



STScI | SPACE TELESCOPE
SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

Hubble Space Telescope Status

Cycle 26 TAC Presentation

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Oct. 8, 2018



Welcome!

Thank you for serving on the Cycle 26 HST TAC

- The Hubble Space Telescope has now completed 28 years in operation
 - We are now 9 years past Servicing Mission 4
 - ▶ At that time, planning was for 5 years of science operations
 - In most respects, Hubble is working now at its very best
 - ▶ There is some slight instrument performance degradation
 - ▶ But we (GOs and STScI+GSFC) have become smarter in how we use the observatory
- Over the next several days, the team in this room has the privilege and responsibility of defining what Hubble does next



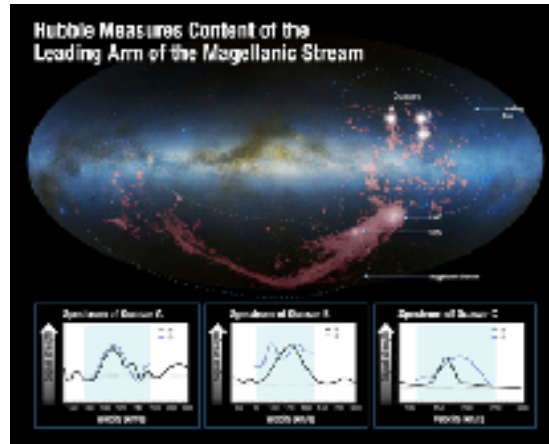
Hubble is as Powerful as Ever

Deep, precise, stable pan-chromatic imaging

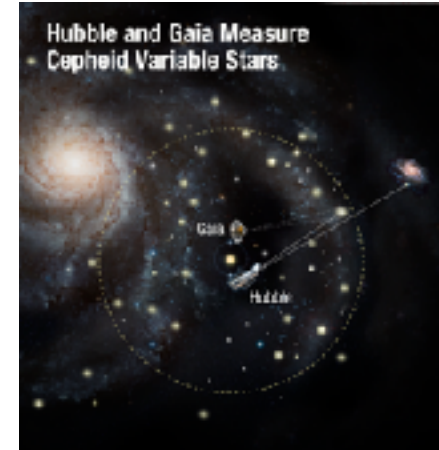
Slitted and slitless spectroscopy, coronagraphy, astrometry



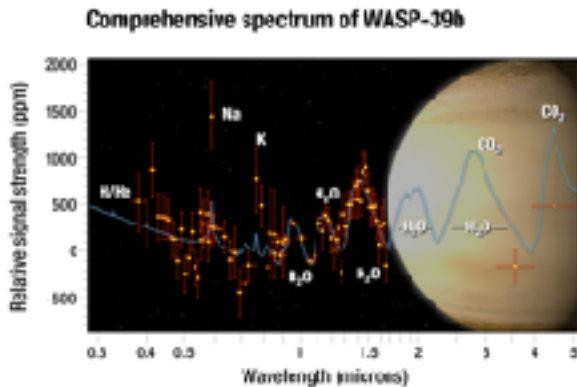
star formation and its galactic impact



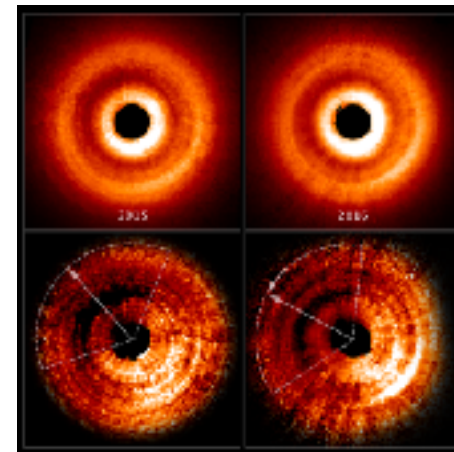
life stories of galaxies



cosmology and fundamental physics



planetary atmosphere characterization



planetary ecosystems



2020 → 2025 Vision

Operate Hubble out to 2020 and beyond so that there is at least one year of overlapping science observations with the James Webb Space Telescope, performed in a manner that maximizes the science return of both observatories by taking full advantage of Hubble's unique capabilities and the astronomical community's scientific curiosity.

How long will Hubble continue to operate?

As long as it remains scientifically productive

What is needed to keep Hubble scientifically productive?

Expect several years of overlap between HST and JWST

- An operating observatory
- Capable science instruments
- Scientific drivers (demand)
- Adequate staffing and user support
- Appropriate funding
- Common purpose & teamwork



The Road to 2020+

	Current Status (2018)	Expectations (2019-2021)
Observatory Health	Excellent (even better than expected after SM4)	<ul style="list-style-type: none"> • Good reliability of science instruments and major systems well beyond 2020 (NESC) • Known modes of degradation
Orbit Decay	Nominal orbit	Orbit stable until mid-2030s
Scheduling Efficiency	~50%, near all-time high Averaging >84 orbits/week	Efficiency will decline to 40% in reduced gyro mode
Scientific Productivity	>900 papers per year (new record!) >50 PhDs per year	<ul style="list-style-type: none"> • Publication rate remains high • New discoveries continue
Demand	~500 proposals (Δ Cycle 26); 13:1 oversubscription (time)	Peak or near-peak demand for time
Staffing	Lean operations	Work efficiencies are harder to achieve beyond FY19 without loss of capability
Mission Funding	\$98.3M/year total budget	Uncertain mission budget presents challenges
Grant Funding	\$28-32M/year in grants to the community	Strong support for science analysis



