WFPC2 Cycle 7 Calibration Plan

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ABSTRACT
This report describes in detail the WFPC2 observations planned to maintain and improve the quality of WFPC2 calibrations during Cycle 7. The total spacecraft time we plan to use for such observations is 76 pointed orbits and ~3000 occultation periods, the latter being used for internal observations and Earth flats.

1. Overview

The main goals of the Cycle 7 Calibration Plan for WFPC2 are: 1) verify that the instrument remains stable in all its characteristics, and 2) aggressively address the area of its photometric accuracy. Cycle 7 is expected to be specially long, about 22 months, and monitoring acquires a special importance. Its centerpiece will be, as usual, the Photometric Monitoring program (7618), consisting of regular one-orbit observations of our photometric standard GRW+70d5824, executed immediately before and after decontaminations. These observations allow us to monitor very efficiently four main areas: the overall photometric throughput of the camera, the contamination of the CCD windows, especially in the UV, the PSF properties at different wavelengths, and the OTA focus. As in the past, we rely heavily on “internal” observations for some instrument maintenance and for many other types of monitoring: decontamination (7619) to clear the contaminants from the CCD windows and to limit the growth in hot pixels; darks (7619, 7620, 7621, 7712, 7713) in order to produce up-to-date, high-quality dark frames and to identify new hot pixels in a timely manner; bias, INTFLATs, and K-spots (7619, 7622, 7623) to verify the integrity of the camera’s optics and electronics chain, and the pixel-to-pixel response in the visible; Earth flats (7625) to follow variations in the overall flat field, and UV flats (7624) to monitor the pixel-to-pixel response in the UV. Most of these programs have remained largely unchanged since the previous cycle, except that internal flats place an increasing emphasis on the INTFLAT channel because of the continuing degradation of the VISFLAT channel.
Two monitoring programs are entirely new and deserve specific mention. The Supplemental Darks program (7621, 7712, 7713) aims at obtaining a large number of relatively short darks on a very frequent basis, with the main goal of helping users identify hot pixels in their observations. The program has been designed to place the least possible burden on the scheduling system; it is understood that these additional darks will have a low priority, and they will be scheduled whenever feasible. Under normal circumstances, this program will provide up to 21 additional 1000s darks per week, thus giving users a good chance of having a dark within half a day of their observations. The Astrometric Monitor program (7627) will monitor the relative placement of the four WFPC2 CCD in the focal plane, following indications that a shift of up to a pixel may have occurred since 1994. Although this is smaller than the quoted astrometric accuracy of the chip-to-chip transformations (0.2”), it appears worthwhile to follow closely the behavior of the camera in this area.

Special calibrations for Cycle 7 consist of only three programs. The first, Photometric Characterization (7628), continues our group’s quest for the ultimate goal of 1% photometry. Observations taken in Cycles 5 and 6 allow us to understand and limit many of the photometric uncertainties in WFPC2 observations, but there is room for improvement, especially since the WFPC2 filters differ substantially from ground-based filter sets, and therefore stars with different properties must be observed to allow significant comparisons with ground-based photometry. In Cycle 6 we included a young LMC cluster, NGC 2100, and an old open cluster, M67, both with good ground-based photometry. This Cycle we plan to repeat some of the NGC 2100 observations and to add NGC 2419, a very distant globular cluster in the Milky Way, which will allow a good coverage of the bright red giants, too bright and rare in nearby clusters. We will also, as usual, carry out a filter sweep on both our primary standard, GRW+70d5824, and our reference rich field in ω Centauri.

Another program, CTE Characterization (7630), aims at a thorough exploration of the various parameters that could affect the so-called “long vs. short” anomaly, that is, the observed difference in count rates between long and short exposures. Our group has been able to quantify this effect by taking advantage of archival data and of a limited number of pointed observations. However, it is clear that a complete characterization of this anomaly, comparable to what we have recently achieved for the “CTE ramp”, requires an extensive set of dedicated observations in which each of the potentially critical parameters is varied in turn. The program will require 15 orbits.

