



STScI

ACS Instrument Status

(N. Grogin and the ACS Team)



- 1) Highlights of Recent ACS Team Activities
- 2) WFC & SBC Long-Term Monitoring
- 3) Recent/Planned ACS Calibration Efforts:
 - WFC Subarray Overhaul Planning & Testing
 - Migration from 2wk → 4wk WFC superdarks
 - “Save the Pixels” Initiative for WFC
- 4) Additional calibration works-in-progress

ACS : Going Strong after 14 Years

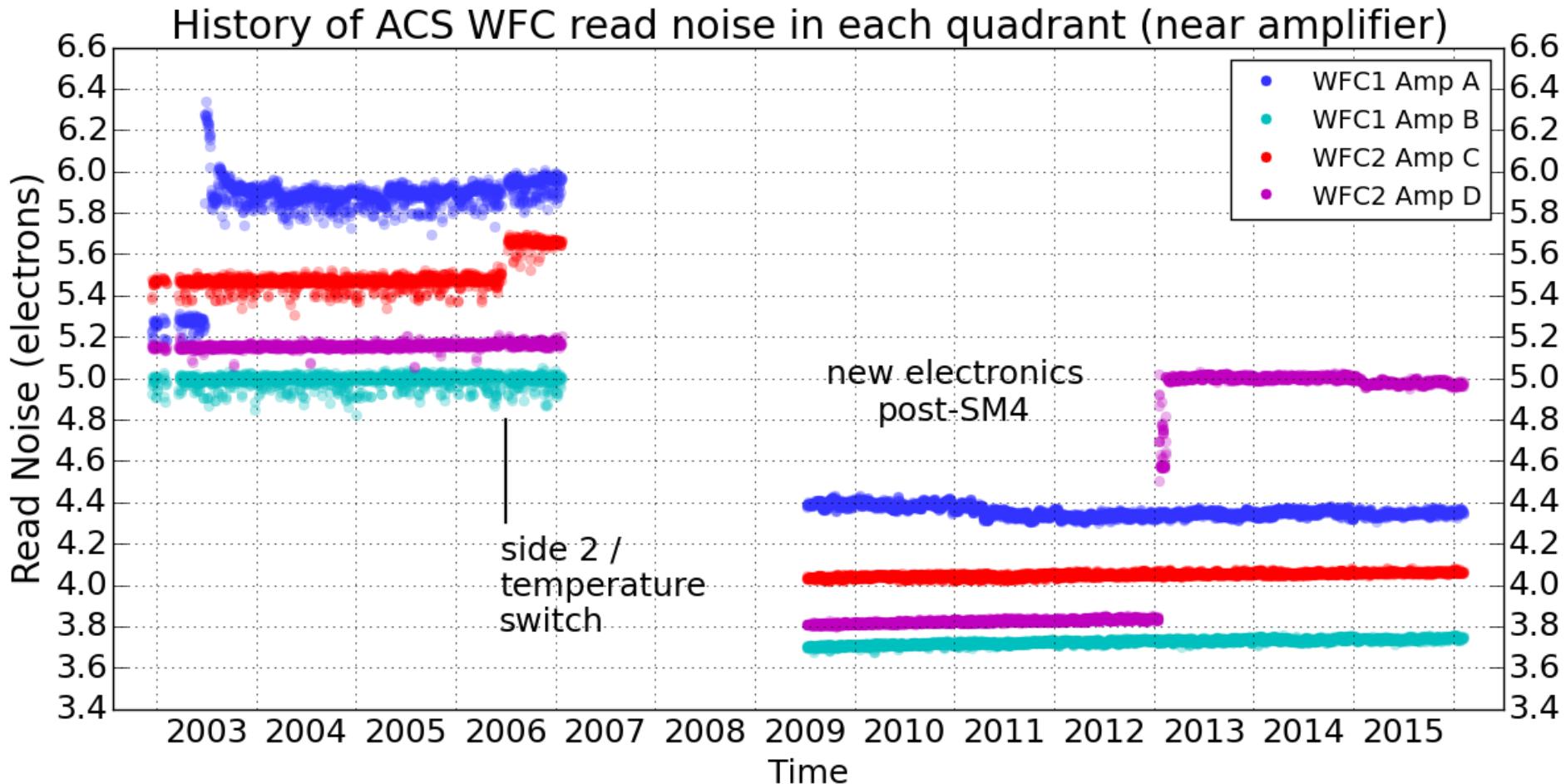
- Demand for ACS remains high in Cycle 23:
 - WFC Prime usage: 703 orbits
 - WFC Parallel usage: 505 orbits
 - SBC usage: 108 orbits
- ACS featured in high-impact GO/DD programs
 - e.g.: Frontier Fields; Comet 67P (Rosetta)
- Net improvement of delivered WFC image quality, b/c understanding is outpacing aging
 - E.g.: Geom. distortion; CTE; flashed darks; etc.

