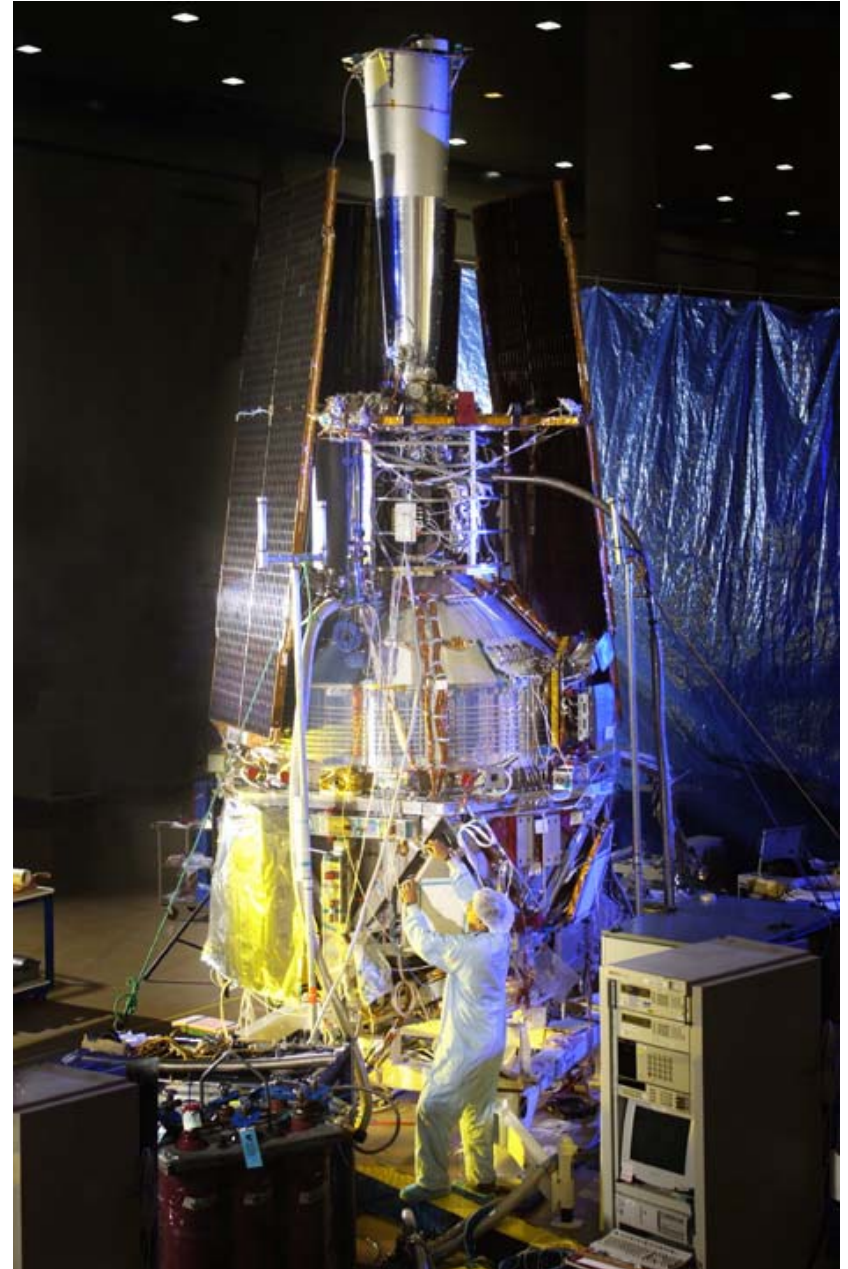




The GP-B Space Vehicle Status

Barry Muhlfelder

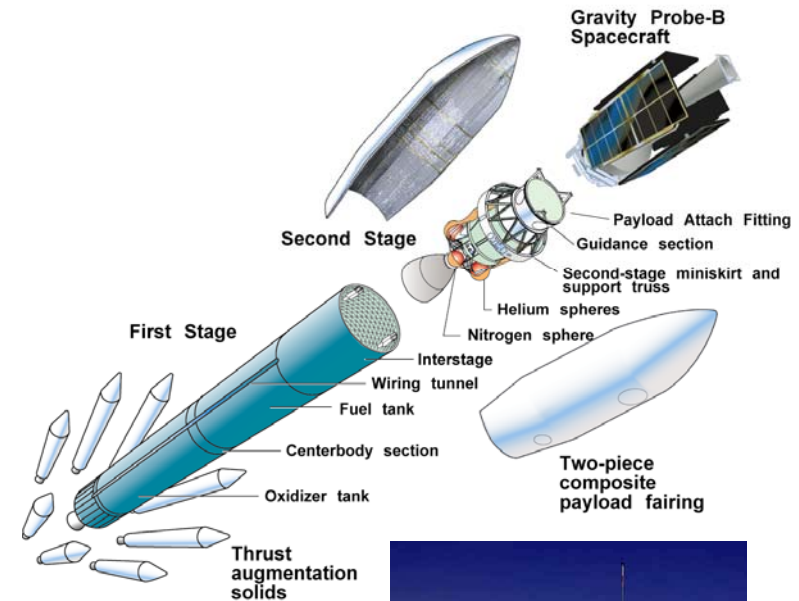




Space Vehicle Status

- **Healthy**
 - 640 km polar orbit
 - Orbit plane aligned with IM Pegasi
- **Mission Operations Center**
 - Located @ Stanford
 - NASA communications provide:
 - Ground network contacts
 - Space network contacts
- **Integrated Test Facility @ Stanford**
