



13367 - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Cycle: 21, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) RXJ1532+3021 CCDFLAT	STIS/CCD	2	02-Jul-2014 21:04:08.0	yes
05	(1) RXJ1532+3021 CCDFLAT	STIS/CCD	1	02-Jul-2014 21:04:09.0	yes
02	(2) RXJ1532+3021-OFFSET	COS/NUV	4	02-Jul-2014 21:04:11.0	yes
03	(2) RXJ1532+3021-OFFSET	COS/FUV COS/NUV	5	02-Jul-2014 21:04:13.0	yes
04	(2) RXJ1532+3021-OFFSET	COS/NUV	4	02-Jul-2014 21:04:15.0	yes

ABSTRACT

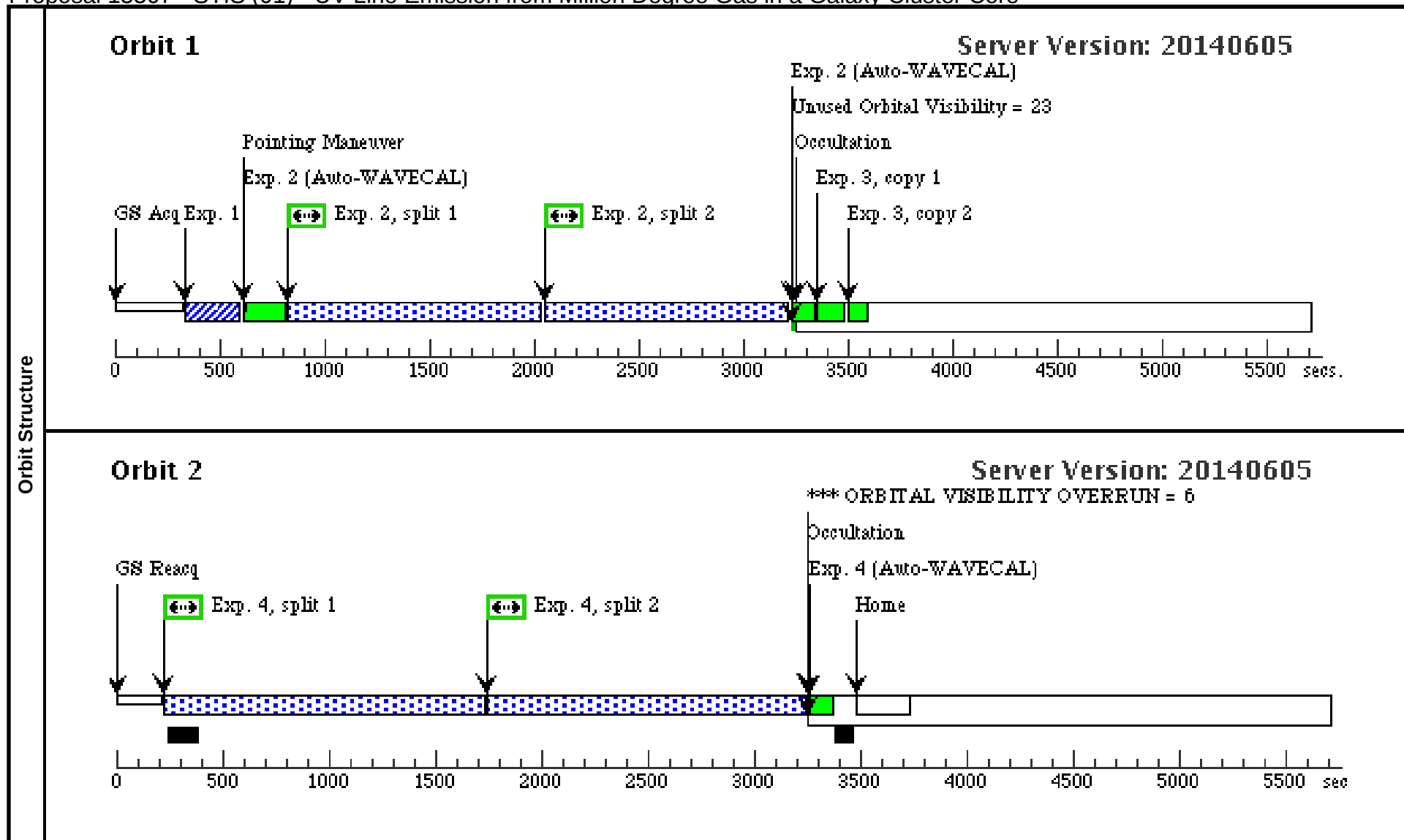
Progress in understanding the nature of galaxy formation and feedback in massive halos depends critically on knowing whether the source of the star-forming gas in Brightest Cluster Galaxies is cooling and condensation out of the hot ambient medium or whether it enters the central galaxy already in cold form. We will study UV and optical line emission from the knots of a powerful star-forming brightest cluster galaxy from the CLASH MCT cluster sample in order to place definitive limits on the presence of intermediate temperature (10^5 - 10^6 K) gas in the center of a massive galaxy that is forming stars at ~ 100 solar masses per year. We have chosen a galaxy cluster at $z \sim 0.35$ to enable the first ever simultaneous measurement of O VI, N V, and C IV from a cluster core. We will compare the observed UV line ratios to those predicted by competing model for steady nonequilibrium cooling, thermal conduction, and cooling mediated by turbulent mixing.

