



HST Status

Ken Sembach

STUC Presentation

June 15, 2009

Last presentation: November 2008



Agenda

- Pre-SM4 activities
- SM4 support
- SMOV overview
- NICMOS/NCS Status
- Cycle 16 Wrap-up and Cycle 17 LRP

Hubble's 19th Anniversary



- April 21, 2009
- “Fountain of Youth” (Arp 194)
- WFPC2 Filters:
 - ◆ F814W, F606W, F450W
- 15+ years of WFPC2 observations

Actions to Keep HST Productive Prior to SM4

- Use of SNAPshot programs
 - ◆ Observed a higher fraction of targets than typical
 - ◆ Encouraged GOs to change/add targets in “good” portion of the sky
 - ◆ 4 programs adjusted targets
- Encouraged submission of FGS DD programs
 - ◆ These programs could be executed without SI C&DH
 - ◆ 3 programs approved for 244 orbits and >300 Supersnaps
- STScI “community service” programs (Leitherer presentation)
 - ◆ Bridged ~ one month gap before Cycle 16 Supplemental programs became available
 - ◆ Two programs with 211 orbits
- Cycle 16 Supplemental solicitation (Leitherer presentation)

Cycle 16 Supplemental Program Status

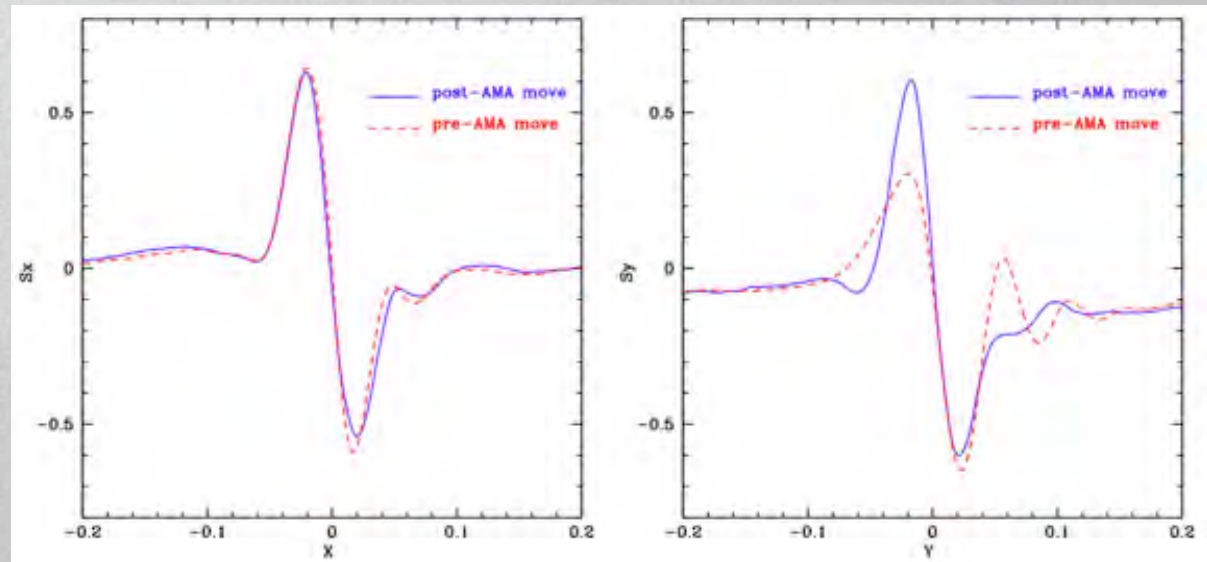
prog	PI	Program Title	Alloc (orb)	Comp (orb)
11972	Meech	Investigating the Early Solar System with Comet Nuclei	85	65
11974	Allam	High-res Imaging for Nine Bright Group-scale Lenses	81	57
11975	Ferraro	UV Sources in Galactic Globular Clusters	177	133
11976	Stecklum	Particle Separation/Expansion of Dust Arcs in V1331 Cyg	4	4
11977	Smith	Proper Motions of Galactic Analogs of SN1987A Rings	3	3
11978	Treu	Luminous and Dark Matter in Disk Galaxies	91	68
11979	Kalas	WFPC2 Imaging of Fomalhaut b	18	18
11980	Veilleux	Deep FUV Imaging of Cooling Flow Clusters	20	15
11981	Maiz Apellaniz	FUV Imaging Survey of Galactic Open Clusters	34	20
11982	Anderson	HST Spectral Survey of Far-UV-Bright Quasars	80	62
11983	Robberto	Protoplanetary Disks and Brown Dwarfs in Chamaeleon I	75	40
11984	Nichols	Observing Saturn's High Latitude Polar Auroras	20	20
11985	Clayton	The Dust Torus Around V605 Aquilae	7	7
11986	Dalcanton	Completing HST's Local Volume Legacy	138	112
11987	Regan	Recent Star Formation History of SINGS Galaxies	98	60
11988	Chandar	Intermediate Mass Black Holes in Globular Clusters	40	40
		TOTAL	971	724 (75%)

Pre-SM4 Activities - Available Instruments

- FGS
 - ◆ FGS1R AMA adjustment
 - ◆ Operational support
- WFPC2
 - ◆ WF4 bias anomaly
 - ◆ Operational support
 - ◆ Close-out and reprocessing (Jenkner presentation)
- ACS
 - ◆ SBC operational support
- NICMOS
 - ◆ NCS anomalies
 - ◆ Close-out and reprocessing (Jenkner presentation)

