Final Calibration and Reprocessing of the WFPC2 Archive

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WFPC2 Pipeline Improvements

In preparation for the decommissioning of WFPC2, we have undertaken a series of calibration and software enhancements to the CALWP2 pipeline, including

- Improved photometric calibrations, geometric-distortion coefficients, and flat fields;
- Improved time-dependent sensitivity and UV-throughput corrections; correction of the photometric errors caused by the WF4 anomaly; and
- The production of a PyDrizzled image for each WFPC2 data set.

WFPC2 Reprocessing

- This fall (September through December), we will reprocess all archival WFPC2 data using the new pipeline.
- The resulting data products will be made available in both waiver FITS (WFITS) and multi-extension FITS (MEF) formats.
- As these data products become available, on-the-fly reprocessing (OTFR) will be discontinued, dramatically improving data delivery speeds.

PyDrizzled Images

- OPUS 2008.2 will run PyDrizzle on each WFPC2 exposure. Output files are labeled *drz.fits.
- Applies updated distortion corrections (geometric corrections, chip-to-chip drifts, etc.)
- No sub-pixel sampling or cosmic-ray rejection

➡ DRZ files are intended as quick-look images, rather than as a science data products.

- DRZ files are provided in MEF format.
- DRZ files will be produced by the OTFR pipeline and will begin to appear next month.

Multi-Extension FITS Files

- Once DMS 2008.2 is installed, user requests will continue to go through OTFR. Users will get WFPC2 files in WFITS format, plus the new DRZ file in MEF.

- We will use a separate pipeline for the reprocessing. It will generate files in both formats (WFITS and MEF) and send them to the archive. These files will *not* be made available to users under 2008.2.

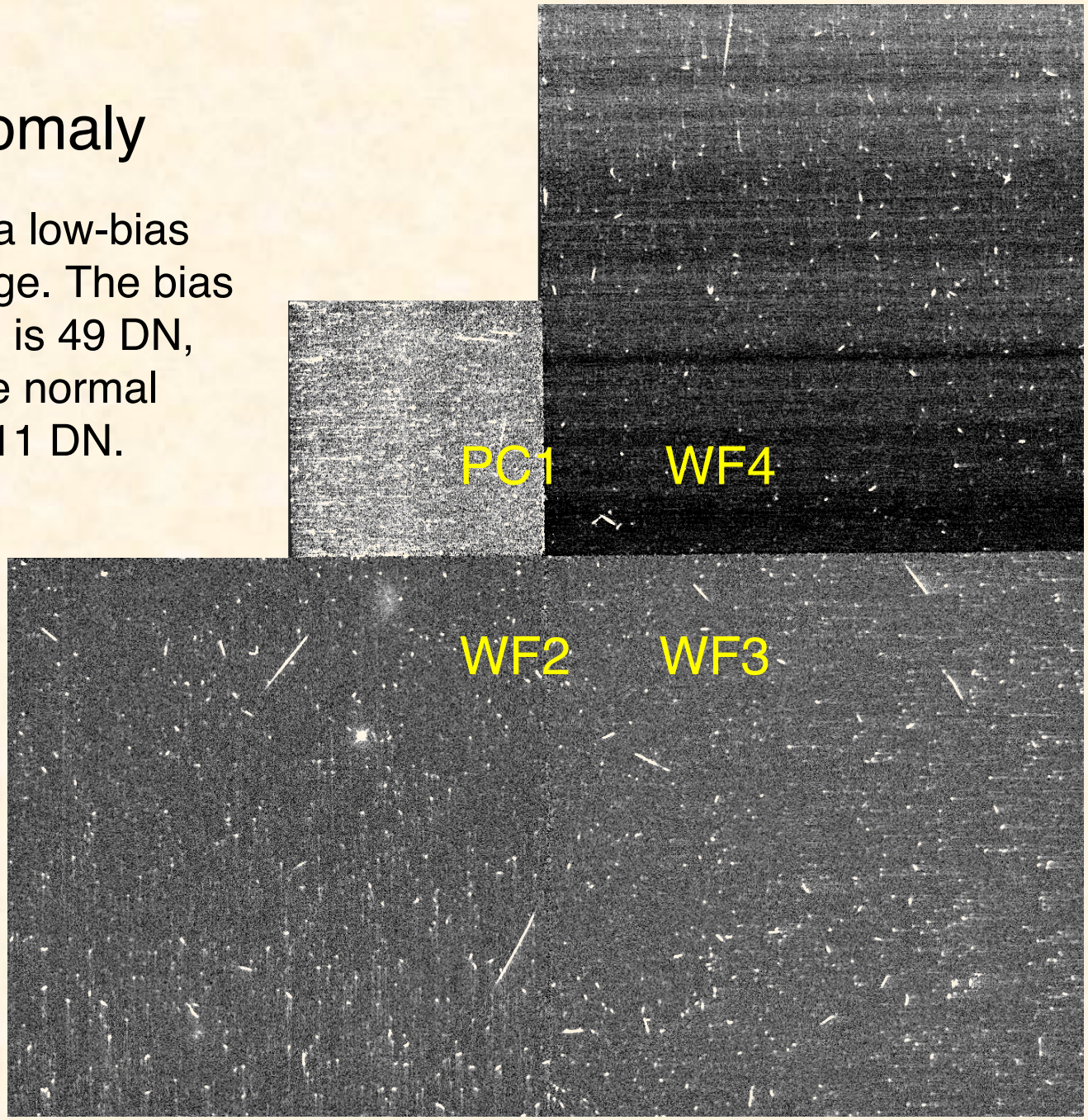
- Once DMS 2008.3 is installed, users will get reprocessed data if it is available. They will be able to choose between MEF and WFITS. Default is MEF. If the data have not yet been reprocessed, requests will go through OTFR.

