

Cycle16 Calibration Plans

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Overview

- Initial C15/16 plan; impact of ACS loss
- Looking ahead; common standards

Cycle 15/16; impact of ACS loss

Going in; assumed 18 month Cycle 15+16 calibration Cycle to run up to SM4;
assumed 6 mo for Cycle 16.

Cycle 15/16 calibration plan included the following external orbit budget

- ACS primary (68 external orbits)
- NICMOS legacy (134)
- WFPC2 closeout (84)
- Focus and astrometry (34)
- FGS (14)
- Outsource (9, NICMOS)
- JWST standards (4, NICMOS)

Current Situation

- Launch delayed until September 2008 - needs extension of routine monitors.
- Will review calibration program in light of Cycle 16 phase 2 submissions.
- 5 more calibration outsource programs (2 orbits WFPC2; 4 AR).

ACS failure impact:

- ACS SBC ongoing and enhanced; significant loss of CCD calibrations
- NICMOS some enhancement (internals) to improve darks given that NICMOS is being used more and is a primary Cycle 16 instrument (Koekemoer)
- WFPC-2 priority shifts as it also is now a primary instrument; ongoing discussion (Biretta).
- Focus monitoring switched to WFPC2/PC; planning ACS/SBC element
 - ◆ consistency of HRC and PC focus established over several years (rms difference ~ 0.5 micron)
 - ◆ Focus measurement accuracy with the PC is better than 0.5 micron, well within requirements to avoid science impact
 - ◆ Tests of focus measurement with ACS/SBC are planned for May-June 07 - SBC is expected to provide the best continuity of focus information across SM4
- Astrometry; FGS; outsource; JWST standards no impact.

Additional STUC presentations

- ACS update (Sembach)
- WFPC2 status, cal plan and closeout (Biretta)
- NICMOS plans (Koekemoer)

- COS report (Keyes)
- WFC3 report (MacKenty)

ACROSS-INSTRUMENT CALIBRATION STANDARDS

- Some use of standard *astrometric* fields across instruments and missions; e.g. recently completed JWST CVZ astrometric field and ACS absolute plate scale combine to satisfy JWST requirements.
- *Flux standards*, based on pure hydrogen WDs. Every instrument has been calibrated to this standard, FOC, GHRS, FOS, WF/PC-1 onward.
- CALSPEC flux standards on-line at:
<http://www.stsci.edu/hst/observatory/cdbs/calspec.html> Bibliography from 1990-2007 Database includes 50 stars, all with SEDs directly tracable to the three primary WD models for G191B2B, GD153, & GD71
- Observational sources include FOS, STIS, NICMOS, IUE, & ground based data from B. Oke For the fundamental standard Vega, STIS observations are extended to long wavelengths with a specially tailored Kurucz 9400K model
- ACS/WFPC-2 cross-calibrated 47 Tuc, NGC2419, WDs
- COS will use common flux standards (FASTEX)
- WFC3 will build on ACS/NICMOS (re-use proposals)
- Other cross-calibrations: Sloan, Spitzer, JWST, ground

Commonality of Standards

- FASTEX program; initiated 1999
 - Faint Standards Extension program to address deficiencies of faint standards in database. Originally for UV/COS, ACS/SBC, GALEX expanded to cover optical and NIR.
 - includes white dwarf, solar analog models and observations.
 - Intended for use with
 - ◆ All HST instrumentation, past, present and future
 - ◆ JWST
 - ◆ Spitzer
 - ◆ JDEM

Example I: COS calibration

COS Calibration (see Keyes presentation):

- STScI and the COS IDT will jointly develop SMOV calibration programs
- All flux, wavelength, and spectral resolution standard targets will be chosen from the STScI HST calibration target list
 - ◆ Four additional faint WD standards (the FASTEX (Faint Standard Extension) stars were specifically observed with STIS in cycle 11, have been modeled to STScI requirements, and have been added as primary photometric standards in the STScI calibration database (Bohlin, Leitherer, and Finley)

Example II: WFC3 plans (MacKenty)

■ Cy 17 Calibration

- ◆ **ACS and NICMOS provide templates**
 - ◆ Re-use of calibration targets should be 100%
 - ◆ IR channel was designed to use relatively bright NICMOS standards
- ◆ **Learn from ACS and NICMOS experience**
 - ◆ Exploring impact of bus voltage slews in TV2
 - ◆ Intend to obtain UDF level Bias (UVIS) and Dark (IR) calibrations during thermal vac to better understand critical calibration needs for Cy 17
- ◆ **WFC3 has a rich filter set (but few modes)**
 - ◆ Spectroscopy out-sourced to ECF via MOU on ACS model
- ◆ **Inputs for calibration plans**
 - ◆ Will need to set priorities on filters (77 elements) and subarrays&binning
 - ◆ WFC3 SOC is developing Early Release Science program (will support this)
 - ◆ STUC and SOC advice most welcome

Example III: HST Calibrations for JWST: Cycle 15 Proposal

- Main seq A-star spectrophotometric observations; Spitzer standards:
 - ◆ 4 more stars (4 orbits) doubles the sample size.
 - ◆ Current greatest uncertainty is extrapolating models to longer wavelengths for 2—5 μm NIRSpec calibration and 5—25 μm MIRI calibration.
 - ◆ Additional stars will probe and reduce modeling-related errors.
- 4 orbits of NICMOS grism observations.

