Mission Design

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Science Orbit Definition

- Orbit configuration is defined by the desired time history of the spacecraft angular separation
  - Absolute spacecraft separation viewed from the Sun
  - Relative spacecraft separation from the Earth-Sun line
- Desired time history of separation defined by dwell angle and duration from Science Definition Team Report (pg. 30)
  - Leading Spacecraft
    - Drifts ahead of the Earth in its orbit
    - 20° from Earth T = 200 to 400 days
    - 45° from Earth T = 600 to 800 days
  - Lagging Spacecraft
    - Follows behind the Earth in its orbit
    - 30° from Earth T = 200 to 400 days
    - 60° from Earth T = 600 to 800 days

Launch Vehicle Requirements

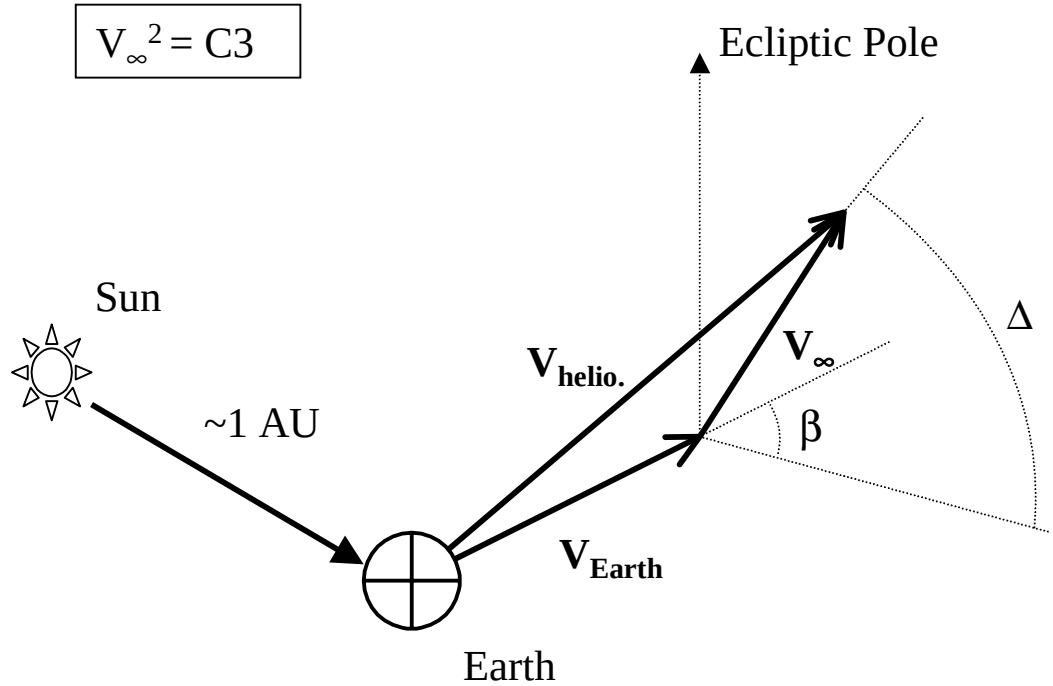
- Launch vehicle provides direct insertion into desired heliocentric orbit
  - Launch energy (C3) requirement limited by launch vehicle and insertion stage motor selection
  - Departure asymptote declination limited by launch vehicle and insertion stage motor selection
  - * No maneuvers by spacecraft to achieve or maintain orbit
- Launch opportunity window (TBD)
- Daily launch window (TBD)

Preliminary Mission Design

- Athena-II Expendable Launch Vehicle
  - 93° Launch azimuth
  - Eastern range (CCAS/KSC) launch site
  - STAR-37 upper stage
  - Preliminary ascent timeline provided by Lockheed-Martin
  - C3 = 1.0 km^2/sec^2
- Launch Dates
  - Leading - October 1, 2002
    - Smallest drift rate ⇒ minimize impact of launch delays for second spacecraft
    - Closer to equinox ⇒ minimize Sun-Probe-Earth angle for RF design
  - Lagging - December 1, 2002

