1) Highlights of Recent ACS Team Activities

2) Cycle 24 ACS CAL Program [reprise]

3) WFC & SBC Long-Term Monitoring

4) Recent ACS Calibration Developments:
   • Updates to CALACS in DMS 2017.2a
   • Enhancements to WFC superdarks & superbiases
   • Improved “drizzle” parameters for WFC stacking

5) ACS Documentation Updates
Recent ACS Team Activities

• Phase II reviews of all Cycle 24 ACS GO/DD/SNAP programs:
  – Reduced Cyc24 usage: WFC = 508 orbits prime + 198 orbits par.; SBC = 48 orbits
  – Latest tally, including DD and mid-Cycle additions, is 51 programs using ACS
  – PhaseII reviewing for Cycle 24 is 100% completed as of May’17

• Publication of ACS Instrument Handbook (for Cycle 25)
  – Revised treatments of WFC geometric distortion, CTE degradation and mitigation
  – Extensive discussion of Cycle 24 changes to WFC subarray modes
  – Incorporating latest developments from last year’s calibration updates [ISRs, TIRs]

• Support of DD/SNAP legacy programs for the external community
  – Finishing support of HST Frontier Fields [observations completed Sep’16]
  – New “Gap-filler” ultra-SNAP program: ≈1’ NGC/IC galaxies (for now)
## ACS Cycle 24 Calibration Plan

<table>
<thead>
<tr>
<th>PI</th>
<th>Proposal Title</th>
<th>Frequency</th>
<th>Time (orbits)</th>
<th>Scheduling Required</th>
<th>Products</th>
<th>Accuracy Required</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Golimowski</td>
<td>ACD CCD Daily Monitor</td>
<td>3x/week</td>
<td>624</td>
<td>Periodic</td>
<td>Ref flies</td>
<td></td>
<td>Dark, bias creation</td>
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<tr>
<td>Chiaberge</td>
<td>ACS External CTE Monitor</td>
<td>Yearly</td>
<td>8</td>
<td>3Q 2017</td>
<td>correction formula</td>
<td>1% abs</td>
<td>Monitoring of CTE losses to calibrate correction formula</td>
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<td>Chiaberge</td>
<td>ACS Internal CTE Monitor</td>
<td>2x/cycle</td>
<td>12</td>
<td>Nov 16, May 17</td>
<td>Web, cte ref files</td>
<td>10%</td>
<td>CTE EPER test</td>
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<tr>
<td>Golimowski</td>
<td>ACS CCD Hot Pixel Annealing</td>
<td>4-weekly</td>
<td>156</td>
<td>Periodic</td>
<td>Ref</td>
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<td>ACS UV Contam. Monitor</td>
<td>Yearly</td>
<td>2</td>
<td></td>
<td>Ref, ISR</td>
<td>1%</td>
<td>SBC sensitivity</td>
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<tr>
<td>Coe</td>
<td>ACS CCD Stability Monitor</td>
<td>3x in cycle</td>
<td>4</td>
<td>Nov 16, Mar/Jul 17</td>
<td>Ref files</td>
<td>1%</td>
<td>L-flat, Distortion, Photometry</td>
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<tr>
<td>Borncamp</td>
<td>ACS Internal Flat Fields</td>
<td>2x/cycle</td>
<td>16</td>
<td>~Dec 16, ~Aug 17</td>
<td>Ref, IRS</td>
<td>&lt;1%</td>
<td>Track flat field changes, uses lamp</td>
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<tr>
<td>Avila</td>
<td>ACS SBC darks</td>
<td>Yearly</td>
<td>4</td>
<td></td>
<td>ISR, IRS</td>
<td>10%</td>
<td></td>
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<tr>
<td>Bohlin</td>
<td>ACS Photometric Calibration</td>
<td>Yearly</td>
<td>9</td>
<td>Mar 17</td>
<td>ISR, zp, ref files</td>
<td>&lt;1%</td>
<td>Photometric standards; new K-type star added</td>
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<tr>
<td>Wheeler</td>
<td>ACS SBC MAMA Recovery</td>
<td>as needed</td>
<td>4</td>
<td></td>
<td>-</td>
<td>-</td>
<td>After irregular safin</td>
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<td>Bellini</td>
<td>WFC Post-flash Calibration</td>
<td>Yearly</td>
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<td>Mar 17</td>
<td>Ref, ISR</td>
<td>1%</td>
<td>Post-flash ref file</td>
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<td>Anderson</td>
<td>Repinning and reformulation of the ACS/WFC CTE model</td>
<td>as needed</td>
<td>12</td>
<td></td>
<td>Model, ISR</td>
<td></td>
<td>Taken within same anneal pd.</td>
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</tbody>
</table>

|                  | Total requested orbits                 | 23  | 829         |

- Cyc24 CAL orbit-cost is significantly reduced from Cyc23 CAL
  - 10 fewer external orbits (less SBC); ≈230 fewer internal orbits (subarray biases)
  - Maintaining/expanding quality, with fewer required resources
**WFC Read-Noise Monitoring**

- All WFC amps’ read-noise have been stable since Jan’13 anomaly
- Noise levels remain below pre-SM4 values for all amps
**SBC Dark Current Monitoring. I.**

- Annual CAL program obtaining 20 consecutive 1000sec darks
- Anomalously high SBC dark current rates $\rightarrow$ SAA close-pass

![Graph showing dark current rates and temperature changes over time](image)

- **Dark rate [counts/s/pix]**
  - 1e-5

- **Temperature [°C]**
  - 15, 20, 25, 30
  - Elapsed time [hrs]: 0, 2, 4, 6, 8, 10
  - GO Usage Cyc21-24 [# orbits]

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SBC Dark Current Monitoring. II.

