

# Cycle 22 COS Calibration Plan

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# Cycle 22 Instrument Usage Statistics Based on Phase II Submissions\*

- COS orbits comprise 20% of all prime orbits in Cycle 22

Instruments	Prime Orbits Usage	SNAP Orbit Usage
ACS	17.4%	8.8%
COS	20.4%	9.8%
STIS	12.6%	68.3%
WFC3	49.7%	13.2%
FGS	0.0%	0.0%

\* Include SNAP STIS program 13776 (450 orbits) for which Phase II still pending

# COS Cycle 22 Usage Statistics based on Phase II Submissions

- 1.2% of the total COS prime observing time consists of NUV Imaging acquisition exposures
- 98.7% of the total COS prime observing time consists of Spectroscopy science exposures
- 82.5% of the COS prime spectroscopy observing time are FUV science exposures

Configuration/ Mode	Prime Usage (COS Instrument science exposures)	SNAP Usage (COS Instrument science exposures)
FUV / Spectroscopy	82.5%	95.5%
NUV / Imaging	0.1%	0.0%
NUV / Spectroscopy	16.3%	---

# COS Cycle 22 Usage Statistics based on Phase II Submissions

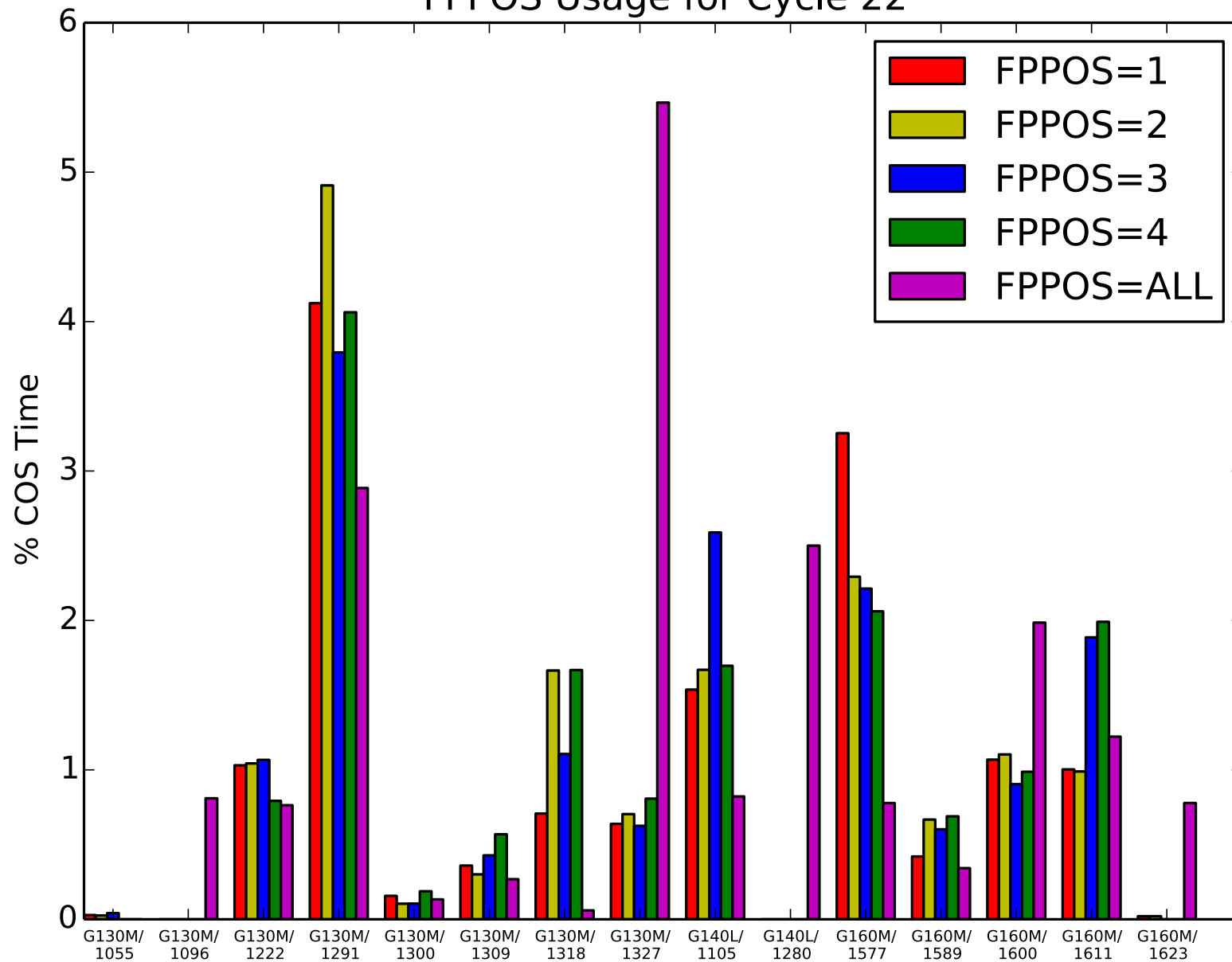
Total science exposures breakdown by Mode and Grating

Configuration	Grating	Percentage of COS Prime Science Exposures (93%)		Percentage of COS SNAP Science Exposures (7%)	
		C21	C22	C21	C22
<b>COS/FUV</b>	G140L	18.9%	13.5% *	94.7%	31.1%
<b>(C22: 82.5% prime)</b>	G130M	41.5%	42.5% **	---	68.9%
	G160M	26.1%	27.6%	---	--
<b>COS/NUV</b>	G230L	3.5%	1.5%	---	--
<b>(C22: 17.5% prime)</b>	G185M	1.9%	8.0%	---	--
	G225M	2.7%	7.1%	---	--
	G285M	2.7%	---	---	--
	MIRROR A/B	0.7%	0.1%	5.3%	--

\* 23% of total G140L observing time goes to exposures using 1280 (77% - 1105)

\*\* 7.0 % of total G130M observing time goes to exposures in the “blue Modes” :  
1222 (83.9%), 1055 (1.7%), 1096 (14.5%)

# FPPOS Usage for Cycle 22



# COS Calibration and Monitor Orbits Request by Cycle

	Programs	External Orbits	Internal Orbits	Parallel Orbits	Total Orbits
<b>Cycle 17</b>	20	149	446	0	595+(21)
<b>Cycle 18</b>	11	65	183	5	248+(21)+5 <sup>†</sup>
<b>Cycle 19</b>	10	51	193	5	244+(21)+5 <sup>†</sup>
<b>Cycle 20</b>	11	44	313+(21)	4	357+(21)+4 <sup>†</sup>
<b>Cycle 21</b>	14	38+(14)	316+(21)	4	354+(35)+4 <sup>†</sup>
<b>Cycle 22</b>	13	44+(11)	488+(21)	2	534+(32)+2 <sup>†</sup>

External Orbit Requests remain < 50 in an continuous effort to preserve the lifetime of the COS FUV detectors. Cycle 22 external orbit increase is related to LP3 move and operations and to a special program.

Internal Orbit Requests have increased primarily due to an increased cadence for the FUV dark monitor in Cycle 20 and again in Cycle 22.

- Cycle 20: the cadence doubled from 5 internal exp. every 2 weeks to 5 exp. /week (130 to 260)
- Cycle 22: an additional 170 internal orbits is requested to monitor the darks at the 2 operational HV after LP3 move

# COS Cycle 22 Calibration and Monitor Orbits Request

Prop. ID	Title	External	Internal	Frequency	Cycle 21 Allocation
<b>FUV Monitors</b>					
	COS FUV Spectroscopic Sensitivity Monitor	26 (10)		10x1 using GD71, 13 using WD0308-565	23 (10)
	COS FUV Detector Dark Monitor		260+170	52x5/wk + 34x5/wk	260
	COS FUV Internal/External Wavelength Scale Monitor	1		1x1	3
	COS Observations of Geocoronal Ly $\alpha$ Emission	2 <sup>†</sup>		See STIS	4 <sup>†</sup>
	COS FUV Gain Maps after HV changes		5 + (3/change)	After HV/LP change	2+(2/change)
	Characterization of HV change effect on sensitivity	2+4		1x1 @ LP3	0
<b>NUV Monitors</b>					
	COS Target Acquisition Monitor	2+(1)		1x1	2+(4)
	NUV Spectroscopic Sensitivity Monitor	6		3x1/(L + M)	6
	NUV Detector Dark Monitor		52	52x1 (2/alt. wk)	52
	NUV Internal/External Wavelength Scale Monitor	3		3x1	3
	NUV MAMA Fold Distribution		1	1x1	1
<b>Contingency programs</b>					
	COS FUV Detector Recovery After Anomalous Shutdown		(17)		(17)
	NUV Detector Recovery After Anomalous Shutdown		(4)		(4)
<b>TOTAL</b>	<b>Cycle 22 Request*</b>	<b>44+(11)+ 2<sup>†</sup></b>	<b>488 + (21) + (3/HV change)</b>		Extern.: 38+(14)+4 <sup>†</sup> Intern.: 316+(21)

† External parallel orbits allocated with a STIS program.

() Contingency orbits not included in Cycle 22 request.

Green indicates “executing this cycle only”

\* Excluding Side 2 programs (see next slide)

# COS Side 2 programs

- Programs will be carried along each cycle's calibration plan (keeping the same ID) so that the impact of any changes to operating conditions (e.g., gyros) can be evaluated and modifications to the programs implemented as needed
  
- **Engineering programs** (22 Internal orbits)
  - 13187 - COS Side 2 Dump Test and Verification of COS Memory Loads - J. Bacinski
  - 13188 - COS Side 2 Science Data Buffer Check/Self-Tests for CS Buffer RAM and DIB RAM - J. Bacinski
  - 13189 - COS Side 2 NUV Detector Recovery After MEB Side Switch - J. Bacinski
  - 13190 - COS Side 2 FUV Detector Recovery After MEB Side Switch - J. Bacinski
  - 13191 - COS Side 2 NUV MAMA Fold Test - J. Bacinski
  
- **Science programs** (7 Internal + 3 External orbits)
  - 13192 - COS Side 2 Initial NUV Checkout - D. Sahnou
  - 13193 - COS Side 2 Initial FUV Checkout - R. Osten
  - 13194 - COS Side 2 Internal NUV Wavelength Verification - S. Lockwood
  - 13195 - COS Side 2 Internal FUV Wavelength Verification - S. Lockwood