OBSERVING DESCRIPTION

We plan to acquire STIS (H-alpha, NII) and COS spectroscopy (OVI, Lyman-alpha, CIV) of UV-bright knots in the Brightest Cluster Galaxy of a moderate redshift cluster RXJ1532+3021. We have in hand rest-frame UV images from the MCT CLASH program so we can accurately position the knots in the STIS aperture. We have a mild constraint that we would like the knots in the COS aperture to be not aligned along the dispersion direction.

Proposal 13367 - STIS (01) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Visit	Proposal 13367, STIS (01), completed										Thu Jul 03 01:04:16 GMT 2014	
	Diagnostic Status: Warning											
	Scientific Instruments: STIS/CCD											
	Special Requirements: ORIENT 45D TO 55 D; ORIENT 225D TO 235 D											
Comments: The allowed orientations put all 3 knots in the slit. The two allowed ranges are 180 degrees different from each other.												
Diagnostics	(STIS (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN											
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous			
	(1)	RXJ1532+3021	RA: 15 32 53.7730 (233.2240542d) Dec: +30 20 59.43 (30.34984d) Equinox: J2000		Redshift: 0.362		V=18+/-0.5		Reference Frame: ICRS			
	Comments: The GSC2 coordinates are similar, with larger error budget 0.2". The target, Knot A in the proposal, is GSC2.2 star N13303016375, at 233.224095 + 30.349857. The STIS PA restrictions place the STIS long slit is oriented approximately N/S, and will include Knot B and possibly Knot C (farther south). The restrictions on the COS PA are to avoid lining up Knot A and B (N/S) along the dispersion direction: assumes the dispersion axis "x" is the U3 axis - 45 degrees. It is unlikely both of these knots will be in the sweet spot of the COS aperture simulatenously, however, so even this weak restriction on COS scheduling is probably unnecessary.											
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit	
	1	STIS acquisition (STIS.ta.513923)	(1) RXJ1532+3021	STIS/CCD, ACQ, 50CCD	MIRROR	ACQTYPE=DIFFUSE; CHECKBOX=7; DIFFUSE-CENTER=FLUX-CENTROID	GS ACQ SCENARIO BASE1B3		2 Secs (2 Secs) [==>]		[1]	
	2	RXJ1532_STIS_1	(1) RXJ1532+3021	STIS/CCD, ACCUM, 52X0.5	G750M 8825 A	CR-SPLIT=2			1800 Secs (2264 Secs) [==>1132.0 Secs (Split 1)] [==>1132.0 Secs (Split 2)]		[1]	
	3	Fringe Frame	CCDFLAT	STIS/CCD, ACCUM, 52X0.5	G750M 8825 A				[==>(Copy 1)] [==>(Copy 2)]		[1]	
	4	RXJ1532	(1) RXJ1532+3021	STIS/CCD, ACCUM, 52X0.5	G750M 8825 A	CR-SPLIT=2			1800 Secs (2944 Secs) [==>1472.0 Secs (Split 1)] [==>1472.0 Secs (Split 2)]		[2]	