- 1st (left) vs. 20th (right) 1000sec dark from Mar’17
- Anisotropic dark-current increase vs. temperature
- Potential justification for adding “dark-quiet” SBC aperture/POSTARG
- Yearly top-end trending: +0.0018 count/pix/ksec
Re-defined WFC Subarrays: Bias

- SM4 replacement electronics for WFC: readout-dependent bias structure
- Original readout-timings for subarrays unlike full-frame (see Figure at right)
- Apr’16: ACS FSW update for subarrays
- May’16: Validation of matched bias gradients in all amps/geometries

(similar old/new results among all 4 amps and all 3 subarray modes)
Re-defined WFC Subarrays: CTE

? Consistent CTE-trailing profiles?
? (Independent of intensity?)

✓ YES, in the mean (Figure at right)

✓ YES, in detail (Figure at bottom)

➢ 3Q17: Correction supported for new-mode subarray images
WFC “Sink Pixels”

- CCD defects that cause charge-trapping are *inhomogeneous*
  - “Sink pixels” ≡ single-pixel large over-densities of charge traps
- Most are easily detectable in post-flashed short (0.5sec) darks
- Drain charge from multiple “upstream” pixels during readout
- Creation rate currently ≈300/month; few healed by annealing
- Currently un-correctable; flagged in DQ array (1–2% of pixels)

Short-superdark pixel histogram
Sink-pixel profiles vs. location & bkgnd.

LED flash-subtracted values

sink pixels
fitting domain
warm/hotpix
Coming Soon to CALACS

• DMS 2017.2a will be including substantive updates/additions to CALACS modules (3Q17):
  • ctecorr: Pixel-based CTE correction overhaul
    – First update since 2011 original; more akin to UVIS
    – Remedy for inaccurate original time-extrapolation
  • sinkcorr: Flagging of excessive charge-traps
    – Newly added, based on WFC3/UVIS paradigm
    – Tracked monthly, with 0.5sec flashed darks
**WFC “Save the Pixels” Initiatives**

- **Motivation:** Many WFC pixels/cols unjustly rejected by DQ flagging
- **Using vast WFC time-history,** can be smarter about superdark DQ
- **After 15yrs, >10⁴ hot pixels; ~all are stable within anneal intervals**
- **Subtract-able; reflected in ERR array (Only DQ-flag unstable pixels)**

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1. **Ratio of Observed to Expected Variance**
2. **Mean Pixel Intensity [electrons]**
3. **Hot stable: 1.3%**
4. **Hot unstable: 0.002%**
5. **Cold unstable: 0.12%**

**Darks from Dec’06 (unflashed)**

**Darks from Nov’15 (flashed)**

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Most ACS observations are taken with multiple dithers: multiple FLC images

Dithers can be combined using the STScI DrizzlePac software: single DRC mosaic

Default “drizzling” configurations used by MAST are encoded in “MDRIZTAB” file

Recent investigations have suggested that few-dither WFC drizzle configuration results in:
  – overly aggressive cosmic-ray clipping of stars
  – improper handling of CCD full-well saturation

New study has optimized the MDRIZTAB (see next)
Revised MDRIZTAB. II.

- Globular cluster photometry: drizzled vs. undrizzled
- Far fewer bad-drizzle outliers, particularly at bright end
ACS/WFC “Gap-Filler” Program. I.

😊 ≈2-3% of HST orbits regularly go un-allocated: schedule “gaps”

😊 Cycle 24: ultra-low-priority SNAP ACS/WFC program to fill gaps
  • Targets: large (0.9’<D<1.6’) bright (11.4<V<13.3) NGC/IC galaxies
  • Two 337-sec exposures per target (1 orbit) in F606W (wide-V)

✓ By mid-Apr’17: 55 targets already observed (>2 per week)

✓ By mid-Apr’17: 4171 MAST retrievals from dozens of IP addrs.
  • Cycle 25: New target lists; possibly 2nd filter for Cyc24 targets
ACS/WFC “Gap-Filler” Program. II.

Schedule Gap Pilot (SNAP–14840)

NGC 1577

NGC 3656

NGC 6557

NGC 7223

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Spreading the ACS News

• Recent ACS Team Instrument Science Reports:
  – 2017-05 : “Updated Measurements of ACS/SBC Dark Rates” (Avila)
  – 2017-04 : “Pixel History for Advanced Camera for Surveys Wide Field Channel” (Borncamp et al.)
  – 2017-03 : “New Subarray Readout Patterns for the ACS Wide Field Channel” (Golimowski et al.)
  – 2017-02 : “Updated MDRIZTAB Parameters for ACS/WFC” (Hoffmann & Avila)
  – 2017-01 : “Sink Pixels in ACS/WFC” (Ryon & Grogin)
  – 2016-06 : “Here Be Dragons: Characterization of ACS/WFC Scattered Light Anomalies” (Porterfield et al.)
  – 2016-05 : “Photometric Aperture Corrections for the ACS/SBC” (Avila & Chiaberge)

• AAS #229, January 2017:
  – Poster #238.06 : “Low Frequency Flats for Imaging Cameras on the Hubble Space Telescope” (Kossakowski et al.)

• Expected Re-release of ACS Data Handbook in 3Q17

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