HST Status

Ken Sembach

STUC Presentation
October 18, 2007

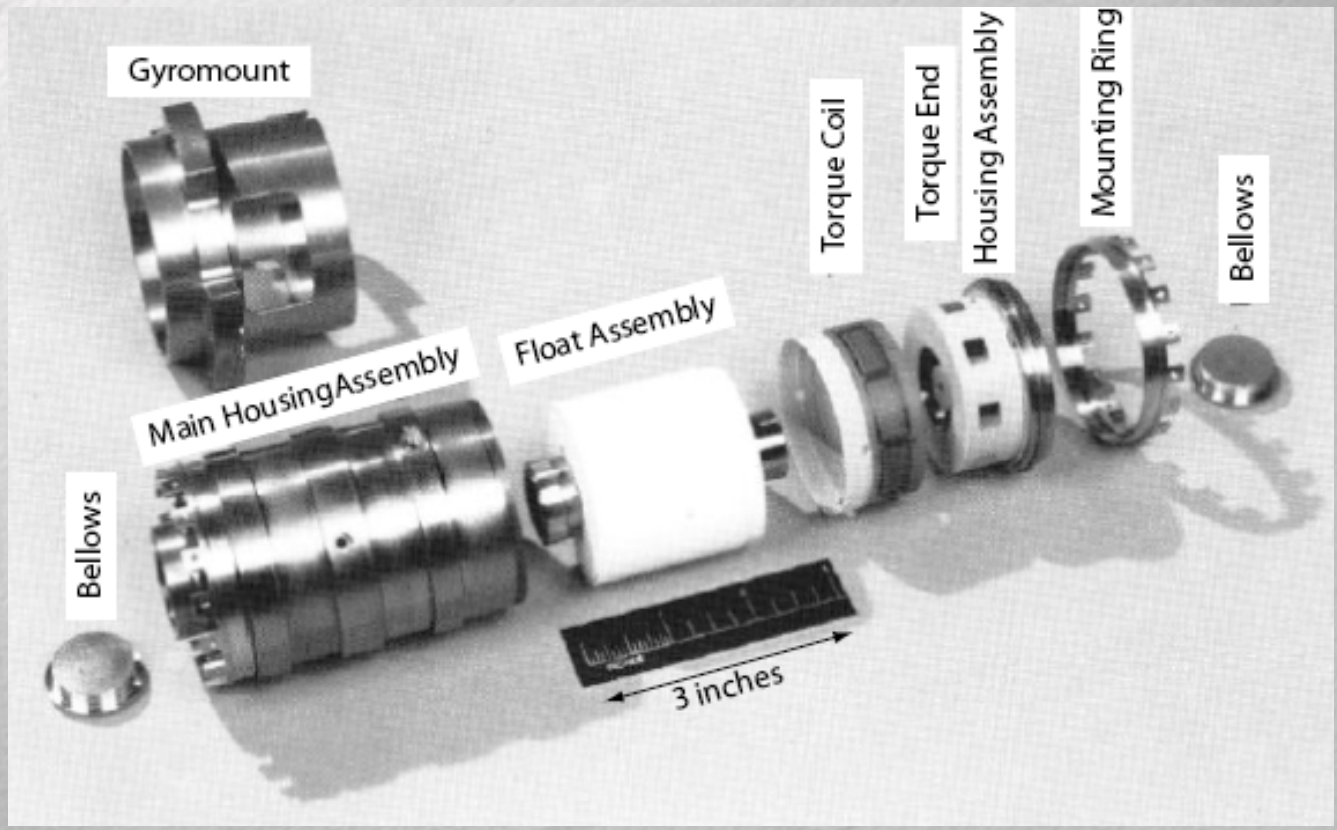
Outline

- Recent gyro failure
- Recent NICMOS safing
- Cycle 16 long range plan
- Instrument status
  - STIS, ACS, WFPC2, NICMOS, FGS
  - COS and WFC3 covered in separate presentations
- Staffing for SM4
- Lunar initiative support

Gyro 2 Failure

- HST entered zero-gyro sun-point safe mode at ~7 PM EDT on August 31, 2007
- Gyro 2 failed on-board sanity check on counts
  - HST responded as expected
  - Eventual failure of Gyro 2 was anticipated
    - HST had reached approximate date of 50% probability of 4 working gyros
  - Most likely cause: flex lead failure
    - Corrosion of thin electrical wire (“traditional” flex lead, no silver plating)
    - Corrosion a function of current, diffusion rates, wire inhomgeneities
    - Had improved fluid and fluid fill process (pressurized nitrogen vs. air)
  - Restart of Gyro 2 was deemed infeasible (failure permanent)
- Gyro 6 was powered on at ~2 AM EDT on September 1, 2007
  - Gyro 6 had been turned off early in its lifetime
  - Gyro 6 shows some bias drift (noise)
  - Gyro 6 bias is settling slowly (1-2 months expected)

