Status of HST operations at STScI

STUC meeting

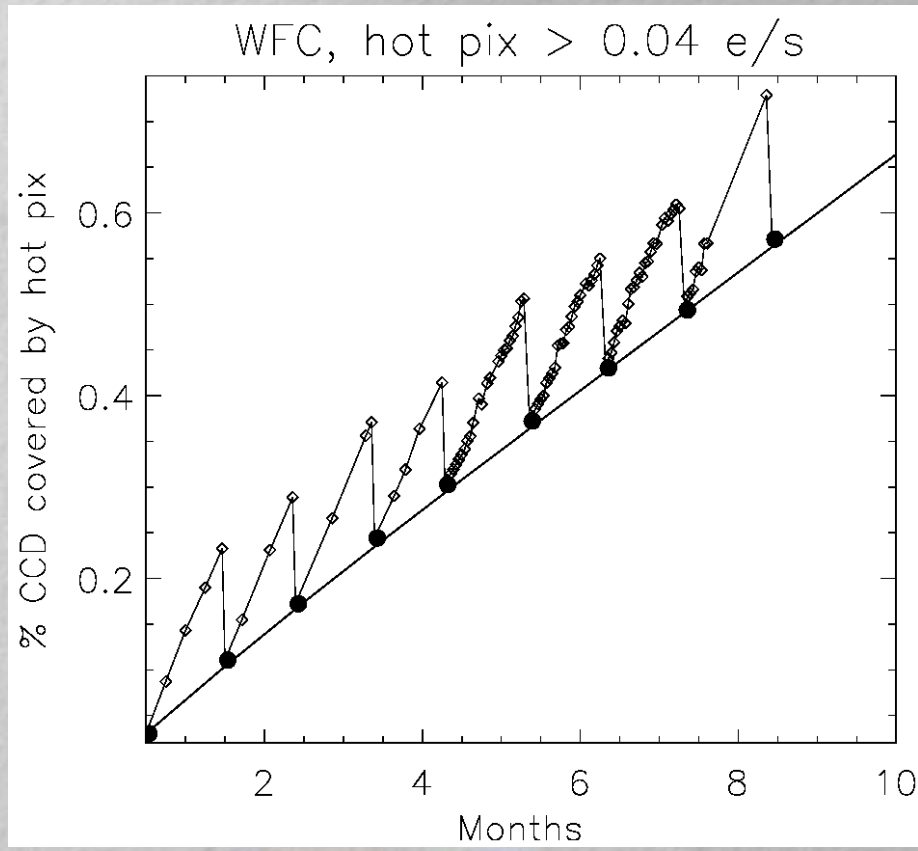
November 6-7, 2003

Topics

- Instrument Status
  - ACS hot pixels and CTE
  - NCS/NICMOS
  - COS
  - WFC3
- Scheduling Status
- Data processing Status
- E/PO funding
- Two Gyro implications
- FY05 planning

ACS/WFC Annealing

- ACS WFC CCDs anneal less efficiently than other HST CCDs
- A "Tiger Team" meeting with detector experts was held at SPIE meeting in August
- Possible causes for anomalous behavior
  - Different integration/read-out (MPP/non-MPP)
  - Different detector shielding (more neutron damage, harder to anneal)
- No theoretical understanding or obvious solutions
  - Expecting some improvement with installation of Aft Shroud Cooling System in SM4, due to lower operating temperatures



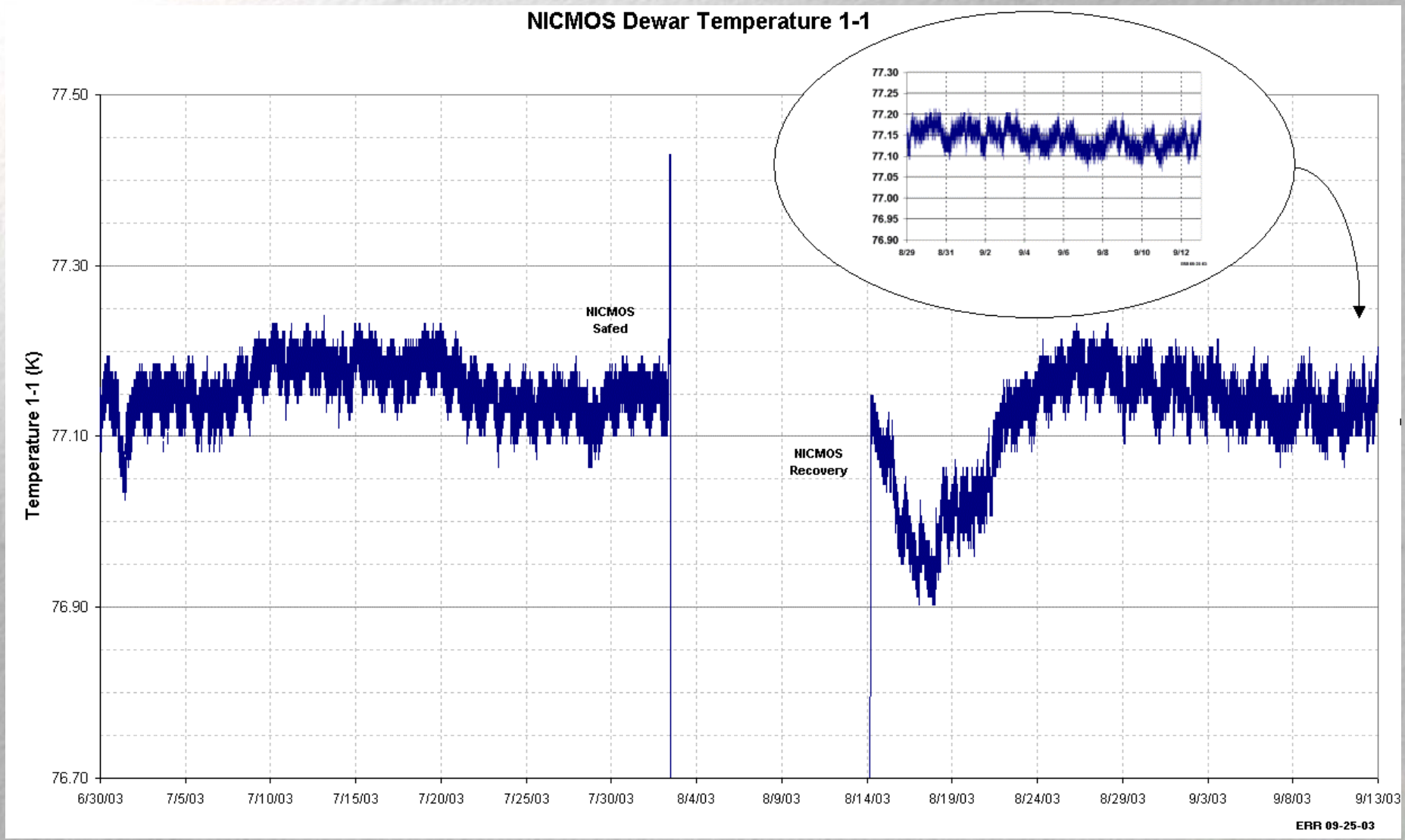
After ~two years the hot pixel count will equal the CR count in 1000s image

ACS Calibrations

- HRC grism wavelength calibration completed (ST-ECF; Pasquali et al.)
- Charge Transfer Efficiency calibrated from observations of 47 Tuc (Riess)
  - CTE loss few % for typical cases – roughly as expected
- New method developed for low-frequency flat-field characterization (van der Marel)
- Geometric distortion solutions from outsourcing (Anderson et al.) being considered for implementation in pipeline (used in UDF)
- Calibration plan for Cycle 12 prepared and started (Giavalisco, Gilliland)