FGS Operational Support

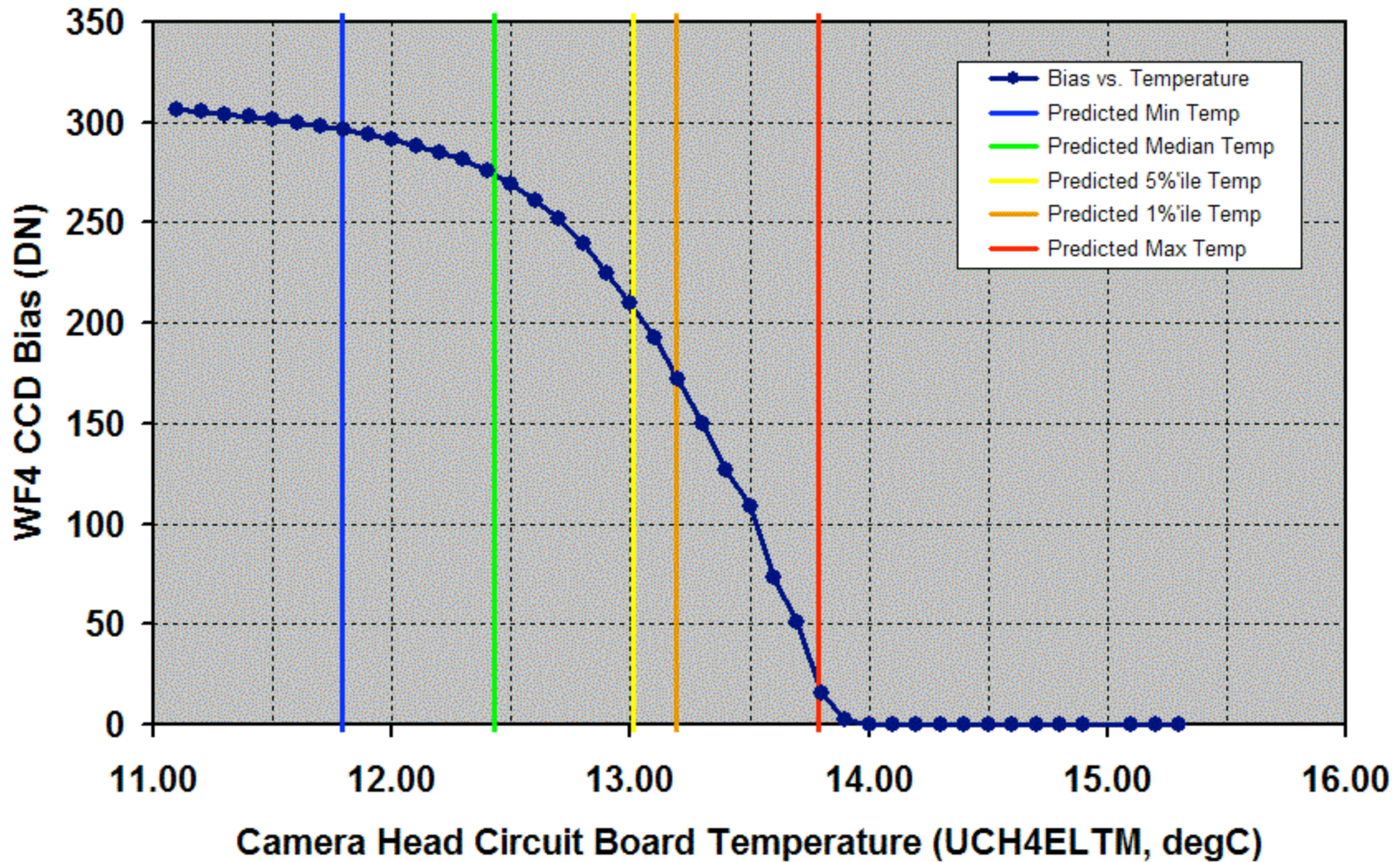
- Supported FGS SNAP and DD programs
- With engineers, reviewed “*Asteroseismology of Extrasolar Planet Host Stars*”, program 11945
 - ◆ Six day nearly continuous observation using a single FGS was reviewed to ensure no impact to hardware
 - ◆ Worked with schedulers to optimize layout of observations
- Adjusted FGS1R articulated mirror
 - ◆ First use in 10 years
 - ◆ Corrects for slight misalignments that likely developed as a result of graphite epoxy desorption



WFPC2 Operational Support

- Reviewed Cycle 16 Supplemental Programs
 - ◆ 13 programs, 806 orbits, (86% of orbits)
- Augmented Cycle 16 calibration program
 - ◆ Extended routine calibrations
 - ◆ Reviewed C16S programs for any special calibration needs
- Active monitoring of WF4 bias situation
 - ◆ Monitor temperature excursions
 - ◆ Bias levels remained acceptable up to SM4