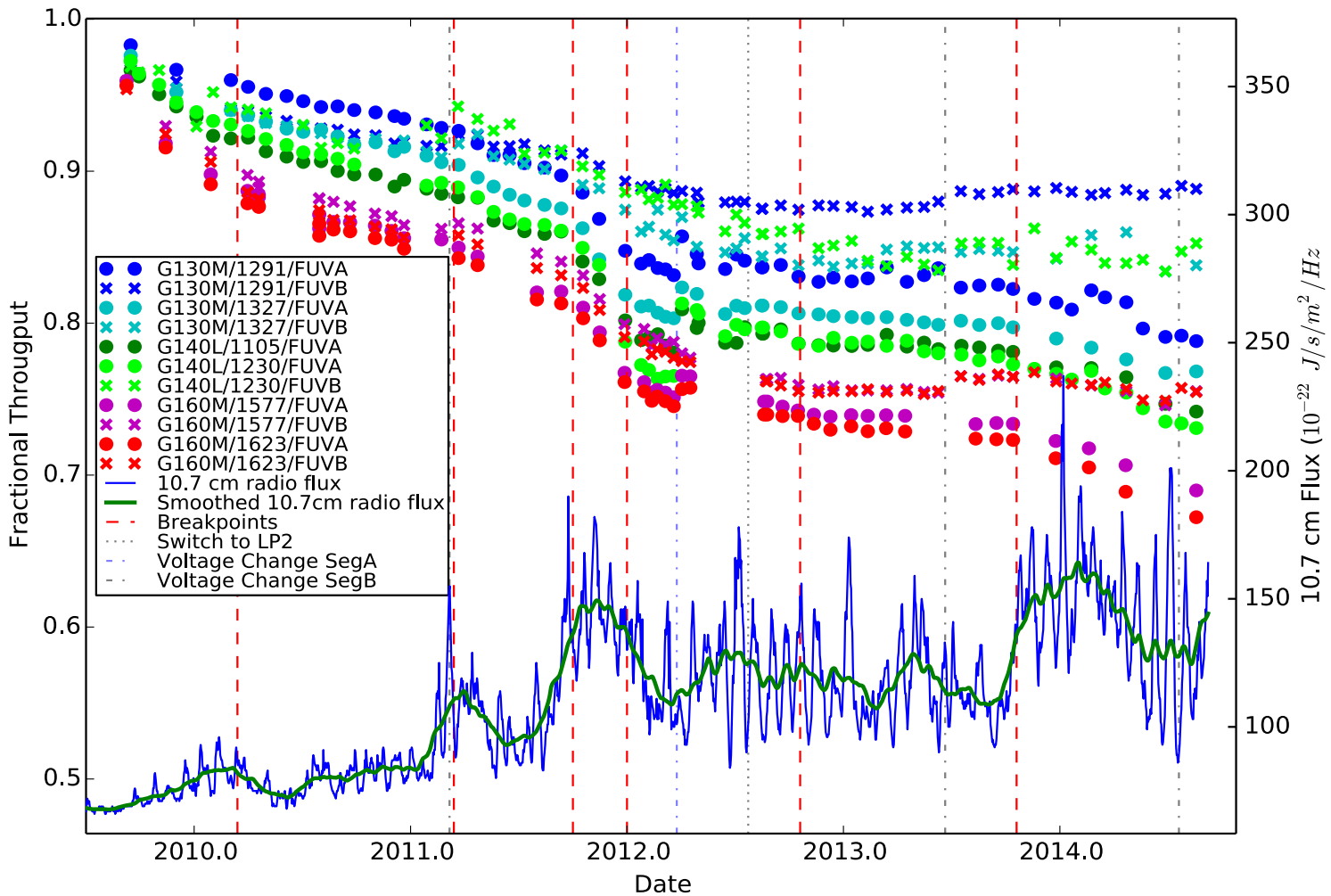
# FUV monitors

# COS FUV Spectroscopic Sensitivity Monitor

## PI: Hugues Sana

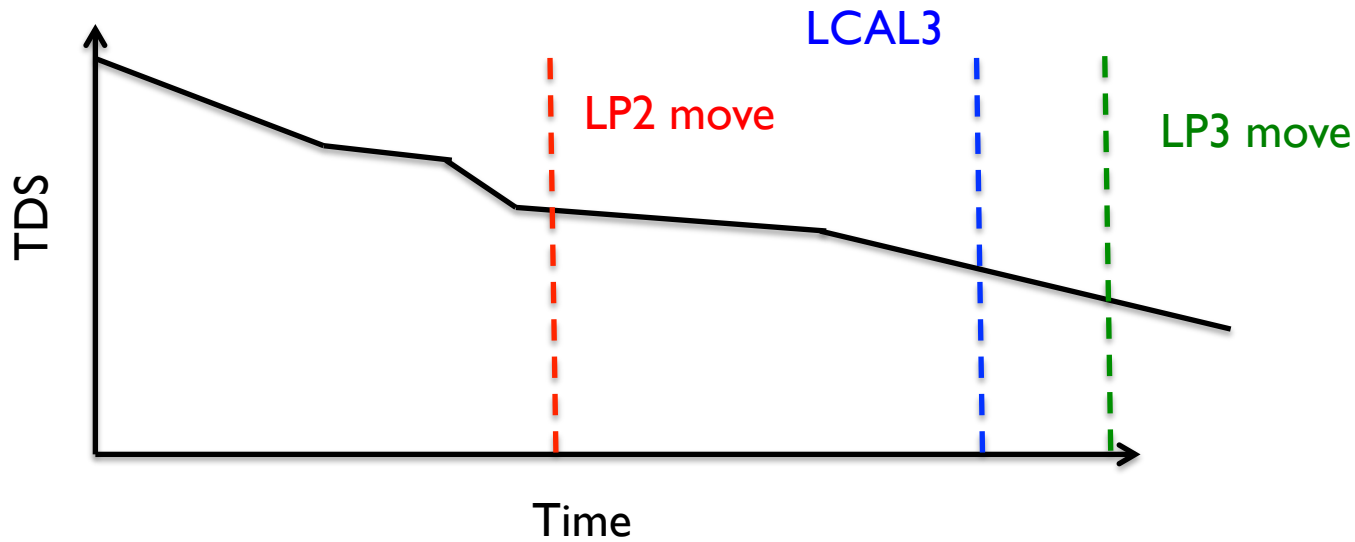
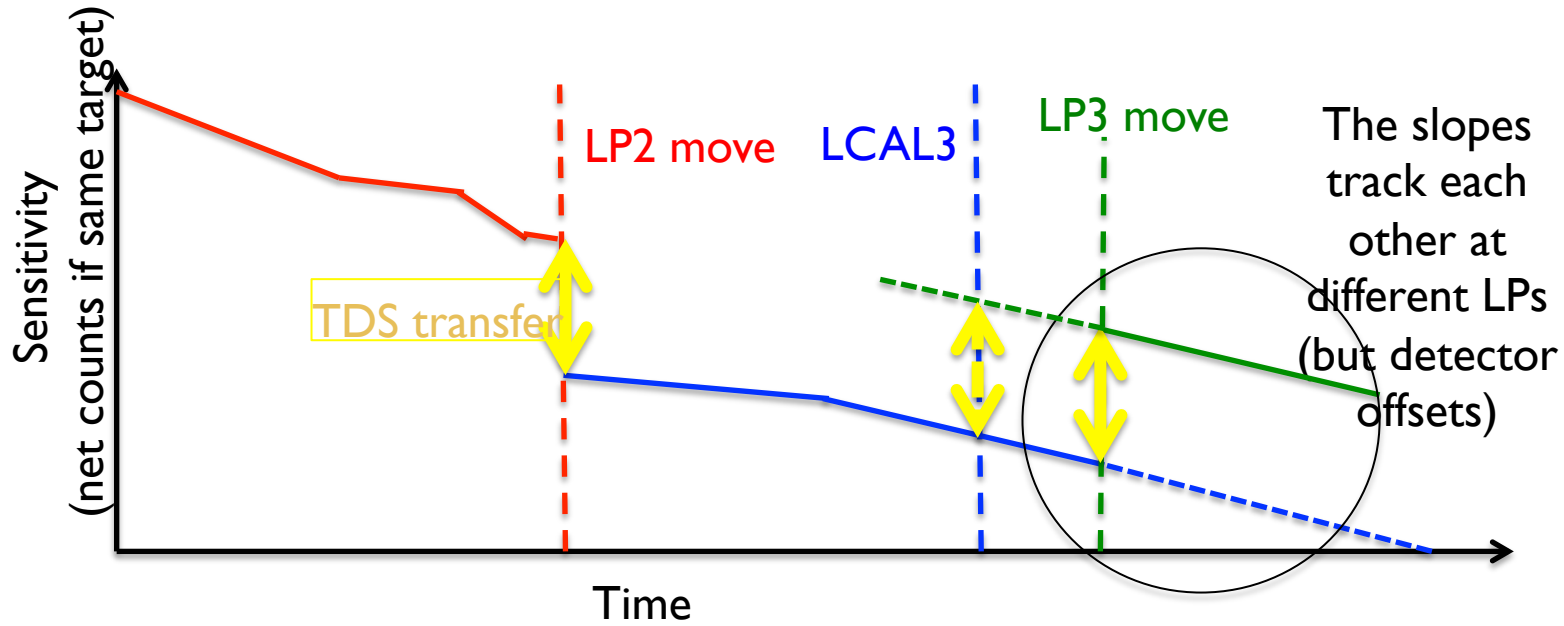
<b>Purpose</b>	Monitor the <b>sensitivity of each FUV grating mode</b> to detect any change due to contamination or other causes. The FUV gratings are the most heavily used modes on COS and have also experienced several changes in the time-dependent spectroscopic sensitivity since launch. These trends appear to be grating-, segment-, and wavelength dependent.
<b>Description</b>	To track the TDS as a function of wavelength we will obtain <b>exposures in all FUV gratings every month</b> . There will be 2 types of monitoring sequences which will occur on alternating months. (i) <b>Full monitoring sequence</b> (every other month except May – Jul when GD71 is unavailable): 3 orbits in 2 visits. The 1 orbit visit (GD71) covers the G130M/1096/FUVB, G160M/1577/FUVA, and G160M/1623/FUVA modes. The 2 orbit visit (WD0308) covers G130M/1222, G130M/1291, G130M/1327, G130M/1055/FUVA, G160M/1577/FUVB, G160M/1623/FUVB, G140L/1105, G140L/1230 modes. These comprise the reddest and bluest central wavelengths of each grating with additional coverage of the G130M blue modes. (ii) <b>Reduced monitoring sequence</b> (in alternating months): 1 orbit visit (WD0308) to monitor the complete wavelength range of the standard modes using one central wavelength per grating. The modes covered are G130M/1291, G160M/1623, and G140L/1230. An additional full sequence (3 orbits) is added compared to C21 to transition the TDS from LP2 to LP3.
<b>Fraction GO/GTO Programs Supported</b>	83% of COS exposure time
<b>Resources Required: Observations</b>	26 external orbits + (10 contingency external orbits)
<b>Resources Required: Analysis</b>	10 FTE weeks
<b>Products</b>	<b>Time-Dependent Sensitivity Reference File</b> as necessary and a summary in the end of cycle ISR
<b>Accuracy Goals</b>	SNR of 15 per resel at wavelength of least sensitivity for the standard modes, SNR of 25 per resel at wavelength of most sensitivity for the blue modes. For the blue modes, this will ensure $S/N > 15$ for $\lambda > 1030 \text{ \AA}$ for 1096/FUVB, $\lambda > 1130 \text{ \AA}$ for 1055/FUVA and 1222/FUVB
<b>Scheduling &amp; Special Requirements</b>	<ul style="list-style-type: none"> <li>Complete monitoring sequence should occur every 2 months starting in December 2014.</li> <li>The reduced monitoring sequence should occur every 2 months starting in November 2014.</li> <li>GD71 is unschedulable May - July 2015.</li> <li>The FUVA turn-off of the GD71 visit should be hidden in the GS-ACQ</li> </ul>
<b>Changes from Cycle 21</b>	<b>1 Full monitoring sequence(3 orbits) added to transition the TDS from LP2 to LP3</b>

