16333 - Cycle 28 COS FUV Characterization of Modal Gain When Changing High Voltage

Cycle: 28, Proposal Category: CAL/COS

(Availability Mode: RESTRICTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
2A	DARK DEUTERIUM NONE	COS COS/FUV S/C	1	09-Sep-2021 09:00:17.0	yes
2C	DARK DEUTERIUM NONE	COS COS/FUV S/C	1	09-Sep-2021 09:00:19.0	yes
3A	DARK DEUTERIUM NONE	COS COS/FUV S/C	1	09-Sep-2021 09:00:20.0	yes
3C	DARK DEUTERIUM NONE	COS COS/FUV S/C	1	09-Sep-2021 09:00:22.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
4A	DARK DEUTERIUM NONE	COS COS/FUV S/C	1	09-Sep-2021 09:00:23.0	yes
4C	DARK DEUTERIUM NONE	COS COS/FUV S/C	1	09-Sep-2021 09:00:25.0	yes

6 Total Orbits Used

ABSTRACT

This program uses the deuterium lamp to illuminate the regions of the detector being used to collect spectra during Cycle 28. The data obtained will be used to create gain maps of the detector. Because of the strongly varying intensity of the lamp as a function of wavelength, G130M/1309 data will be obtained for Segment A, and G160M/1600 will be used for Segment B.

Gain map data will be obtained both before and after any change is made to any nominal high voltage value on either segment, and before and after any lifetime move. Obtaining a gain map at these times will help to improve the modeling of the modal gain as a function of time and extracted charge, since it will provide data that cover the full time span of each high voltage at each LP. Improving these models will allow better predictions of the future lifetime of the detector.

OBSERVING DESCRIPTION

This program will obtain spectra from the deuterium lamp with enough counts to permit the construction of a gain map covering the region where the spectra fall. In order to efficiently illuminate the two segments, the G130M/1309 setting will be used for Segment A, and G160M/1600 will be used for Segment B. Both segments can safely remain on with either setting.

Gain maps should be taken before and after any high voltage change, and before and after any change in Lifetime Position. They should be obtained at the appropriate HV levels and detector locations.

The plan for Cycle 28 includes 2 one-orbit contingency visits for each HV change. These two visits will be used if a HV change is made during the cycle. One will be taken immediately before the change using the current HV values (visits 2A, 3A, or 4A), and one will be taken after at the new

values (visits 2C, 3C, or 4C).

The procedure for collecting this data in each visit is:

* Adjust the HV values if necessary.

* Adjust the aperture in the cross dispersion direction so that the deuterium lamp will illuminate the appropriate region on Segment A when using G130M/1309.

* Take a 440 second deuterium lamp exposure using both detector segments.

* Adjust the aperture to a second cross-dispersion location to obtain additional coverage on Segment A and take another 440 second deuterium lamp exposure.

* Adjust the aperture in the cross dispersion direction so that the deuterium lamp will illuminate the appropriate region on Segment B when using G160M/1600.

* Take a 440 second deuterium lamp exposure using both detector segments.

* Adjust the aperture to a second cross-dispersion location to obtain additional coverage on Segment B and take another 440 second deuterium lamp exposure.

*Return the aperture to the nominal LP4 location.

*Return the HV values to the nominal values for the standard modes, if necessary.

Note that because TRANS resets its aperture zero point when FCA exposures are taken, the aperture is explicitly moved using "QESIPARM

XSTEPS", as was done in Program 13970, 14439, 14519, 14941, 15534, 15772, etc.

For reference, the soft and hard stops for the apertures are listed below. All aperture moves should be kept within these ranges.
MEB1:
SOFT STOPS = -275 to 275
HARD STOPS = -282 to 285

MEB2:
SOFT STOPS = -275 to 275
HARD STOPS = -284 to 283

Summary table:

Visit	LP	Grating/Segment	Y Position	LAPXSTP	XAPER
2A/2C	2	G130M/A	1	-213	-448
2A/2C	2	G130M/A	2	-267*	-502
2A/2C	2	G160M/B	1	-225	-460
2A/2C	2	G160M/B	2	-267*	-502
3A/3C	3	G130M/A	1	-72	-307
3A/3C	3	G130M/A	2	-128	-363
3A/3C	3	G160M/B	1	-84	-319
3A/3C	3	G160M/B	2	-140	-375

4A/4C	4	G130M/A	1	-32	-267
4A/4C	4	G130M/A	2	-86	-321
4A/4C	4	G160M/B	1	-41	-276
4A/4C	4	G160M/B	2	-95	-330

* Limited to be within the soft stops

The Mission Office approved using visit 4C of this program to be the 'after' visit for the HV increase on 10/4/2021. As a result, the 'On Hold' for that visit was removed, and the structure of the visit was changed to match visit 4C of program 16323, which had been updated several months earlier. In addition, the HV values were changed to 173/169. The new description of the layout of this visit (as described in 16323) is:

* Take an exposure at LP1 to set up the aperture position and HV. This can also be used to measure the gain at LP1.

* Adjust the HV values

* Adjust the aperture in the cross dispersion direction so that the deuterium lamp will illuminate the appropriate region on Segment A when using G130M/1309.

* Take a 440 second deuterium lamp exposure using both detector segments.

* Adjust the aperture to a second cross-dispersion location to obtain additional coverage on Segment A and take another 440 second deuterium lamp exposure.

* Adjust the aperture in the cross dispersion direction so that the deuterium lamp will illuminate the appropriate region on Segment B when using G160M/1600.