Finally, the PSF Characterization program (7629) will continue our accumulation of data for the WFPC2 PSF library, by addressing often-used filters such as F300W, F450W, F702W which were not included in previous cycles. Its modest cost can be justified by the wealth of data taken in those filters, both already in the archive and in planned observations.
# Table 1: WFPC2 Cycle 7 Calibration Plan

<table>
<thead>
<tr>
<th>ID</th>
<th>Proposal Title</th>
<th>Frequency</th>
<th>Estimated Time (orbits)</th>
<th>Products</th>
<th>Accuracy</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>“External”</td>
<td>“Internal”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7618</td>
<td>Photometric Monitoring</td>
<td>1-2/4 weeks</td>
<td>36</td>
<td>SYNPHOT</td>
<td>1-2%</td>
<td>Also focus monitor</td>
</tr>
<tr>
<td>7619</td>
<td>Decontamination</td>
<td>1/4 weeks</td>
<td>288</td>
<td>CDBS</td>
<td>n/a</td>
<td>Used together with darks, internals</td>
</tr>
<tr>
<td>7620</td>
<td>Standard Darks</td>
<td>weekly</td>
<td>360</td>
<td>CDBS, WWW</td>
<td>1 e/hr</td>
<td>Also hot pixel lists on WWW</td>
</tr>
<tr>
<td>7621, 7712, 7713</td>
<td>Supplemental Darks</td>
<td>weekly</td>
<td>2016</td>
<td>n/a</td>
<td></td>
<td>No analysis provided</td>
</tr>
<tr>
<td>7622</td>
<td>Internal Monitor</td>
<td>2/4 weeks</td>
<td>72</td>
<td>CDBS, TIR</td>
<td>0.8 e/pixel</td>
<td>New superbias (with 7619)</td>
</tr>
<tr>
<td>7623</td>
<td>Internal Flats</td>
<td>1/4 weeks</td>
<td>75</td>
<td>TIR</td>
<td>0.3%</td>
<td>Mostly INTFLATs</td>
</tr>
<tr>
<td>7624</td>
<td>UV Flat Field Monitor</td>
<td>2/cycle</td>
<td>4</td>
<td>8</td>
<td>2-8%</td>
<td>Before and after decon</td>
</tr>
<tr>
<td>7625</td>
<td>Earth Flats</td>
<td>continuous</td>
<td>155</td>
<td>CDBS</td>
<td>0.3%</td>
<td>Also LRF, Methane quads</td>
</tr>
<tr>
<td>7626</td>
<td>UV Throughput</td>
<td>2/cycle</td>
<td>4</td>
<td>SYNPHOT</td>
<td>3-10%</td>
<td></td>
</tr>
<tr>
<td>7627</td>
<td>Astrometric Monitor</td>
<td>2/cycle</td>
<td>2</td>
<td>2</td>
<td>0.05”</td>
<td>Also K-spots</td>
</tr>
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</table>

**Routine Monitoring Programs**

**Special Calibration Programs**

<table>
<thead>
<tr>
<th>ID</th>
<th>Proposal Title</th>
<th>Frequency</th>
<th>Estimated Time (orbits)</th>
<th>Products</th>
<th>Accuracy</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7628</td>
<td>Photometric Characterization</td>
<td>1</td>
<td>10</td>
<td>ISR</td>
<td>2-5%</td>
<td>Also test zeropoint differences between chips, UV vignetting, astrometry</td>
</tr>
<tr>
<td>7629</td>
<td>PSF Characterization</td>
<td>1</td>
<td>5</td>
<td>WWW</td>
<td>10%</td>
<td>Covers widely used, high-throughput filters</td>
</tr>
<tr>
<td>7630</td>
<td>CTE Characterization</td>
<td>1</td>
<td>15</td>
<td>ISR</td>
<td>0.01 mag</td>
<td>Extensive coverage of preflash levels, exposure times in F814W; spot checks in F555W, F300W, and for hysteresis, CTE ramp</td>
</tr>
</tbody>
</table>

**TOTAL TIME (including all executions)**: 76  2976

Assumes Cycle 7 length of 96 weeks (22 months)
This report consists of a summary description of each calibration program, with a statement of the purpose of the program and of how it will be carried out, plus indications of the cost, time, and expected products. The desired and expected accuracy of each program is also explicitly stated. Table 1 summarizes the relevant data for all programs. The orbits required for monitoring programs are estimated on the basis of an expected length of 22 months (24 4-week periods) for Cycle 7.

An electronic version of this document is available via the World Wide Web on the WFPC2 instrument pages, at URL http://www.stsci.edu/ftp/instrument_news/WFPC2/wfpc2_doc.html; follow the link for Instrument Science Reports. Details on individual proposals can be found through the HST Program Information page maintained by PRESTO, at URL http://presto.stsci.edu/public/propinfo.html.
Proposal ID 7618: WFPC2 Cycle 7: Photometric Monitor

Purpose: Regular external check of instrumental stability. Based on Cycle 6 program 6902.