Recent ACS Team Activities

- Major revision of ACS Data Handbook (v7.2 → v8.0)
 - DHB last major revision was in Aug'13; last minor revision was in Jun'14
 - Revised treatments of WFC geometric distortion, CTE degradation and mitigation
 - Planned Cycle 24 changes to WFC subarray modes
 - Updates to the available suite of stand-alone codes for image reductions
- Phase II reviews of *all* Cycle 23 ACS GO/DD/SNAP programs:
 - Strong Cyc23 usage: WFC = 703 orbits prime + 505 orbits parallel; SBC = 108 orbits
 - Current tally, incl. DD and mid-Cycle additions, is 69 programs using ACS
 - 53 programs (77%) are fully reviewed as of May 2016
- Ongoing support of HST Frontier Fields [final year of obsvs.]
 - PhaselII preparation; supplemental unflashed darks; 4wk base-line superdarks
 - Quality assurance & pipeline “self-calibration” of HFF ACS imagery

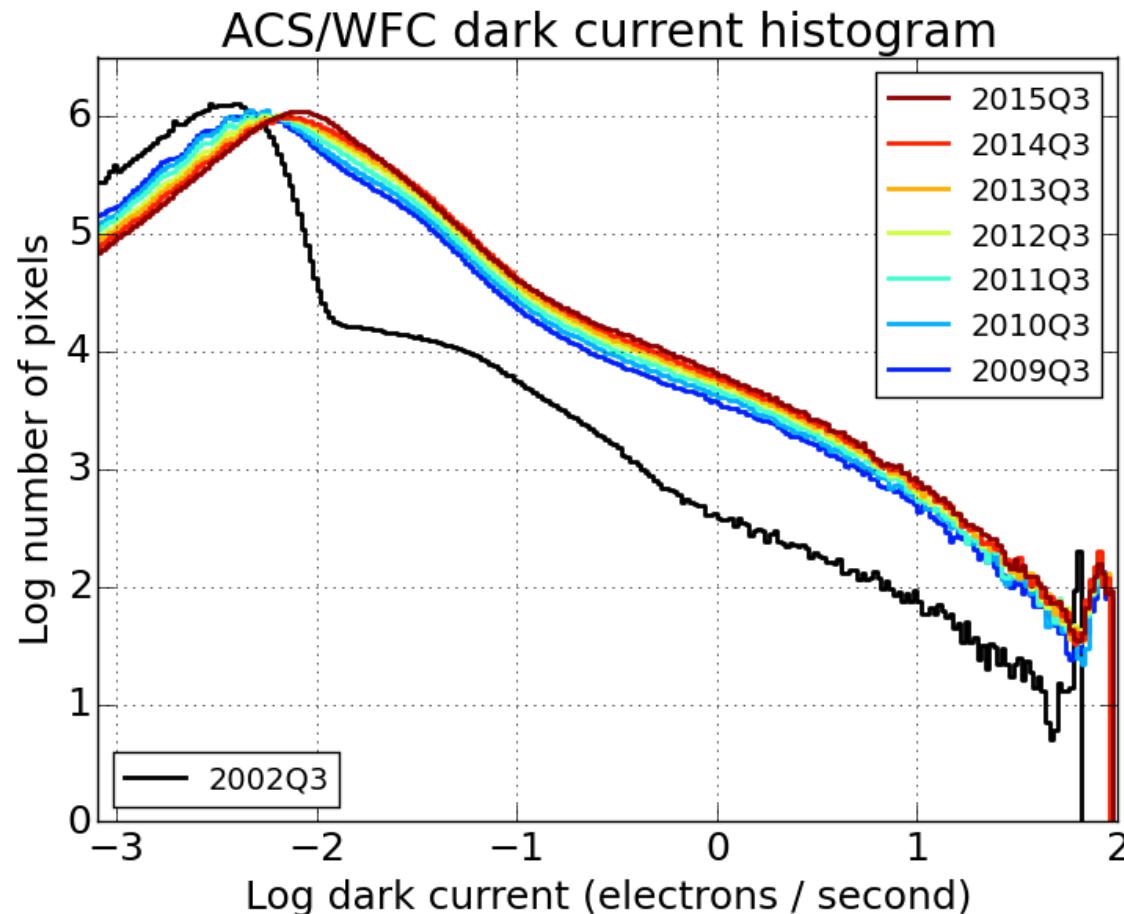
WFC Read-Noise Monitoring

- All WFC amps' read noise have been stable since Jan'13 anomaly
- No anomalous behavior during/after Aug'15 LVPS-R concerns



