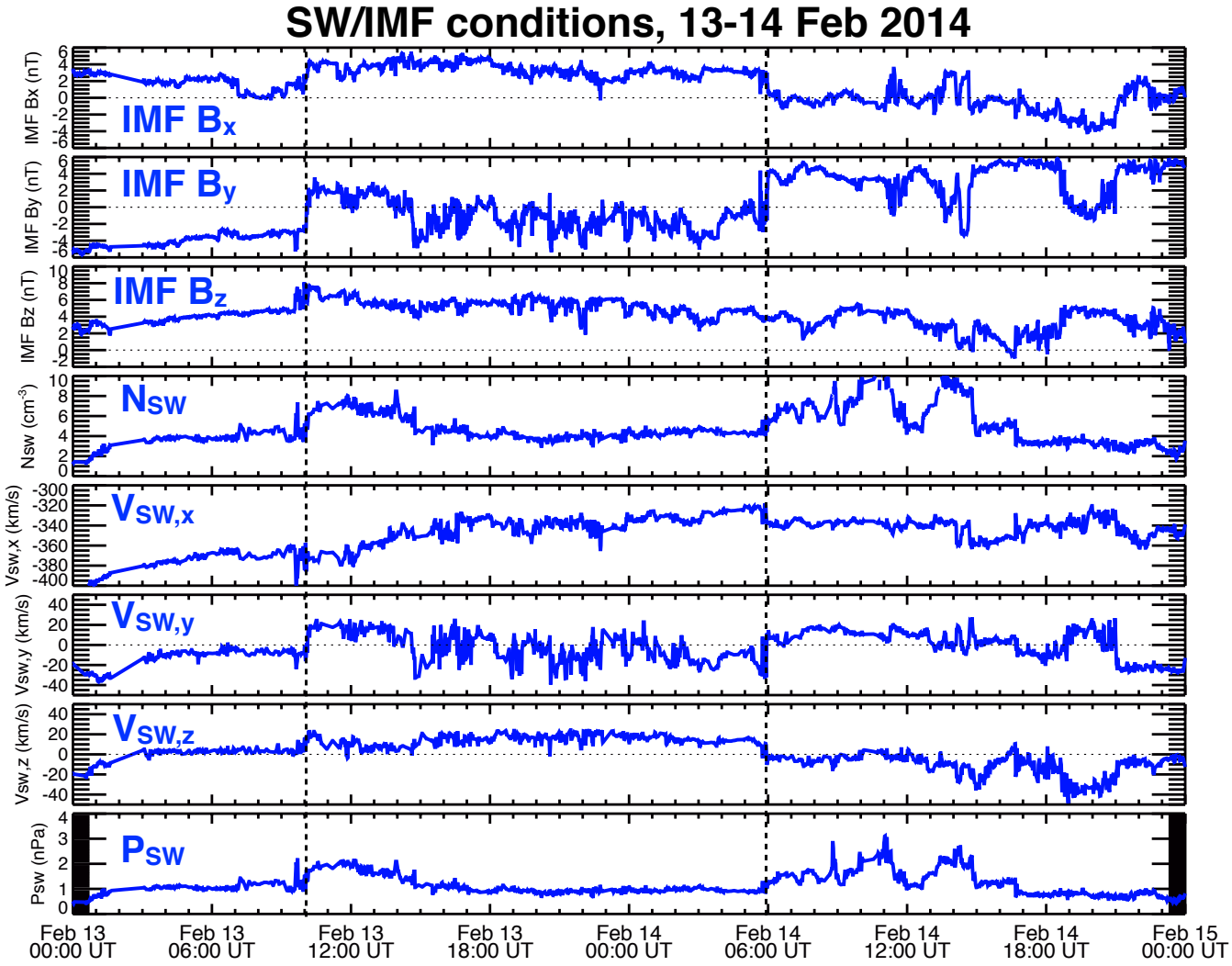
2016 Summer GEM
Mid-tail (60 Re) modeling challenge
"Tail Environment and Dynamics at Lunar Distances" & "Modeling Methods and Validation" FGs

