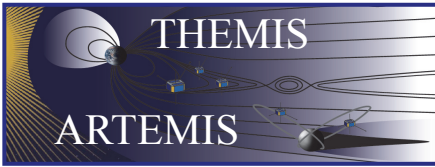


Orbit Design Updates for Upcoming Seasons

S. Frey
SSL UCB



Overview

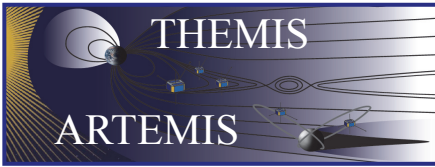


THEMIS P3,4,5

- Design Driver
- Dayside 4
- Tail Season 5

ARTEMIS P1,2 in Lunar Phase

- Lunar Wakes
- Periapsis Passes

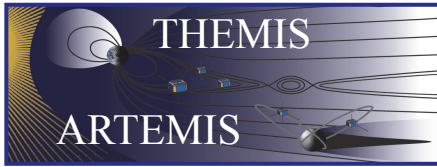


THEMIS P 3, 4, 5



Orbit Design Driver in Extended Phase

- Maintain differential precession within a few degrees
 - Perigee, Inclination -> Change of Argument of Perigee
- Lower Perigee for P3 in order to align with MMS
 - P3 perigee low since Tail 3, lower further after Day 4
 - Vary P4,P5 perigees to control differential precession
- Season specific 3 probe formations (science driven)
 - Tail seasons in meridional plane, .5 to 1 Re to NS
 - Dayside formation to tangentially skim along MP
 - Significant z-separation by offset in inclination ($dInc$)

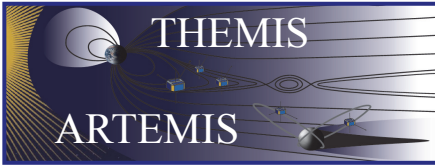


THEMIS P 3, 4, 5



Upcoming Dayside 4

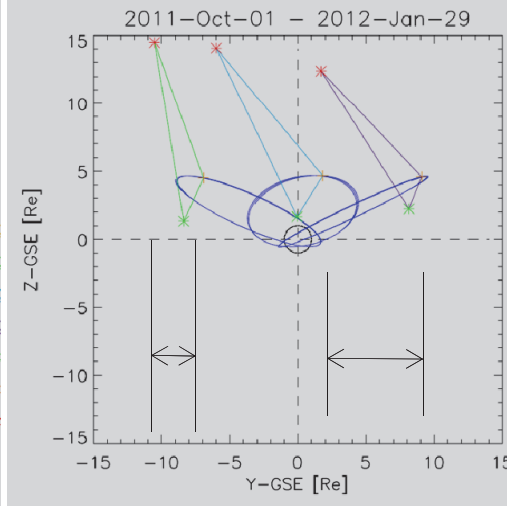
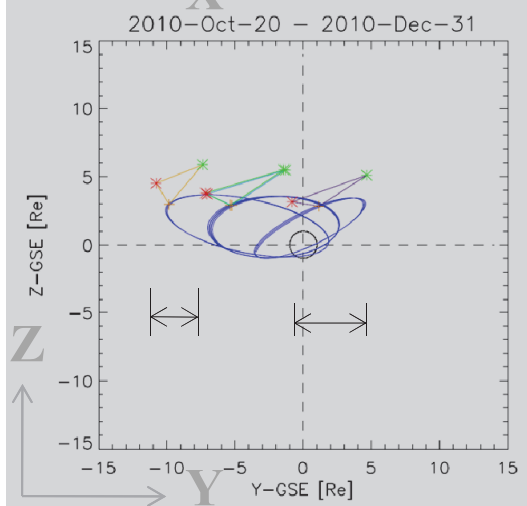
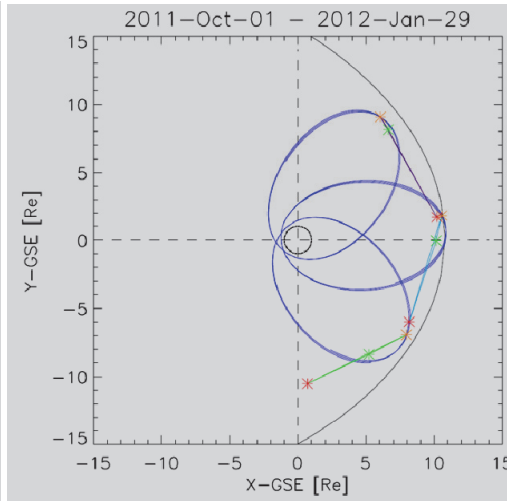
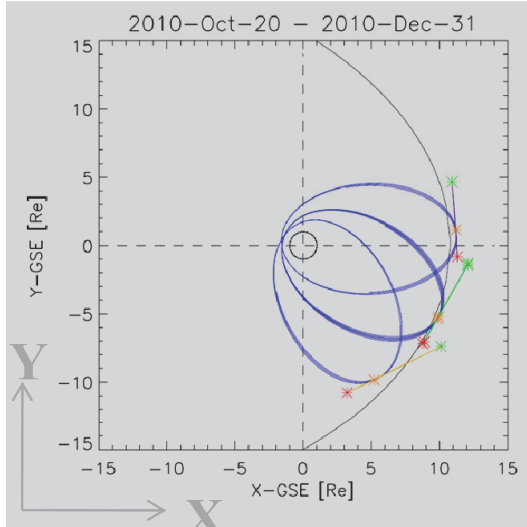
- Time Frame as WD-60d to WD+60d
 - Center Epoch (WD) 30 Nov 2011 21:00 UTC
 - 01 Oct 2011 - 29 Jan 2012
- Orbit parameters
 - Apogees P3,4,5 around $11.7 \pm 0.1R_E$
 - Separations at perigee P3 to P4,P5 : 1000 km
(was -700 km in Day3)
 - Longitude of apogee passes
 - P3,P4 at -130 deg and P5 10 deg further west
 - Inclination offsets
 - P3,P4 1deg, P3 to P5 4 deg