NICMOS

- **NCS/NICMOS safing event**
  - NCS safed on 2 August at 06:39 UT
  - NICMOS was commanded to safe mode later that day at ~22:00 UT
  - Most likely cause of NCS failure was determined to be a single event upset (SEU) in circulator commanded voltage bit 8
- NCS/NICMOS recovery
  - NCS was restarted on 7 August at ~13:00 UT
  - Neon temperature control point reached on 9 August
  - NICMOS recovery plan started on 14 August
  - NICMOS science resumed on 21 August
- Lesson learned: cooldown faster than expected → SM4
  - Science enabled includes Mars campaign (Bell) and NICMOS UDF (Thompson)
  - Also gravitational lenses (Kochanek), massive mergers (Veilleux), search for planets around white dwarfs (Debes), T dwarf companions (Burgasser)


NICMOS Dewar Temperature 1-1
Temperature 1-1 (K)
77.50
77.30
77.10
76.90
76.70
6/30/03
7/5/03
7/10/03
7/15/03
7/20/03
7/25/03
7/30/03
8/4/03
8/9/03
8/14/03
8/19/03
8/24/03
8/29/03
9/3/03
9/8/03
9/13/03
NICMOS Safed
NICMOS Recovery
77.30
77.25
77.20
77.15
77.10
77.05
77.00
76.95
76.90
8/29
8/31
9/2
9/4
9/6
9/8
9/10
9/12
ERR 09-25-03

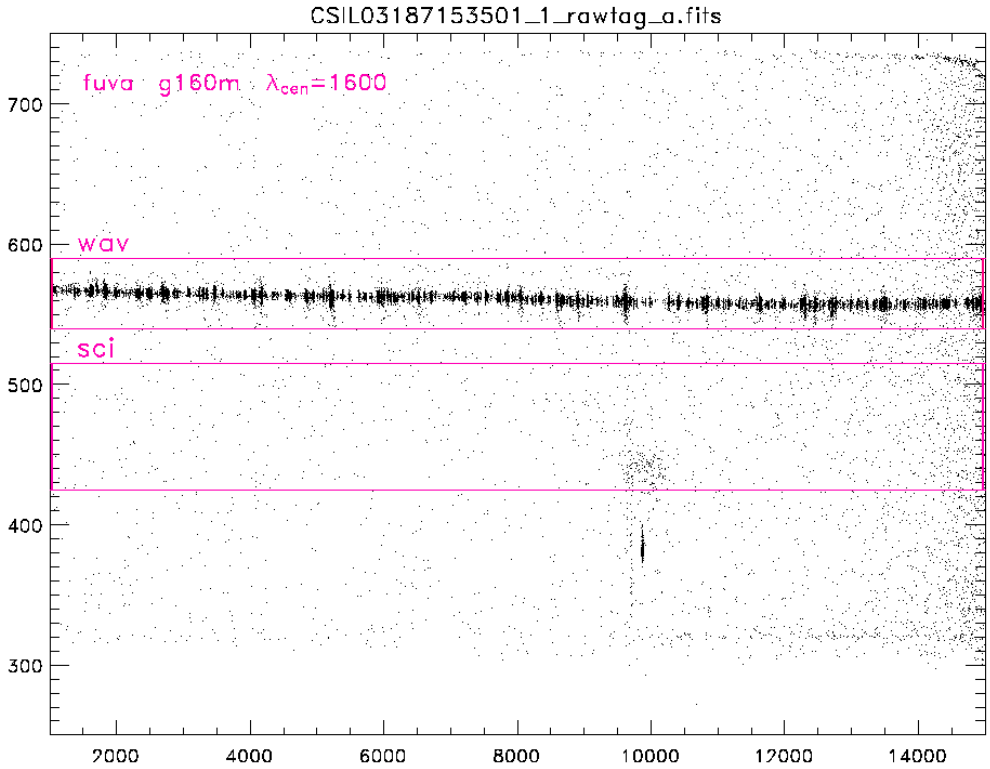
COS Thermal vacuum testing

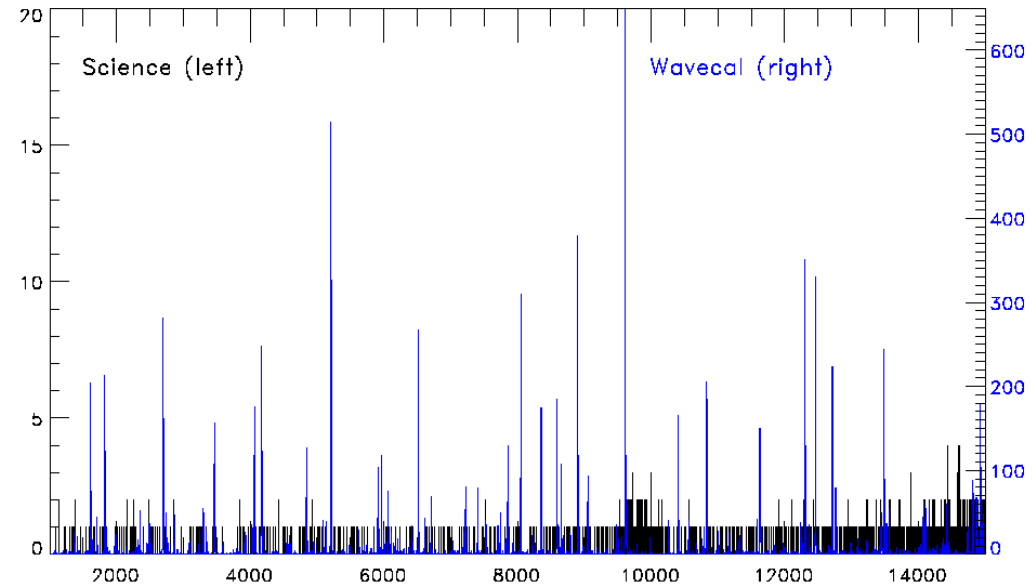
- **Initial Alignment and Verification at Ball: 25 June-10 July**
- **Thermal-Vac Science Calibration at Ball: 22 Sep-22 Oct**
- **STScI Thermal-Vac participation**
  - **STScI Instrument Scientists provided onsite support for SI operation, data-taking, and analysis (Keyes, Sembach, Leitherer, Friedman, and Bohlin)**
  - **Hartig provided onsite optical alignment support**
    - **Additional CAOS/HOMES testing this week**
  - **STScI provided OPUS processing, conversion to FITS, and HDA-archival of all COS Thermal-Vacuum data**
    - **Processed ~550 datasets from alignment and verification activities**
    - **Processed ~2200 science calibration datasets**

COS TV support

- **STScI post-test analysis activities**
  - Completed:
    - NUV Repeatability monitor (Friedman): no anomalies in verification testing
    - NUV Flat fields (Bohlin): verified 1% flatfield and 1% rms per pixel in extracted absorption line spectrum
    - Keyword processing anomalies (Sembach, Keyes, Friedman, Hartig, Hodge)
  - In progress:
    - FUV flat fields (Bohlin)
    - Resolution and FP-Splits (Sembach)
    - Wavecals (Keyes)
    - FUV Repeatability (Friedman)
    - Sensitivity (Leitherer)

Sample COS FUV Spectrum "A" Segment



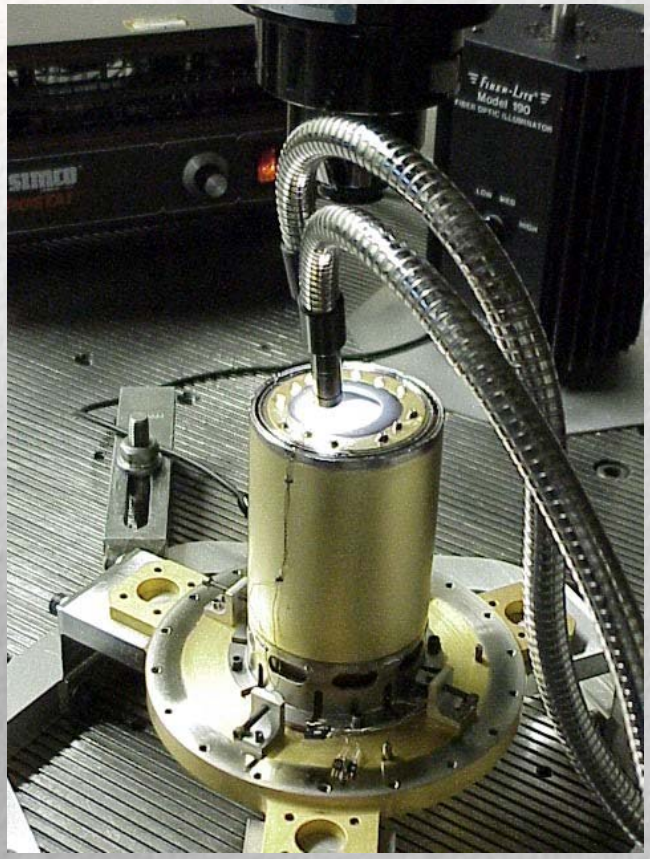


Internal PtNe calibration lamp (no distortion correction)

WFC3 Highlights

- UVIS 1 detector assembly delivered to GSFC
  - Detector was successfully integrated into instrument
  - Noise testing started last week, ~ 3 electrons
- Flight IR detector assembly completed vacuum processing but continuity test revealed a broken wire.
  - Opened, broken wire repaired, being reassembled.
- Instrument system electrical integration shows low noise in both UVIS and IR imaging with surrogate detectors.