Gas-Bearing Gyroscope

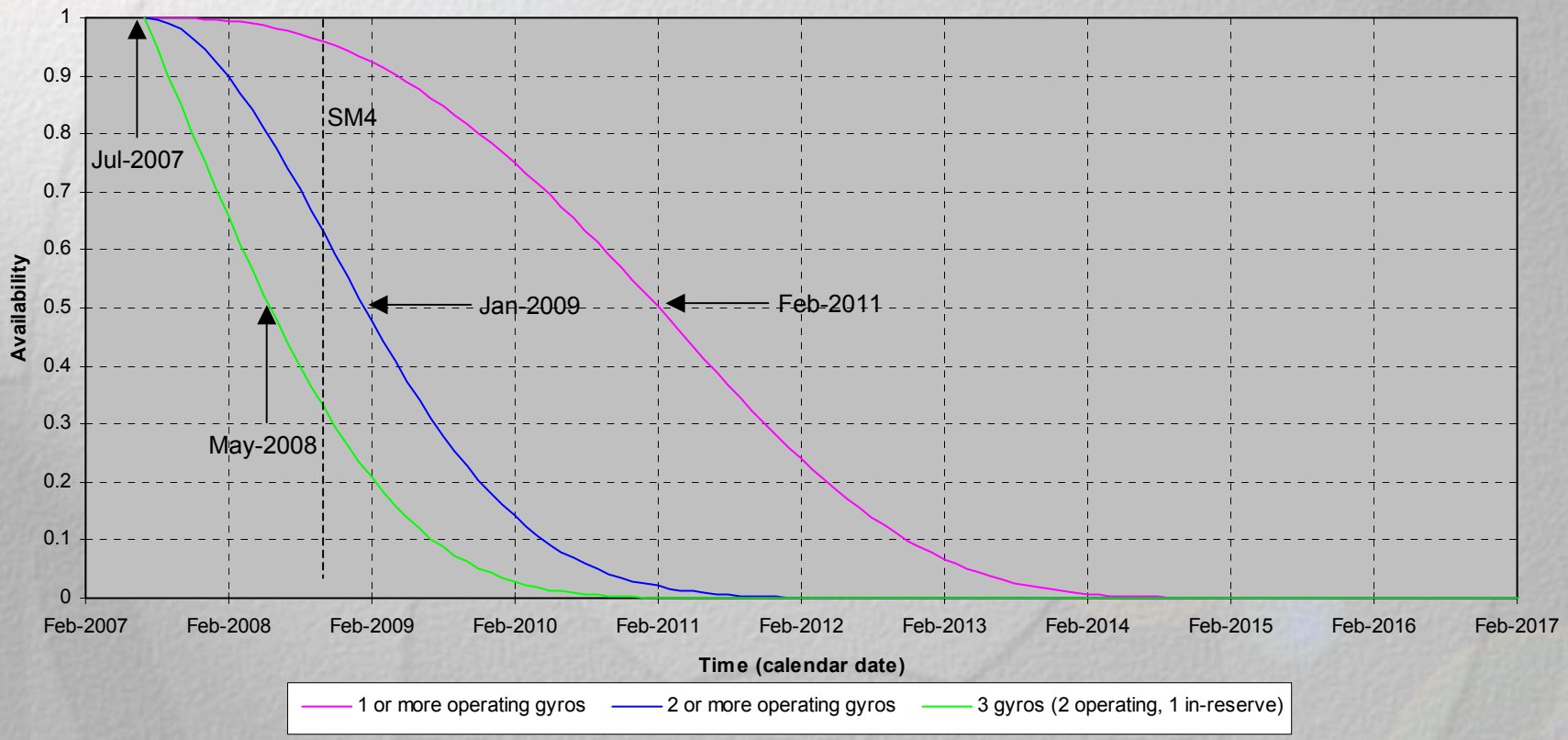


Gyro Status

- Full complement of gyros (6) was replaced during SM3A in December 1999
- Gyro run times as of August 31, 2007
  - G2 57315 hours - failed, 31-Aug-2007, flex lead
  - G4 53505 hours - operational, turned off 28-Aug-2005
  - G1 45578 hours - operational, powered
  - G3 33197 hours - failed 29-Apr-2003, rotor restriction
  - G5 16126 hours - failed 28-Apr-2001, rotor restriction
  - G6 12547 hours - operational, powered
  - Mean time for flex lead failures is 41800 hours
- All 6 gyros (3 rate sensing units - RSUs) are slated to be replaced during SM4 during EVAs 1 and 2.