Hubble is in Excellent Health

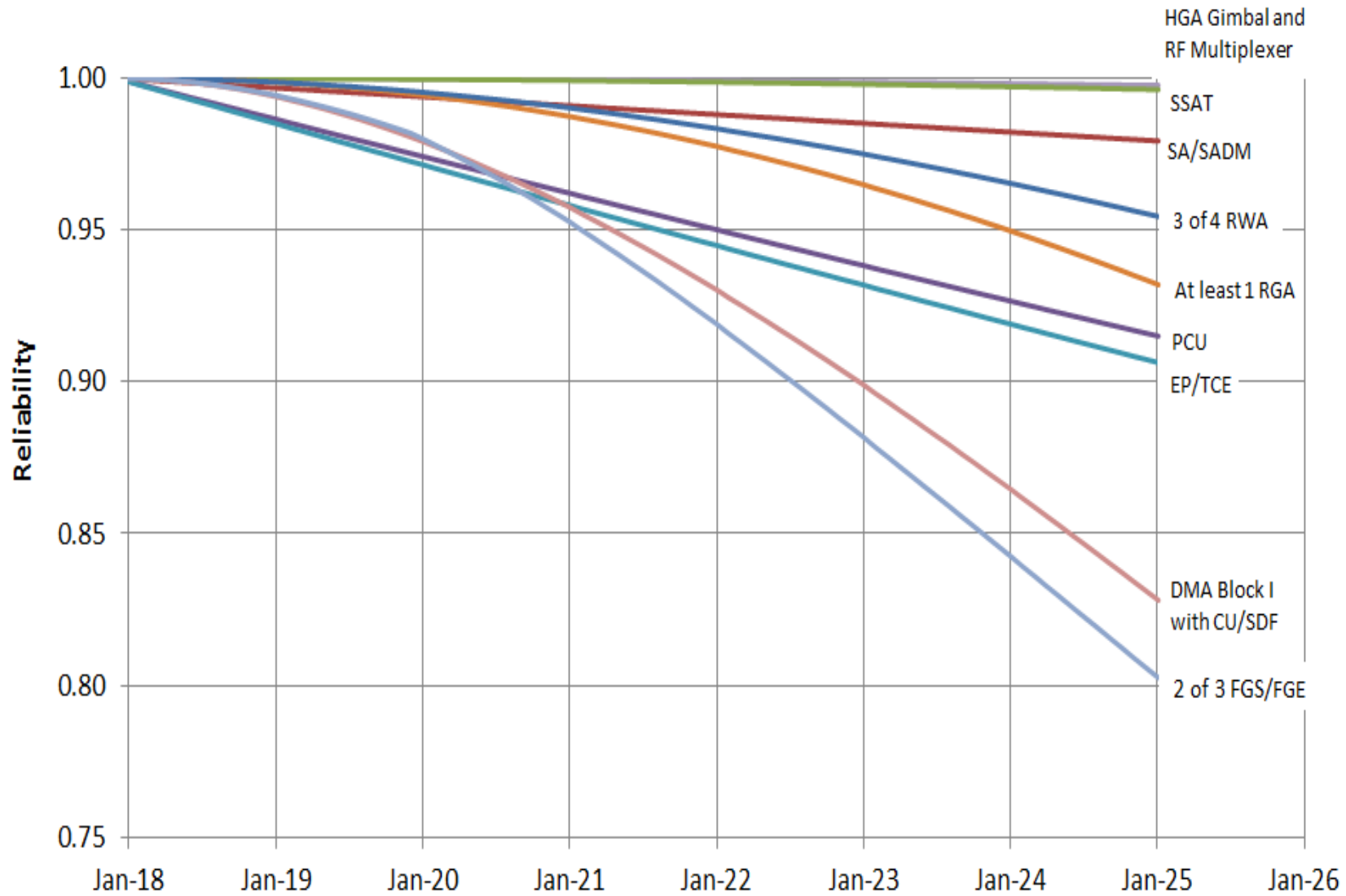
Observatory Systems Status



ACS	Operating well. Improved CTE corrections and SBC calcs.
COS	Far-UV sensitivity remains excellent. Move to LP4 in October 2017 with new operating strategy.
STIS	Operating well. BAR5 coronagraphy competitive with ground reaching 1E-6 with ADI and KLIP. Spatial scanning now available.
WFC3	Excellent stability, sensitivity, astrometry. Spatial scanning and Tiling (DASH) available. CTE corrections for UVIS channel. Persistence maps available for IR channel.
Fine Guidance Sensors	Slow degradation being monitored, understood.
Electrical and Power System	No serious issues.
Pointing and Control System	Two working gyros (Gyros 4 & 6). Anomaly in bringing up Gyro 3 after Gyro 2 failure - troubleshooting underway.
Science Instrument Command & Data Handler	Lockups are rare (1-2x per year) and understood.
Thermal Control System	Excellent, no serious issues.

