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Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Orbital Analysis

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Orbit Insertion Requirements*

- **Altitude**
  - **High enough to enable a 2 year mission lifetime without propulsion**
  - **High enough to provide large swath path for GUVI**
  - **High enough to allow solar measurements not attenuated by atmosphere by SEE**
  - **Low enough to allow limb viewing with reasonable vertical resolution for TIDI and SABER**
  - **Low enough to minimize off-axis scattering from bright limb for TIDI**

* Per System Requirements Document, Jan 1997

Orbit Insertion Requirements*

- **Inclination**
  - **High enough to allow global coverage (all latitudes) for GUVI, SABER, and TIDI**
  - **High enough to allow GUVI to view aurora zone**
  - **Low enough to allow a fast local time drift rate to allow 24 hour local time measurement within a season**
  - **Integral number of precessions to allow a repeating local time one year later**

* Per System Requirements Document, Jan 1997

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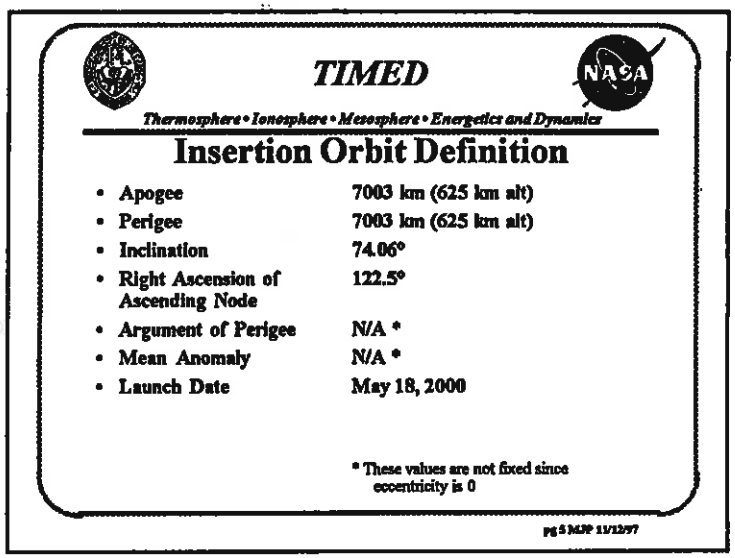
Orbit Insertion Mission Requirements*

• **Apogee Radius**	**7003 ± 25 km (625 ± 25 km alt) ****
• **Perigee Radius**	**7003 ± 25 km (625 ± 25 km alt) ****
• **Inclination**	**74.1 ± 0.1° ****
• **Nodal Regression Rate**	**720 ± 10 °/year**
• **Mission Lifetime**	**2 years**
• **Launch Constraints**	**Orbit shall provide for observation of the Summer Mesopause for SABER**

* Per System Requirements Document, Jan 1997

** Modified per GEC-97-05



Perigee must be lower than apogee, but these are the requirements

The right ascension of ascending node is dependent on launch date. This value will change with moving launch date.

Since the orbit is nearly circular, the argument of perigee and mean anomaly need not be defined. The launch vehicle provider will give these upon completion of the trajectory analysis.

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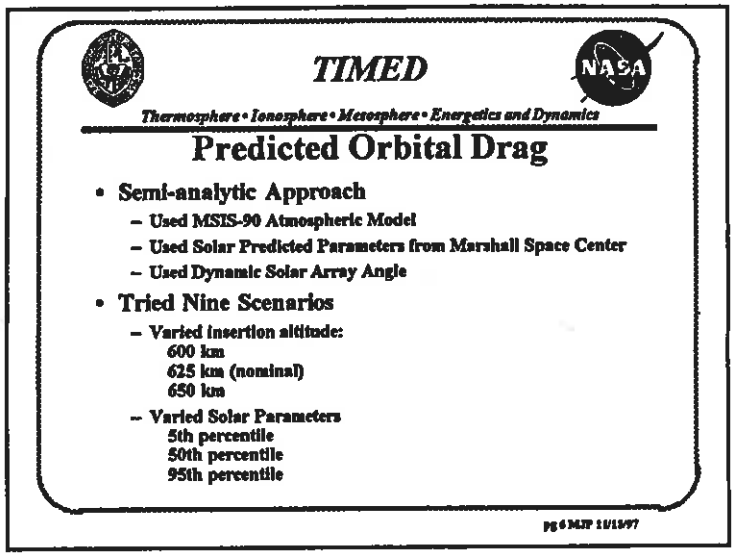
Insertion Orbit Definition

• Apogee	7003 km (625 km alt)
• Perigee	7003 km (625 km alt)
• Inclination	74.06°
• Right Ascension of Ascending Node	122.5°
• Argument of Perigee	N/A *
• Mean Anomaly	N/A *
• Launch Date	May 18, 2000

* These values are not fixed since eccentricity is 0



The semi-analytic approach averages the orbital effects over 1 orbit and applies the effects to determine the next orbit parameters

The Solar parameters from Marshall include the Solar Flux, F10.7, number and Magnetic Index, Ap. Each parameter has three sets of values, a 5 percentile, 50 percentile, and 95 percentile.

The orbit was run with 9 scenarios. Each altitude was run with the three different solar parameters. The F10.7 and Ap percentile was varied the same, i.e., when selecting the 5 percentile F10.7 number, the 5 percentile Ap number was selected.

