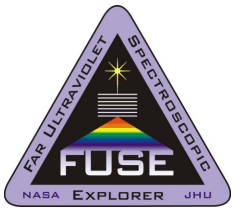

Jeff Kruk (JHU) AAS June 3, 2002

Development of FUSE "Gyroless" Operations

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FUSE Gyroless Operations

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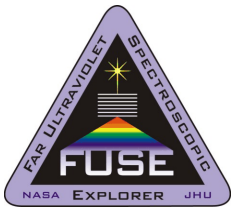
AAS June 3, 2002

Gyro Status

- Six Ring Laser Gyros in 2 packages, aligned on 3 orthogonal axes
- A Gyro Y (roll) axis failed May 29 2001

  → Switch to B Gyro package
- Gyro laser intensity warnings:
  - A Gyro X, Z axes: January 2000
  - A Gyro Y axis: April 2000
  - B Gyro X axis: August 31 2001
  - B Gyro Y axis: October 6 2001
- Switch to cross-strapped mode if an axis fails in B Gyro package
- If we lose both gyros on a single axis (before new S/W is ready):
  - Use Magnetometer data to compute rates on that axis
  - Can probably utilize coarse control modes (as opposed to safe mode) to maintain pointing near poles.

FUSE Gyroless Operations



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Redesigning FUSE Attitude Control

- Redesign Attitude Control System and instrument software to work with existing (reduced) hardware.
  - Not starting from scratch: have to work with what we have
- Maintain existing operations concept
  - Observing scenarios & Mission Planning system
  - Goal is to make changes transparent whenever possible
- Maintain all existing scientific capabilities
- New system must perform acquisitions rapidly enough to enable adequate observing time in each orbit.
- Have new system ready when we lose backup gyros!

FUSE Gyroless Operations

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Gyroless Systems Operations Concept

- Will use Magnetometers & non-linear model of S/C dynamics for attitude estimation during slews and occultations
  - Main problem is managing uncertainty in rotation about instantaneous B-field direction.
- Will use Fine Error Sensor (FES) for rate information while observing.
  - Will still meet basic science requirements for absolute attitude and jitter ($\sim 1''$)
- Expected attitude and rate errors (w/o FES data):
  - Drift rates: $20''$/sec (worst-case; $10''$/sec typical)
    - Drift rates presently $\sim 0.01''$/sec
  - Slew errors & drifts during occultations: $\pm 2^\circ$.
    - Presently $5' - 30'$

FUSE Gyroless Operations

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New Aspects of Operations Concept

- Star table covers a 4° diameter region (originally 1°)
- Achieve tracking in <3 sec (originally ∼50 sec)
  - FES to process images & select guide stars autonomously
  - FES to track motion of guide stars autonomously (FES reads out small subimages centered on stars while tracking, not entire CCD)
- Will have 3 types of Slews:
  - Large slews performed with attitude feedback from Magnetometers
    - Errors ∼2°
  - Slews 10′ to ∼2° performed by "dead reckoning"
    - Errors ∼10% of slew length
  - Slews <10′ performed while guiding
    - Slew rate ∼6″/ sec
    - Instrument Data System autonomously selects stars, changes them when they leave FES FOV

FUSE Gyroless Operations

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Development Status

Attitude Control System

- Simulations of new algorithms mostly complete, some tuning to continue
- Initial versions of new code modules written, beginning standalone testing
- Development to continue through July 2002

Instrument Data System

- New S/W modules written, tested (standalone), and integrated
- Preliminary revised instrument CMD/TLM database ready
- Acceptance test procedures being revised

Fine Error Sensor

- New S/W development complete, beginning acceptance testing

Upload of complete system scheduled for early October 2002