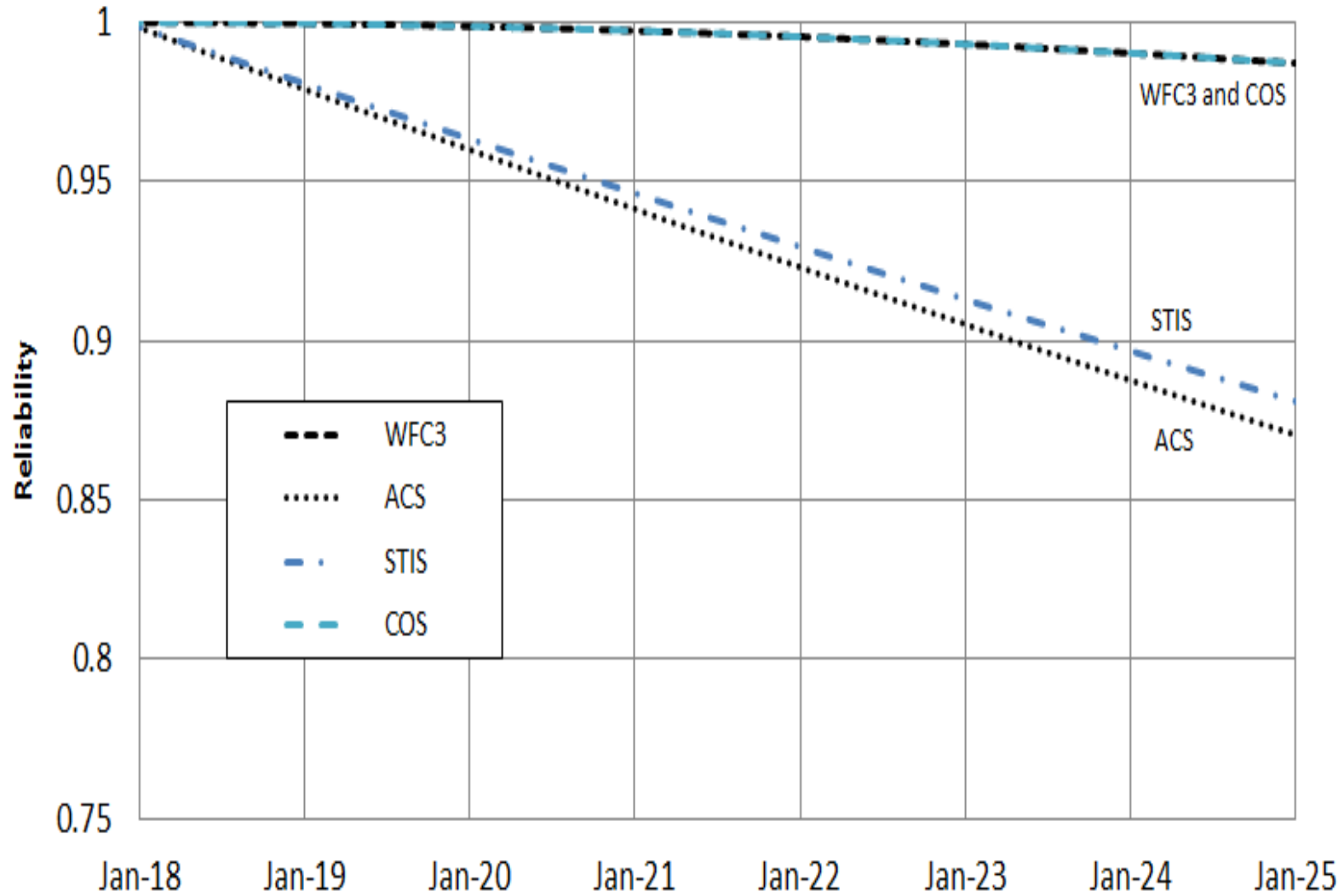


Critical System Reliability





Critical System Reliability – Science Instruments





Advanced Camera for Surveys

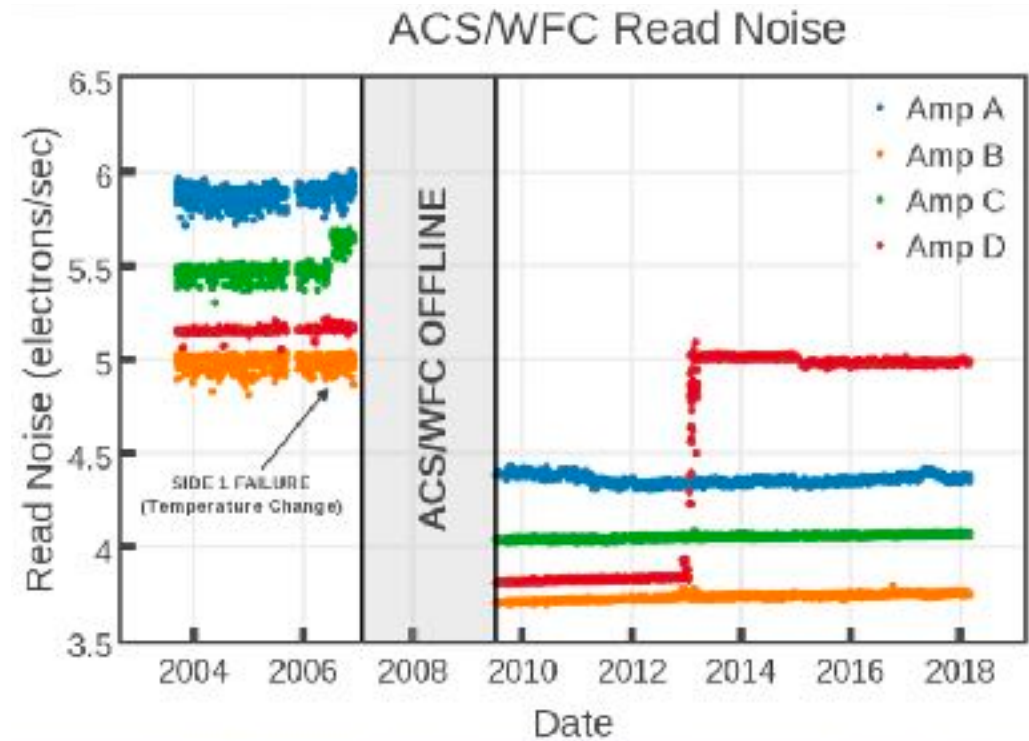
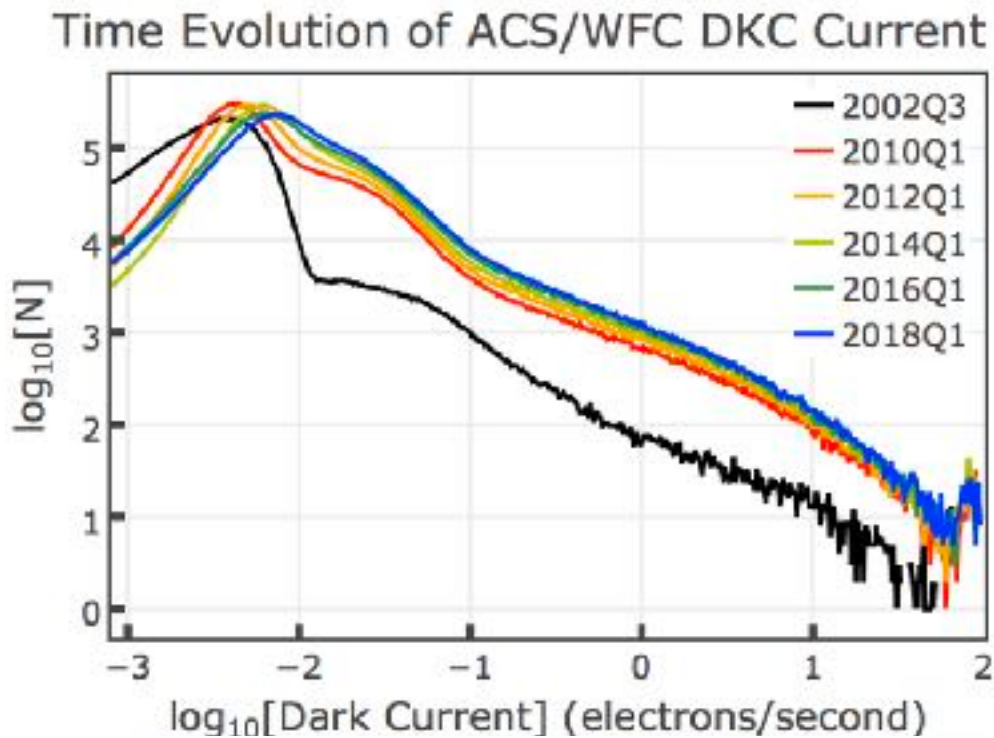
Continued Good Performance

- Updates to CALACS include sink pixel detection, DQ-array flagging, retention of long-term stable warm/hot pixels in DQ array, high dynamic range WFC super darks, Gaia DR2 refinements to WFC Geometric Distortion solution, updates to WFC bias shift correction
- SBC dark current vs temperature being characterized with 16 yrs' data
- Improved LED flash reference file
- Updated web tools for WFC Zero-Points and Pixel-Area Maps
- Revised L-flats for WFC, based on 16 yrs of 47 Tuc monitoring



Advanced Camera for Surveys

Smooth Trend-Lines in Long-Term Monitoring

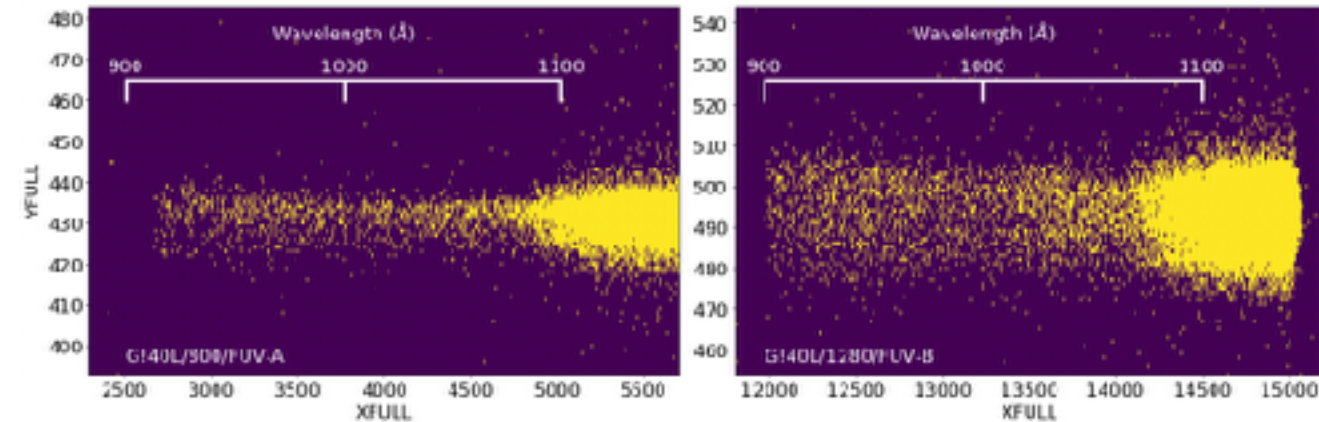
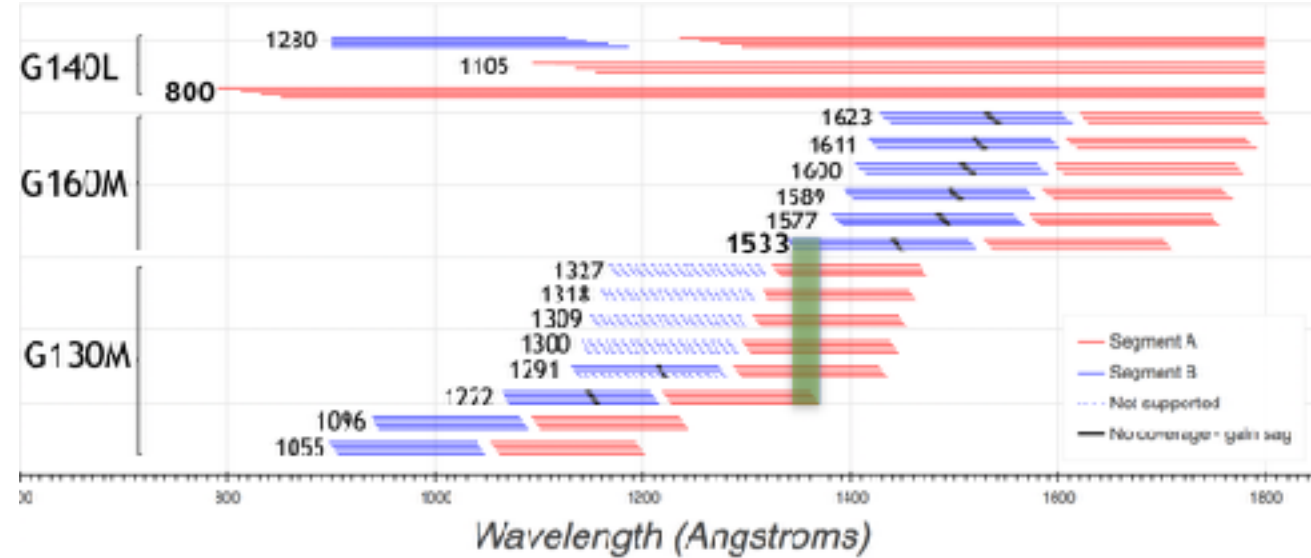




