**WFPC2 Cycle 8 Calibration Plan**

S. Baggett, S. Casertano, J. Biretta, S. Gonzaga, and the WFPC2 Group  
May 19, 1999

**ABSTRACT**

This report presents the details of the WFPC2 observations planned to maintain and improve the instrument calibration during Cycle 8. The total spacecraft time required for the calibration is 73 external pointed orbits and 2892 internal orbits (occultation periods). This estimate does not include any calibrations associated with the planned servicing mission (SM 3a) in October 1999; the SM 3a plan is currently under development and will be presented at a later date.

**1. Introduction**

The Cycle 8 calibration program is aimed at maintaining the calibration of WFPC2 via monitoring programs, as well as continuing some proposals from previous Cycles into Cycle 8 and performing new tests to improve our understanding in several key areas. The WFPC2 calibration for Cycle 8 is estimated at 73 orbits, which is based upon a 66 week cycle with enough repeats in the monitoring proposals to ensure a smooth transition from Cycle 7 to Cycle 8; this includes a 10% reserve of 7 orbits, for unanticipated items that may arise during the Cycle.

**Table 1: Summary of WFPC2 Orbits Required for Cycle 8 Calibrations**

<table>
<thead>
<tr>
<th>proposal type</th>
<th>external orbits</th>
<th>internal (occultations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>monitors</td>
<td>40</td>
<td>2234</td>
</tr>
<tr>
<td>special (continuations)</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>special (new)</td>
<td>12</td>
<td>720</td>
</tr>
<tr>
<td>reserve</td>
<td>7</td>
<td>--</td>
</tr>
<tr>
<td>total</td>
<td>73</td>
<td>2964</td>
</tr>
</tbody>
</table>
**Monitors**

As in previous cycles, a substantial part of the program consists of the routine monitors and decontamination (decon) procedures. In Cycle 8, the decons will continue to be performed on a monthly basis, to remove the UV contaminants and anneal hot pixels. The monitoring observations associated with the decons are similar to those from previous Cycles, allowing us to efficiently track the overall long-term photometric throughput of the camera, the monthly throughput decline rates due to contaminant buildup on the CCD windows, the return to nominal throughput after the decons, the PSF properties at different wavelengths, the OTA focus, and the general health and performance of the cameras. A new aspect this cycle is that a handful of programs tied to a decon (internals, photometric monitor, focus check, UV throughput) have been combined into the decon proposal, to help minimize scheduling problems. For convenience, the resulting decon proposal was split into two pieces (8441, 8459; see Table 1), to run before and after SM 3a in Oct 1999.

In addition to the decon proposal and its associated observations, we will continue the standard darks program (six darks per week, used for reference files), the supplemental darks program (0-3 darks per day, low priority, for archive only), and the weekly internal monitor (biases and kspots). The Earth flat program will also be continued, to allow tracking and correction for changes in the flatfield. Following the general plans of previous cycles, streak flats in a subset of filters will be obtained to construct superflats which are used to generate the pipeline flats.

The other monitoring proposals include the astrometric monitor, the CTE monitor, the INTFLAT/VISFLAT sweeps, and the UV internal flats. The astrometry program, along with the internal kspots, will allow measurement of any chip position shifts or changes in the astrometry. The CTE monitor program will allow tracking of the CTE problem, which continues to worsen with time. The internal flats programs will provide verification of the pixel to pixel flatfield response; as in Cycle 7, the emphasis will be on the INTFLATS, so as to minimize shortening the VISFLAT lamp lifetime.

**Special Programs - Continuations**

The remaining proposals planned for Cycle 8 will be used to verify and improve the existing WFPC2 calibration in key areas. Several special programs which were executed in previous cycles will be run as shorter versions in Cycle 8: the photometric and PSF characterization proposals, the polarization check, and the linear ramp filter proposal. Cycle 7 included a thorough test of the photometric zeropoints and contamination rates; the Cycle 8 proposal will be a spot-check of those results, with a comparison to the baseline observations to identify any time dependencies. The PSF characterization proposal will be similar to Cycle 6, but only two filters will be checked (F555W and F814W), instead of the full suite of filters. The polarization proposal will allow us to verify the stability of the polarization calibration from Cycle 5 via observations of polarized and
unpolarized standards; a small set of VISFLATs will be obtained to check for flatfield changes. The linear ramp filter proposal is at present only a placeholder, pending receipt and analysis of the Cycle 7 data; however, the plan is to merely spot-check a subset of wavelengths in Cycle 8.

