Operating COS to 2025

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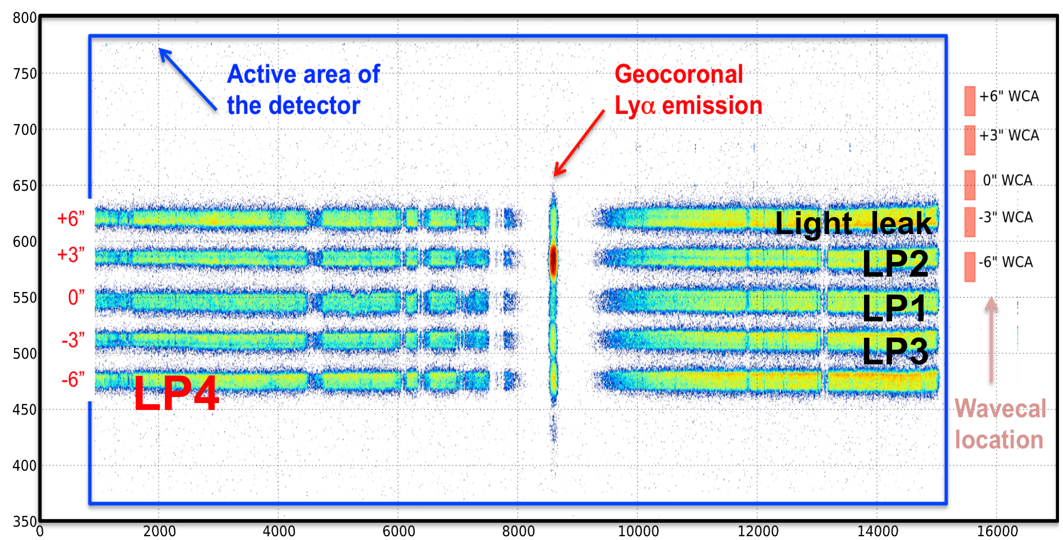
The Issue

- The COS/FUV Photocathode is depleted during normal usage
  - Existing area provides 4 “normal” lifetime positions: now at LP3
  - Most of the problem is gain sag (holes) due to bright geocoronal lines
  - Largest problem is G130M/Segment B
  - LP4 (2017-2019) – might last until Feb 2020 at current usage rate
- Big picture
  - HST likely to last beyond 2021 (2025+ possible)
  - COS is fully redundant w/o liens today (STIS is single string)
- What is the best strategy for UV Spectroscopy going forward?



Good News: We have Options

- Less good news: all involve some degree of compromise
- Need to consider this issue and develop a strategy by June 2017
  - First question: use up LP4 with current strategy?
    - That is, get the best science now while everything is working.
    - Value of HST/UV in JWST overlap era? Sole UV spectrograph?
  - Second question: relative science priorities of COS lifetime extensions? There is some trade space between performance, efficiency, and investment.