# COS TDS Trends



Increased FUVB slopes (but  $< 6\%$ ) since 2013.8

# Reconnecting life time positions



# COS FUV Detector Dark Monitor

## P.I. Justin Ely

<b>Purpose</b>	Perform routine <b>monitoring of FUV XDL detector dark rate</b> . The main purpose is to look for evidence of a change in the dark rate, both to track on-orbit time dependence and to check for a developing detector problem.
<b>Description</b>	<p>Monitor the FUV detector dark rate by taking TIME-TAG science exposures with no light on the detector. <b>Five times every week</b> a 22-min exposure is taken with the FUV detector with the shutter closed. The length of the exposures is chosen to make them fit in Earth occultations. All orbits &lt; 1800s.</p> <p>Adjustments for LP3 multiple HV operations: <b>an additional 5 exposures/week @ the HV used for the G140L setting</b> as long as it operates at a different HV than the M-modes</p>
<b>Fraction GO/GTO Programs Supported</b>	83% of COS total exposure time
<b>Resources Required: Observations</b>	260 internal orbits + 170 additional internal orbits starting at LP3 (# estimate based on LP3 move @Feb 01)
<b>Resources Required: Analysis</b>	4 FTE weeks
<b>Products</b>	Provide ETC and IHB dark rate estimates, along with weekly monitoring for changes and a summary in the end of cycle ISR. Update monitor and COS webpages. As allowed by resources and necessitated by data quality: improve dark subtraction method and update bad-pixel tables.
<b>Accuracy Goals</b>	Obtain enough counts to track <b>1%-level changes on timescales of ~1-3 months</b> .
<b>Scheduling &amp; Special Requirements</b>	<p>At LP2 : 5x / week during Earth occultations.</p> <p>At LP3: 5x / week at nominal HV for M modes and 5x/week at G140L operational HV [also during Earth occultation].</p>
<b>Changes from Cycle 21</b>	Adjusted for LP3 multiple HV operations

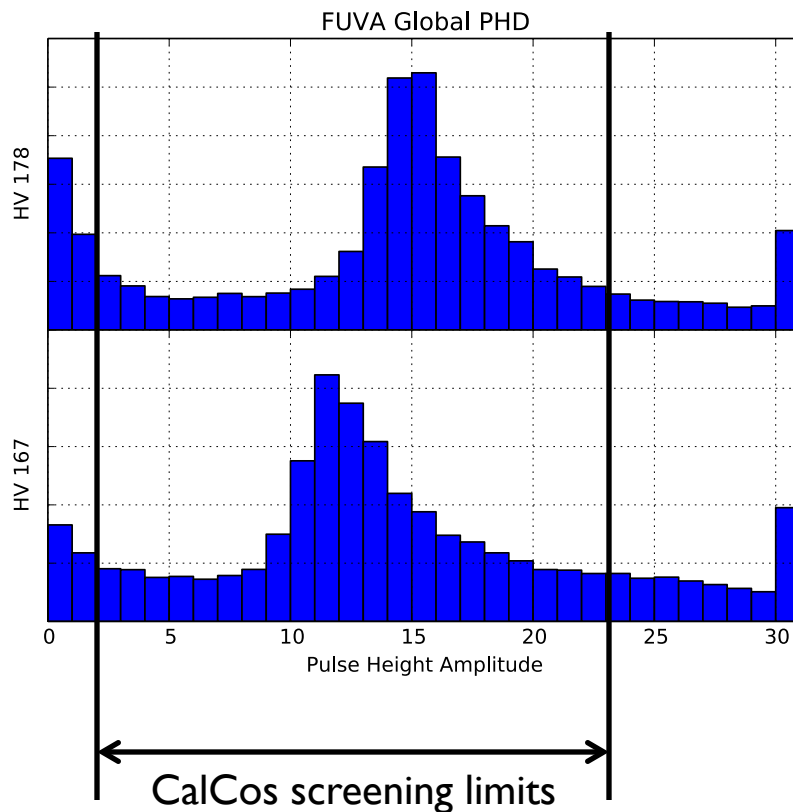
## MOTIVATION for Dark monitoring strategy

- COS FUV background subtraction performed by **pipeline, using regions adjacent to spectrum** to estimate dark rate
- As gain sags in region where spectrum falls, background in regions adjacent to spectrum is **not accurate representation of dark rate under spectrum**
- Not an issue for bright sources, but **impacts background limited observations**
- **Community** working on background limited regime uses COS darks to **build master dark** and use it to subtract background from their data. In order to reach an **accuracy of 1%, 3 months of darks are needed at a rate of 5 darks per week** (master darks build with only 3 months of data as gain changes on larger time scales do not allow 1% accuracy to be reached)
- At LP3, **G140L will start operations at HV level different from other modes**. Request additional 5 darks per week at HV level used for G140L (while different from that of other modes) to support community and to determine impact of HV change on the 2D structure of darks

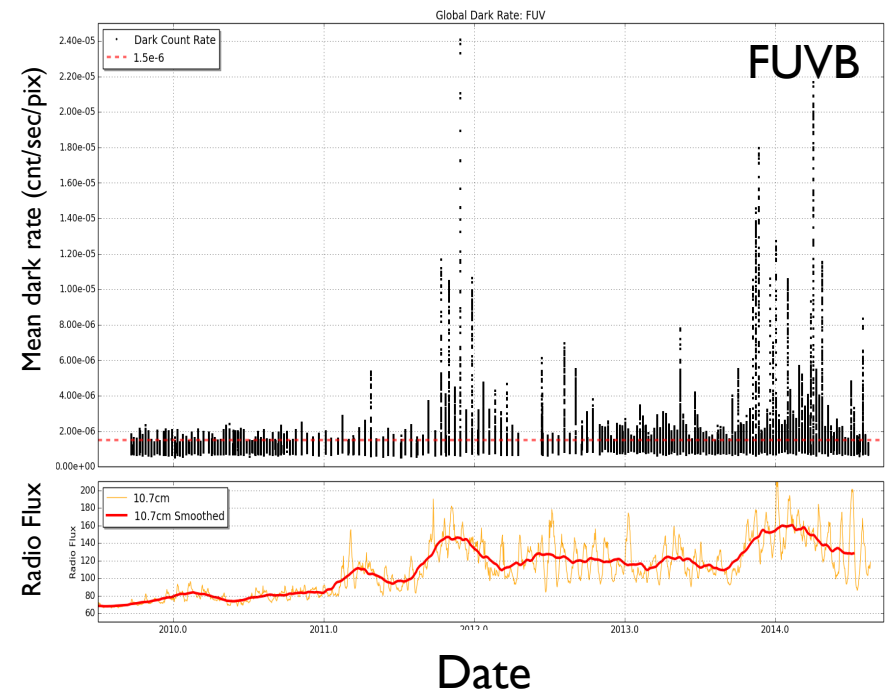
## MOTIVATION for Dark monitoring strategy

- 5x/week cumulated over 2-3 months allows one to reach 1% accuracy on dark level as a function of detector location
- Actively requested by community to enable background limited science
- PHD and (likely) 2D structure impacted by HV change → need to monitor Darks at 2 different HV (M modes + GI40L)

### Impact of HV change on Dark PHA



### Temporal variability of the Dark level



# COS FUV Internal to External Wavelength Scale Monitor

## P.I. Paule Sonnentrucker

<b>Purpose</b>	This program monitors the offsets between the wavelength scale set by the internal wavecal versus that defined by absorption lines in external targets obtained through the PSA.
<b>Description</b>	This program monitors the <b>offset between the internal and external wavelength scales</b> ; this offset is referred to as "DELTA" in the wavelength dispersion reference file and corrects for the shift between the WCA and PSA in TV03 versus the shift between the WCA and PSA in orbit : (WCA-PSA)_TV03 - (WCA-PSA)_orbit. Analysis of TV data indicates that this DELTA (offset) is cenwave and FPPOS independent for a particular grating, but it is grating dependent. To verify and monitor this dependency, this program observes the G130M/1096 and G140L/1105 & 1280 cenwaves at different FPPOS in cycle 22 alone. All orbits > 1800s. Data to monitor the dispersion solutions for some standard modes of G130M and G160M are obtained as part of LP3 calibration effort LCAL2.
<b>Fraction GO/GTO Programs Supported</b>	83% of COS total exposure time.
<b>Resources Required: Observations</b>	1 external orbit > 1800s. Schedulability set to 30%
<b>Resources Required: Analysis</b>	4 FTE weeks
<b>Products</b>	Update of <b>wavelength dispersion reference file</b> if necessary, ISR, and a summary in the end of cycle ISR.
<b>Accuracy Goals</b>	G140L 150km/s, 7.5-12.5 pixels G130M 15km/s, 5.7-7.5 pixels (will be checked using LCAL2 data) G160M 15km/s, 5.8-7.2 pixels (will be checked using LCAL2 data)
<b>Scheduling &amp; Special Requirements</b>	ORIENT for some exposures to avoid bright field targets. These observations are taken <b>once per cycle</b> . External target used is AV75 (target used since Cy 20).
<b>Changes from Cycle 21</b>	1 orbit for monitoring of the G130M/1096 and G140L/1105 & 1280 settings for cycle 22 only. The <b>other standard modes are observed in LCAL2 and will be used for this monitoring</b> .

# COS Observations of Geocoronal Lyman- $\alpha$ emission

## PI: Sean Lockwood

<b>Purpose</b>	To obtain COS G130M spectra of geocoronal Lyman- $\alpha$ and other airglow emission lines with S/N ratios sufficient to trace the line wings of Lyman- $\alpha$
<b>Description</b>	Obtain parallel airglow spectra with COS/FUV to characterize the profile of airglow lines. Visible in G130M/I291: H I 1215.67; O I 1302.2, 1304.9, 1306.0, 1355.6, 1358.5; N I 1199.5-1200.7
<b>Fraction GO/GTO Programs Supported</b>	43% (G130M observations)
<b>Resources Required: Observations</b>	2 external parallel orbits (in parallel with STIS MAMA TDS and focus monitor) in Cy 22 ~0.75% of lifetime at brightest Ly- $\alpha$ pixel for each FP-POS (2 FPPOS used) in Cy 22
<b>Resources Required: Analysis</b>	2 FTE day
<b>Products</b>	Update of the website listing airglow datasets. Observers must reduce these data themselves. Summary in end of cycle ISR
<b>Accuracy Goals</b>	SN = 1.5 per pixel at 1213 A
<b>Scheduling &amp; Special Requirements</b>	Parallel with STIS MAMA TDS monitor. Roll angle must be chosen to avoid objects in the COS PSA or BOA apertures.
<b>Changes from Cycle 21</b>	Requirements have been achieved (10,000s) for 1105, 1291, and 1327 at LP2. In Cy22, we will start accumulating data for 1291 (most used cenwave) at LP3. We plan to continue in future cycles to reach S/N requirement and monitor other cenwave (as done at LP2).