Special Programs - New

There are five new special programs, designed to address the remaining photometric issues (CTE and long vs short) as well as user concerns from previous cycles.

The noiseless preflash proposal will test whether illuminating the detectors prior to an exposure reduces the impact of the CTE and long vs short anomalies. The preflash will be accomplished via INTFLATs which will be readout prior to the external exposures, thereby minimizing additional noise in the observations. Darks will be taken before the visit and during occultations, to insure that no prior exposures will effectively preflash the non-preflashed images.

The CTE for extended sources proposal will, for the first time, allow a direct measurement of the CTE effect on small (2-3’’) extended sources; the tentative target, selected from the archive, is galaxy cluster 135951+621305. The cluster will be positioned at a variety of chip locations; images will be obtained in F606W and F814W to match those in the archive, thereby allowing an assessment of any temporal changes in the CTE.

The Cycle 8 special programs also include a check of the photometric calibration for very red stars (two late M dwarfs, VB8 and VB10) in BVRI. The current zeropoints (based on a white dwarf UV standard and verified via solar analog data) and the color transformations from HST BVRI to groundbased BVRI are highly uncertain for stars this red; this program will provide straightforward empirical calibration. In addition, a short single-orbit program will allow us to measure variations in the plate scale with wavelength, particularly in the UV, where the index of refraction in the MgF window increases rapidly. Finally, a special program is being developed to help improve the quality of the UV flatfields: the Earth flats will be obtained in a variety of UV filters as well as some crossed filter combinations to account for any redleak contributions. Several of these special programs have been designated as candidates for “calibration outsourcing” where external groups would be funded to perform the analysis.

2. Format

Table 1 summarizes the Cycle 8 calibration programs for WFPC2; the remainder of the report contains details for each proposal, including purpose, a brief description, and estimates of the accuracy goals and resources required. The proposal pages are intentionally in landscape format, to facilitate reporting of the results at the end of Cycle 8. Phase II versions of the proposals can be viewed at http://www.stsci.edu/public/propinfo.html.
# WFPC2 Cycle 8 Calibration Plan

<table>
<thead>
<tr>
<th>ID</th>
<th>Proposal Title</th>
<th>Frequency</th>
<th>Estimated Time (orbits)</th>
<th>Scheduling Required</th>
<th>Products</th>
<th>Accuracy Required</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>“External”</td>
<td>“Internal”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8441</td>
<td>WFPC2 Decons &amp; Associated Observations</td>
<td>1-2/4 wks</td>
<td>32</td>
<td>72</td>
<td>every 28 d</td>
<td>Synphot, CDBS</td>
<td>1-2%</td>
</tr>
<tr>
<td>8442</td>
<td>Standard Darks</td>
<td>weekly</td>
<td>324</td>
<td>72</td>
<td>every 7 d</td>
<td>CDBS</td>
<td>1 e/hr</td>
</tr>
<tr>
<td>8443</td>
<td>Supplemental Darks (8460, 8461)</td>
<td>0-3/day</td>
<td>1308</td>
<td>anytime</td>
<td>n/a</td>
<td>For archive only, no analysis provided</td>
<td></td>
</tr>
<tr>
<td>8444</td>
<td>Internal Monitor</td>
<td>3/4 wks</td>
<td>45</td>
<td>mid-cycle</td>
<td>CDBS</td>
<td>0.8e/pixel</td>
<td>New superbiases, not run on decon wks</td>
</tr>
<tr>
<td>8445</td>
<td>Earth Flats</td>
<td>continuous</td>
<td>442</td>
<td>mid-cycle</td>
<td>CDBS</td>
<td>0.3%</td>
<td>Also LRF, Methane quads</td>
</tr>
<tr>
<td>8446</td>
<td>Astrometric Monitor</td>
<td>2/cycle</td>
<td>2</td>
<td>mid-cycle</td>
<td>ISR</td>
<td>0.05”</td>
<td>Also K-spots &amp; platescale check in red</td>
</tr>
<tr>
<td>8447</td>
<td>CTE Monitor</td>
<td>2/cycle</td>
<td>4</td>
<td>mid- &amp; late</td>
<td>ISR</td>
<td>0.01 mag</td>
<td></td>
</tr>
<tr>
<td>8448</td>
<td>Intflat and Visflat Sweeps</td>
<td>1/cycle</td>
<td>43</td>
<td>mid-cycle</td>
<td>TIR</td>
<td>0.3%</td>
<td>Mostly intflats</td>
</tr>
<tr>
<td>8449</td>
<td>UV Flats Internal Monitor</td>
<td>1/cycle</td>
<td>2</td>
<td>mid-cycle</td>
<td>TIR</td>
<td>2-8%</td>
<td>Uses UV cal channel lamp</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Routine Monitoring Programs