Gyro Lifetime Estimates

Chart below shows approximate gyro failure probabilities assuming a gyro failure in July 2007 (close to time of Gyro #2 failure)



Predictions from Helen Wong (Aerospace Corp)
as communicated to Art Whipple (HSTP)

One-Gyro Mode Preparations

- One-gyro mode is in an advanced stage of preparation, work begun in mid-2005
- One-gyro mode is expected to perform as well as two-gyro mode
  - Target availability should be similar to two-gyro mode
  - Jitter expected to be slightly larger than in two-gyro mode, but still very good
- Current plan is to power on Gyro 4 if either Gyro 1 or Gyro 6 fails prior to SM4
- Gyro 2 failure has not significantly altered one-gyro work schedule
  - On-orbit test currently planned during week of January 28, 2008

Impact to Science

- Safing occurred near end of week (late Friday)
  - ~25 orbits of science deferred
- Health and safety SMS loaded September 1, 2007 (Saturday)
- Science SMS loaded September 2, 2007 (Sunday)
  - All WFPC2
    - Time-critical WFPC2 orbits from previous week were rescheduled
  - No NICMOS orbits because of unrelated NICMOS safing event
    - ~20 orbits of science deferred with no NICMOS during WFPC2 anneal cycle
- The team here and at GSFC did a great job to allow a speedy recovery!

NICMOS Safing

- NICMOS entered safe mode at ~11 PM EDT on September 1, 2007
  - NICMOS was in SAA/Operate mode as a result of previous HST safing
  - No NICMOS activities at the time of event
- Cause: Single event upset (SEU) affecting the engineering data buffer, a CPU register, or a memory location
  - Appropriate response to empty A/D FIFO is to safe instrument
  - "Verified" on VSTIF ops bench
  - Recommended action was to recover from safe mode
- NICMOS was brought up to SAA/Operate mode
  - Telemetry nominal
  - Normal engineering data process functioned as expected
- Buffer box temperatures were raised to nominal values
  - Had been running cold due to NICMOS inactivity
  - Brief transition to Operate and back to SAA/Operate to refresh buffer box telemetry
- NICMOS science resumed with SMS loaded September 9, 2007

Cycle 16 Long Range Plan

LRP built	Complete through	Total orbits	Through 08.220	08.220 – 08.255	08.255 – 09.068
July 7	07.203	4470	3375	349	746
Aug 16	07.238	4052	3040	277	735
Sep 10	07.267	3764	2793	236	735
Oct 10	07.295	3576 (1)	2661	229	686 (2)

Post-SM4 Instrument Breakdown

Instrument (prime)	Orbits (08.220–08.255)	Orbits (>08.255)
FGS	6	21
ACS/SBC	36	210
WFPC2	124	0
NICMOS	87	455
Total	229 (3)	686

Notes:

(1) - new to the LRP: 140 orbits of Cycle 16 calibration

(2) - 49 orbits moved forward to fill under-subscriptions

(3) - 24 orbits have both NIC and ACS prime

Cycle 16 Tail

WFPC2 prime visits past 08.220 (SM4)

- Programs that will be less than 10% complete at SM4:
  - Leave post-SM4 visits alone; they will be converted to WFC3.
- Programs greater than 90% complete at SM4:
  - Leave post-SM4 orbits alone; program considered complete. PI can appeal for reinstatement of orbits to TTRB.
- Programs between 10-90% complete at SM4:
  - Move forward if possible.

Important Cycle 17 Dates

- CP release: December 3, 2007
- Phase I deadline: March 7, 2008
- TAC/Panel meetings (at STScI/JHU): May 12-16, 2008
- Phase II deadline: July 3, 2008
- SM4: August 7, 2008
- First science observations: SM4 + ~4-6 weeks (TBD)
- End of Cycle 17, start of Cycle 18: January 1, 2010

HST Instrument Teams

- New team structure put in place within INS in late April 2007 (new since last STUC meeting)
- COS and STIS combined into single team
- ACS and WFPC2 combined into single team
- Team leads:
  - ACS+WFPC2: Marco Sirianni
  - COS+STIS: Alessandra Aloisi
  - NICMOS: Anton Koekemoer
  - WFC3: John MacKenty
  - Telescopes: Roeland van der Marel

SMOV & Cycle 17 Preparations

- SMOV
  - Activities defined, and activity descriptions written
  - HST Project review of SMOV plan held on October 12, 2007
- Instrument Handbooks under revision for Cycle 17
  - ACS - completed
  - NICMOS - in final review
  - STIS - nearing completion
  - COS & WFC3 - in progress (first handbooks)
- ETC testing underway