WF4 CCD Bias and Predicted Temperatures - May 2009

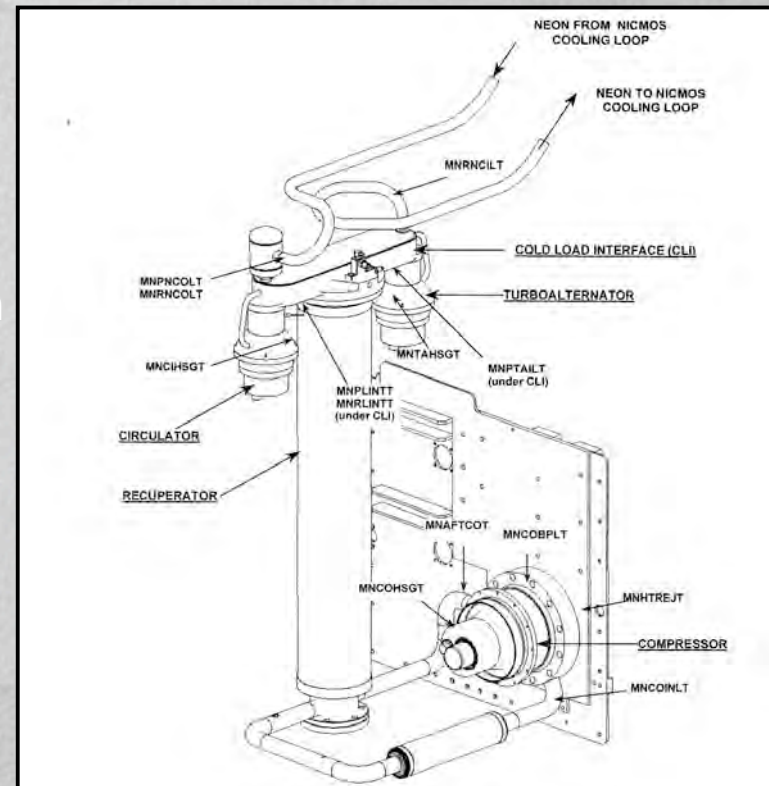


ACS/SBC Operational Support

- ACS Team reviewed Cycle 16 Supplemental Programs
 - ◆ 3 programs, 128 orbits, (14% of orbits)
 - ◆ Bright Object Protection checks, with some help from COS/STIS team
- Augmented Cycle 16 calibration program
 - ◆ Extended routine calibrations
 - ◆ Reviewed C16S programs for any special calibration needs

NICMOS / NCS Support

- NICMOS Cooling System inoperative since it was shut off for a NSSC-1 flight software installation on September 8, 2008
- Several restart attempts in the fall of 2008 failed due to inability to restart circulator loop
 - ◆ Possible culprit: water ice
- Circulator loop successfully restarted in December 2008, but cooling loop shut down due to turboalternator speed violation
 - ◆ Culprit unknown (maybe transient electrical short)
- Briefing held in April, with decision to stand down during SM4
- Restart attempt in late June / early July
- Power may be an issue
 - ◆ Safe NICMOS for extended periods



SM4 Preparations

- STScl was prepared for SM4 and SMOV4 in September
- Additional time prior to SM4 was put to good use:
 - ◆ WFC3 and COS Pipeline verifications
 - ◆ WFC3 and COS Data Handbooks
 - ◆ ACS optimization campaign dry run
 - ◆ SMOV adjustments
 - ◆ SIMs, JISs, and other training
 - ◆ Cycle 17 preparations

Pipeline Verifications

- WFC3 and COS groups conducted extensive testing of calibration pipelines
 - ◆ Primary objective was to verify/improve scientific performance of pipeline
 - ◆ Wide use of Thermal Vac data, as well as test data sets
 - ◆ Verified pipelines on a step-by-step basis
 - ◆ Secondary objective was to catch and fix minor bugs
 - ◆ Automatic processing at STScI
 - ◆ Processing by GO/ARs at home
- Improvements were implemented in software changes and improved calibration files
 - ◆ DMS Build 2009.1 and 2009.2 prior to SM4

ACS Optimization Campaign

- Replacement CCD electronics for ACS includes programmable Teledyne ASIC
 - ◆ Allows and requires adjustment (reprogramming) on orbit
 - ◆ “Oscilloscope Mode” is used to obtain data for a range of voltages and timing settings
 - ◆ SMOV4 plan includes a multi-cycle, multi-day campaign to determine best settings
- End-to-end dry run exercised all components of the campaign
 - ◆ Data processing software, analysis software, people on distributed team, reporting paths, etc.
 - ◆ 4 Cycles were carried out in February-March
 - ◆ Minor issues with proposals/keywords fixed
 - ◆ Timing and analysis plans revised

Other SM4 Related Activities

- SI C&DH-R support
 - ◆ Provided SMS for ground system test of replacement unit
- SMOV4
 - ◆ All proposals were ready for 14 October launch
 - ◆ Some targets had to be changed to support mid-May launch
 - ◆ Calendar rebuilds
 - ◆ Preparations to schedule new instruments after SM4
 - ◆ Commanding updates (correct/improve/document)
- SM4 training
 - ◆ Participated in SIMs and JISs
 - ◆ Planned training/familiarization sessions for those directly supporting SM4, mostly instrument groups and management
 - ◆ Planned general staff training sessions
- STScI Delta Readiness Review held mid-April

General Work

- Exposure time calculator updates
- User support
- Multidrizzle updates (particularly for WFC3)
 - ◆ But also improvements in code / algorithms / formats
- Reference file generation
- etc.....

Cycle 17 Preparations

- Cycle 17 calibration plans finalized
 - ◆ Concern about scheduling opportunities for internal calibrations was addressed with a test using DRM programs and representative internal calibrations
 - ◆ Some adjustments were made to WFC3 plans for internal calibrations
 - ◆ Phase II programs for Cycle 17 Calibration program are complete
- Instrument teams have been reviewing GO programs
 - ◆ Bright object checking
 - ◆ General review

Hubble Servicing Mission 4 (May 2009)