Software Changes

New Code	New Keywords	Old Keywords
Velocity aberration	VAFACTOR	
WF4 Anomaly	WF4TCORR	BIASEVEN
	WF4TFILE	BIASODD
	BIASEVNU	
	BIASODDU	
CTE Keywords	CTE_100	
	CTE_1000	
	CTE10000	
QE Variation	ZP_CORR	
PyDrizzle	Various	

WF4 Anomaly

Example of a low-bias science image. The bias level in WF4 is 49 DN, far below the normal value of ~ 311 DN.



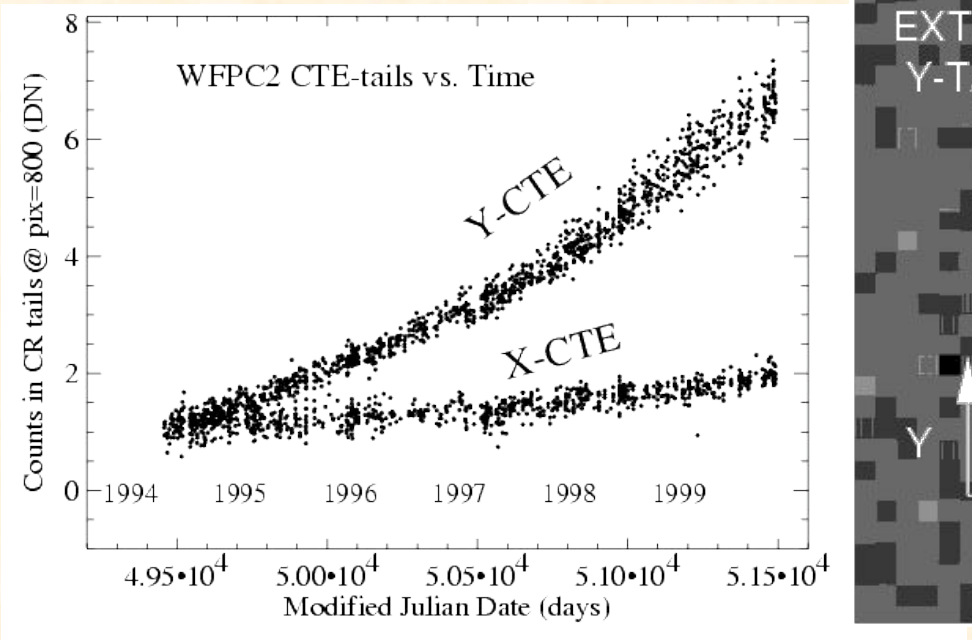
WF4 Anomaly

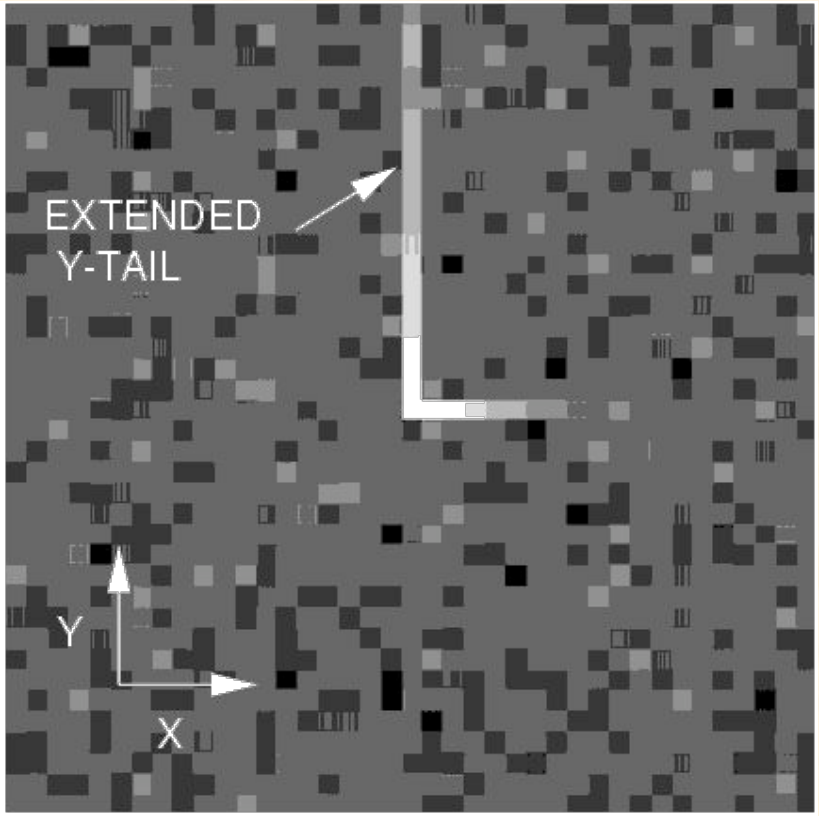
- Characterized by low or zero bias levels, faint horizontal streaks, and low count levels.
- Thought to be caused by a failing amplifier in the WF4 signal-processing electronics.
- Temperature dependent: since 2006 January, mitigated by reducing the temperature of the instrument by 1°C at six-month intervals.

New Software

- A program to rescale the counts in each pixel of the detector, correcting the photometry and restoring the bias to its normal level (included in calwp2)
- A second program to remove the streaks seen in low-bias WF4 images (stand-alone, not in calwp2)

Charge-Transfer Efficiency (CTE)





The charge-transfer efficiency decreases with time
(from the WFPC2 Instrument Handbook)

New CTE Keywords

Three new header keywords, CTE_100, CTE_1000, and CTE10000, contain estimates of the light lost to charge-transfer inefficiencies for a star at x = 400, y = 400 with 100, 1000, and 10,000 e^- (respectively) in units of Δmag.

The program uses Andrew Dolphin's (2004) recipe, which is a function of star brightness, observation date, and background level.

This is not a CTE correction. Only these header keywords are added. No changes are made to the pixel values themselves.

Reference-File Changes

WF4 Anomaly: Rescales individual pixel values. Photometry is corrected to within 0.02-0.03 mag (1σ).

UV contamination & QE changes with time: Corrects for UV flux lost to condensation onto detector window and long-term changes in instrument sensitivity.

PyDrizzle: Corrects for geometric distortion, chip-to-chip motions, and other effects (e.g., 34th-row problem).

Two-filter problem: OPUS does not know how to populate the BANDWID and CENTRWV keywords when multiple filters are used.

Reference-File Changes