# COS FUV Detector Gain Maps

## PI: David Sahnou

<b>Purpose</b>	Obtain gain maps of the FUV detector before and after changes to the Lifetime Position or nominal high voltage levels, to check that the expected modal gain is achieved, and to constrain dependence of modal gain on HV.
<b>Description</b>	<p>Use the deuterium lamp to illuminate the entire LP2 or LP3 region of the COS FUV detector as follows:</p> <ul style="list-style-type: none"> <li>• At LP2, immediately before the Segment A HV is increased while still operating at LP2</li> <li>• At LP2, immediately after the Segment A HV is increased while still operating at LP2</li> <li>• At LP2, after nominal LP2 operations have ended, using the final LP2 HV levels</li> <li>• At LP3, immediately before nominal LP3 operations begin (at the two LP3 HV levels)</li> <li>• Contingency: At LP2, if additional data is needed to make a gain map for the Blue Modes once nominal operations has shifted to LP3</li> <li>• Contingency: At LP3, before and after any changes to nominal HV levels</li> </ul>
<b>Fraction GO/GTO Programs Supported</b>	83%
<b>Resources Required: Observations</b>	<p>5 internal orbits</p> <p>3 internal contingency orbits</p>
<b>Resources Required: Analysis</b>	Existing CCI / gain map procedures will be used to process these data
<b>Products</b>	Gain map before and after HV change, constrain models of gain vs. HV. Updates to GSAGTAB and BPIXTAB.
<b>Accuracy Goals</b>	0.1 pulse height bin
<b>Scheduling &amp; Special Requirements</b>	Immediately before and immediately after any HV change or LP move
<b>Changes from Cycle 21</b>	Modified to accommodate move to LP3

# COS FUV Detector Gain Maps

## Description of First Contingency Visit

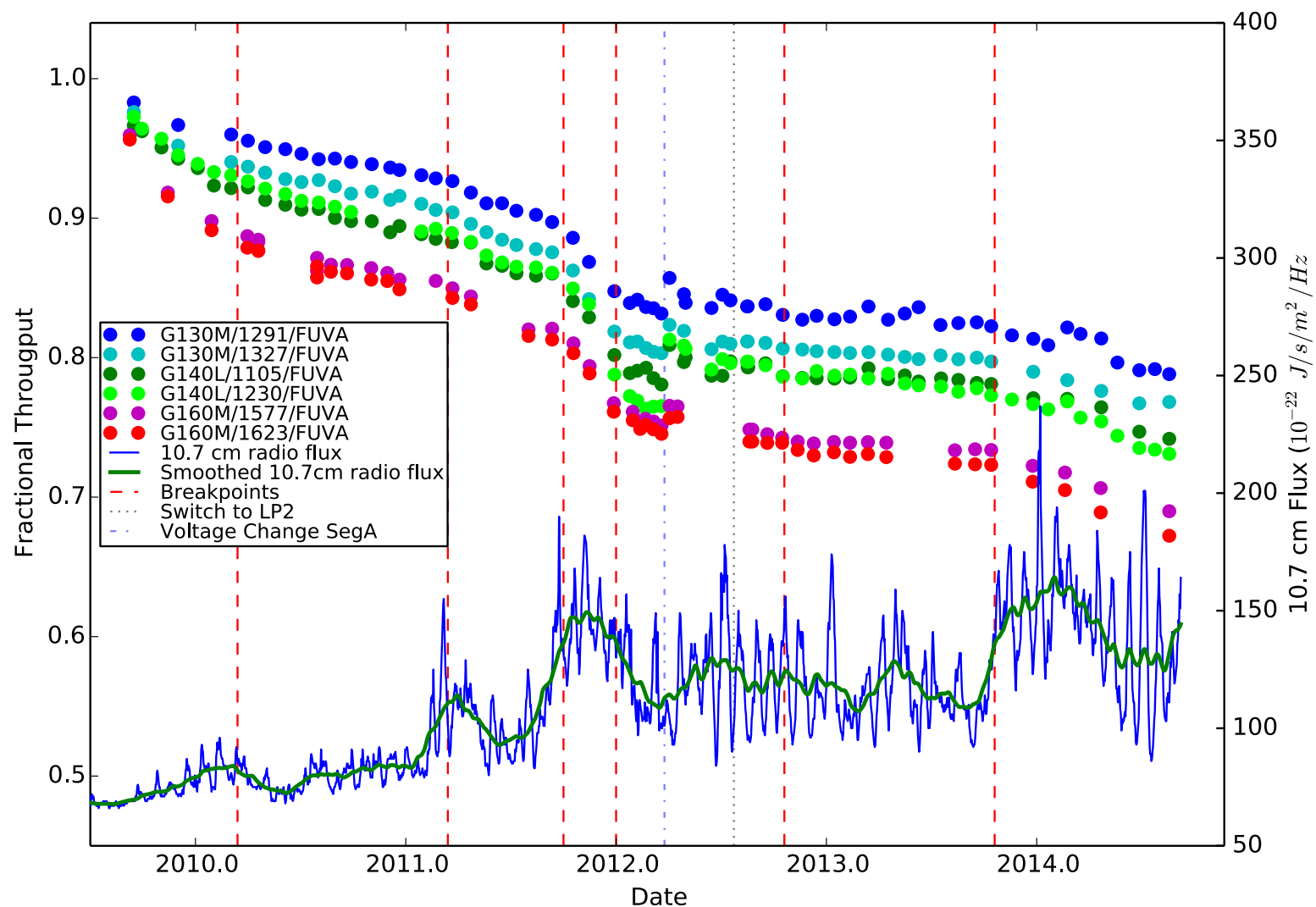
- If Blue Mode usage is low enough so that there are not enough counts in the normal weekly gain maps to derive a bad pixel table, a deuterium exposure will be taken to provide a snapshot of the gain at some point during the Cycle.
- Data important to predict degradation of detector gain and to catch possible issues early

# COS FUV Sensitivity as a function of High Voltage

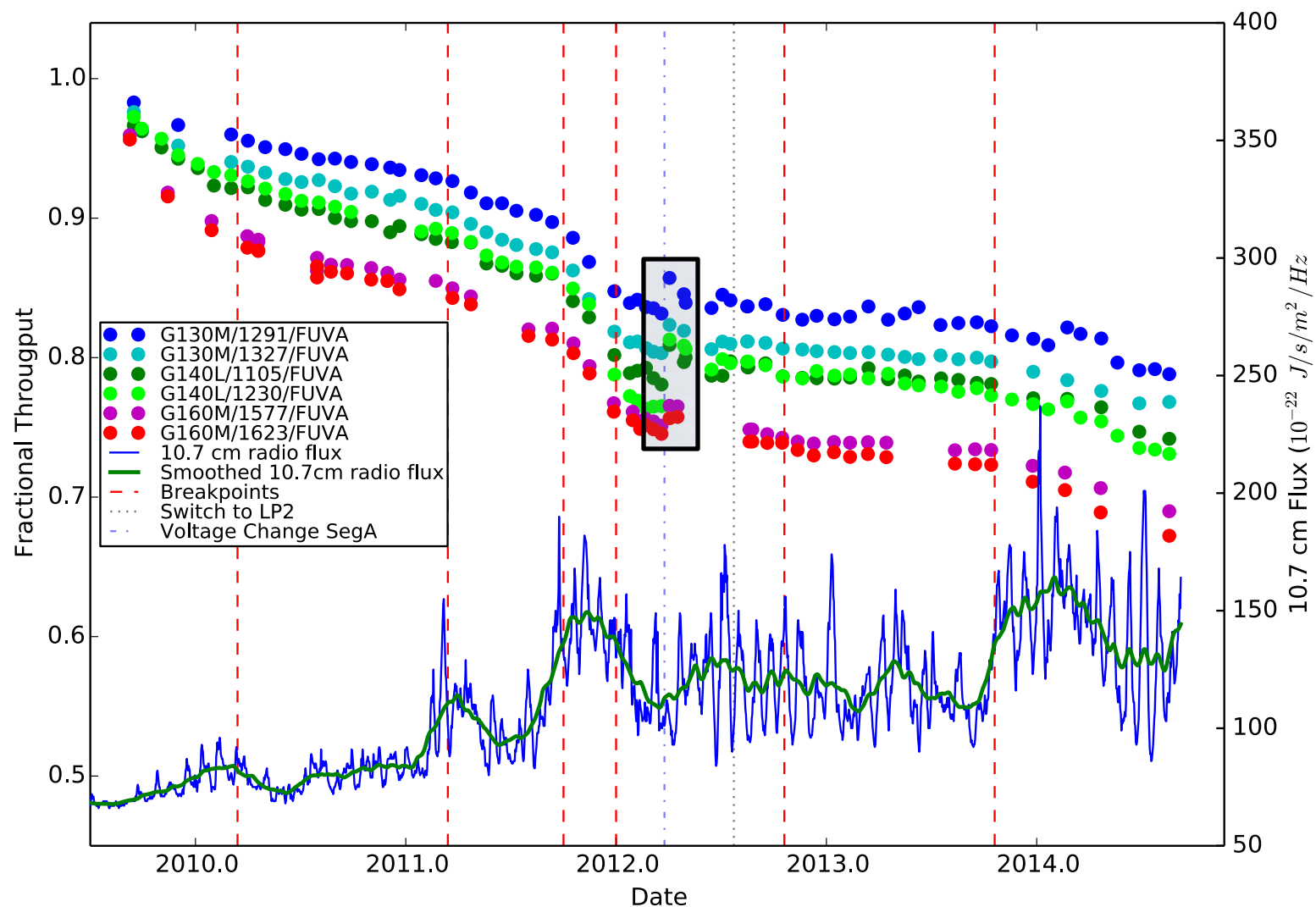
## P.I. David Sahnou

<b>Purpose</b>	Determine <b>the effect of the commanded high voltage on the measured sensitivity</b> . Identify dependencies of this effect on other variables such as detector segment, detector pixel, wavelength, shape of the pulse height distribution.
<b>Description</b>	<p>Measure the effect of the commanded high voltage on the sensitivity by <b>collecting spectra of an external target at a variety of HV levels</b>. Identify other contributing factors by taking similar data with all three gratings. The program will consist of three two-orbit visits. Each visit will obtain data for a single grating and cenwave, but at multiple HV levels to cover the range of voltages used on orbit. No mechanisms will be moved after the initial science exposure, and the voltage will be changed in a semi-random manner – including some repeated values - in order to identify drift or hysteresis effects in the instrument.</p> <p>The first visit will be a proof of concept using G130M/I291. The following two visits will be used to disentangle the dependencies (e.g. pixel vs. wavelength effects) in the measurements. All visits use the TDS target WDO308</p>
<b>Fraction GO/GTO Programs Supported</b>	All FUV exposure
<b>Resources Required: Observations</b>	6 external orbits
<b>Resources Required: Analysis</b>	8 FTE Weeks
<b>Products</b>	Curves of sensitivity as a function of detector high voltage and as a function of some or all of the following: segment, detector x pixel, wavelength, pulse height distribution shape, gain, etc. Eventually provide a new reference file so that CalCOS can include the effect. An ISR will be written + summary for end of cycle ISR
<b>Accuracy Goals</b>	Determine Sensitivity vs. HV to 1%
<b>Scheduling &amp; Special Requirements</b>	<b>First visit (2 orbits) to be scheduled soon after move to LP3</b> in order to sample maximum HV range. Remaining visits will follow after analysis of data from first visit shows the effect is measurable and stable.
<b>Changes from Cycle 21</b>	N/A: this is a new program