Description: The standard star GRW+70d5824 is observed before and after a decontamination using three different strategies:

1. F170W in all four chips to monitor contamination in the far UV;
2. F439W, F555W, F814W on the PC to monitor focus;

Observations are taken after each decontamination and before every other decontamination, resulting in 36 orbits for 24 decontamination cycles.

Fraction of GO/GTO Programs Supported: 100%

Resources:

Observation: 36 pointed orbits (assumes 24 decon cycles in Cycle 7)

Special Requirements: Needs to be scheduled shortly before and after decontaminations (up to 5 days).

Accuracy: Overall discrepancies between the results of this test need to be measured to better than 2% and are expected to be less than 1% rms. This has been the case in Cycles 4 through 6. The point of the test is to measure this variation. Focus measurements have an expected accuracy of 1.5 micron, and a goal of 1 micron; the uncertainty in the focus determination is dominated by external factors, such as OTA breathing.

Products: Instrument Handbook, reports at monthly TIPS meetings, WWW (sensitivity trends); updates in UV sensitivity variation used in SYNPHOT.
Proposal ID 7619: WFPC2 Cycle 7: Decontamination

**Purpose:** UV blocking contaminants are removed, and hot pixels cured, by warming the CCDs to +20°C for six hours.

**Description:** The decontamination itself is implemented via the DECON mode, in which the TECs are turned off and the CCD and heatpipe heaters are turned on to warm the detectors and window surfaces. Keeping WFPC2 warm for ~6 hours has been shown in previous Cycles to be sufficient to remove the contaminants and anneal many hot pixels; continuation of 6-hour decons is anticipated for Cycle 7.

The internal observations taken before and after each decontamination consist of: 4 biases (2 at each gain setting), 4 INTFLATs (2 at each gain setting), 2 K-spots (both at gain 15, one short and one long exposure, optimized for PC and WF), and finally, 5 darks (gain 7, clocks off). To minimize time-dependent effects, each set of internals will be grouped within 2 days and performed no more than 1 day before the decon and no later that 12 hours after the decon. To protect against residual images in the darks (which results in the irretrievable loss of the critical pre-decon hot pixel status), the darks will be executed as a non-interruptible sequence at least 30 minutes after any other WFPC2 activity.

**Fraction of GO/GTO Programs Supported:** 100%

**Resources:**

- **Observation:** 288 internal (assumes 24 decon cycles in Cycle 7)

**Special Requirements:** Requires scheduling at 4 week intervals. Prevents WFPC2 from being used for several hours, although other instruments can be used most of that time. Dark frames taken before decontaminations need to be protected from possible residual images from overexposed sources.

**Accuracy:** This proposal is mainly designed to maintain the health of the instrument. Biases, darks and other internals taken with this proposal are used in generating appropriate reference files (see Proposals 7620 and 7622).

**Products:** Those obtained from use of darks, biases and other internals (see Proposals 7620 and 7622).
**Proposal ID 7620: WFPC2 Cycle 7: Standard Darks**

**Purpose:** Measure dark current on individual pixels and identify hot pixels at frequent intervals.

**Description:** Every week, five 1800s exposures are taken with the shutter closed. The length of the exposures is chosen to fit nicely within an occultation period. The weekly frequency is required because of the high formation rate of new hot pixels (several tens per CCD per day). Five darks a week are required for cosmic ray rejection, to counterbalance losses due to residual images, and to improve the noise of individual measurements. Even with these measures, some weeks no usable darks will be available because of residual images. Normally this results only in a longer-than-usual gap in the hot pixel lists, but in a decontamination week, information on pixels that became hot and then annealed would be lost irretrievably. For this reason, pre-decon darks are to be executed NON-INT and at least 30 minutes after any WFPC2 activity (see Proposal 7619). Normal darks do not need to be protected in this fashion. The Supplemental Darks program (7621, 7712, 7713) will provide additional information on hot pixels.

**Fraction of GO/GTO Programs Supported:** 90%

**Resources:**

- **Observation:** 360 internal orbits (occultation periods)

**Special Requirements:** None. (Darks associated with decontaminations are to be protected from residual images due to saturated sources)

**Accuracy:** The required accuracy for darks is about 1 e⁻/hour (single-pixel rms) for the vast majority of science applications. The expected accuracy in a typical superdark is 0.05 e⁻/hour for normal pixels. The need for regular dark frames is driven by systematic effects, such as dark glow (a spatially and temporally variable component of dark signal) and hot pixels, which cause errors that may exceed these limits significantly.