THEMIS P 3, 4, 5



DAY SIDE FORMATIONS



Day3 **DAY 3**

Day4 **DAY 4**

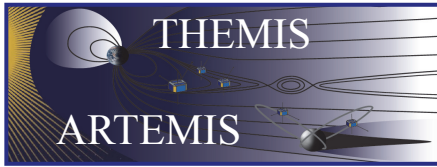
Day3	P34	P35	P45
<dx>	1400	2000	650
<dy>	2500	3600	1100
<dz>	1600	1109	500

$dy > dz$

Day4	P34	P35	P45
<dx>	±500	± 2000	±2000
<dy>	1500	4000	5000
<dz>	1700	-7500	-5600

$dy < dz$

P3 P4 P5
dx,dy,dz *10



THEMIS P 3, 4, 5

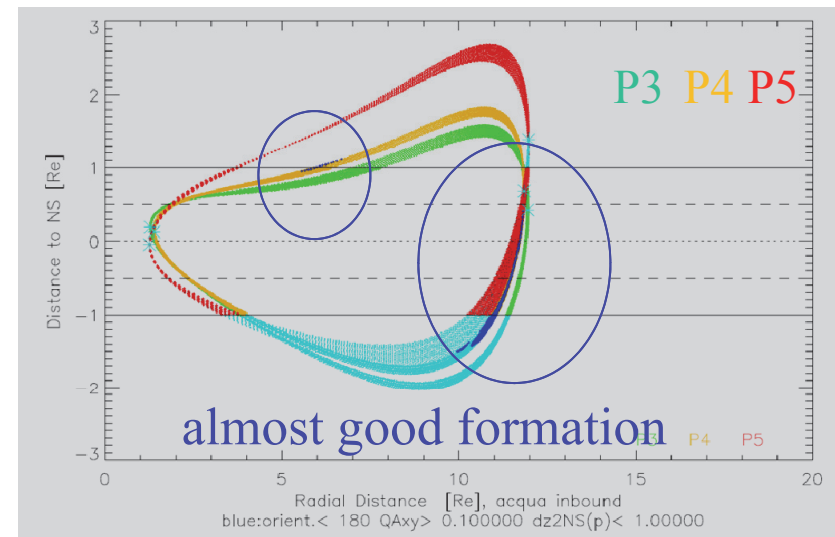


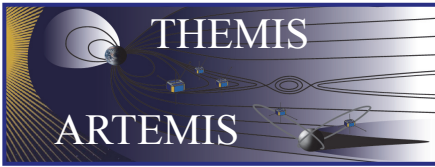
Upcoming Tail Season 5

- WD 15 Jun 2012 09:30 UT
- 16 Apr 2012 -14 Aug 2012
- Need to set up P3 for *MMS*
- Orbit parameters
 - P3-perigee *1.3 to 1.15 Re*
 - $drp(p3,45)$ - *650 to 100 km*
 - Longitude of apogee passes near -130 deg to catch NS
 - $dInc(P3,45)=1;4deg$

WORK IN PROGRESS

Dist. To NS vs. Radial Dist.

