12189 - Do stars ionise the filaments in NGC 1275 ?

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

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?*
01	(2) NGC1275-P2 (3) NGC1275-P3 (4) NGC1275-P4 (7) NCJ1045244	COS/FUV COS/NUV	4	16-Nov-2011 21:01:11.0	yes
02	(1) NGC1275-P1 (5) NGC1275-P5 (7) NCJ1045244	COS/FUV COS/NUV	3	16-Nov-2011 21:01:19.0	yes
52	(1) NGC1275-P1 (5) NGC1275-P5 (7) NCJ1045244	COS/FUV COS/NUV	3	16-Nov-2011 21:01:27.0	yes

10 Total Orbits Used

ABSTRACT

Brightest Cluster Galaxies (BCGs) in cool core clusters show filaments of line emitting gas whose ionization physics has been much studied but little understood. Some filaments show blue knots suggesting young star clusters; others do not. We request deep COS G140L FUV spectra of five

regions in the filaments surrounding the BCG NGC 1275 in the nearby Perseus cluster. Analysis of the spectra, and particularly the [CIV] feature will clarify whether the filaments are ionized by normal stars, ultrahot stars, or a nonthermal source weak in FUV photons. The possible role of the active nucleus will be investigated by selecting regions located at various distances from the nucleus. Understanding the ionization and heating of these filaments, and why some filaments form stars, whilst others are prevented from collapsing, is important not only to the understanding of cool core clusters, but also to the wider issue of galaxy formation.

OBSERVING DESCRIPTION

Choice of Target:

NGC 1275 is the BCG in the Perseus cluster, one of the nearest and best studied of the massive cool core clusters. It has a distance of 70 Mpc (z=0.01756) where 1 arcsec equals 350 pc. Five regions in three ionized filaments are selected in NGC 1275 for this study. The two outer regions (green circles in Fig. 1) correspond to regions 2 and 38 from Conselice et al. 2001 and are located 21 and 25 kpc from the nucleus. The three inner regions (yellow circles in Fig. 1) lie at increasing distances from the nucleus along the Perseus East filament.

Velocity studies show that this gas is related to the BCG and not the high velocity system north-west of the NGC 1275 nucleus. We will observe these regions with COS using the G140L grating which allows for a spectral resolution of 0.6 A. The COS primary science aperture has a diameter of 2.5 arcsec, but due to strong vignetting only the inner 1 arcsec is usable.

The regions are picked to sample a variety of ratios of H-alpha/Blue continuum emission and a variety of distances from the AGN, so that we can test the contributions to ionization from stars, the AGN, and "missing" sources.

Time justification:

From H-alpha and FUV imaging of z=0.1 BCGs O'Dea et al. 2004 finds that F(FUV) =(2-4)xF(H-alpha). The H-alpha surface brightness is 0.5x1e-14 and 1.0x1e-14 erg/s/cm2/arcsec2 for the two outer regions and three inner regions respectively (Conselice et al. 2001). Following O'Dea et al. 2004 this translates to an FUV surface brightnesses per unit of wavelength of 0.5x1e-16 and 1.0x1e-16 erg/s/cm2/A/arcsec2 for the outer regions and inner regions respectively.

Here we have used the conservative lower estimate of the F(FUV) to F(H-alpha) ratio. The selected HII emitting regions fill the COS primary science aperture. Inserting these values into the COS ETC for the above mentioned instrumental setup we find that we require 2 orbits for each of the outer

regions and 1 orbit for each of the inner regions to detect the FUV continuum with a SNR > 5 per resolution element at the redshifted wavelength of the [CIV] feature. In total we thus require 7-orbits to obtain our goals with COS.

Choice of Instrument:

We choose to use COS instead of STIS because COS has a lower background and higher throughput than STIS. If we were to use STIS with grating G140L, a 52x2 arcsec slit and integrating 1 arcsec along the slit, then we find that we require 5-10 times longer exposure times to detect the FUV continuum in the selected regions at the same signal to noise.

Visit

Proposal 12189, Visit 01, completed Thu Nov 17 02:01:33 GMT 2011

Diagnostic Status: Warning

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Diagnostics

(Visit 01) Warning (Form): If the target coordinates are not known to 0.4" (or better) an ACQ/SEARCH should precede the ACQ/IMAGE.