WFC3 Detector Assemblies



Flight IR2 Detector Assembly
Wire Fixed and Ready for
Re- Alignment

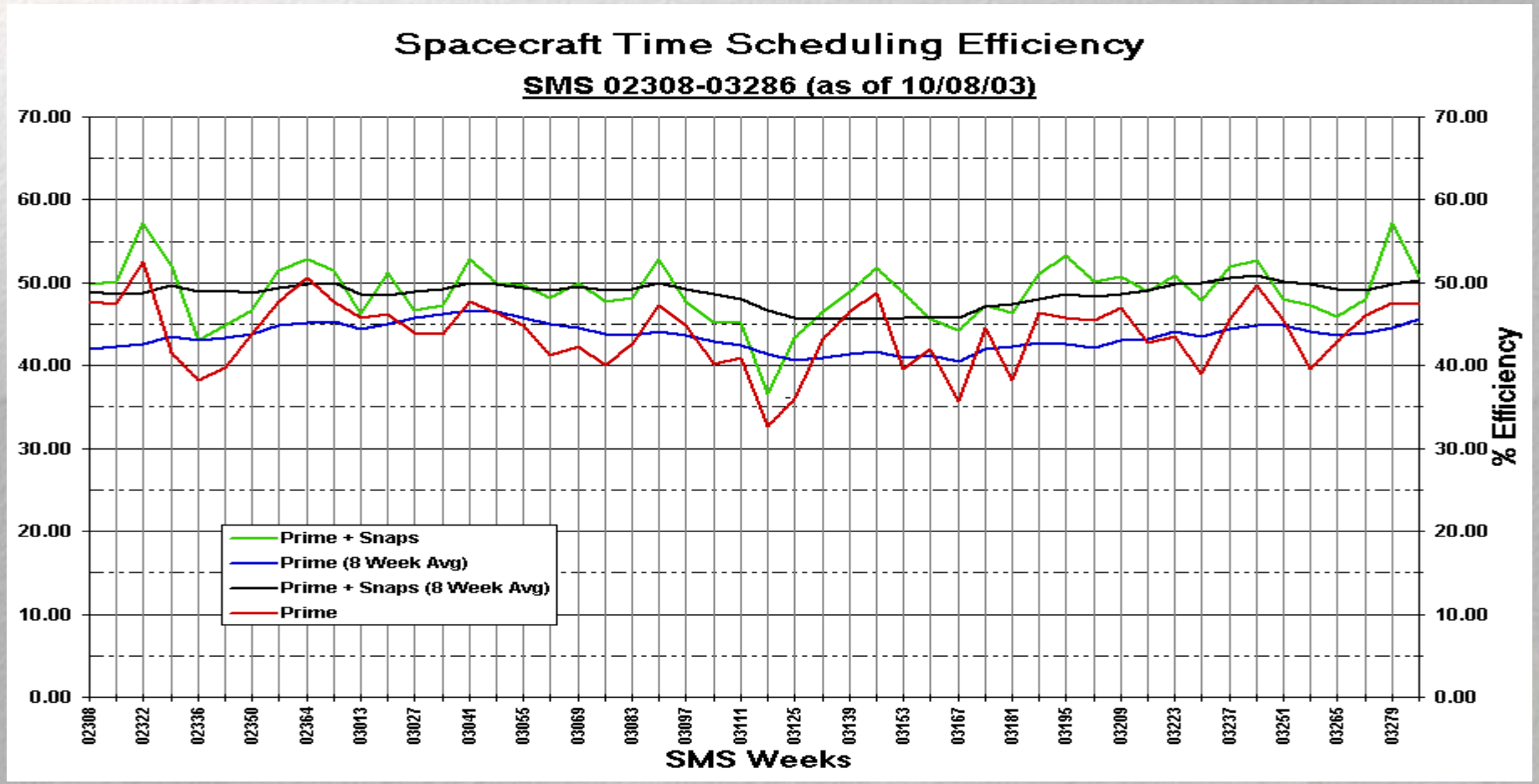
Flight UVIS Detector Assembly
Installed in WFC3

WFC3 IPT Activities

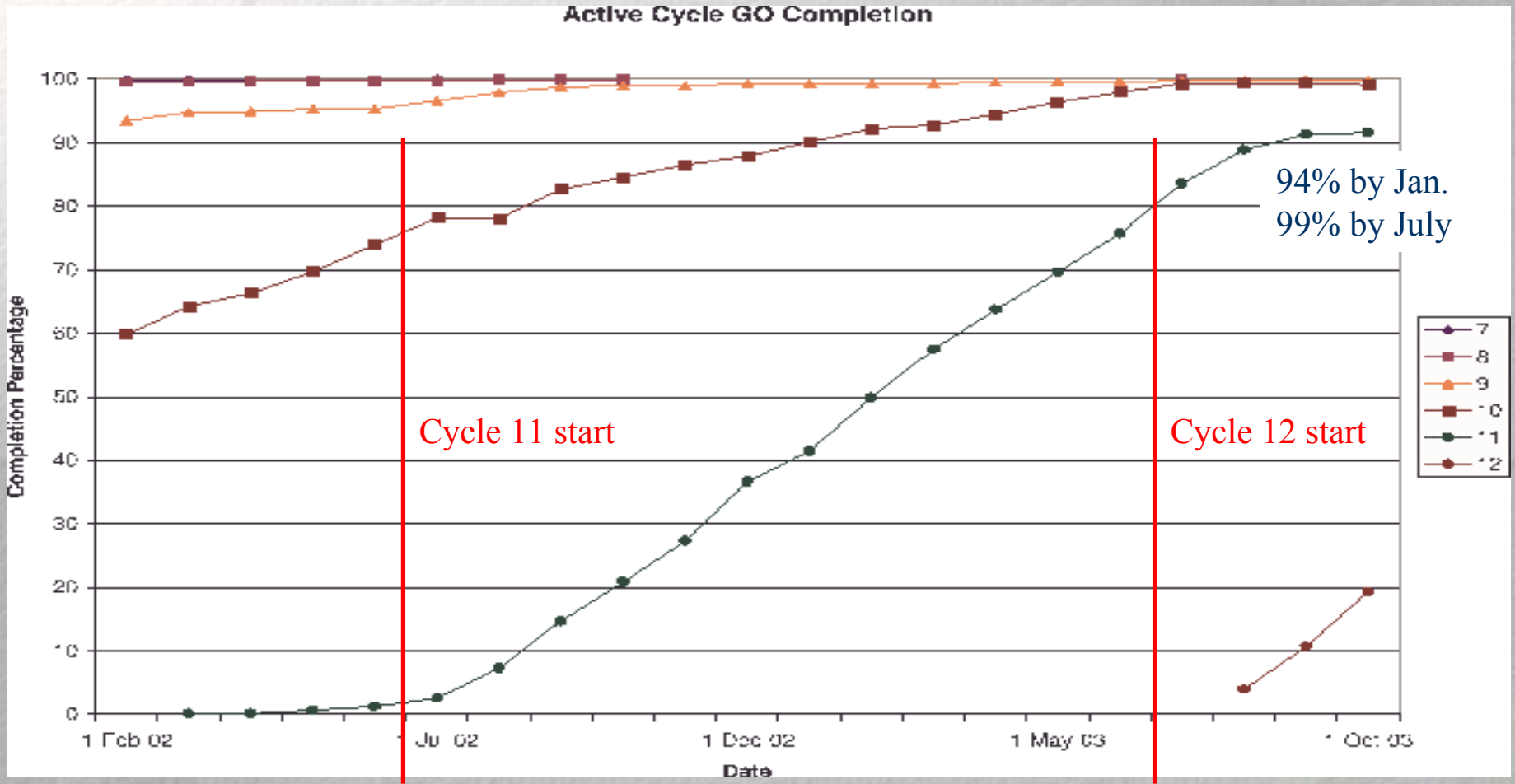
- Ready to proceed with ground testing of WFC3
  - 4th End-to-End test completed with only 1 minor issue
    - Organized by Ray Kutina
    - H. Bushouse has demonstrated data flow to archive/StarView
  - Participate in UVIS (CCD) noise testing starting late Oct
    - Supported by M. Robberto and S. Baggett
  - Test program developed for "mini-ambient" in early Nov
    - Organized by Neill Reid (Project Scientist) and Ray Kutina (ICAL)
    - Significant test of UVIS channel (Optics: G. Hartig; Detector: M. Robberto, S. Baggett, B. Hilbert, et al.; operations: O. Lupie, W. Baggett, T. Wheeler)
    - Validates expectations for ambient testing and ground test flow