Predicted Orbital Drag

- **Semi-analytic Approach**
  - **Used MSIS-90 Atmospheric Model**
  - **Used Solar Predicted Parameters from Marshall Space Center**
  - **Used Dynamic Solar Array Angle**
- **Tried Nine Scenarios**
  - **Varied insertion altitude:**
    600 km
    625 km (nominal)
    650 km
  - **Varied Solar Parameters**
    5th percentile
    50th percentile
    95th percentile

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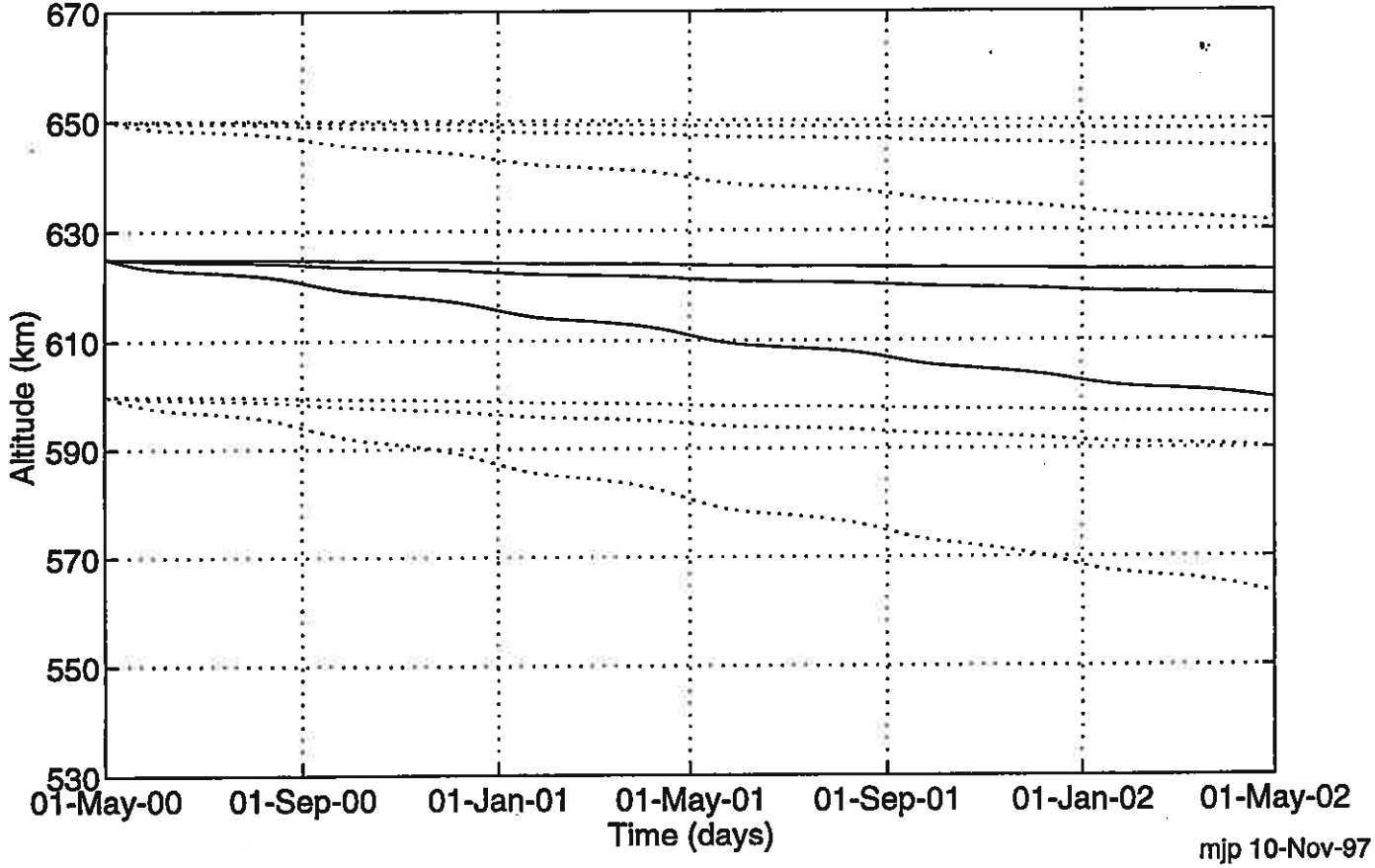
Orbital Drag



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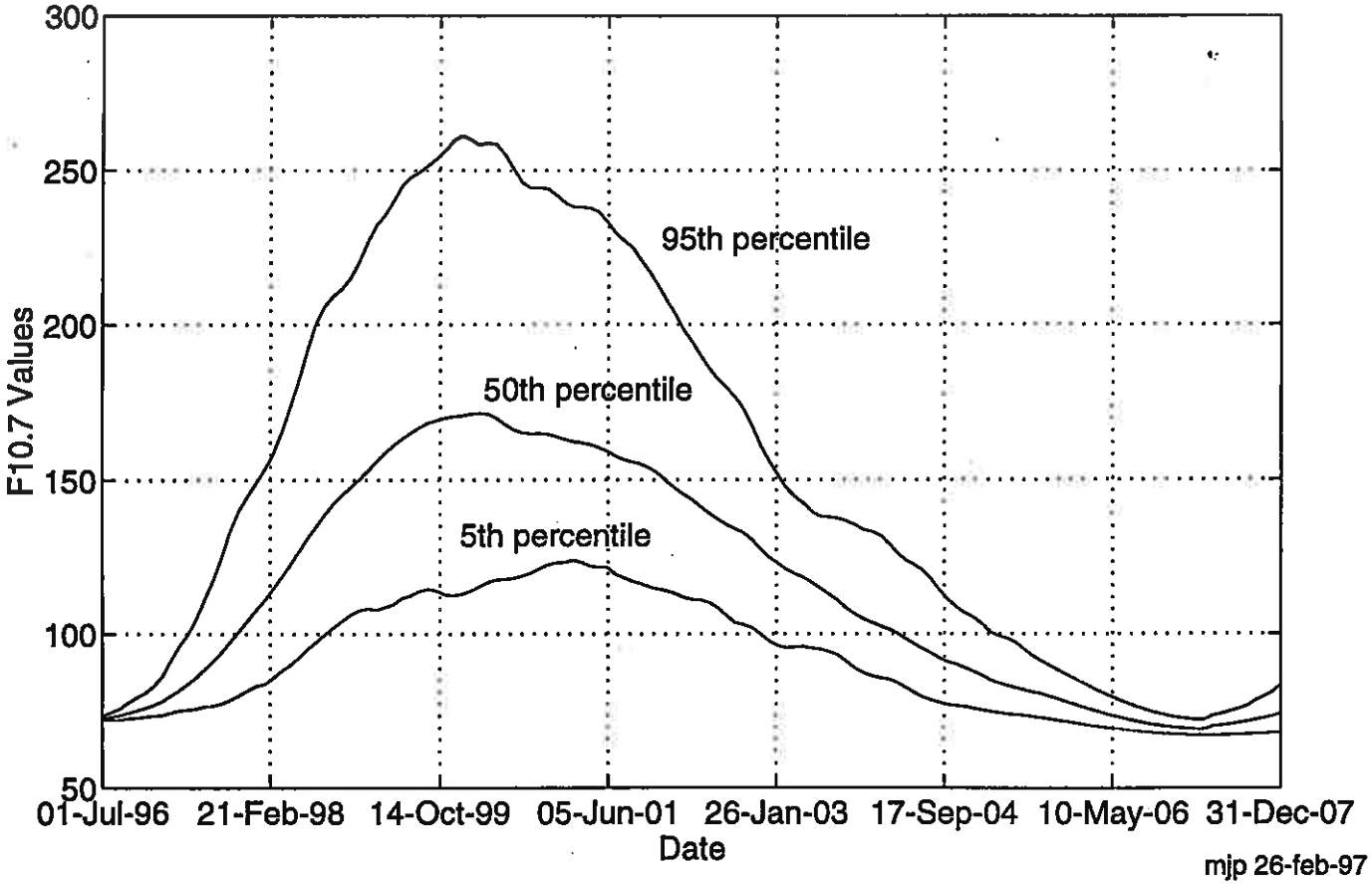
F10.7 and Ap