Launch Parameter Definition

$V_\infty^2 = C3$



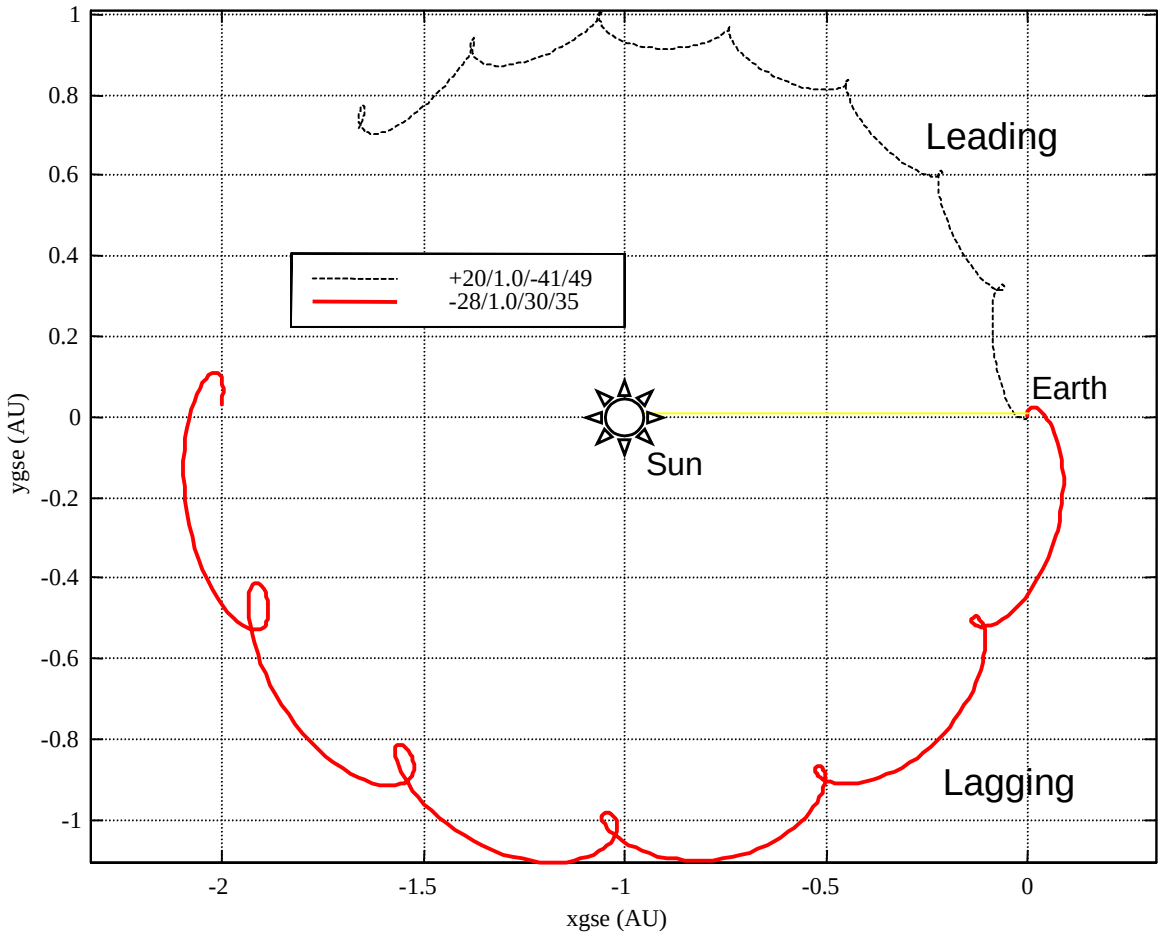
Preliminary Mission Design (cont'd)