 - Verifies command loads prior to use on vehicle
- **Continuing to collect engineering data**
- **Investigating novel uses of vehicle**


Delta II 7920-10 Launch Vehicle






Operations & Communications


Reliable data transmission using TDRSS and NASA ground station communications.




Solid State Recorder (SEAKR)



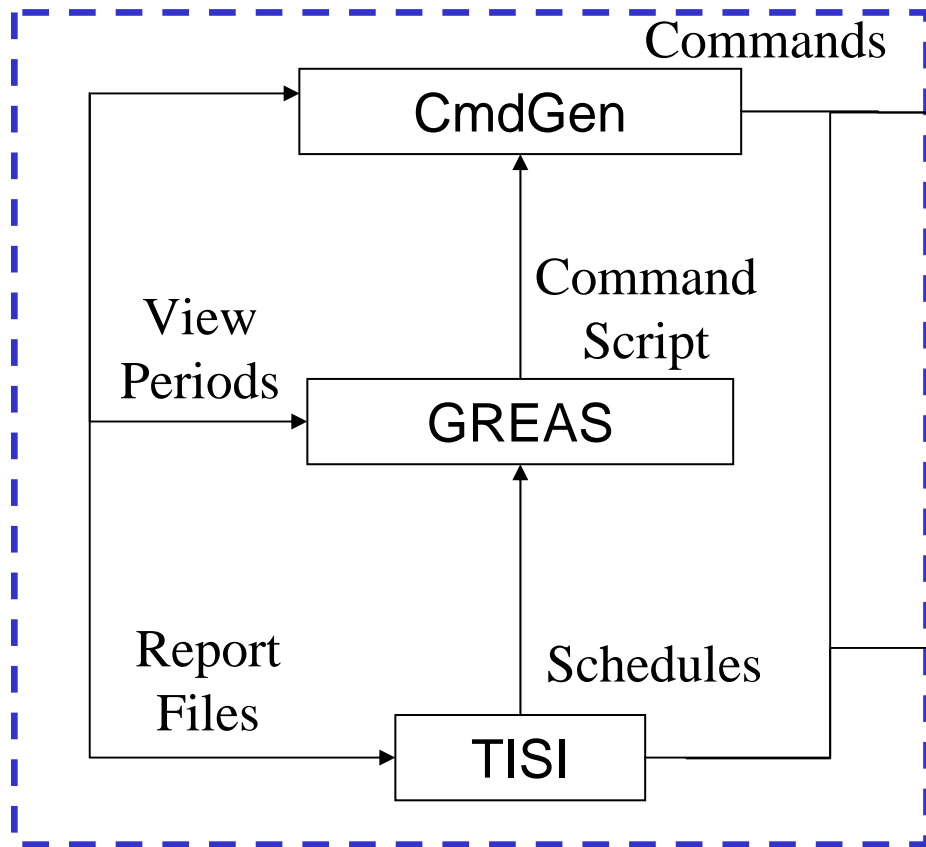
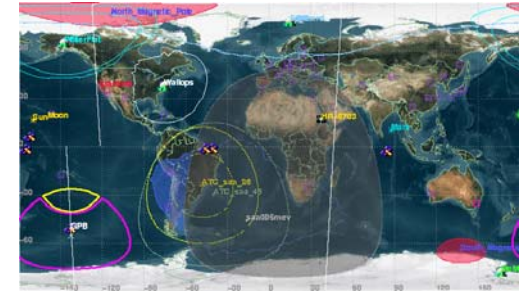
Command & Data Handling Unit (Goodrich)