WFC Dark-Current Monitoring

- Global dark-current: slowly and steadily worsening with time
- Improved warm-pixel fidelity from CTE-mitigating post-flash

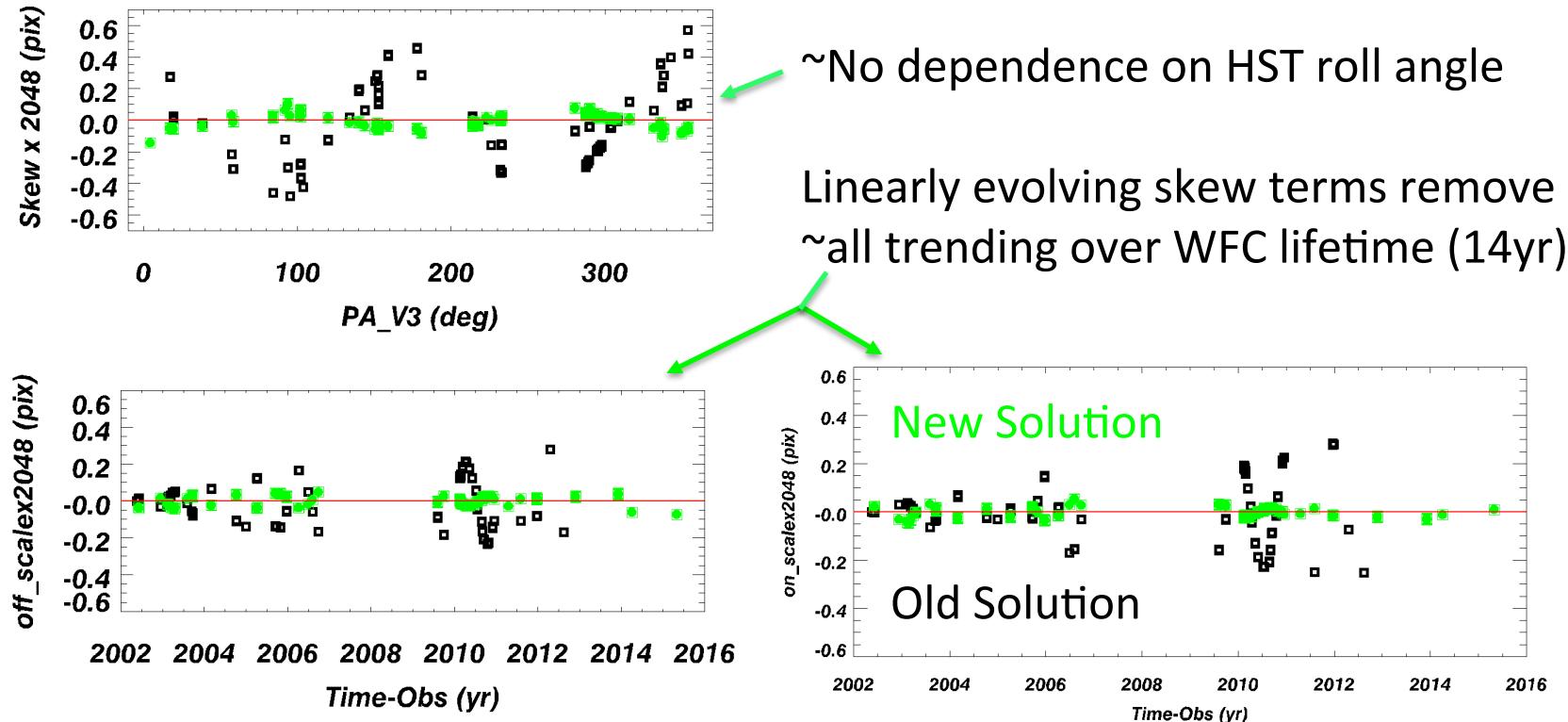


ACS Cycle 23 Calibration Plan

PI	Proposal Title	Frequency	Time (orbits)		Scheduling Required	Products	Accuracy Required	Notes
			External	Internal				
Golimowski	ACD CCD Daily Monitor	3x/week		681	Periodic	Ref files		Dark, bias creation
Chiaberge	ACS External CTE Monitor	Yearly	8		<Feb 2016	correction formula	1% abs	Monitoring of CTE losses to calibrate correction formula
Ogaz	ACS Internal CTE Monitor	2x/cycle		12	Nov 15 May 16	Web, cte ref files	10%	CTE EPER test
Golimowski	ACS CCD Hot Pixel Annealing	4 weeks		156	Periodic	Ref		
Avila	ACS UV Contam. Monitor	Yearly	2			Ref, ISR	1%	SBC sensitivity
Coe	ACS CCD Stability Monitor	3x in cycle	8	4	Nov 15 Mar/Jul 16	Ref files	1%	L-flat, Distortion, Photometry
Borncamp	ACS Internal Flat Fields	2x/cycle		28	~Dec 15 ~Aug 16	Ref, IRS	<1%	Track flat field changes, uses lamp
Ogaz	ACS SBC darks	Yearly		4			10%	
Bohlin	ACS Photometric Calibration	Yearly	4	6	Mar 15	ISR, zp, ref files	<~1%	Time-dependent phot. cal
Wheeler	ACS SBC MAMA Recovery	as needed		4		-	-	After irregular safing
Golimowski	Bias Frames for Subarrays	Weekly; as needed		<110	Linked to GO prog	Ref files	-	Subarray biases for WFC
Ogaz	WFC Post-flash Calibration	Yearly		1	March 2016	Ref, ISR	1%	Post-flash ref file
McMaster	ACS Polarization calibration		8	4		Ref, ISR		Polarization coefficients
Avila	Encircled Energy Curves for ACS/SBC		3			ISR		SBC PSF
Grogin	New WFC Subarray Modes			22	May 2016	ISR		Short/long darks; biases
Grogin	Un-flashed WFC Darks			27	With HFF			Leveraging HFF
Total requested orbits			33	<1059				