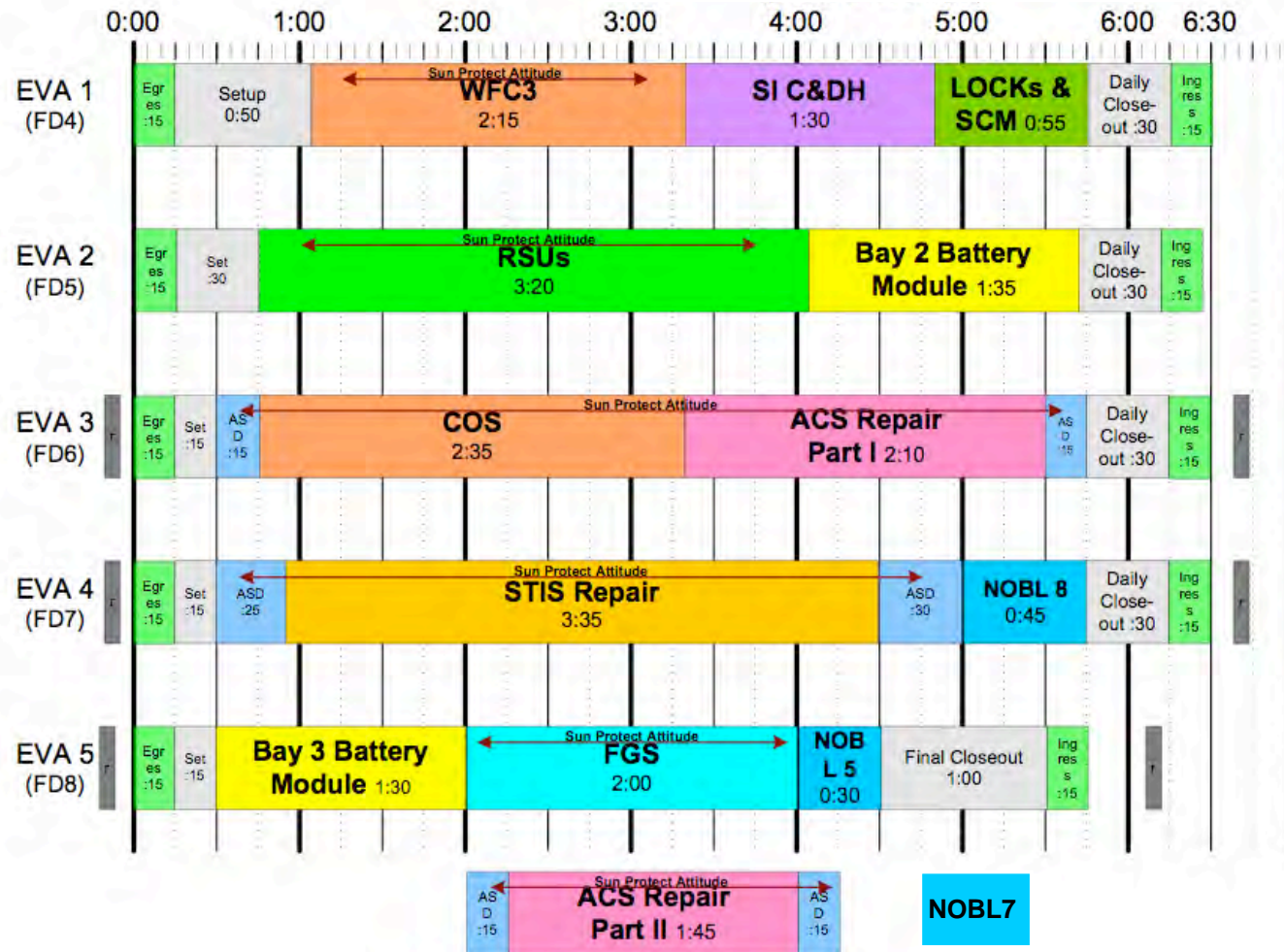


- Two new science instruments
 - ◆ Wide Field Camera 3 (WFC3) and Cosmic Origins Spectrograph (COS)
- Replacement Science Instrument Control & Data Handling Unit
- Replacement of batteries (2 BMAs, 6 batteries)
- Replacement of gyros (3 RSUs, 6 gyros)
- Replacement of one of three Fine Guidance Sensors (FGS2R)
- Repair of the Space Telescope Imaging Spectrograph (STIS)
- Repair of the Advanced Camera for Surveys (ACS)
- New thermal blankets on equipment bays 5, 7, and 8
- Installation of the Soft Capture Mechanism (SCM)



SM4 EVA Manifest

EVA Times



07^h20^m

07^h58^m

06^h36^m

08^h02^m

07^h02^m

36^h58^m total

SM4 Support Team

	<u>Project/JSC</u>	<u>Project/GSFC</u>	<u>STOCC</u>	<u>STScI</u>
Orbit	Mountain	Jenkner	C. Long	Blades
Planning	Hauser	Sembach	Wheeler	Biagetti

	<u>WFC3</u>		<u>COS</u>		<u>STIS</u>		<u>ACS</u>	
	<u>GSFC</u>	<u>STScI</u>	<u>GSFC</u>	<u>STScI</u>	<u>GSFC</u>	<u>STScI</u>	<u>GSFC</u>	<u>STScI</u>
Orbit	Hartig Petro		Lennon Sahnaw Green Penton McPhate		Oliveira Kaiser Woodgate		L. Smith Lucas	Cox Platais Gonzaga
Analysis	MacKenty Bushouse	Baggett Hilbert	Keyes Friedman Osterman	Ake York Beland Froning	Goudfrooij Proffitt Gull Lindler	Lennon Wolfe	Golimowski Mutchler Lim	Maybhate Chiaberge Desjardins

<u>FGS</u>	Lallo/ Nelan
<u>NICMOS</u>	Koekemoer / Wiklind
<u>Commanding</u>	Welty / Dashevsky

Servicing Mission Observatory Verification

- Joint STScI/Project Team for SMOV Planning and Implementation
 - ◆ SI teams, Power and Electrical Systems, Temperature Control Systems, Pointing and Attitude Control Systems, and ERO team representatives
 - ◆ SMOV Working Group Leads: Biagetti (STScI), Burley (GSFC)
 - ◆ Continual integrated plan refinement and resolution of issues
- STScI SMOV Team leads the post-SM4 operations
- Early Release Observations (EROs)
 - ◆ Joint STScI/Project/IDT/HQ team
 - ◆ Planned for late August / early September