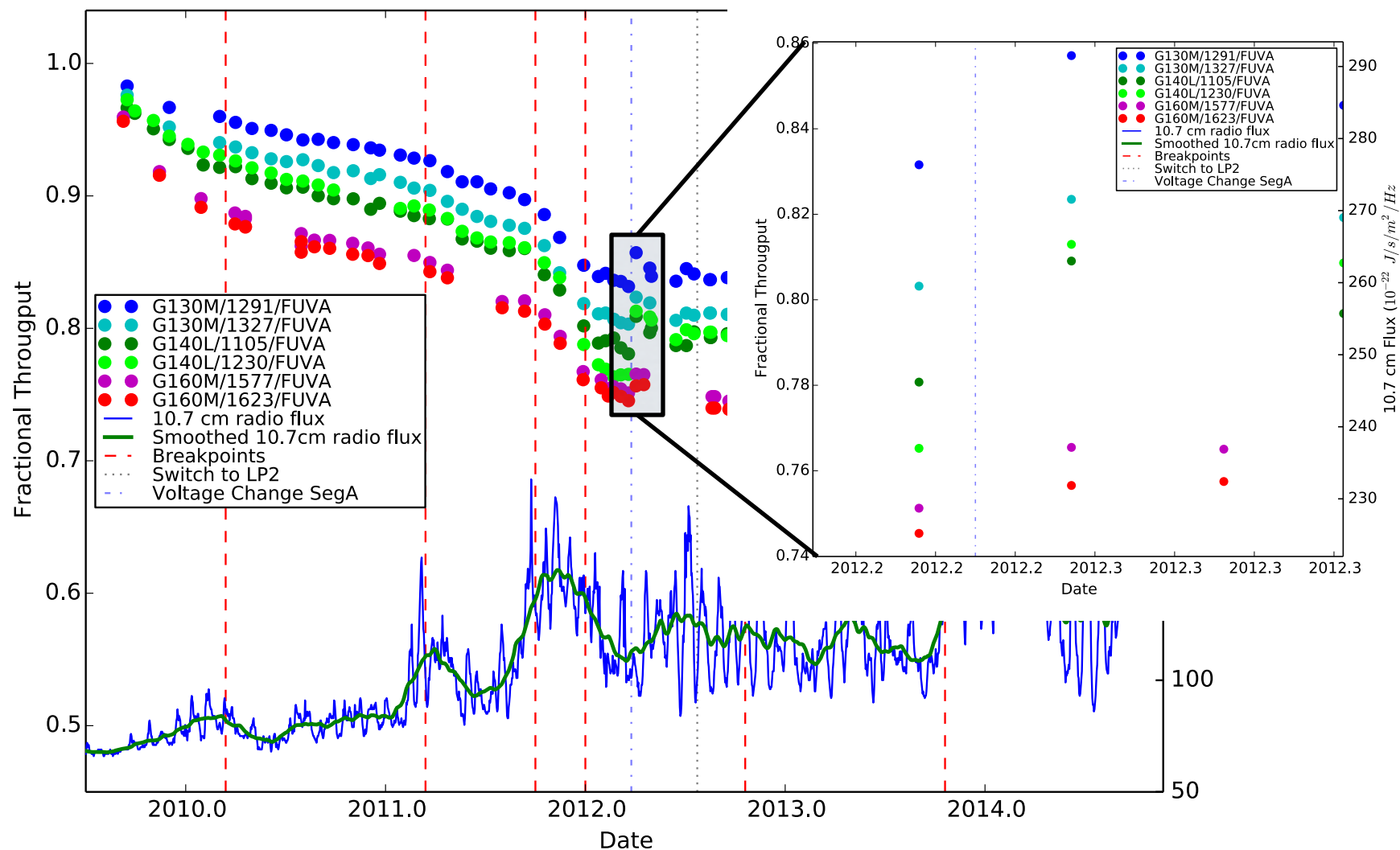
# Throughput vs. Time SegA



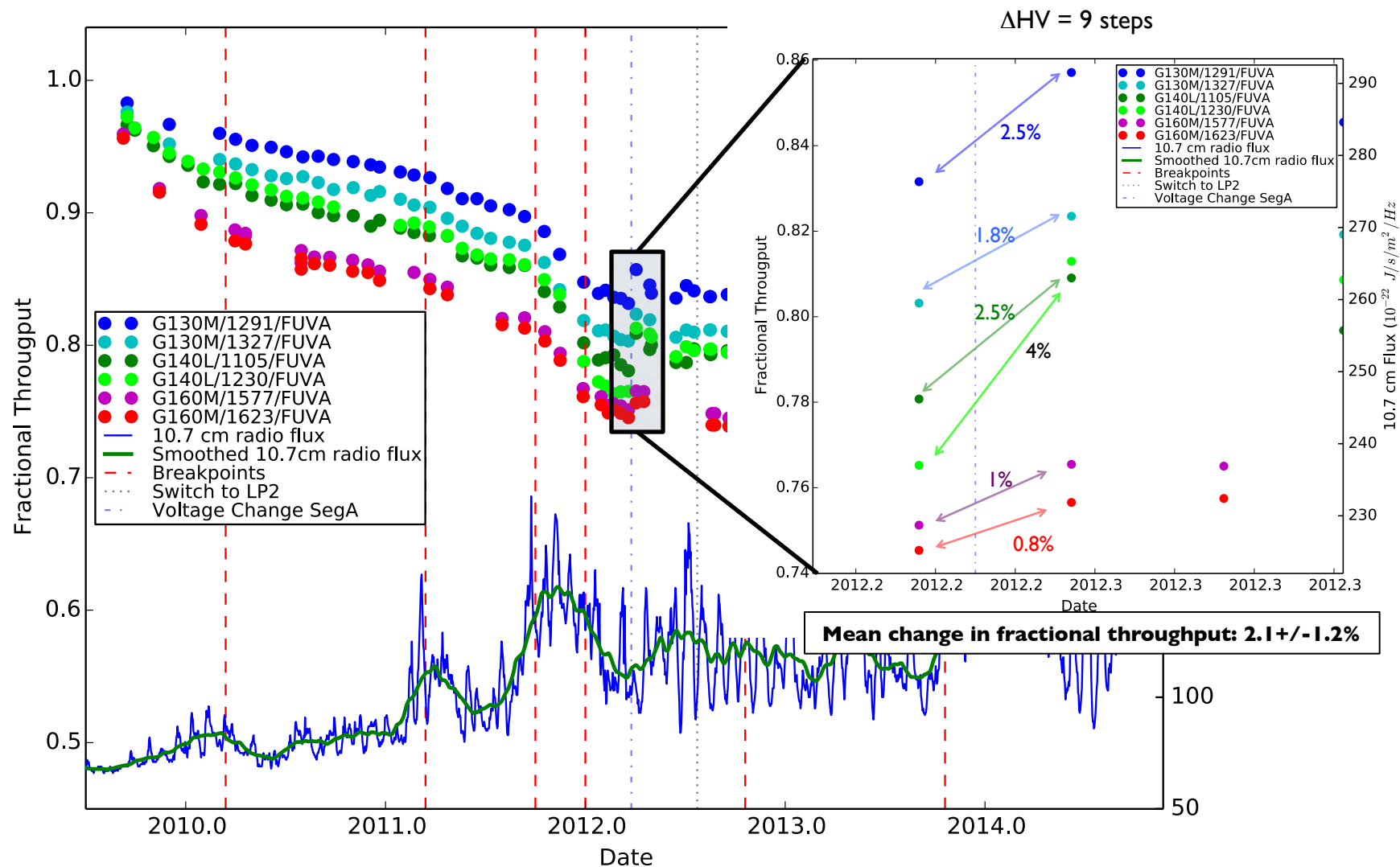
# Throughput vs. Time SegA



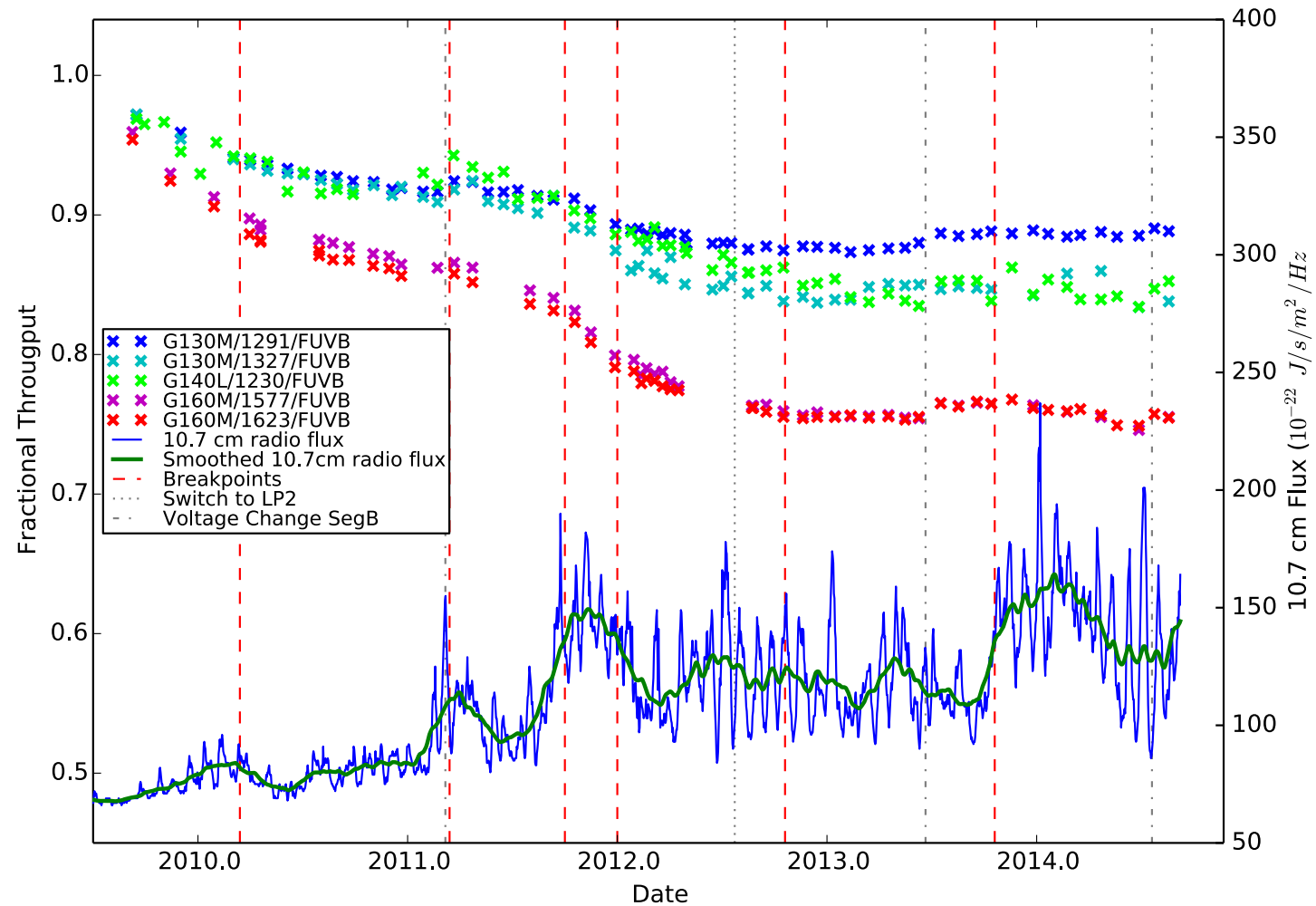
# Throughput vs. Time SegA



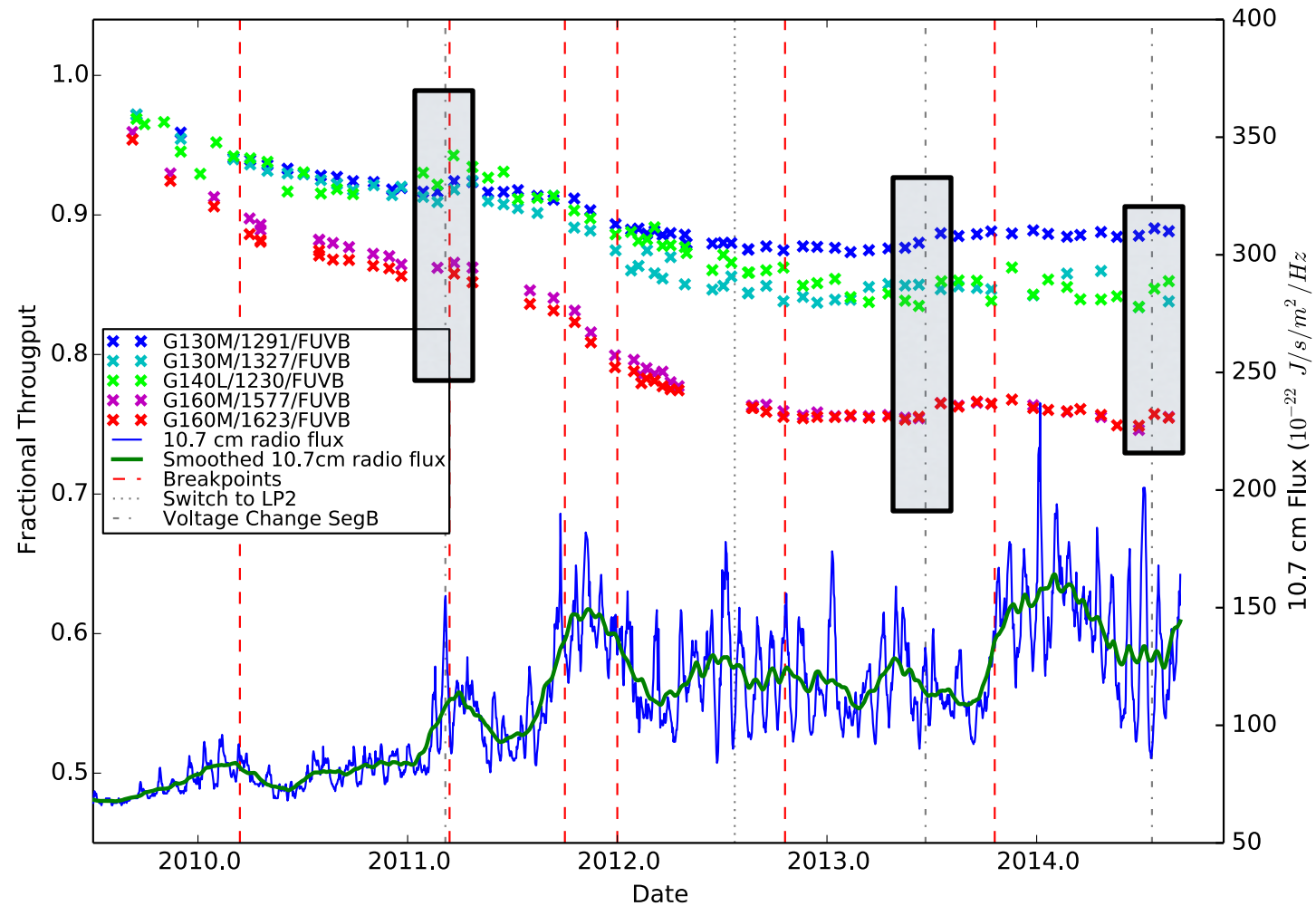
# Throughput vs. Time SegA



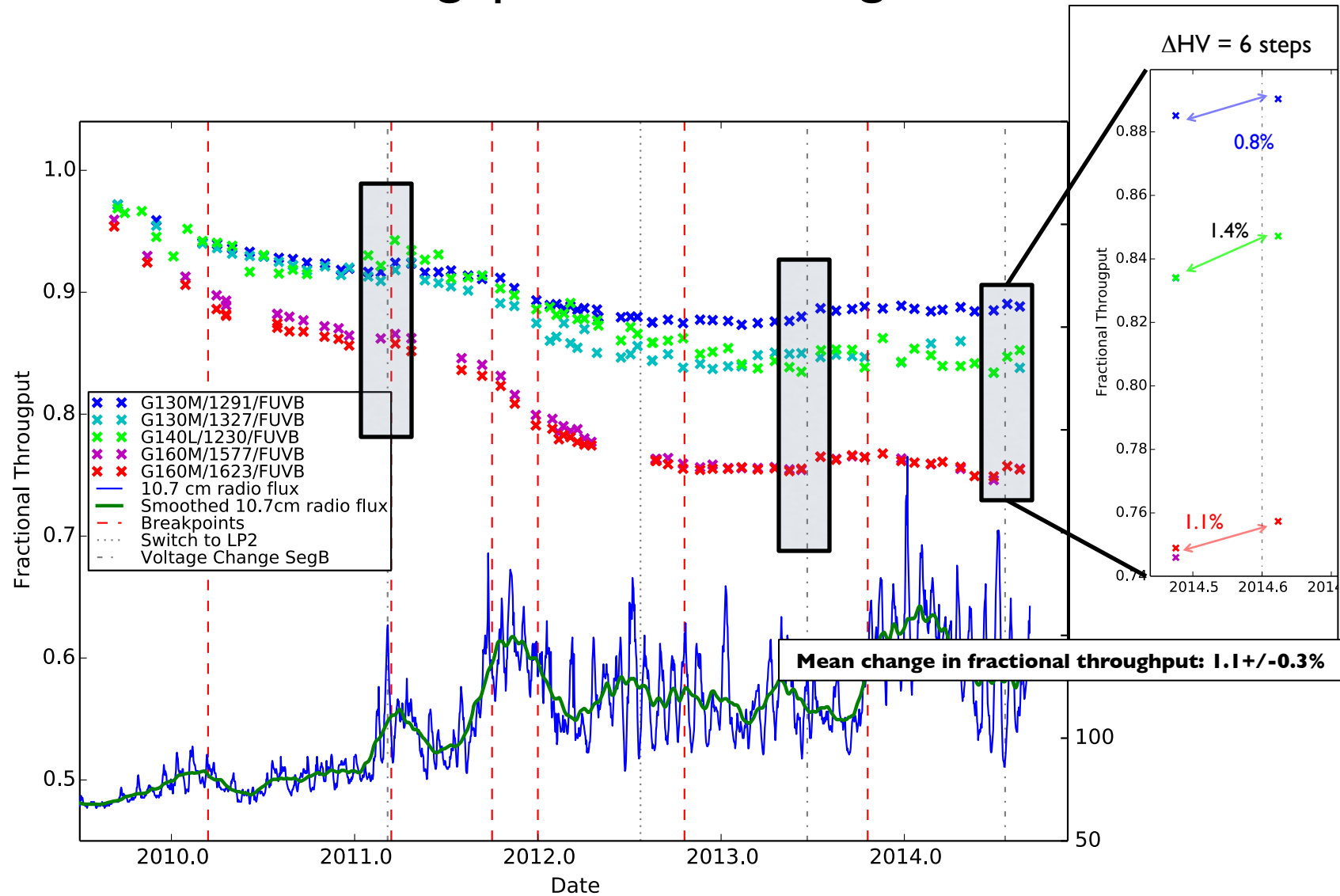
# Throughput vs. Time SegB



# Throughput vs. Time SegB



# Throughput vs. Time SegB



# COS FUV Sensitivity as a function of High Voltage

## MOTIVATION

- The TDS requirement is 2%
- The TDS program has shown that changing the COS FUV HV changes the sensitivity
  - **Systematic effect** – increasing HV increases sensitivity
- Measured changes are as large as 4% and appear to be a function of wavelength
  - **Typical changes are comparable to TDS changes**
- Seems to affect Segment A more than B
- Effect is seen even when PHDs are well separated from zero, so it does not appear to be a gain effect
- So far, we have just smoothed over the discontinuities, but once we move to LP3 and start using multiple HVs simultaneously, this will be more difficult to do.
  - **Significant contribution to the TDS error budget**
- The new HV commanding scheme allows us to make these measurements in an efficient manner.

# COS FUV Sensitivity as a function of High Voltage:

## GOALS

- Measure how the sensitivity changes as a function of commanded high voltage
- Identify and disentangle at least some of the other dependencies (e.g., pixel vs wavelength)
- Measure changes to  $<1\%$ 
  - Part of overall 2% sensitivity calibration requirement

## REQUIREMENTS

- Stable instrument over  $\sim 2$  orbits.
- Stable target – can't use the lamps
- Current HV commanding scheme
- Run at LP3 position soon after the move in order to get maximum gain range.

# COS FUV Sensitivity as a function of High Voltage:

## PROGRAM LAYOUT

Visit 01: obtain overall sense of the **shape of the sensitivity vs voltage curve**, as well as the **repeatability** of the effect

- Schedule within 1 week of a normal TDS visit
- G130M/I291
