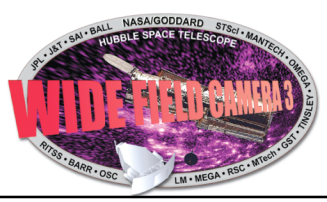
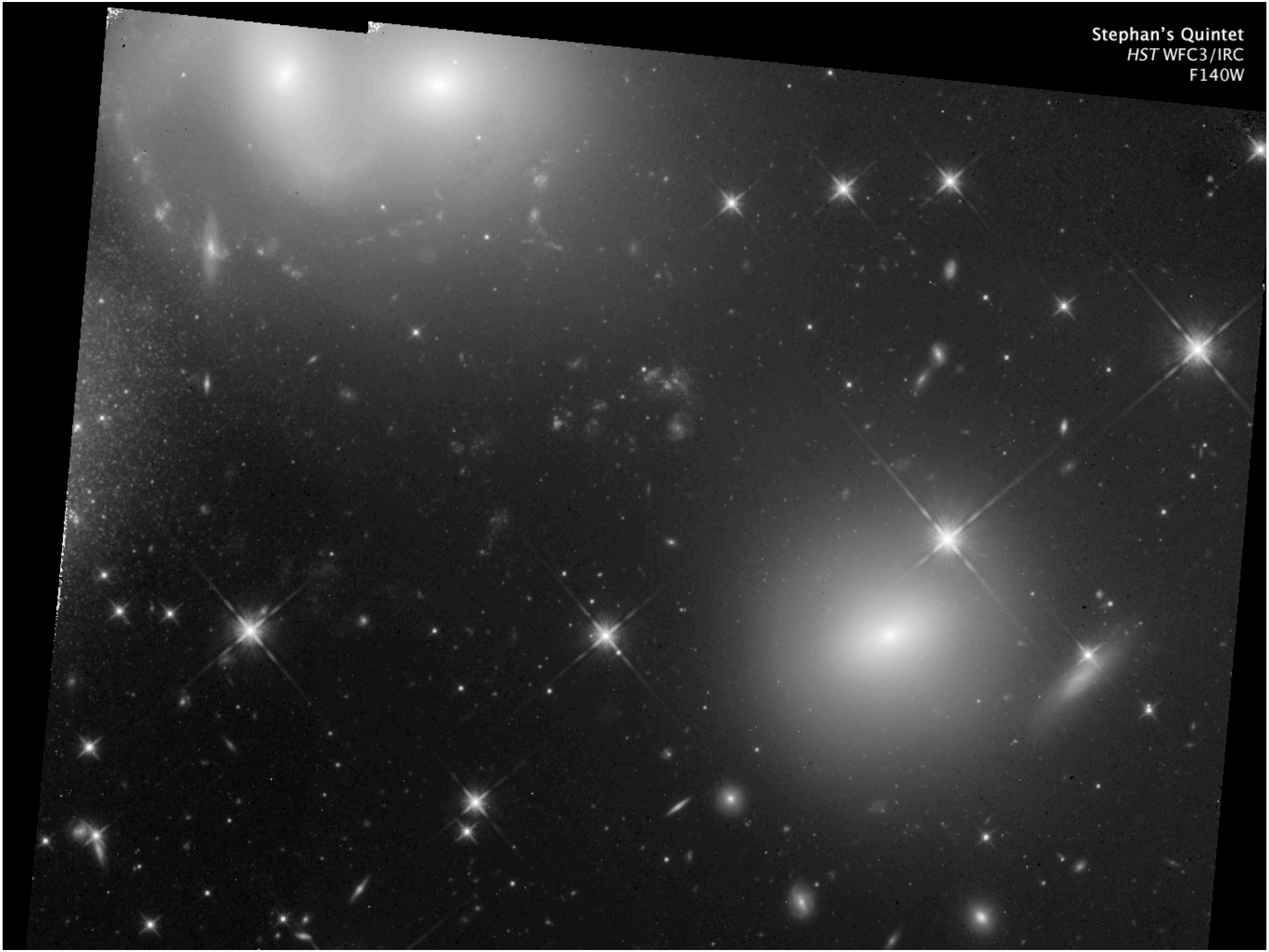


Wide Field Camera 3

John W. MacKenty and the WFC3 Team


Stephan's Quintet
HST WFC3/IRC
F140W

Team Accomplishment

- **The WFC3 Science Integrated Product Team (2009)**
- Sylvia Baggett
- Tiffany Borders
- Howard Bushouse
- Linda Dressel
- Susana Deustua
- Michael Dulude
- George Hartig
- Bryan Hilbert
- Robert Hill (GSFC)
- Jason Kalirai
- Jessica Kim Quijano
- Randy Kimble (Instrument Scientist, GSFC)
- Vera Kozhurina-Platais
- Knox Long
- John MacKenty (Deputy Instrument Scientist)
- Brian McLean
- Peter McCullough
- Cheryl Pavlovsky
- Larry Petro
- Nor Pirzcal
- Abhijith Rajan
- Adam Riess
- Elena Sabbi
- Alex Viana
- Michael Wong

- **Past Science IPT Members**
- Wayne Baggett
- Howard Bond
- Tom Brown
- Laura Cawley
- Ed Cheng (GSFC, now Conceptual Analytics)
- Ilana Dashevsky
- Don Figer
- Mauro Giavalisco
- Shireen Gonzaga
- Christopher Hanley
- Ron Henry
- Pat Knezek
- Ray Kutina
- Casey Lisse
- Olivia Lupie
- André Martel
- Neill Reid
- Massimo Robberto
- Michael Robinson
- Megan Sosey
- Massimo Stiavelli

- **The WFC3 Scientific Oversight Committee**
- Bruce Balick, University of Washington
- Howard E. Bond, Space Telescope Science Institute
- Daniela Calzetti, Space Telescope Science Institute
- C. Marcella Carollo, Institute of Astronomy, ETH, Zurich
- Michael J. Disney, Cardiff University
- Michael A. Dopita, Mt Stromlo and Siding Spring Observatories
- Jay Frogel, AURA
- Donald N. B. Hall, University of Hawaii
- Jon A. Holtzman, New Mexico State University
- Randy Kimble, NASA Goddard Space Flight Center (ex officio)
- Gerard Luppino, University of Hawaii
- Patrick J. McCarthy, Carnegie Observatories
- John MacKenty, Space Telescope Science Institute (ex officio)
- Robert W. O'Connell, University of Virginia (Chair)
- Francesco Paresce, European Southern Observatory
- Abhijit Saha, National Optical Astronomy Observatory
- Joseph I. Silk, Oxford University
- John T. Trauger, Jet Propulsion Laboratory
- Alistair R. Walker, Cerro Tololo Interamerican Observatory
- Bradley C. Whitmore, Space Telescope Science Institute
- Rogier A. Windhorst, Arizona State University
- Erick T. Young, University of Arizona