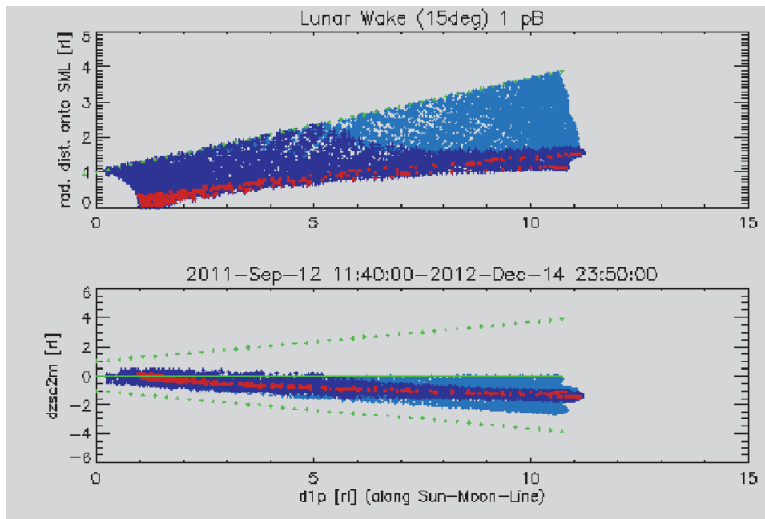




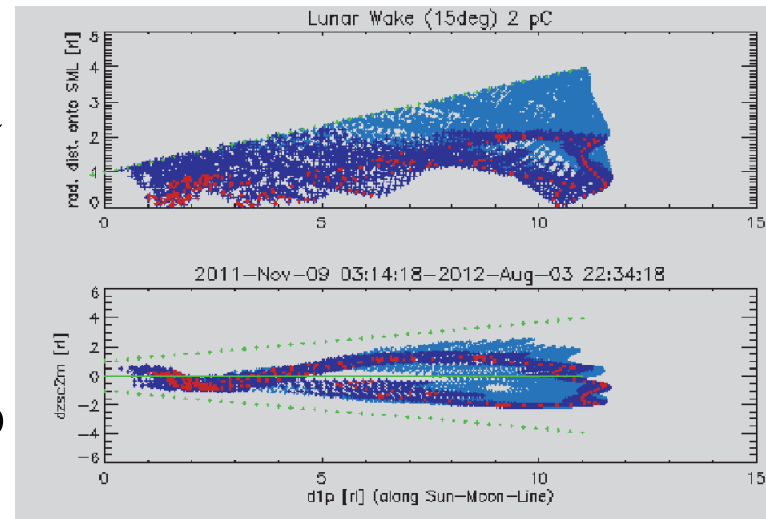
ARTEMIS P 1, 2



Lunar Wakes During Lunar Phase Radial Distance (a) and dZ (b) to Sun-Moon Line vs. Dist. Along Sun-Moon Line [r]

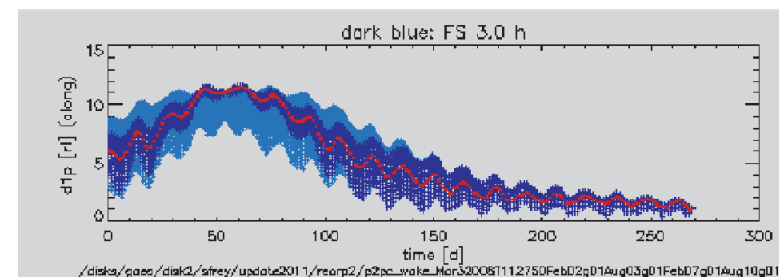
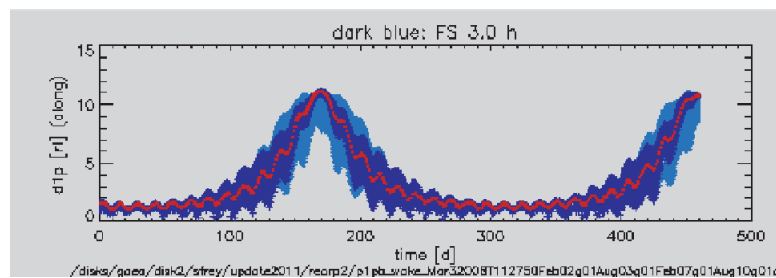