Ramp-Filter Photometric Calibration: Based on pre-flight measurements, may be off by 5-10% at some wavelengths (affects 2% of data).

Ramp- and Narrow-Band Filter Wavelength Calibration: Filter properties may evolve with time (10-15% of data).

Polarizer filters: Issues are similar to those for ramp filters (2% of data). *[This calibration effort is currently on hold.]*

Proper superdarks were never constructed for 2006-2007.

In what order should we reprocess the data?

(1) Data from 1995-2003 (if not listed below), starting with the oldest data.

(2) Data from 2004 onwards (if not listed below). We need the final WF4 correction files and superdark files for data taken in 2006-2007.

(3) Narrow-band filters (filter names *N): Photometric calibration work is ongoing. About 10% of WFPC2 images.

(4) Data using linear ramp filters (filter names LRF, FR*): Photometric calibration work is ongoing. About 2% of images.

In what order should we reprocess the data?

(5) Data using polarizer filters (filters POLQ or POLQ*): Issues are similar to those for ramp filters. About 2% of images. *[This calibration effort is currently on hold.]*

(6) All data taken within previous six months: We should let the dust settle on their reference files before processing these. We will likely be making reference files for several weeks after the servicing mission. There could also be some complications with WF4, depending on how things evolve over the summer and fall.

(7) We may come back in 6 or 12 months to revisit data sets for which new reference files become available.

Schedule

August:

- Installation of DMS 2008.2
- Final testing of WFPC2 pipeline

September:

- Begin reprocessing.
- Installation of DMS 2008.3
- Static archive goes on line.

December:

- Complete reprocessing.

Getting the Word Out

- Information about the new DRZ files will be included in the next MAST newsletter.
- MAST will maintain a web page documenting the status of the WFPC2 reprocessing effort. It will include links to other pages with more details (provided by the WFPC2 team) and will be updated weekly.
- Both MAST and WFPC2 will post information about the new DRZ files, the new MEF files, and the final reprocessing effort on their respective web sites.