Cosmic Origins Spectrograph

COS is operating nominally; FUV detector at LP4 since Oct. 2017

- New FUV observing modes
 - G160M/1533 enables high SNR, medium resolution spectra over a broad range of wavelengths with just 2 settings: G130M/1222 and G160M/1533.
 - G140L/800 provides broad wavelength coverage (800-1950 Å) on FUV segment A with no gaps and lower astigmatic height

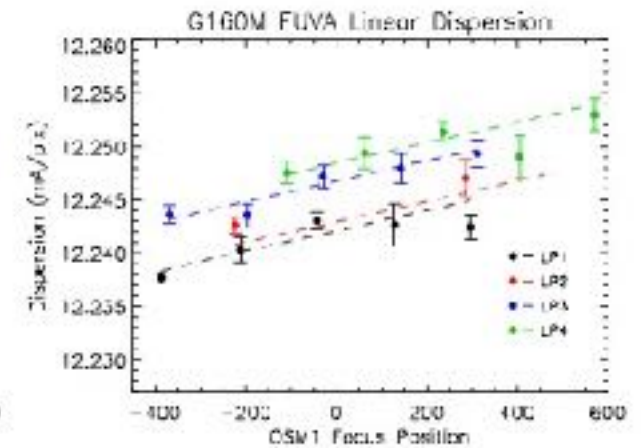
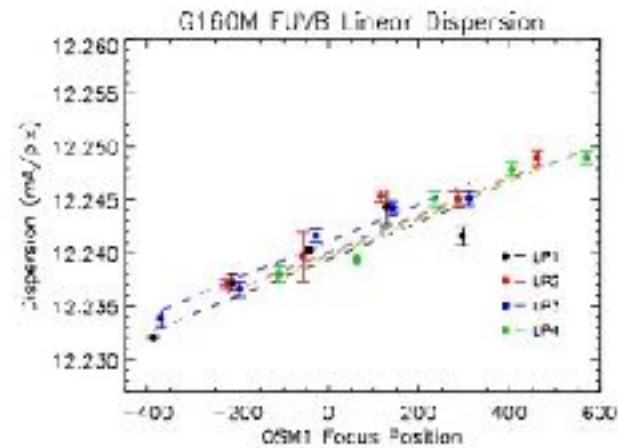
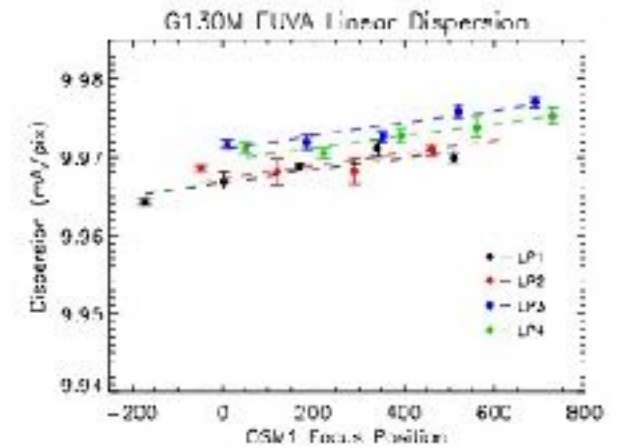
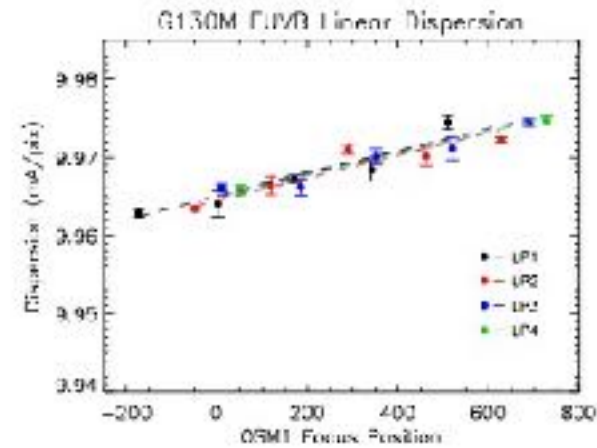




Cosmic Origins Spectrograph

COS is operating nominally; FUV detector at LP4 since Oct. 2017

- FUV dispersion solutions at LP3 & LP4
 - Special calibration programs compare COS and STIS data of same target
 - New wavelength calibration accuracy is ± 3 pixels, compared to ± 6 pixels before
- Change to recommended S/N for imaging target acquisitions

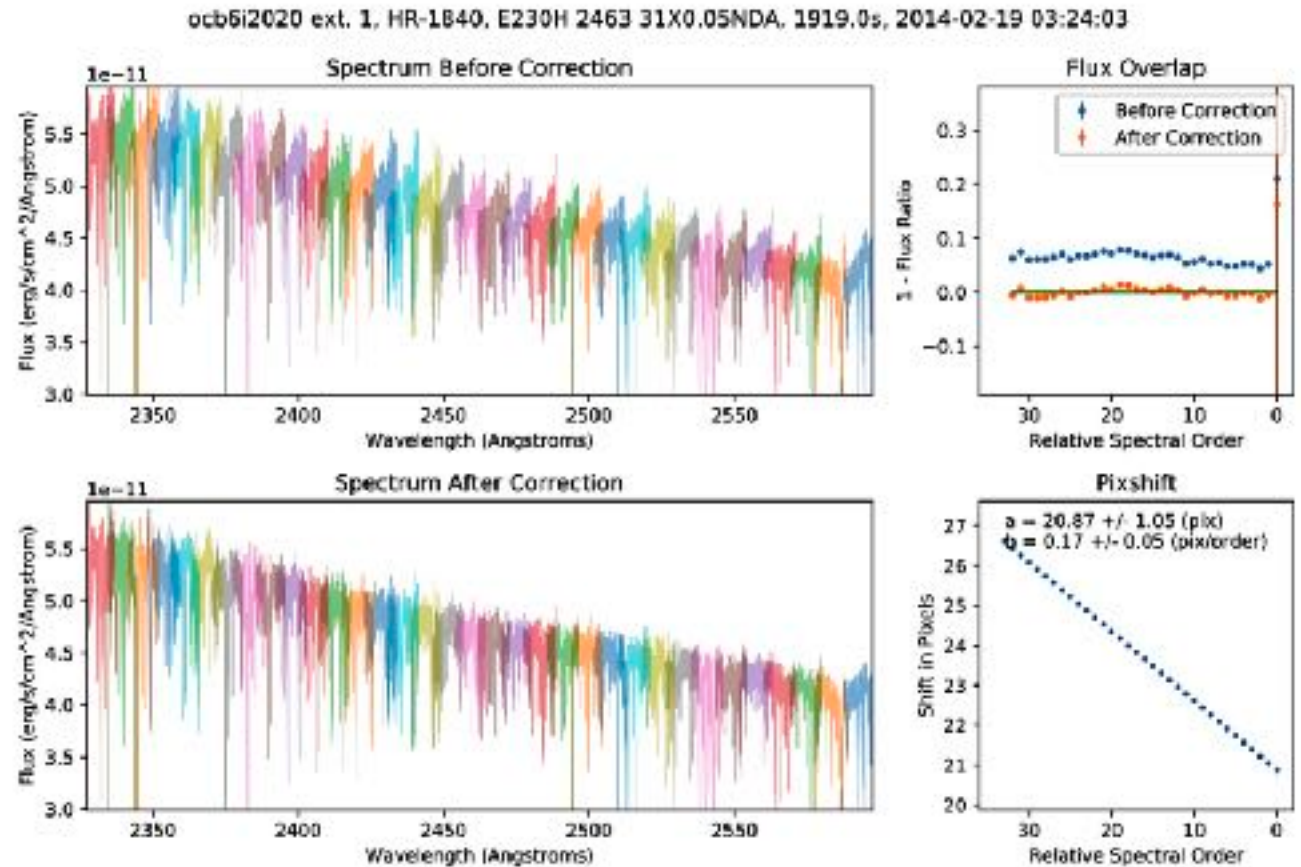




Space Telescope Imaging Spectrograph

STIS status is unchanged; celebrating 21+ years in space

- STIS Blazefix Tool corrects 5-10% flux mismatches in overlapping spectral regions in echelle spectra