- Leading Spacecraft
  - Design parameters
    - $C3 = 1.0\ km^2/sec^2$, $\beta = -41°$, $\Delta = 49°$
  - $C3 > C3_{min} \approx 0.3\ km^2/sec^2$
    - Reduce sensitivity to launch vehicle dispersions
    - Tailor Sun-Probe-Earth angle characteristics for RF design
  - β selected maximize dwell time at desired separation angle
  - Δ selected to tailor Sun-Probe-Earth angle characteristics for RF design
  - Departure asymptote declination, $\delta = -28°$
    - δ with respect to equator
    - Maximum achievable declination (absolute value) for Athena-II with 93° launch azimuth (maximum launch mass)
  - Mean drift rate relative to Earth-Sun line = 20° per year

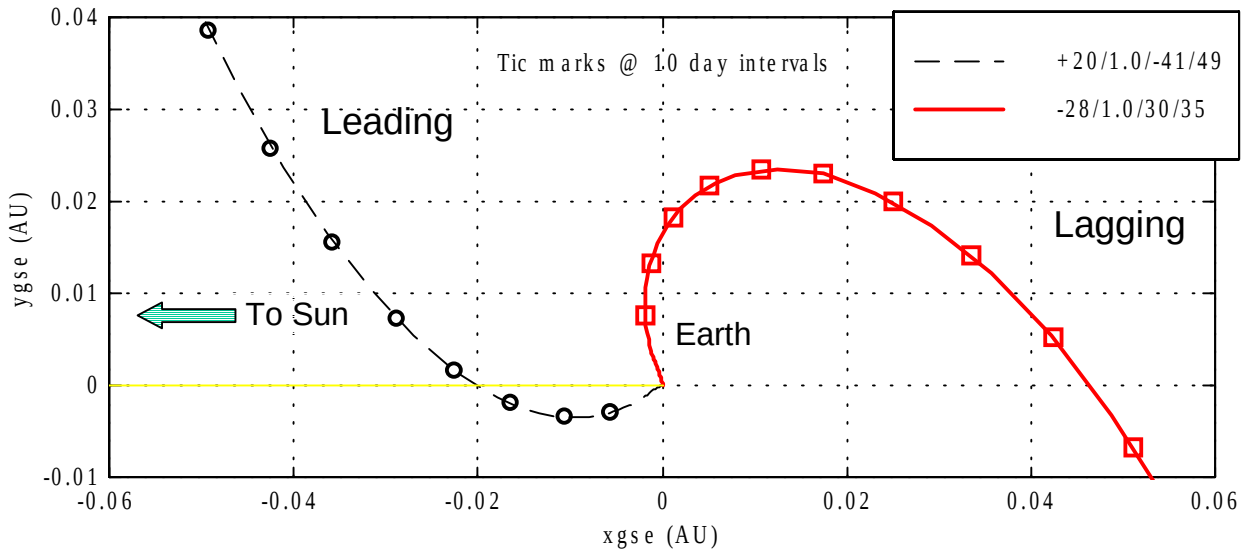
Preliminary Mission Design (cont'd)

- Lagging Spacecraft
  - Design parameters
    - $C3 = 1.0\ km^2/sec^2$, $\beta = 30°$, $\Delta = 35°$
  - $C3 > C3_{min} \approx 0.6\ km^2/sec^2$
    - Reduce sensitivity to launch vehicle dispersions
  - β, Δ
    - Launch phase definitions identical to leading
    - Impacts to dwell time/separation behavior (TBD)
  - Departure asymptote declination, $\delta = -28°$
  - Mean drift rate relative to Earth-Sun line = 28° per year