NASA Standard Transponder (Motorola)



2 Antenna (Lockheed Martin)



Mission Operations Center



TDRSS Satellites



Ground Stations

Commands & Telemetry



Commands & Telemetry



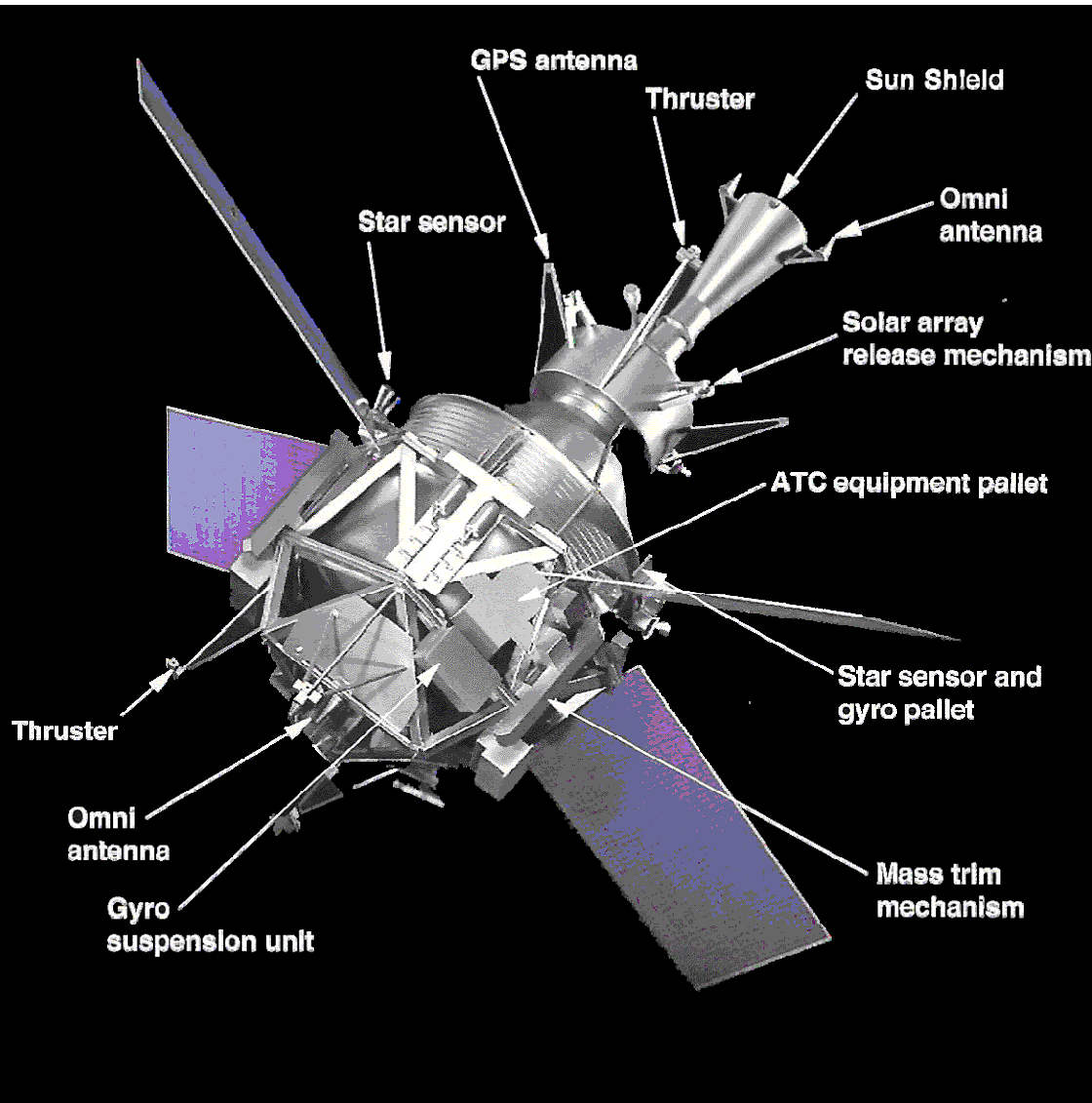
On-Orbit: GP-B Mission Operations



Mission Operations Center



The Space Vehicle

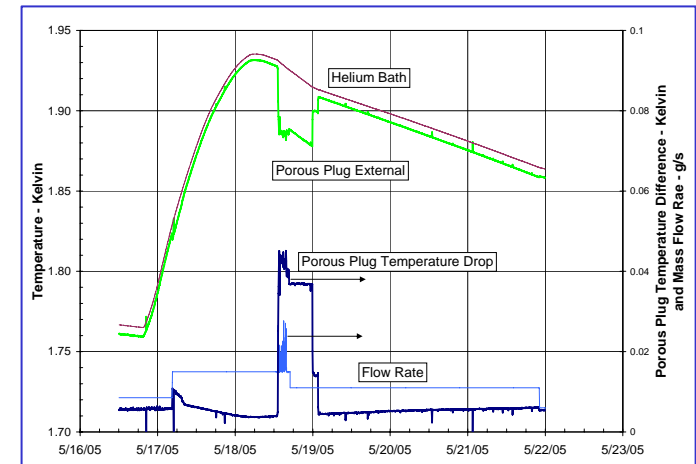


- ♠ Redundant spacecraft processors**
- ♠ Roll star sensors for fine pointing **
- ♠ Proton monitor**
- ♠ Magnetometers for attitude determination **
- ♠ GPS for science and ephemeris**
- ♠ Thermometers for science & environment monitoring
- ♠ Dual transponders for space network(TDRSS) & ground network
- ♠ Tertiary sun sensors for very coarse attitude determination.