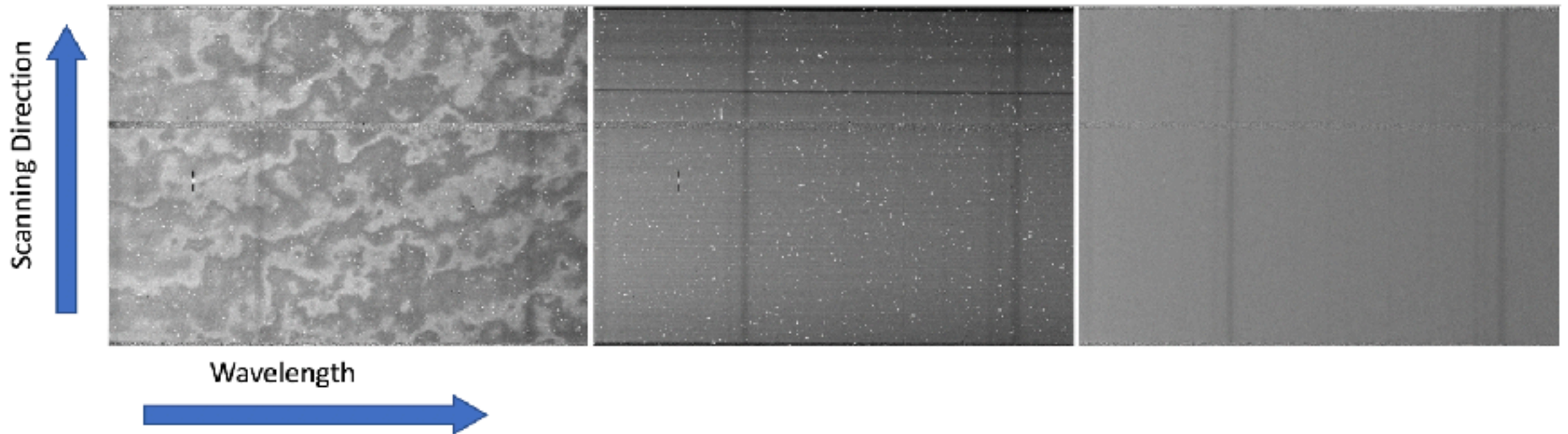




Space Telescope Imaging Spectrograph

STIS status is unchanged; celebrating 21+ years in space

- Available but unsupported spatial scanning modes for moderate resolution, high S/N spectra to observe weak spectral features

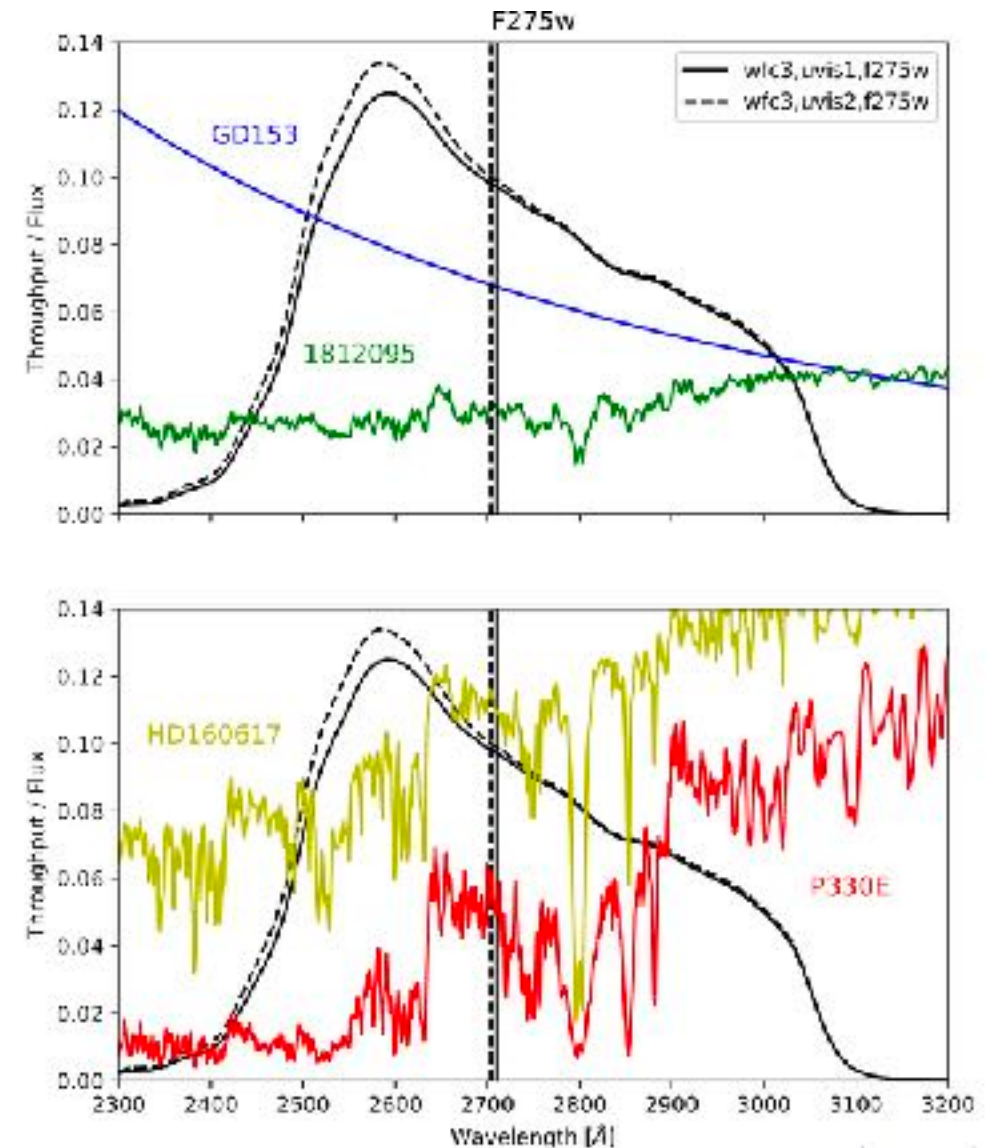




Wide Field Camera 3

WFC3 operations are nominal

- Filter-based geometric distortion solution for full-frame broad, medium, narrow band UVIS filters
- UVIS 2 chips have different QE in UV
- UVIS time-dependent zero points have filter and chip dependence