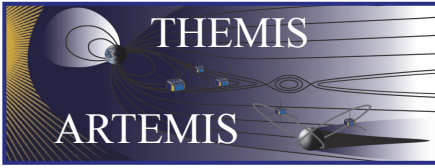
a



b

Dist. Along Sun-Moon line [r] vs. Time Since 2011/250 [d]





ARTEMIS: P1, 2: Periapsis



Periapsis Altitude [km]

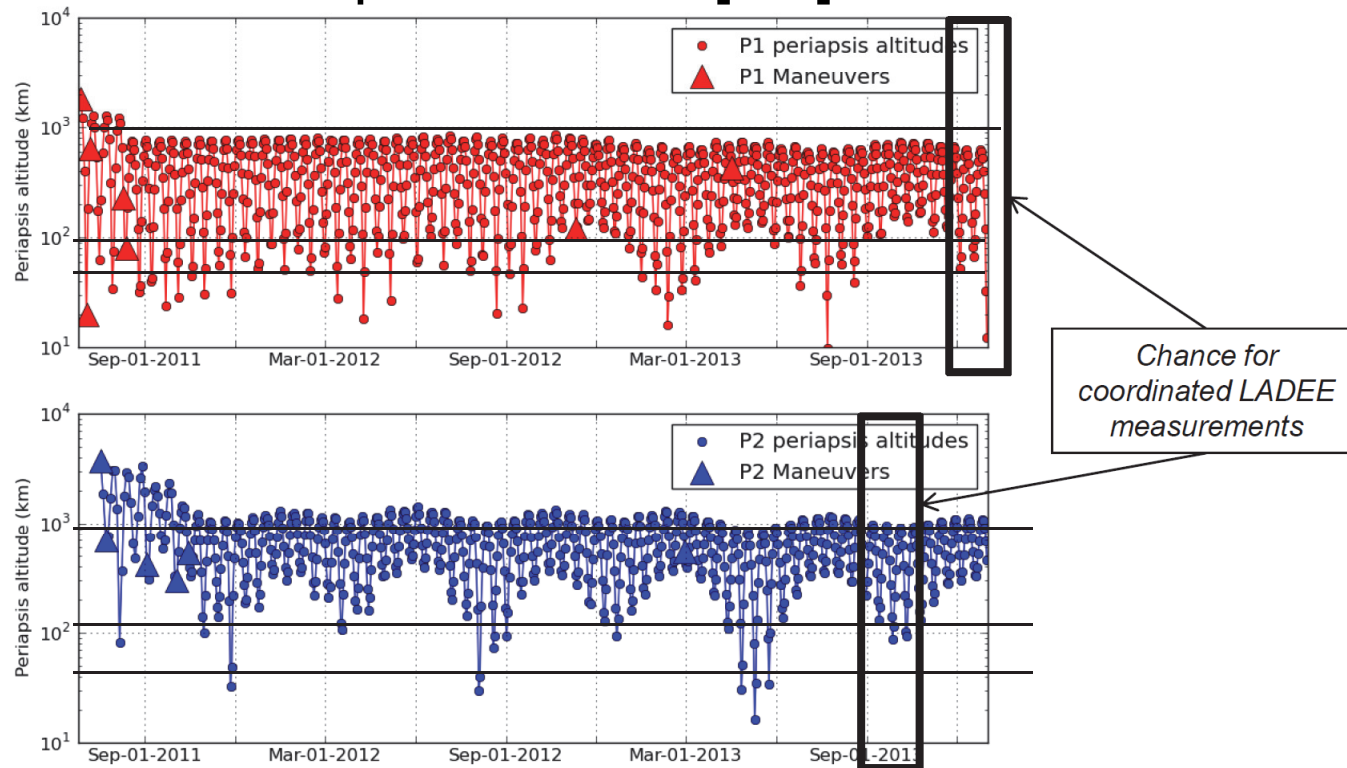
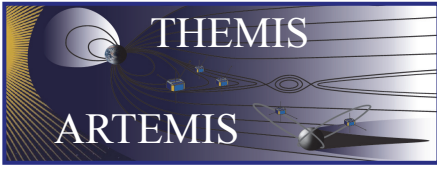
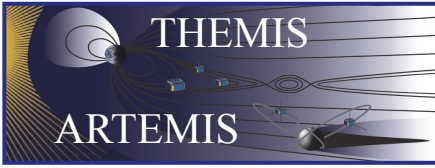