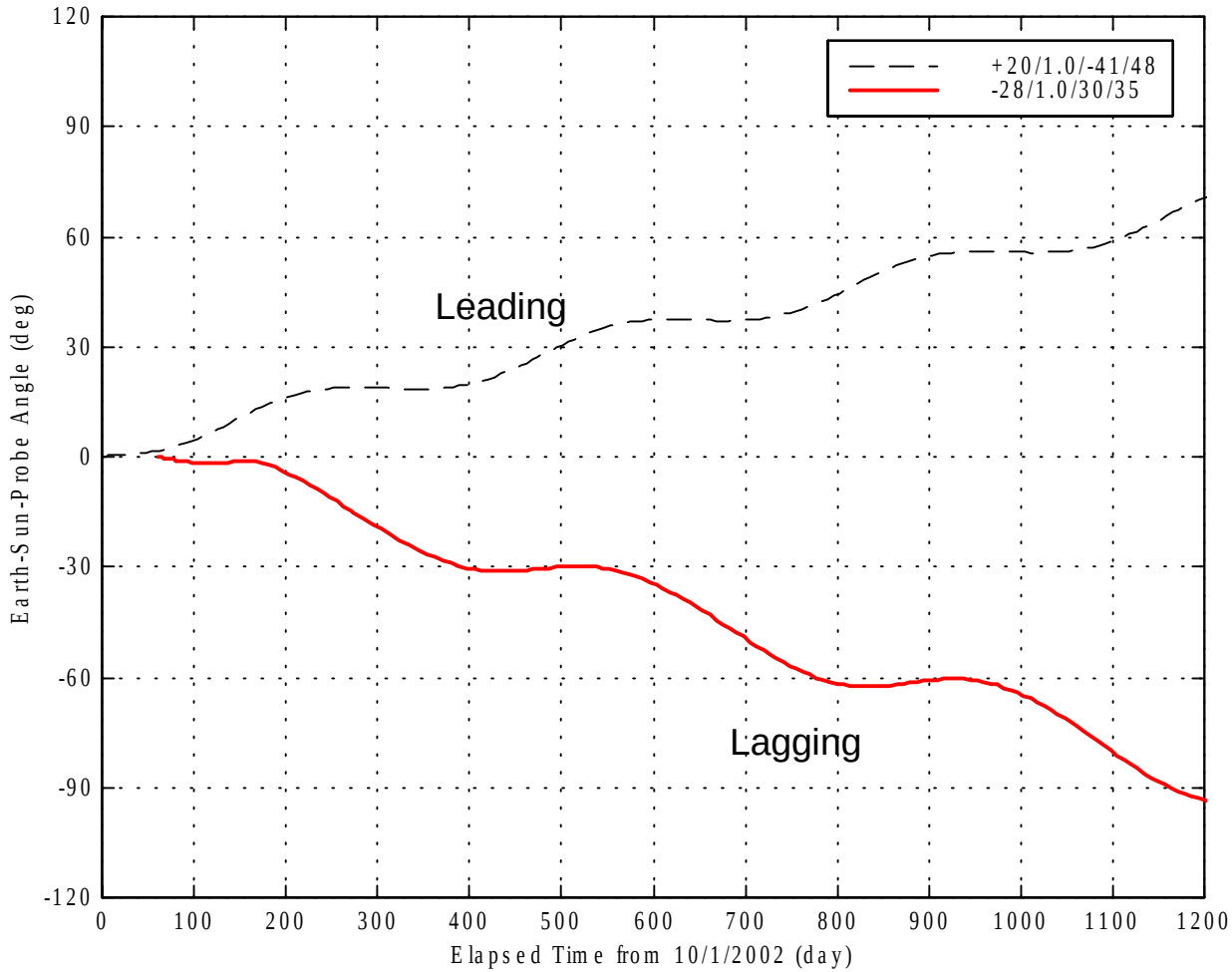
STEREO Orbit
(Geocentric Solar Ecliptic Coordinates)