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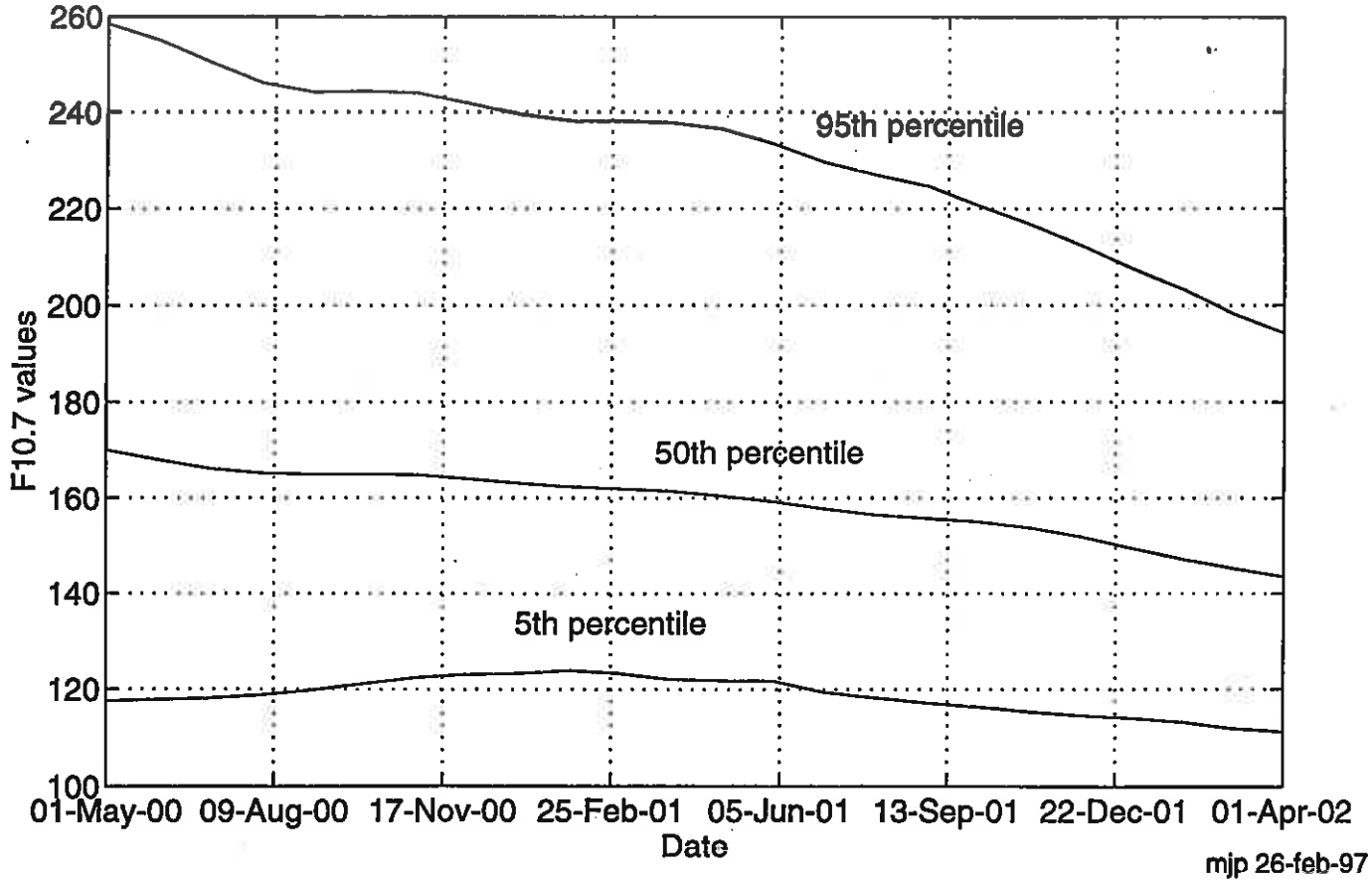
F10.7 and Ap