* Take a 440 second deuterium lamp exposure using both detector segments.

* Adjust the aperture to a second cross-dispersion location to obtain additional coverage on Segment B and take another 440 second deuterium lamp exposure.

Visit	**Proposal 16333, LP2 gain map - before HV increase (2A), implementation** Thu Sep 09 13:00:25 GMT 2021 **Diagnostic Status: Warning** Scientific Instruments: S/C, COS, COS/FUV Special Requirements: ON HOLD ; PARALLEL *Comments: This visit collects data at LP2. It uses the HV values appropriate for the Blue Modes at the current HV (173/175).* *On Hold Comments: Only needed if HV changed during Cycle 28*
Diagnostics	(LP2 gain map - before HV increase (2A)) Warning (Orbit Planner): MAXIMUM DURATION EXCEEDED FOR INTERNAL OR EARTH CALIB SU (Aperture Adjustment 1 for Segment A (2A.002)) Warning (Form): This ALIGN/APER exposure should be preceded by a science exposure to define the starting position for the scan.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Adjust HV to Blue Mode values	DARK	S/C, DATA, NONE			SAA CONTOUR 31; SPEC COM INSTR ELHLTHVF; QASISTATES COS FUV HVLOW HVNOM; QESIPARM ENDCTSA 173; QESIPARM ENDCTSB 175; QESIPARM SEGMENT AB		295 Secs (295 Secs) *[==>]*	***[1]***
	Comments: Adjust the HV to the Blue Mode values.								
2	Aperture Adjustment 1 for Segment A	NONE	COS, ALIGN/APER		XAPER=-448			0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 1 for LP2 is -213* *Therefore, XAPER is set to -213 - 235.1 = -448*								
3	G130M/1309 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	***[1]***
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
4	Aperture Adjustment 2 for Segment A	NONE	COS, ALIGN/APER		XAPER=-502	QESIPARM XSTEPS -54		0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 2 for LP2 is -267* *Therefore, XAPER is set to -267 - 235.1 = -502. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -54" [(-502 - -448) = -54] Special Requirement is necessary to move the aperture to the correct location.*								
5	G130M/1309 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	***[1]***
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								

6	Aperture Adjustment 1 for Segment B	NONE	COS, ALIGN/APER		XAPER=-460	QESIPARM XSTEPS 42	0.0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 1 for LP2 is -225

*Therefore, XAPER is set to -225 - 235.1 = -460. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS 42" [(-460 - -502) = +42] Special Requirement is necessary to move the aperture to the correct location.*

7	G160M/1600 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	***[1]***

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

8	Aperture Adjustment 2 for Segment B	NONE	COS, ALIGN/APER		XAPER=-502	QESIPARM XSTEPS -42	0.0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 2 for LP2 is -280, but the aperture soft stop is at -275 and we don't want to exceed that value when including the 5 step overshoot.. To leave some pad, I will set it to match the G130M exposure (-267).

*Therefore, XAPER is set to -267 - 235.1 = -502. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -42" [(-502 - -460) = -42] Special Requirement is necessary to move the aperture to the correct location.*

9	G160M/1600 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	***[1]***

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

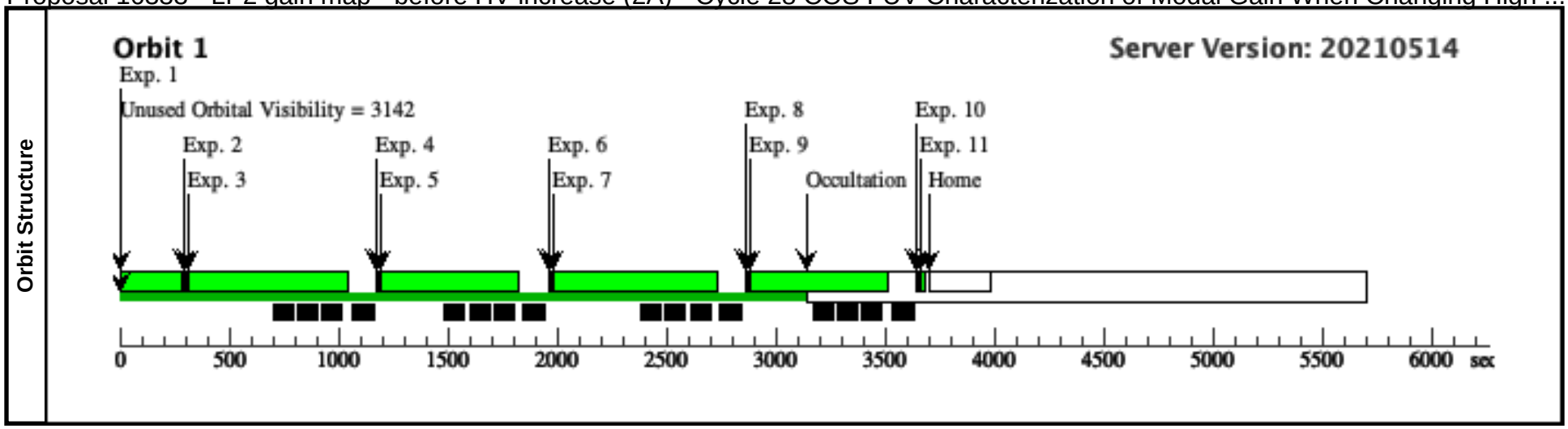
10	Return Aperture to Nominal Position	NONE	COS, ALIGN/APER		XAPER=0	QESIPARM XSTEPS 502	0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Return the aperture to its nominal position, i.e. XAPER=0.
**HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS +502" [(0 - -502) = +502] Special Requirement is necessary to move the aperture to its correct location.*

11	Return to nominal HV for standard modes	DARK	S/C, DATA, NONE			SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 163; QESIPARM ENDC TSB 163	39 Secs (39 Secs) *[==>]*	***[1]***

Comments: Set HV to nominal values used for the standard modes.