Types of Extension Strategies

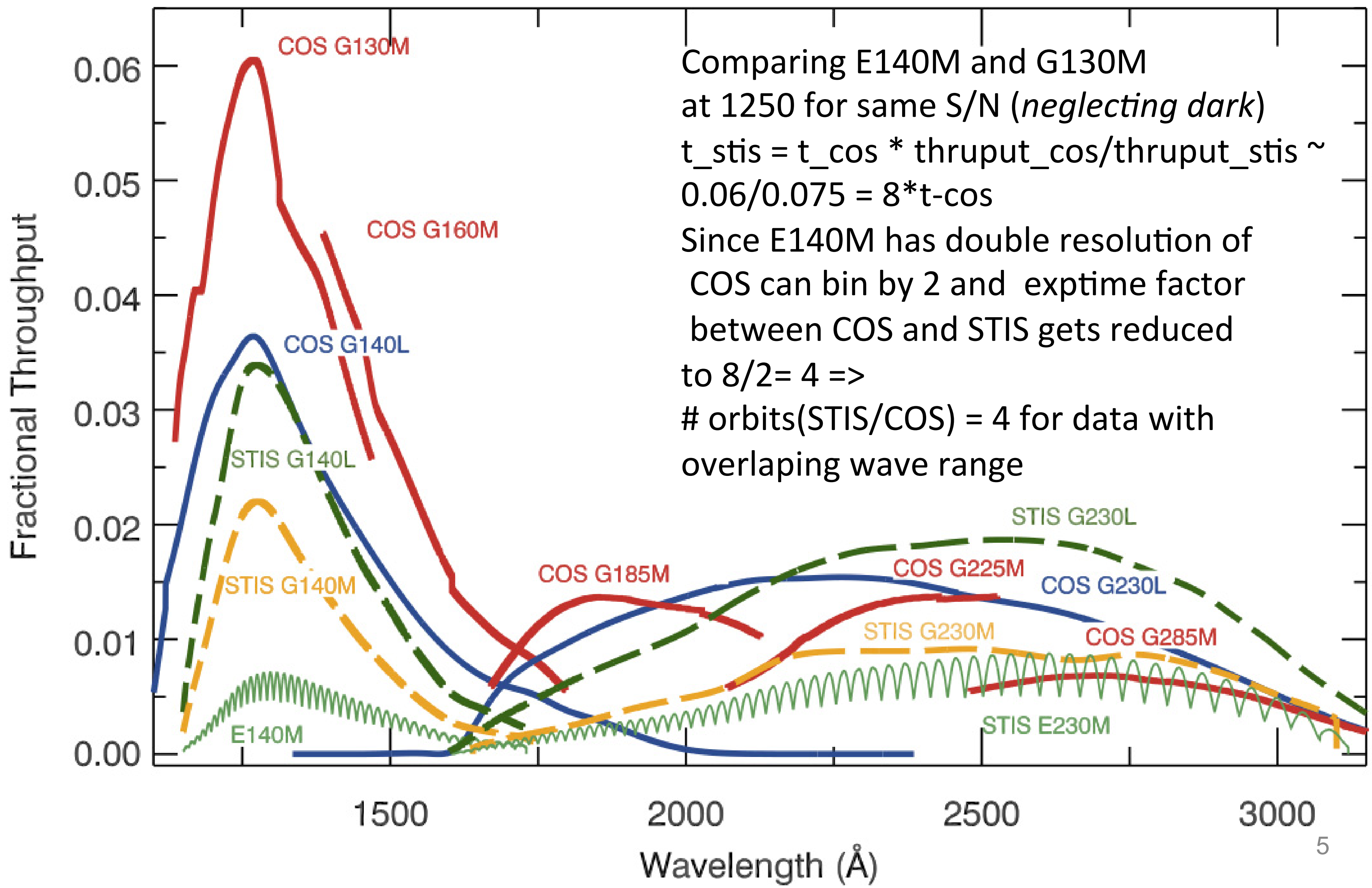
- Encourage/require STIS where possible. This would be a policy choice.
- Restrict COS/FUV observations to limited range of wavelengths
  - Can my science be accomplished “between the holes”?
  - Decreases archival value of datasets
  - Users/TAC/STScI share burden of assessment and planning
- Trade efficiency and science quality (resolution/calibration)
  - Do all observations require the “best” COS can provide?

- Current Analysis:
  - No single strategy will achieve 2025 (not close if usage increases)
  - All actions require non-trivial increase in work to support COS