**Products:** Weekly dark frames delivered to CDBS and monthly tables of hot pixels on the Web.
Proposal ID 7621, 7712, 7713: WFPC2 Cycle 7: Supplemental Darks

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 7620, Standard Darks, whose longer individual observations are better suited to produce high-quality pipeline darks and superdarks, and are also carried out at higher priority. Note that hot pixels are often a cause of concern for relatively short science programs, since they can mimic or mask key features of the observations, and about 400 new hot pixels per CCD are formed between executions of the Standard Darks program (7620). 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. This program is only feasible starting in Cycle 7, thanks to the Solid State Recorder.

Fraction of GO/GTO Programs Supported: 30%

Resources:

Observation: 2016 internal orbits (occultation periods) maximum, depending on availability of suitable opportunities; program runs in no-interference, low-priority mode. The proposal will be designed to obtain up to 3 darks per day over Cycle 7, provided there are no other scheduling conflicts.

Special Requirements: Must be designed to allow automatic scheduling at low priority. Needs three program IDs because of large number of visits (one dark per visit).

Accuracy: N/A

Products: None
Proposal ID 7622: WFPC2 Cycle 7: Internal Monitor

Purpose: Verification of short-term instrument stability for both gain settings.

Description: The internal observations will consist 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. This proposal is similar to the Cycle 6 Internal Monitor (6905).

Fraction of GO/GTO Programs Supported: 100%

Resources:

Observation: 72 internal orbits (occultation periods)

Special Requirements: None

Accuracy: Approximately 120 bias frames will be 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.

Products: Superbiases delivered yearly 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.
Proposal ID 7623: WFPC2 Cycle 7: Internal Flats

**Purpose:** Monitor the pixel to pixel flatfield response and the VISFLAT lamp degradation as well as detect any possible changes due to contamination. This program is a combination and continuation of the Cycle 6 VISFLAT Monitor and INTFLAT Monitor proposals (6906, 6907, respectively). The VISFLAT portion has been minimized to conserve lifetime of the CAL channel lamp.

**Description:** This proposal contains an INTFLAT filter sweep, a VISFLAT mini-sweep, linearity tests, and monitoring images. Monitoring is carried out by taking INTFLATs with the photometric filter set after each decon. The VISFLAT mini-sweeps (before and after decon, twice during the cycle) will include the photometric filter set at gain 7, plus the linear ramp filter FR533N at both gains to test the camera linearity. The INTFLAT sweep, taken within a two-week period, includes almost all filters, some with both blades and gains (F336W, F439W, F547M, F555W, F569W, F606W, F622W, F631N, F502N, F656N, F675W, F673N, F702W, F785LP, F814W, F1042M), others with just one blade and gain (F487N, F467M, F588N, F380W, F658N, F791W, F850LP, F953N, F450W, F300W, F390N, F410M, F437N, F469N, and F160BW). The linearity test will be done at both gains and blades using F555W, and an additional set with one blade and gain with clocks on.

**Fraction of GO/GTO Programs Supported:** 100%

**Resources:**

- **Observation:** 75 internal orbits (occultation periods)

**Special Requirements:** Observations, especially VISFLATs, should be scheduled into a minimum of lamp cycles in order to help preserve the lamp's lifetime. To minimize filter wheel usage during the INTFLAT portion of the proposal, each filter will be cycled through the two shutters and two gains. Each visit will contain just a few filters, in order to allow flexibility in scheduling; however, the INTFLAT sweep should be completed over a time span of no more than two weeks.

**Accuracy:** Assuming Cycle 7 results will be similar to those from previous cycles, the VISFLATs should be stable to better than 1%, both in overall level and spatial variations (after correcting for lamp degradation), and contamination effects should be < 1%. For the INTFLATs, the signal-to-noise ratio per pixel is estimated to be similar to the VISFLATs, but the spatial and wavelength variations in the illumination pattern are much larger. However, the INTFLATs will provide a baseline comparison of INTFLAT vs VISFLAT, in the event of a complete failure of the CAL channel system. Temporal variations in the flatfields can be monitored at the 1% level. Gain ratios should be stable to better than 0.1%.