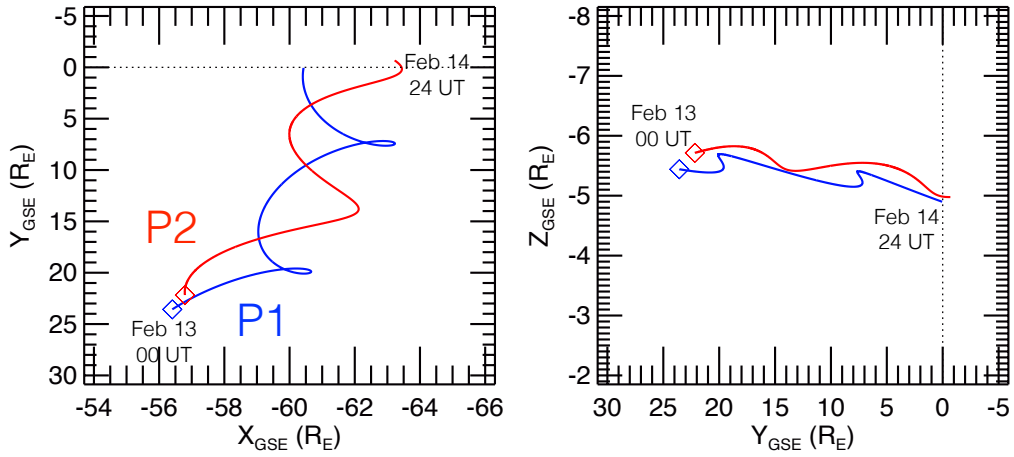
ARTEMIS observations for a northward IMF event:
IMF remains northward for 48 hr from 13 Feb to 14 Feb 2014
The two ARTEMIS probes at X = -60 R_E moving from Y = 23 to 3 Re and are close to the plasma sheet.
The two probes (separation ~1 to 3 R_E) provide determination of spatial and temporal variations.

We would like to investigate the ability of global models (both MHD and hybrid models) on the following questions:

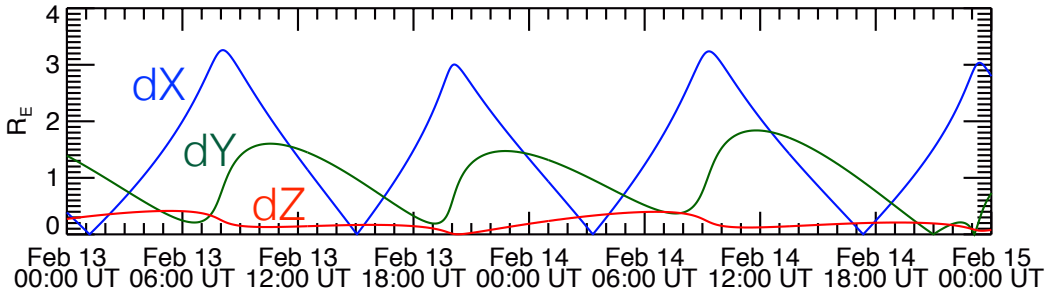
1. How does the mid-tail configuration response to changes in IMF By and solar wind dynamic pressure?
2. What processes cause the 10 to 30 min perturbations in the mid-tail plasma sheet?
3. What are characteristics of plasma flows in mid-tail plasma sheet?