STIS Status

October 2007

STIS Data Enhancement

- All STIS data have been reprocessed ~ 120,000 data sets
- Associations were redefined for 1654 datasets to allow these science datasets to use GO-specified wavecals during calibration
  - Re-associations for 336 data sets waiting for an OPUS software update (expected late October)
  - A few other problem data sets to also be rerun after update
- OTFR has been turned off for STIS
  - Static archive now used to satisfy data requests
  - Retain ability to recalibrate and update static archive if future calibration improvements needed
    - Anticipate only limited updates
- OTFR will be turned on for data obtained post-SM4
  - Improvements (like the association updates) will be included

STIS Documentation

- Complete revision of STIS Data Handbook published in July 2007
- New STIS Instrument Science Reports:
  - ISR 2007-04: wx2d: A PyRAF Routine to Resample Spectral Images

    L. Dressel, 22-Aug-2007
  - ISR 2007-03: Time Dependent Trace Angles for the STIS First Order Modes L. Dressel, 17-Aug-2007
  - ISR 2007-02: Changes in the STIS FUV MAMA Dark Current

    C. Proffitt, 06-Aug-2007

STIS Repair

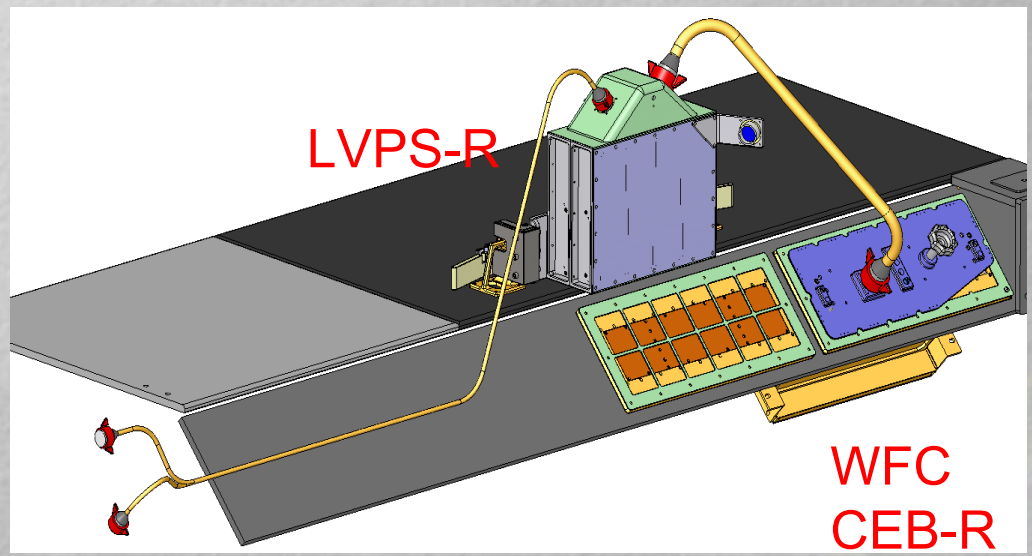
- Flight hardware manufactured
  - LVPS-2R replacement card (2 flight copies)
  - MEB replacement cover
- Hardware undergoing functional and environmental testing
- STIS Cooling System dropped from SM4
  - Minimal benefit for EVA time and resources required
- Aliveness and Functional tests to be run for a repaired STIS during SM4 have been defined

ACS Status

October 2007

ACS-Repair

- Goals:
  - Restore WFC functionality under side-1 (LVPS failed in June 2006) by replacing the 4 WFC CEB cards with a new module (CEB-R) powered by a new LVPS (LVPS-R)
  - Restore HRC functionality by backpowering the existing HRC CEB (success depends on the status of the existing wire harness within ACS)
  - Requirement: do no harm to SBC
- ACS-R passed CDR on Oct 3-4, 2007



ACS-R Schedule Highlights

- Testing with the first engineering module of CEB-R and ACS flight spare CCDs will start on October 25, 2007
- Flight LVPS-R ready mid-January 2008
- Flight CEB-R ready early March 2008
- Servicing Mission Ground Testing (SMGT) at end of February 2008 (possibly a second test with fully flight-hardware
- Thermal vacuum testing - April 2008
- Shipment to KSC - June 9, 2008
- Launch - August 7, 2008

ACS - STScI Activities

- Support ground calibration and identify areas where science operations may need modification (commanding, proposal preparation, data processing)
- Define and support the functional test to be executed during SM4
- SMOV planning and on-orbit re-commissioning

ACS SMOV

- Sixteen calibration activities executed during SMOV will be complemented by Cycle 17 calibration programs
  - Activity descriptions have been completed and reviewed

- Cycle 17 will contain a new “CCD optimization program” that may allow the possibility of reducing the noise of the WFC CCDs.
  - This program will be executed promptly if the noise measured during the SM4 Functional Test is not satisfactory.
  - Unless needed immediately, new readout modes will be deferred until Cycle 18
    - Full characterization is necessary to determine the impact on noise, CTE, cross-talk, etc.