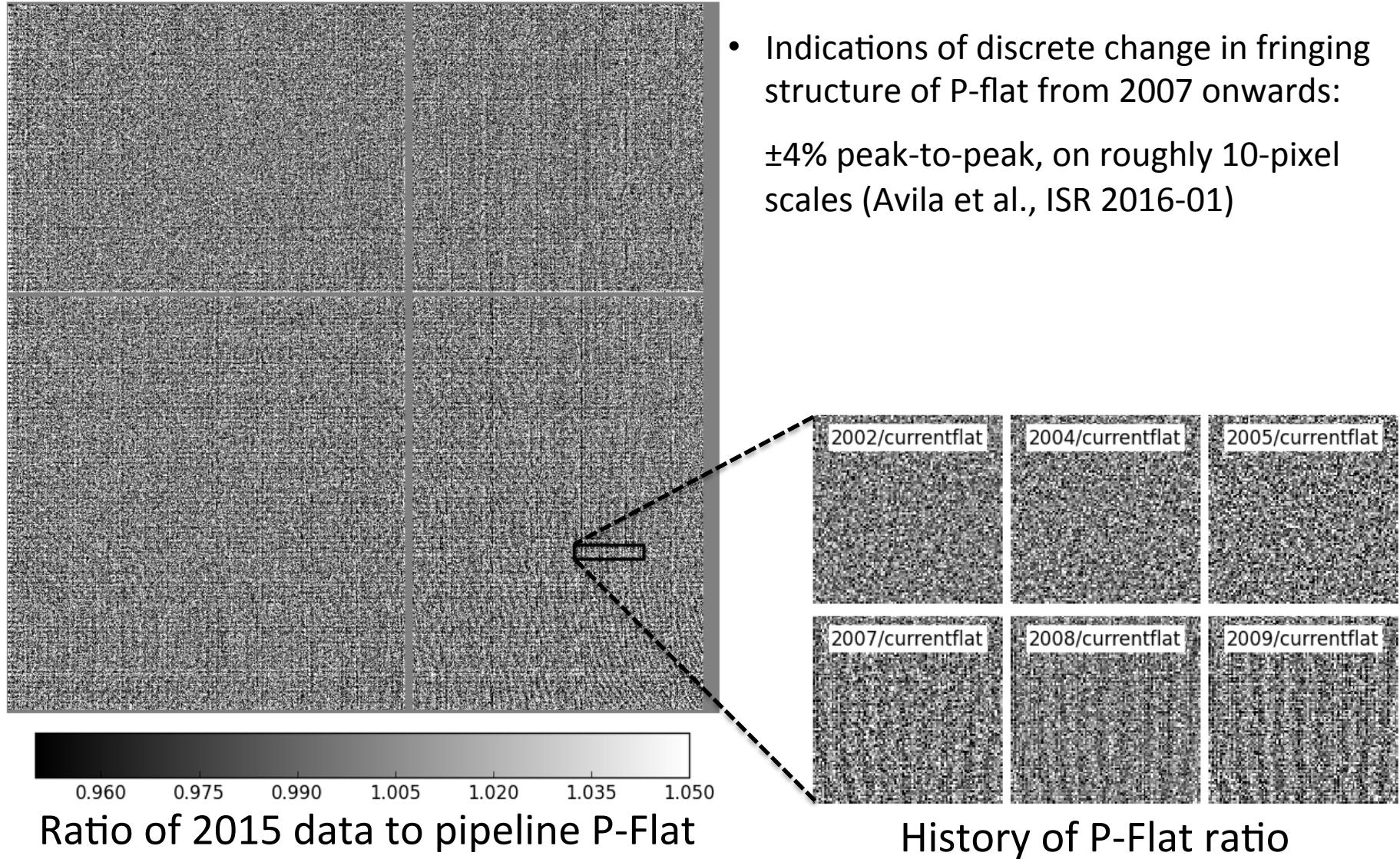
WFC Geometric Distortion: Update

- Astrometric residuals reduced to <0.03pix (1.5mas)



- Solutions for most WFC filters are now in pipeline:
 - 1yr ago, only the “big three”: F435W, F606W, F814W
 - Now: +F475W, F502N, F555W, F625W, F658N, F775W, F850LP

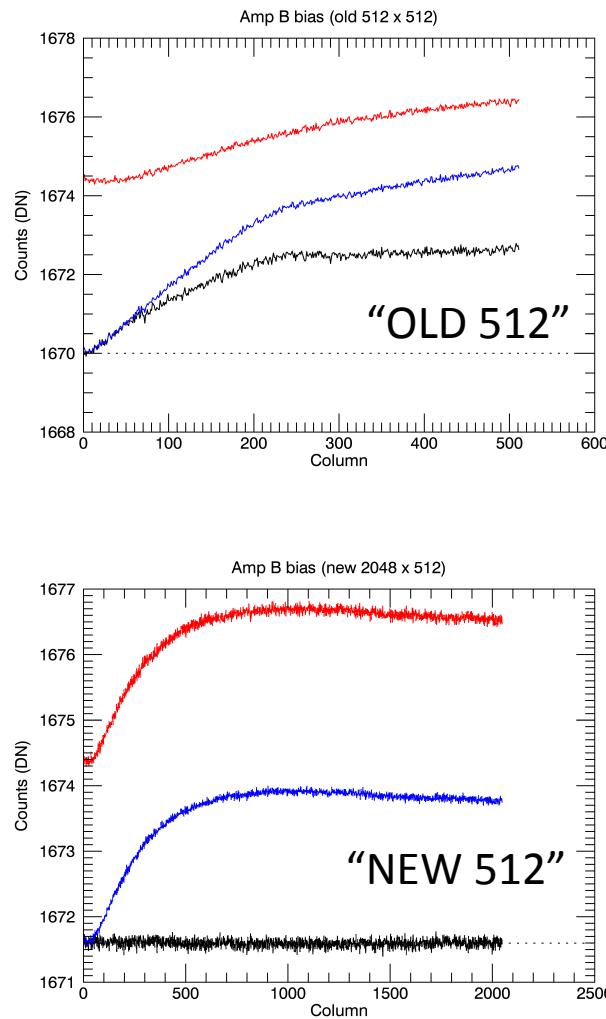
SBC Flatfield Monitoring



WFC Subarray Overhaul

- Calibration headaches for post-SM4 ACS/WFC subarrays:
 - De-biasing post-SM4 subarray images
 - Post-SM4 bias structure varies with readout timing pattern (because of new ASIC & DSI)
 - Readout timing patterns, unchanged since pre-SM4, differ b/w subarrays and full-frame
 - Overhead in calibration orbits (~100 orbits/year) to obtain subarray-mode bias frames
 - Overhead in personnel resources to insure subarray biases are contemporaneous
 - Readout-timing Δ makes pixel-based CTE correction inapplicable to non-2K subarrays
 - Readout overheads *longer* than full-frame; <2K columns prevents bias-shift correction
- Solution: Re-define WFC subarray readouts to match full-frame timing
 - Twelve new subarray modes, all with 2K columns: (512,1K,2K) rows; all 4 quadrants
 - Subarray biases no longer needed (excerpt from full-frame); identical CALACS steps
- Implementation/Validation time-table:
 - GSFC ground-testing in Oct/Nov'15; On-orbit testing (23 Nov'15): all validated
 - *Ops Acceptance Test (5 Apr 2016) recently validated [see following slides]*
 - Successful FSW installation on 2 May'16; validation program executed 9-10 May'16
 - Existing subarray modes will transition to “available but unsupported” as of Cycle 24
 - Subarray changes already documented: ACS IHB for Cycle 24; ACS DHB v8.0; APT