<table>
<thead>
<tr>
<th>ID</th>
<th>Proposal Title</th>
<th>Frequency</th>
<th>Estimated Time (orbits)</th>
<th>Scheduling Required</th>
<th>Products</th>
<th>Accuracy Required</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8451</td>
<td>Photometric Characterization</td>
<td>1</td>
<td>2</td>
<td>mid-cycle</td>
<td>ISR</td>
<td>2.5%</td>
<td>Subset of Cycle 7 proposal, as check.</td>
</tr>
<tr>
<td>8452</td>
<td>PSF Characterization</td>
<td>1</td>
<td>2</td>
<td>late in cycle</td>
<td>CDBS</td>
<td>10%</td>
<td>Subset of standard broadband filters.</td>
</tr>
<tr>
<td>8453</td>
<td>Polarization</td>
<td>1</td>
<td>6</td>
<td>early in cycle</td>
<td>CDBS</td>
<td>3-5%</td>
<td>Subset of Cycle 6, as check</td>
</tr>
<tr>
<td>8454</td>
<td>Linear Ramp Filters</td>
<td>1</td>
<td>4</td>
<td>late in cycle</td>
<td>CDBS</td>
<td>3%</td>
<td>Placeholder, pending results from Cy.7.</td>
</tr>
<tr>
<td>8455</td>
<td>Noiseless Preflash</td>
<td>1</td>
<td>5</td>
<td>early in cycle</td>
<td>TIR</td>
<td>0.01 mag</td>
<td>Test scheme to reduce CTE problem</td>
</tr>
<tr>
<td>8456</td>
<td>Photometry of Very Red Stars</td>
<td>1</td>
<td>2</td>
<td>mid-cycle</td>
<td>ISR</td>
<td>2-5%</td>
<td>Outsourcing candidate.</td>
</tr>
<tr>
<td>8457</td>
<td>CTE for Extended Sources (2-3&quot;)</td>
<td>1</td>
<td>4</td>
<td>mid-cycle</td>
<td>ISR</td>
<td>0.01 mag</td>
<td>Outsourcing candidate.</td>
</tr>
<tr>
<td>8458</td>
<td>UV Earth Flats</td>
<td>continuous</td>
<td>720</td>
<td>early in cycle</td>
<td>CDBS</td>
<td>3-10%</td>
<td>Outsourcing candidate.</td>
</tr>
</tbody>
</table>

## Special Calibration Programs

<table>
<thead>
<tr>
<th>ID</th>
<th>Proposal Title</th>
<th>Frequency</th>
<th>Estimated Time (orbits)</th>
<th>Scheduling Required</th>
<th>Products</th>
<th>Accuracy Required</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8451</td>
<td>Photometric Characterization</td>
<td>1</td>
<td>2</td>
<td>mid-cycle</td>
<td>ISR</td>
<td>2.5%</td>
<td>Subset of Cycle 7 proposal, as check.</td>
</tr>
<tr>
<td>8452</td>
<td>PSF Characterization</td>
<td>1</td>
<td>2</td>
<td>late in cycle</td>
<td>CDBS</td>
<td>10%</td>
<td>Subset of standard broadband filters.</td>
</tr>
<tr>
<td>8453</td>
<td>Polarization</td>
<td>1</td>
<td>6</td>
<td>early in cycle</td>
<td>CDBS</td>
<td>3-5%</td>
<td>Subset of Cycle 6, as check</td>
</tr>
<tr>
<td>8454</td>
<td>Linear Ramp Filters</td>
<td>1</td>
<td>4</td>
<td>late in cycle</td>
<td>CDBS</td>
<td>3%</td>
<td>Placeholder, pending results from Cy.7.</td>
</tr>
<tr>
<td>8455</td>
<td>Noiseless Preflash</td>
<td>1</td>
<td>5</td>
<td>early in cycle</td>
<td>TIR</td>
<td>0.01 mag</td>
<td>Test scheme to reduce CTE problem</td>
</tr>
<tr>
<td>8456</td>
<td>Photometry of Very Red Stars</td>
<td>1</td>
<td>2</td>
<td>mid-cycle</td>
<td>ISR</td>
<td>2-5%</td>
<td>Outsourcing candidate.</td>
</tr>
<tr>
<td>8457</td>
<td>CTE for Extended Sources (2-3&quot;)</td>
<td>1</td>
<td>4</td>
<td>mid-cycle</td>
<td>ISR</td>
<td>0.01 mag</td>
<td>Outsourcing candidate.</td>
</tr>
<tr>
<td>8458</td>
<td>UV Earth Flats</td>
<td>continuous</td>
<td>720</td>
<td>early in cycle</td>
<td>CDBS</td>
<td>3-10%</td>
<td>Outsourcing candidate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~10% reserve for unexpected items</td>
</tr>
</tbody>
</table>