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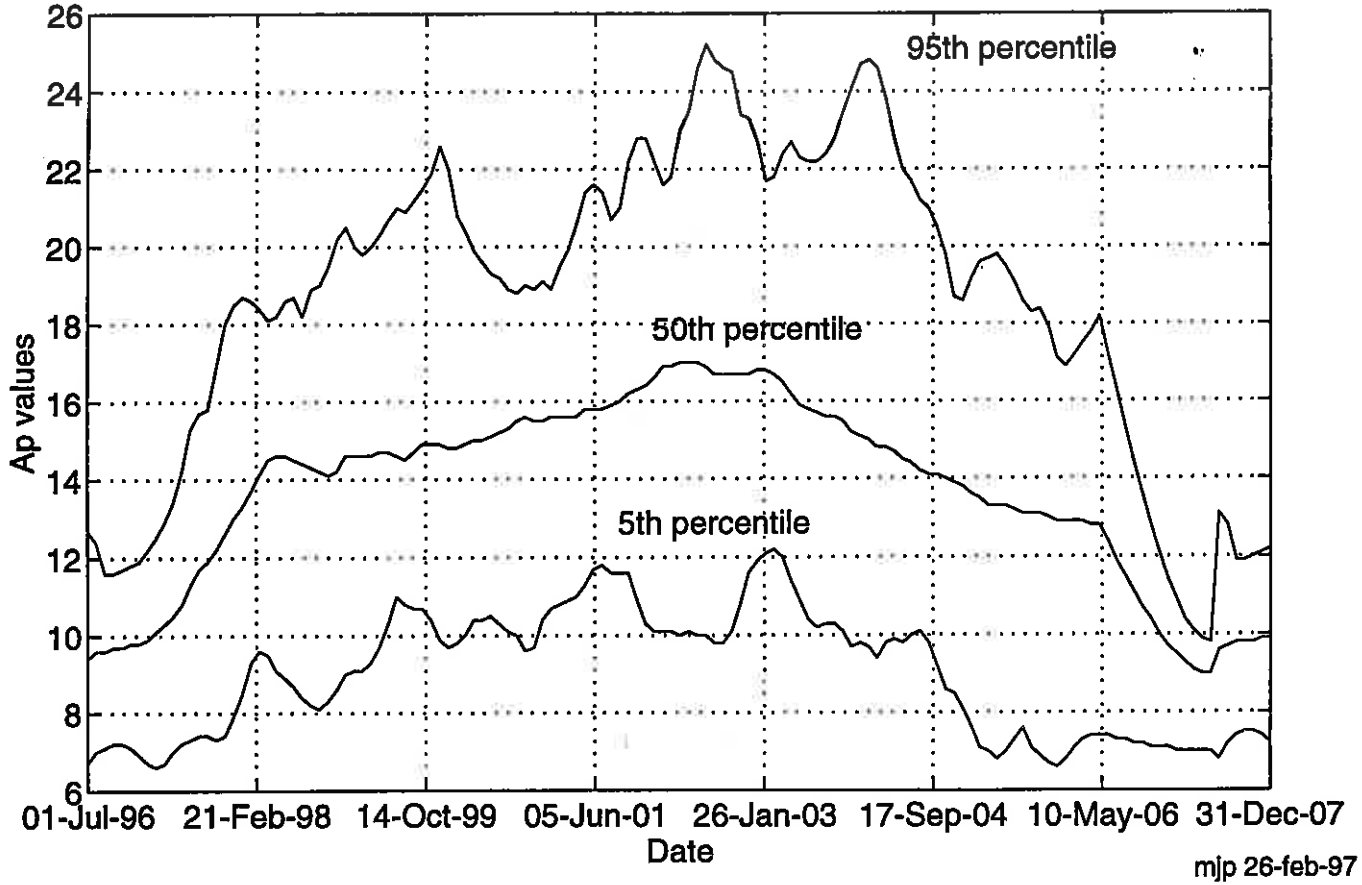
F10.7 and Ap



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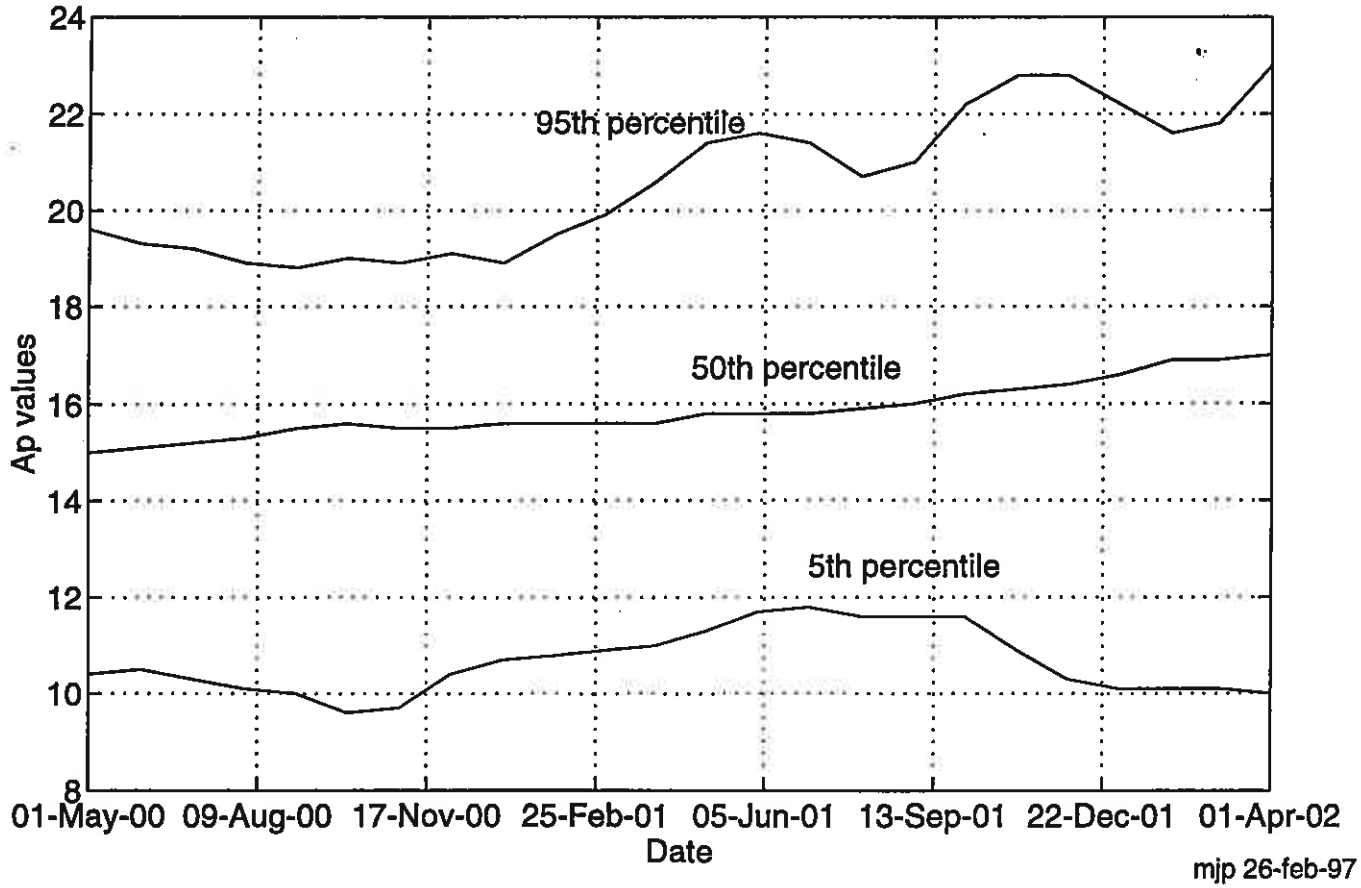
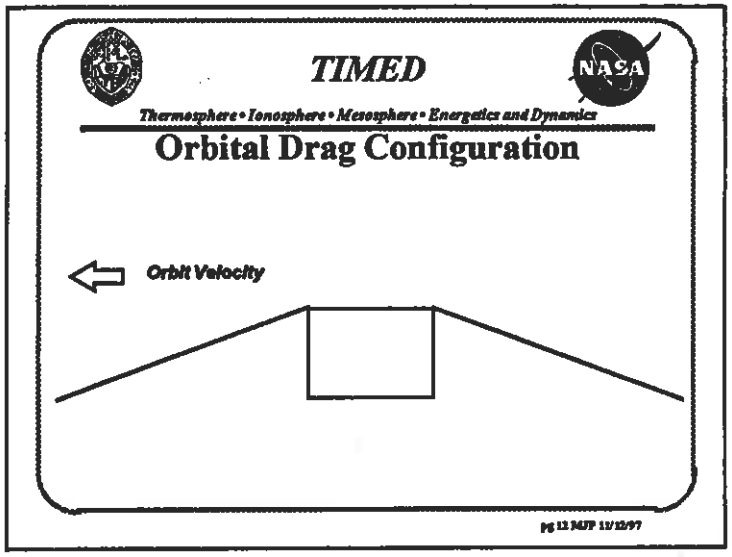
F10.7 and Ap