ACS Documentation

- New Instrument Science Reports
  - ISR 2007-02: WFC Zeropoints at -80C

    J. Mack et al., 03-May-2007
  - ISR 2007-03: ACS CCDs UV and Narrow-band Filters Red Leak Check

    M. Chiaberge and M. Sirianni, 16-May-2007
  - ISR 2007-04: ACS/WFC: Differential CTE Corrections for Photometry and Astrometry for Non-Drizzled Images

    V. Kozhurina-Platais et al., 08-Jun-2007
  - ISR 2007-05: Detection of Optical Ghost in the HST ACS Solar Blind Channel Filter 122M

    K. Collins et al., 04-Jun-2007
  - ISR 2007-06: Photometric Calibration of the ACS CCD Cameras

    R. Bohlin, 12-Jun-2007

ACS Documentation

- New Instrument Science Reports (continued)
  - ISR 2007-07: Calibration of ACS/WFC Absolute Scale and Rotation for Use in Creation of a JWST Astrometric Reference Field

    R. van der Marel et al., 05-Jul-2007
  - ISR 2007-08: Variation of the Distortion Solution of the WFC

    J. Anderson, 18-Sep-2007
  - ISR 2007-09: Two astrometric fields for UV observations (ISR 07-09)

    J. Maiz-Apellaniz, 05-Sep-2007
  - ISR 2007-10: ACS Polarization Calibration - Data, Throughput, and Multidrizzle Weighting Schemes

    M. Cracraft and B. Sparks, 20-Aug-2007
  - ISR 2007-11: Calibration of Ramp Filters Using the ACS Grism

    A. Fruchter, 18-Sep-2007

WFPC2 Status

October 2007

WFPC2 Status

- WFPC2 continues to perform well and is operating nominally
- The third temperature reduction of the WFPC2 replacement heater occurred in August 2007
  - Mitigates the effects of the WF4 anomaly
  - One additional adjustment is planned for February 2008
  - ISR2007-01: Temperature Reductions to Mitigate the WF4 Anomaly
    W. V. Dixon et al. 18-Apr-2007
- Dolphin 2004 CTE correction formula validated for data taken in 2007
  - The extrapolation works remarkably well
  - Andy Dolphin has been awarded an archive outsourcing program in Cycle 16 to review the formula with data taken after 2004
  - The WFPC2 team is in close contact with Dolphin and does not plan an independent revision of the formula
- Closeout plans have been defined
  - Most WFPC2 data has already been obtained (modulo remaining Cycle 16)

WFPC2 Reprocessing

- The following improvements are being made to CALWFPC2 to support the final reprocessing of all WFPC2 data for the static archive (starting Spring 08):
  - *UV throughput correction*
    - A new keyword will contain the correction to apply to the zeropoint to take into account the time-dependent UV contamination
  - *WF4 photometric correction* (completed)
  - *WF4 bias streak removal*
    - Algorithm is being tested
  - *CTE warning*
    - A new keyword will contain the amount of CTE loss expected for a point source in the middle of the chip with a given signal level
  - *Pydrizzle*
    - For each image, the pipeline will produce a new geometrically corrected 4-chip mosaic in the FITS image format.

NICMOS Status

October 2007

NICMOS Status

- NICMOS has been on-orbit for 10 yrs, post-NCS 5 yrs
  - >100,000 datasets in archive
  - Continues as major science instrument in Cycles 15/16
  - Expanded effort to characterize instrument as fully as possible
- Calibration:
  - Expanded normal calibration program (additional flats, darks)
  - Special close-out calibration programs (photometry, grism, distortion)
  - New reference files being delivered (time-dependent flatfields, etc)
- Software:
  - Completed: SAAclean, Staypuft, count-rate-dependent non-linearity
  - In progress: calnica improvements, temperature from bias
  - Near-term: pedestal correction, amp glow persistence, electronic shading