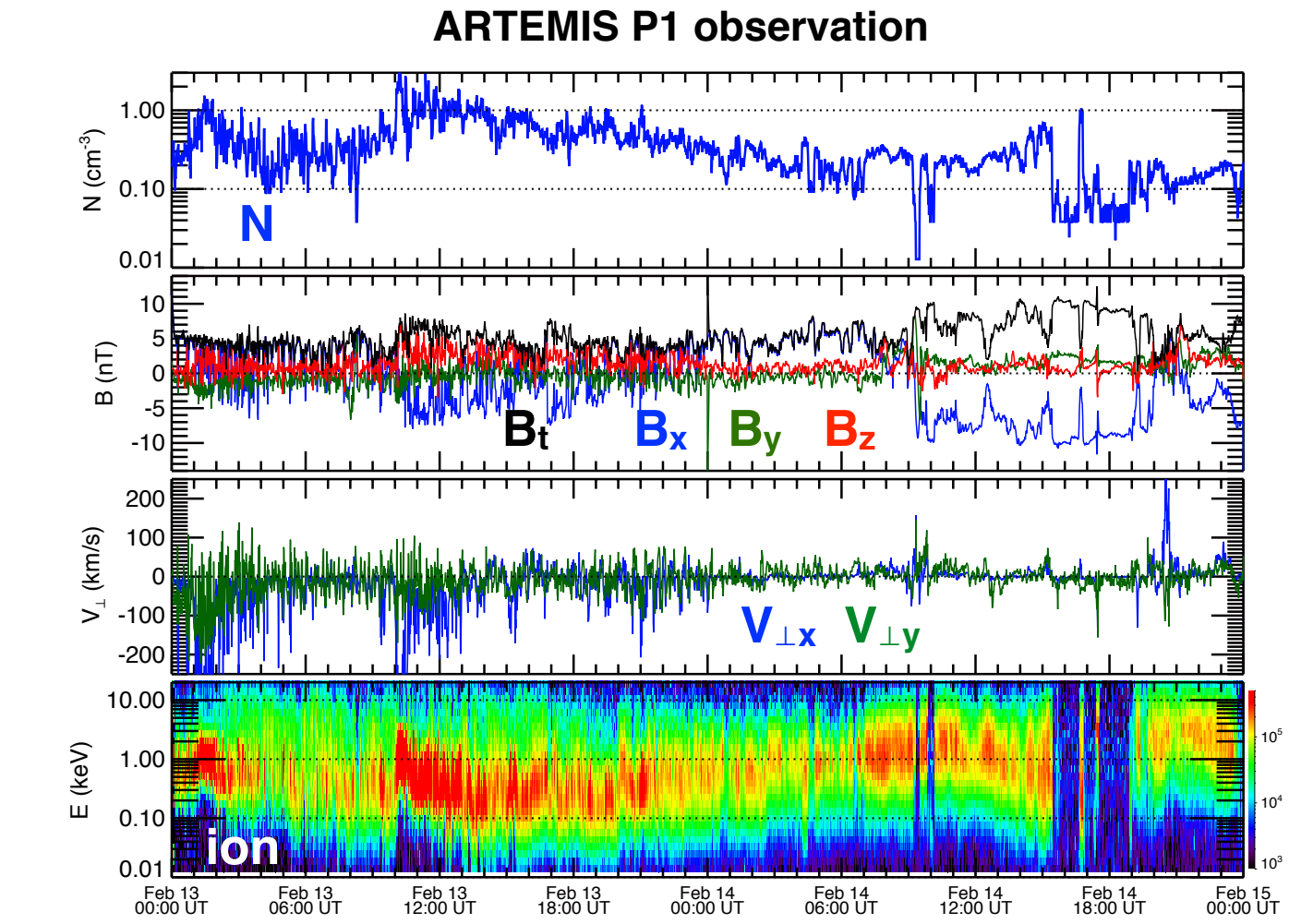

SW/IMF conditions, 13-14 Feb 2014
IMF Bx (nT)
IMF Bx
IMF By (nT)
IMF By
IMF Bz (nT)
IMF Bz
Nsw (cm-3)
NSW
Vsw,x (km/s)
VSW,x
Vsw,y (km/s)
VSW,y
Vsw,z (km/s)
VSW,z
Psw (nPa)
PSW
Feb 13 00:00 UT
Feb 13 06:00 UT
Feb 13 12:00 UT
Feb 13 18:00 UT
Feb 14 00:00 UT
Feb 14 06:00 UT
Feb 14 12:00 UT
Feb 14 18:00 UT
Feb 15 00:00 UT

locations of ARTEMIS P1 and P2



Separation between P1 and P2



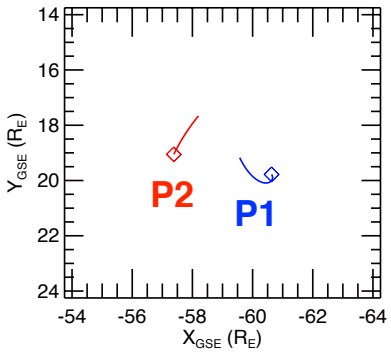


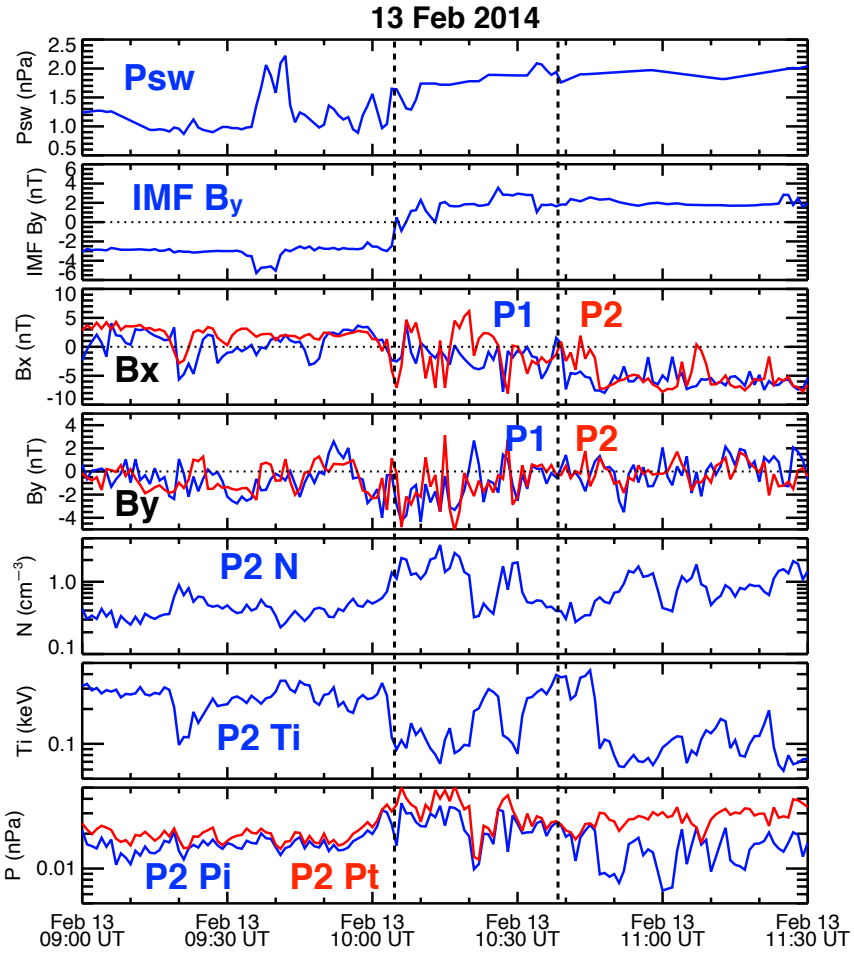
Y_{GSE} (R_E)	23.8	20	19.2	15.9	12	8.2	7.2	3.9	0.1