- **WFC3 Management, Engineering, and Contractor Teams**
- Thai Pham and Jackie Townsend, GSFC Instrument Managers
- GSFC Engineering Teams in Codes 400, 500, and 600 (plus Code 300 reviewers)
- Ball Aerospace, Swales Aerospace (now ATK), Teledyne, E2V, and many others
- *By my estimate 300-400 people made significant contributions to the development of Wide Field Camera 3*

WFC3 Science Status Summary

Parameter	UVIS Channel	IR Channel
Read Noise	2.9 - 3.0 e- (1x1 binning)	Up-the-ramp: 12.5 e- (16 samples) CDS = 22-23 e-
Dark Current	1.5 e-/pix/hour (0.3 expected) (growing at ~2 e-/pix/hr/year)	0.05 e-/pix/second
Gain	1.61 - 1.63 e-/DN	2.3-2.45 e-/DN
Throughput	5 to 20% above ground tests	~10-15% above ground tests
Photometric Stability	<1%	<1% (wide and medium), 1-2% (narrow)
Image Quality	nominal	nominal
Background	TBD	Consistent with Cy17 Handbook
LOS stability over 2 orbits (milliarcseconds)	max excursion = 14 Specification = 10	max excursion = 25 Specification = 20
Pointing	Nominal (SIAF Update installed on Day 215)	
Geometric Distortion Accuracy	0.08 pix (3 milliarcseconds RMS)	0.08 pix (10 milliarcseconds RMS)
Current Flat Field Correction Accuracy	1% Visible; 3-5% Ultraviolet	<1.5%
Grisms	To be calibrated in Cycle 17	Throughput 10% above expectations Dispersion nominal

WFC3 Engineering Status Summary

Parameter	UVIS Channel	IR Channel
Lamps	Tungsten and D2 verified (10-15% brighter than ground test)	Tungsten verified (10-15% brighter than ground test)
QEH	Bowtie mitigation works to ~0.5%	< 1%
Thermal	Good margin on UVIS @ -83C	Expect to maintain IR @-128C for Cycle 17
Anneal	Hot pixel removal presently >90%	N/A
SAA Passage	Contours nominal; No SEU problems	Contours nominal; No SEU problems 12% pixels hit per minute in SAA core

WFC3 SMOV Program

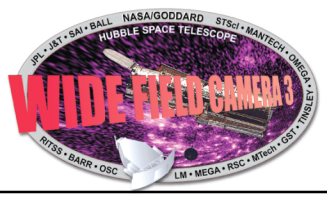
- Three phases:
  - Engineering: Instrument Performance Nominal
    - Complete except for TEC setpoint verification ongoing
  - Optical Alignment: met expectation (one extra iteration in each channel)
  - Science performance and calibration verification
    - Demonstrates that WFC3 *can* be calibrated to anticipated levels
    - Early calibration of geometric distortion for EROs successful
- 43 distinct SMOV Activities following SM4
  - 4 used engineering telemetry data only
  - 39 required a total of 429 visits.
  - Total number of Images: ~4100 (completed September 11)
- Results
  - Viewgraph stack posted 9/9 on WFC3 www with results of each activity
  - Preliminary Photometry zero points, IDCTABs, and UVIS Bias file also posted
  - Instrument Science Reports in review/editing cycle for SMOV review next week
  - Instrument Handbook being revised for Cy18 CP (handoff in December)

WFC3 SMOV Programs

Activity	PropID	Title	PI	Start Date	End Date	Visits	Status
WF01	11454	Activation Test	LP	25-May-09	08-Jun-09	7	Done
WF02	11357	Memory Test	ID	25-May-09	25-May-09	1	Done
WF03	11358	Sci Data Buffer Test	ID	26-May-09	27-May-09	13	Done
WF04	n/a	UVIS CCD Cooldown	JM	04-Jun-09	04-Jun-09	N/A	Done
WF05	n/a	IR Detector Cooldown	JM	04-Jun-09	04-Jun-09	N/A	Done
WF06	11419	UVIS Det Functional	SB	12-Jun-09	13-Jun-09	12	Done
WF07	11420	IR Det Functional	PM	15-Jun-09	24-Jun-09	12	Done
WF08	11421	CSM Test	HB	24-Jun-09	24-Jun-09	2	Done
WF09a	11422	UVIS SOFA Test	SB	11-Jun-09	12-Jun-09	2	Done
WF09b	11529	UVIS Spare Tungsten La	SB	13-Jun-09	13-Jun-09	2	Done
WF10a	11423	IR FSM Test	SB	12-Jun-09	12-Jun-09	4	Done
WF10b	11543	IR Spare Tungsten Lamp	SB	24-Jun-09	25-Jun-09	4	Done
WF11	11424	UVIS Initial Alignment	GH	25-Jun-09	27-Jun-09	3	Done
WF12	11425	IR Initial Alignment	GH	26-Jun-09	28-Jun-09	3	Done
WF13	11426	UVIS Contam Monitor	SB	26-Jun-09	04-Aug-09	21	Done
WF14	11427	UVIS Shutter Test	BH	14-Jul-09	14-Jul-09	3	Done
WF15	11428	D2 Cal Lamp Test	SB	17-Aug-09	19-Aug-09	12	Done
WF16	n/a	UVIS TEC Performance	LP	11-Jun-09	18-Jun-09	N/A	Ongoing
WF17	n/a	IR TEC Performance	LP	11-Jun-09	18-Jun-09	N/A	Ongoing
WF18	11431	UVIS Hot Pixel Anneal	SB	19-Jun-09	21-Jul-09	6	Done
WF19	11432	UVIS Int Flats	AR	07-Jul-09	03-Sep-09	63	Done
WF20	11433	IR Int Flats	BH	13-Jul-09	21-Jul-09	50	Done

