CHAPTER 2

Special Considerations for Cycle 7–NICMOS

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HST’s second servicing mission successfully installed two second-generation instruments, NICMOS and STIS (the Space Telescope Imaging Spectrograph) while removing the Faint Object Spectrograph (FOS) and Goddard High Resolution Spectrograph (GHRS). In addition, a Fine Guidance Sensor (FGS) was replaced and a solid state data recorder installed. The increased data capacity of the new recorder, exploited through a series of changes to the ground system, considerably increases the capacity of HST to handle large volumes of data.

While NICMOS has demonstrated its capability for excellent scientific observations, problems within its cryogenic cooling system resulted in some degradation of the Camera 3 capability and a significantly shortened life expectancy. As discussed in the Cycle 7-NICMOS call for proposals (CP), this special CP is being issued to maximize the scientific return from NICMOS within its predicted lifetime. To solicit, select, and prepare proposals within the timescale necessary to accelerate the NICMOS science program, this Handbook is being prepared before the Servicing Mission Observatory Verification (SMOV) period is completed and its results fully analyzed. Thus, this Handbook represents a snapshot of our current but evolving understanding of NICMOS. While observers should rely upon this Handbook (except where noted) when preparing proposals for Cycle 7-NICMOS, they are advised to seek updated information when preparing Phase II proposals and analyzing NICMOS observations.
NICMOS is a New Instrument

While planning your Cycle 7-NICMOS observations, keep in mind that NICMOS is a new capability, as well as a new instrument for HST. The sensitivities, brightness limits, and optical performance contained in this Handbook are based on our initial calibration and test observations (and in many instances also rely upon ground-based tests). You should rely upon the WWW based Exposure Time Calculator (ETC) for the best available estimates of NICMOS performance, as these may still change.

HST’s performance as an infrared telescope is now significantly better characterized than it was prior to the installation of NICMOS. The level of thermal emission from the telescope is considerably lower than was predicted in the previous version of this Handbook (see Chapter 3).

As NICMOS is experiencing difficulties with both cryogen lifetime and Camera 3 focus, observers should pay careful attention to its status, the limitations imposed by this situation, and the resulting policies which have been adopted to maximize its scientific return.

Information Updates for Cycle 7-NICMOS

Updates with new results from SMOV will be posted to the STScI NICMOS WWW site (see “Supporting Information and the NICMOS Web Site” on page 9) as soon as they become available. Additional updates, applicable only to accepted Cycle 7-NICMOS proposals, will be provided prior to Phase II Submission as required.

Because the SMOV testing of the coronograph is underway as this Handbook is being completed, a summary of the coronograph performance will be posted on the STScI NICMOS WWW site on August 1, 1997.

Your Cycle 7-NICMOS HST proposal must be based on the Exposure Time Calculator (ETC) predictions of NICMOS performance. The ETC is accessible from the STScI NICMOS WWW site and has been updated to reflect the on-orbit performance of NICMOS.
Early on-orbit tests of NICMOS revealed dynamic changes to its characteristics and performance. On-orbit expansion of the solid nitrogen in the dewar (used to cool the detectors) has deformed the dewar leading to a thermal contact between the instrument cold well (which contains the three detectors inside the solid nitrogen dewar) and the inner vapor-cooled shield and also causing changes in focus for all three NICMOS cameras. The expected lifetime of the NICMOS cryogen has been significantly reduced as a result. Best estimates are that, if the current rate of cryogen loss continues, NICMOS will remain operational until late 1998 or early 1999. If the thermal contact breaks and the cryogen loss rate is consequently decreased, that time could be longer. NICMOS camera 3 (NIC3) has suffered the largest performance loss. Cameras 1 and 2 (NIC1, NIC2) are performing well and can meet most observational requirements. Based on our best estimates of the current situation, we are working from the following set of assumptions:

- **Lifetime:**
  - The useful lifetime of NICMOS will be reduced; we are planning for NICMOS observations to end by about November 1998.

- **Focus Issues:**
  - Image quality in NIC1 and NIC2 is excellent. Both cameras are, however, very slightly vignetted.
  - The best focus positions for NIC1 and NIC2 are different, but the image quality of NIC1 at NIC2’s focus or NIC2 at NIC1’s focus is only marginally degraded.
  - NIC3 cannot currently be brought into focus using the internal NICMOS focus mechanism. The image quality is very poor when either NIC1 or NIC2 are in focus as the prime camera. NIC3 is vignetted over approximately 25% of the detector (although this vignetting may be reduced as a result of ongoing experiments with the internal optical alignment of the NICMOS optics).
  - NIC3 may return to focus as cryogen is depleted, but when and if this will occur is difficult to predict. NIC3 can be placed into focus by adjusting the OTA focus mechanism although other instruments would then be (temporarily) out of focus.
  - The spectral resolution and sensitivity of the grisms are seriously degraded for point sources when NIC3 is out of focus. For extended sources the loss of performance is less severe.