This depicts the spacecraft's orientation relative to orbit velocity. Drag force is then anti-velocity direction.

The picture indicates this orientation is minimum drag orientation. The least amount of projected area is presented.

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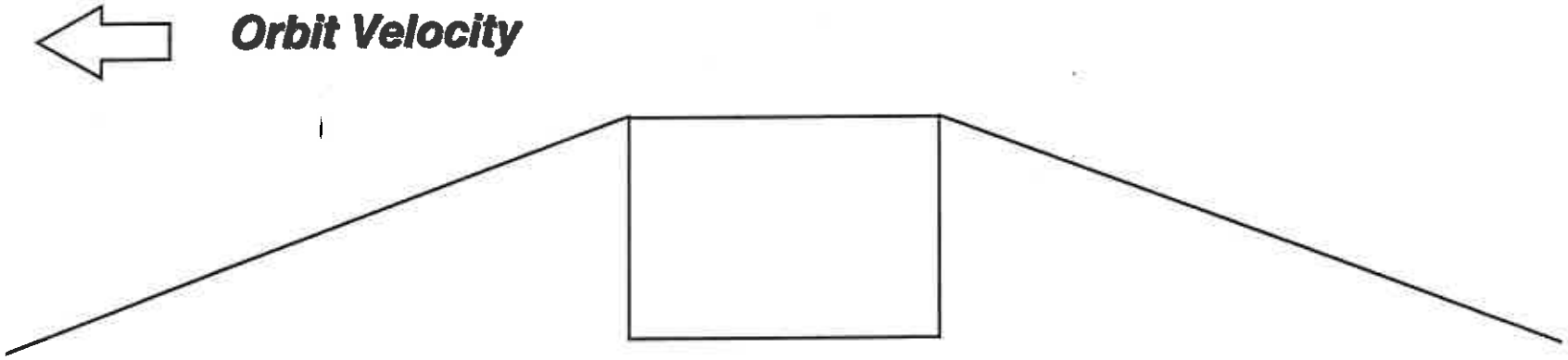
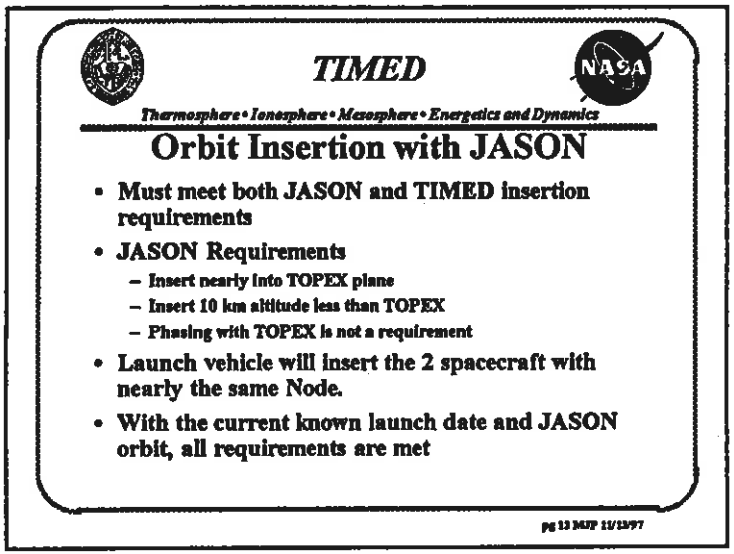
Orbital Drag Configuration

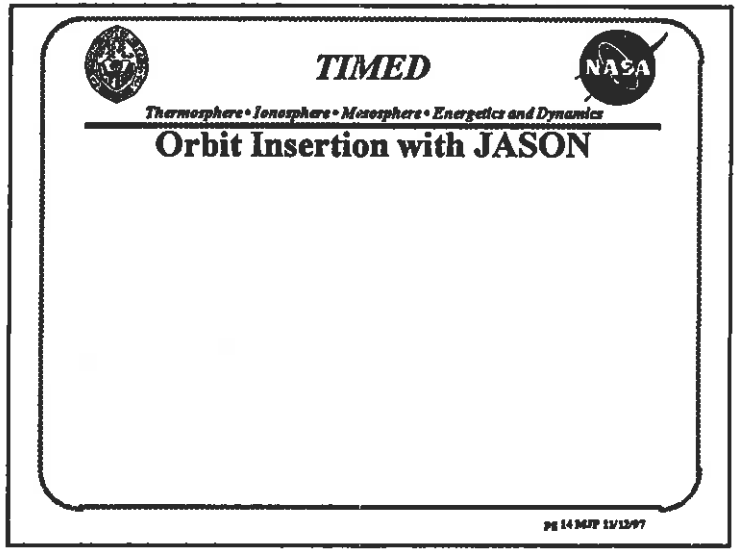




As slide the launch date later, the TIMED node curve will slide up, and the beta curve will slide left, very slowly.