Advanced Camera for Surveys ERO - SM3B

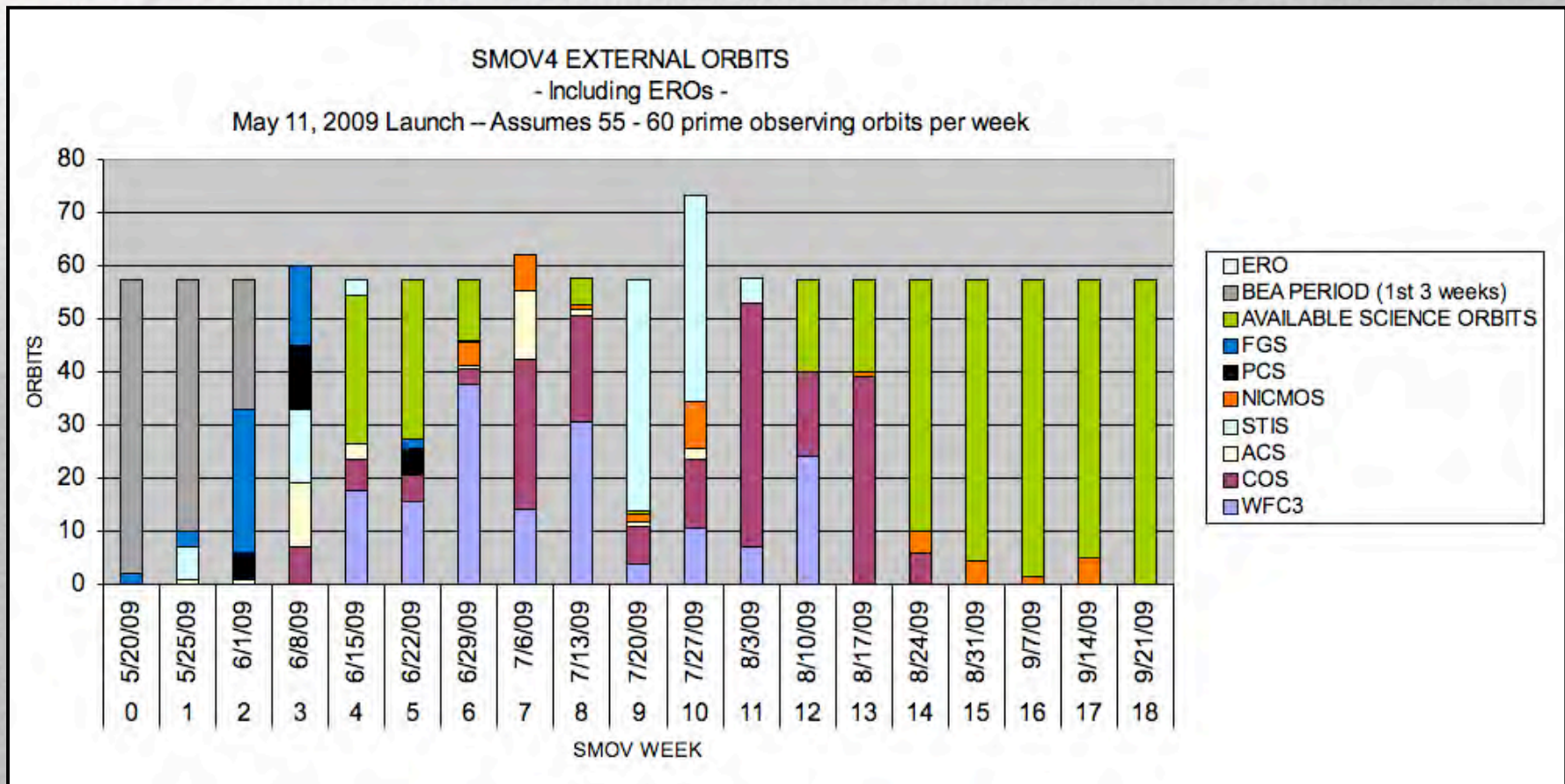
Science and ERO Enabling Dates

- SM4 Launch on May 11, 2009
- SMOV starts on May 19, 2009
- Bright Earth Avoidance (BEA) period ends June 10 (21 days after release)

Instrument Availability Dates for GO Science / EROs (current estimate)			
STIS	CCD		17 Jun
	MAMA		27 Jun
NICMOS	Cameras	To be determined	
ACS	SBC		12 Jun
	HRC	Not recovered	
	WFC		09 Jul
WFC3	UVIS	Outgas	01 Jul (easy) 12 Aug (hard)
	IR	Outgas	13 Jul (easy) 14 Aug (hard)
COS	NUV	Outgas	13 Aug
	FUV	Outgas	27 Jul
FGS	1R		10 Jun (science)
	2R2		29 Jun (guiding)

General SMOV Flow

- Pre-launch estimate of general SMOV timeline
 - ◆ Changing details as SMOV progresses