WFC3 SMOV Programs

Activity	PropID	Title	PI	Start Date	End Date	Visits	Status
WF21	11434	UVIS Fine Alignment	GH	02-Jul-09	08-Jul-09	4	Done
WF22	11435	IR Fine Alignment	GH	02-Jul-09	10-Jul-09	4	Done
WF23	11436	UVIS Image Quality	GH	01-Aug-09	01-Aug-09	1	Done
WF24	11437	IR Image Quality	GH	30-Jul-09	30-Jul-09	1	Done
WF25	11438	UVIS PSF Wings	GH	30-Jul-09	02-Aug-09	4	Done
WF26	11439	IR PSF Wings	GH	31-Jul-09	31-Jul-09	1	Done
WF27/28	11549	UVIS & IR Pointing Stability	TB	22-Aug-09	24-Aug-09	12	Done
WF29	11442	FGS-UVIS Update	LD	13-Jul-09	13-Jul-09	1	Done
WF30	11443	FGS-IR Update	LD	13-Jul-09	13-Jul-09	1	Done
WF31	11444	UVIS Plate Scale	LD	15-Jul-09	15-Jul-09	2	Done
WF32	11445	IR Plate Scale	LD	23-Jul-09	02-Aug-09	2	Done
WF33	11446	UVIS Dark, Noise, Backgnd	SB	26-Jun-09	29-Aug-09	22	Done
WF34	11447	IR Dark, Noise, Backgnd	PM	26-Jun-09	17-Aug-09	22	Done
WF35	11448	UVIS SAA Passage	AM	30-Jun-09	30-Jun-09	3	Done
WF36	11449	IR SAA Passage	AM	27-Jun-09	03-Jul-09	3	Done
WF37	11450	UVIS Phot Zero Points	JK	13-Jul-09	11-Aug-09	4	Done
WF38	11451	IR Phot Zero Points	JK	13-Jul-09	13-Aug-09	8	Done
WF39	11452	UVIS Flat Field Uniformity	ES	15-Jul-09	18-Jul-09	2	Done
WF40	11453	IR Flat Field Uniformity	BH	16-Jul-09	17-Jul-09	3	Done
WF42	11552	IR Grisms	HB	03-Aug-09	06-Aug-09	4	Done
WF43	11798	UVIS PSF Core Modulation	ES	23-Jul-09	29-Jul-09	2	Done
WF44	11808	UVIS Bowtie Monitor	JM	11-Jun-09	09-Aug-09	100	Done



The Photometric Performance and Calibration of WFC3

SMOV4 Calibration: The Photometric Stability and Absolute Throughput of WFC3

UVIS and IR

1.) Observations of HST spectrophotometric standards:

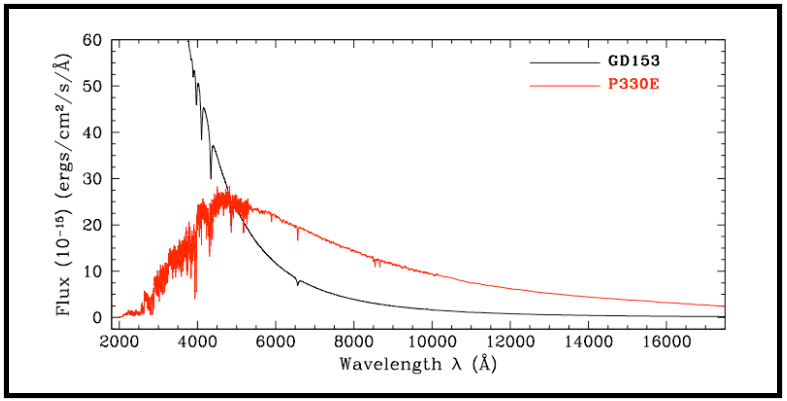
GD153 in 37 UVIS filters; GD153 and P330E in all 15 IR filters

- 1% absolute accuracy in medium and broadband filters.
- 2-3% absolute accuracy in narrow band filters.

2.) Repeat observations: Measure photometry stability, both temporal and spatial.

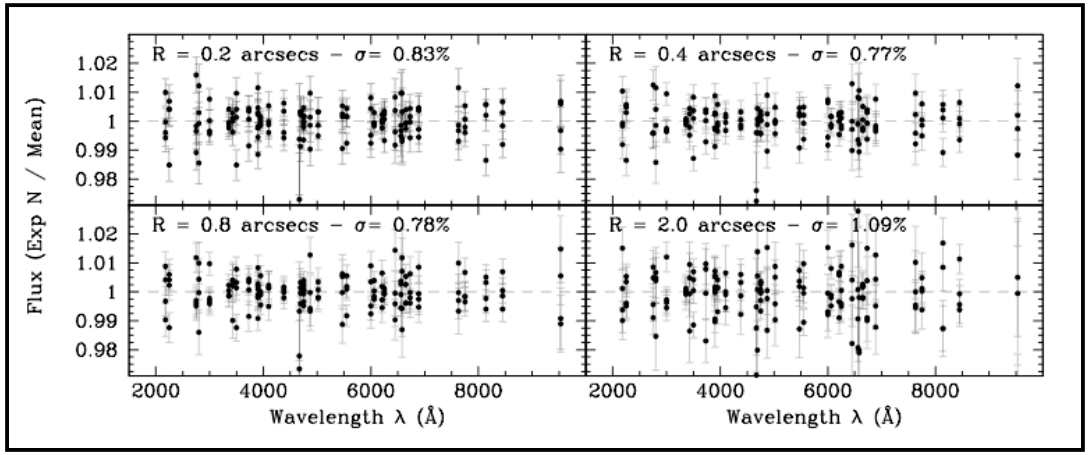
→ High S/N subarray imaging, multiple dither positions.

Star	B	V	J	H	Temp (K)	Log(g)
G191B2B	11.45	11.77	12.55	12.66	61,193	7.492
GD153	13.06	13.35	14.07	14.19	38,686	7.662
GD71	12.78	13.03	13.74	13.86	32,747	7.683
P330E	13.62	13.00	11.88	11.60	G0V	G0V