- ♠ Magnetic torque rods for coarse orientation control.
- ♠ Mass trim to tune moments of inertia.
- ♠ 70 A-Hr batteries, solar arrays.

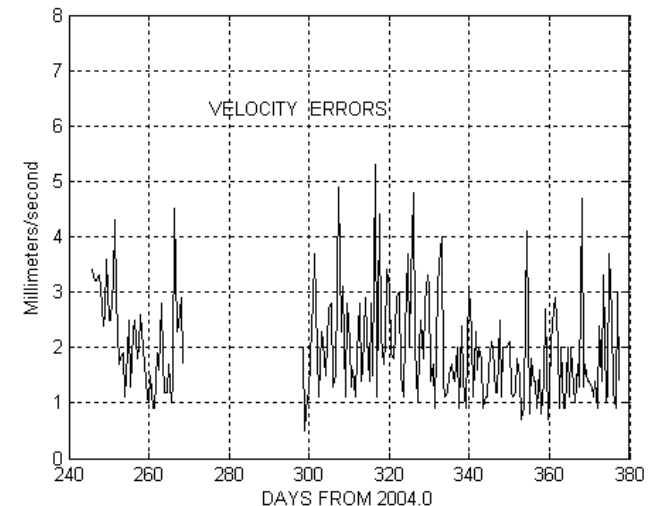


Engineering Capabilities & Novel Uses

- Thermal environment
 - 11 active thermometers on-board
 - Dozens of heaters
- Roll Star Sensors
 - Used for ATC during science mission
 - Planet finding proposal to NASA
- GPS
 - Used for precision attitude determination
- Magnetic environment
 - Lockheed Martin SV sensors
 - Typical commercial sensitivities
 - Stanford Payload sensors
 - State-of-the-art sensitivities
- Proton & electron flux monitoring
 - In study for NASA to support human flight