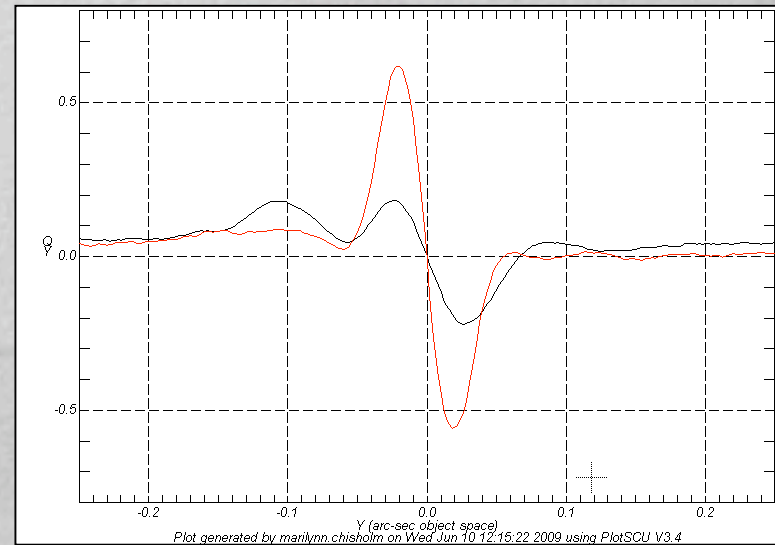
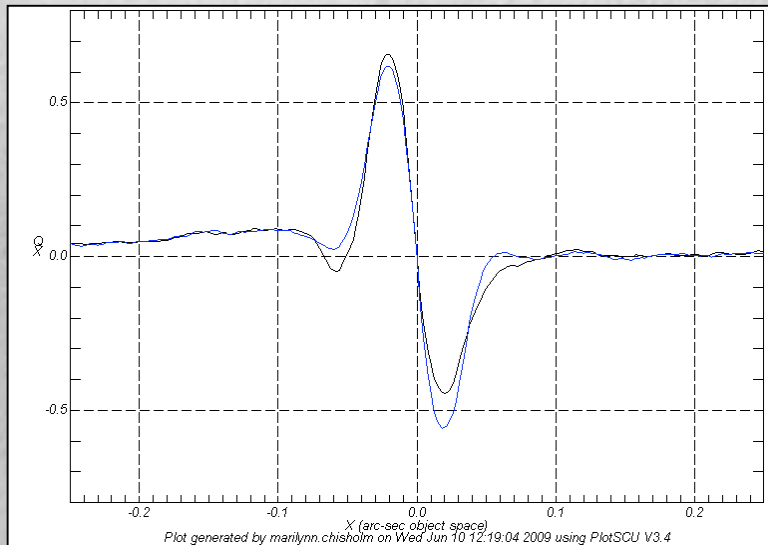


SMOV Progress

- Spacecraft and subsystems performing well
 - ◆ Pointing, guide star acquisitions, thermal, power
- BEA contamination requirement (<5% degradation at UV wavelengths) satisfied
- Outgassing continues slowly after rapid decline
 - ◆ COS pressure dropped quickly after release and is now at $\sim 3 \mu\text{Torr}$
- Detector activities have proceeded smoothly, with only minor exceptions
- Internal calibrations (flat-fields, biases, darks) are being examined for each instrument
- External focus and alignment checks have begun

FGS SMOV Status

- Guide star acquisitions with FGS1r and FGS3 have been successful → good alignment of FGSs and FHSTs
- Pointing and jitter are nominal (~2 mas)
- FGS1r has been re-enabled for astrometry
 - ◆ GO observations already being scheduled
- FGS2R2
 - ◆ FGS is performing well, and commissioning is on schedule
 - ◆ Observations to optimize S-curves are complete



WFC3 SMOV Status

- WFC3 outgassing, now past BEA requirement of 21 days
- Detectors have been cooled to operating temperatures
 - ◆ UVIS CCD: -83 C
 - ◆ IR: -128 C
 - ◆ Temperatures are stable and power use is nominal
 - ◆ UVIS anneal occurs this week
- Mechanism checkouts are in progress this week
 - ◆ Channel select mechanism (CSM) test
 - ◆ Lamp tests
- Internal calibrations and checkout continue this week
 - ◆ Detector functional tests (darks, flats, readnoise, backgrounds)
 - ◆ SAA passage test
- External calibrations begin this week
 - ◆ Initial alignment for both channels

COS SMOV Status

- COS continues to outgas,
 - ◆ Pressure is low enough ($<10 \mu\text{Torr}$) for HV ops
 - ◆ Pressure gauge to be disabled this week (adds noise to darks)
- Detector HVs are being ramped up slowly, deliberately in stages
 - ◆ So far, both detectors are working as expected
 - ◆ NUV dark background is several times lower than predicted
- Initial COS-FGS alignment check of NUV channel occurred 6/11
 - ◆ Alignment and coarse focus of channel look good
 - ◆ Additional NUV fine alignment and focus activities this week
- FUV internal (darks, flats, wavecals) at nominal HV voltage begin this week

STIS SMOV Status

- CCD channel is fully operational
 - ◆ Readout through Amp B (mostly for cals) has high offset (serial DT issue)
 - ◆ Other amps are nominal, with pre-failure performance
 - ◆ Functional tests (darks, biases, flats) demonstrate expected performance
 - ◆ Spectroscopic throughput tests occur this week
 - ◆ GO science will resume soon
- STIS-FGS alignment and focus check occurred 6/5
 - ◆ External CCD observation of astrometric standard
 - ◆ Both were found to be very close to pre-failure values
 - ◆ No alignment or focus corrections needed
- MAMA HVs are being ramped up slowly, deliberately in stages
 - ◆ Nominal performance so far
 - ◆ FUV recovery complete,
 - ◆ NUV recovery to be completed this week
- MAMA optical format, image quality, and spectroscopic throughput checks occur this week

ACS SMOV Status

- SBC operations are nominal
 - ◆ GO science and calibrations have resumed
 - ◆ SBC UV contamination monitor demonstrated minimal contamination of OTA optics
- WFC CCD optimization campaign has completed
 - ◆ Only minor changes to parameters (voltages, clocking, etc)
 - ◆ Optimization deliberately terminated early
 - ◆ External cross-talk and CTE measures obtained last weekend
- WFC activities this week
 - ◆ Functional test (more comprehensive test than during SM4)
 - ◆ Image quality and PSF checks
 - ◆ Flat field stability tests
 - ◆ Bias and dark monitors