- **Thermal Background:**
  - Thermal backgrounds are much lower than estimated in Version 1.0 of the *NICMOS Instrument Handbook* (see Chapter 3).
• **Coronograph:**
  - The coronograph performance in NIC2 is slightly degraded as the coronographic hole is no longer confocal with the detector (a compromise focus is presently being explored and results should be available on the WWW by August 1, 1997).
  - The position of the coronographic hole is changing with time. A flight software modification is being developed in time for Cycle 7-NICMOS which will locate the hole prior to a coronographic acquisition with minimal overhead cost.

• **Detector Issues:**
  - A small percentage of pixels in each camera have reduced throughput, probably from debris on the detectors. The pattern of affected pixels is time variable and therefore difficult to fully calibrate.
  - The bias level exhibits enhanced signal after periods of non-use which presently cannot be fully calibrated out. Excess signal levels of ~10 DN are not uncommon. Laboratory testing is ongoing to validate an improved detector operation method which may reduce or eliminate this effect.

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**Recommendation Summary**

We give here a summary of general recommendations. However, observers are strongly advised to read the technical sections that follow and develop an optimal observation strategy based on the demands of their individual scientific goals.

• Proposers should attempt to use NIC1 or NIC2 if their scientific objectives can be met. Proposals which require NIC3 (e.g., for its field of view or spectroscopic capabilities) should recognize the scheduling limitation which campaigns may impose.

• Proposers should weigh the use of the grisms in NIC3 against using narrow band filters in NIC2 or NIC1 to meet their science goals.

• Proposers should dither observations that could be adversely affected by bad pixels.

• Proposers should eliminate restrictive scheduling requirements (e.g., ORIENT) wherever possible to decrease the chance that their program will fail to be scheduled before the NICMOS cryogen supply is exhausted.
As was done for both NICMOS and STIS for Cycle 7, we have established a set of core scientific capabilities of NICMOS which will be supported for Cycle 7-NICMOS science. These capabilities cover an enormous range of science applications. In practice, the supported capabilities will be phased in during Cycle 7, as our understanding of the instrument and on-orbit performance grows. This phasing will optimize the likelihood that observations are successfully executed and assure that the requisite calibration observations are obtained.

NICMOS has additional capabilities that are not supported for Cycle 7-NICMOS. These capabilities are “available” in the form of Engineering-only modes, upon consultation with a NICMOS Instrument Scientist. If you find that your science cannot be performed with the capabilities described in this handbook, you may wish to consider an unsupported capability. The use of these capabilities requires approval from STScI and support for calibration may be limited or non-existent.

**Supported capabilities include:**

- NIC1, NIC2 observations in any filter or polarizer.
- NIC3 observations in campaign mode (i.e., in-focus NIC3 observations).
- MULTIACCUM and ACCUM detector readout modes (but see Chapter 8 for a discussion of the problems that can be faced when using ACCUM mode).
  - The defined MULTIACCUM SAMP-SEQ exposure time sequences,
  - A subset of the ACCUM exposure times as defined in Chapter 8.
  - ACCUM NREAD=1 or 9 values only.
- Coronographic observations including on-board target acquisitions.

**Unsupported (“available”) capabilities include:**

- The Field Offset Mirror (FOM).
- BRIGHTOBJ readout mode. The calibration and linearity of this mode is problematic.
- The RAMP readout mode. This detector readout mode is similar to a limited version of the MULTIACCUM mode with the processing carried out within the NICMOS instrument computer and only the final processed image downlinked.
- Any non-standard ACCUM exposure time or any MULTIACCUM exposure times not incorporated in one of the standard sequences of exposures (SAMP-SEQ). ACCUM with NREAD other than 1 or 9.

Use of unsupported modes comes at a price, and these modes should be used only if the need and scientific justification are particularly compelling. Proposers should be aware of the following caveats in the use of unsupported modes:
• Calibrations for unsupported capabilities will not be provided by STScI. Observers must either determine that they can create calibration files from data in the HST Archive or they must obtain calibrations as part of their observations. The STScI pipeline will not calibrate data taken in unsupported modes but will deliver uncalibrated FITS files (or in some cases partially calibrated FITS files) to the observer and the HST Archive.

• STScI adopts a policy of *shared risk* with the observer for the use of unsupported capabilities. Requests to repeat failed observations taken using unsupported capabilities will not be honored if the failure is related to the use of the unsupported capability.

• User support from STScI for the reduction and analysis of data taken using unsupported capabilities will be limited and provided at a low priority. Users taking data with unsupported capabilities should be prepared to shoulder the increased burden of calibration, reduction, and analysis of these data.

Cycle 7-NICMOS proposals which include use of unsupported NICMOS capabilities must include a justification of why the science cannot be done with a supported configuration, must include a request for any observing time needed to perform calibrations, must justify the added risk of using an unsupported mode in terms of the science payback, and must include a demonstration that the observers are able to shoulder the increased burden of calibration, reduction, and analysis of their data.