Expanded NICMOS Calibration Programs

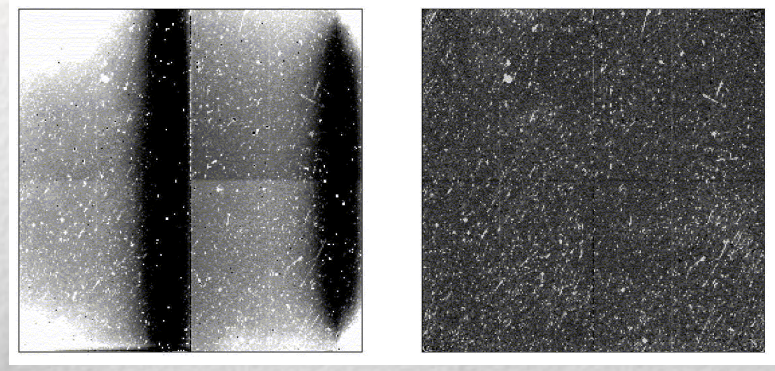
- Cycle 16 normal calibration programs expanded:
  - Improved flatfields:
    - All filters, all 3 cameras
    - Multiple epochs to enable time dependence
  - Substantially expanded darks (400 orbits):
    - Cover all widely used SPARS/STEP readout sequences and timing patterns
    - Repeat observations across ~20 epochs
    - Improves temperature-dependent darks, reduce reliance on synthetic darks
- Special “legacy” calibration programs
  - Improved photometric non-linearity calibration in all cameras
  - Photometric cross-calibration
  - Revised geometric distortion
  - Improved grism calibration across entire detector

Special “legacy” Calibration Programs

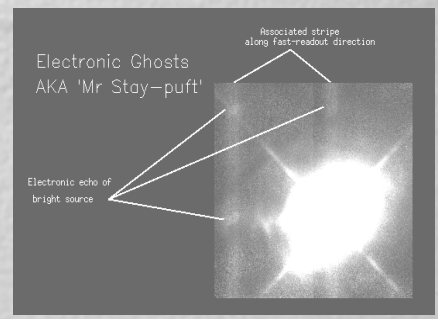
- Spectrophotometric standards
  - Grism spectroscopy of primary and secondary standards
  - Imaging of grism standards to provide cross-calibration with WFC3, JWST, other future missions
- Improved grism calibration
  - Grism zeropoint/dispersion are only well characterized at nominal position
  - To improve legacy science value, characterize across entire detector:
    - Evidence suggests that errors up to a few pixels exist
    - Can be readily calibrated by placing targets at different locations on detector
- Geometric distortion
  - Evidence for changes of ~1-2 pixel since the last geometric distortion measurements (pre-2002)
  - Observe astrometric standard field (NGC1850), aim for <18mas accuracy

NICMOS Calibration Software Work

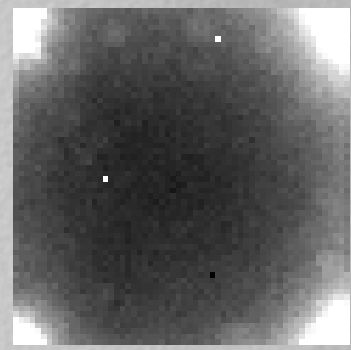
- SAA-impacted CR persistence



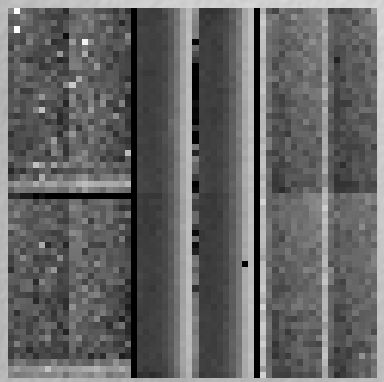
- Electronic ghosts ("Mr. Staypuft")



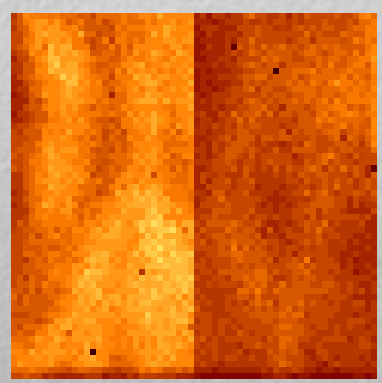
- Amplifier glow



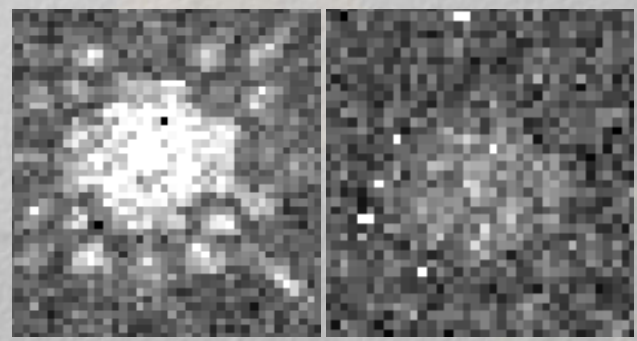
- Electronic shading



- "Supershading"



- Bright object persistence



NICMOS Documentation

- Completely updated website
- New Instrument Science Reports
  - ISR 2007-001: Removing Post-SAA Persistence in NICMOS Data

