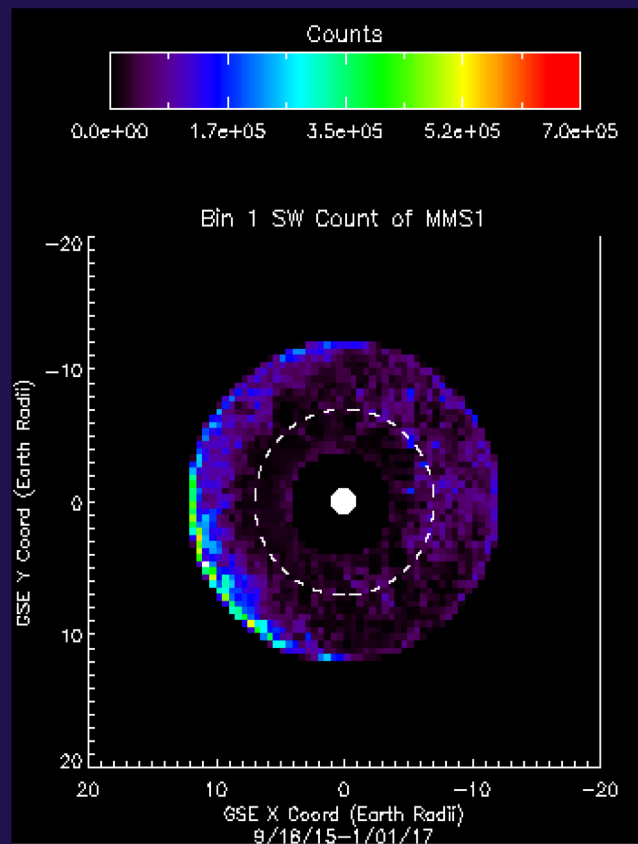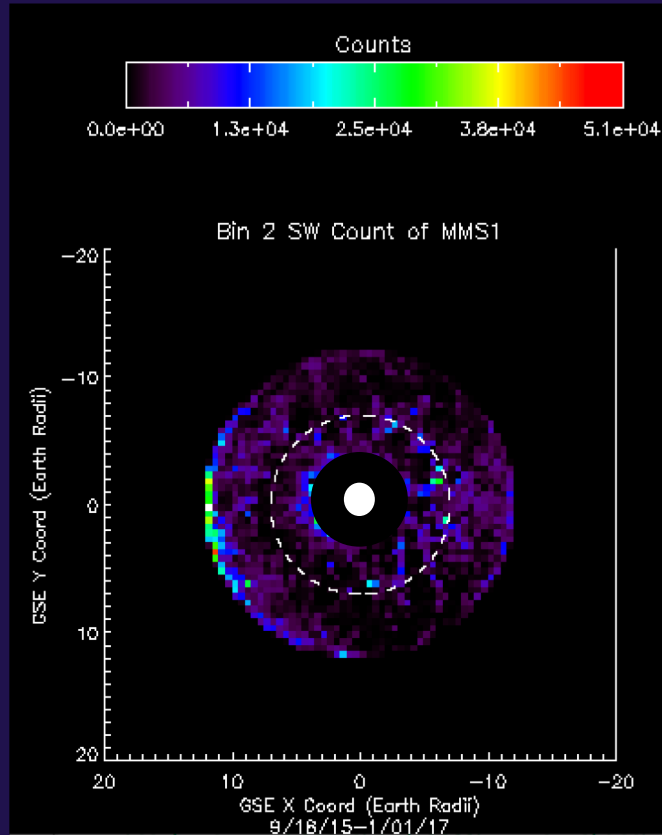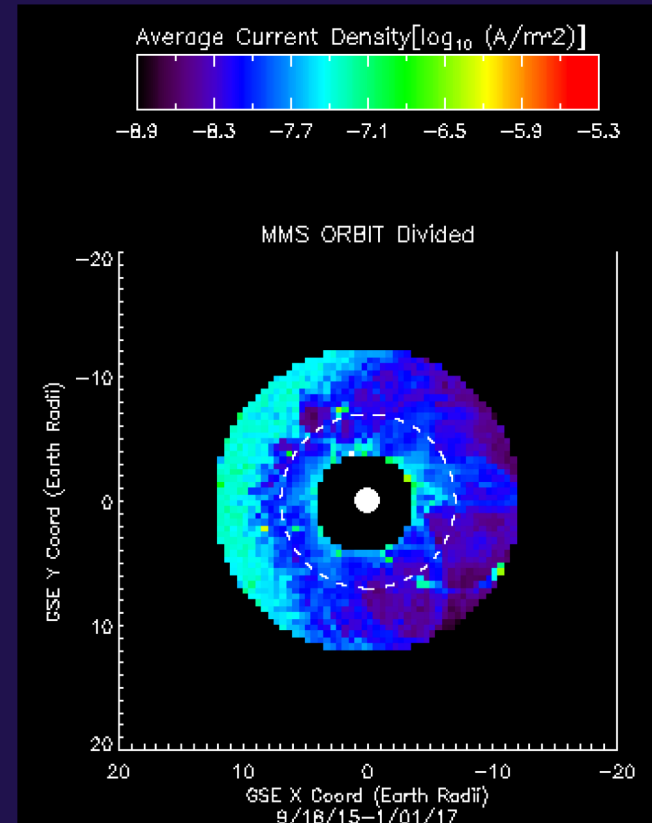
New Data: Orbit