Exposure Time is 39 seconds since the HV is not increasing on either segment.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Occultation
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Exp. 11
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5500
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sec

Visit	**Proposal 16333, LP2 gain map - after HV increase (2C), implementation** Thu Sep 09 13:00:26 GMT 2021 **Diagnostic Status: Warning** Scientific Instruments: S/C, COS, COS/FUV Special Requirements: ON HOLD ; PARALLEL *Comments: This visit collects data at LP2. It uses the HV values appropriate for the Blue Modes after increasing the HV (178/175).* *On Hold Comments: Only needed if HV changed during Cycle 28*
Diagnostics	(LP2 gain map - after HV increase (2C)) Warning (Orbit Planner): MAXIMUM DURATION EXCEEDED FOR INTERNAL OR EARTH CALIB SU (Aperture Adjustment 1 for Segment A (2C.002)) Warning (Form): This ALIGN/APER exposure should be preceded by a science exposure to define the starting position for the scan.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Adjust HV to Blue Mode values	DARK	S/C, DATA, NONE			SAA CONTOUR 31; SPEC COM INSTR ELHLTHVF; QASISTATES COS FUV HVLOW HVNOM; QESIPARM ENDCTSA 178; QESIPARM ENDCTSB 175; QESIPARM SEGMENT AB		295 Secs (295 Secs) *[==>]*	*[1]*
	Comments: Adjust the HV to the Blue Mode values.								
2	Aperture Adjustment 1 for Segment A	NONE	COS, ALIGN/APER		XAPER=-448			0.0 Secs (0 Secs) *[==>]*	*[1]*
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 1 for LP2 is -213* *Therefore, XAPER is set to -213 - 235.1 = -448*								
3	G130M/1309 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	*[1]*
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
4	Aperture Adjustment 2 for Segment A	NONE	COS, ALIGN/APER		XAPER=-502	QESIPARM XSTEPS -54		0.0 Secs (0 Secs) *[==>]*	*[1]*
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 2 for LP2 is -267* *Therefore, XAPER is set to -267 - 235.1 = -502. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -54" [(-502 - -448) = -54] Special Requirement is necessary to move the aperture to the correct location.*								
5	G130M/1309 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	*[1]*
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								

6	Aperture Adjustment 1 for Segment B	NONE	COS, ALIGN/APER		XAPER=-460	QESIPARM XSTEP S 42	0.0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 1 for LP2 is -225

*Therefore, XAPER is set to -225 - 235.1 = -460. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS 42" [(-460 - -502) = +42] Special Requirement is necessary to move the aperture to the correct location.*

7	G160M/1600 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	***[1]***

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

8	Aperture Adjustment 2 for Segment B	NONE	COS, ALIGN/APER		XAPER=-502	QESIPARM XSTEP S -42	0.0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP2/Blue Modes region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 2 for LP2 is -280, but the aperture soft stop is at -275 and we don't want to exceed that value when including the 5 step overshoot.. To leave some pad, I will set it to match the G130M exposure (-267).

*Therefore, XAPER is set to -267 - 235.1 = -502. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -42" [(-502 - -460) = -42] Special Requirement is necessary to move the aperture to the correct location.*

9	G160M/1600 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	***[1]***

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

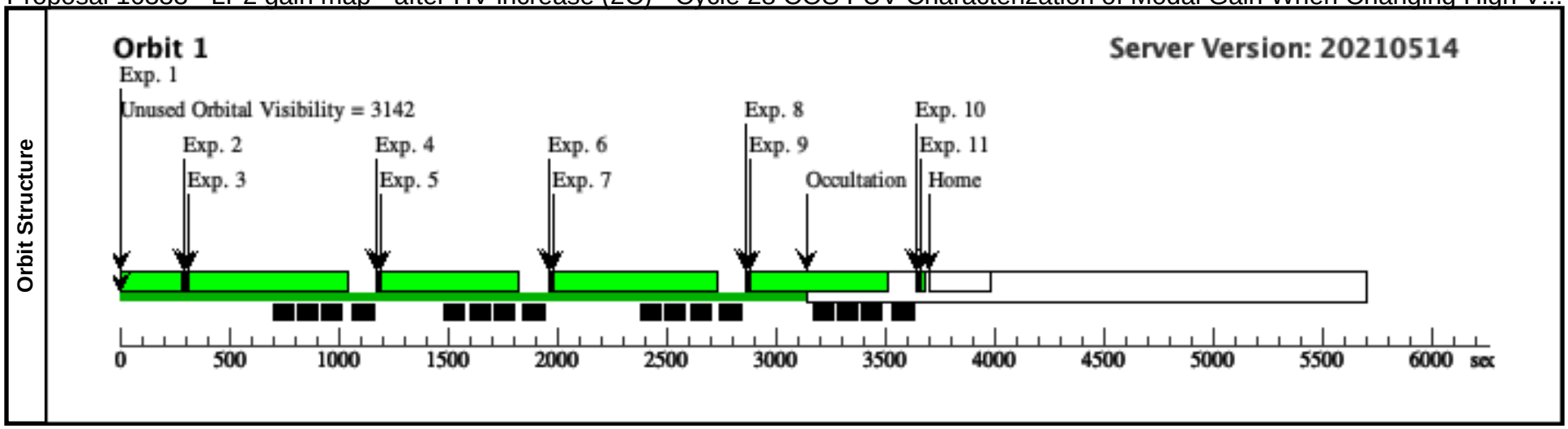
10	Return Aperture to Nominal Position	NONE	COS, ALIGN/APER		XAPER=0	QESIPARM XSTEP S 502	0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Return the aperture to its nominal position, i.e. XAPER=0.
HOWEVER, because of the TRANS rules, the "QESIPARM XSTEPS +502" [(0 - -502) = +502] Special Requirement is necessary to move the aperture to its correct location.*