Scheduling Status

Spacecraft Efficiency



Cycle Completion Status



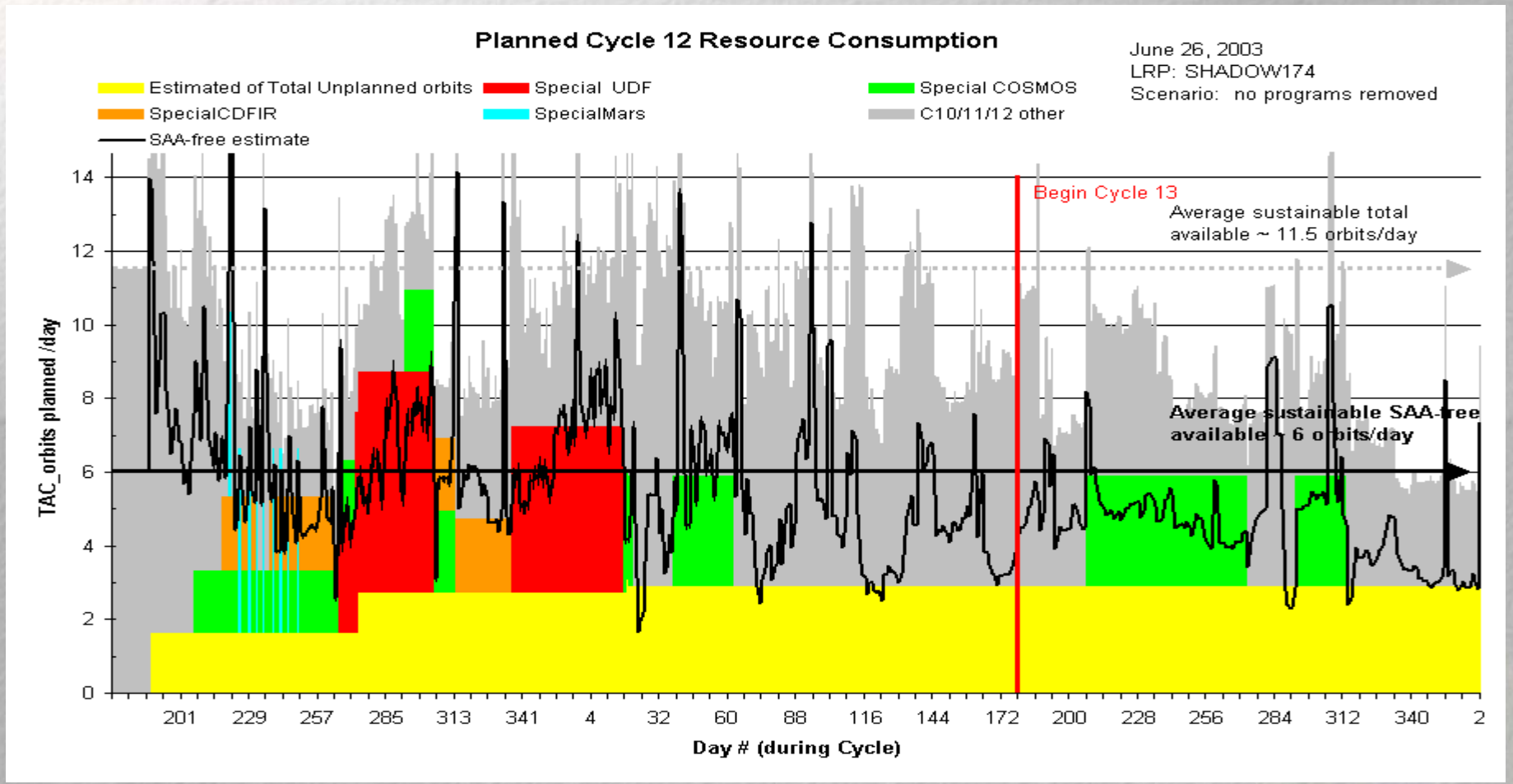
Cycle 12 Planning

- Five large programs to schedule in Cycle 12
- Three of these had targets at roughly the same RA, and hence roughly the same time
- This created ~2x oversubscription of SAA-free orbits in multiple intervals in Fall 2003
- LRPG and PC's worked with Director's Office and PI's over a 2 month period to identify alternate target and/or orientation selections.
- Compounded by uncertainty in 'unplannable' activity