1. How do mid-tail respond to IMF By and Psw changes?

P1 and P2 responses to the 1st change

- P1 P2 moved from N hemisphere to S hemisphere ~30 min after IMF By direction change
- In response to the P_{SW} increase from ~1 to 2 nPa, N increases from 0.3 to 0.9 cm^{-3} but Ti decreases from 0.3 to 0.1 keV, Pi increases slightly from 0.016 to 0.02 nPa



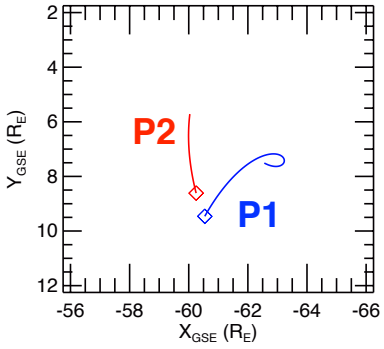


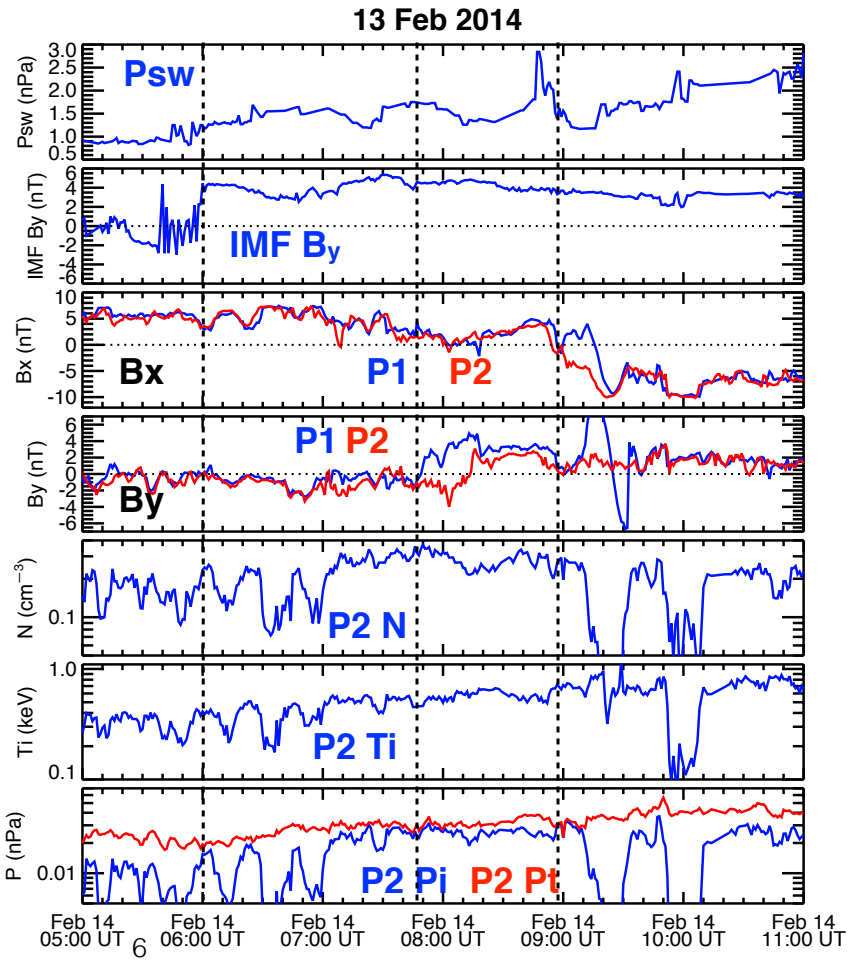
1. How do mid-tail respond to IMF By and Psw changes?