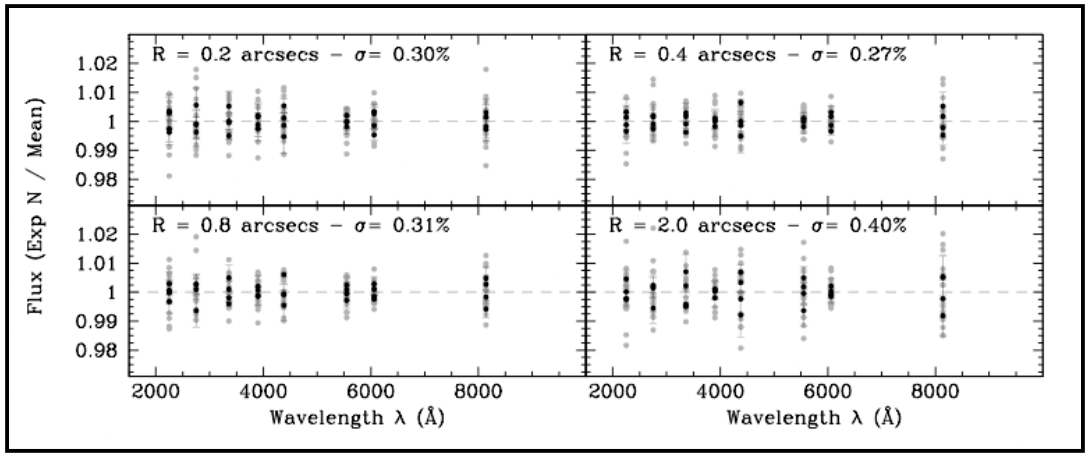


SMOV4 Calibration: The Photometric Stability and Absolute Throughput of WFC3

Spatial stability over 4 (small) dither positions; <1%



Temporal stability over 1 month; <0.5%

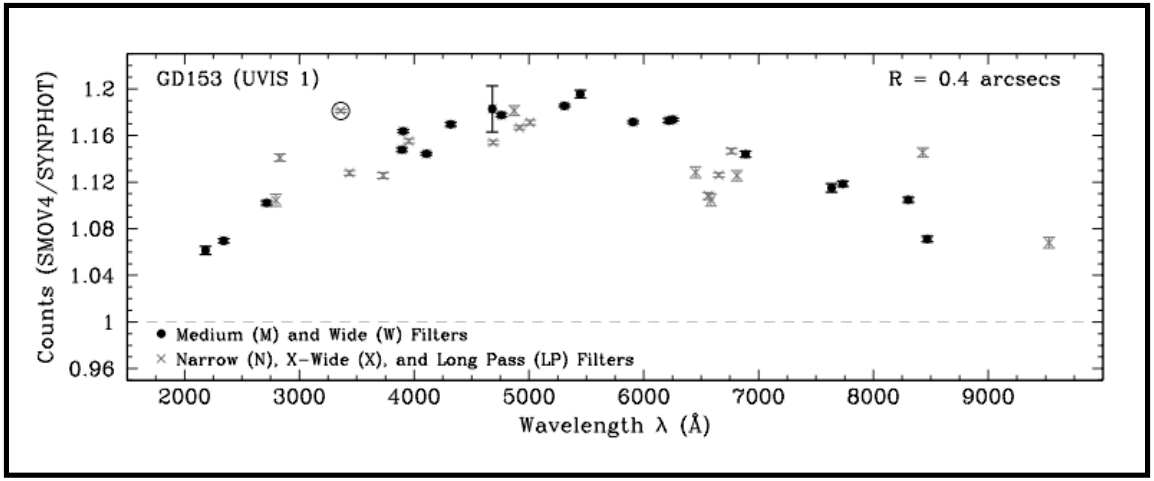


The Photometric Performance and Calibration of WFC3

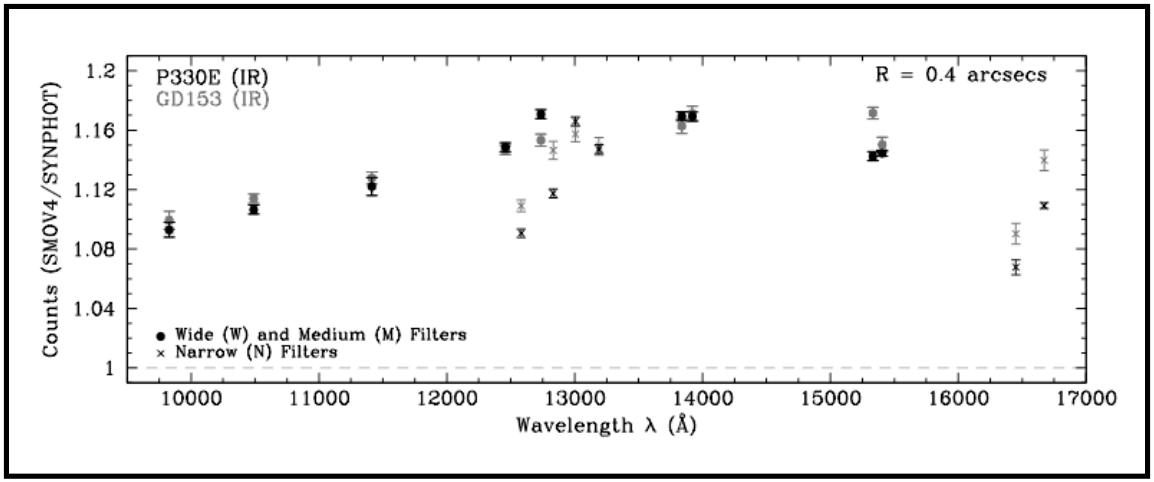
The WFC3 System Throughput

1.) The HST OTA
2.) Pickoff mirror
3.) CSM
4.) Mirror reflectivity
5.) Filter throughputs
6.) Detector window
7.) Detector QE

→ Calibration Performed in TV3



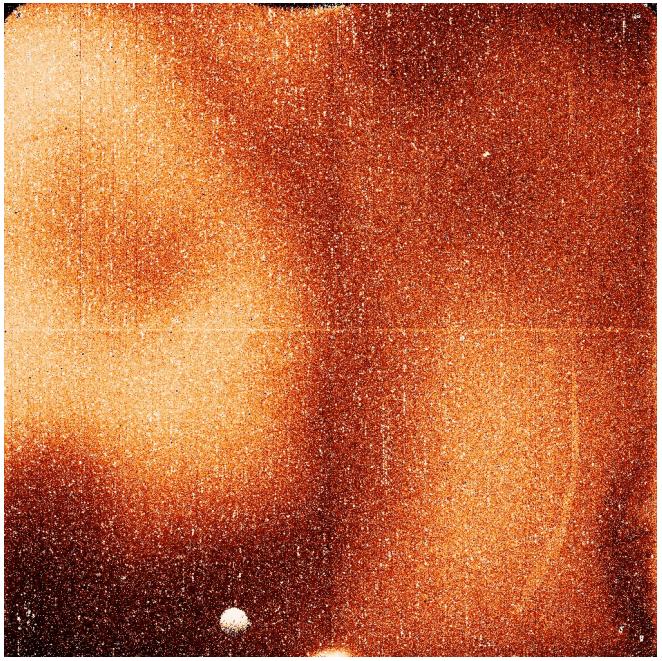
UVIS: 5-10% boost in efficiency at blue/red λ's, 15-20% at 400-700 nm



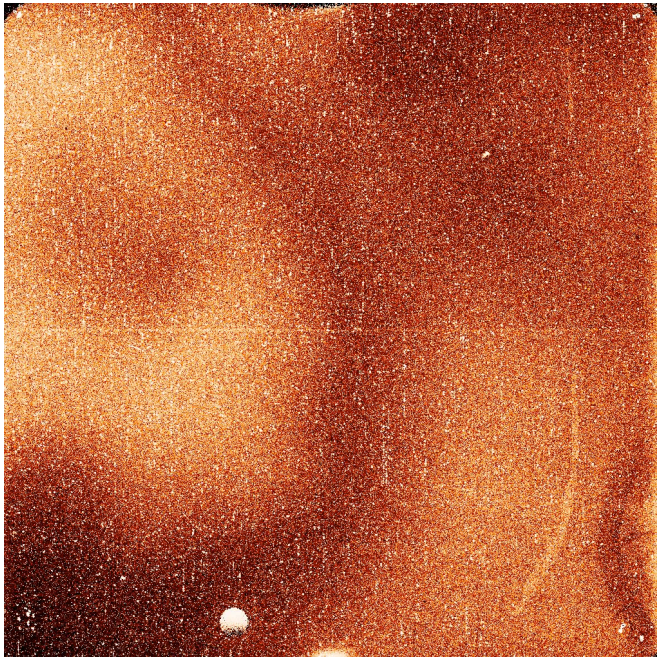
IR: 10-15% boost in efficiency at all λ's