Proposal 13367 - STIS (05) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Visit	Proposal 13367, STIS (05), implementation										Thu Jul 03 01:04:17 GMT 2014
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: STIS/CCD										
	Special Requirements: ORIENT 45D TO 55 D; ORIENT 225D TO 235 D										
Comments: The allowed orientations put all 3 knots in the slit. The two allowed ranges are 180 degrees different from each other.											
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous					
	(1)	RXJ1532+3021	RA: 15 32 53.7730 (233.2240542d) Dec: +30 20 59.43 (30.34984d) Equinox: J2000	Redshift: 0.362	V=18+/-0.5	Reference Frame: ICRS					
	Comments: The GSC2 coordinates are similar, with larger error budget 0.2". The target, Knot A in the proposal, is GSC2.2 star N13303016375, at 233.224095 + 30.349857. The STIS PA restrictions place the STIS long slit is oriented approximately N/S, and will include Knot B and possibly Knot C (farther south). The restrictions on the COS PA are to avoid lining up Knot A and B (N/S) along the dispersion direction: assumes the dispersion axis "x" is the U3 axis - 45 degrees. It is unlikely both of these knots will be in the sweet spot of the COS aperture simulatenously, however, so even this weak restriction on COS scheduling is probably unnecessary.										
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	STIS acquisition (STIS.ta.513 923)	(1) RXJ1532+3021	STIS/CCD, ACQ, 50CCD	MIRROR	ACQTYPE=DIFFUSE; CHECKBOX=7; DIFFUSE-CENTER=FLUX-CENTROID	GS ACQ SCENARIO BASE1B3		60 Secs (60 Secs) [==>]	[1]	
	2	RXJ1532_S TIS_1	(1) RXJ1532+3021	STIS/CCD, ACCUM, 52X0.5	G750M 8825 A	CR-SPLIT=2			1800 Secs (2054 Secs) [==>1027.0 Secs (Split 1)] [==>1027.0 Secs (Split 2)]	[1]	
	3	Fringe Frame	CCDFLAT	STIS/CCD, ACCUM, 52X0.5	G750M 8825 A				[==>(Copy 1)] [==>(Copy 2)]	[1]	
Orbit Structure	Orbit 1 Server Version: 20140605 Unused Orbital Visibility = 1 Exp. 3, copy 1 Occultation Exp. 3, copy 2 Home GS Acq Exp. 1 Exp. 2 (Auto-WAVECAL) Pointing Maneuver Exp. 2, split 1 Exp. 2, split 2 05001000150020002500300035004000450050005500 sec										

Proposal 13367 - COS NUV visit 1 Knot A (02) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Visit	Proposal 13367, COS NUV _ visit 1_Knot A (02), implementation Diagnostic Status: Warning Scientific Instruments: COS/NUV Special Requirements: ORIENT 120D TO 160 D; ORIENT 300D TO 340 D <i>Comments: The orient constraint is in place simply to avoid lining up Knot A and B (almost directly north-south) along the dispersion direction. A long IMAGE/acquisition is in place because the Lyman alpha flux is uncertain by a factor of 2 or so. The orient constraint is intended to keep the cross-dispersion direction in roughly a north-south orientation.</i>						Thu Jul 03 01:04:17 GMT 2014
	(COS NUV _ visit 1_Knot A (02)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS (COS NUV _ visit 1_Knot A (02)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS						
Diagnostics							
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	
	(2)	RXJ1532+3021-OFFSET	RA: 15 32 53.7730 (233.2240542d) Dec: +30 20 59.53 (30.34987d) Equinox: J2000	Redshift: 0.362	V=18+/-0.5	Reference Frame: ICRS	
	<i>Comments: The GSC2 coordinates are similar, with larger error budget 0.2". The target, Knot A in the proposal, is GSC2.2 star N13303016375, at 233.224095 + 30.349857. I've provided a position that is 0.1" North of the actual position to avoid centering on Knot B, 0.5" to the south of Knot A.</i> <i>The STIS PA restrictions place the STIS long slit is oriented approximately N/S, and will include Knot B and possibly Knot C (farther south). The restrictions on the COS PA are to avoid lining up Knot A and B (N/S) along the dispersion direction: assumes the dispersion axis "x" is the U3 axis - 45 degrees. It is unlikely both of these knots will be in the sweet spot of the COS aperture simulatenously, however, so even this weak restriction on COS scheduling is probably unnecessary.</i>						

