Orbit Design Updates for Upcoming Seasons

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SSL UCB
Overview

THEMIS P3,4,5
• Design Driver
• Dayside 4
• Tail Season 5

ARTEMIS P1,2 in Lunar Phase
• Lunar Wakes
• Periapsis Passes
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)
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 +/- 0.1Re
  - 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

<table>
<thead>
<tr>
<th>Day</th>
<th>P34</th>
<th>P35</th>
<th>P45</th>
</tr>
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\[ dy > dz \]

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<th>P34</th>
<th>P35</th>
<th>P45</th>
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\[ dy < dz \]

P3 P4 P5

dx,dy,dz *10
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)=1.4 deg
Lunar Wakes During Lunar Phase
Radial Distance (a) and dZ (b) to Sun–Moon Line
vs. Dist. Along Sun-Moon Line [rl]

Dist. Along Sun-Moon line [rl] vs. Time Since 2011/250 [d]
Periapsis Altitude [km]

Figure from Broschart et al, ARTEMIS Lunar Orbits through 2013
2011 Astrodynamics Specialists Conference
Day 3 WD: Nov 01 2010 18:30 UTC

**RAP=RAAN+APER: Right Asc. of Perigee**

<table>
<thead>
<tr>
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<th>Inc</th>
<th>RAP</th>
<th>APER</th>
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- **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**

<table>
<thead>
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<th>APER</th>
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- **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**

<table>
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<th>APER</th>
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**Differential Precession**

Within 2 deg

**Perigee separation**

P3 to P4,5: + 950 km
CONJUNCTIONS

DAY 3

TAIL 4

DAY 4

THEMIS/ARTEMIS SWG

Annapolis, MD, Sep 14-16, 2011