Orbit Insertion with JASON

- **Must meet both JASON and TIMED insertion requirements**
- **JASON Requirements**
  - **Insert nearly into TOPEX plane**
  - **Insert 10 km altitude less than TOPEX**
  - **Phasing with TOPEX is not a requirement**
- **Launch vehicle will insert the 2 spacecraft with nearly the same Node.**
- **With the current known launch date and JASON orbit, all requirements are met**



A Positive beta angle will cause the cold side or SABER side of the spacecraft to view the south pole.

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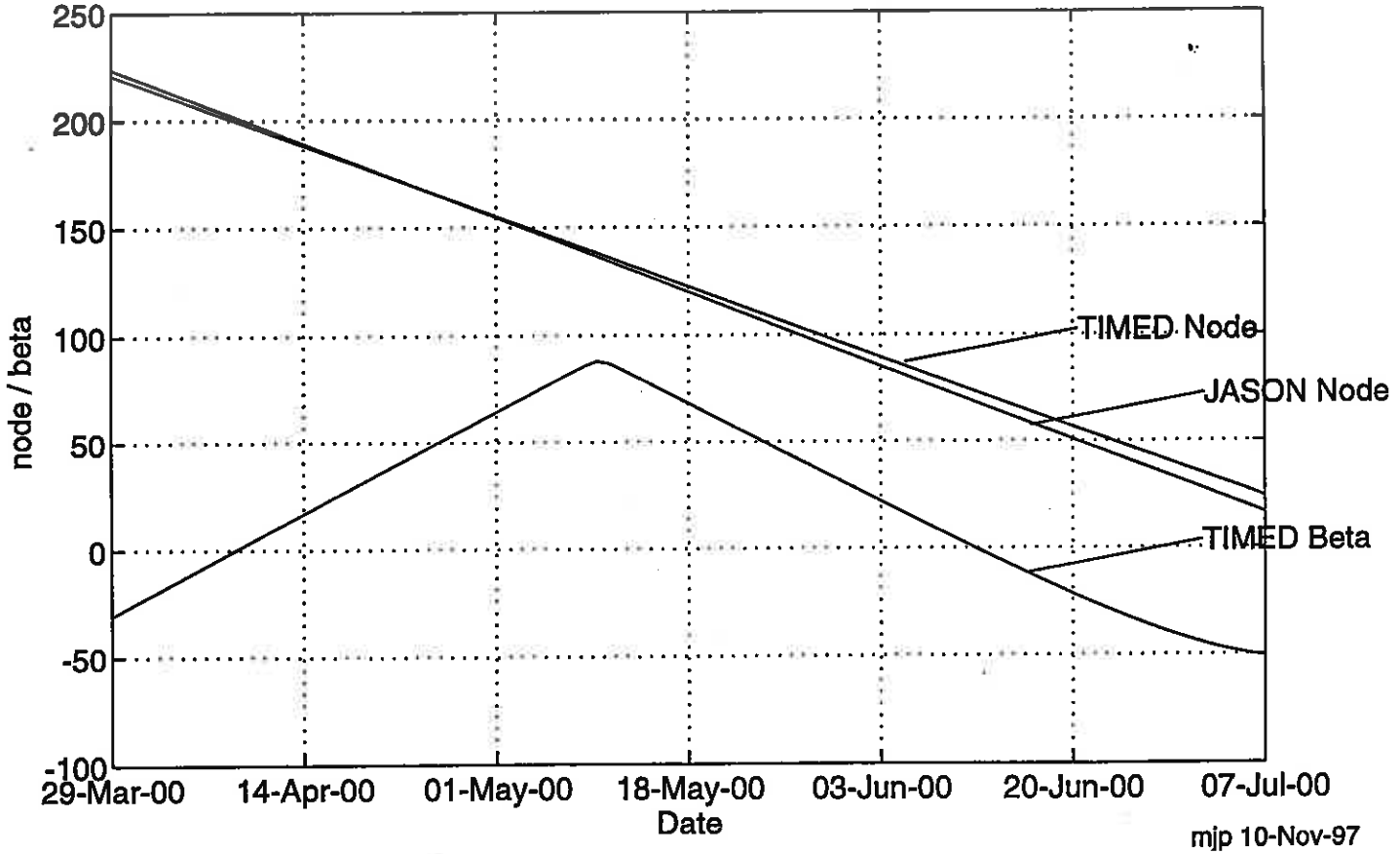
Orbit Insertion with JASON