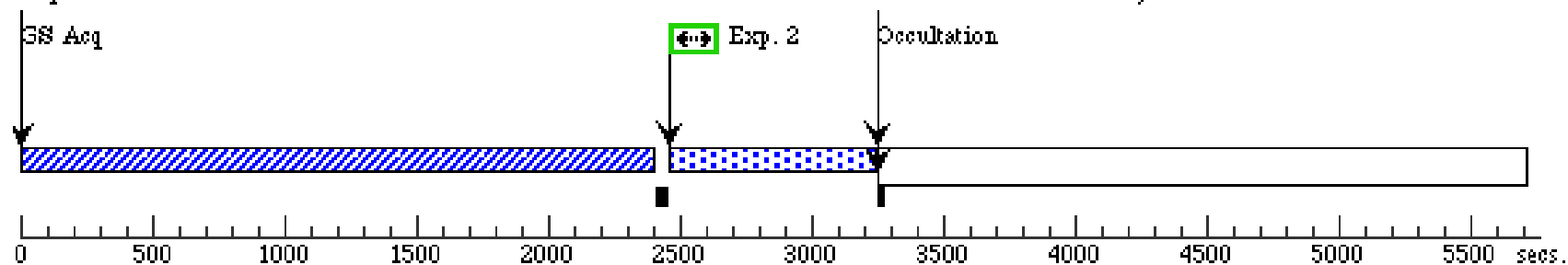
Proposal 13367 - COS NUV visit 1 Knot A (02) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Acquisition (COS.ta.512 291)	(2) RXJ1532+3021- OFFSET	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				1000 Secs (1000 Secs) [==>]	[1]
	Comments: This acquisition is slight offset to ensure the aperture centers on Knot A rather than Knot B. Both will be in the aperture. All of the acquisition images, summed, will be a high-resolution map of the Lyman Alpha emission line nebula in the center of this BCG, should be really nice.									
	2	Short NUV (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 3360 A	BUFFER-TIME=1.e 4; EXTENDED=YES; FLASH=YES; FP-POS=3			500 Secs (662 Secs) [==>662.0 Secs]	[1]
	3	COS NUV1 a (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 3360 A	BUFFER-TIME=13 35; EXTENDED=YES; FLASH=YES; FP-POS=ALL			1200 Secs (5880 Secs) [==>1470.0 Secs (Split 1)] [==>1470.0 Secs (Split 2)] [==>1470.0 Secs (Split 3)] [==>1470.0 Secs (Split 4)]	[2] [3]
	Comments: Buffer time adjusted to be shorter than actual exposure time, to minimize the read-out time between exposures. I think FP-POS hits all 4 recommended dither positions but if this is wrong, I'll need to redo each exposure to do so.									
	4	COS NUV2 a (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 3360 A	BUFFER-TIME=13 35; EXTENDED=YES; FLASH=YES; FP-POS=1			600 Secs (1470 Secs) [==>1470.0 Secs]	[4]
	Comments: Buffer time adjusted to be shorter than actual exposure time, to minimize the read-out time between exposures.									
	5	COS NUV3 a (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 3360 A	BUFFER-TIME=13 35; EXTENDED=YES; FLASH=YES; FP-POS=2			1470 Secs (1470 Secs) [==>1470.0 Secs]	[4]
	Comments: Buffer time adjusted to be shorter than actual exposure time, to minimize the read-out time between exposures.									