TOTAL TIME (including all executions) | 73 | 2964
Proposal ID 8441/8459: WFPC2 Cycle 8: WFPC2 Decontaminations and Associated Observations

Plan

**Purpose**
Monthly WFPC2 decons. Instrument monitors tied to decons: photometric stability check, focus monitor, pre- and post-decon internals--bias, intflats, kspots, & darks, UV throughput checks.

**Description**
- **Decontamination:** UV-blocking contaminants removed and hot pixels annealed, by warming the CCDs to +20C for 6 hours.
- **Internals:** intflats, biases, darks & kspots, before/after decons.
- **Photometric and Focus Monitor:** Standard star GRW+70d5824 is observed after each decon and before every other decon: (1) F170W in all chips to monitor far UV contamination. (2) PC focus monitor observations in F439W, F555W, F814W. (3) F160BW, F218W, F255W, F336W, F439W, F555W, F814W observed in a different chip each month.
- **UV Throughput:** PC & WF3 UV observations in all UV filters, popular UV filters in all chips, to verify that the UV spectral response curve is unchanged. Also check methane Quads.

**Fraction**
100%

**GO/GTO Programs Supported**

**Resources Required:**
- Observation: 32 external orbits (13 decon cycles, 3 spare decons, +2 extra for smooth Cycle 7 to 8 transition). Also includes 4 orbits for UV throughput and 1 orbit for methane quad photometry check.

**Products**
SYNPHOT, CDBS, Instr. Handbk, TIPS meetings, WWW reports, TIR, ISR.

**Accuracy Goals**
- **Photometry:** less than 2% discrepancy btw results, 1% rms expected. **Focus measurement:** 1.5 mic accuracy w/goal of 1 mic. **UV throughput:** better than 3%. **Flatfield:** temporal variations monitored at 1% level. **Gain ratios:** stable to better than 0.1%.

**Scheduling & Special Requirements**
Decons required every 4 weeks. Observations tied to within +/- 1 week of decons. Darks should be NON-INT to prevent residual image problems.
Proposal ID 8442: WFPC2 Cycle 8: Standard Darks

Plan

Purpose  Measure dark current & identify of hot pixels.

Description  Six 1800s exp/week with the shutter closed, five with clocks off, one with clocks on. This frequency is required due to the high formation rate of new hot pixels (several tens/CCD/day). Five darks per week are required for cosmic ray rejection, counter-balancing losses due to residual images, & improving the noise of individual measurements. Sometimes, no usable darks are available for a given week due to residual images, resulting in a longer-than-usual gap in the hot pixel lists, but in a decon week, information on hot pixels that became hot and then annealed would be lost irretrievably. As a result, pre-decon darks (see Decon proposal) are executed NON-INT and at least 30 min after any WFPC2 activity.

Fraction  90%

GO/GTO  Programs

Supported  Resources  324 internal orbits (occultation periods), enough 6-dark sets for Cycle 8 plus additional darks to ensure smooth Cycle 7 to 8 transition.

Observation  Products  Weekly darks delivered to CDBS and monthly tables of hot pixels on the WWW. Supercark reference files.

Accuracy  Goals  Require ~1 e-/hour (single-pixel rms) accuracy for most science applications. Expected accuracy in a typical superdark is 0.05 e-/hour for normal pixels. The need for regular darks is driven by systematic effects, such as dark glow (a spatially and temporarily variable component of dark signal) and hot pixels, which cause errors that may exceed these limits significantly.

Scheduling & Special  Requirements  Do not schedule during decon weeks (those darks are in decon proposal).
Proposal ID 8443/8460/8461: WFPC2 Cycle 8: Supplemental Darks

Plan

Purpose Obtain very frequent monitoring of hot pixels.

Description This program is designed to provide up to three short (1000s) darks per day, to be used primarily for the identification of hot pixels. Shorter darks are used so that observations can fit into almost any occultation period, making automatic scheduling feasible. Supplemental darks will be taken at low priority, and only when there is no other requirement for that specific occultation period. This program is complementary with the higher priority Standard Darks proposal that has longer individual observations for producing high-quality pipeline darks and superdarks. Note that hot pixels are often a cause of concern for relatively short science programs, since they can mimic stars or mask key features of the observations. (About 400 new hot pixels/CCD are formed between executions of the Standard Darks program. These observations will be made available as a service to the GO community, and there is no plan to use them in our standard analysis and products.