- WD0308-565 (TDS target with flat SED; COS.sp.395841)
- ~250 second exposures (TDS exposure time)
- 2 orbits / ~11 exposures **to cover the full range of operational HV values** [SegA: 162-178; SegB: 159-175], **+ a few values below, with a 2 step sampling**
- **Repeat some of the HV values to assess repeatability/stability**

Visit 02: obtain sense of **wavelength and spatial (detector position) dependency**

- Schedule only after initial examination of Visit 01 data (6 weeks after execution)
- Schedule within 1 week of a normal TDS visit
- G160M/I623
- WD0308-565 (Lower S/N on Segment B; COS.sp.395848)
- ~350 second exposures (TDS exposure time)
- 2 orbits / ~9 exposures with HV values chosen based on the results of Visit 01

Visit 03: finalize the **wavelength dependency** (as G140L covers the whole wavelength range)

- Schedule only after initial examination of Visit 01 data (6 weeks after execution)
- Schedule within 1 week of a normal TDS visit
- G140L/I280
- WD0308-565 (Full wavelength, but not full pixel coverage; COS.sp.395854)
- ~280 second exposures (TDS exposure time)
- 2 orbits / ~10 exposures with HV values chosen based on the results of Visit 01

# COS FUV Sensitivity as a function of High Voltage:

## ANALYSIS PLAN

After initial visit:

- Plot **count rate as a function of commanded HV for a variety of wavelength bin sizes**
  - Can TDS results be reproduced?
  - How does scatter in points compare to the 1% of the TDS?
  - How does the measured sensitivity at the nominal HV compare to the nearby TDS visits?
- Examine **PHDs as a function of HV**
  - How does the PHD shape change?
  - What fraction of counts are in the low PH tail?
  - Ensure extraction windows are not affected by LPI gain sag

After later visits:

- Repeat previous analysis
- **Separate dependencies on other variables (wavelength, x pixel, etc.)**
- Determine how to best apply the derived correction to the data

## OTHER USE OF THE DATA

Measure/verify the **walk correction at LP3.**

- Since the lamp can not be moved to LP3, it can only be tested with an external target