11	Return to nominal HV for standard modes	DARK	S/C, DATA, NONE			SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 163; QESIPARM ENDC TSB 163	39 Secs (39 Secs) *[==>]*	***[1]***

Comments: Set HV to nominal values used for the standard modes.

Exposure Time is 39 seconds since the HV is not increasing on either segment.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Exp. 7
Exp. 8
Exp. 9
Occultation
Exp. 10
Exp. 11
Home
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500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit	**Proposal 16333, LP3 gain map - before HV increase (3A), implementation** Thu Sep 09 13:00:26 GMT 2021 **Diagnostic Status: Warning** Scientific Instruments: S/C, COS, COS/FUV Special Requirements: ON HOLD ; PARALLEL *Comments: This visit collects data at LP3. It uses the HV values appropriate for LP3 (167/175).* *On Hold Comments: Only needed if HV changed during Cycle 28*
Diagnostics	(LP3 gain map - before HV increase (3A)) Warning (Orbit Planner): MAXIMUM DURATION EXCEEDED FOR INTERNAL OR EARTH CALIB SU (Aperture Adjustment 1 for Segment A (3A.002)) Warning (Form): This ALIGN/APER exposure should be preceded by a science exposure to define the starting position for the scan.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Adjust HV to LP3 values	DARK	S/C, DATA, NONE			SAA CONTOUR 31; SPEC COM INSTR ELHLTHVF; QASISTATES COS FUV HVLOW HVNOM; QESIPARM ENDCTSA 167; QESIPARM ENDCTSB 175; QESIPARM SEGMENT AB		295 Secs (295 Secs) *[==>]*	***[1]***
	Comments: Adjust the HV to the LP3 values.								
2	Aperture Adjustment 1 for Segment A	NONE	COS, ALIGN/APER		XAPER=-307			0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 1 for LP3 is -72* *Therefore, XAPER is set to -72 - 235.1 = -307*								
3	G130M/1309 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	***[1]***
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
4	Aperture Adjustment 2 for Segment A	NONE	COS, ALIGN/APER		XAPER=-363	QESIPARM XSTEPS -56		0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 2 for LP3 is -128* *Therefore, XAPER is set to -128 - 235.1 = -363. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -56" [(-363 - -307) = -56] Special Requirement is necessary to move the aperture to the correct location.*								
5	G130M/1309 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	***[1]***
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								

6	Aperture Adjustment 1 for Segment B	NONE	COS, ALIGN/APER		XAPER=-319	QESIPARM XSTEPS 44	0.0 Secs (0 Secs) *[==>]*	**[1]**

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 1 for LP3 is -84

*Therefore, XAPER is set to -84 - 235.1 = -319. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS 44" [(-319 - -363) = +44] Special Requirement is necessary to move the aperture to the correct location.*

7	G160M/1600 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	**[1]**

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

8	Aperture Adjustment 2 for Segment B	NONE	COS, ALIGN/APER		XAPER=-375	QESIPARM XSTEPS -56	0.0 Secs (0 Secs) *[==>]*	**[1]**

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 2 for LP3 is -140.

*Therefore, XAPER is set to -140 - 235.1 = -375. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -56" [(-375 - -319) = -56] Special Requirement is necessary to move the aperture to the correct location.*

9	G160M/1600 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	**[1]**

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

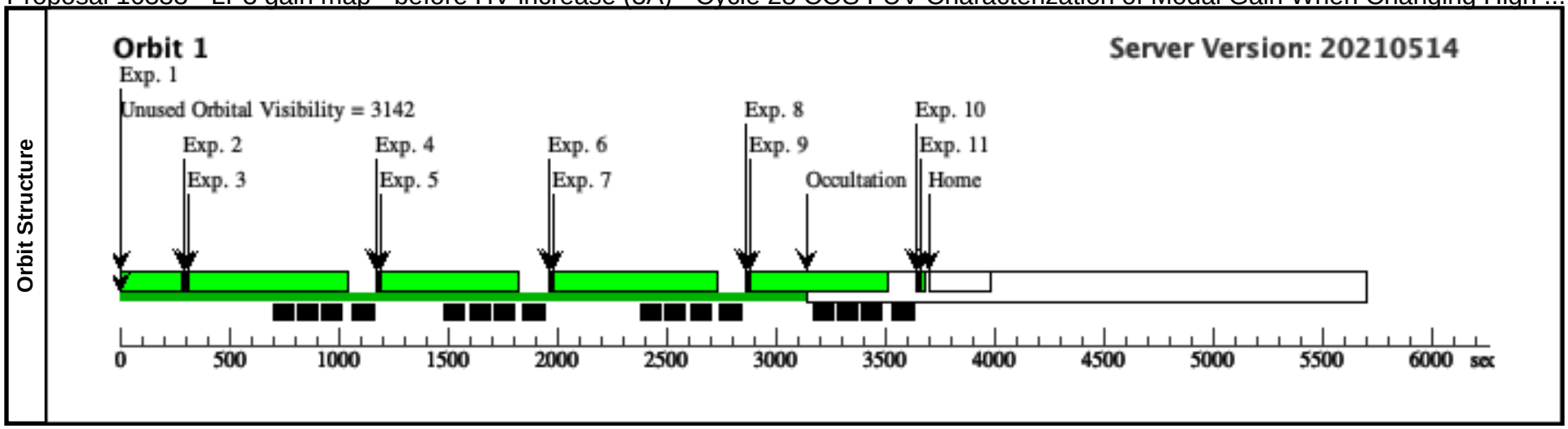
10	Return Aperture to Nominal Position	NONE	COS, ALIGN/APER		XAPER=0	QESIPARM XSTEPS 375	0 Secs (0 Secs) *[==>]*	**[1]**