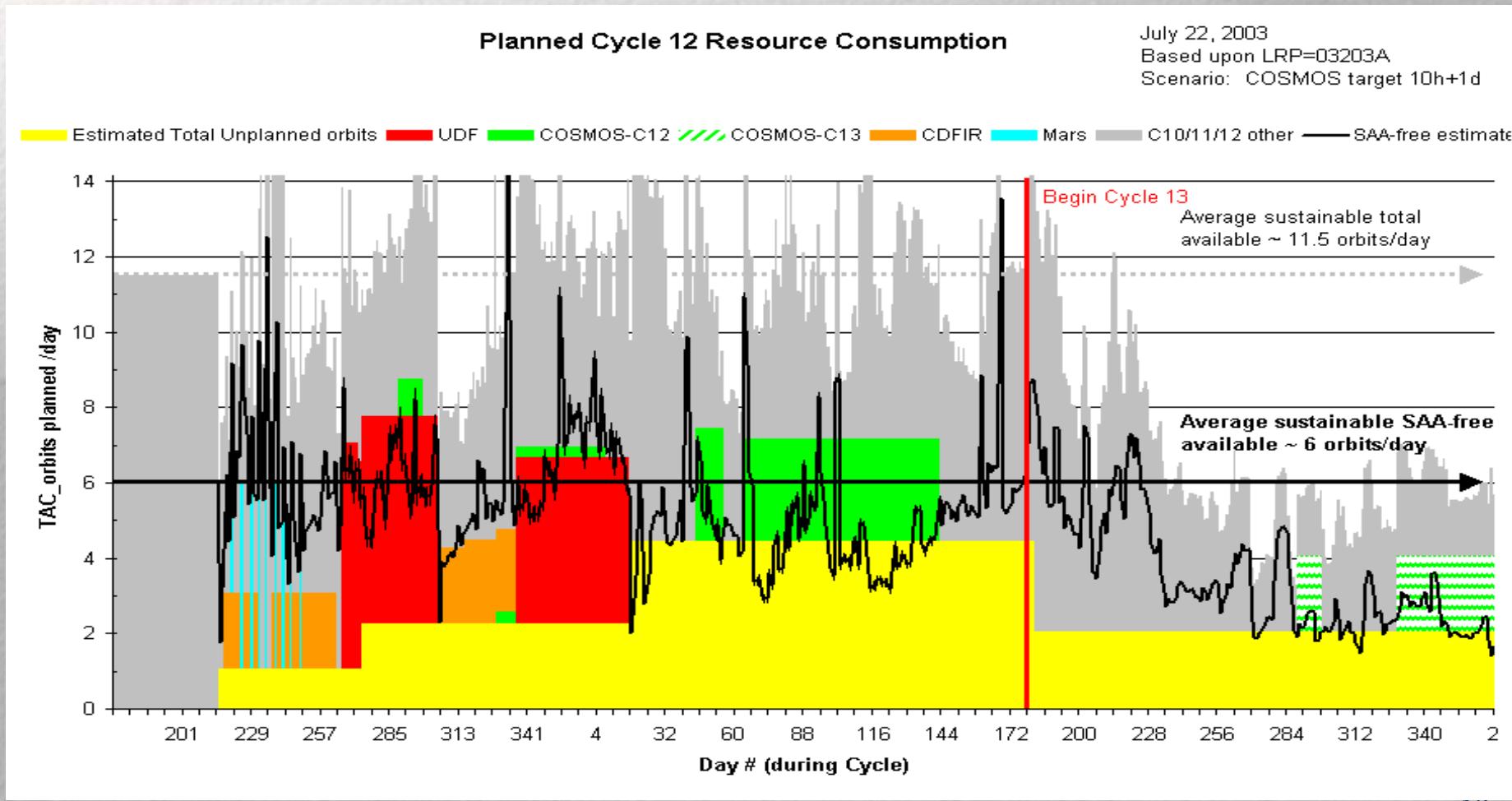
Cycle 12 Large Programs (June implementation)

Program		Orbits	Planning/Scheduling Restrictions
9978	UDF	412	Chandra Deep Field 2 Orients, 2 epochs (6 wks) (Fall 2003)
9803	CDFIR	144	Chandra Deep Field 2 Orients, 2 epochs (3& 5wks)
9822	COSMOS	270 Cycle12 320 Cycle13	2 Orients, 2 epochs (Fall 2003)
9750	GBDF	110	1 Orient, 7 consecutive days (Overlaps Mars)
9744	Gravitational Lensing Survey	110	No scheduling restrictions

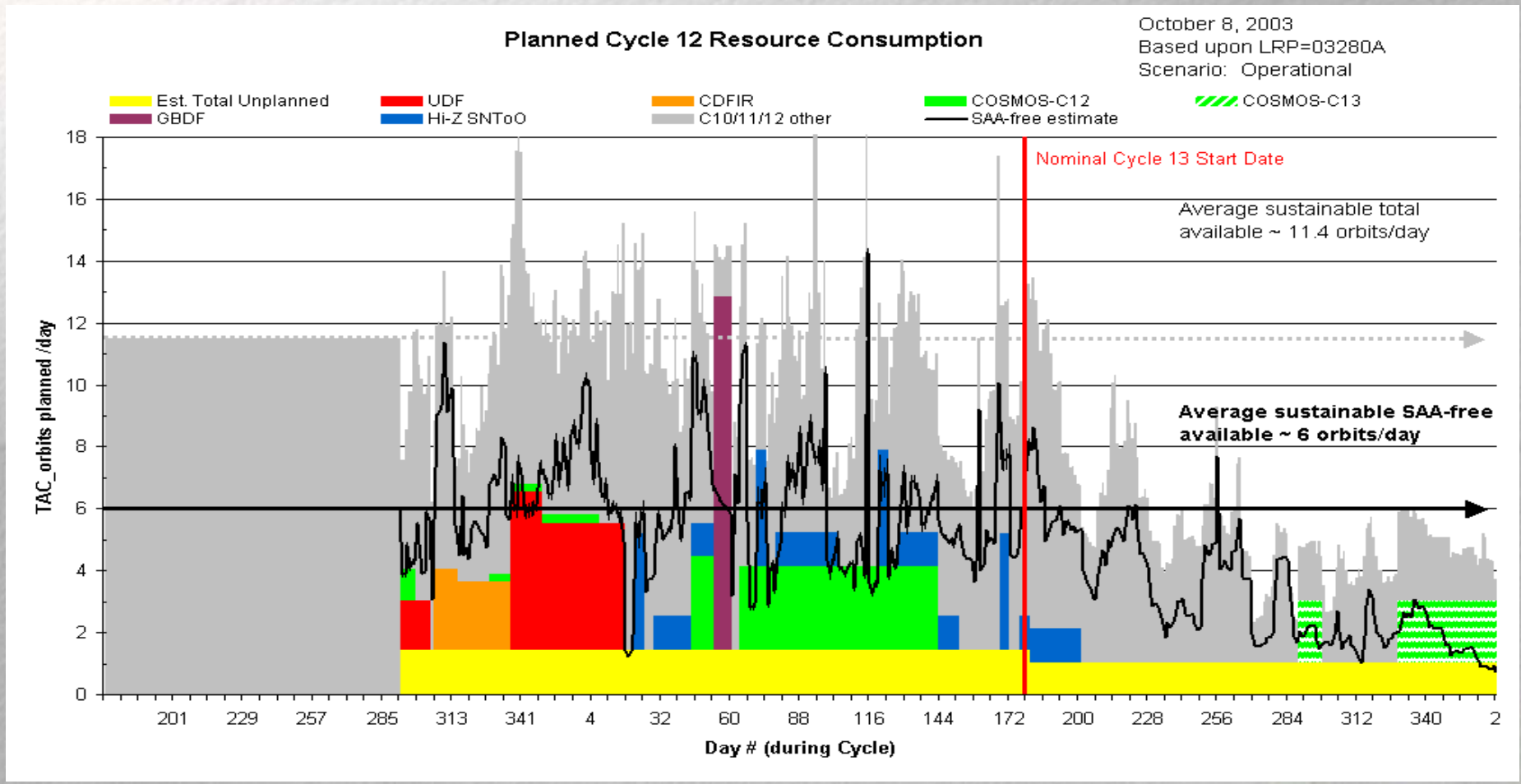
HST Long Range Plan (as of June 26)



HST Long Range Plan (as of July 22)



HST Long Range Plan (Current)



Cycle 12 Large Programs
(Current implementation/ schedule status)

Program		Orbits		Planning/Scheduling Restrictions
9978	UDF	412	206	Chandra Deep Field (Slight orient 2 Orients, 2 6-week epochs changes)
9803	CDFIR	144	105	Chandra Deep Field 2 Orients, 2 epochs (3&5 wks)
9822	COSMOS	270Cycle12 320 Cycle13	33	3 Orients, 4 epochs (target & orient (1wk, 6wks, 10d, 10wks) changes)
9750	GBDF	110	0	1 Orient, 7 consecutive days (orient changed)
9744	Gravitational Lensing Survey	110	50	No scheduling restrictions