# NUV monitors

# COS Target Acquisition Monitor

## P.I. Steve Penton

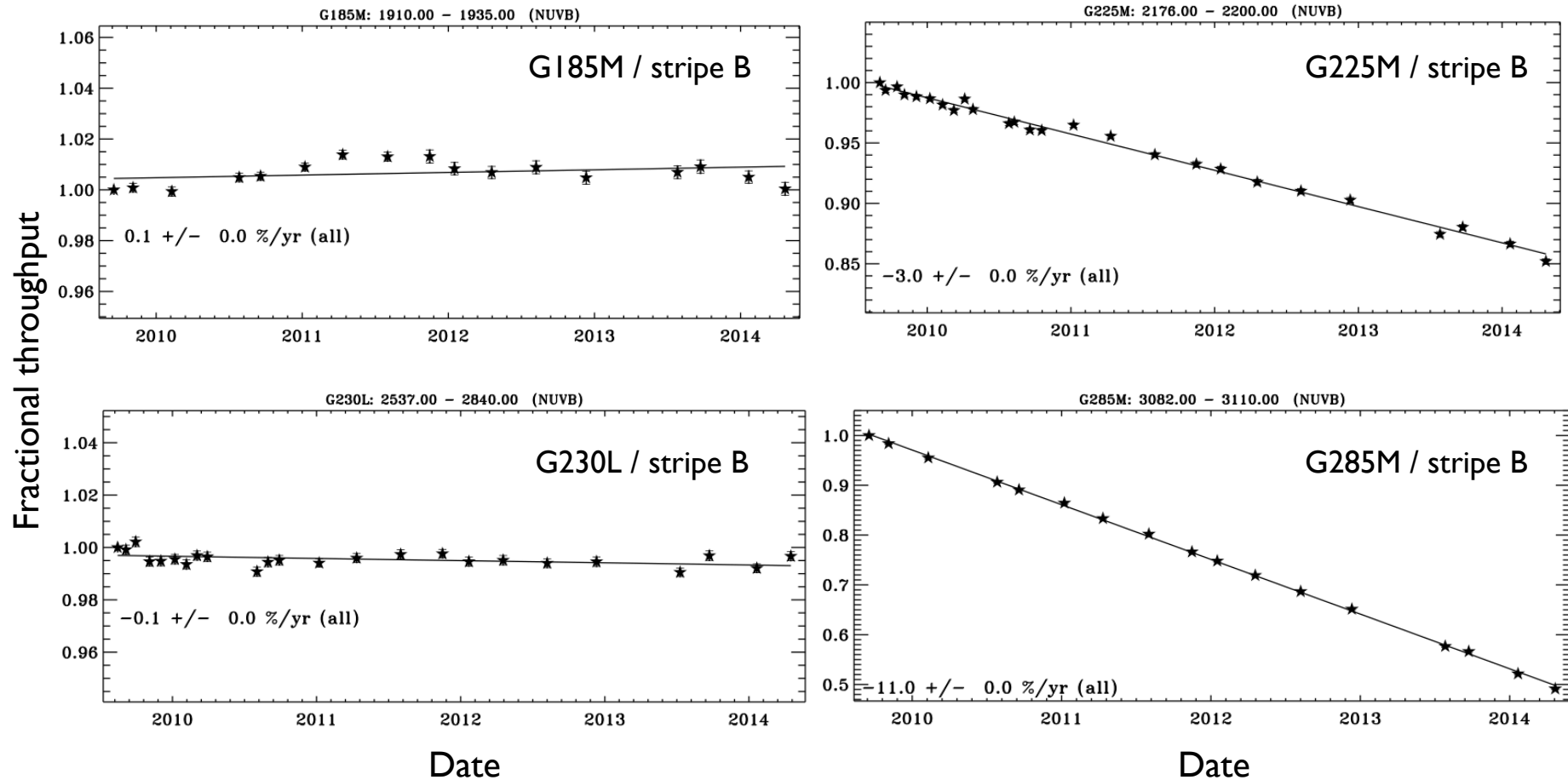
<b>Purpose</b>	Measure/monitor the <b>WCA-to-PSA and WCA-to-BOA offsets</b> used for target acquisitions (both IMAGING and SPECTROSCOPIC).
<b>Description</b>	There are <b>four NUV ACQ/IMAGE mechanism combinations</b> : 2 science apertures ( <b>PSA &amp; BOA</b> ) x 2 mirror modes ( <b>MIRRORA &amp; MIRRORB</b> ). During SMOV, the WCA-to-PSA+MIRRORA offset was determined by an aperture scan; the other offsets were bootstrapped from this offset. In Cycle 20, changes in the PSA+MIRRORA-to-PSA+MIRRORB offset were detected in the Focal Plane Calibration (SI-FGS Alignment) program (13171). This, and the background-related issues with MIRRORB ACQ/Images, motivates the need to monitor all WCA-ScienceAperture offsets. This program <b>repeats the SMOV process for ACQ/IMAGE co-alignment</b> (without the aperture scan). In addition, this program <b>obtains spectra of the centered targets with all COS gratings</b> to track any changes in the spectroscopic WCA-to-Science Aperture offsets used for spectroscopic target acquisitions.
<b>Fraction GO/GTO Programs Supported</b>	~100% of COS total exposure time (all COS exposures with target acquisitions depend on WCA-to-Scientific Aperture offsets)
<b>Resources Required: Observations</b>	2 external one-orbit visits + 1 external orbit contingency visit. <b>Visit 1</b> : WD1657+343 is used to <b>co-align the PSA/MIRRORB and BOA/MIRRORA</b> modes. <b>Visit 2</b> : HD66578 is used to <b>co-align the BOA/MIRRORA and BOA/MIRRORB</b> modes. <b>Contingency visit</b> : 206W3 would be used to <b>co-align the PSA/MIRRORA and PSA/MIRRORB</b> modes. The PSA+MIRRORA and PSA+MIRRORB co-alignment is periodically tested in the HST SI-to-FGS verification program (13616 in C21). We rely upon these observations as our verification of the PSA+MIRRORB alignment upon which the other combinations are bootstrapped. If for some reason this program has not been run as scheduled (twice a year), a contingency visit would be needed to measure the PSA+MIRRORA-to-PSA+MIRRORB offset.
<b>Resources Required: Analysis</b>	4 FTE weeks for analysis, creating new offsets, and writing an ISR.
<b>Products</b>	Updated <b>NUV imaging WCA-to-Science Aperture offsets, NUV &amp; FUV Spectroscopic WCA-to-Science Aperture offsets</b> , summary in end of cycle ISR
<b>Accuracy Goals</b>	Imaging WCA-to-Science Aperture offsets should be known to better than 0.5 NUV pixels in both dispersion and cross-dispersion. Spectroscopic WCA-to-Science Aperture offsets also need to be known to 0.5 XD pixel.
<b>Scheduling &amp; Special Requirements</b>	Annually.
<b>Changes from Cycle 21</b>	None

# COS NUV Spectroscopic Sensitivity Monitor

## PI: Jo Taylor

<b>Purpose</b>	Monitor sensitivity of each NUV grating mode to detect any change due to contamination or other causes. The NUV gratings on COS degrade with a rate that has been steady since the start of on-orbit operations, with the bare-Aluminum grating degrading at a faster rate (~3 and 11%/yr) than the MgF coated gratings (~0%/yr). Additionally, track the time dependence of the sensitivity as a function of wavelength.
<b>Description</b>	Obtain exposures in all NUV gratings – G230L (target: WD1057+719), G185M, G225M, and G285M (target: G191828) – 3 times a year. We will monitor the following modes: G230L/2635, G230L/2950, G185M/1786, G185M/1921, G225M/2186, G285M/2617, and G285M/3094. These central wavelengths constitute the reddest and bluest central wavelengths containing only first order light with the exception of the G225M which was unused in Cycles 19 and 20 and was minimally used in Cycles 21. NUV trends are stable, therefore we will continue to monitor the central wavelengths used in previous cycles.
<b>Fraction GO/GTO Programs Supported</b>	17% of COS exposure time
<b>Resources Required: Observations</b>	6 external orbits
<b>Resources Required: Analysis</b>	5 FTE weeks
<b>Products</b>	Time-Dependent Sensitivity Reference File and a summary in the end of cycle ISR. As permitted by resources and data quality: add wavelength dependence to TDS reference files
<b>Accuracy Goals</b>	Characterize evolution of TDS within 2% .
<b>Scheduling &amp; Special Requirements</b>	Space observations at 4 month intervals
<b>Changes from Cycle 21</b>	None