P1 and P2 responses to the 2nd changes

- P1 P2 moved from N hemisphere to S hemisphere ~3 hr after IMF By direction change. **Why did it take much longer than the 1st one? Because of smaller |Y|?**

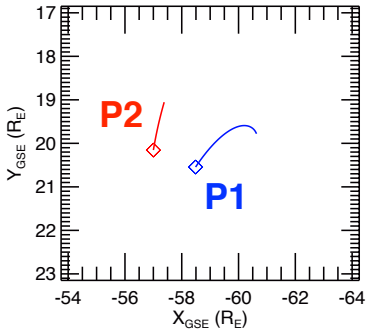
- In response to gradual P_{SW} increase from ~0.9 to 1.5 nPa before 08 UT, N increases from 0.17 to 0.22 cm^{-3} and Ti increases from 0.4 to 0.6 keV, Pi increases from 0.017 to 0.03 nPa

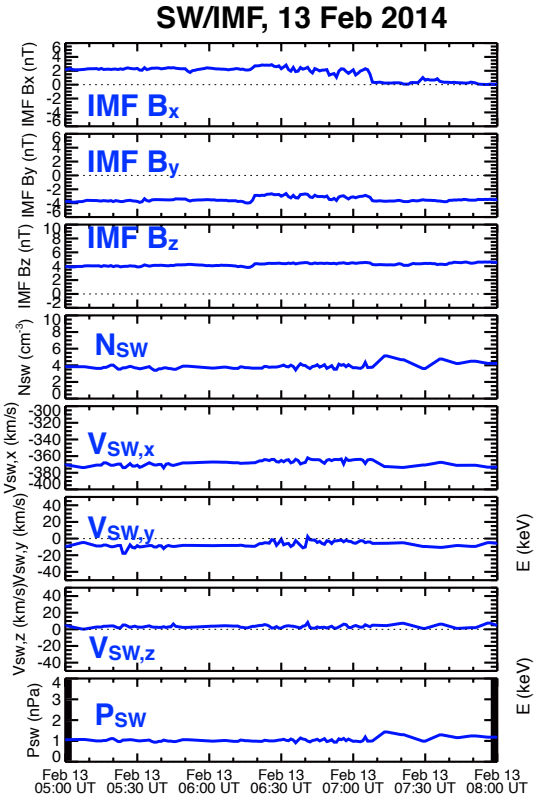


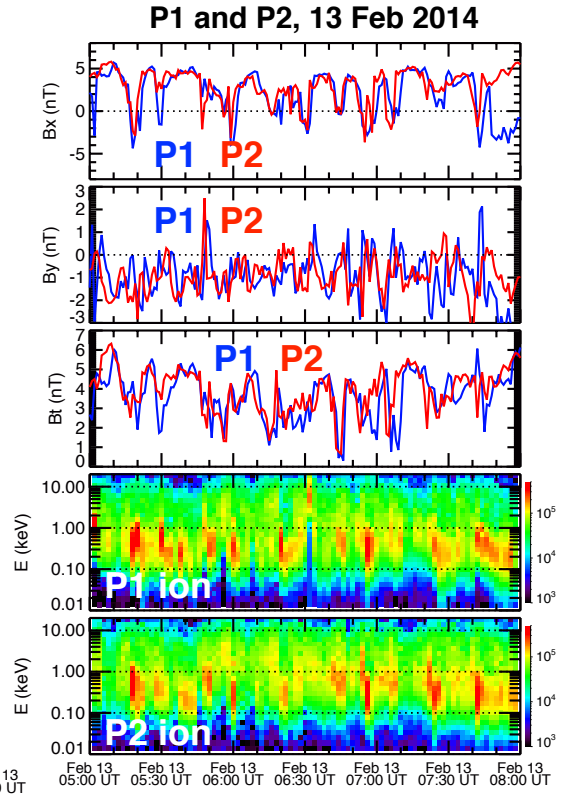


2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when SW/IMF are steady?

- From ~04-09 UT on 13 Feb all SW/IMF parameters are relatively steady
- quasi-periodic fluctuations in magnetic field and plasma with appearance of cold plasma.