Orbit 1

Exp. 1

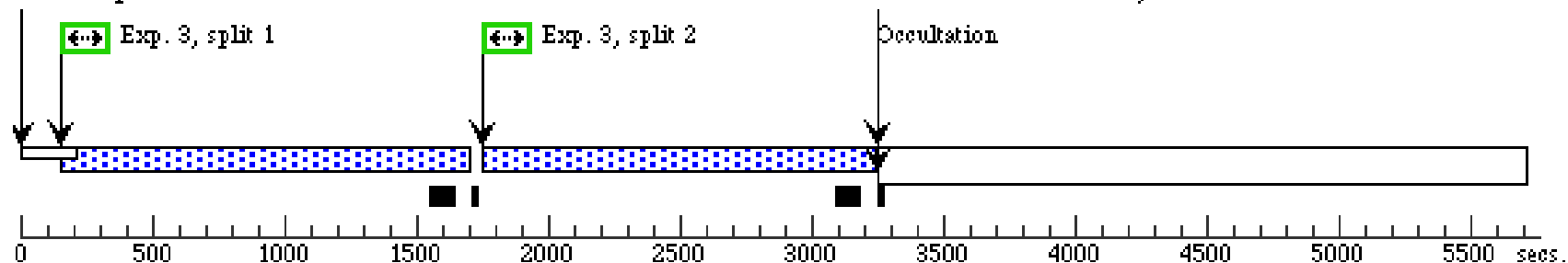
Server Version: 20140605



Orbit 2

GS Reacq

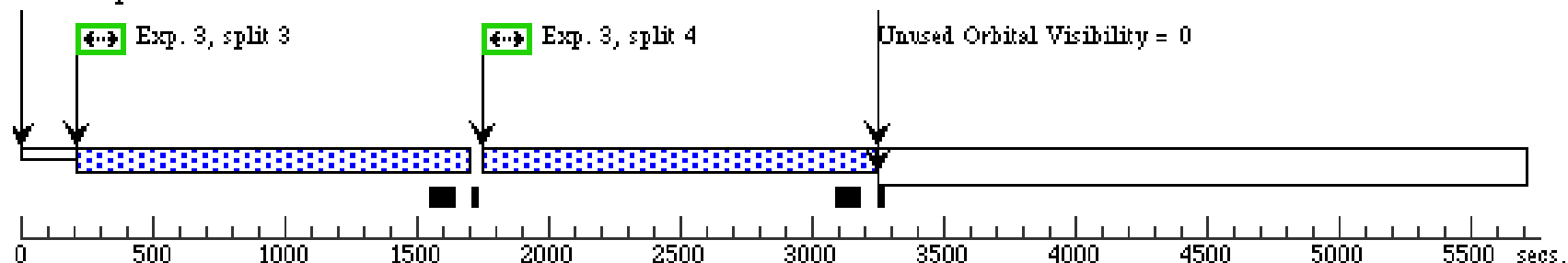
Server Version: 20140605

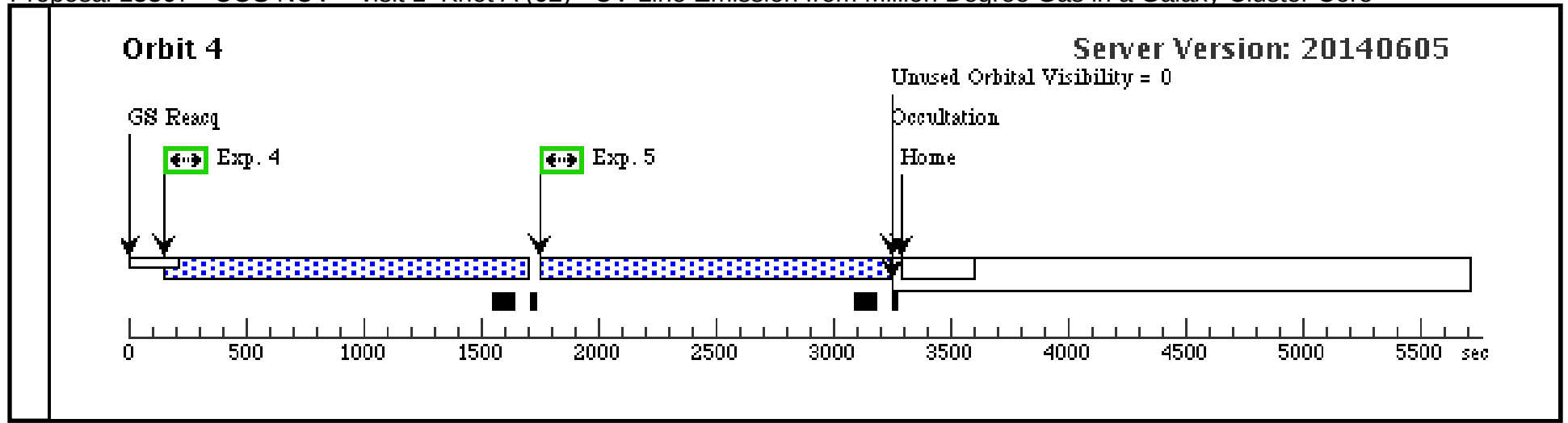


Orbit 3

GS Reacq

Server Version: 20140605





Proposal 13367 - COS FUV visit 2 Knot A (03) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

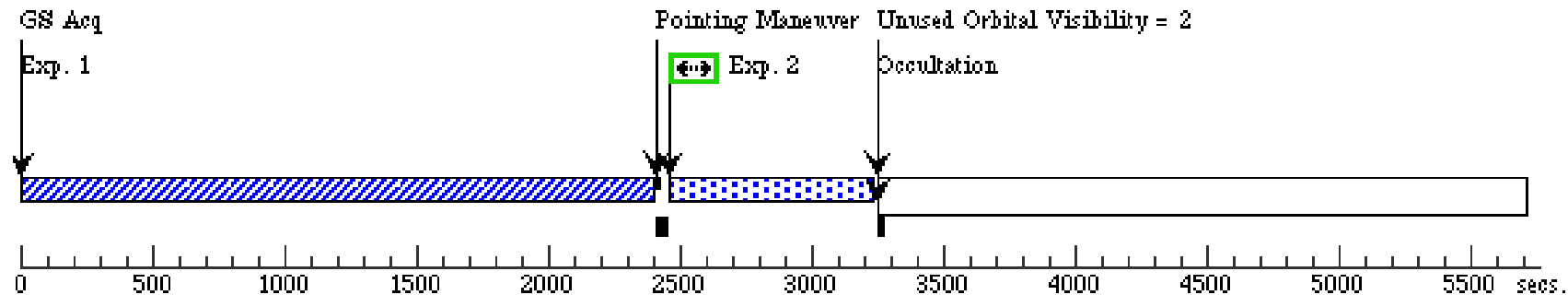
Visit	Proposal 13367, COS FUV _ visit 2 Knot A (03), completed					Thu Jul 03 01:04:17 GMT 2014
	Diagnostic Status: Warning					
Diagnostics	Scientific Instruments: COS/NUV, COS/FUV					
	Special Requirements: ORIENT 120D TO 160 D; ORIENT 300D TO 340 D					
	Comments: The orient constraint is in place simply to avoid lining up Knot A and B (almost directly north-south) along the dispersion direction. A long IMAGE/acquisition is in place because the Lyman alpha flux is uncertain by a factor of 2 or so. The orient constraint is intended to keep the cross-dispersion direction in roughly a north-south orientation.I am considering switching to grating G160M, 1589 central wavelength to avoid source overlap in the cross dispersion (Perp to dispersion) direction.					
Fixed Targets	(COS FUV _ visit 2 Knot A (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN					
	(COS FUV _ visit 2 Knot A (03)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS					
	(COS FUV _ visit 2 Knot A (03)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(2)	RXJ1532+3021-OFFSET	RA: 15 32 53.7730 (233.2240542d) Dec: +30 20 59.53 (30.34987d) Equinox: J2000	Redshift: 0.362	V=18+/-0.5	Reference Frame: ICRS
	Comments: The GSC2 coordinates are similar, with larger error budget 0.2". The target, Knot A in the proposal, is GSC2.2 star N13303016375, at 233.224095 + 30.349857. I've provided a position that is 0.1" North of the actual position to avoid centering on Knot B, 0.5" to the south of Knot A. The STIS PA restrictions place the STIS long slit is oriented approximately N/S, and will include Knot B and possibly Knot C (farther south). The restrictions on the COS PA are to avoid lining up Knot A and B (N/S) along the dispersion direction: assumes the dispersion axis "x" is the U3 axis - 45 degrees. It is unlikely both of these knots will be in the sweet spot of the COS aperture simulatenously, however, so even this weak restriction on COS scheduling is probably unnecessary.					