Long Range Plan Summary

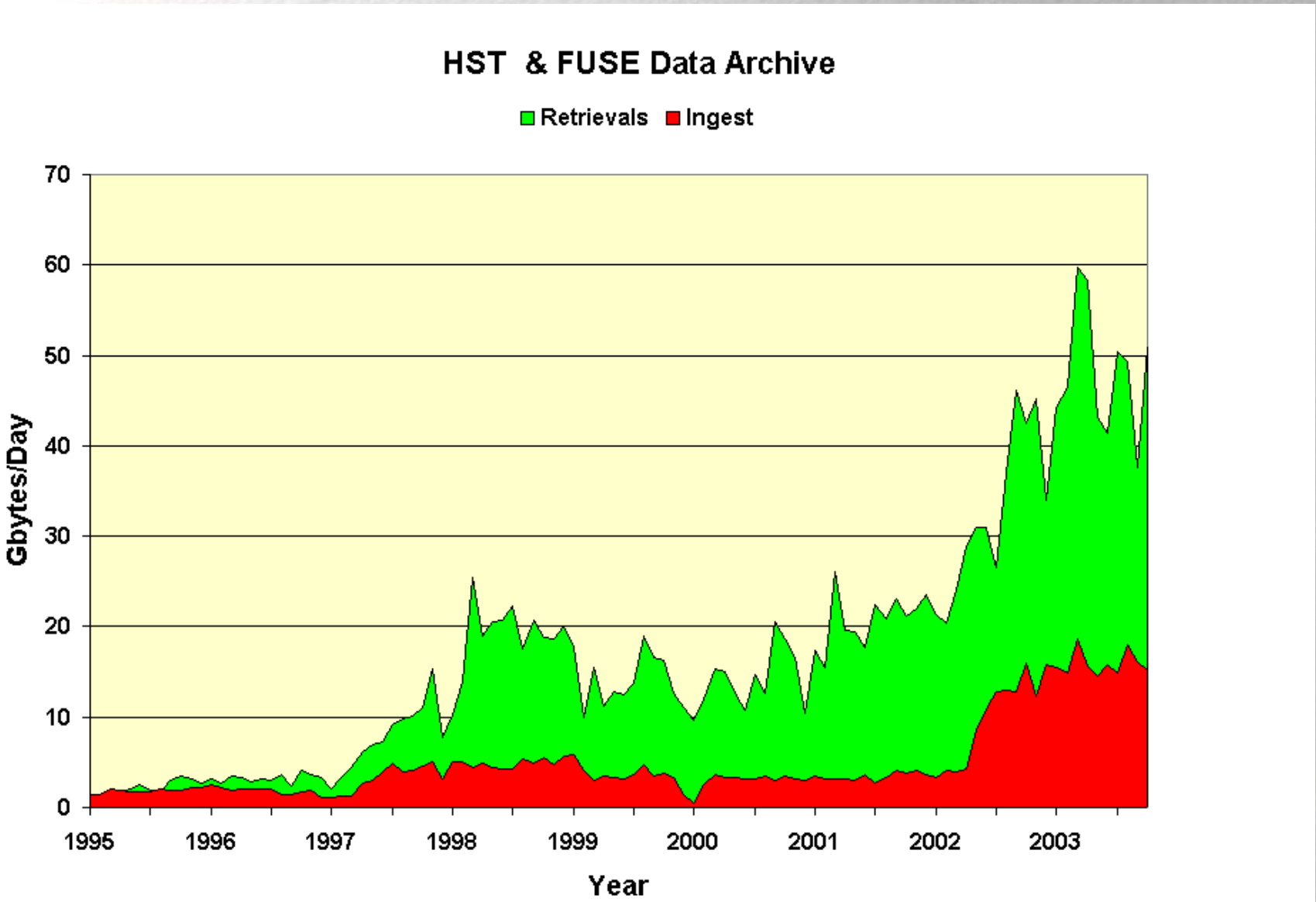
Current Status:

- Long Range Plan is stable
- Executing Cycle 11 and 12 Observations according to the Long Range Plan

Future:

- Working on changes to Phase I and II to identify and resolve resource conflicts in advance of Cycle 13 start
  - User Information page for Large programs - http://www.stsci.edu/hst/proposing/LargePrograms
  - Tools in Phase I APT
  - Request more specific planning information in Phase I text portion of proposal
  - Start LRP development on the day acceptance letters go out
  - Pro-actively contact PIs for Large and Treasury programs in first few days after acceptance letters are out

Data Processing Status

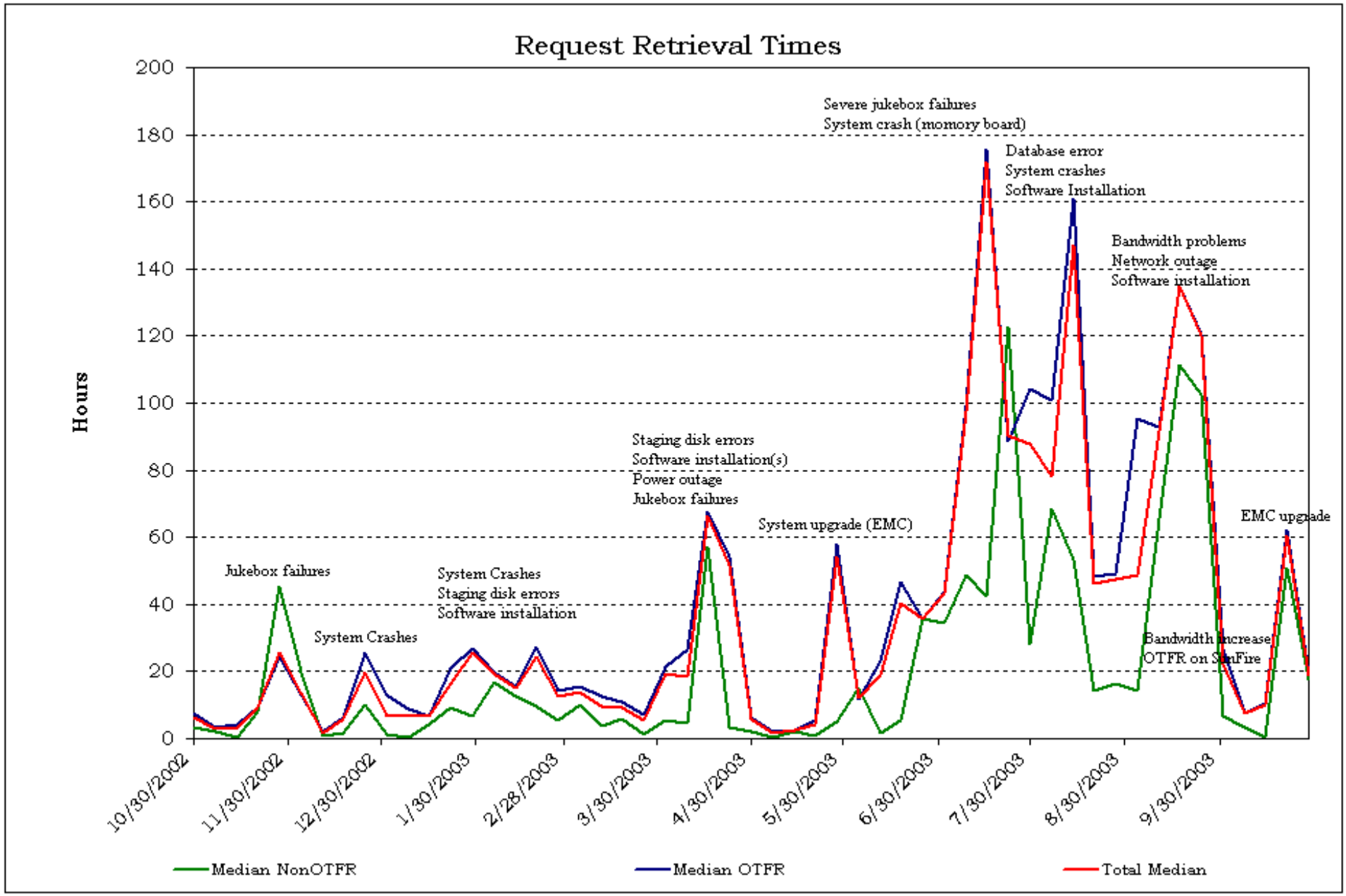

HST & FUSE Data Archive
Retrievals
Ingest
Gbytes/Day
70
60
50
40
30
20
10
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
Year

Data Processing System Replacement

- In Spring of 2002, a number of processing power and robustness issues became apparent
- Over Summer of 2002 existing equipment was upgraded (memory, CPU boards, etc.)
- Over Summer/Fall 2002 we developed plans and obtained equipment
  - EMC storage device
  - Sun Fire 15K processor
  - Reviewed Operational transition plan with Project in March
- Over Spring/Summer 2003 we implemented the plans
  - Transitioned development and test environments first
  - Transitioned pre-archive pipeline in early August
  - Implemented Data Depot in mid-August
  - Transitioned OTFR processing in mid-September