Fraction 30%

GO/GTO Programs Supported

Resources Required: Total of 1308 internal orbits (occultation periods), which allows for a maximum of 3 darks per day plus enough extra to ensure a smooth transition between Cycle 7 and 8.

Products None.

Accuracy Goals For archive only, no STScI analysis provided.

Scheduling & Special Requirements Scheduled at low priority, non-interference basis, maximum of 3/day. Will require multiple proposal IDs due to large number of visits (1 dark/visit to maximize scheduling flexibility).
Proposal ID 8444: WFPC2 Cycle 8: Internal Monitor

Plan

**Purpose**
Verify the short-term instrument stability at both gain settings.

**Description**
Each set of internal observations consists of 8 biases (4 at each gain) and 4 INTFLATs (2 at each gain). The entire set should be run once per week, except for decon weeks, on a non-interference basis.

**Fraction**
100%

**GO/GTO Programs Supported**

**Resources**
45 internal orbits (occultation periods), plus existing Cycle 7 visits, will provide sufficient repetitions for Cycle 8.

**Observation**

**Products**
Superbiases delivered annually to CDBS; TIPS reports on possible buildup of contaminants on the CCD windows (worms) as well as gain ratio stability, based on INTFLATs. A Technical Instrument Report will be issued if significant changes occur.

**Accuracy Goals**
Approximately 120 bias frames are used for each superbias pipeline reference file, generated once a year; accuracy is required to be better than 1.5 e-/pixel, and is expected to be 0.8 e-/pixel.

**Scheduling & Special Requirements**
Do not schedule on decon weeks (internals for those weeks are in decon proposal).
**Proposal ID 8445: WFPC2 Cycle 8: Earth Flats**

**Plan**

**Purpose**  Monitor flatfield stability.

**Description**  As in Cycle 7 programs 7625 & 8053, sets of 200 Earth streak flats are taken to construct high quality narrow-band flatfields with the filters F375N, F502N, F656N and F953N. Of these 200 perhaps 50 will be at a suitable exposure level for destreaking. The resulting Earth superflats map the OTA illumination pattern and are combined with SLTV data (and calibration channel data in case of variation) for the WFPC2 filter set to generate a set of superflats capable of removing both the OTA illumination and pixel-to-pixel variations in the flatfields. The general plans of Cycles 5, 6, and 7 are repeated.

| Fraction | 100% |
| GO/GTO Programs Supported | |
| Resources Required: | 442 internal orbits (occultation periods). |
| Observation Products | New flatfields generated and delivered to CDBS if changes detected. |
| Accuracy Goals | The single-pixel signal-to-noise ratio expected in the flatfield is 0.3%. |
| Scheduling Special Requirements | None. |
Proposal ID 8446: WFPC2 Cycle 8: Astrometric Monitor

Plan

Purpose  Verify relative positions of WFPC2 chips with respect to one another.

Description  The rich field in w Cen (same positions as cycle 7 proposal 7627) is observed with large shifts (35’’) in F555W only, at two different times during Cycle 8. This will indicate whether there are shifts in the relative positions of the chips or changes in the astrometric solution at the sub-pixel level. Kelsall spot images will be taken in conjunction with each execution. The K-spots data and some external data indicate that shifts of up to 1 pixel may have occurred since mid-1994.

Fraction  <20%

GO/GTO Programs Supported

Resources Required: 2 pointed orbits and 2 occultation periods

Observation Products  TIPS, Technical Instrument Report, update of chip positions in PDB and of geometric solution in STSDAS tasks metric and wmosaic if significant changes are found.

Accuracy Goals  At least 0.01” in relative shifts; 0.05” or better for absolute.