    E. Barker et al., 15 May 2007
  - ISR 2007-002: NICMOS Time Dependent Flat-fields

    T. Dahlen et al., 29 Jun 2007
  - ISR 2007-003: NICMOS Focus Update

    H. McLaughlin and T. Wiklind, 29 Jun 2007
  - ISR 2007-004: NICMOS Cycle 15 Baseline Calibration Plans

    N. Pirzkal et al., 16 Jul 2007

FGS Status

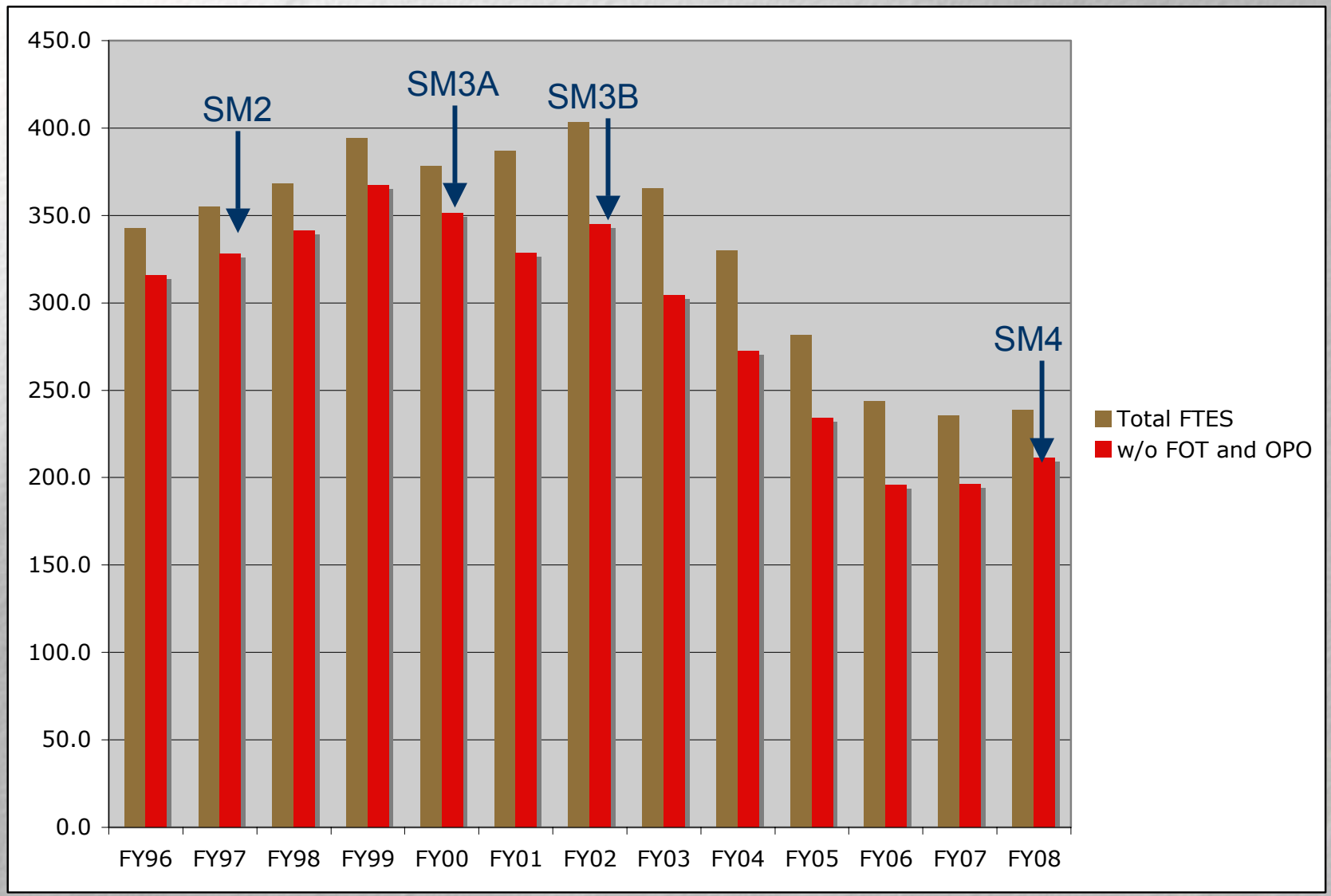
October 2007

FGS

- FGS3 is exhibiting gradual degradation related to coarse track cycles on a servo bearing
  - Lifetime is limited by this degradation
- For several years we have been biasing guide star selections away from FGS3 after the observing calendar is built
  - Reduced FGS3 usage by about 1/3
  - Currently use FGS3 for ~26 acqs per week
- Preparing a process to avoid using FGS3 unless necessary
  - Should reduce usage to ~15-18 acqs per week
- OTA group at GSFC is also looking into reducing coarse track cycles for secondary stars
  - Plan is to use FGS3 only as secondary, not as primary