Comments: Return the aperture to its nominal position, i.e. XAPER=0.
**HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS +375" [(0 - -375) = +375] Special Requirement is necessary to move the aperture to its correct location.*

11	Return to nominal HV for standard modes	DARK	S/C, DATA, NONE			SPEC COM INSTR ELHVADJPROP; QESIPARM ENDCTSA 163; QESIPARM ENDCTSB 163	39 Secs (39 Secs) *[==>]*	**[1]**

Comments: Set HV to nominal values used for the standard modes.

Exposure Time is 39 seconds since the HV is not increasing on either segment.


Orbit Structure
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Server Version: 20210514
Exp. 1
Unused Orbital Visibility = 3142
Exp. 2
Exp. 3
Exp. 4
Exp. 5
Exp. 6
Exp. 7
Exp. 8
Exp. 9
Occultation
Exp. 10
Exp. 11
Home
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1500
2000
2500
3000
3500
4000
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5000
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6000
sec

Visit	**Proposal 16333, LP3 gain map - after HV increase (3C), implementation** Thu Sep 09 13:00:26 GMT 2021 **Diagnostic Status: Warning** Scientific Instruments: S/C, COS, COS/FUV Special Requirements: ON HOLD ; PARALLEL *Comments: This visit collects data at LP3. It uses the HV values appropriate for LP3 after a HV increase (173/175).* *On Hold Comments: Only needed if HV changed during Cycle 28*
Diagnostics	(LP3 gain map - after HV increase (3C)) Warning (Orbit Planner): MAXIMUM DURATION EXCEEDED FOR INTERNAL OR EARTH CALIB SU (Aperture Adjustment 1 for Segment A (3C.002)) Warning (Form): This ALIGN/APER exposure should be preceded by a science exposure to define the starting position for the scan.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Adjust HV to LP3 values	DARK	S/C, DATA, NONE			SAA CONTOUR 31; SPEC COM INSTR ELHLTHVF; QASISTATES COS FUV HVLOW HVNOM; QESIPARM ENDCTSA 173; QESIPARM ENDCTSB 175; QESIPARM SEGMENT AB		295 Secs (295 Secs) *[==>]*	***[1]***
	Comments: Adjust the HV to the LP3 values.								
2	Aperture Adjustment 1 for Segment A	NONE	COS, ALIGN/APER		XAPER=-307			0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 1 for LP3 is -72* *Therefore, XAPER is set to -72 - 235.1 = -307*								
3	G130M/1309 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	***[1]***
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
4	Aperture Adjustment 2 for Segment A	NONE	COS, ALIGN/APER		XAPER=-363	QESIPARM XSTEPS -56		0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 2 for LP3 is -128* *Therefore, XAPER is set to -128 - 235.1 = -363. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -56" [(-363 - -307) = -56] Special Requirement is necessary to move the aperture to the correct location.*								
5	G130M/1309 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	***[1]***
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								

6	Aperture Adjustment 1 for Segment B	NONE	COS, ALIGN/APER		XAPER=-319	QESIPARM XSTEPS 44	0.0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 1 for LP3 is -84

*Therefore, XAPER is set to -84 - 235.1 = -319. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS 44" [(-319 - -363) = +44] Special Requirement is necessary to move the aperture to the correct location.*

7	G160M/1600 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	***[1]***

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

8	Aperture Adjustment 2 for Segment B	NONE	COS, ALIGN/APER		XAPER=-375	QESIPARM XSTEPS -56	0.0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP3 region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 2 for LP3 is -140.

*Therefore, XAPER is set to -140 - 235.1 = -375. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -56" [(-375 - -319) = -56] Special Requirement is necessary to move the aperture to the correct location.*