Observatory Focus Strategy

- Telescopes group is determining the most accurate ACS/WFC to PC focus offset from archival measurements
- Make best estimates of OTA focus based on fits to pre-SMOV data as well as SMOV measurements
 - ◆ Express with respect to WFC focus
- Determine best focus for each instrument (WFC3, COS)
 - ◆ Use OTA/WFC information to facilitate cross-instrument confocality
- Determine the amount and timing of a secondary mirror move, if necessary
 - ◆ Move should occur before WFC3 ERS and GO science

Remaining Cycle 15/16 Observations

Instrument	Visits	Orbits
NICMOS	206	227
WFC3 (1)	155	200
ACS/SBC (2)	16	40
WFPC2 (3)	3	13
FGS	8	8
STIS	0	0
COS	0	0
TOTAL	388	488

357 visits/421 orbits are currently planned in the operational LRP

Notes:

1. Converted WFPC2/NIC programs
2. Includes 3 visits/9 orbits Cycle 15 ACS/HRC
3. Awaiting PI decision on conversions

Current Cycle 17 Statistics

Primes

Cycle	Orbits
C15/16	254
C17	4132
total	4386

Instrument	Orbits
WFC3	1783
COS	1282
ACS	700
STIS	508
FGS	121
NIC	87
WFPC2	0
Total	4481

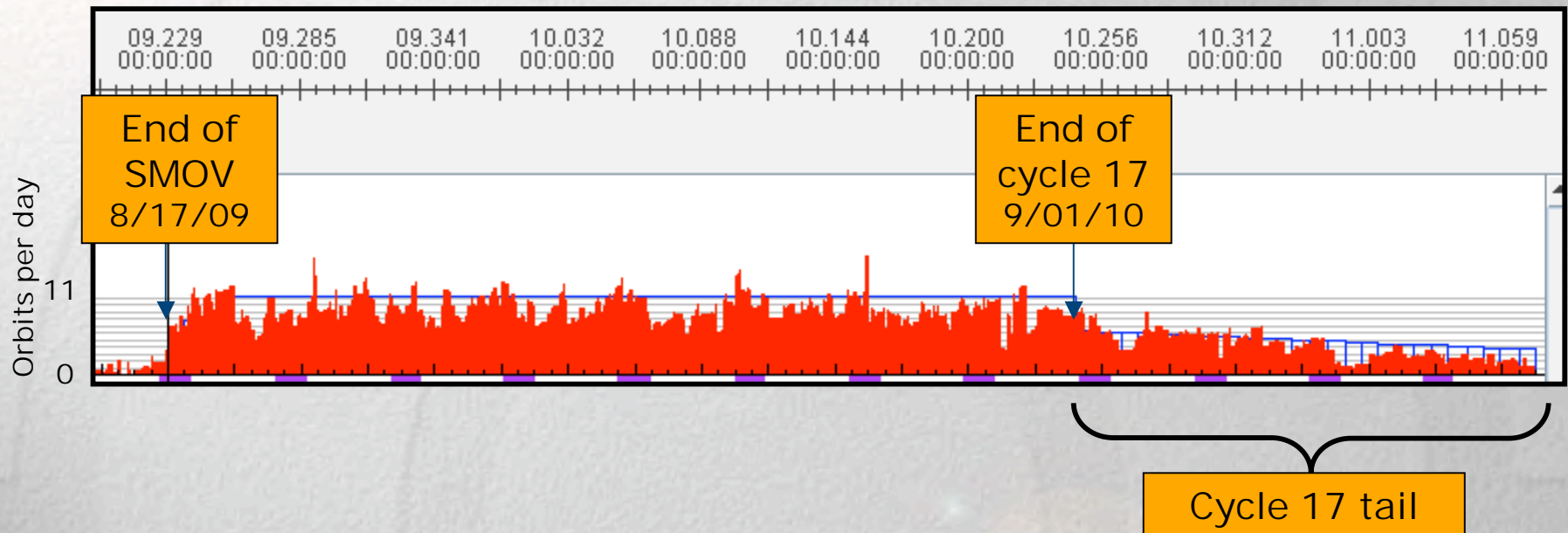
Snaps

Instrument	Snaps
ACS	686
WFC3	584
STIS	140
COS	40
FGS	19
NIC	0
Total	1469

Notes:

- Some SIs have more than one instrument prime
- Not included:
 - Currently unschedulable: 185 orbits
 - Schedulable, no plan windows: 145 orbits
 - No plan windows (TOO, etc): 355 orbits