Proposal 13367 - COS FUV visit 2 Knot A (03) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Acquisition (COS.ta.512 291)	(2) RXJ1532+3021- OFFSET	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				1000 Secs (1000 Secs) [==>]	[1]
	Comments: This acquisition is slight offset to ensure the aperture centers on Knot A rather than Knot B. Both will be in the aperture. All of the acquisition images, summed, will be a high-resolution map of the Lyman Alpha emission line nebula in the center of this BCG, should be really nice.									
	2	Short FUV (COS.sp.484 650)	(2) RXJ1532+3021- OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=10 000; EXTENDED=YES; FLASH=YES; FP-POS=4; SEGMENT=BOTH			500 Secs (601 Secs) [==>601.0 Secs]	[1]
	3	COS FUV1 (COS.sp.484 650)	(2) RXJ1532+3021- OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=13 35; EXTENDED=YES; FLASH=YES; FP-POS=ALL; SEGMENT=BOTH			1200 Secs (5742 Secs) [==>1438.0 Secs (Split 1)] [==>1438.0 Secs (Split 2)] [==>1433.0 Secs (Split 3)] [==>1433.0 Secs (Split 4)]	[2] [3]
	Comments: Buffer time adjusted to be shorter than actual exposure time, to minimize the read-out time between exposures. I think FP-POS hits all 4 recommended dither positions but if this is wrong, I'll need to redo each exposure to do so.									
	4	COS FUV2 (COS.sp.484 650)	(2) RXJ1532+3021- OFFSET	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=13 35; EXTENDED=YES; FLASH=YES; FP-POS=ALL; SEGMENT=BOTH			1200 Secs (5732 Secs) [==>1433.0 Secs (Split 1)] [==>1433.0 Secs (Split 2)] [==>1433.0 Secs (Split 3)] [==>1433.0 Secs (Split 4)]	[4] [5]
	Comments: Buffer time adjusted to be shorter than actual exposure time, to minimize the read-out time between exposures. I think FP-POS hits all 4 recommended dither positions but if this is wrong, I'll need to redo each exposure to do so.									