9	G160M/1600 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	***[1]***

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

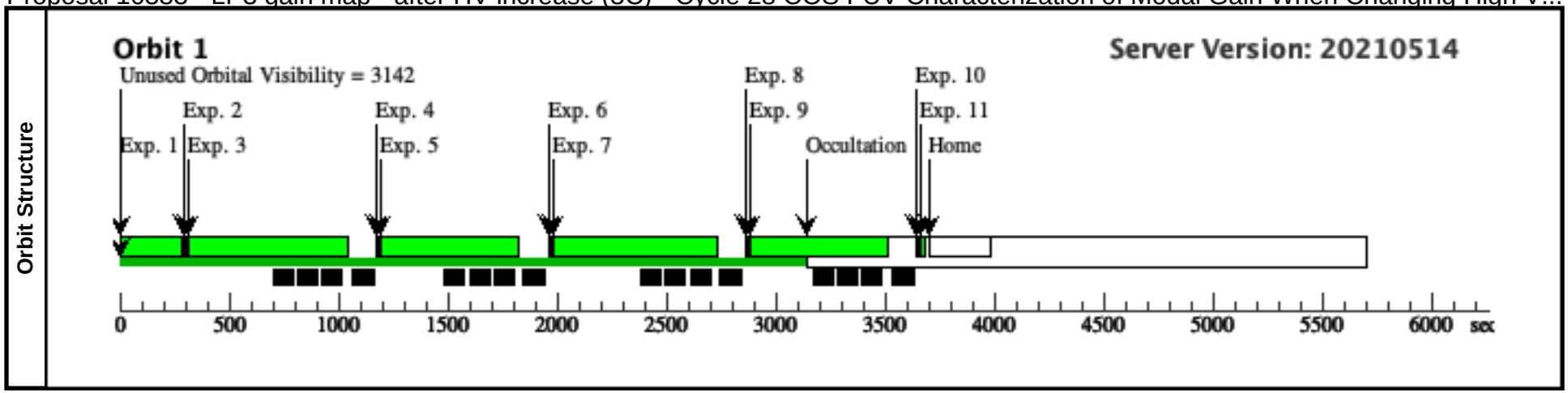
10	Return Aperture to Nominal Position	NONE	COS, ALIGN/APER		XAPER=0	QESIPARM XSTEPS 375	0 Secs (0 Secs) *[==>]*	***[1]***

Comments: Return the aperture to its nominal position, i.e. XAPER=0.
**HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS +375" [(0 - -375) = +375] Special Requirement is necessary to move the aperture to its correct location.*

11	Return to nominal HV for standard modes	DARK	S/C, DATA, NONE			SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 163; QESIPARM ENDC TSB 163	39 Secs (39 Secs) *[==>]*	***[1]***

Comments: Set HV to nominal values used for the standard modes.

Exposure Time is 39 seconds since the HV is not increasing on either segment.


Orbit Structure
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Server Version: 20210514
Unused Orbital Visibility = 3142
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Exp. 2
Exp. 3
Exp. 4
Exp. 5
Exp. 6
Exp. 7
Exp. 8
Exp. 9
Occultation
Exp. 10
Exp. 11
Home
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sec

Visit	**Proposal 16333, LP4 gain map - before HV increase (4A), implementation** Thu Sep 09 13:00:26 GMT 2021 **Diagnostic Status: Warning** Scientific Instruments: S/C, COS, COS/FUV Special Requirements: ON HOLD ; PARALLEL *Comments: This visit collects data at LP4. It uses the HV values appropriate for the Standard Modes (163/163) or G130M/1222 (163/167).* *NOTE that the HV values should be adjusted appropriately before this visit is executed.* *On Hold Comments: Only needed if HV changed during Cycle 28* *HV values should be verified before scheduling*
Diagnostics	(LP4 gain map - before HV increase (4A)) Warning (Orbit Planner): MAXIMUM DURATION EXCEEDED FOR INTERNAL OR EARTH CALIB SU (Aperture Adjustment 1 for Segment A (4A.002)) Warning (Form): This ALIGN/APER exposure should be preceded by a science exposure to define the starting position for the scan.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Adjust HV to LP4 values	DARK	S/C, DATA, NONE			SAA CONTOUR 31; SPEC COM INSTR ELHLTHVF; QASISTATES COS FUV HVLOW HVNOM; QESIPARM ENDCTSA 163; QESIPARM ENDCTSB 163; QESIPARM SEGMENT AB		295 Secs (295 Secs) *[==>]*	*[1]*
Comments: Adjust the HV to the LP4 TBD Modes values.									
2	Aperture Adjustment 1 for Segment A	NONE	COS, ALIGN/APER		XAPER=-267			0.0 Secs (0 Secs) *[==>]*	*[1]*
Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 1 for LP4 is -32* *Therefore, XAPER is set to -32 - 235.1 = -267*									
3	G130M/1309 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	*[1]*
Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.									
4	Aperture Adjustment 2 for Segment A	NONE	COS, ALIGN/APER		XAPER=-321	QESIPARM XSTEPS -54		0.0 Secs (0 Secs) *[==>]*	*[1]*
Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment A with G130M/1309. *PSA LAPXSTP value at LP4 is 235.1* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 2 for LP4 is -86* *Therefore, XAPER is set to -86 - 235.1 = -321. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -54" [(-321 - -267) = -54] Special Requirement is necessary to move the aperture to the correct location.*									
5	G130M/1309 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP4			440 Secs (440 Secs) *[==>]*	*[1]*
Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.									

6	Aperture Adjustment 1 for Segment B	NONE	COS, ALIGN/APER		XAPER=-276	QESIPARM XSTEPS 45	0.0 Secs (0 Secs) *[==>]*	**[1]**

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 1 for LP4 is -41

*Therefore, XAPER is set to -41 - 235.1 = -276. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS 45" [(-276 - -321) = +45] Special Requirement is necessary to move the aperture to the correct location.*

7	G160M/1600 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	**[1]**

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

8	Aperture Adjustment 2 for Segment B	NONE	COS, ALIGN/APER		XAPER=-330	QESIPARM XSTEPS -54	0.0 Secs (0 Secs) *[==>]*	**[1]**

Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment B with G160M/1600.

PSA LAPXSTP value at LP4 is 235.1
Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 2 for LP4 is -95.