# COS NUV TDS trends



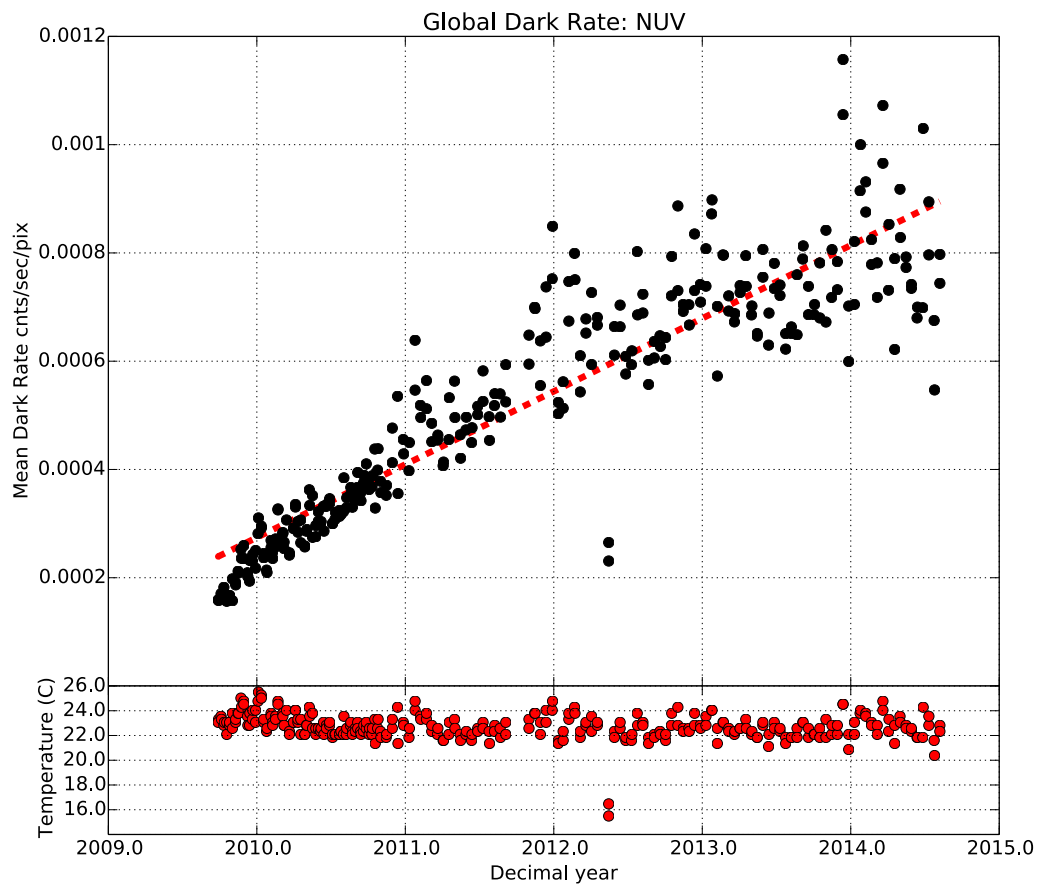
Stable and linear since SM4

# COS NUV Detector Dark Monitor

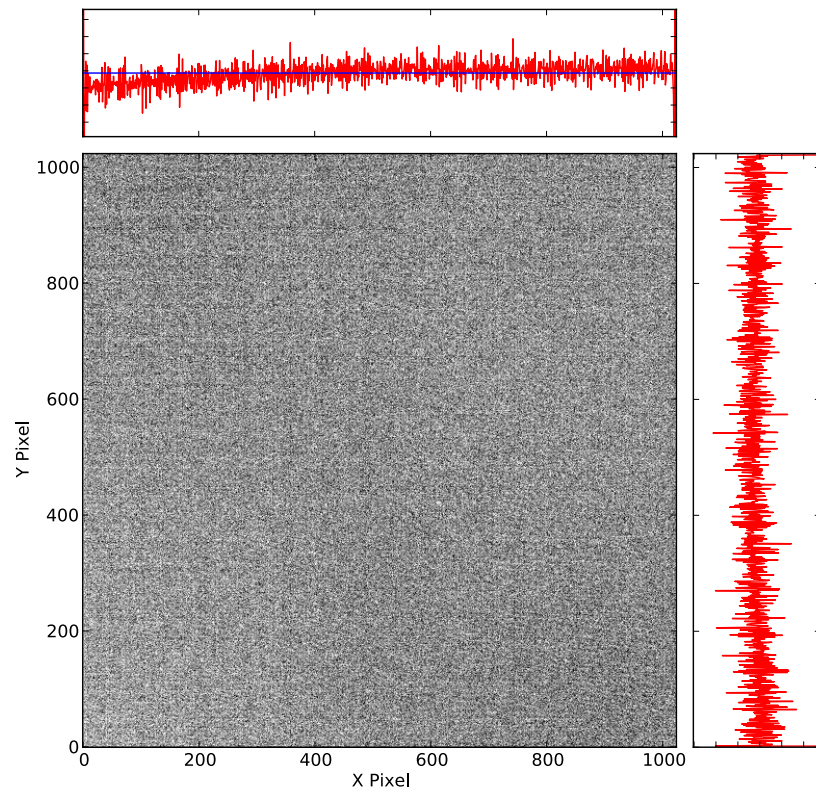
## P.I. Justin Ely

<b>Purpose</b>	<b>Perform routine monitoring of MAMA detector dark current.</b> The main purpose is to look for evidence of a change in the dark, both to track on-orbit time dependence and to check for a developing detector problem.
<b>Description</b>	Monitor the NUV detector dark rate by taking TIME-TAG science exposures without illuminating the detector. Twice every other week a 22-min exposure is taken with the NUV (MAMA) detector with the shutter closed. The length of the exposures is chosen to make them fit in Earth occultation. All orbits < 1800s.
<b>Fraction GO/GTO Programs Supported</b>	17% of COS total exposure time.
<b>Resources Required: Observations</b>	52 internal orbits
<b>Resources Required: Analysis</b>	4 FTE weeks
<b>Products</b>	<b>Provide ETC and IHB dark rate estimates, along with weekly monitoring</b> for changes and a summary in the end of cycle ISR. As allowed by resources and necessitated by data quality: update bad-pixel tables. Update monitor webpage
<b>Accuracy Goals</b>	30%
<b>Scheduling &amp; Special Requirements</b>	Twice every other week, in earth occultation
<b>Changes from Cycle 21</b>	None

# NUV Dark Current Plots



Spatial Variation  
All darks to date



# COS NUV Internal to External Wavelength Scale Monitor

## P.I. Paule Sonnentrucker

<b>Purpose</b>	This program monitors the offsets between the wavelength scale set by the internal wavecal versus that defined by absorption lines in external targets obtained with the PSA.
<b>Description</b>	This program monitors the <b>offsets between the internal and external wavelength scales</b> : this offset is referred to as “DELTA” in the wavelength dispersion reference file and corrects for the shift between the WCA and PSA in TV03 versus the shift between the WCA and PSA in orbit: (WCA-PSA)_TV03 - (WCA-PSA)_orbit. Analysis of TV data indicates that this DELTA is cenwave and FP-POS independent for a particular grating, but it is grating and stripe dependent. To verify and monitor this dependency, this program observes some cenwaves at different FP-POS. All orbits > 1800s.
<b>Fraction GO/GTO Programs Supported</b>	17 % of COS total exposure time.
<b>Resources Required: Observations</b>	3 external orbits and all orbits > 1800s.
<b>Resources Required: Analysis</b>	3 FTE weeks
<b>Products</b>	<b>Update to wavelength dispersion reference file</b> as needed, ISR, and a summary in the end of cycle ISR.
<b>Accuracy Goals</b>	G230L 175km/s, 2.0-3.7 pixels G185M 15km/s, 1.7-2.4 pixels G225M 15km/s, 2.3-3.2 pixels G285M 15km/s, 2.3-3.5 pixels
<b>Scheduling &amp; Special Requirements</b>	These observations are taken <b>every 4 months</b> . External target is HD6655 (target used since Cy 17)
<b>Changes from Cycle 21</b>	No changes

# COS NUV MAMA Fold Distribution

## P.I. Thomas Wheeler

<b>Purpose</b>	The fold analysis provides a measurement of the <b>distribution of charge cloud sizes incident upon the anode</b> providing some measure of changes in the pulse-height distribution of the MCP and, therefore, MCP gain.
<b>Description</b>	While globally illuminating the detector with a flat field the valid event (VE) rate counter is monitored while various combinations of row and column folds are selected.
<b>Fraction GO/GTO Programs Supported</b>	All NUV observations (17% of COS time)
<b>Resources Required: Observations</b>	1 internal orbit
<b>Resources Required: Analysis</b>	0.5 FTE day.
<b>Products</b>	The results will be sent to the COS Team and V.Argabright.
<b>Accuracy Goals</b>	
<b>Scheduling &amp; Special Requirements</b>	This proposal is <b>executed annually</b> .
<b>Changes from Cycle 21</b>	None

# Contingency programs

# COS FUV Detector Recovery after Anomalous Shutdown

## P.I. Thomas Wheeler

<b>Purpose</b>	The <b>safe and orderly turn-on and ramping-up the COS FUV high voltage</b> in a conservative manner after a HV anomalous shutdown.
<b>Description</b>	Day 01 activities, visits 01-07, contain both QE grid off and on HV ramping to HVLow (100/100) with diagnostics (DCE dumps) and darks to exclude QE grid involvement in the shutdown. Subsequent to day 01, all HV rampings, diagnostics and darks will be with the QE grid on. The HV commanded values for the subsequent days are: 154/151, 160/157, 167, 163, etc. until the desired HV is obtained.
<b>Fraction GO/GTO Programs Supported</b>	83% of COS exposure time
<b>Resources Required: Observations</b>	17 internal orbits
<b>Resources Required: Analysis</b>	If activated, 0.5 FTE day per test.
<b>Products</b>	After thorough data analysis for each test day, a Go/No-Go to proceed will be given.
<b>Accuracy Goals</b>	
<b>Scheduling &amp; Special Requirements</b>	This is a contingency proposal activated only in the event of an anomalous shutdown.
<b>Changes from Cycle 21</b>	None

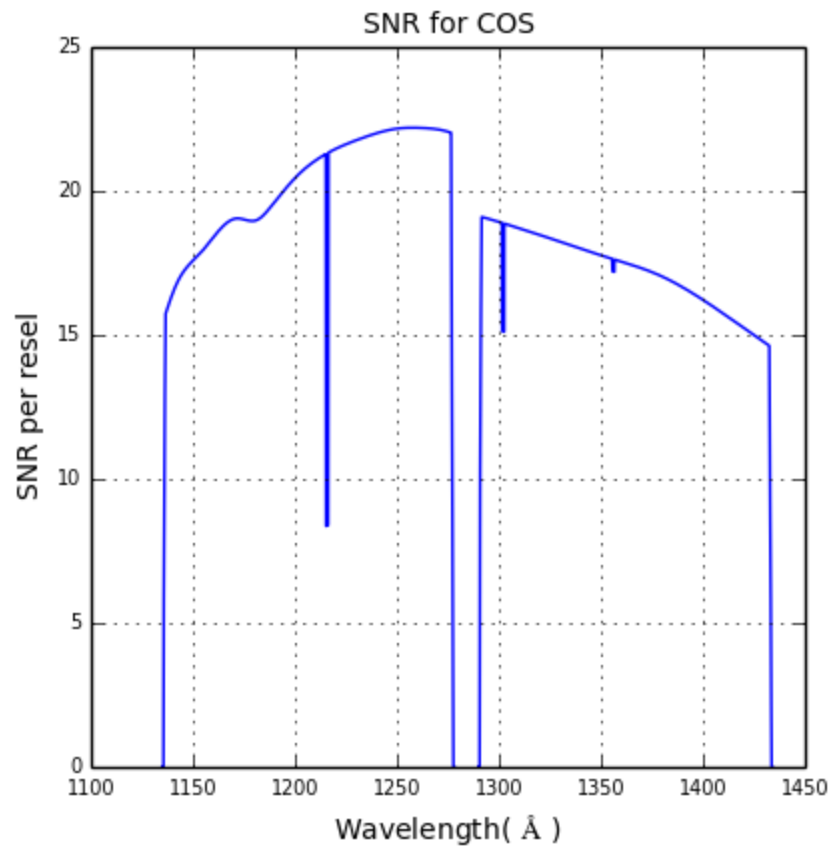
# COS NUV Detector Recovery after Anomalous Shutdown

## P.I. Thomas Wheeler

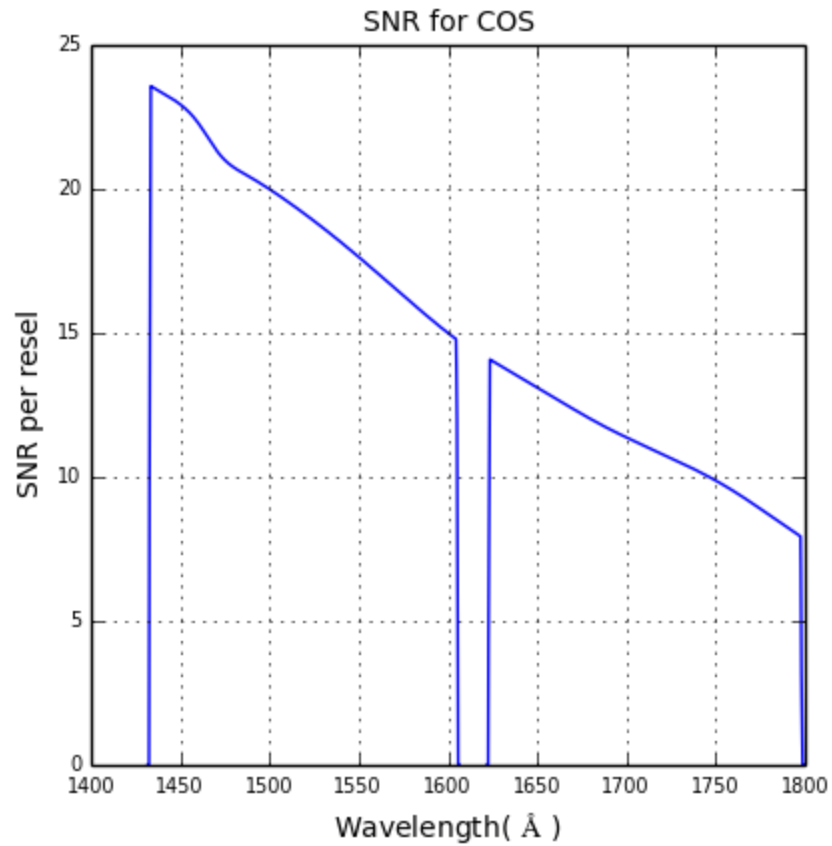
<b>Purpose</b>	The <b>safe and orderly recovery of the NUV-MAMA detector</b> after an anomalous shutdown.
<b>Description</b>	The recovery procedure consists of four separate tests (i.e. visits) to check the MAMA's health after an anomalous shutdown. Each must be successfully completed before proceeding onto the next. They are: (1) signal processing electronics check, (2) slow, intermediate voltage high-voltage ramp-up, (3) ramp-up to full operating voltage, and (4) fold analysis test.
<b>Fraction GO/GTO Programs Supported</b>	17% of COS exposure time
<b>Resources Required: Observations</b>	4 internal orbits
<b>Resources Required: Analysis</b>	If activated, 0.5 FTE day per visit.
<b>Products</b>	For tests 1-3, only a Go/No-Go to proceed will be given. For test 4, the results will be sent to the COS/STIS Team and V. Argabright.
<b>Accuracy Goals</b>	
<b>Scheduling &amp; Special Requirements</b>	This is a contingency proposal activated only in the event of an anomalous shutdown.
<b>Changes from Cycle 21</b>	None

**Additional slides**

# GI30M/I29I S/N (COS.sp.39584I)



# GI 60M/I 623 S/N (COS.sp.395848)



# GI40L/I280 S/N (COS.sp.395854)