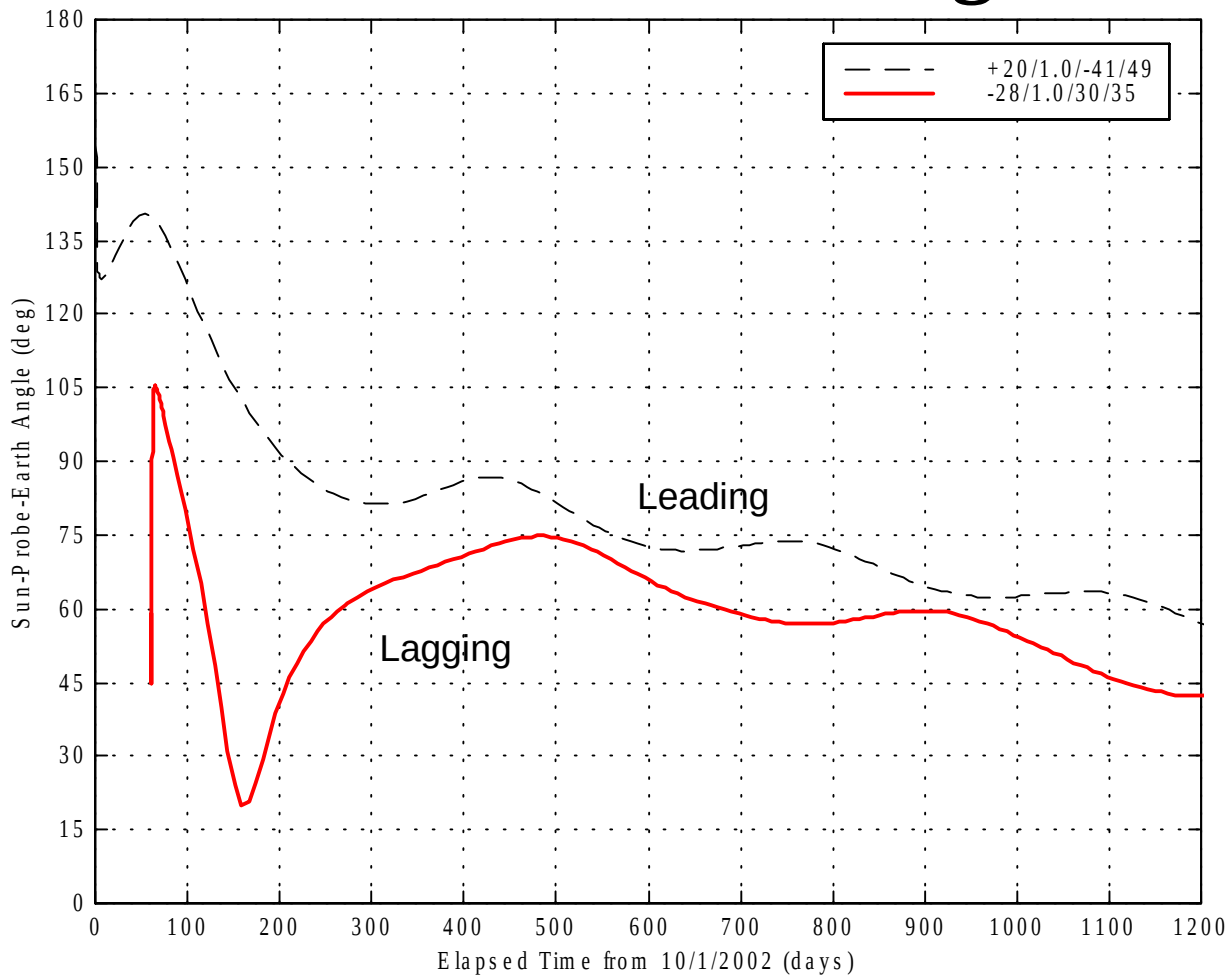
STEREO Orbit Detail
(Geocentric Solar Ecliptic Coordinates)