Old vs. New Subarray Readouts



Curves show the average bias level of 512 rows in quadrant B for:

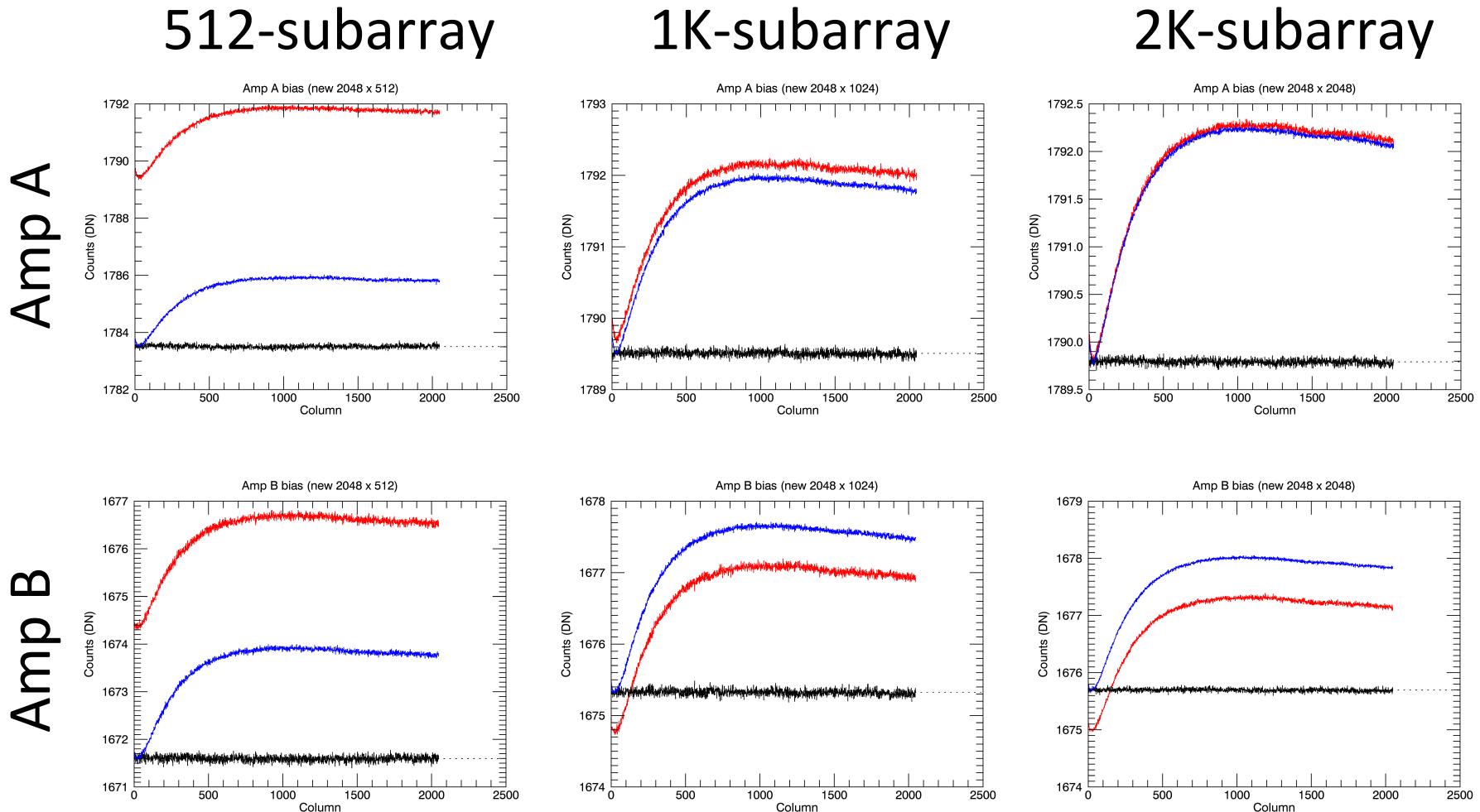
- Blue: 512x512 (old, top) and 2048x512 (new, bottom) subarrays
- Red: Corresponding regions of full-frame bias
- Black: normalized difference of subarray and full-frame
- Dotted: ideal fat-zero (min. subarray bias value)

Take-aways:

- Bias gradients in the old 512x512 subarray and the corresponding region of full frame differ up to ~ 2 DN (modulo the fat-zero offset and 1/f noise)
- Bias gradients in the new 2048x512 subarray and the corresponding region of full frame are *identical* (modulo the fat-zero offset and 1/f noise)
- The prior two slides show similar results for all new subarrays (512-, 1K-, and 2K-columns) in all four quadrants

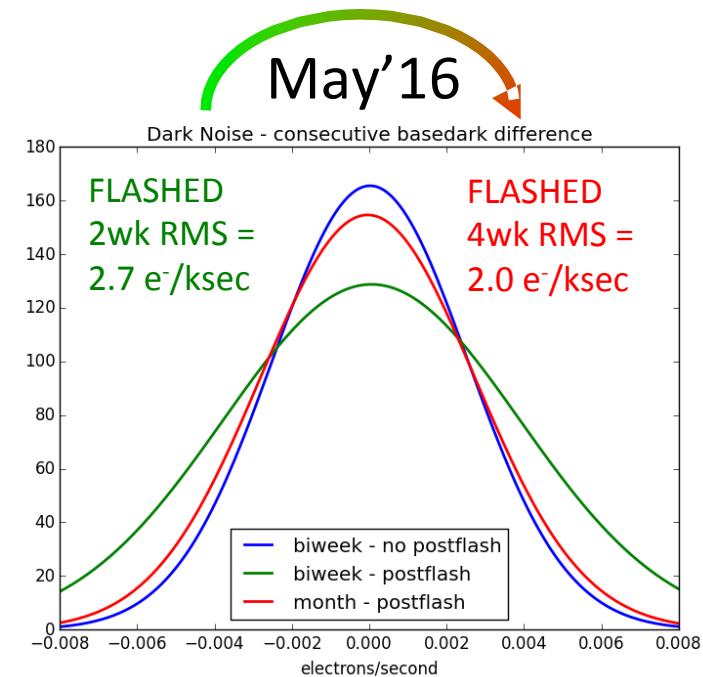
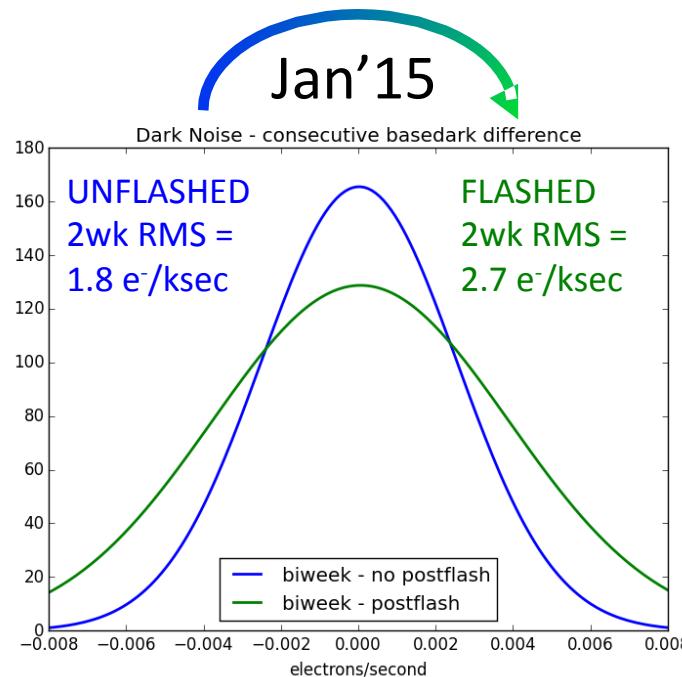
Ops Acceptance Test: Amps A&B