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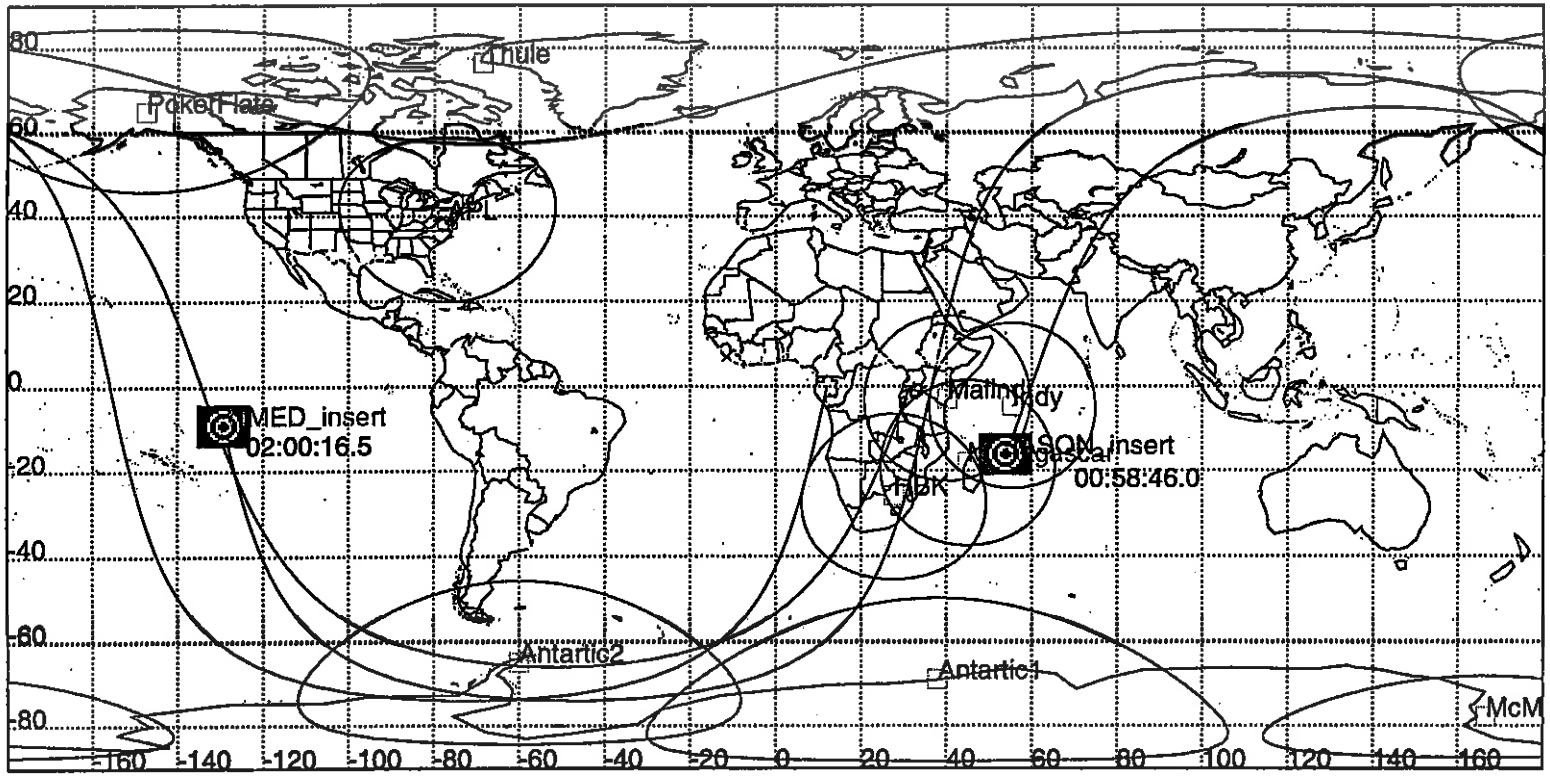
Orbit Insertion with JASON



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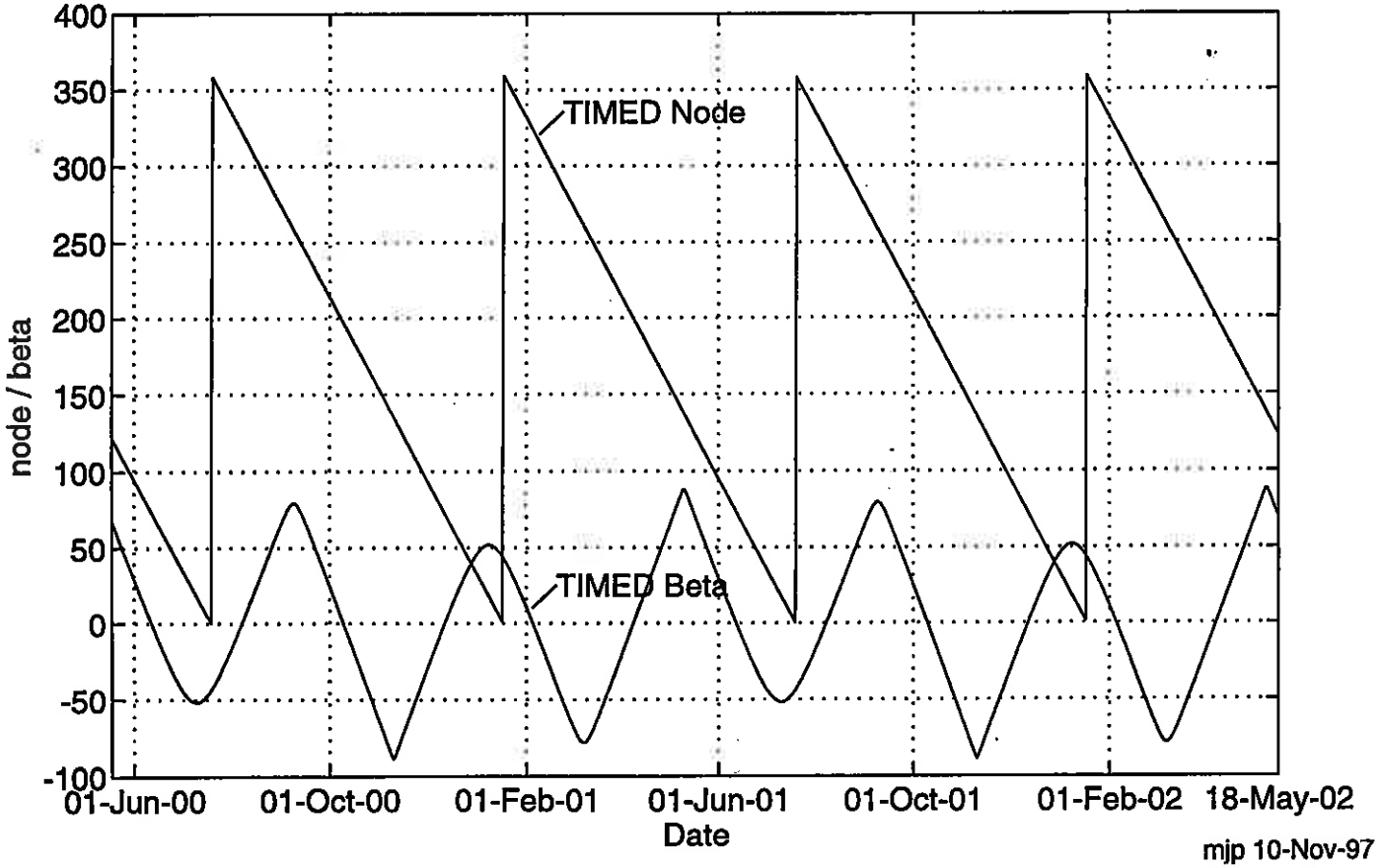
Orbit Node and Beta Angles