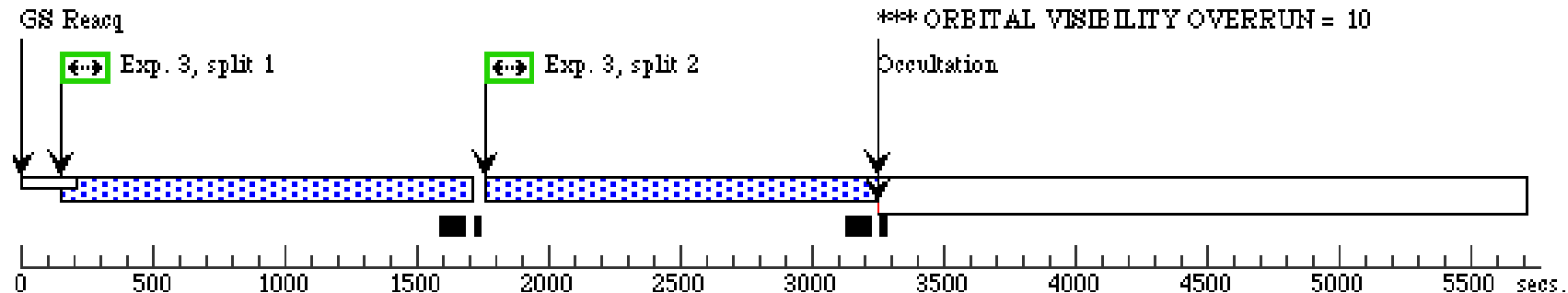
Orbit 1

Server Version: 20140605



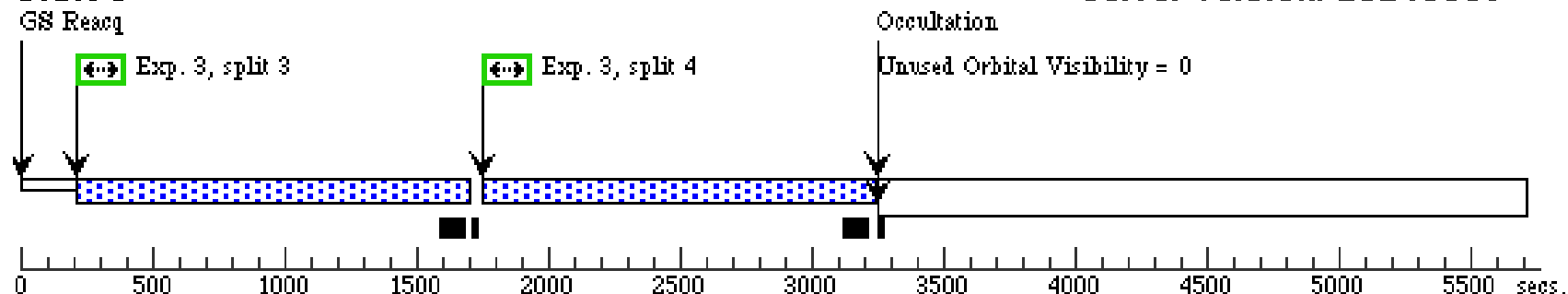
Orbit 2

Server Version: 20140605



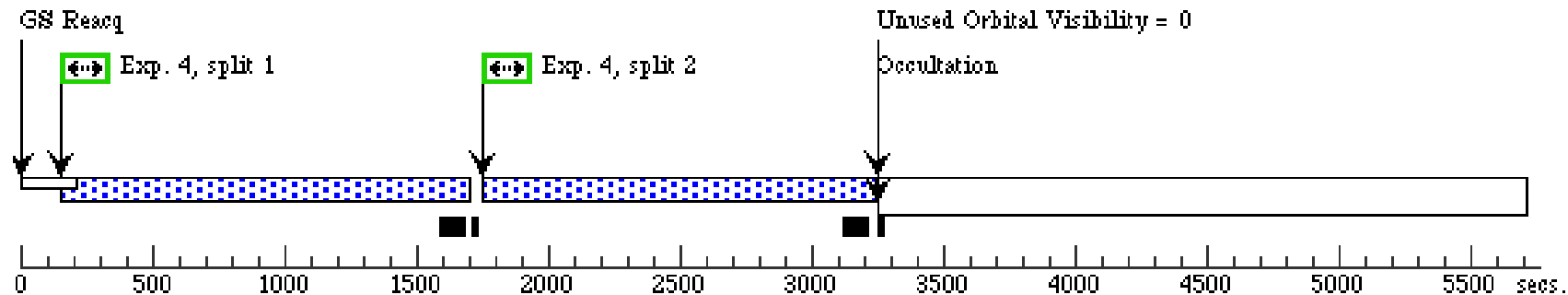
Orbit 3

Server Version: 20140605



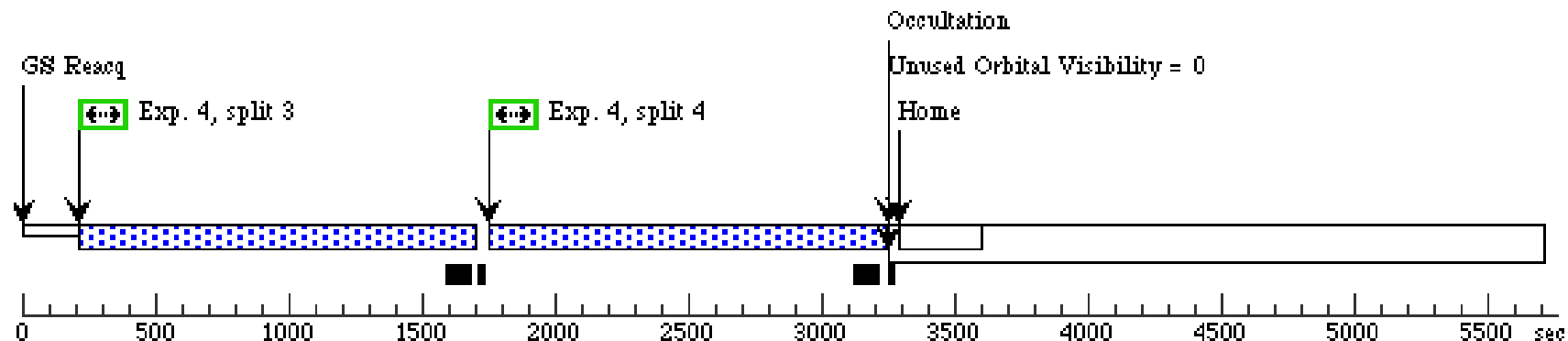
Orbit 4

Server Version: 20140605



Orbit 5

Server Version: 20140605



Proposal 13367 - COS-NUV Knot A (04) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Visit	Proposal 13367, COS-NUV Knot A (04), completed					Thu Jul 03 01:04:17 GMT 2014
	Diagnostic Status: Warning					
Diagnostics	Scientific Instruments: COS/NUV					
	Special Requirements: ORIENT 120D TO 160 D; ORIENT 300D TO 340 D					
	Comments: The orient constraint is in place simply to avoid lining up Knot A and B (almost directly north-south) along the dispersion direction. A long IMAGE/acquisition is in place because the Lyman alpha flux is uncertain by a factor of 2 or so. The orient constraint is intended to keep the cross-dispersion direction in roughly a north-south orientation					
	(COS-NUV Knot A (04)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS					
Fixed Targets	(COS-NUV Knot A (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN					
	(COS-NUV Knot A (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN					
	(COS-NUV Knot A (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN					
	(COS-NUV Knot A (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(2)	RXJ1532+3021-OFFSET	RA: 15 32 53.7730 (233.2240542d)	Redshift: 0.362	V=18+/-0.5	Reference Frame: ICRS
			Dec: +30 20 59.53 (30.34987d)			
			Equinox: J2000			
Fixed Targets	Comments: The GSC2 coordinates are similar, with larger error budget 0.2". The target, Knot A in the proposal, is GSC2.2 star N13303016375, at 233.224095 + 30.349857. I've provided a position that is 0.1" North of the actual position to avoid centering on Knot B, 0.5" to the south of Knot A.					
	The STIS PA restrictions place the STIS long slit is oriented approximately N/S, and will include Knot B and possibly Knot C (farther south). The restrictions on the COS PA are to avoid lining up Knot A and B (N/S) along the dispersion direction: assumes the dispersion axis "x" is the U3 axis - 45 degrees. It is unlikely both of these knots will be in the sweet spot of the COS aperture simulatenously, however, so even this weak restriction on COS scheduling is probably unnecessary.					