Dark Current Similar to Ground Test

- Dark current levels and spatial morphology are very similar to ground test -- both at 145K
- Median rates: 0.048 e-/pix/s in flight, 0.057 e-/pix/s in T-V
- Only 0.6% of pixels above spec of 0.4 e-/pix/s



Flight



Thermal-Vac

Read Noise Improved vs. Ground Test

- CDS read noise is 20-22 e- rms (varies with quadrant); same as ground result; noise in RAPID reads also similar to T-V result
- Effective noise reading up the ramp is actually a bit lower in flight than in thermal-vac for long exposures: (average of the 4 quadrants shown)

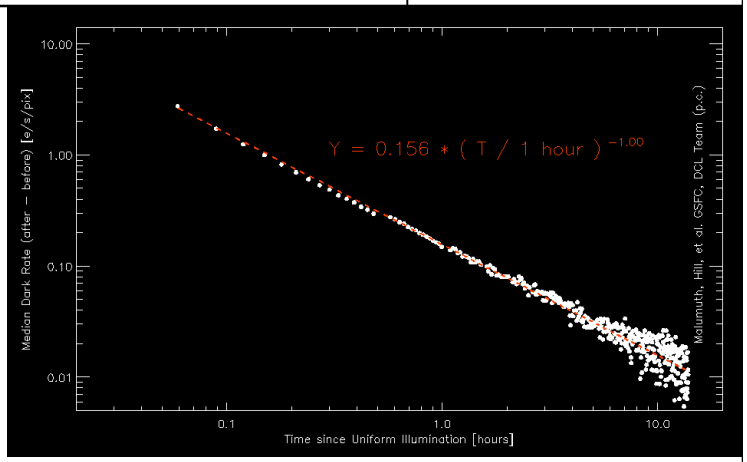
# of Reads	3	8	15
Effective noise (e- rms; SMOV)	19.6	16.0	12.4
Effective noise (e- rms; thermal-vac)	20.8	17.8	14.6

For SPARS200 sample sequence

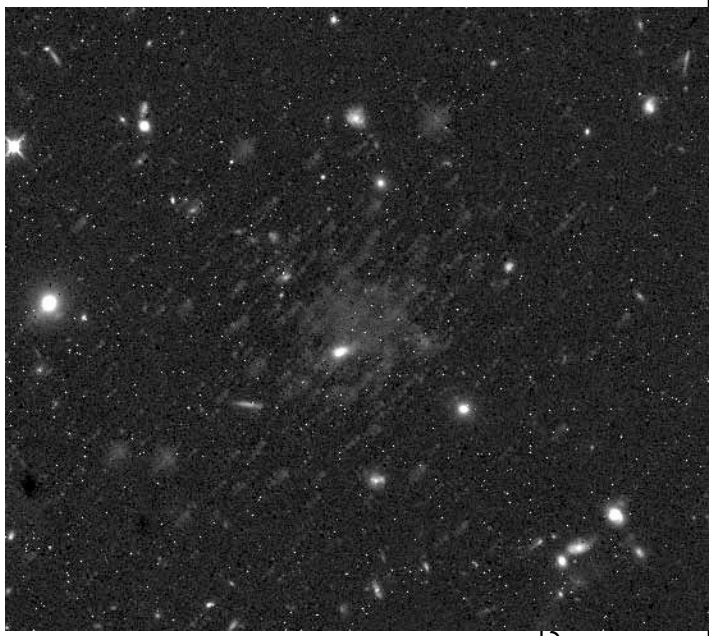
- *Combined with excellent dark current, very well satisfies goal of being zodiacal-background-limited for long exposures in broad bands (zodi rates from a few tenths to >1 e-/pix/s)*

IR Persistence

- IR Persistence was always expected to be an issue
  - IR persistence has rapid decay and long (multi-orbit) decay components [fit as either 2 exponentials or a power law]
  - BOT analysis of GO program indicates >50% of all observations can generate residual images
  - SAA passage CR's do not seem to be a major impact
- A few examples of severe persistence following long observations of bright targets
- Modest overlight appears to effect linearity near zero bias regime
  - Can compensate partially (few % → 1%) by decreasing full well defn
  - Replicated at GSFC/DCL but their data shows effect over larger range
  - Hints that persistence and "rate dependent nonlinearity" may be related phenomena.
- Strategy
  - GOs were required to dither IR observations (except pure parallels)
  - CS review of proposals flagged ~10 worst Cy17 cases to avoid scheduling IR observations for 5 orbits afterwards
  - Ongoing characterization of detectors (in-flight and lab)
  - Adam Riess has a prototype tool to correct within a visit
  - Looking at mechanisms to track pixel history over longer periods (very preliminary)