STScI Staffing for SM4

Staffing Trend



Staffing Trend

- SM4 will be carried out with a substantially smaller overall staff than previous SMs
- Major areas with fewer staff:
  - Software maintenance and test
  - Operations
  - Engineers (2 vs. ~6-8)
  - Commanders (2 vs. ~6-8)
- Instrument support will be stressed
  - All 5 instruments affected
  - No WFC3 IDT team

Current Staffing for HST Instruments

Team	Instrument Scientists & Engineers[1]	Data Analysts[1]	Total[1]
COS[2]	3.9	0.6	4.5
STIS[2]	1.3	0.2	1.5
WFC3	7.5	2.5	10.0
ACS[3]	1.5	3.0	4.5
WFPC2[3]	5.5	3.0	8.5
NICMOS	3.5	2.5	6.0
HST Observatory	3.0	0.0	3.0
Total	26.2	11.8	38

[1]Entries are FTEs, and do not include research time.
[2]The COS+STIS team shares personnel that work on both instruments.
[3]The ACS+WFPC2 team shares personnel that work on both instruments.

Expected Staffing in August 2008

Team	Instrument Scientists & Engineers[1]	Data Analysts[1]	Total[1]
COS[2]	5.5	2.0	7.5
STIS[2]	2.5	1.0	3.5
WFC3	9.0	4.0	13.0
ACS[3]	5.7	4.5	10.2
WFPC2[3]	1.3	1.5	2.8
NICMOS	3.5	2.0	5.5
HST Observatory	4.0	0.0	4.0
Total	31.5	15	46.5

[1]Entries are FTEs, and do not include research time.
[2]The COS+STIS team shares personnel that work on both instruments.
[3]The ACS+WFPC2 team shares personnel that work on both instruments.

Strategy for Increasing Support

- Our subcontract with JHU provides 3.0 FTE.
  - Comprises 6 half-time scientists with FUSE and ACS experience.
  - All personnel in place and contributing.
- Recruiting 3 new DAs for HST support.
- Recruiting 4 Term-hires, Visiting Scientists, or permanent staff.
  - Final mix depends on qualifications of the applicant pool.
  - 1 Term-hire position filled, to start in November.
  - 19 term-hire and 4 Visiting Scientist applicants being vetted by the Science Recruitment Committee.
  - Permanent staff recruitment ad open until December 1.
  - Goal is to have new term hires in place by early 2008.
- Recruiting 4 ESA positions, 3 for instrument support.
  - SRC has created a short list of 9.

Strategy for Increasing Support

- Will adjust staffing among instruments as appropriate
  - Results of TAC (May 08) will show relative use of instruments after SM4
  - Results of on-going hardware development may drive some changes
  - Results of SM4 itself may affect priorities and distribution of staff

Lunar Initiative Timeline

- 10-Oct-2007: Call for white papers issued
  - Day after A. Stern's DPS announcement
  - HST website updated accordingly
- 31-Jan-2008: White paper deadline
  - Lunar Advisory Group (LAG) reviews and ranks white papers
- 31-Mar-2008: LAG report to STScI Director
- 01-May-2008: Technical report to STScI Director
  - STScI and HSTP preliminary technical assessment
- 08-Aug-2008: SM4 begins
- 01-Sep-2008: Call for lunar science proposals issued
- 15-Nov-2008: Lunar science proposal deadline
- 21-Jan-2009: Lunar science proposal review
- 01-Feb-2009: Proposers notified of review results
- 15-Apr-2009: Phase II submissions
- Cycle 18: Proposals implemented

Lunar Initiative Support

- User Information Report to be released with Cycle 17 CP
  - To help proposers understand what lunar observations are possible within current operations framework
- STScI and HSTP will work together to determine what operational changes my be needed to support future lunar observations
  - Work will have to be scheduled to avoid conflicts with SM4
  - Initial assessment after white papers are submitted

LCROSS

- LCROSS (Lunar Crater Observation and Sensing Satellite)
  - Goal is to determine whether water ice exists in permanently shadowed regions - polar crater site
  - Scheduled for lunar impact in January 2009
  - Uses Earth-departure upper rocket stage to impact lunar surface
    - Impact creates an ejecta plume subject to solar UV radiation
    - Plume to be observed by LCROSS and Earth-based telescopes
    - LCROSS passes through plume and also impacts surface 10-15 minutes later
- HST observations
  - Goal is to observe OH 3085A emission and possibly hydrocarbons
  - Orbit 1: Timed to observe impact (STIS/CCD?)
  - Orbits 2+: To observe transient OH exosphere over several hours