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NICMOS Cycle7 Calibration Plan and Beyond

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Abstract. This document summarizes the various calibration programs that form the basis of the NICMOS Cycle 7 calibration plan. Specific calibration plans to support the NIC3 campaign are also described.

1. Introduction

The calibrations available during Cycle 7 and Cycle7-NICMOS are based on three distinct calibration activities. First, NICMOS has been extensively tested on the ground. These tests included a limited amount of calibration, particularly during the System Level Thermal Vacuum (SLTV) testing. Second, a period following the installation of NICMOS into HST for testing and initial calibration has been completed. This activity is known as the Servicing Mission Observatory Verification (SMOV). Finally, the routine Cycle 7 calibration program is now underway.

It is important to distinguish between the various goals of these calibration activities. SLTV was intended to demonstrate the proper functioning of NICMOS and to obtain an initial calibration of a subset of its capabilities. SMOV was intended to demonstrate that the instrument is functioning as expected, based on the SLTV experience, to characterize those parameters not measurable during SLTV (e.g. the thermal background generated by the HST optics), to establish necessary operation parameters (e.g. plate scale), and to begin the calibration of NICMOS. In many cases the complete calibration will be conducted during Cycle 7 with SMOV being used to demonstrate that the planned calibrations are in fact feasible. This document summarizes the content of the Cycle 7 calibration plan for NICMOS and also describes the calibration plans to support a NIC3 campaign.

2. Cycle 7 Calibration Plan

As a consequence of the NIC3 defocus, the Cycle 7 calibration plan that went into operation in June 1997 focuses only on the calibration of NIC1 and NIC2 cameras and executes a limited calibration programs for NIC3. A summary of the calibration programs included in the Cycle 7 calibration plan is found in Table 1.

The Cycle 7 calibration plan consists of routine monitoring and special calibration programs as well as of contingency calibration programs that will be executed only in the event the cameras show large physical displacements. NIC3 specific calibration programs were part of the calibration plan but are now included in the NIC3 campaign calibration plan.

A revision of this calibration plan will be undertaken by the end of 1997, after we gain experience during the first 5–6 months of Cycle 7 and after the evolution of NICMOS is better known. A postscript version of the Report fully describing NICMOS calibra-

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tion activities for Cycle 7 (NICMOS ISR-021) is available on the NICMOS WEB page: `http://www.stsci.edu/ftp/instrument_news/NICMOS/nicmos_doc.html`

The calibration programs may each be examined by using the ID number and the HST Program and Schedule Information Page:

`http://presto.stsci.edu/public/propinfo.html`

Information about all the reference calibration files and tables created as a result of the various calibration programs is available on the NICMOS documentation page: `http://www.stsci.edu/ftp/instrument_news/NICMOS/nicmos_doc_cal_list.html`

Table 1. NICMOS Cycle 7 Calibration Plan

ID	Proposal Title	Frequency	Execution	Accuracy	Comments
	Routine Monitoring Program				
many	MULTIACCUM Darks	1	Jun. 97	10 DN	Data in all cameras
7596	Darks Monitoring	monthly		10 DN	Data in all cameras
7689	Earth Flats	continuous		2%	NIC1&2; reduced NIC3
7690	Internal Lamp Flats	monthly		1%	NIC1&NIC2
7607	Photometric Monitoring	monthly		2%	NIC1&2; reduced NIC3
7608	Focus Monitoring	bi-weekly		1 mm	Data in all cameras
	Special Calibration Programs				
7688	ACCUM Darks	1	Sept. 97	10 DN	Data in all cameras
7691	Photometric Zero Point	1	Aug. 97	5-10%	NIC1&NIC2
7692	Polarizers	1	Sept. 97	1%	NIC1&NIC2
7693	Pupil Transfer Function	1	Sept. 97	1%	NIC1&NIC2
7611	Thermal Background	continuous	Jun/Jul. 97	n/a	Data in NIC2&NIC3
	Contingency Calibration Programs				
7609	NICMOS to FGS Astrometry	TBD	TBD	0.″1	On hold
7610	Plate Scale	TBD	TBD	0.2%	On hold
7694	Coronograph Stability	TBD	TBD	n/a	On hold

2.1. Detector Performance

All three detectors are being characterized to the same extent. High quality darks were obtained for all requested MULTIACCUM sequences during June and early July 1997 (proposals ID 7703 to 7710). Changes in the detectors' performance are being monitored with a monthly periodicity (proposal ID 7596). Darks are also being obtained for a limited subset of ACCUM exposure times (proposal ID 7688). Other ACCUM exposure times will require an interpolated dark current substraction that may be less satisfactory.

2.2. Flat Fields

High quality internal lamp flat-fields for all NIC1 and NIC2 polarizers, broad- and medium-band filters have been obtained during July and August 1997 (proposal ID 7690). The temporal evolution of the pixel-to-pixel response as a function of camera and wavelength is being monitored once a month using a subset of NIC1 and NIC2 filters. Earth flat-fields are been obtained for the complete set of NIC1 and NIC2 narrow-band filters as well as for a few NIC3 filters (proposal ID 7689). Data in a few medium-band filters are also being obtained to characterize the OTA illumination patterns. Additional measurements aimed at the detection and modelling of any spurious large scale structure in the flat-fields will be obtained (proposal ID 7693). Since flat-fields are generated illuminating the detectors with a bright diffuse source (i.e. internal lamps or Earth), these spurious structures could be introduced by the possible leaks of NICMOS cold mask when illuminated by these diffuse sources.