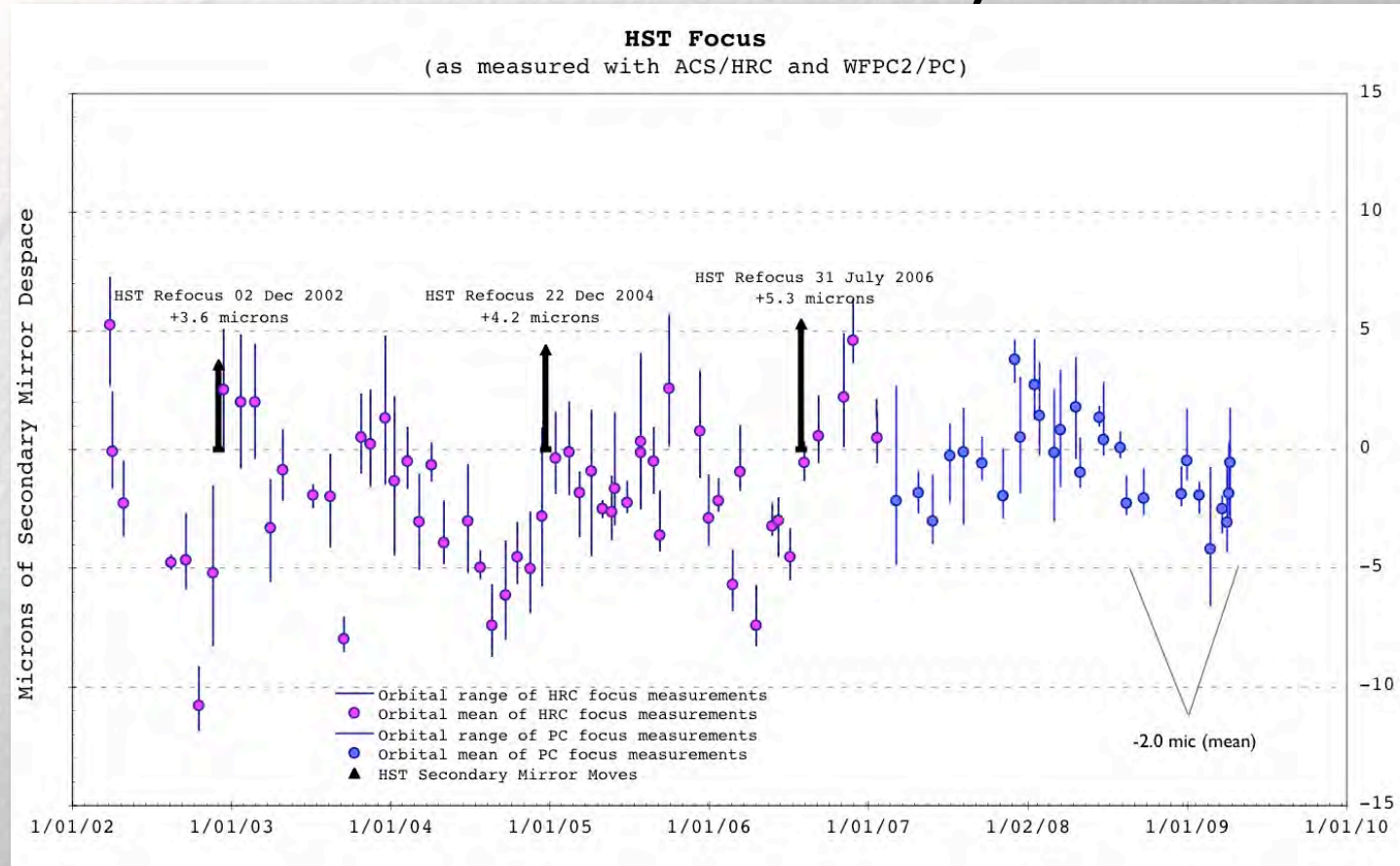
Cycle 17 Long Range Plan



- Plan is still a work in progress
- Current tail includes ~800 orbits, lasts six months; working to add more (50-100 orbits) into cycle
- Takes into account 1.5 orbits a day of “unplanned” programs (ToOs, HOPR repeats, DD, etc.)
- Plan windows will be released after FGS2R rework (mid-July)

Backup Slides

Focus History



- 1 micron @ Secondary induces rms wavefront error of $\sim 1/83$ wave (V-band)
- Secondary Mirror adjustments have been made to maintain within ~ 5 microns or $1/16$ wave.
- Secondary Mirror location giving best WFPC2/PC focus defined as zero microns. STIS & ACS were set to be as close to confocal as practical (< 1.5 microns)
- Goal was to enter SMOV with existing SIs very near best focus. Delay has resulted in focus going moderately negative.

Instruments Division Staffing

WFPC2

John Biretta
Shireen Gonzaga

NICMOS

Anton Koekemoer²
Tommy Wiklind
Thomas Dahlen
Deepashri Thatte

ACS

Linda Smith
Dave Golimowski
Luigi Bedin
Aparna Maybhathe
Norm Grogin
Marco Chiaberge
Andy Fruchter
Ralph Bohlin²
Tyler Desjardins
Ray Lucas
Matt McMaster
Max Mutchler
Jennifer Mack
Francesca Boffi
Pey-Lian Lim

WFC3

John Mackenty
Sylvia Baggett
Howard Bushouse
Susana Deustua
Linda Dressel
Jason Kalirai
Nor Pirzkal
Larry Petro
Adam Reiss
Elena Sabbi
Michael Wong
Elizabeth Barker²
Tiffany Borders²
Michael Dulude
Bryan Hilbert
Cheryl Pavlovsky
Vera Platais
Alex Viana
Abi Rajan

COS

Alessandra Aloisi¹
Nolan Walborn¹
Tony Keyes
Dave Soderblom
Rachel Osten
Paul Goudfrooij
Parviz Ghavamian
Cristina Oliviera
Ilaria Pascucci
Dave Sahnou
Tom Ake
Derck Massa
Van Dixon
Ed Smith
Rosa Diaz¹
Sammi Niemi
Michael York

STIS

Alessandra Aloisi¹
Charles Proffitt
Danny Lennon
Nolan Walborn¹
Wei Zheng
Rosa Diaz¹
Michael Wolfe

Notes:

¹ Split w/ another instrument

² Transitioning to JWST

Embargo Agreement Text

(as revised per STScI RR A104)

Because NASA has not yet made the first Early Release Observations (EROs) public for the new and serviced instruments, the STScI requires that you agree to abide by the restrictions below before we can make your data accessible to you for retrieval. Once we receive an email reply with your acceptance of these restrictions, we will allow you access to your Cycle 17 data.

All Guest Observers requesting access to their Cycle 17 data from new and serviced instruments before the NASA ERO press release date must agree to refuse any public discussion or display of these data and/or any scientific results derived from them until after the official NASA ERO press conference. Public discussions include seminars, colloquia, press conferences, lectures, conference posters, website postings, mass media interviews, and journal publications. Do you agree to these terms?

Before you distribute these data further to co-investigators or other collaborators working with you on these data, they must agree to these terms also.

Matt Mountain
Director, Space Telescope Science Institute