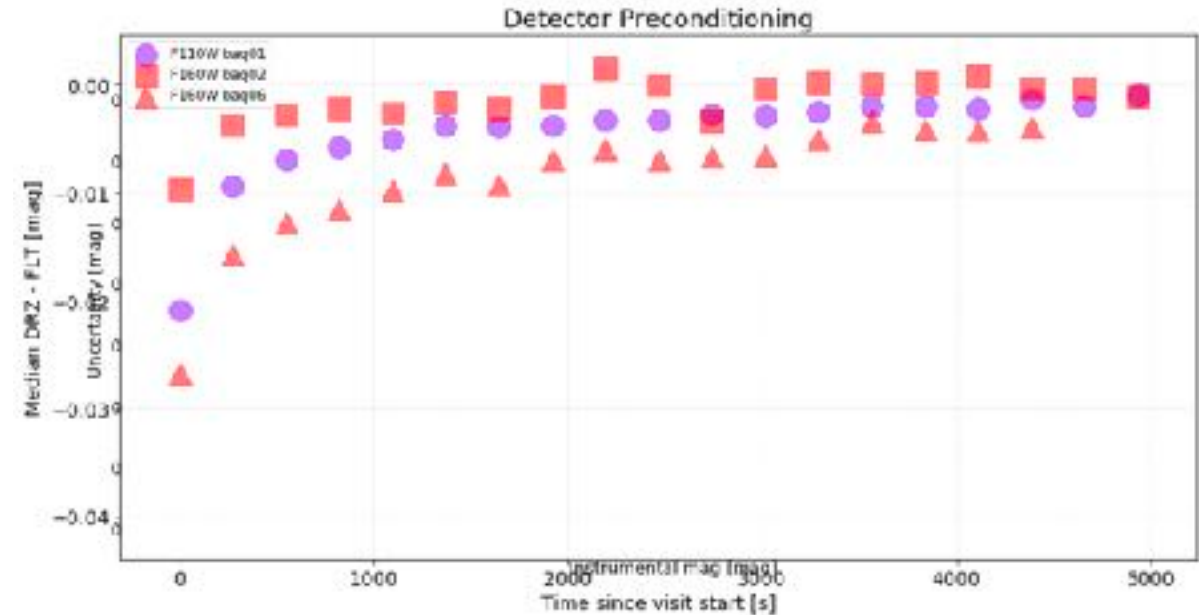




Wide Field Camera 3

WFC3 operations are nominal

- Photometric standards, spatial scan and photometry of star clusters indicate 1-2% repeatability for IR channel
- No noticeable changes in zero points within uncertainties
- Geometric distortion for IR channel remains stable

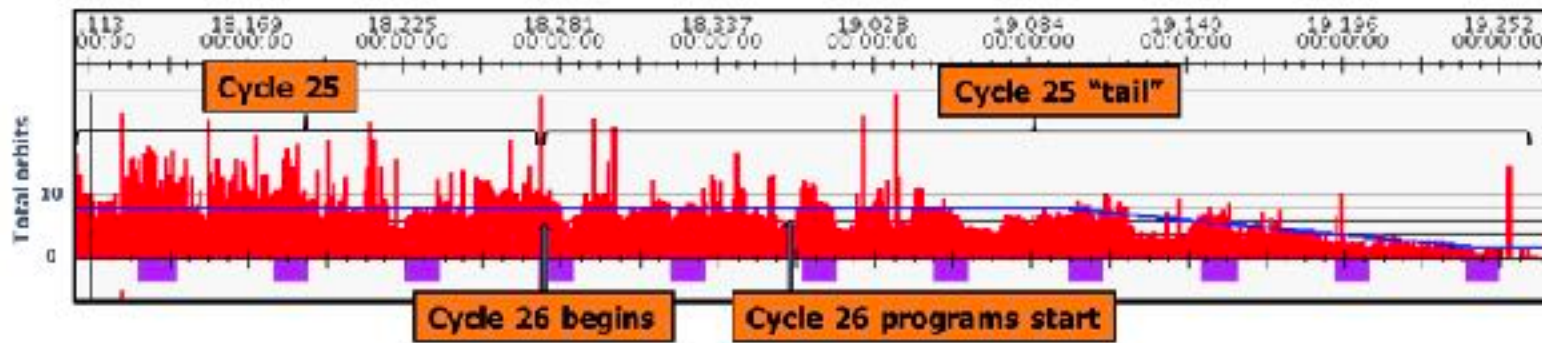
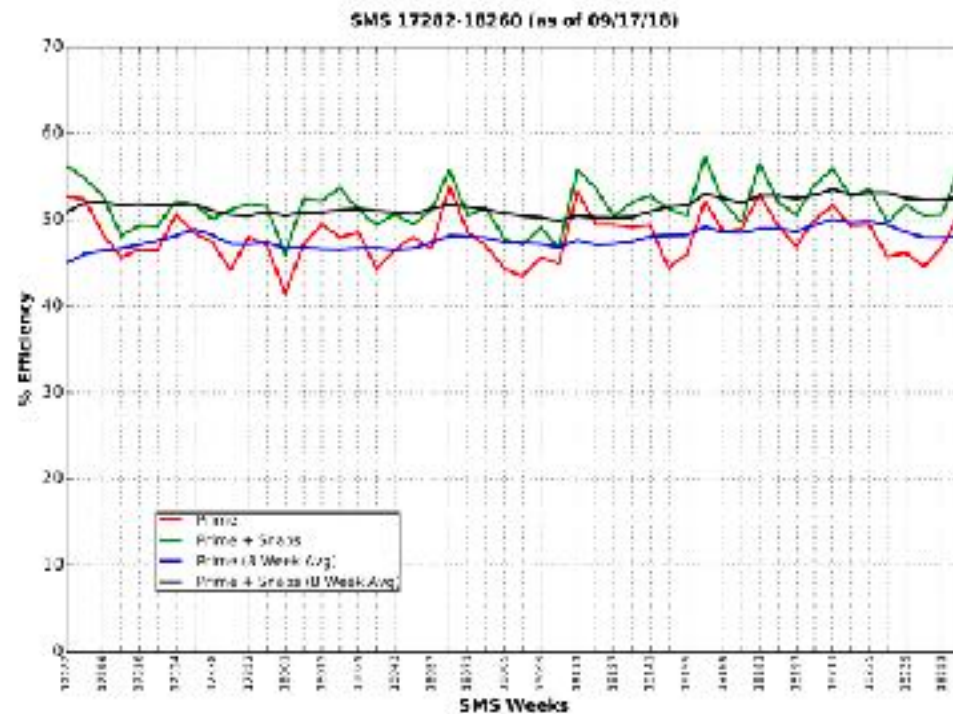