Scheduling Special Requirements  None.
Proposal ID **8447: WFPC2 Cycle 8: CTE Monitor**

**Plan**

**Purpose**  Monitor CTE changes during cycle 8.

**Description**  Observations of omega Cen (NGC 5139) are taken every 6 months during cycle 8 to monitor changes in Charge Transfer Efficiency (CTE) of the WFPC2 (extension of cycle 7 proposal 7629). The principal observations will be in F814W at gain 15 in WF2 and WF4. Supplemental observations at gain 7, and in the WF3 will be performed if time permits, along with observations in F439W and F555W. For each visit, observations will be done in single guide star mode.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>GO/GTO</td>
<td></td>
</tr>
<tr>
<td>Programs Supported</td>
<td>4 orbits total (twice per cycle, 2 orbits each).</td>
</tr>
<tr>
<td>Resources</td>
<td></td>
</tr>
<tr>
<td>Observation</td>
<td>Instrument Science Report</td>
</tr>
<tr>
<td>Products</td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.01 magnitudes.</td>
</tr>
<tr>
<td>Goals</td>
<td></td>
</tr>
<tr>
<td>Scheduling &amp; Special Requirements</td>
<td>For each visit, use the same guide star for the small angle maneuvers between the chips.</td>
</tr>
</tbody>
</table>
Proposal ID 8448: WFPC2 Cycle 8: Intflat and Visflat Sweeps

Plan

**Purpose**  Monitor the pixel to pixel flatfield response and the VISFLAT lamp degradation, as well as detect any possible changes due to contamination. The linearity test obtains a series of INTFLAT with both gains and both shutters. Since the INTFLATs have significant spatial structure, any non-linearity would appear as a non-uniform ratio of INTFLATs with different exposure times.

**Description**  *VISFLAT mini-sweep:* pre- and post-decon observations using the photometric filter set at gain 7, and FR533N at both gains to test the camera linearity. *INTFLAT sweep:* taken within a two-week period. Almost all filters used, some with both blades and gains, others with just one blade and gain. *Linearity test:* done at both gains and blades using F555W, and an additional set with one blade and gain with clocks=on.

**Fraction** 100%

**GO/GTO Programs Supported**

**Resources Required:**
- 43 internal orbits (occultation periods)

**Observation Products**  TIPS, TIR if any significant variations are observed.

**Accuracy Goals**  *VISFLATs:* stable to better than 1% in overall level and spatial variations (after correcting for lamp degradation). Contamination effects should be < 1%. *INTFLATs:* SNR per pixel similar to the VISFLATs, but spatial and wavelength variations in the illumination pattern are much larger. (INTFLATs will provide a baseline comparison of INTFLAT vs VISFLAT if the CAL channel system fails.)

**Scheduling & Special Requirements**  Intflat sweeps should be scheduled within a 2-week period. VISFLAT sweep must be done with minimum lamp cycles to prevent further degradation of the lamp.
Proposal ID 8449: WFPC2 Cycle 8: UV Flats Internal Monitor

Plan

Purpose
Monitor the stability of UV flatfield.

Description
UV flatfields obtained with the CAL channel’s ultraviolet lamp (UVFLAT) using the UV filters F122M, F170W, F160BW, F185W, & F336W. The UV flats are used to monitor UV flatfield stability and the stability of the F160BW filter by using F170W as the control. The F336W ratio of VISFLAT to UVFLAT provides a diagnostic of the UV flatfield degradation & ties the UVFLAT and VISFLAT flatfield patterns. Two supplemental dark frames must be obtained immediately after each use of the lamp to check for possible after-images.

Fraction 10%
GO/GTO Programs Supported

Resources 2 orbits (non-pointed, but displaces WFPC2 science because of timing requirements), plus occultation periods before and after each orbit.

Observation Products
New UV flatfields if changes are detected.

Accuracy Goals
About 2-8% pixel-to-pixel expected (depending on filter).

Scheduling & Special Requirement
To prevent excessive degradation of the UV lamp, the SU duration for each UVFLAT visit should be kept the same as that in cycle 7 (prop. 7624); the lamp should not remain on for periods of time longer than those used in Cycles 6 & 7. Due to timing requirements, each visit covers a 2-hour time span--one visibility period and two occultation periods. Note that other instruments can be used during this period. Execute once during Cycle 8, after a decontamination.
Proposal ID 8451: WFPC2 Cycle 8: Photometric Characterization

Plan

Purpose  Determine whether any changes in the zeropoint, the spatial
dependence of the zeropoint, or contamination rates have
occurred, by comparing with the baseline measurements for
GRW+70D5824 (single photometric standard with 13 filters)

Description  Observe the standard star GRW+70D5824 in PC1 and WF3
using filters F380W, F410M, F450W, F467M, F547M, F569W,
F606W, F622W, F702W, F785LP, F791W, F850LP, and
F1042M. Observations should be done within 7 days after a
decon. These observations will be compared with data from the
cycle 7 program 7628.

Fraction  100%

GO/GTO Programs Supported

Resources  2 orbits.
Required: Observation

Products  TIR, SYNPHOT update if necessary.

Accuracy  2% photometry.

Goals

Scheduling  Within 7 days of decon.