100x Overlight in TV3

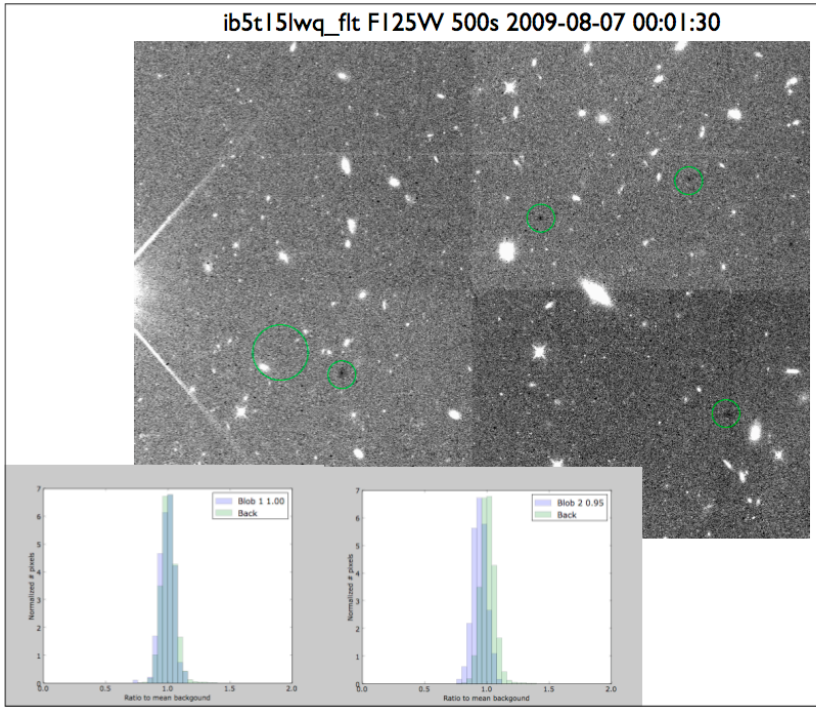


Rate-Dependent Non-Linearity

- For NICMOS, effect is 3-6 %/dex decline in response at lower count rates, with the steeper behavior at shorter wavelengths
- WFC3 flight spares measured at 0.3, 0.4, 1.0 %/dex at 1600nm
- Adam Riess has done a preliminary analysis of this behavior in the flight array
  - Compares WFC3 photometry to NIC2 photometry on same fields
  - Relatively limited dynamic range and color range
- *Assuming that the NIC2 non-linearity calibration is accurate:*
  - Yields ~1.1 %/dex for WFC3 flight array
- Will attempt to calibrate WFC3 independently in Cycle 17 by doing repeat photometry of the same sources with varying background

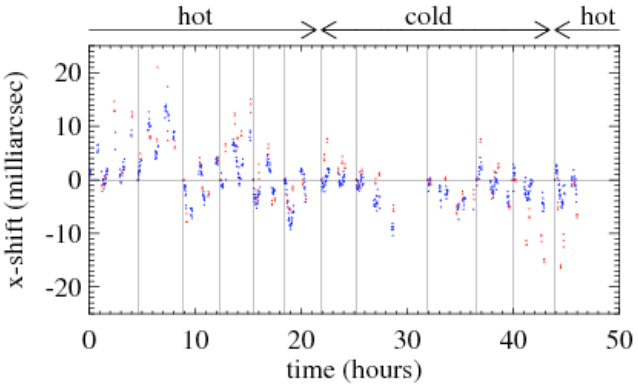
CSM Operations and Spots

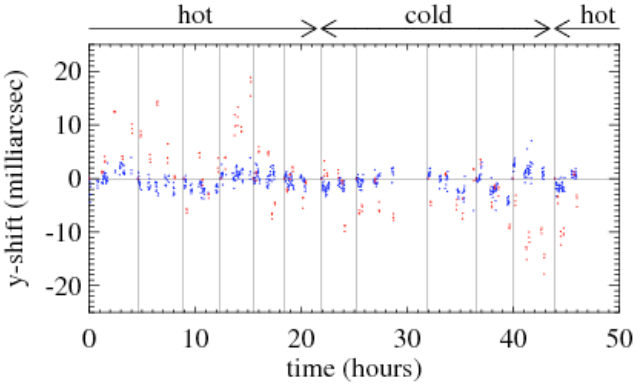
- Small dark spot ("Blobs") observed in IR images
  - Not in flats, shift with CSM offset → on CSM
  - 5-6 clear examples: individually appeared over summer and do not go away – growth rate ~1/month
  - Not obviously correlated with periods of high CSM motion or other activity
- One example seen of anomalous CSM motion
  - CSM offset ~1 motor step in IR position (direction correct, close on offset)
  - Telemetry (resolver) inconsistent with observed optical shift
    - No shift indicated by resolver (very close to nominal) or commutation
- Forward plan
  - Detailed search for blob generation history
  - Examining history of CSM motions (1200+ by late September)
  - Proposal 12006 to characterize motion of blobs with single step CSM motions
  - Implemented option to reduce "unnecessary" CSM motions
  - Monitoring for additional blobs

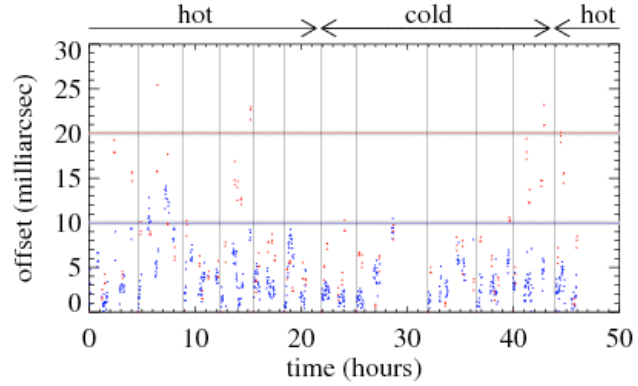


WF27&WF28: UVIS and IR Image Stability (11549)

- PI : Tom Brown
- #Visits: 12 #Images: 804
- Purpose:
  - Measure WFC3 line of sight pointing stability over 2 orbit intervals at HOT and COLD spacecraft attitudes and after large slews from HOT→ COLD and COLD→HOT attitudes.
  - Observations of IC-4499 (hot orbits) and NGC 7492 (cold orbits) in UVIS/F814W and IR/F110W with a pattern of 10 UVIS followed by 3 IR subarray images.
  - Implemented as 12 orbits at hot, 10 orbits at cold, and 2 orbits at hot attitudes.
- Results:
  - Maximum UVIS excursion in 2-orbit block was 14 milliarcsecs
  - Maximum IR excursion in 2-orbit block was 25 milliarcsecs.
  - While these exceed the instrument specifications of 10 and 20 milliarcsec, respectively, they are consistent with predictions in the Cycle 17 Instrument Handbook based on ground testing.
  - Stability exceptions were less frequent than in ground testing.
- Exceptions:
  - Stability analysis over periods longer than 2-orbit blocks is complicated by inadvertent execution at independent orientations for each visit (each hot visit distinct at ~0.1 degrees, each cold visit distinct at ~0.5 degree)
  - Backing out change in orientation by analysis shows much smaller drift between consecutive 2-orbit visits on a target than orbital variation within visits







Other Issues (1)

- UVIS QEH ("bowtie")
  - Planned fix works well (<1% residuals)
  - Ramped down cadence from 12h to 48h at end of SMOV
- Flat fields
  - UVIS flats are unchanged from ground with stable "droplet" features
  - IR internal flats are contaminated by earth light
- UVIS Shutter jitter
  - As modeled pre-launch: 2-3x amplitude seen in TV3
  - Damps rapidly (no impact at 10s, very little impact at 3s)
  - Test did highlight impact of breathing near Amp A
- Grisms –ECF will report on their excellent work!
  - ECF team has initial calibrations of IR Grisms (all nominal)
  - Replicate ~10% photometric improvement over TV3
- IR SAA performance
  - 12% of pixels hit per minute (can do IR observations in SAA)

Other Issues (2)