Long Range Plan Highlights

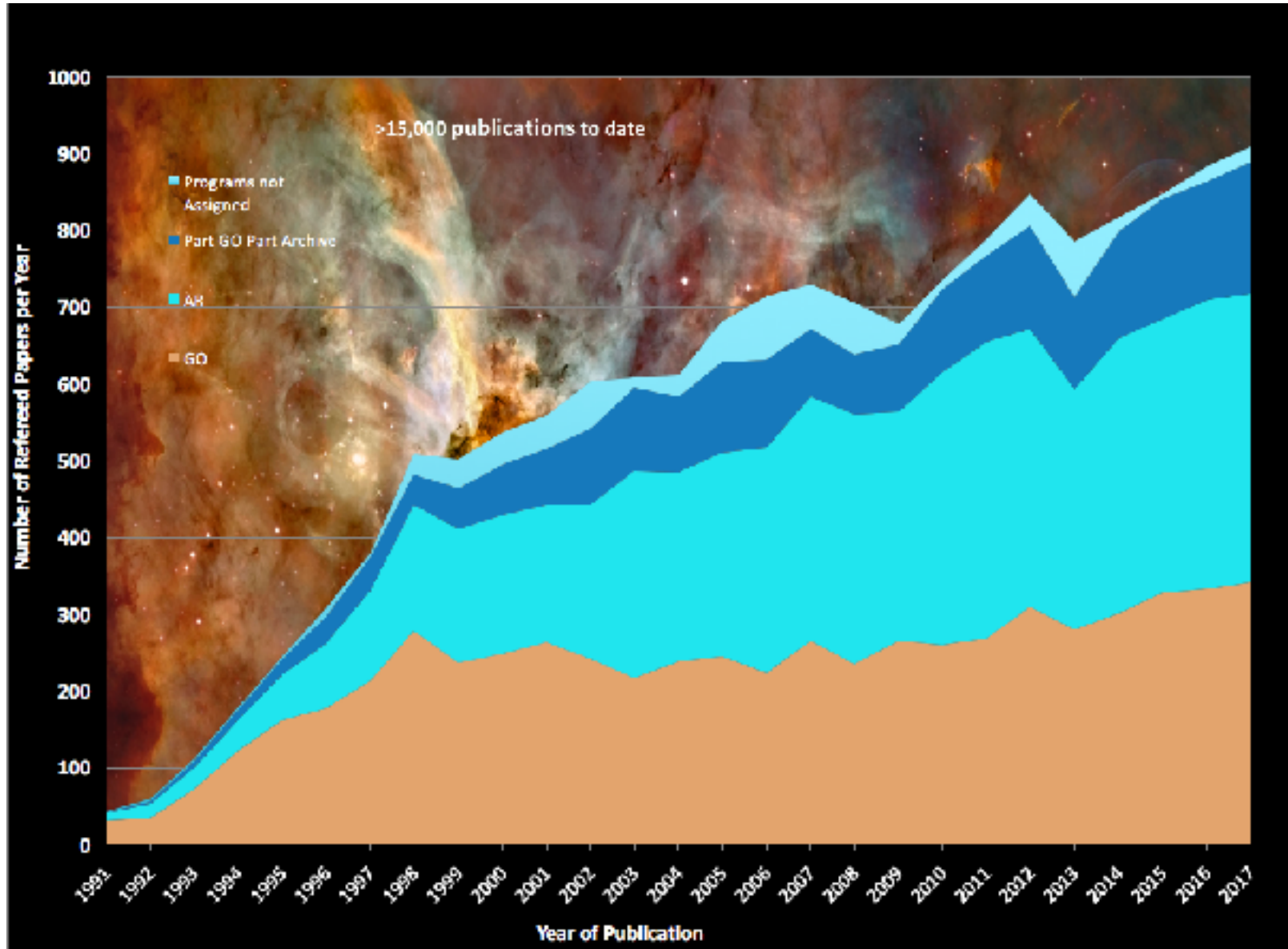
Scheduling efficiency remains high

- Cycle 25 average: 85 orbits/week
 - Cycles 17-23: 84 orbits/week
 - Cycle 24 average: 82 orbits/week
- Key factors:
 - (+) Flexible mix of science accepted by TAC
 - (+) Larger than normal “tail”
 - (-) Impacts of highly constrained observations
 - ▶ N.B. constraints require justification in Phase I





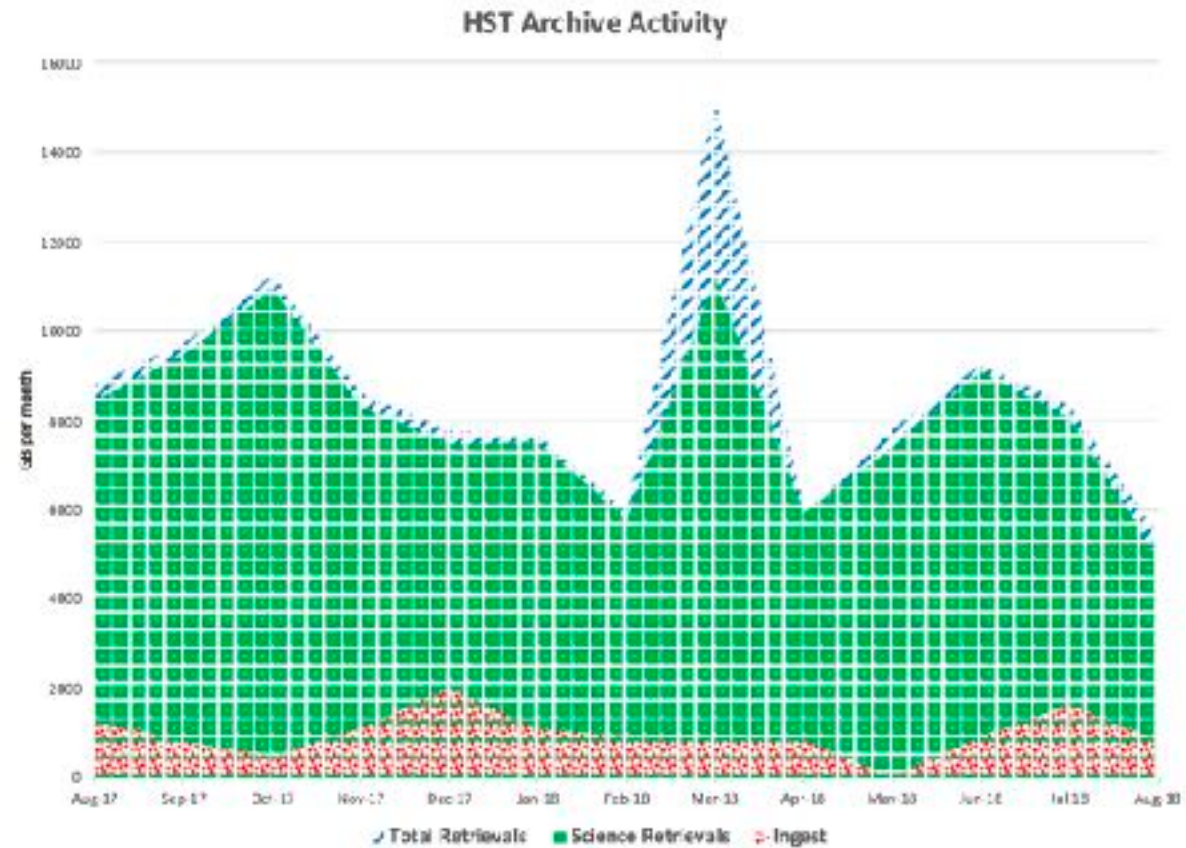
HST Productivity — A New Record # of Publications





Data from the Programs You Select Will Produce Science for Years to Come

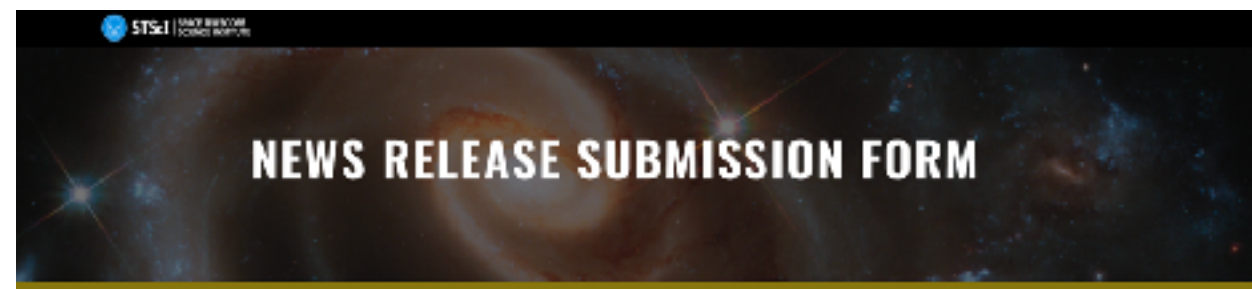
- HST archive size is ~160 TB
- 6-15 TB per month retrieved
- >12,000 registered archive users (85 countries, 50 states)
- HST archive online cache delivers data within minutes to users





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HST JWST Other

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Congratulations! Your program, GO-12345, “Amazing HST Observations”, is nearing completion. As your program draw to a close, we would like to ask you to coordinate with Space Telescope Science Institute to improve the dissemination of your results and help us better follow HST usage...