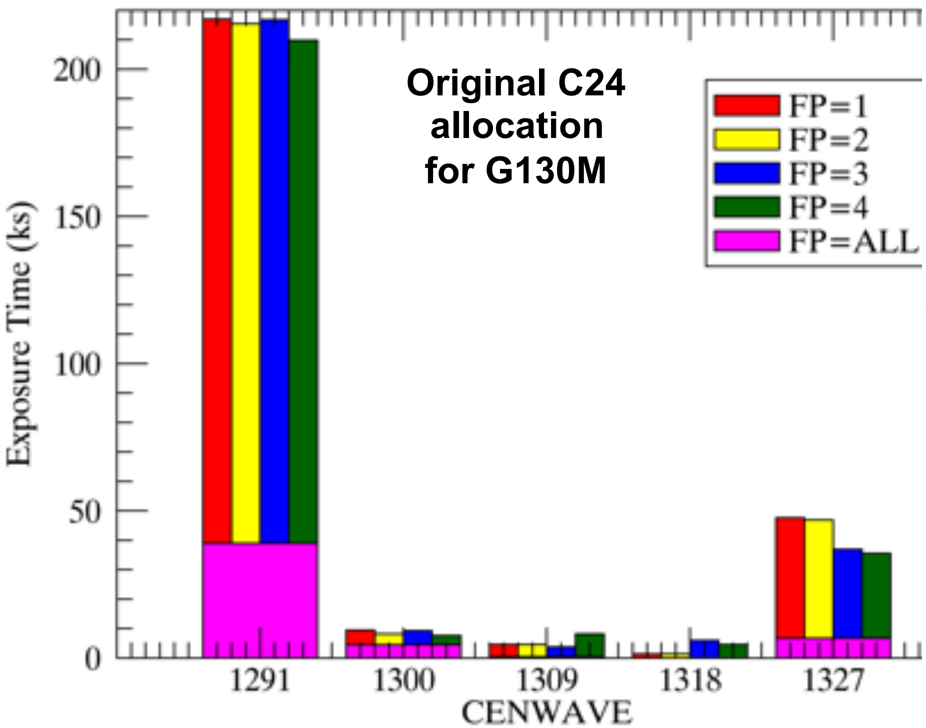
Create incentive to use STIS by charging orbits differently and saving COS for δλ that STIS doesn't have access to

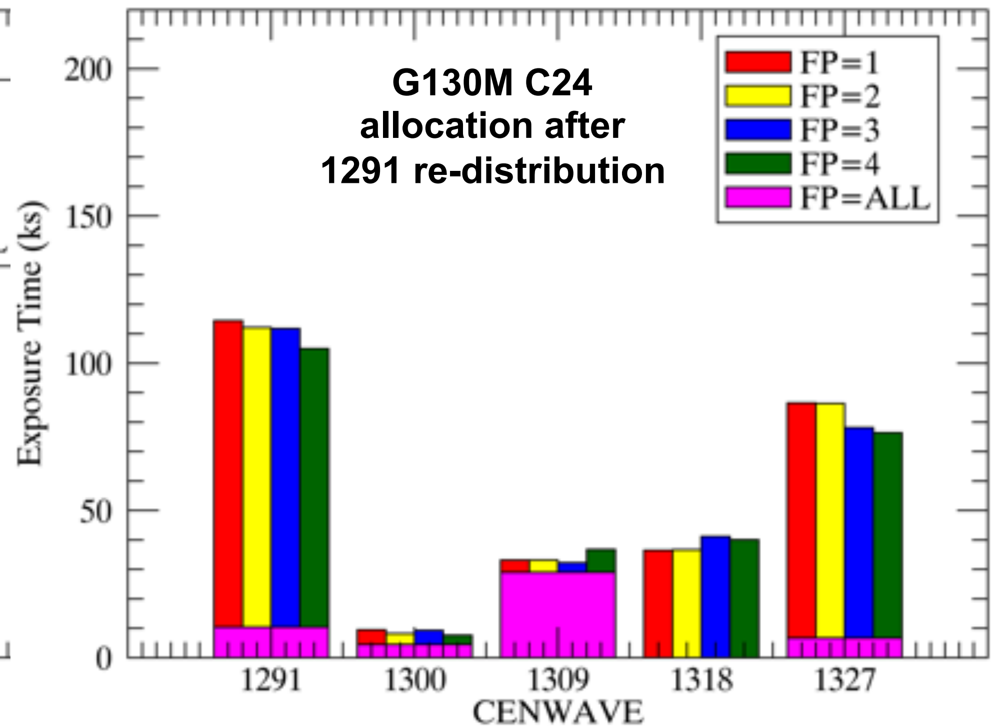
Figure 4.6: Throughputs for COS and STIS in the FUV and NUV.