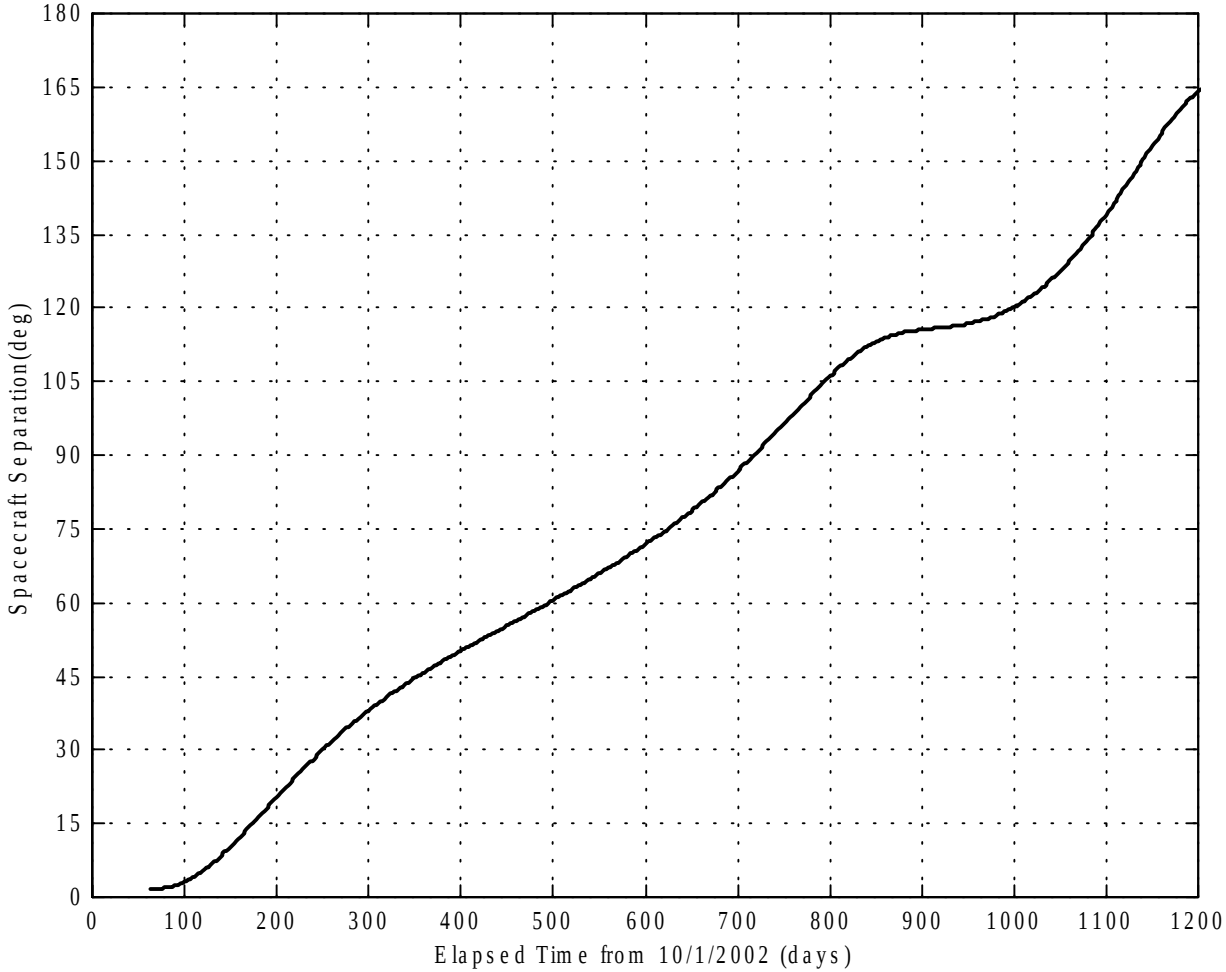
Earth-Sun-Probe Angle



Sun-Probe-Earth Angle



Spacecraft Separation (Alpha angle)



Spacecraft System

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