*Therefore, XAPER is set to -95 - 235.1 = -330. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -54" [(-330 - -276) = -54] Special Requirement is necessary to move the aperture to the correct location.*

9	G160M/1600 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=111; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP4		440 Secs (440 Secs) *[==>]*	**[1]**

Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.

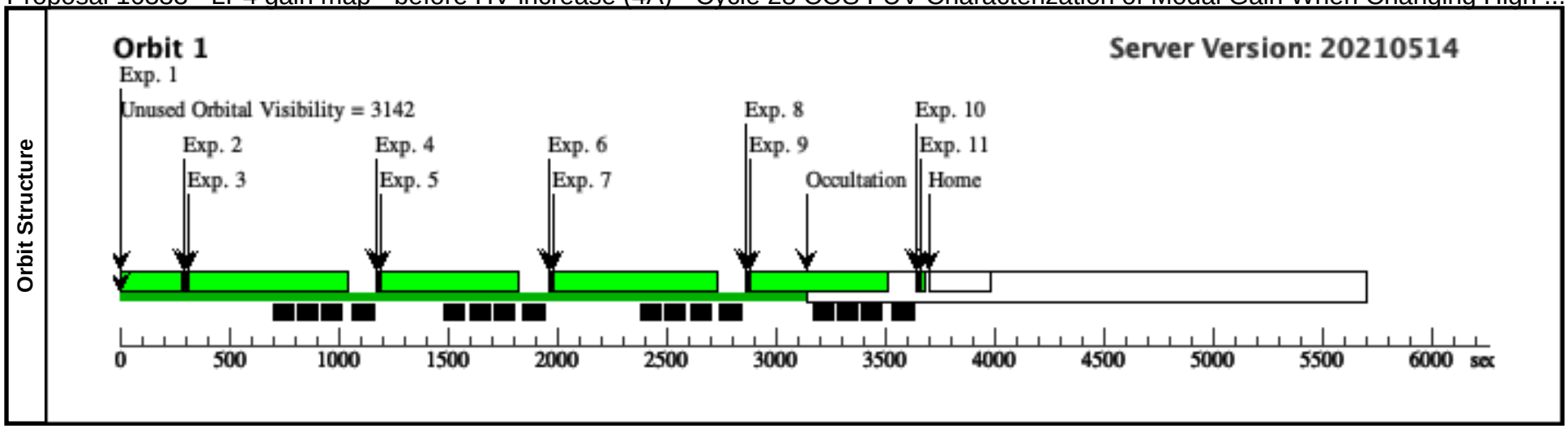
10	Return Aperture to Nominal Position	NONE	COS, ALIGN/APER		XAPER=0	QESIPARM XSTEPS 330	0 Secs (0 Secs) *[==>]*	**[1]**

Comments: Return the aperture to its nominal position, i.e. XAPER=0.
**HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS +330" [(0 - -330) = +330] Special Requirement is necessary to move the aperture to its correct location.*

11	Return to nominal HV for standard modes	DARK	S/C, DATA, NONE			SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 163; QESIPARM ENDC TSB 163	39 Secs (39 Secs) *[==>]*	**[1]**

Comments: Set HV to nominal values used for the standard modes.

Exposure Time is 39 seconds since the HV is not increasing on either segment.


Orbit Structure
Orbit 1
Server Version: 20210514
Exp. 1
Unused Orbital Visibility = 3142
Exp. 2
Exp. 3
Exp. 4
Exp. 5
Exp. 6
Exp. 7
Exp. 8
Exp. 9
Occultation
Exp. 10
Exp. 11
Home
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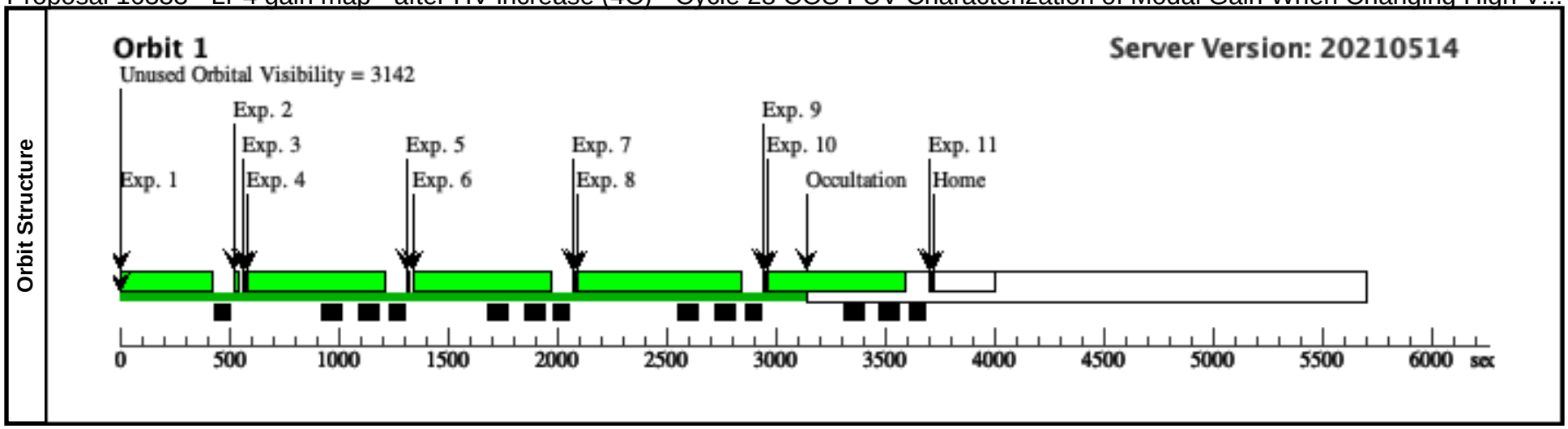
Visit	**Proposal 16333, LP4 gain map - after HV increase (4C)** Thu Sep 09 13:00:26 GMT 2021 **Diagnostic Status: Warning** Scientific Instruments: S/C, COS, COS/FUV Special Requirements: PARALLEL *Comments: This visit collects data at LP4. It uses the HV values appropriate for LP4 after the HV increase (173/169).*
Diagnostics	(LP4 gain map - after HV increase (4C)) Warning (Orbit Planner): MAXIMUM DURATION EXCEEDED FOR INTERNAL OR EARTH CALIB SU