Figure from Broschart et al,
ARTEMIS Lunar Orbits through 2013
2011 Astrodynamics Specialists Conference



BACK-UPS





Day 3 WD: Nov 01 2010 18:30 UTC



RAP=RAAN+APER: Right Asc. of Perigee

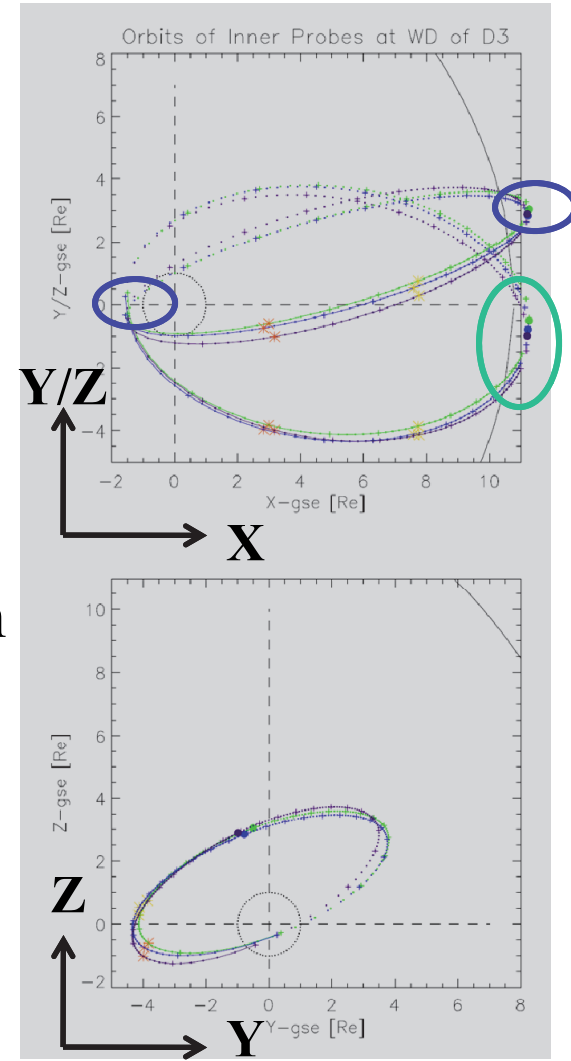
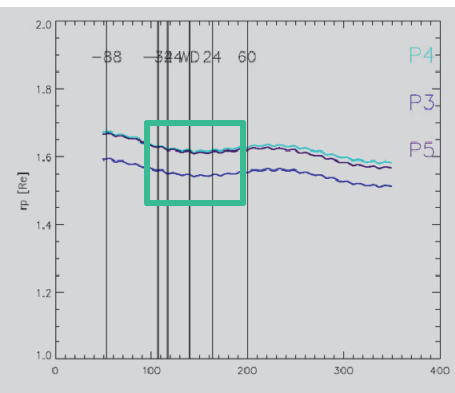
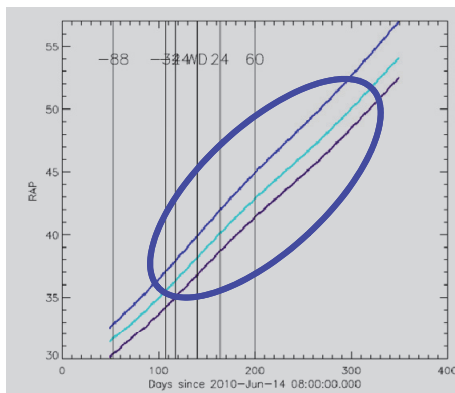
WD	Inc	RAP	APER	ra	rp	Lon
	deg	deg	deg	Re	Re	deg
P3P	2.0	40	197	11.7	1.547	-99
P4E	2.2	38	183	11.6	1.619	-103
P5A	7.2	37	185	11.6	1.616	-102