Proposal 13367 - COS-NUV Knot A (04) - UV Line Emission from Million Degree Gas in a Galaxy Cluster Core

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Acquisition (COS.ta.512 291)	(2) RXJ1532+3021- OFFSET	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				800 Secs (800 Secs) [==>]	[1]
	Comments: This acquisition is slight offset to ensure the aperture centers on Knot A rather than Knot B. Both will be in the aperture. All of the acquisition images, summed, will be a high-resolution map of the Lyman Alpha emission line nebula in the center of this BCG, should be really nice. The NUV COS acquisition is somewhat shorter to allow for longer NUV spectrum exposure. Ideally this visit happens after Visit 2 OR Visit 3 (either one) ; if acquisition should be longer, we wouldn't want this visit to be the first COS visit of the program.									
	2	RXJ1532-C OS NUV fir st orbit (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 2635 A	BUFFER-TIME=1.e 4; EXTENDED=YES; FLASH=YES; FP-POS=1			800 Secs (1065 Secs) [==>1065.0 Secs]	[1]
	3	RCJ1532-C OS NUV -2 (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 2635 A	BUFFER-TIME=13 35; EXTENDED=YES; FLASH=YES; FP-POS=2			1000 Secs (1470 Secs) [==>1470.0 Secs]	[2]
	Comments: Buffer time adjusted to be shorter than actual exposure time, to minimize the read-out time between exposures.									
	4	RXJ1532 - COS NUV-3 (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 2635 A	BUFFER-TIME=1.e 4; EXTENDED=YES; FLASH=YES; FP-POS=3			1000 Secs (1470 Secs) [==>1470.0 Secs]	[2]
	5	RXJ1532-C OS NUV -4 (COS.sp.508 526)	(2) RXJ1532+3021- OFFSET	COS/NUV, TIME-TAG, PSA	G230L 2635 A	FP-POS=ALL; BUFFER-TIME=13 35; EXTENDED=YES; FLASH=YES			1200 Secs (5900 Secs) [==>1475.0 Secs (Split 1)] [==>1475.0 Secs (Split 2)] [==>1475.0 Secs (Split 3)] [==>1475.0 Secs (Split 4)]	[3] [4]
	Comments: Buffer time adjusted to be 100s shorter than actual exposure time, to minimize the read-out time between exposures. I think FP-POS hits all 4 recommended dither positions but if this is wrong, I'll need to redo each exposure to do so.									