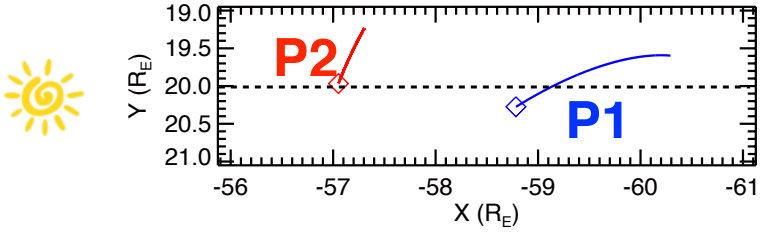




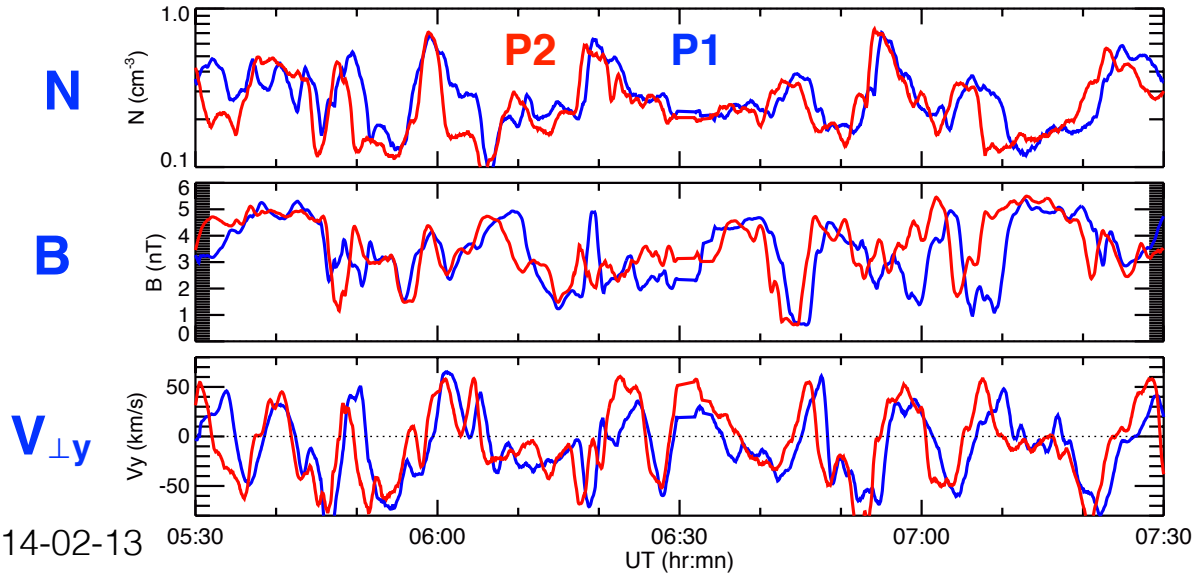


2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when SW/IMF are steady?

- P2 closer to the Earth and saw perturbations first, indicating the perturbations propagate tailward

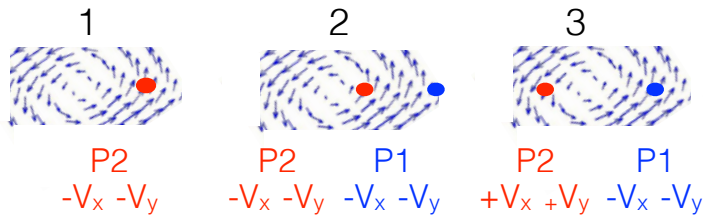


same Y
different X



2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when SW/IMF are steady?

- Flow direction perturbations consistent with a tailward moving vortex



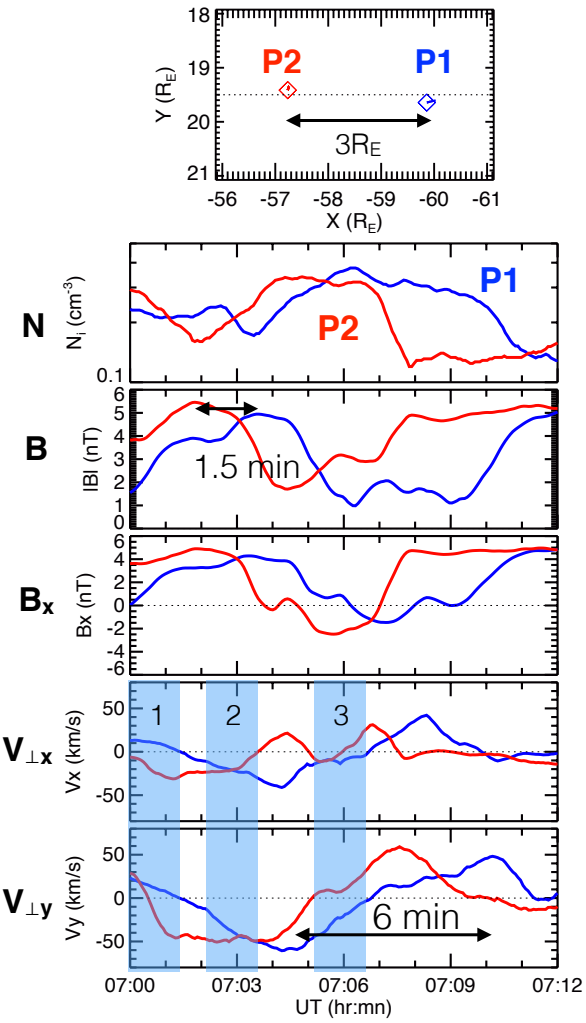
- From the delay time between P1 and P2 (1.5 min) the speed of vortex is