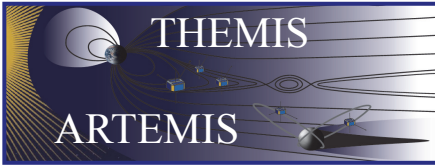


Differential Precession
Within 4 deg



Perigee separation
P4,P5 to P3: -650 km





Tail 4 WD: May 15 2011 09:40 UTC



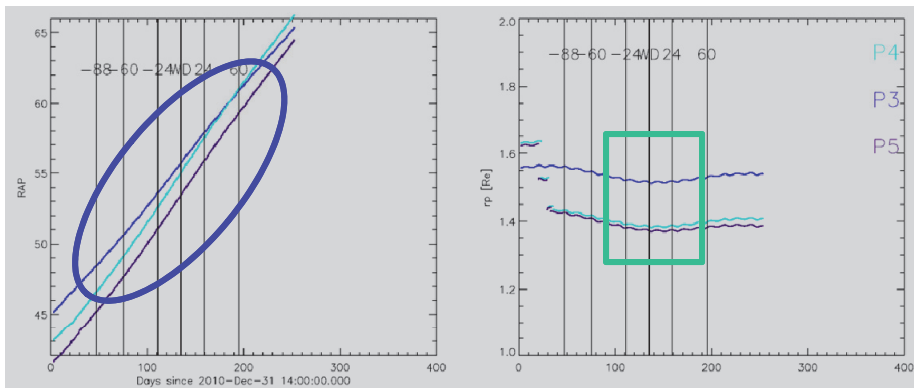
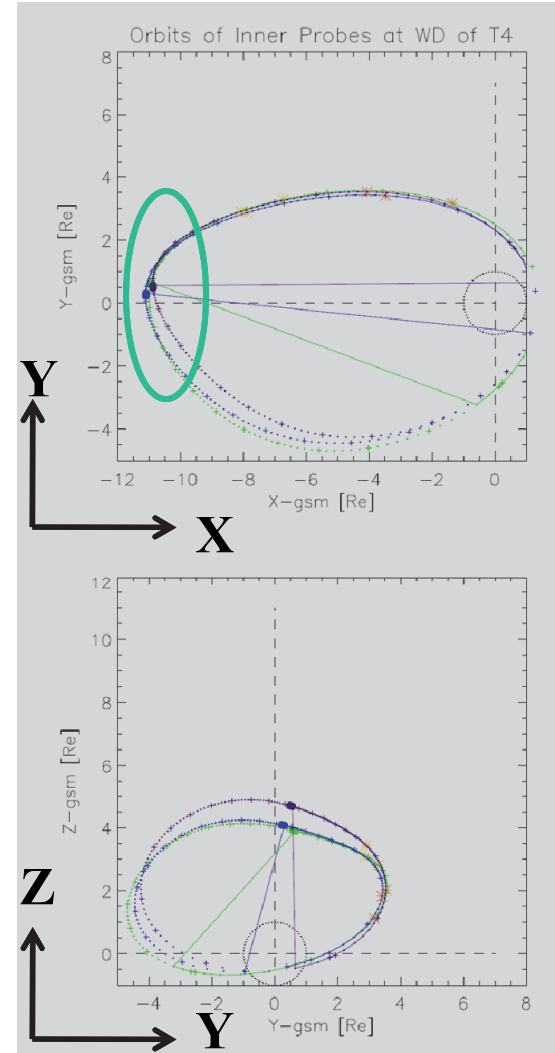
RAP=RAAN+APER: Right Asc. of Perigee

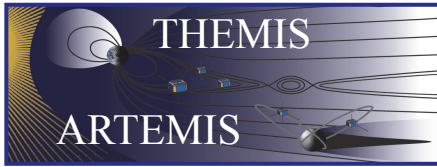
WD	Inc	RAP	APER	ra	rp	Lon
	deg	deg	deg	Re	Re	deg
P3D	1.3	56	306	11.7	1.541	-152
P4E	1.6	55	323	11.8	1.384	-142
P5A	6.9	53	222	11.9	1.372	-137