- Bias gradients for **full-frame** vs. **subarray** readouts



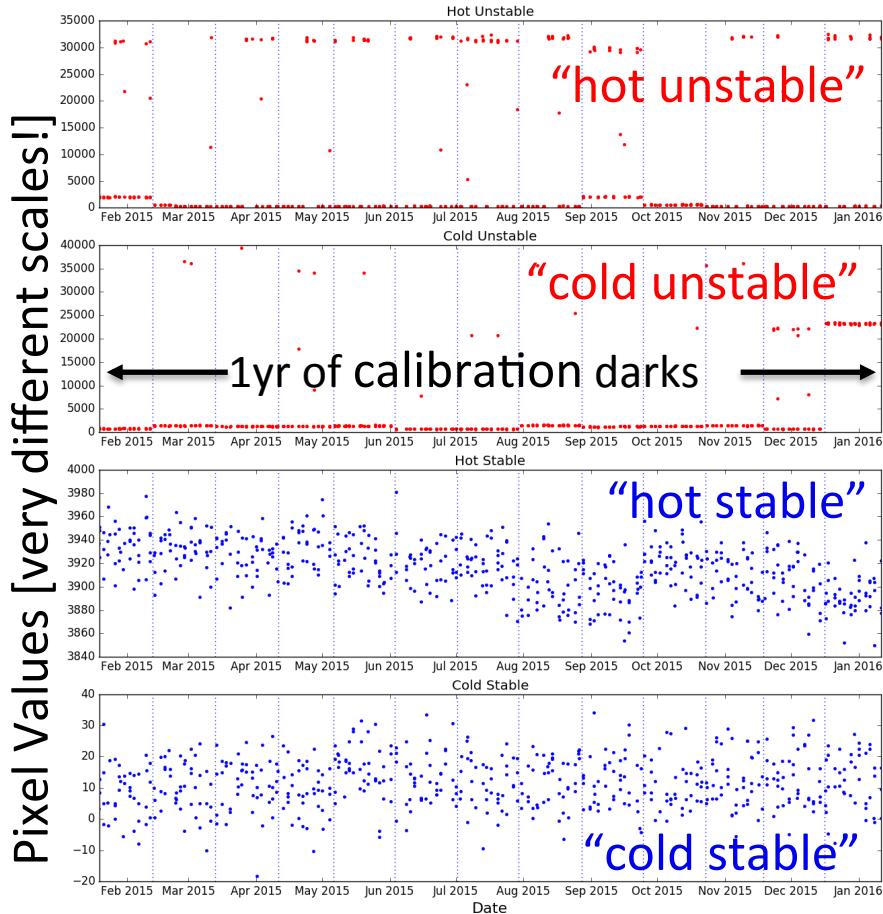
Migration to 4-Week WFC Superdark

- WFC calibration darks add LED post-flash after Jan'15
 - 65e⁻ flash mitigates severe (and uneven) CTE trailing of warm pixels
 - Adds nontrivial (and uneven) noise to calibration superdarks
 - Deep ACS programs report up to 7% increase in background noise
- Retroactive shift to 4wk flashed superdarks by May'16
 - Slow increase in dark current allows for long(est) base-line: 4wks

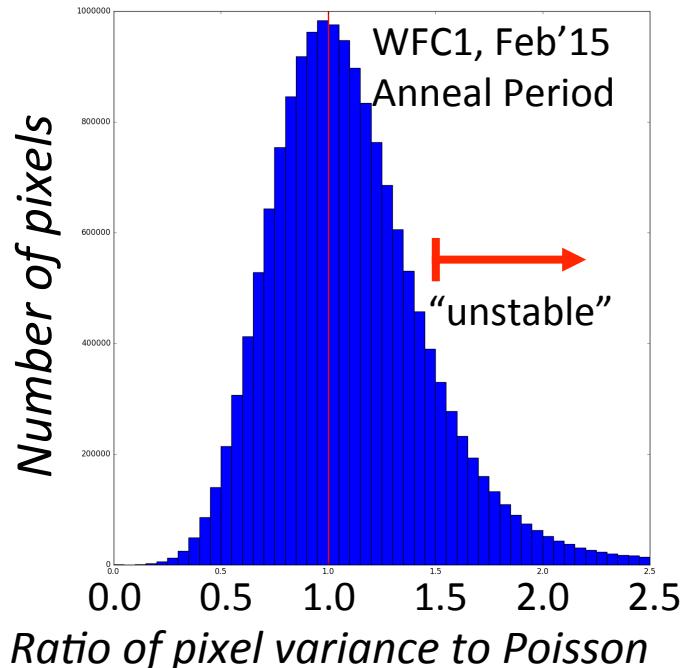


WFC “Save the Pixels” Initiative

- Motivation: Many WFC pixels/cols unjustly rejected via DQ flagging
- Using vast WFC time-history, can be smarter about superdark DQ



- After 14 years, very many hot-pixels
- Many are *stable* in a given anneal interval
- Dark-subtract-able; reflected in ERR array
- Only DQ-flag the “unstable” pixels:



Additional ACS Works-in-Progress

- Pixel-based CTE correction update
 - All subarrays (new modes *should* match full-frame CTE)
 - Introduce non-linear time dependence (seen also with UVIS)
- “Save the Pixels” II: readout dark (superbiases)
 - “Bad columns” from readout dark are often stable
- Pinning down the SBC PSF wings (out to ~5’’)
 - TinyTim PSF significantly underestimates the SBC halo
- Expanded polarimetry calibrations
 - Several new filters: from F435W to F775W, incl. narrow-band
 - Unique capability for optical: high resolution + precision