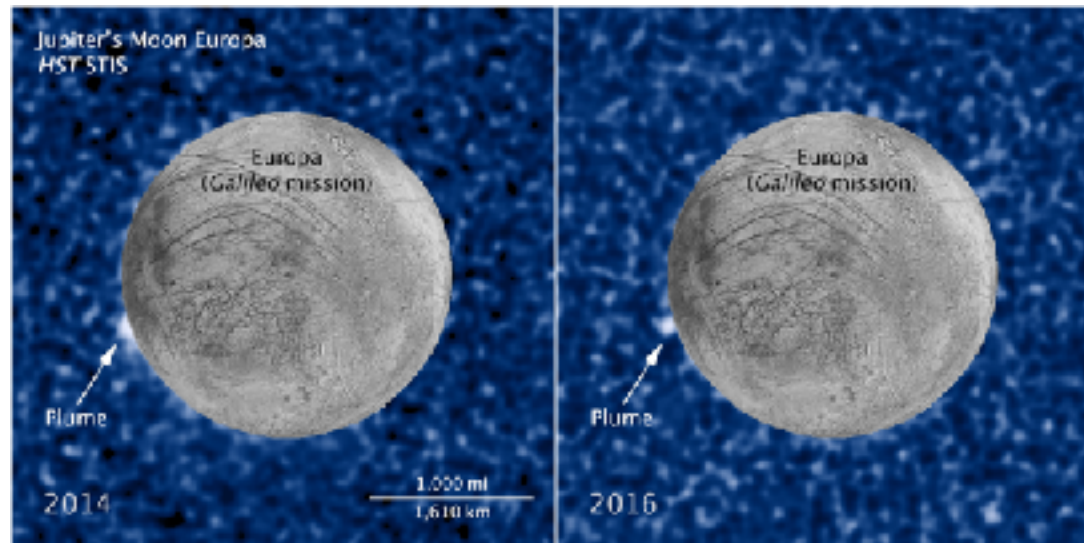
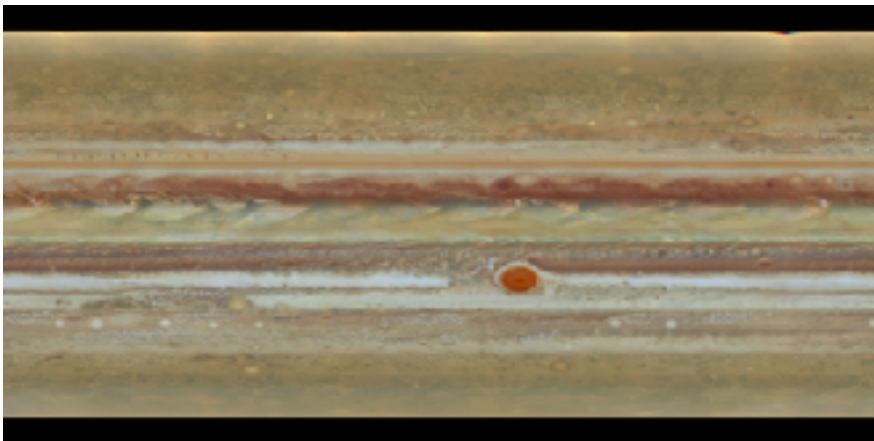
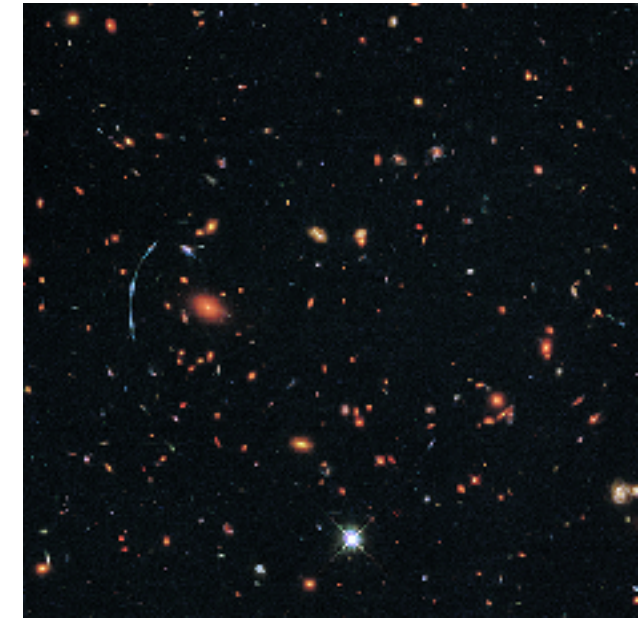
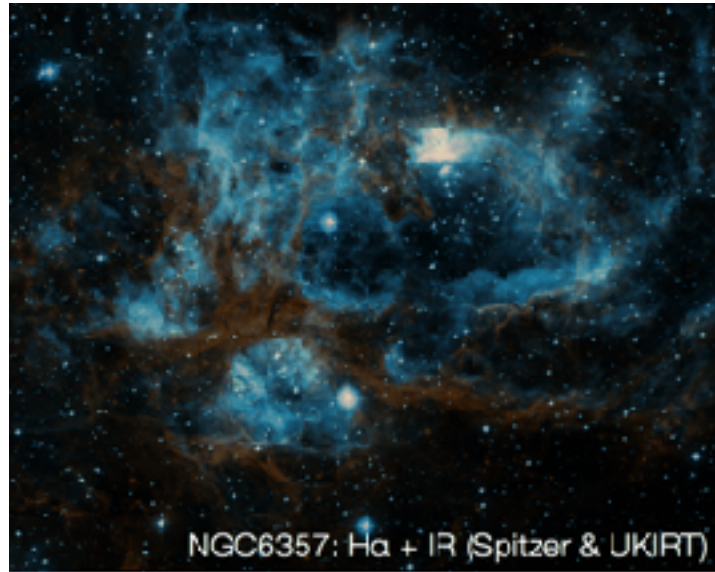
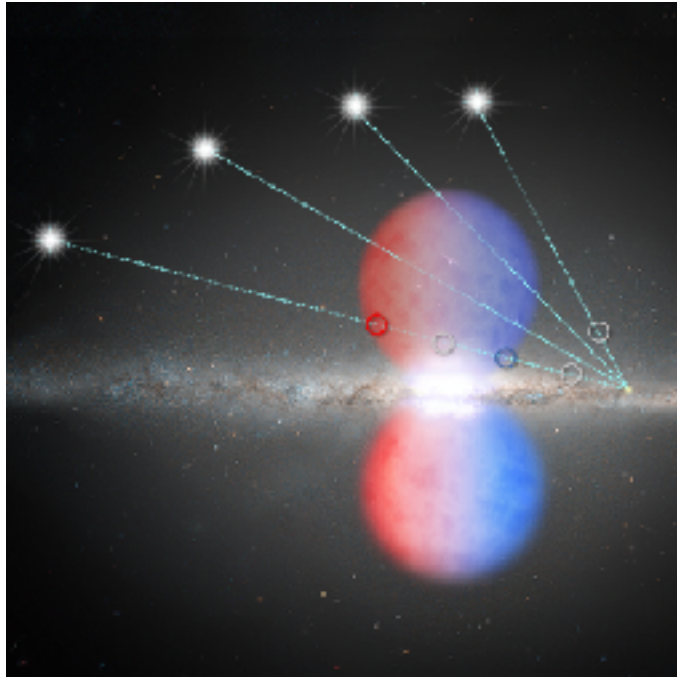


Leave the Scheduling to Us

- In reviewing Cycle 26 proposals, Panels and TAC should focus on the best science
 - Constraints must be scientifically justified
 - However, leave scheduling constraints to us to consider in the context of the entire Cycle 26 pool of recommended proposals
 - Also, let us consider the suitability of observing programs if we do not return to a normal 3-gyro configuration



Hubble may be 28 years old, but its best years are still ahead. . .





End