Differential Precession
Within 3 deg

Perigee separation
P3 to P4,P5:1000km





Day 4 WD: Nov 30 2011 21:00 UTC



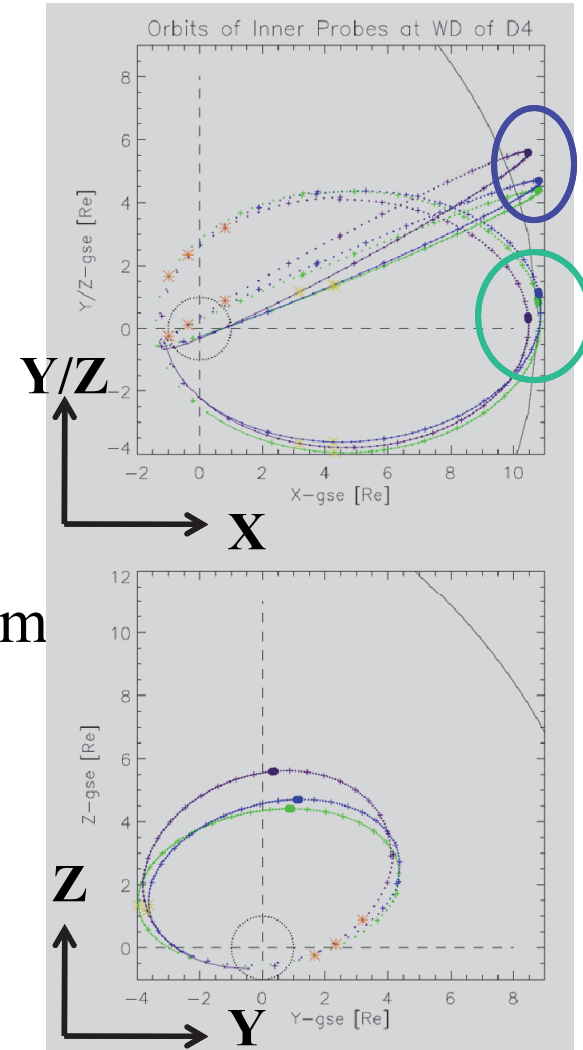
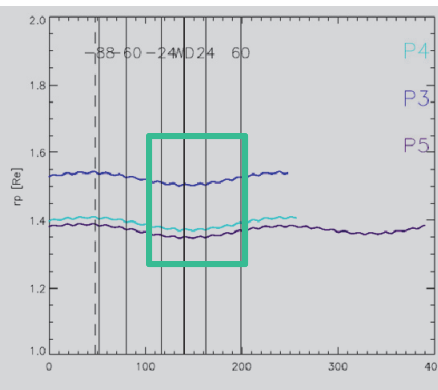
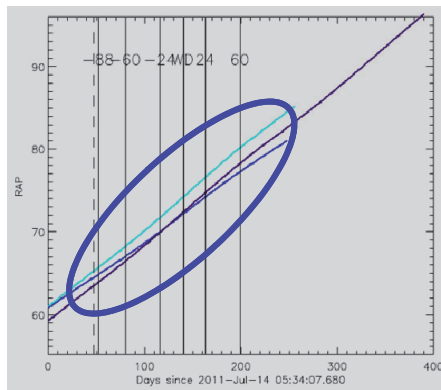
RAP=RAAN + APER: Right Asc. of Perigee

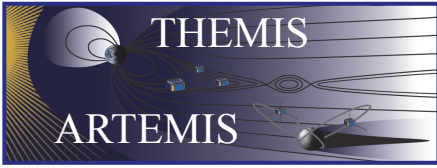
WD	Inc	RAP	APER	ra	rp	Lon
	deg	deg	deg	Re	Re	deg
P3D	3.6	72	3	11.7	1.506	-131
P4E	2.7	74	343	11.8	1.373	-131
P5A	6.1	72	286	11.9	1.351	-139