2.3. Photometry

Photometric observations of two standard stars have been obtained for NIC1 and NIC2 filters (proposal ID 7691). In addition, images of a bright red star (OPH-S1) were also

taken to measure possible red-leaks in the filters, in particular the narrow filters at the short wavelength range of NICMOS. The photometric stability of NIC1 and NIC2 cameras as a function of time and wavelength is being monitored once a month with observations of a standard star in a subset of filters (proposal ID 7607). In addition, the photometric stability of NIC3 camera is being monitored with observations in the filters F110W and F160W.

2.4. Thermal Background

The absolute level and stability of the thermal background as seen by the NICMOS cameras has already been measured as part of the SMOV program. The Cycle 7 calibration program extends the SMOV program with images obtained in the F237M (NIC2) and F222M (NIC3) filters (proposal ID 7611). Images were taken during June and July 1997 as pointed parallel observations to map possible changes in the thermal background as a result of temperature changes in HST optics.

2.5. Polarizers

The instrumental polarization and zero position angle of NIC1 and NIC2 polarizers will be measured by taking images of two bright near-infrared polarized standards: HDE283812 and CHA-DC-F7. Changes in the polarization as a function of position within the detectors will also be measured by moving one of the polarized targets in a spiral pattern across the detector. Additional images of the HST unpolarized standards HD64299 and BD+32d3739 will also be taken.

2.6. Focus Monitoring

The focus of all three cameras is being monitored throughout the entire Cycle 7 (prop ID 7608). During the first few months, focus measurements will be obtained every other week with the three cameras. The frequency of the monitoring will most likely be decreased to once a month, after the first few months. Information regarding the results of the focus monitoring program are posted on the NICMOS focus Web page:

`http://www.stsci.edu/ftp/instrument_news/NICMOS/nicmos_doc_focus.html`

2.7. Point Spread Function

No calibration program specifically designed to measure the point spread function of the three cameras as a function of wavelength and location was included in the Cycle 7 calibration plan. Observers requering PSFs in specific filters and/or locations within the field of view are advised to include these in their own program. NICMOS PSFs can also be modeled using Tiny Tim V4.3. Tiny Tim software can be retrieved from the Web at:

`http://scivax.stsci.edu/~krist/tinytim.html`

2.8. Coronograph

The ability to position a star behind the coronographic mask has been enabled during SMOV. The PSF within the coronograph has also been characterized during SMOV. A contingency program designed to measure the stability of the coronograph performance will be executed as part of the Cycle 7 calibration plan if large physical motions in the NIC2 camera are detected (proposal ID 7694). This program focus on measuring the possible change in the scattering and diffracted energy rejection patterns as a function of target decentration in the mask. The latest information on the status of the coronograph can be found on the NICMOS updates page:

`http://www.stsci.edu/ftp/instrument_news/NICMOS/NICMOS_updates/`

3. Calibrations Supporting the NIC3 Campaign

In support of the NIC3 campaign, the original Cycle 7 calibration plan is being expanded to include NIC3-specific programs. These new programs will provide an accurate calibration of the NIC3 detector and its different modes of operation: imaging and spectrophotometry. A preliminary list of programs is indicated in the accompanying table.

MULTIACCUM darks are being obtained as part of the regular Cycle 7 calibration plan and no additional data are required to support the campaign. Flats will be obtained before the campaign once the validation of the Field Offset Mirror (FOM) is completed. A revalidation of the grisms' wavelength calibration is also needed before the campaign since the results of the corresponding SMOV test have not been conclusive.

The rest of the NIC3 calibration programs will be executed during the campaign. These include the photometric calibration of the filters, the accurate calibration of the grisms and additional programs aimed at measuring the plate scale of the detector during the campaign and at characterizing any residual large scale effects due to NICMOS cold mask.

Table 2. Preliminary NIC3 Campaign Calibration Plan

ID	Proposal Title	Frequency	Execution	Accuracy	Comments
		Before the Campaign			
many	MULTIACCUM Darks	1	Jun/Oct. 97	10 DN	Data for all MULTIACCUMs
new	Earth Flats	continuous	Nov/Dec. 97	2%	details to be defined
new	Internal Lamp Flats	1	Nov/Dec. 97	1%	medium- & broad-band filters
7806	GRISM Revalidation	1	Oct. 97	n/a	wavelength cal: G096, G141
		During the Campaign			
new	Photometric Zero Point	1	Jan. 98	5-10%	all filters
new	Photometric Monitoring	2	Jan. 98	2%	subset of filters
7610	Plate Scale	1	Jan. 98	0.2%	
new	Pupil Transfer Function	1	Jan. 98	1%	two/three filters
7695	GRISM Wavelength Calib.	1	Jan. 98	0.01μm	
7696	GRISM Absolute Calib.	1	Jan. 98	20-30%	

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