Special Requirements
Proposal ID **8452: WFPC2 Cycle 8: PSF Characterization**

**Plan**

**Purpose** Provide a check of the subsampled PSF over the full field.

**Description** Observations using just two of the standard broadband filters (F555W & F814W). With one orbit per photometric filter, DITHER-LINE and POS TARG observations are performed in a 4x4 parallelogram. The dither-line-spacing=0.177, and POS TARG steps are 0.125; this gives a critically sampled PSF over most of the visible range. Each star is measured 16 times per filter at different pixel phase, providing a high S/N, critically sampled PSF. This will improve the quality of PSF fitting photometry.

**Fraction** 15%

**GO/GTO Programs Supported**

**Resources Required:** 2 pointed orbits.

**Products** PSF library (WWW). Updates for TIM and TINYTIM. Accurate empirical PSFs to be derived for PSF fitting photometry.

**Accuracy Goals** Results will be limited by breathing variations in focus, so predicting PSF accuracy is difficult. (For breathing < 5 mic peak-to-peak, PSFs should be good to ~10% in each pixel.) Proposal provides a measurement of pixel phase effect on photometry (sub-pixel QE variations exist), and gives a direct measurement of sub-pixel phase effects on photometry, measured to better than 1%.

**Scheduling & Special Requirements** Same pointing and orientation as Cycle 7 observations for proposal 7629. Visits should be completed within 2 week timeframe to minimize spacecraft temperature differences.
Proposal ID 8453: WFPC2 Cycle 8: Polarization

Plan

**Purpose**  
Verify stability of polarization calibration.

**Description**  
The data from this proposal will be used to identify any changes that may have occurred since the polarizer calibration in Cycles 5 and 6. Two stars will be observed, G191B2B and BD+64D106, a non-polarized and polarized standard star, respectively. The unpolarized star will be observed in 2 visits with the ORIENT changed by 90 degrees between visits, so as to sample any residual polarization of the star. The polarized star will be observed in 4 visits with the ORIENT changed by 45 degrees between visits, so as to fully sample the properties of each polarizer quad. Each visit consists of F555W exposures in PC1 and WF3, followed by F555W+POLQ exposures in PC1, WF2, WF3, and WF4. Other popular broadband filters (F300W, F439W, F675W, and F814W) will be checked using only the unrotated polarizer. Finally, a small set of VISFLATs (with a minimum of lamp cycles) will be included to check for flatfield changes.

**Fraction**  
5%

**GO/GTO Programs Supported**

**Resources**  
6 external orbits, 10 internal orbits.

**Observation Required:**

**Products**  
TIR or ISR report. Update of SYNPHOT tables, WWW polarization calibration tools, and new CDBS flatfields if necessary.

**Accuracy Goals**  
Expected accuracy is <3%.

**Scheduling & Special Requirements**  
Requires use of POLQ and rotated POLQ filter.
Proposal ID **8454: WFPC2 Cycle 8: Linear Ramp Filter**

**Plan**

**Purpose**  Check wavelength and throughput calibration for LRFs at selected wavelengths.

**Description**  A thorough check of the linear ramp filters (LRFs) is being done as part of the Cycle 7 calibration program, where the UV spectrophotometric standard (grw+70d5824) is observed at 75 different wavelengths and an extended source (Orion nebula) is observed for an orbit as well. This proposal is currently a placeholder, pending data analysis results from the Cycle 7 program. We anticipate requiring 4 orbits to spot-check some of the more popular wavelengths as well as cover any wavelengths requested by Cycle 8 GOs that weren’t observed as part of the Cycle 7 calibration program.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>GO/GTO Programs Supported</td>
<td></td>
</tr>
<tr>
<td>Resources Required: Observation</td>
<td>4 pointed orbits.</td>
</tr>
<tr>
<td>Products</td>
<td>Updates to SYNPHOT tables if necessary and an ISR.</td>
</tr>
<tr>
<td>Accuracy Goals</td>
<td>Throughput accuracy should be better than 3%.</td>
</tr>
<tr>
<td>Scheduling &amp; Special Requirements</td>
<td>None.</td>
</tr>
</tbody>
</table>
Proposal ID 8450: WFPC2 Cycle 8: Noiseless Preflash

Plan

Purpose  Test effectiveness of "Noiseless" preflash in reducing CTE and long vs. short Photometric effects.

Description  A globular cluster is observed both before and after a preflash that has been read out (i.e. noiseless). The preflash will be tailored to expose the CCDs to about 3000 DN without saturation. The hypothesis is that the traps in the CCD will remain filled even though the preflash has been read out, thereby minimizing the effects of CTE.