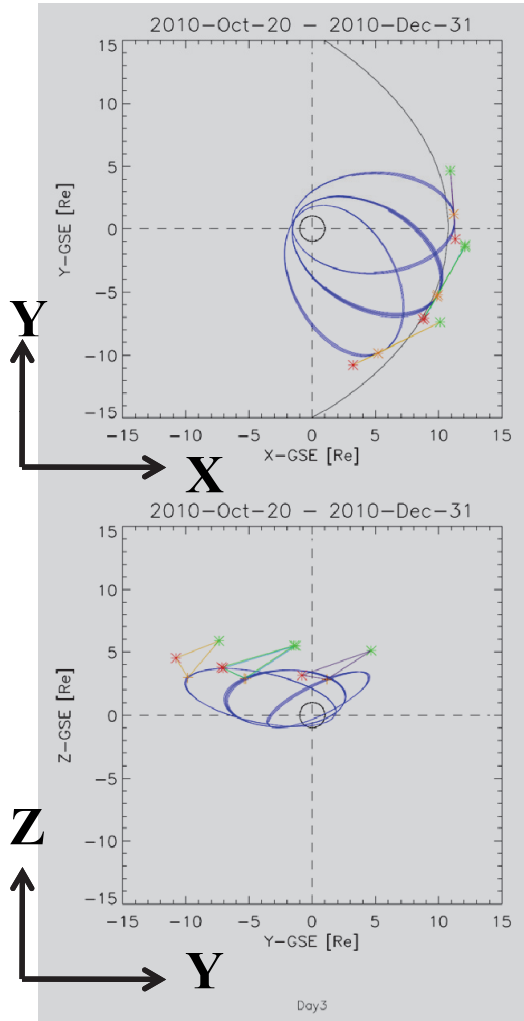
Differential Precession
Within 2 deg

Perigee separation
P3 to P4,5: + 950 km

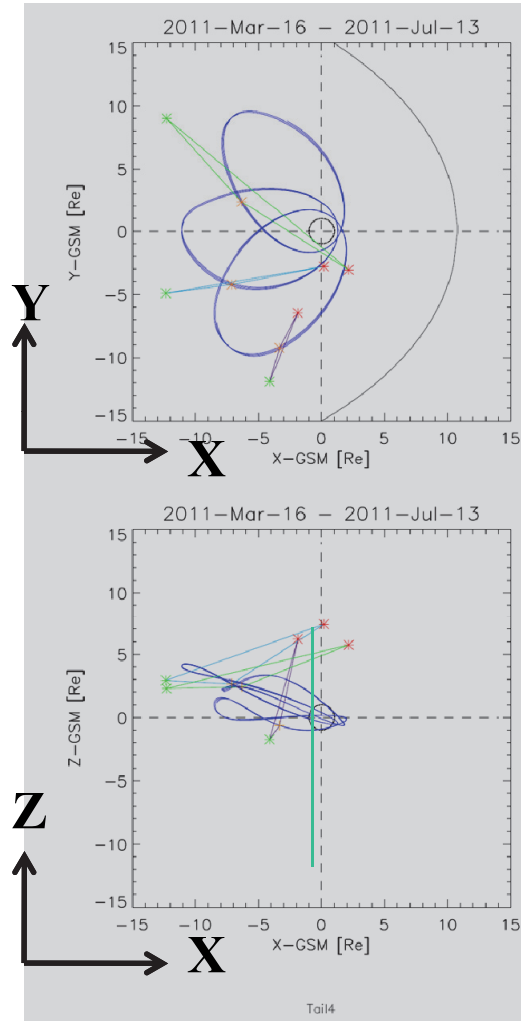




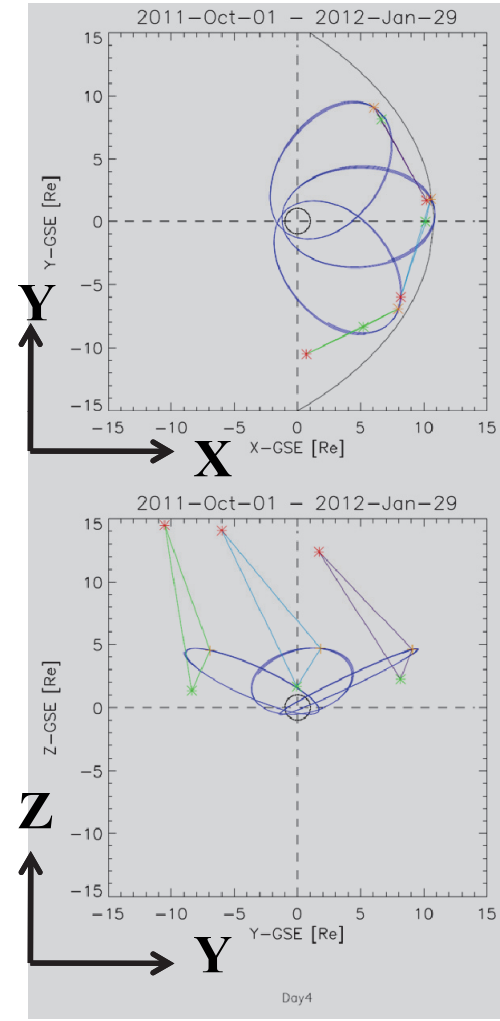
CONJUNCTIONS



DAY 3



TAIL 4



DAY 4