**Products:** TIPS report, Technical Instrument Report if any significant variations are observed.
Proposal ID 7624: WFPC2 Cycle 7: UV Flat Field Monitor

**Purpose:** Monitor the stability of UV flat field.

**Description:** UV flat fields will be obtained with the CAL channel’s ultraviolet lamp (UVFLAT) using the UV filters F122M, F170W, F160BW, F185W, and F336W. The UV flats will be used to monitor UV flat field stability and the stability of the Woods filter (F160BW) by using F170W as the control. The F336W ratio of VISFLAT (Cycle 6 proposal 6906) to UVFLAT will provide a diagnostic of the UV flat field degradation and tie the UVFLAT and VISFLAT flat field patterns together. Two supplemental dark frames must be obtained immediately after each use of the lamp, in order to check for possible after-images.

**Fraction of GO/GTO Programs Supported:** 10%

**Resources:**

**Observation:** 4 orbits (non-pointed, but displaces WFPC2 science because of timing requirements), plus the 8 occultation periods before and after each. If possible, externals to be run as pure parallels to minimize science impact.

**Special Requirements:** Uses the limited-life UV lamp. In order to prevent excessive degradation of the lamp, the SU duration for each UVFLAT visit should be kept the same as the durations used during Cycles 5 and 6 (proposals 6191, 6908); the lamp should not remain on for periods of time longer than those used in Cycles 5 and 6. Because of timing requirements, the observations cannot be taken entirely during occultation; each visit covers a 2-hour time span, thus one visibility period and two occultation periods. Note that other instruments can be used during this period. To be executed twice during Cycle 7, after a decontamination.

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

**Products:** New UV flat fields if changes are detected.
Proposal ID 7625: WFPC2 Cycle 7: Earth Flats

**Purpose:** Monitor flat field stability.

**Description:** As in Cycle 6 program 6909, sets of 200 Earth-streak flats are taken to construct high quality narrow-band flat fields with the filters F160BW, 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 will be 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 flat fields. The general plan of Cycles 5 and 6 is repeated.

**Fraction of GO/GTO Programs Supported:** 100%

**Resources:**
- **Observation:** 155 non-science-impacting orbits (during occultation periods)

**Special Requirements:** None.

**Accuracy:** The single-pixel signal-to-noise ratio expected in the flat field is 0.3%.

**Products:** New flat fields to CDBS if changes detected.
Proposal ID 7626: WFPC2 Cycle 7: UV Throughput

**Purpose:** Verify throughput for all UV filters. Loosely based on the Cycle 5 and 6 UV throughput proposal (6186, 6936).

**Description:** GRW+70d5824 will be observed shortly before and after a DECON through all the UV filters in PC and WF3. Observations should be taken roughly mid-way through the cycle.

**Fraction of GO/GTO Programs Supported:** 10%

**Resources:**

- **Observation:** 4 pointed orbits

**Special Requirements:** Timing requirements with respect to decontaminations.

**Accuracy:** The UV throughput will be measured to better than 3%.

**Products:** TIPS, SYNPHT update if necessary, Technical Report to document any changes if necessary.
Proposal ID 7627: WFPC2 Cycle 7: Astrometric Monitor

**Purpose:** Verify relative positions of WFPC2 chips with respect to one another. Repeats parts of Cycle 6 proposal 6942 twice during Cycle 7.

**Description:** The rich field in ω Cen used for the Astrometry Verification (6942) is observed with large shifts (35") in F555W only, at two different times during Cycle 7. This will indicate whether there are shifts in the relative positions of the chips or changes in the astrometric solution at the subpixel 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 of GO/GTO Programs Supported:** 20%

**Resources:**

- **Observation:** 2 pointed orbits and 2 occultation periods

**Special Requirements:** None

**Accuracy:** At least 0.1" in the relative shifts, with a goal of 0.02-0.05".

**Products:** TIPS, Technical Instrument Report; update of chip positions in PDB and of geometric solution in STSDAS task metric if any changes are found.
Proposal ID 7628: WFPC2 Cycle 7: Photometric Characterization

Purpose: (1) Determine whether any changes in the zeropoint, or in the spatial dependence of the zeropoint or contamination, have occurred; (2) include another globular cluster (NGC 2419) in order to extend the parameter space for determinations of photometric transformation. Combines and continues Cycle 6 proposals 6934, 6935.