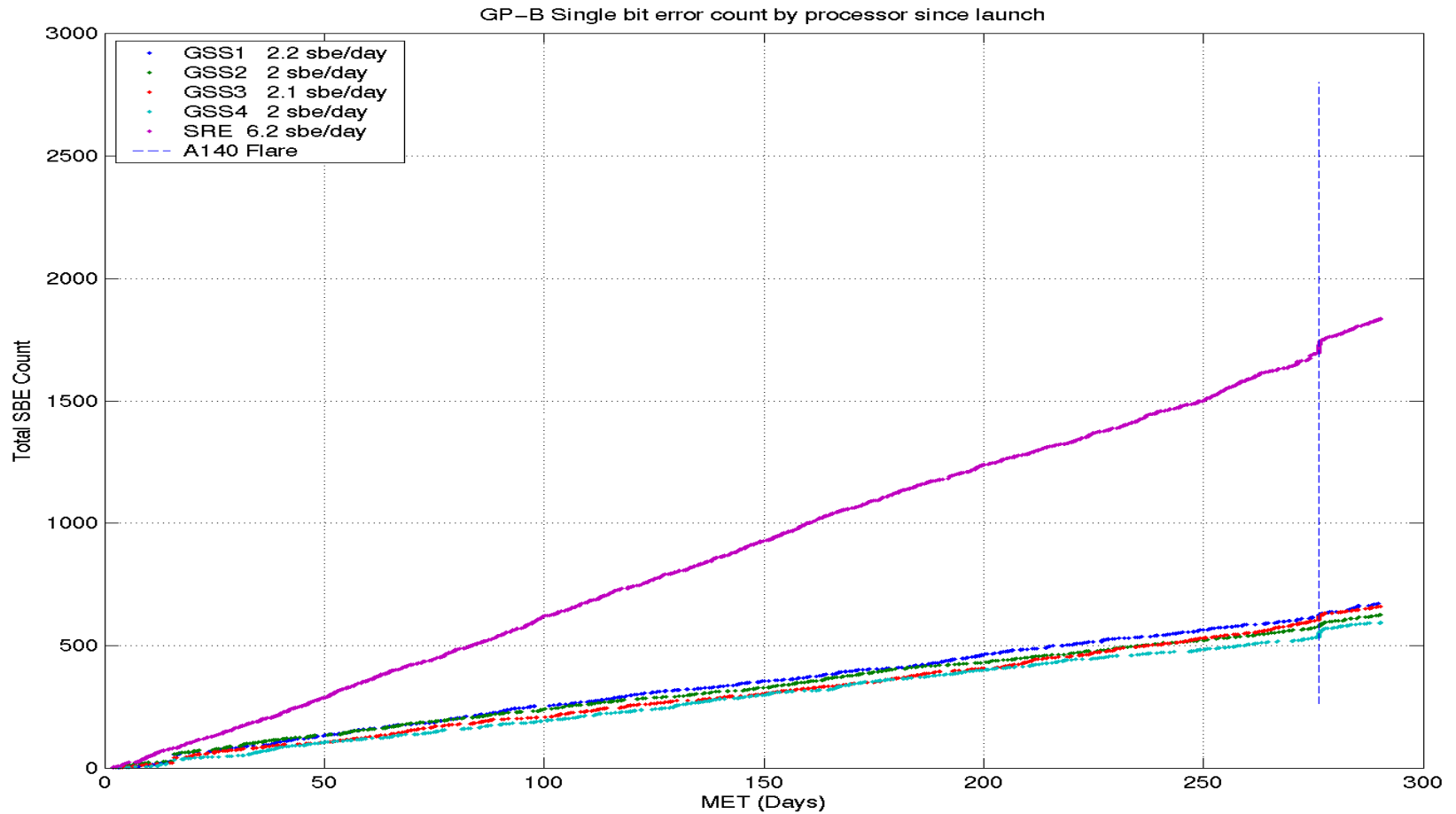
Temperature data



GPS Velocity Comparisons



Energetic Proton Flux induced errors...

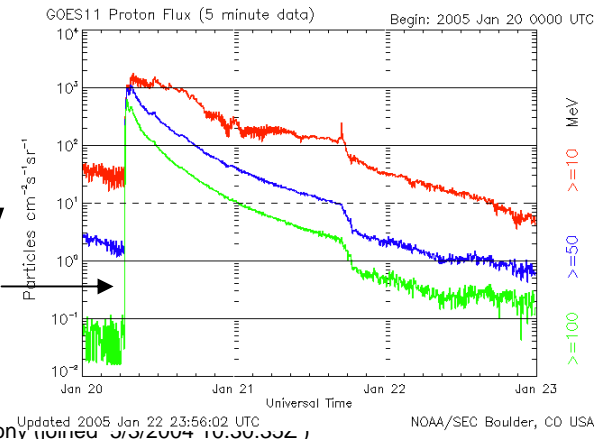


...resulted in 6 of 9 major GPB spacecraft anomalies



Solar protons can keep you up at night.....