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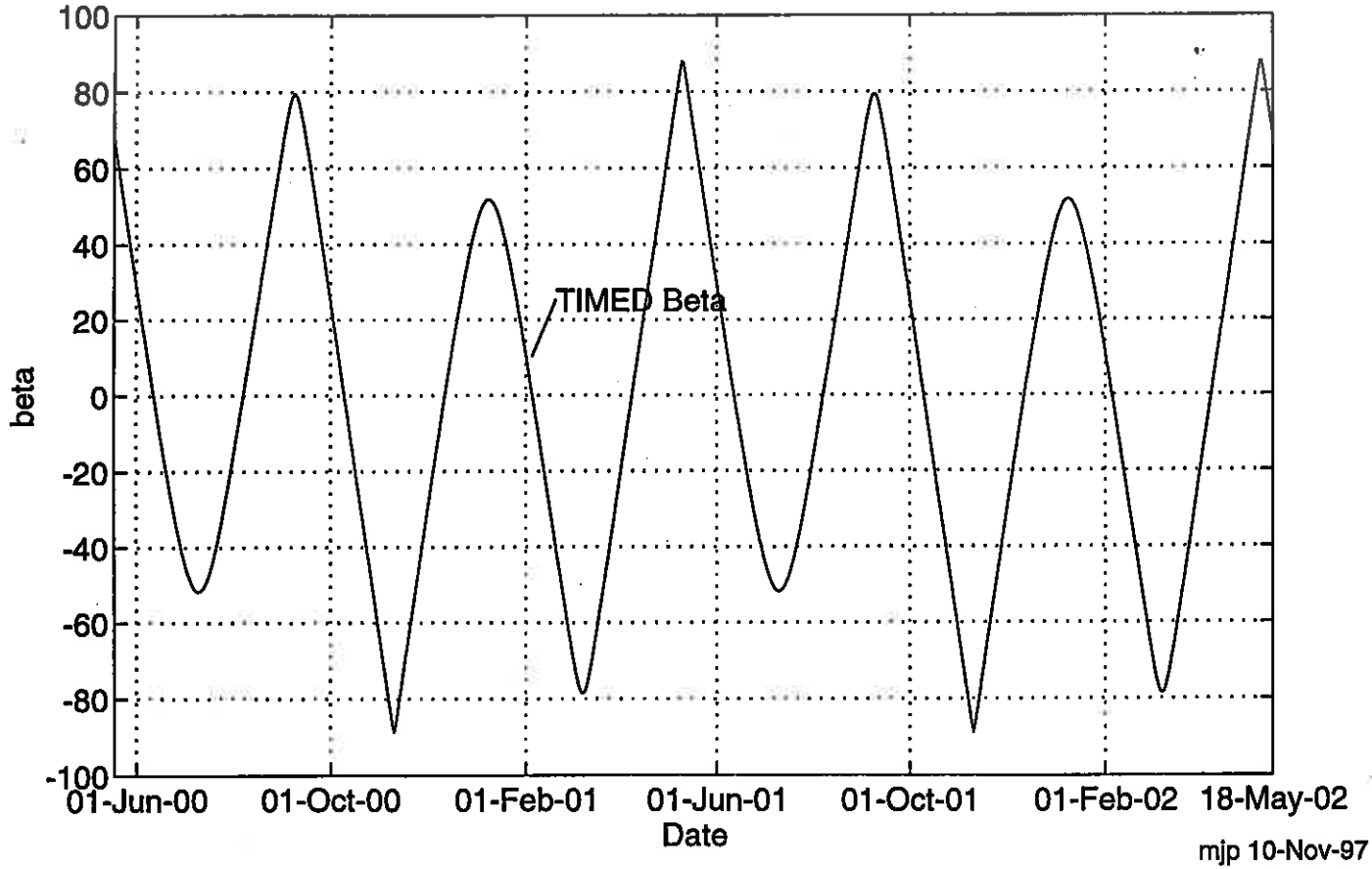
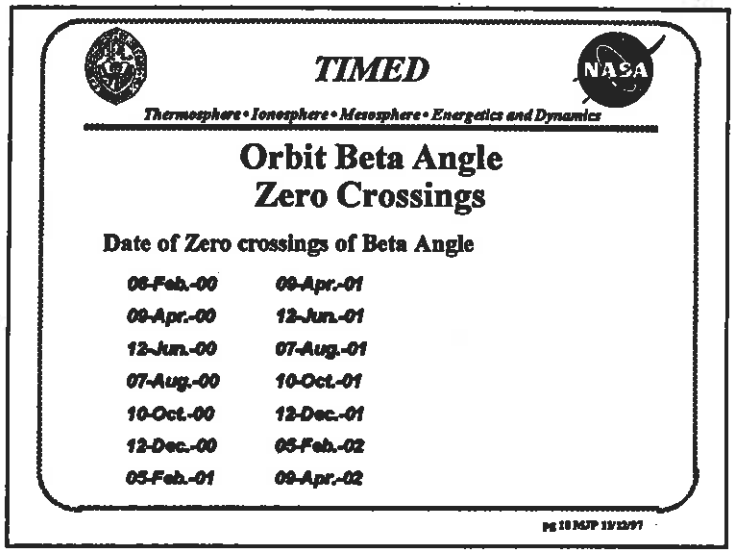
Orbit Beta Angle





The dates when the beta angle crosses zero. These are the dates when the spacecraft will need to do a yaw maneuver.

Orbit Beta Angle Zero Crossings

Date of Zero crossings of Beta Angle

06-Feb.-00	*09-Apr.-01*
09-Apr.-00	*12-Jun.-01*
12-Jun.-00	*07-Aug.-01*
07-Aug.-00	*10-Oct.-01*
10-Oct.-00	*12-Dec.-01*
12-Dec.-00	*05-Feb.-02*
05-Feb.-01	*09-Apr.-02*