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC1275-P2	Offset from NCJ1045244 by	Redshift: 0.01756	V=12.48+/-0.2	Offset Position (NGC1275-P2)
	Alt Name1: N1275-SE	RA Offset: 11.322 Secs		SURF_CONT(1500)=0.5e-16	Reference Frame: ICRS
		Dec Offset: -30.76 Arcsec			
Comments: The V magnitude given above corresponds to the total integrated V-magnitude of NGC1275. The FUV surface brightness, as estimated from H-alpha measurements, at our proposed positions is much lower and is given in the other fluxes box i.e. F(FUV)= 0.5e-16 erg/s/cm2/A/arcsec2.					
(3)	NGC1275-P3	Offset from NCJ1045244 by	Redshift: 0.01756	V=12.48+/-0.2	Offset Position (NGC1275-P3)
	Alt Name1: N1275-E1	RA Offset: 8.765 Secs		SURF_CONT(1500)=1.0e-16	Reference Frame: ICRS
		Dec Offset: 12.48 Arcsec			
Comments: The V magnitude given above corresponds to the total integrated V-magnitude of NGC1275. The FUV surface brightness, as estimated from H-alpha measurements, at our proposed positions is much lower and is given in the other fluxes box i.e. F(FUV)= 1.0e-16 erg/s/cm2/A/arcsec2.					
(4)	NGC1275-P4	Offset from NCJ1045244 by	Redshift: 0.01756	V=12.48+/-0.2	Offset Position (NGC1275-P4)
	Alt Name1: N1275-E2	RA Offset: 7.962 Secs		SURF_CONT(1500)=1.0e-16	Reference Frame: ICRS
		Dec Offset: 9.58 Arcsec			
Comments: The V magnitude given above corresponds to the total integrated V-magnitude of NGC1275. The FUV surface brightness, as estimated from H-alpha measurements, at our proposed positions is much lower and is given in the other fluxes box i.e. F(FUV)= 1.0e-16 erg/s/cm2/A/arcsec2.					
(7)	NCJ1045244	RA: 03 19 41.7123 (49.9238012d)		V=14.659+/-0.1	Reference Frame: ICRS
	Alt Name1: STAR-5	Dec: +41 30 36.65 (41.51018d)		GALEX(NUV) = 20.19 +- 0.05 mag	
		Equinox: J2000			
Comments: This object was generated by the targetselector and retrieved from the GSC 2.3 database.					

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(7) NCJ1045244	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				100 Secs *[==>]*	 ***[1]***

Comments: Acquisition of star5. This target will be used as the offset-reference. It has a GALEX(NUV)=20.19 mag according to the COS ETC this means that we will obtain S/N=60 in 50-100 sec (for spectral types G 5V-O5V), using ETC settings: mirrorA, PSA, point-source (radius=0.4 arcsec), standard background and average_airglow.

Star5 has been investigated for propermotion; A catalog search in Vizier (CDS) showed that within errors the proper motion of this star is zero. There was no preferred direction of the proper motion between the 8 cat alogs containing this star. Any proper motion values given by these catalogs is less then 10 mas/yr. As we are obtaining our target coordinates relative to star5 from an HST-ACS observation in 2006 this means that an y propermotion of this star will lead to a shift which is less then 50 mas, at the time of observing with COS, which is neglible.

This acquisition of star5 will be followed by three offset pointings to NGC1275-P4 (1 orbit), NGC1275-P3 (1 orbit) and NGC1275-P2 (2 orbits) for a total of 4 orbits.

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
2		(4) NGC1275-P4	COS/NUV, TIME-TAG, PSA	MIRRORA	BUFFER-TIME=1000.0; EXTENDED=YES; FLASH=NO			100 Secs *[==>]*	 ***[1]***

Comments: From ACQ/IMAGE on STAR5 we point towards our first target NGC1275-P4 in this visit, prior to the spectrum we take a 100 sec NUV image.

The integration time for the NUV images in this project is based on SBC F140LP data of the NGC1275-P2 pointing. The flux of the brightest point sources in this region is 7e-18 erg/s/cm2/A. Assuming that these are A 0V stars and using the COS-ETC we find that we require an integration time of 100 sec to obtain a S/N=6.9 for these sources. We will assume that these point-sources are typical for all our pointings. Using GALEX w e find NUV surface brightnesses 22.96-27.46 mag/arcsec2. Again assuming A0V stars using the COS ETC we find that in an integration time of 100 sec we obtain S/N=1.0-32.3.

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
3		(4) NGC1275-P4	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2240.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			2240 Secs *[==>]*	 ***[1]***

Comments: Following the 100 sec NUV image we take a FUV spectrum of NGC1275-P4. The total integration time on this target is 1 orbit minus overheads.