System performance – Summer 2003

- Series of hardware and system problems aggravated situation over the summer
  - Major Jukebox problems in June
  - Data base corruption, bad CPU board, system crashes through rest of summer
  - Internet throughput became bottleneck after Mars and GOODS releases
- Resulted in large backlog and long delivery times for data
- Diverted some staff from working on transition to new equipment and software


Request Retrieval Times
Hours
200
180
160
140
120
100
80
60
40
20
0
Severe jukebox failures
System crash (memory board)
Database error
System crashes
Software Installation
Bandwidth problems
Network outage
Software installation
Staging disk errors
Software installation(s)
Power outage
Jukebox failures
System upgrade (EMC)
EMC upgrade
Jukebox failures
System Crashes
Staging disk errors
Software installation
System Crashes
Bandwidth increase
OTFR on SunFire
10/30/2002
11/30/2002
12/30/2002
1/30/2003
2/28/2003
3/30/2003
4/30/2003
5/30/2003
6/30/2003
7/30/2003
8/30/2003
9/30/2003
Median NonOTFR
Median OTFR
Total Median

Data Processing Systems - Current Status

- Performance of new processing hardware is excellent
  - Works off backlogs quickly
  - Several processing records set recently
    - 380 GBytes in one day
    - 1215 GBytes in one week
- DADS 10.2 will be installed early December
  - Removes VMS systems from Distribution
  - Provides more user and operator flexibility
- Developing strategies for major releases (GOODS, UDF, etc.)
- Bandwidth to Internet at our end is the next major issue to work

Archive user feedback

- MAST Users Group met October 20
- Formal report is not available yet
- From feedback at meeting, expect their priorities to include:
  - Keep retrieval times low! Consider further prioritization by request types
  - Keep bandwidth high
  - Convergence of DADS release, Cycle 13 Phase I deadline, UDF release, etc. may cause performance problems

Cycle EPO Grants

- At last years STUC we discussed some concerns with the Cycle E/PO program
  - Low participation, though some high impact projects have resulted:
    - 'Touch the Universe' braille book, funded by Cycle E/PO reaches new audiences
  - Budget caps thought to be too low to encourage participation
- Following STUC discussion, we changed the program; Grant Cap increased to $20,000 for single programs. This seems to have had a very positive effect, judging from the submissions received.

Cycle	Requested Funds	Awarded Funds	Requested Proposals	Programs	Awarded Proposals	Programs
8	268,186	209,434	11	28	8	22
9	167,960	112,427	11	19	7	8
10	414,105	282,365	17	43	13	30
11	278,808	215,917	15	28	10	18
12	858,000	400,000	25	41		

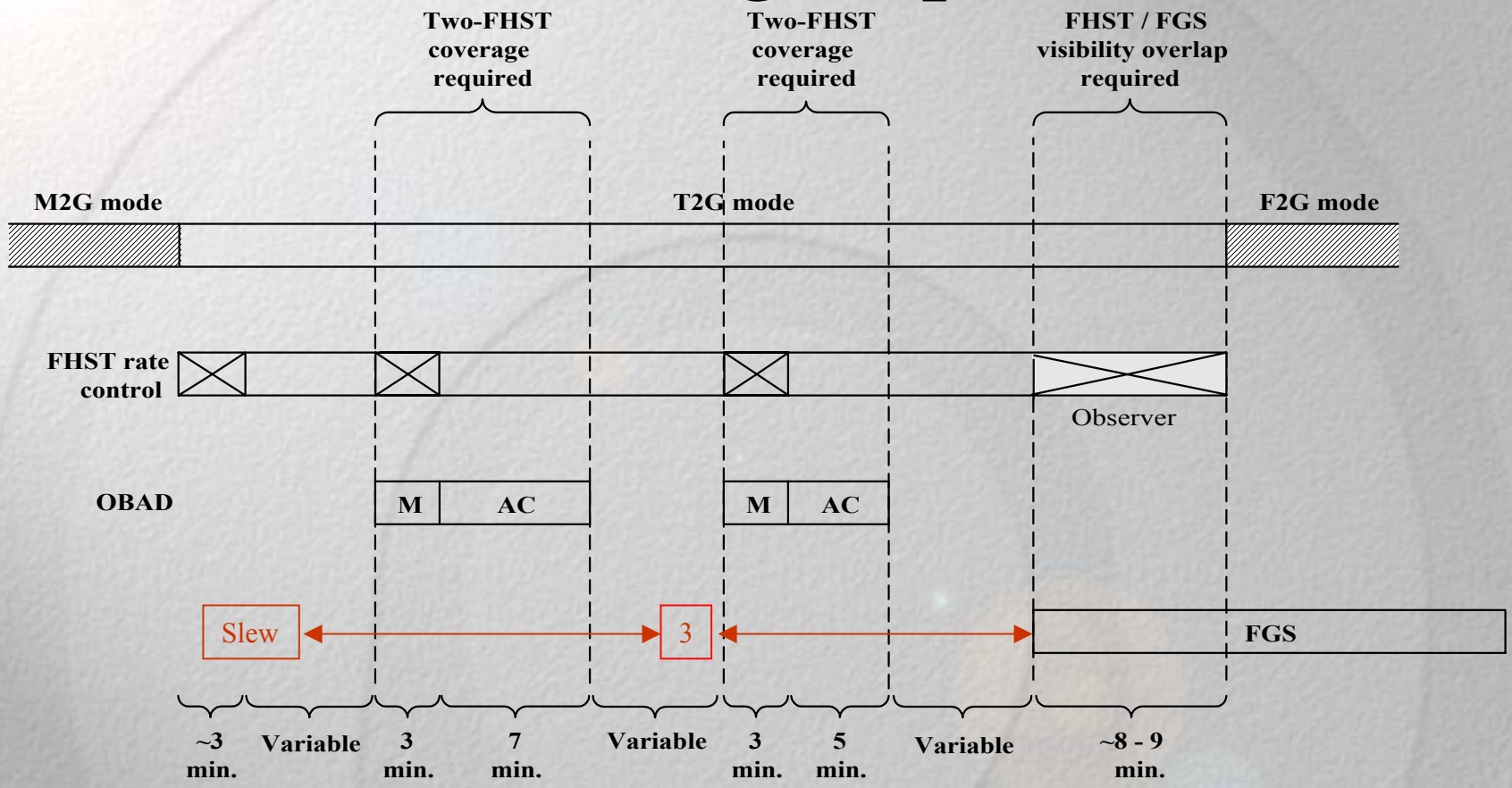
Two Gyro Implications

What do we do with the science program after entry into two gyro mode?

Impact of Two Gyro operations on the HST Science program

- Most current visits will not schedule due to longer Guide Star acquisition times (simple problem)
  - Packed orbits may not accommodate extra duration
  - Would require small tweaks by observers (~ 5 minutes/visibility)
  - Would require iteration with many observers
- Most current visits will not schedule due to FHST requirements (difficult problem)
  - GO specified scheduling requirements (ORIENT, BETWEEN, etc.) imply a time of year and roll angle restriction for visits
  - These will conflict with FHST visibility requirements
  - Will frequently require substantial redesign of observing strategy by observers
  - Most targets will have schedulability (number of days per year when observation can be executed) reduced by more than a factor of two

FHST scheduling requirements



Legend:

- ✕ = **No rate control handoff allowed**
- **M** = **Map**
- **AC** = **Attitude correction**

3 = 3-axis update, anytime between end of slew and start of GS Acq
Currently, 80% of GS Acqs have 3-axis update prior to GS Acq.