- Thermal Performance
  - GSFC analysis ongoing (model correlations)
  - UVIS appears fine; IR close during winter but options other than FPA setpoint change clearly exist
- IR Darks have a light leak with CSM in IR position
  - Fixed by operations change
- Tungsten lamps show 1-2% decline over SMOV
  - Not an issue for 5 year life on primary bulbs
- Optical alignment appears OK and image quality in analysis
  - UVIS channel tip-tilt mechanism had more play than expected
  - IR offset was larger than expected but acceptable
  - We are at (or very near) expected EE; Hartig is modeling wings
- D2 lamp operation nominal (start delays shorter than ground test)
- UVIS Contam monitor nominal

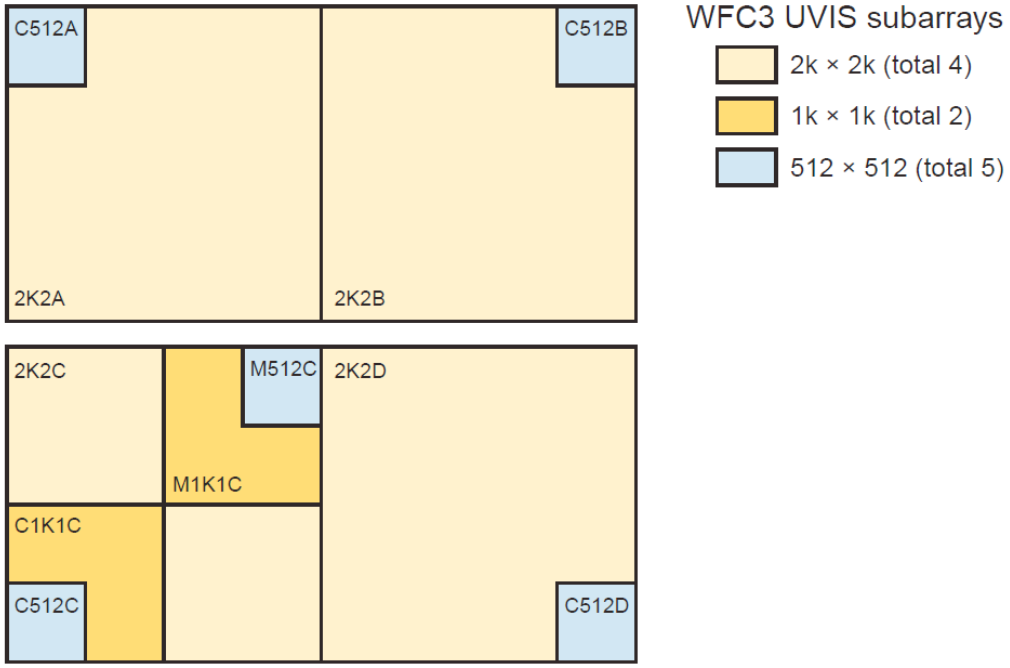
User Support

- WFC3 Contact Scientist Program
  - Each proposal has a Contact Scientist (for Cy17 only)
  - ~170 proposals now being supported
  - IR Bright Object checking → 50-60% create some residual image
    - Really bad ones have been flagged to scheduling team
  - GOs will start getting follow-up phone calls to solicit issues/concerns
- Documentation
  - Revisions of Handbook underway (will publish in January)
  - 30+ ISRs on SMOV results in review/edit cycle
  - First STAN released
  - WFC3 www site has all post-SM4 information in "Late Breaking News" section – remainder of site urgently needs work
- Data Pipeline and Multidrizzle
  - A number of bug fixes installed
  - Synphot updated with in-flight results (also SIAF updated)
  - Multidrizzle in OPUS is coming soon (IDCTABs and alpha-release via www)

UVIS Subarrays

- UVIS Sub-Arrays are extensively used
  - Replacement of HRC capability for many exposures per orbit
  - 20 QUAD filter passbands
- Decision (also taken by ACS) to drop user defined subarrays
  - Also deleted 2K x 4K and old 512 x 512 at center
- Increased set of defined subarrays to include
  - 2K x 2K in each quad
  - 1K x 1K in corner and center
  - 512 x 512 in center and each corner
- Approach minimizes calibration overhead, keeps overscan for most subarrays, and gives users two new subarrays near field center

Figure 6.2: WFC3 UVIS subarrays available for Cycle 18. The full name of each subarray is prepended by "UVIS-" and appended by "-SUB"; for instance the central 512x512 subarray is called "UVIS-M512C-SUB".



Cy17 Calibration Plan

- WFC3 Cy17 Calibration Plan
  - Covers 15 months starting 1 August 2009
  - Scope: 35 proposals, 249 external orbits, ~2220 internal orbits
    - 17 UVIS Imaging (3 monitors)
    - 13 IR Imaging (1 monitor)
    - 2 UVIS and 2 IR Grism
- Three ISRs describe our approach in key areas
  - ISR 2009-07: Overview of the WFC3 Cycle 17 Detector Monitoring Campaign
    M. H. Wong et al. 29 May 2009 (Pdf 1182 Kb)
  - ISR 2009-06: WFC3 Calibration Using Galactic Clusters
    Sabbi et al. 08 Sep 2009 (Pdf 1853 Kb)
  - ISR 2009-05: The Photometric Calibration of WFC3: SMOV and Cycle 17 Observing Plan
    J. S. Kalirai et al. 12 Jun 2009 (Pdf 301 Kb)

WFC3 Cal Plan (1/3)

wfc3ID	Cy17 ID	Proposal Title	Freq.	No. Orbits		Scheduling Required	Accuracy Goal	Notes
		PI		Ext	Int/P			
wfc3_01	11903	UVIS Zero points. J. Kalirai	10x	46		Monthly	2% W, 5% M, N	Measure zero points and monitor sensitivity (throughput). Once per month for 6 months, then once every 3 months, for 10 visits over cycle.
wfc3_02	11905	UVIS CCD Daily Monitor. A. Martel	1/day		825		0.1 e- readnoise	Build daily, weekly superbias and superdark reference files. Avoid periods just before and after annealing. Two daily visits, but 3 daily visits +/- 7 days around anneal. 900 sec. darks.
wfc3_03	11906	UVIS CCD Gain. A. Martel	3x		18	Months 4, 8, 12 post SMOV	<1% per quadrant	Calculate absolute gain per amplifier at nominal temperature.
wfc3_04	11907	UVIS Bowtie Monitor. S. Baggett	1/day		455	Daily	<1%	Minimize and neutralize "bowtie" effect. 455 daily 10 min visits, equivalent to 165 30 min. internal orbits. Depending on ground experiment results frequency may decrease. Visits may be scheduled with other internal orbits activities, if possible.
wfc3_05	11908	UVIS Contamination Monitor. S. Baggett	1/wk	39	39	Weekly	2%	Monitor contamination by measuring throughput in a subset of key filters using stars. Weekly for 14 weeks, then every other week. 39 visits.
wfc3_06	11912	UVIS Internal Flats. J. Kim	5x		65	Quarterly	< 5%	Assess stability of flat field structure
wfc3_07	11911	UVIS L-Flats and Geometric Distortion. E. Sabbi	2x	30		Early in cycle		Build L-flats using star field.
wfc3_08	11918	UVIS Image Quality. L. Dressel	3x	9		SMOV + 3, 6, 9 months		Image stability assessment
wfc3_09	11919	UVIS PSF Wings. L. Dressel	1x	7		Mid Cycle	>5arcsec radius	Evaluate PSF stability at 5 field points, in two filters.
~~wfc3_10~~		~~UVIS PSF Core Modulation. E. Sabbi~~	~~0x~~	~~0~~		Cancelled in Cycle 17		~~Measure stellar peak to peak variations induced by shutter motion. Omit from Cycle 17, see what are SMOV results.~~
wfc3_11	11913	UVIS Filter Wedge Check. J. Kim	1x	3		Early in cycle	0.5 pixels at 633 nm.	Verify UVIS filters positions for image displacement
wfc3_12	11938	UVIS Stray Light. L. Petro	1x	4		After SMOV	10%	Characterize stray light from bright sources outside the UVIS FOV.