Description: Observations of the primary photometric standard GRW+70d5824 will be compared against baseline observations. The cluster fields in ω Cen and NGC 2100 will be compared to previously obtained data in order to test for spatial variations in the throughput. Most broad-band and intermediate-width filters, including the far UV set for NGC 2100 (very young, many blue stars). A contamination test using UV filters will also be performed for NGC 2100. New observations of the Galactic globular cluster NGC 2419 will be compared with good ground-based photometry; this cluster is very distant (100 kpc) and will provide a large color spread on giant branch and HB.

Fraction of GO/GTO Programs Supported: 30%

Resources:

Observation: 10 pointed orbits

Special Requirements: Specific orientations will be required to match previous cycles or optimize overlap with ground-based data. All observations should be executed shortly after decontamination, except for the pre-decon visit in the contamination test.

Accuracy: Photometric stability expected to be better than 2%. Photometric transformations to be defined to 2-5%, depending on filter; most of the error derives from limited knowledge of the transformations between ground-based and WFPC2 photometric systems.

Products: ISR; SYNPHOT updates if necessary.
Proposal ID 7629: WFPC2 Cycle 7: PSF Characterization

**Purpose:** Provide a subsampled PSF over the full field to allow PSF fitting photometry, test PSF subtraction as well as dithering techniques. Based on Cycle 6 program 6938.

**Description:** Measure PSF over full field in often-used, high-throughput filters in order to update the TIM and TINYTIM models and to allow accurate empirical PSFs to be derived for PSF fitting photometry. Compared to Cycles 5 and 6, we will repeat F814W to provide a continuing baseline, and will replace the other filters with F300W, F450W, F606W and F702W, which are often used because of their high throughput but are not as well characterized as the photometric set (F336W, F439W, F555W, F675W) used in previous Cycles. These observations will also be useful in order to test PSF subtraction and dithering techniques at various locations on the CCD chips. With one orbit per photometric filter, a spatial scan is performed over a 4x4 grid on the CCD. The step size is 0.025 arcseconds; this gives a critically sampled PSF over most of the visible range. This program uses the same specially chosen field in ω Cen as the Cycle 5 proposal 6193. The proposal also allows a check for sub-pixel phase effects on the integrated photometry.

**Fraction of GO/GTO Programs Supported:** 15%

**Resources:**

**Observation:** 5 pointed orbits

**Special Requirements:** Needs same pointing and orientation as Cycle 5 observations for proposal 6193, thus should be scheduled within a similar time frame.

**Accuracy:** Provides measurement of pixel phase effect on photometry (sub-pixel QE variations exist). The chosen field will have tens of well exposed stars in each chip. Each star will be measured 16 times per filter at different pixel phase. The proposal therefore provides, in principle, a high signal-to-noise, critically sampled PSF. This will improve the quality of PSF fitting photometry for the filters used. The result will be largely limited by breathing variations in focus. It is difficult to predict the PSF accuracy that will result. If breathing is less than 5 microns peak-to-peak, the resulting PSFs should be good to about 10% in each pixel. In addition, the test gives a direct measurement of sub-pixel phase effects on photometry, which should be measured to better than 1%.

**Products:** PSF library (WWW)
Proposal ID 7630: WFPC2 Cycle 7: CTE Calibration

**Purpose:** Conduct a thorough examination of the variation in photometric zeropoint as a function of exposure length, background (via preflash), and position in the chip. Include spot checks for the dependence of zeropoint variations on filter, order of exposures, and camera shifts (CTE ramp).

**Description:** A well-studied field in the globular cluster NGC 2419 will be observed through F814W with a combination of exposure times (10, 40, 100, 300, 1000s) and preflash levels (0, 5, 10, 100, and 1000 e−). Completes Cycle 6 proposal 6937, which was shortened substantially because of SM constraints. Will also include several observations in reverse order (to test for hysteresis), in F555W and F300W (filter dependence), and after a pointing shift (to test for x, y dependence), as well as a series of equal-length exposures to test the effect of noiseless preflash. This proposal should improve substantially our understanding of CTE and of the long vs. short anomaly.

**Fraction of GO/GTO Programs Supported:** 30%

**Resources:**

**Observation:** 15 pointed orbits

**Special Requirements:** Observations should be made at the same position and roll angle as the NGC 2419 exposures in proposals GO 5481 and CAL 6937.

**Accuracy:** The reported short vs. long effect is ~0.05 mag. We want to determine it to better than 0.02 mag, with a goal of 0.01 mag.

**Products:** ISR, paper; if appropriate, a special task to correct the CTE effect will be generated.