  V_{vortex} = 3 R_E / 1.5min = 140 km/s

- From 6 min between two |Vy| peak, the X-scale of the vortex is

  X_{vortex} = V_{vortex} * 6 min = 8 R_E

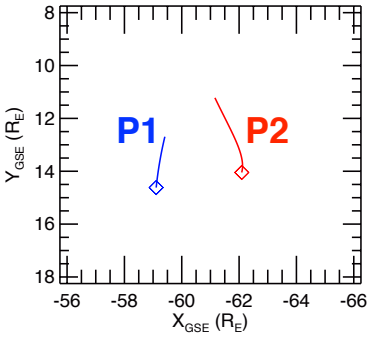
- **Are the fluctuations caused by K-H waves?**

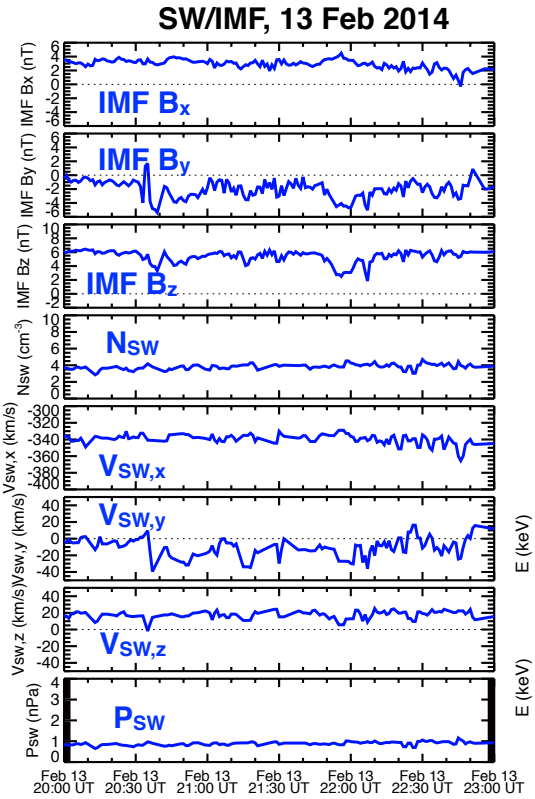


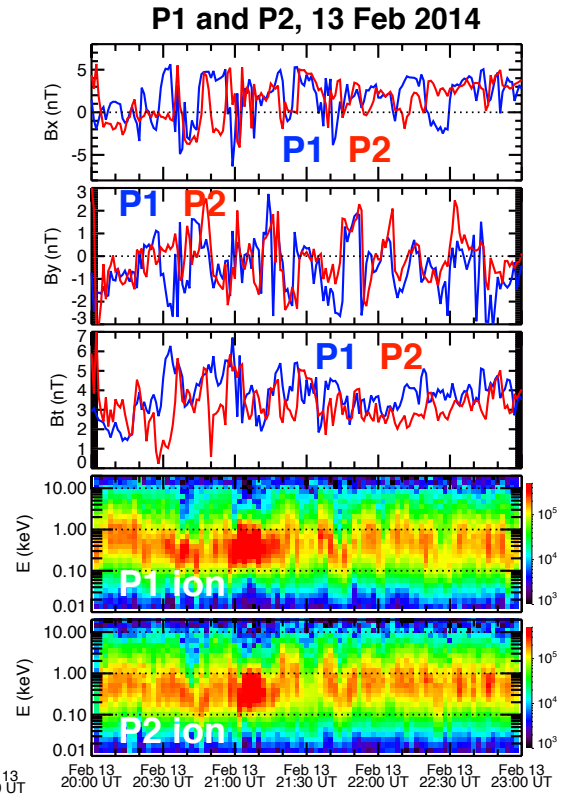
2014-02-13

2. What processes cause the 10-30 min perturbations in the mid-tail plasma sheet during a period when there are small SW/IMF perturbations?