Figure from Cycle 24 primer – not sure when last updated...



Some fixes are relatively easy
-- buy some more time at LP4





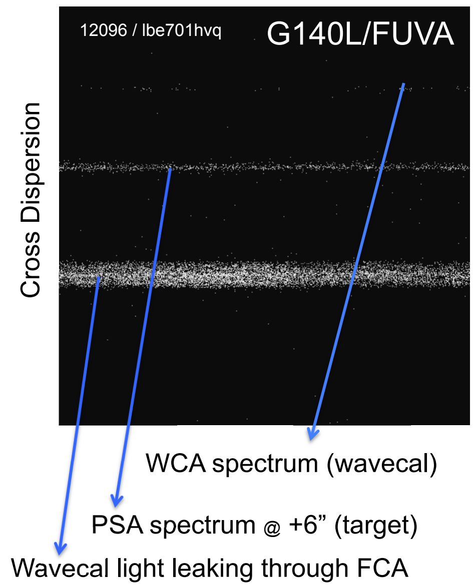
Options for COS/FUV Operations beyond LP4

1. Change lamp operations to have another LP at +6” from LP1
2. Turn off FUVB unless scientifically justified in Phase I
3. Re-use previous LP and live with gain sag holes
4. Hybrid model where LP used and having holes or not depends on science goal of program – i.e. different LP for each visit
5. Operate multiple LPs simultaneously, and in different locations, depending on setting, to minimize gain sag hole impact
6. Create another G160M cenwave to complement 1222 with the resolution optimized for FUVA.

Engineering Option: operate FUV detector at higher voltage (risk?)

1. Change lamp operations to have another LP at +6” from LP1

- Description
  - Light leaks through FCA when WCA is turned on beyond +5” (global count rate violation http://www.stsci.edu/hst/cos/documents/isrs/ISR2013_02.pdf)
  - Even if come up with a scheme to flash lamp at +6” without BOP violation need to consider: 1) impact on calibration of having an FCA spectrum under the science spectrum; 2) gain sag in the location where FCA spectrum falls
  - Can consider obtaining wavecal spectrum at a different detector location than spectrum to avoid problem
    - Would loose ability to do drift correction in long exposures – but could force science exposures to be less than certain value or could take wavecal before and after each exposure to correct for drift – again for very long exposures might loose some drift correction capabilities unless exptime trimmed (would also need to study drift vs. time in more detail and re-evaluate tagflash rules)
- PROS
  - Get another LP
- CONS
  - May not work and poses multiple issues)



2. Turn off FUVB unless scientifically justified in Phase I

- Description
  - Gain sag is worse in FUVB due to Lyα airglow when observing with G130M. Turning off FUVB for G130M observations would remove this issue
- PROS
  - Increases the lifetime of each lifetime position – TBD how much time given that continuum-driven gain sag will go on with each exposure
- CONS
  - Additional overhead with turning a segment off (potentially can be hidden in setup and/or occultation depending on orbit layout)
  - Archival value of the data is lost

3. Re-use previous LP and live with gain sag holes

- Description
  - Can go back to use LP1 and LP2, if not care about holes. Or can continue at LP3 beyond appearance of first hole; similarly for LP4

- PROS
  - Resolution is recovered if going back to LP1 (has the highest R)
  - Minimal impact on calibration activities given that LP1 and LP2 ref files already exist

- CONS
  - Almost too late to continue at LP3 beyond appearance of first hole due to some Cy 24 programs having to experience it. Would need warning in CP/ Primer for Cy 25 soon
  - Certain $\delta\lambda$ would be lost to science both for G130M, G140L, and G160M observations – $\delta\lambda$ ranges would have to be redefined – TBD which depends on LP
  - Impact on archival value of the data

4. Hybrid model where LP used and having holes or not depends on science goal of program

- Description
  - User selects LP and SI configuration do optimize their science
- PROS
  - Most likely to optimize science for individual programs
- CONS
  - Requires extensive support (tools, calibration)
  - Imposes workload on users

5. Operate multiple LPs simultaneously, and in different locations, depending on setting, to minimize gain sag hole impact

- Description
  - Operate different settings on different regions of the detector depending on the spectral height. e.g. G160M between LP1 and LP2 etc., G130M at +5” etc.