Impact of Two Gyro operations on the HST Science program

- Net result is the current science program at the time of Two Gyro mode entry will be largely unusable in the state it is in
- Need to develop strategy for transition from normal science program to one supported by Two Gyro mode
  - Keep HST scientifically productive
  - Get back to broad, peer-review program as soon as possible
  - Could happen at any time

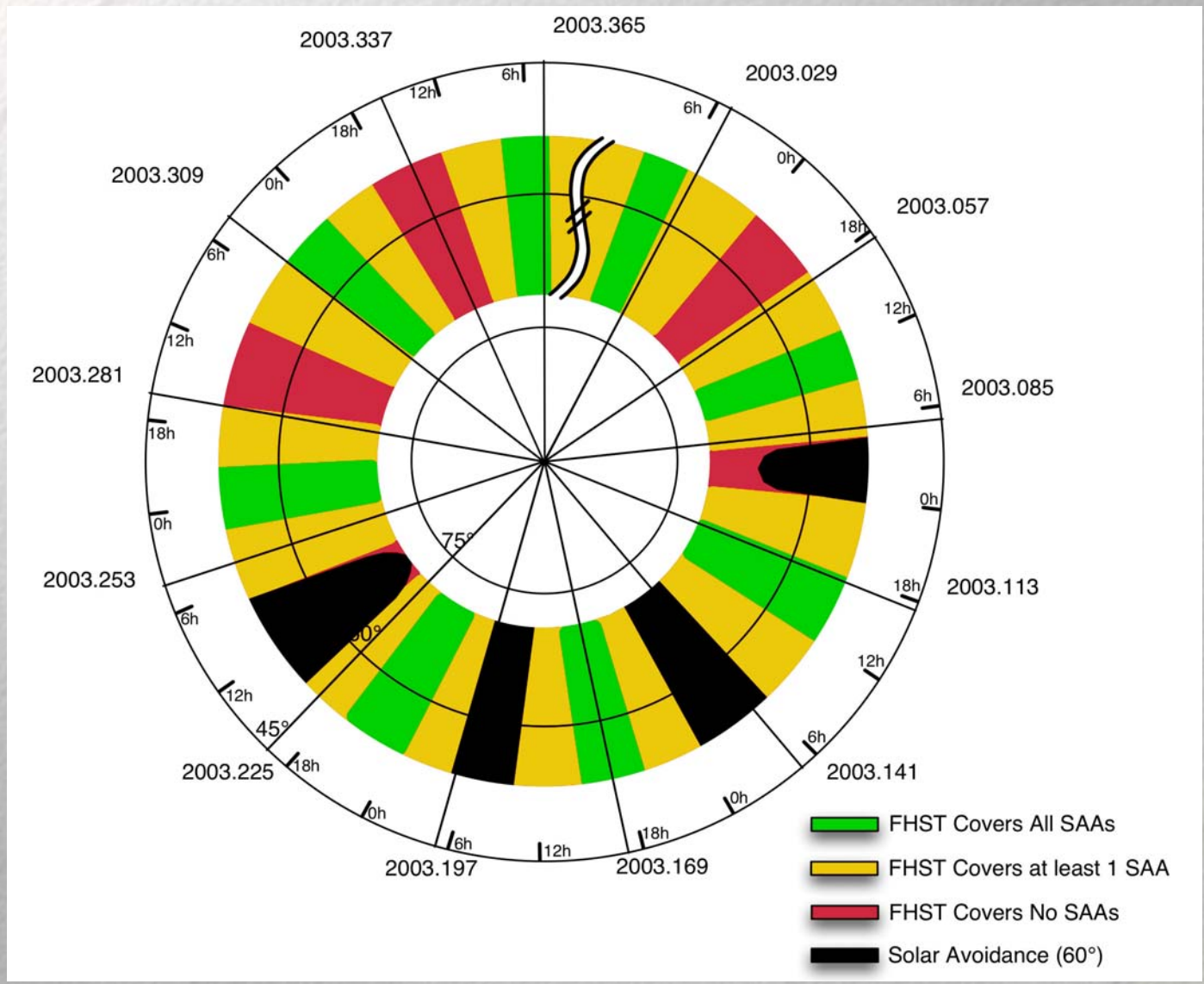
Concept for use of Two Gyro mode

- Initial operations period using CVZ (continuous viewing zone) – several months
- Widen target pool with programs/visits rebuilt by observers – several months
- Full sky availability, but limited by FHST scheduling requirements –
  - Probably at next full GO cycle (requires Two-Gyro Phase II implementation)
  - Will depend on timing of cycles relative to two-gyro entry and to SM4

Why use the CVZ ?

- CVZ provides long, continuous observing periods
  - ~ 12 hours between SAA impacted orbits
  - > 1 day if SAAs can be bridged with FHST coverage
- Relatively easy to schedule initial operational tests and science observations
  - FGS is always available, removes one scheduling constraint
  - Test and science programs are not sensitive to acquisition times, we can start with very conservative values
  - Well defined region for target selection, with 56 day repeat cycle
- Can facilitate some performance evaluations
  - Jitter vs. orbital effects
  - Jitter vs. Guide Star magnitude
  - Use of FHSTs to cover SAAs (possibly occultations)

Northern FGS CVZ -Nominal Roll



Science program in CVZ

- Use of CVZ will allow some advance work to be done
  - Target locations restricted
  - Any given target in the CVZ will be viewable within 56 days of entry into Two Gyro mode
- Expect to concentrate on relatively long observations to take advantage of CVZ
- Likely to be non-proprietary observations, similar to HST Treasury Programs
- Policies and processes to be worked with:
  - Space Telescope Users Committee (November 7)
  - Astronomy community
  - HSTP

Widening target pool

- Start with T2G coverage of SAA passages during CVZ observing
- Adjust timing restrictions for FHST coverage based on performance evaluation
- Re-work applicable GO programs to adapt to guide star acquisition times and FHST scheduling requirements
- Begin scheduling non-CVZ visits as they are available and can be scheduled

FY05 Planning

Development of FY05 plans

- Need to accommodate budget decrease in FY05
  - STScI planning assumed we would enter a period of declining budgets after SM4 (assumed to be in FY04)
  - SM4 timing is unclear, no additional resources are expected for the delay
  - Need to adjust for higher indirect rates due to lower business base as a result of smaller JWST effort
- Internal STScI planning process is in progress
  - Working groups have looked at tactics and strategies in different areas
  - Developing an overall HST Mission strategy
- Some changes may affect community/science program

General trends to expect

- Reduced development activity, limited changes to basic systems
  - Data processing will stay within new architecture
  - APT will see fewer changes in cycle 14 and beyond
  - Planning systems will stay within current architecture
  - Risks to system maintainability will accumulate (Operating Systems, staff retention, etc.)
- Tighter operations environment
  - Concentrate effort on primary activities, with less margin
  - Less opportunity for special support situations
  - Drop “nice to do” support items – not all services that have been traditionally provided will continue
- Focus on most important areas of scientific support

Instrument support

- STScI has traditionally supported all modes of all Instruments
  - Major exception with STIS
- STScI has traditionally adjusted support levels based on instrument/mode utilization each cycle
- We will need to further concentrate our support in those areas that provide the highest overall scientific return
  - Do not support overlapping modes, make a choice
  - Follow the proposal pressure

Instrument Support

- Over the next 6 months, we need to develop the process for prioritization of Instrument support
  - Solicit STUC input on process and outcome
- There may be a role for expanding the Calibration Outsourcing program
  - Response has been relatively light
  - Source of funds

Pure Parallel Observations

- Concept for parallel operations dates from early ’90s
  - Get additional diffraction limited images while observing with small aperture SIs
- Current science program has many surveys
  - Large/Treasury programs
  - ACS (and WFC3) are designed for surveys
- Pure parallel observations do have a cost
  - ~ 1/3 of total data volume
  - Requires scheduling effort every week
  - Requires PC and software effort every year
  - Scheduling becoming less effective as number of high data rate SIs increases

Pure Parallel Observations

- Considering dropping pure parallels, and focusing on coordinated parallels
  - Must support coordinated parallels anyway
  - Large and survey programs are likely the most useful for parallel observations
- Two internal working groups formed
  - One led by Marc Postman will evaluate scientific issues
  - One led by Alan Patterson will evaluate technical issues
  - STUC participation is invited
  - Plan to make a decision ~ January