The observation sequence is repeated at two detector positions and exposure times, so as to test for CTE and long vs. short effects. The four orbits are done in one non-int visit, which is preceded by a pair of 1800s darks and includes single darks during occultation periods to insure no prior exposures will effectively preflash the non-preflash exposures.

Fraction  20%

GO/GTO Programs Supported

Resources  5 orbits

Required:

Observation

Products  Improved observing strategies; ISR.

Accuracy  1% photometry

Goals

Scheduling & Special Requirements

Will require manual work to hide DARKS during occultation.

Would be most useful if scheduled as early as possible in, or prior to, Cycle 8.
Proposal ID 8455: WFPC2 Cycle 8: Photometry of Very Red Stars

Plan

**Purpose**  Verify the photometric calibration of WFPC2 filters and obtain estimated color terms (HST to Johnson) for late M stars.

**Description**  WFPC2 imaging (F439W, F555W, F675W, F814W) of two well-known M dwarfs, VB8 and VB10, for which ground-based measurements in the Johnson filters exist. Use two different y positions to account for CTE. The current calibration is based on white dwarf and solar analog data, which are insufficient to produce an accurate calibration for cool red stars (late K and M) in broad-band filters. The calibration of cool stars is especially difficult at the red end (F814W), because their spectra can rise quickly where the DQE drops substantially (increasing the uncertainty in the synthetic magnitude calibration). The observations of two well-studied late M stars, VB8 and VB10, will provide a direct empirical calibration of these effects and reduce the uncertainties in the photometric response of WFPC2 for very red stars.

**Fraction**  < 10%

**GO/GTO Programs Supported**

**Resources Required:**  2 pointed orbits, one per star.

**Accuracy Goals**  Better than 0.03 mag. Outsourcing candidate.

**Scheduling & Special Requirements**  None.
Proposal ID 8456: WFPC2 Cycle 8: CTE for Extended Sources

Plan

**Purpose**  
Determine the effect of Charge Transfer Efficiency (CTE) on small extended sources.

**Description**  
Previous CTE proposals have all focused on stellar targets. This proposal is aimed at observing small (~2-3") extended sources in a suitable galaxy cluster. The target (tentatively cluster 135951+623105, at z=0.3) will be observed in WF2 and WF4, in F606W and F814W. The filter F606W is chosen instead of the F555W used for stellar CTE measurements, to allow a comparison to archival images for estimating of any possible time-dependence. One orbit is needed for each pointing for each filter, for a total of four orbits.

**Fraction**  
30%.

**GO/GTO Programs Supported**

**Resources Required:**  
4 pointed orbits.

**Observation Products**  
ISR

**Accuracy Goals**  
10%. Outsourcing candidate.

**Scheduling & Special Requirements**  
TBD
Proposal ID 8457: WFPC2 Cycle 8: UV Earth Flats

Plan

**Purpose**  Improve quality of pipeline UV flatfields.

**Description**  Earth streakflats are taken in UV filters (F170W, F185W, F218W, F255W, F300W, F336W, and F343N). Those UV filters with significant redleak will also be observed crossed with selected broadband filters (F450W, F606W, F675W, and F814W), in order to assess and remove the redleak contribution. Earth flats required: 100 for each of the 7 UV filters plus 20 with each of the crossed filter sets.

**Fraction**  ~10%

**GO/GTO Programs Supported**

**Resources Required:** 720 non-science impacting orbits (occultation periods).

**Observation**

**Products**  Updated flatfields for pipeline via CDBS.

**Accuracy Goals**  3-10%. Outsourcing candidate.

**Scheduling & Special Requirements**  None.
Proposal ID 8458: WFPC2 Cycle 8: Plate Scale Verification

Plan

**Purpose**  Check of the WFPC2 plate scale in the UV and red.

**Description**  UV and F953N observations of the bright cluster NGC2100. Data will be taken in F170W, F218W, F300W, F555W (to allow tie-in to previous observations) and F953N. To minimize orbits required, the program is designed around short exposures in the filters listed above; the data will provide a verification the plate scale in the UV but exposure times will not be long enough to allow a full distortion solution.

**Fraction**  < 10%

**GO/GTO Programs Supported**

**Resources**  1 external orbit.

**Required:**

**Observation Products**  ISR

**Accuracy**  Better than 0.05% (0.4 pixels over 1 chip), or 0.05 mas/pixel in WF. Outsourcing candidate.

**Scheduling & Special Requirements**  Usual difficulties with omega Cen; no orient special requirement.