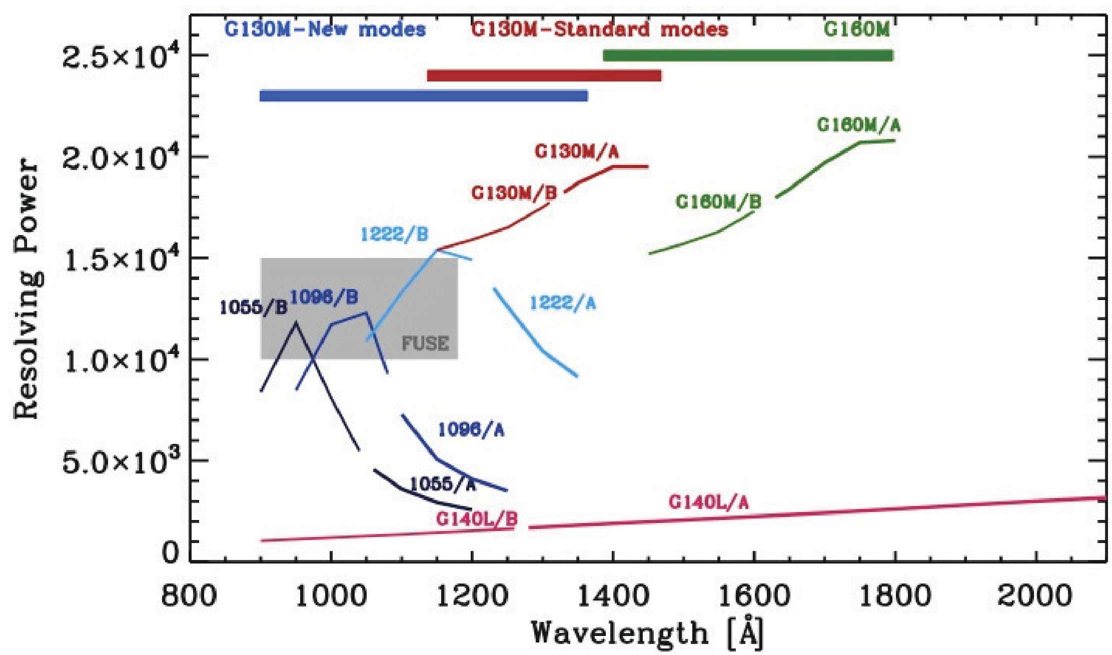
- PROS
  - Extends usable lifetime of remaining photocathode area. How much depends upon mixture of science and how restrictive we make the rules.
- CONS
  - Increase in the # of aperture block moves
  - Increased overhead in visits due to aperture move

6. Create another G160M cenwave to complement 1222 with the resolution optimized for FUVA

- Description
  - G130M/1222 setting places Lyα airglow in segment gap. 1222 resolution optimized for FUVB, FUVA resolution much lower than 1291. By creating a new setting that optimizes resolution of 1222/A people could cover the 1291 $\delta\lambda$ using 2 cenwaves and not placing Lyα airglow in the detector

- PROS
  - Improved performance at 1291 without airglow damage

- CONS
  - Increase overhead



Questions for STUC

- How do we value COS science capability?
  - Now vs. JWST era?
  - Full wavelength coverage vs. accepting gaps in spectra?
- How to balance workloads on STScI vs. Users?
- Balance and timing for this effort against other calibration activities?
- Are there options we have listed that you like? Don't like?
- Are there other options we should consider?
- How urgent do you see resolving this prior to starting with LP4?