New Data: Bin 1
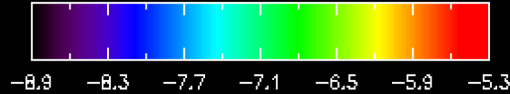
New Data: Bin 2

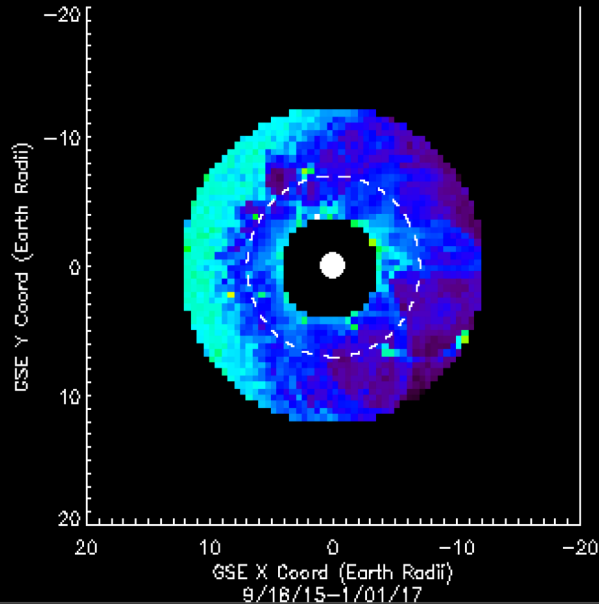# New Data: Current Density
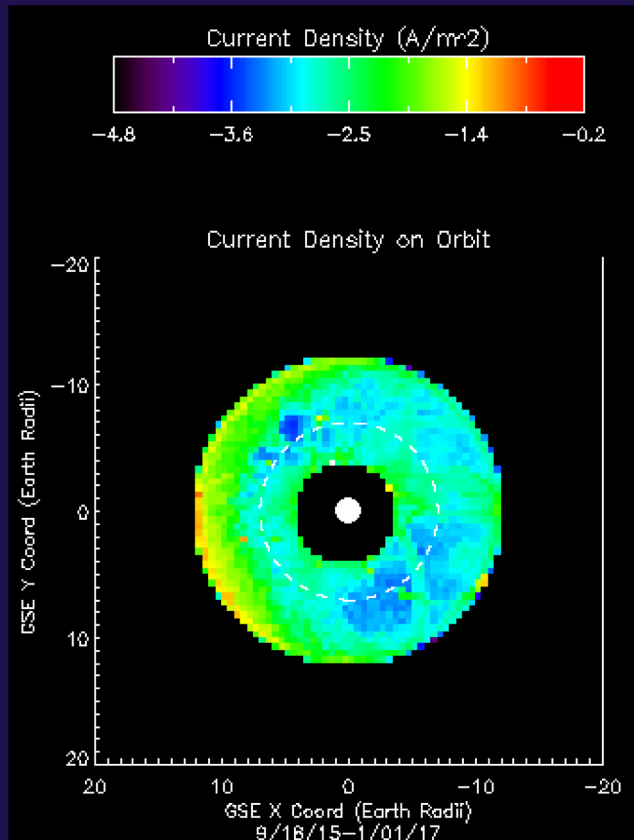
Comparing Current to SW
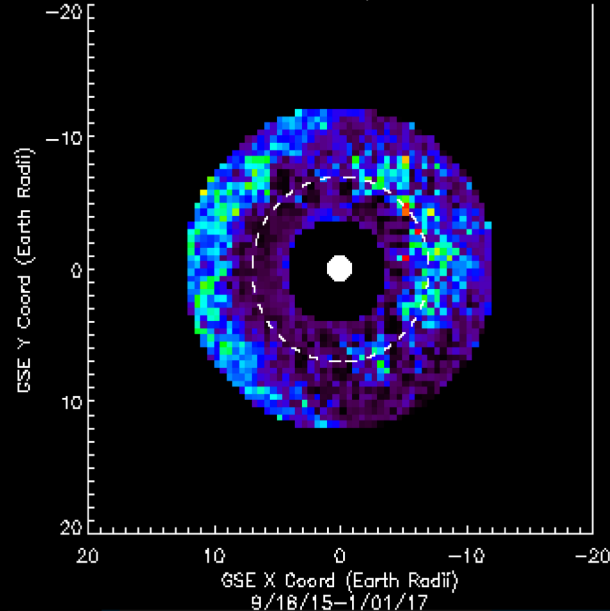
Remaining Questions