GPB Proton Activity & huge spike



- **ARB Event #34 Review Board Meeting Notes:**
- **Subject: Anomaly: Space Vehicle Switched to B-side**
- **Date time: 5/3/2004 10:20Z**
- ARB Bob Schultz
- Board:
- SU: Bill Bencze (ARB chair as of 1152Z), Lewis Wooten
- LM: Bill Reeve, Norm Bennett, Bill Jacobsen
- MSFC: Lewis Wooten, Buddy Randolph, Keith Shackelford
- Brett (FD), Rob (MD), Lewis (ARB chair), Bill (LM ARB), Keith, Buddy (5/3/2004 10:28:37Z Marcie joined), Tony (joined 5/3/2004 10:30:30Z)
- Anomaly declared at 3:05 AM PDT (3 May 2004) – first ARB telecon at 3:20 AM
- **Prelim data:** Started at 0505 Z – 0500-0525 AFT TDRSS support that was coherent – 1 5 minutes were go then nothing (though SMA support and it did not work). Support Alaska 0713Z and got nothing through whole pass (could have been Alaska problem). Started working playback support at 0815Z, also aft support on TDRS AFT and no command and telemetry. Not sure if RF of if site issues. Try 1k on 0815Z – no signal. Asked for TDRS at 0935-0950 (special request) – locked up on telemetry – all RTWorks was red. Currently on C&DH b-side. All SM test were reset to disabled. Not sure what tripped. Event proc shows last event on swing shift and first event on b-side. One SM message, application 9 136833068 and looks like ECU was coming on (which was part of the normal recovery sequence). At 136833165, we have a SM re-enabled on B-side. So maybe switched to b-side ECU. Greg is rescheduling to add a few events in future – asked to scheduled on FWD (because on B-side). All global variables have been reset. Marcie advises show gyro 4 is not levitated. Rob and Bill J request subsystem leads to come in:
- **TCS** – Kevin Burns ETA 4:10 AM **(arrived)**
- **ATC** – Jon K ETA: 4:50 AM **(arrived at 4:35 AM)**
- **C&DH** – Rita Miller ETA 5:30-6AM (arrived 5:35 AM) **arrived**
- Oi-Ling ETA 5 AM **arrived**
- **ECU**- Dave Meriwether ETA 5 AM **(arrived at 4:55AM)**
- **EPS** – Shawky ETA 5 AM **arrived**
- **GSS** – Dave Hipkins – ETA **arrived**
- **Cryo** – Mike Taber ETA 5 AM **arrived**
- **SRE/TRE** – Werner Growitz ETA -6 AM **arrived**
- Bruce Clarke **(paged 5:10 – Werner good enough)**
- Bob Farley **(paged 5:10 – Werner good enough)**
- McGinnis (not yet paged) **(arrived 6AM)**
- Maggie Johnston ETA 5:45AM
- Norm ETA 5:30 to 6AM (page if needed before) - **arrived**
- Bill J ETA 4:30 AM **(arrived 5AM)**
- **GPS** - Paul S – called telecon 4:40 AM (temps okay – appears GPS turned off) ETA 7 AM
- **Bill Bencze** – **arrived at ARB at 4:45 AM and will chair ARB**
- Bill Reeve –**arrived at LM** around 5:15AM (on via telecon)
- 5/3/2004 12:15:59Z
- Jennifer Spencer – (1k did not get in) ETA 6AM **arrived**
- Jeff Wade **is coming in**



Anomaly Room



Conclusion

- GP-B space vehicle remains healthy
- Continue to collect engineering data
- Mission operations center fully operational
 - NASA ground & space network
 - Integrated Test Facility for command verification
- Investigating novel uses of spacecraft
- Educational tool for AA students
- Maintains capability for STEP & follow on missions