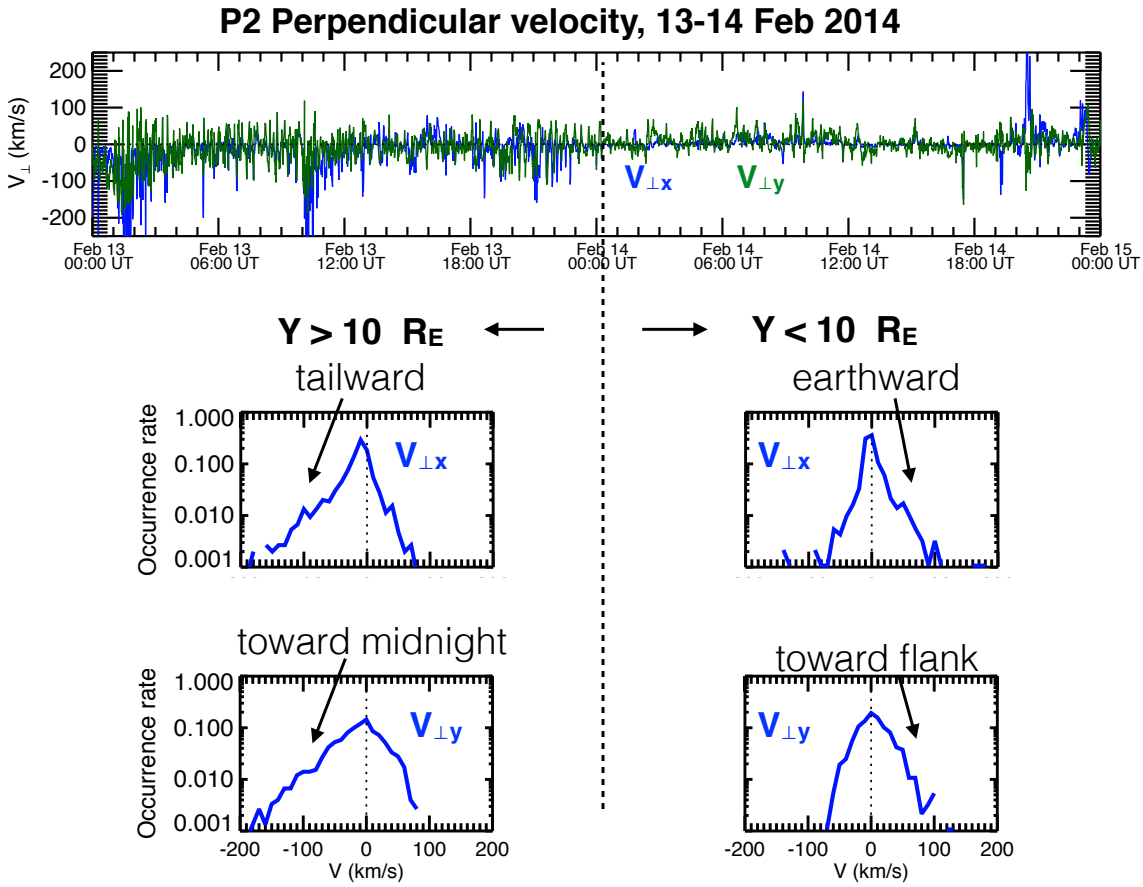
- Another period of magnetic field and plasma fluctuations, **more irregular**. Are the fluctuations current sheet flapping motion?
- **Are the fluctuations caused by the small fluctuations in IMF By or Vsw, y?**







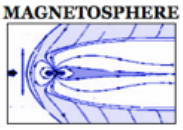
3. What are characteristics of plasma flows in mid-tail plasma sheet?



participating global models

1. LFM: Slava Merkin
2. OpenGGCM: Joseph Jensen
3. GUMICS: Ilja Honkonen
4. BATS-R-US: (Daniel Welling)
5. Auburn University hybrid code: Yu Lin, Xueyi Wang

global models on CCMC



- Also run LFM, OpenGGCM, BATS-R-US, and GUMICS on CCMC as baseline

		cells	ΔX (R_E) at X = -60 R_E	Δ Y (R_E)	Δ Z (R_E)
LFM	SM	106x96x128	1.2-1.8	1.2-1.8	1.2-1.8
OpenGGCM midtail emphasis grid	GSE	9M	0.6	0.4-1.2	0.2-0.6
SWMF/ BATS-R-US	GSM	2M	0.5-2	0.5-2	0.5-2