1. TQF of MMS questionable in Magnetotail

2. Going deeper into the physics of current in tail
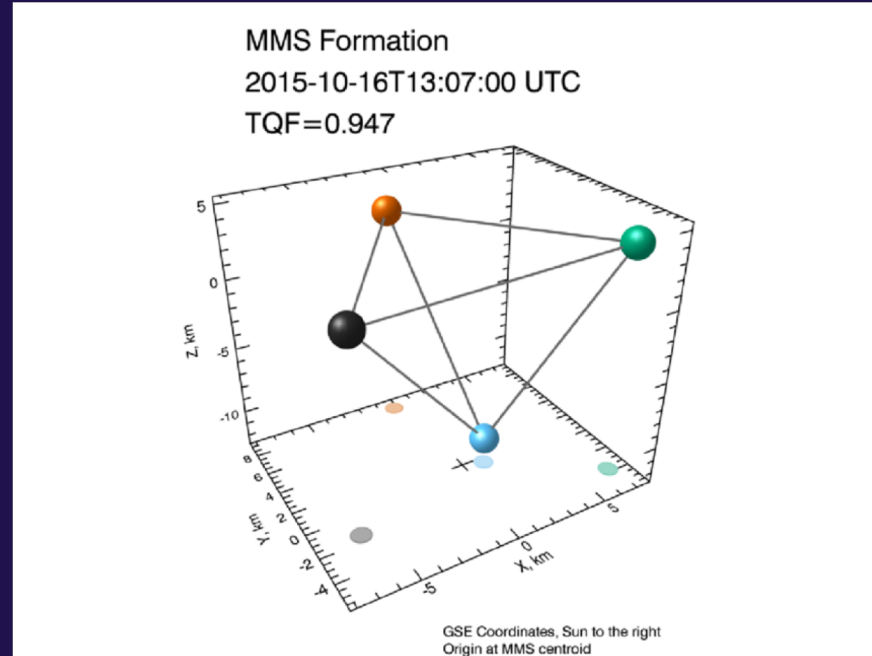
Remaining Questions
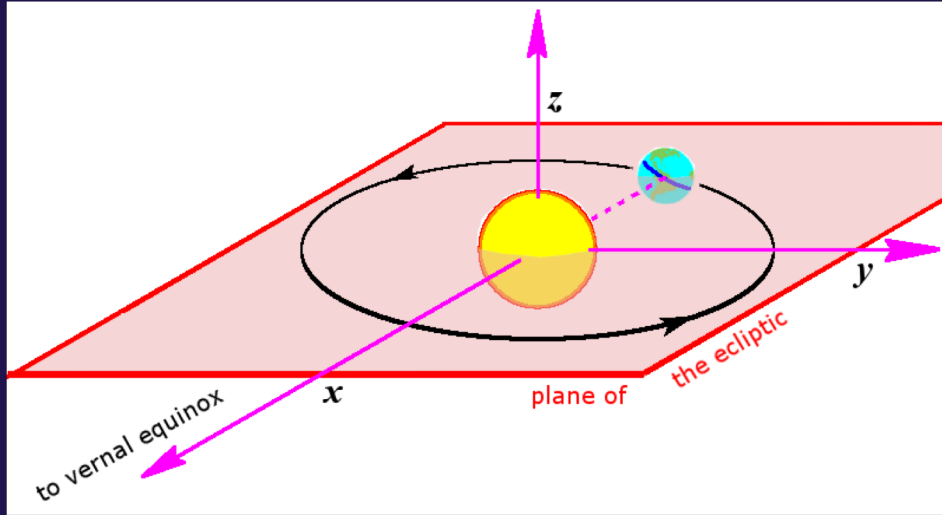
3. Using GSM instead of GSE

4. Seeing if average current is not showing on map

Conclusions

Overall Motivations:
-Determine current threshold
-Investigate energy transition

Successes:
-Improved understanding of
 Solitary Waves
-Comparing SW to Current
-Mapping outer region

Finally: We believe there is a visible correlation between current and solitary waves but further research is needed

References

1. Burch, J. L., T. E. Moore, R. B. Torbert, and B. L. Giles. "Magnetospheric Multiscale Overview and Science Objectives." (2015): 5-21. *Springer*. Web. 20 Mar. 2015.

2. Torbert, R. B., and C. T. Russell., et al., "The FIELDS Instrument Suite on MMS: Scientific Objectives, Measurements, and Data Products." (2014): 106-35. *Springer*. Web. 14 May 2014.

3. Collins, Rachael. "Magnetospheric Multiscale Mission." ASEN, 2013. Web. <http://ccar.colorado.edu/asen5050/projects/projects_2013/Collins_Rachael/results-and-conclusions.html>.

4. Romeo, G. "Multi-Mission Orbit Plotter." *Van Allen Probes Science Gateway*. Ed. JHU/APL Webmaster. N.p., 24 Feb. 2017. Web. <http://rbspgway.jhuapl.edu/ExtendedMissionOrbit>.

Questions?