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	G130M/1309 Deuterium Exposure - Set up at LP1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=196; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP1			125 Secs (125 Secs) *[==>]*	***[1]***
	Comments: Short exposure to set aperture to LP1, which is near the center of the aperture range used in this program. It also sets the HV to the LP1 values.								
2	Adjust HV to LP4 values	DARK	S/C, DATA, NONE			SAA CONTOUR 31; SPEC COM INSTR ELHVADJPROP; QASISTATES COS FUV HVNOM HVNOM; QESIPARM ENDCTSA 173; QESIPARM ENDCTSB 169; QESIPARM SEGMENT AB		39 Secs (39 Secs) *[==>]*	***[1]***
	Comments: Adjust the HV to LP4 values. *Since the HV is not increasing, exposure time = 39 seconds*								
3	Aperture Adjustment 1 for Segment A	NONE	COS, ALIGN/APER		XAPER=121			0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment A with G130M/1309. *FCA LAPXSTP value at LP1 is -153* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 1 for LP4 is -32* *Therefore, XAPER is set to -32 - -153 = +121*								
4	G130M/1309 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=165; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP1			440 Secs (440 Secs) *[==>]*	***[1]***
	Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
5	Aperture Adjustment 2 for Segment A	NONE	COS, ALIGN/APER		XAPER=67	QESIPARM XSTEPS -54		0.0 Secs (0 Secs) *[==>]*	***[1]***
	Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment A with G130M/1309. *FCA LAPXSTP value at LP1 is -153* *Desired LAPXSTP value for FCA to illuminate Segment A with G130M/1309 at Position 2 for LP3 is -86* *Therefore, XAPER is set to -86 - -153 = +67. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -54" [(+67 - +121) = -54] Special Requirement is necessary to move the aperture to the correct location.*								

6	G130M/1309 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G130M 1309 A	CURRENT=MEDIUM; BUFFER-TIME=165; FP-POS=1; SEGMENT=BOTH; LIFETIME-POS=LP1		440 Secs (440 Secs) *[==>]*	***[1]***
Comments: Deuterium exposure optimized for Segment A. FP-POS=1 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
7	Aperture Adjustment 1 for Segment B	NONE	COS, ALIGN/APER		XAPER=112	QESIPARM XSTEPS 45	0.0 Secs (0 Secs) *[==>]*	***[1]***
Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment B with G160M/1600. *FCA LAPXSTP value at LP1 is -153* *Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 1 for LP4 is -41* *Therefore, XAPER is set to -41 - -153 = +112. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS 45" [(+112 - +67) = +45] Special Requirement is necessary to move the aperture to the correct location.*								
8	G160M/1600 Deuterium Exposure 1	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=165; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP1		440 Secs (440 Secs) *[==>]*	***[1]***
Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
9	Aperture Adjustment 2 for Segment B	NONE	COS, ALIGN/APER		XAPER=58	QESIPARM XSTEPS -54	0.0 Secs (0 Secs) *[==>]*	***[1]***
Comments: Put the aperture in the appropriate position to illuminate a portion of the LP4 region of the detector when illuminating Segment B with G160M/1600. *FCA LAPXSTP value at LP1 is -153* *Desired LAPXSTP value for FCA to illuminate Segment B with G160M/1600 at Position 2 for LP4 is -95.* *Therefore, XAPER is set to -95 - -153 = +58. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS -54" [(+58 - +112) = -54] Special Requirement is necessary to move the aperture to the correct location.*								
10	G160M/1600 Deuterium Exposure 2	DEUTERIUM	COS/FUV, TIME-TAG, FCA	G160M 1600 A	CURRENT=MEDIUM; BUFFER-TIME=165; FP-POS=4; SEGMENT=BOTH; LIFETIME-POS=LP1		440 Secs (440 Secs) *[==>]*	***[1]***
Comments: Deuterium exposure optimmized for Segment B. FP-POS=4 was chosen because previous observations show that it has slightly more counts than the other FP-POS values.								
11	Return Aperture to Nominal Position	NONE	COS, ALIGN/APER		XAPER=387	QESIPARM XSTEPS 329	0 Secs (0 Secs) *[==>]*	***[1]***
Comments: FCA LAPXSTP value at LP1 is -153, but we want to return the aperture to its nominal position at PSA LP4 (+234), or XAPER = (234 - -153) = 387. *HOWEVER*, because of the TRANS rules, the "QESIPARM XSTEPS +329" [(387- 58) = +329] Special Requirement is necessary to move the aperture to its correct location.*								


Orbit Structure
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Server Version: 20210514
Unused Orbital Visibility = 3142
Exp. 1
Exp. 2
Exp. 3
Exp. 4
Exp. 5
Exp. 6
Exp. 7
Exp. 8
Exp. 9
Exp. 10
Occultation
Exp. 11
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