BACKUP FOLLOWS:

- Cycle 15/16 material presented to STUC October 2006

FASTEX program: in progress

- Archival proposal with Finley as PI to revise primary WD Teff & $\log g$ co-Is: Hubeny & Bohlin
- Re-determination of Teff & $\log g$ from STIS spectra of 5 faint WDs for COS flux calibration. [Propid (orbits): 8423 (16), 8849 (8), 9631 (19), 10037 (1)]
- NICMOS absolute spectroscopy from 0.8-2.5 microns for community standards, WFC3, JWST, JDEM calibrations; ACS cross-cal; & Spitzer & Sofia cross calibration [For the entire 5 year program, including primary standards to calibrate the new modes and extra orbits to quantify the non-linearity discovered in this program. 9998 (10), 10014 (18), 10383 (2), 10385 (7), 10709 (2), 10726 (1), 10754 (8), 11064 (32), 11068 (4)]
- Request submitted to Kurucz for better A star models to extend the NICMOS data to longer wavelengths
- Complete ACS CCD photometric recalibration for its closeout. Based on the 3 primary WDs, STIS spectra of F, G, M, L, & T stars supplemented by NICMOS observations from the STIS 1micron limit to the ACS sensitivity limit at 1.1micron [over the 5 year ACS lifetime, some of the main programs were: 9563 (28), 9654 (12), 9655 (13), 9664 (5), 10054 (16), 10374 (12), 10740 (7), 11054 (8). Numerous other programs contributed the odd relevant standard star obs., while many other cal programs (eg. flat fields,dark,bias) contribute indirectly.]
- More NICMOS observation are needed to monitor for sensitivity changes, verify the M, L, T star repeatability, provide more STIS cross calibration, and extend more of the STIS SEDs to longer wavelengths [~30 orbits the next year to get more stars, monitor sensitivity, monitor stellar variability, and increase precision. ~15orbits/year thereafter]

Special Considerations for Cycle 15/16

- Cycle 15 calibration plan is to cover Cycles 15 and 16 up to SM4; 6 mo C16 assumed (Agreed by HSTMO, SPD, DO)
- WFPC2 must be closed out at the time of the Servicing Mission. Hence this represents the final opportunity to acquire calibration observations for that instrument. Biretta to present.
- Post- SM4 anticipate much reduced useage of NICMOS as primary IR instrument, hence develop augmented calibration plan. Noll/Pirzkal to present.
- Teams requested to consider calibrations generic to multiple instruments, such as faint standards, or which might cross instrument boundaries, e.g. NICMOS non-linearity.
- Are there any forward-looking calibrations needed for WFC3/COS or JWST at this stage?
- As always, teams asked to be prudent in use of both external and internal orbits.

Usage by Instrument Cycle 15

Instruments	Mode	Requested Orbits	%	Approved	%
ACS/HRC	Imaging	1813	9.2	543	
ACS/HRC	Spectroscopy	111	0.6	21	
ACS/SBC	Imaging	532	2.7	273	
ACS/SBC	Spectroscopy	237	1.2	66	55.1
ACS/WFC	Imaging	9706	49.2	2249	
ACS/WFC	Spectroscopy	64	0.3	24	
FGS	POS	219	1.1	49	
FGS	TRANS	29	0.1	25	1.3
NIC1	Imaging	459	2.3	186	
NIC2	Imaging	2002	10.1	727	24.2
NIC3	Imaging	1995	10.1	485	
NIC3	Spectroscopy	168	0.9	48	
WFPC2	Imaging	2405	12.2	1073	18.6
		19740*		5769*	

* Includes Coordinated Parallels

Imaging 96.0% Spectroscopy 2.7% FGS 1.3%

Excludes Pure Parallel and Snapshot programs

Cycle 15 request overview: context in red below

	Nominal	External actual	Internal/par actual
ACS	144	68	1665
NICMOS	63	134	36
WFPC2	48	84	1380
Astrometry/focus	3	34	
FGS	N/A	14	
HST/JWST	N/A	4	
Outsourcing	N/A	9	
Total	262	347+35=382 (7%, 12mo 255) C14: 177 C13: 164 C12: 289 C11: 407	