WFC3 Cal Plan (2/3)

wfc3ID	Cy17 ID	Proposal Title	Freq.	No. Orbits		Scheduling Required	Accuracy Goal	Notes
		PI		Ext	Int/P			
wfc3_13	11925	UVIS Linearity S. Deustua	1x	2	3	1st Quarter	<5% correctable to < 0.3%	Measure linear response, well depth at non-linearity onset, and, response curve through saturation in key filter subsets.
wfc3_14	11924	UVIS CTE Monitoring V. Platais	3x	3	24	Early, Mid and late Cycle	<1% photometry, 1% pixel shift	Monitor CTE effects on photometry and astrometry, using standard star field.
wfc3_15	11922	UVIS Fringing E. Sabbi	1x	3		Any	<1%	Monitor fringing in red UVIS filters, check fringing model.
wfc3_16	11904	UVIS Droplets J. Kalirai	3x	9	3	1st Quarter	<1%	Characterize and monitor effect of droplets on photometry. Initial visit early in Cycle 17, repeat visits after 6 months.
wfc3_17	11909	UVIS Hot Pixel Anneal. S. Baggett	15x		75	Monthly	< 0.1 e/pix, dark to 0.01 e/pix/hr	Fix hot pixels. 8 orbits/anneal. 3 biases and 5 900-sec darks before and after anneal, for a total of 6 and 10, respectively.1 per month.
wfc3_18	11914	UVIS Earth Flats Pathfinder P. McCullough	1x		50	Late in Cycle	1% relative	Determine pixel to pixel flat field of WFC3+OTA.
wfc3_19	11926	IR Zero points. S. Deustua	14x	28		Monthly	2% W, 5% M & N	Measure and monitor IR zero points and sensitivity curves in all IR filters.
wfc3_20	11929	IR Dark Monitor. B. Hilbert	many		428	Weekly	0.1 e-	Monitor IR dark current and read noise. Creat superdarks. Seldom used subarrays have less frequent monitors. GO proposals modified to use no MIFS, and one to use full-frame arrays.
wfc3_21	11930	IR Gain. B. Hilbert	3x		8	Early, Mid-Cycle	5% per iteration	Determine effective electronic gain of MCT array through internal flats.
wfc3_22	11931	IR Count Linearity. B. Hilbert	3x	6	9	Every 4 months	<5%, correctable to < 0.3%	Quantify non-linear behavior of IR detector, and determine corrections.
wfc3_23	11915	IR Internal Flats. P. McCullough	3x		150	Every 4 months	< 5%	Monitor IR flat stability
wfc3_24	11928	IR L- Flat and Geometric Distortion. V. Platais	3x	18		Every 4 months	1%	Build L-flats using star field. Third iteration can be closer to end of cycle.
wfc3_25	11920	IR Image Quality. L. Dressel	3x	6		SMOV + 4, 8, 12 months	20 stars with high SNR	Asses overall image performance and stability during Cycle 17. Measure FGS-IR alignment.
wfc3_26	11921	IR PSF Wings. L. Dressel	1x	5		Late in cycle	>5arcsec radius	Evaluate PSF stability at 5 field points, in two filters.
wfc3_27	11913	IR Filter Wedge Check. J. Kim	1x	2		Early to mid cycle	0.5 pixel	Verify IR filters meet CEI spec. for image displacement
wfc3_28	11932	IR Stray Light. L. Petro	1x	4		After SMOV	10%	Characterize stray light from bright sources outside the IR FOV & verify gravitational stress release has not increased stray light.

WFC3 Cal Plan (3/3)

wfc3ID	Cy17 ID	Proposal Title	Freq.	No. Orbits		Scheduling Required	Accuracy Goal	Notes
		PI		Ext	Int/P			
wfc3_29	11916	IR Intrapixel Sensitivity Variation. P. McCullough	1x	2		Early in cycle	<0.2% rms precision (relative) on photometry	Measure IPSV of array
wfc3_30	11933	IR Rate Dependent Non-linearity. A. Riess	1x	9		mid-cycle	1%	Characterize rate dependent non-linearity by observing star cluster with wide range of star brightnesses.
wfc3_31	11927	IR Persistence. S. Deustua	1x	6	18	SMOV + 6,		Measure and monitor persistence through observations of sparse star fields.
wfc3_32	11917	IR Earth Flats Pathfinder. P. McCullough	1x		50	anytime	1% relative	Determine pixel to pixel flat field of WFC3+OTA.
wfc3_33	11934	UVIS G280 Flux Calibration. H. Bushouse	1x	1		early in cycle	<10% in 1st orders	Establish flux calibration for G280 grisms, wrt spatial position in FOV
wfc3_34	11935	UVIS G280 Wavelength Calibration. H. Bushouse	1x	1		early in cycle	14 angstroms	Establish G280 wavelength calibration over FOV wrt position.
wfc3_35	11936	IR Grism Flux Calibration. H. Bushouse	2x	4		early in cycle	<5% in 1st order	Establish flux calibration for both IR grisms , wrt spatial position in FOV
wfc3_36	11937	IR Grism Wavelength Calibration. H. Bushouse	1x	2		early in cycle	1 pixel in 1st orders	Establish wavelength calibration over FOV wrt position for both IR grisms
Cycle 17 Orbit Totals				**249**	**2220**			

Summary

- Wide Field Camera 3 is working well
  - Instrument meets or exceeds our prelaunch expectations
  - Heavily used and generating science
  - SI C&DH safing recoveries now possible without detector thermal cycle – taking only a few hours
- Team is completing SMOV, supporting users, and looking to future calibration and operations activities
- Feedback and suggestions for analysis and calibration priorities is most timely!