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
4		(3) NGC1275-P3	COS/NUV, TIME-TAG, PSA	MIRRORA	BUFFER-TIME=1000.0; EXTENDED=YES; FLASH=NO			100 Secs *[==>]*	 ***[2]***

Comments: From NGC1275-P4 we point towards our second target NGC1275-P3 in this visit, prior to the spectrum we take a 100 sec NUV image (see comments for exposure2 in visit1).

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
5		(3) NGC1275-P3	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2693.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			2693 Secs *[==>]*	 ***[2]***

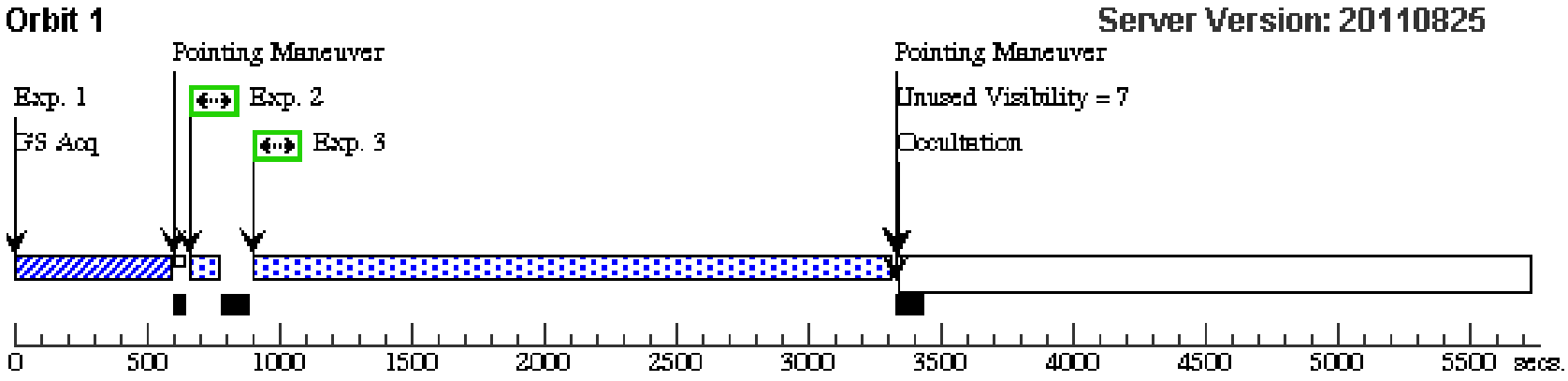
Comments: Following the 100 sec NUV image we take a FUV spectrum of NGC1275-P3. The total integration time on this target is 1 orbit minus overheads.

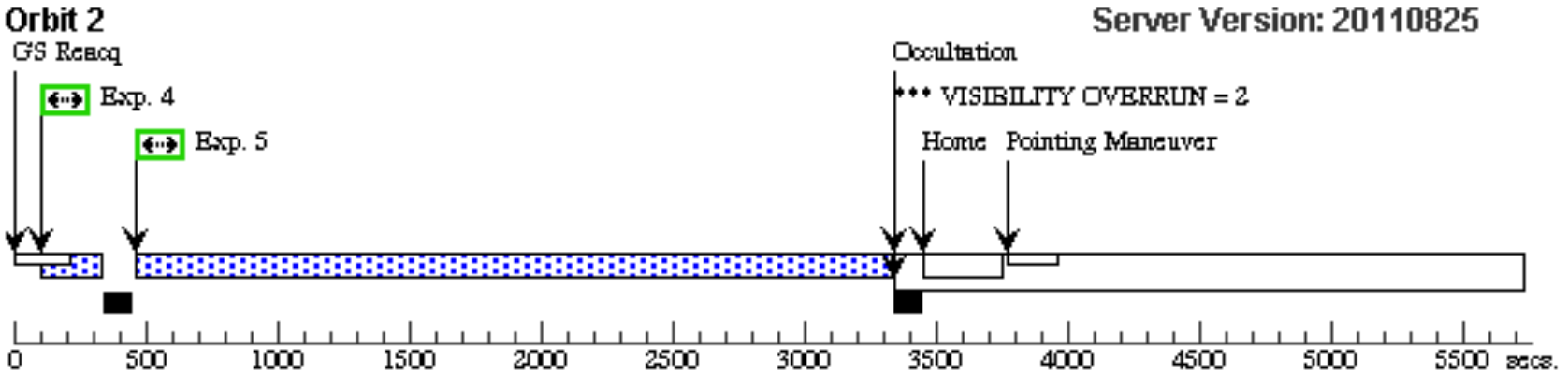
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
6		(2) NGC1275-P2	COS/NUV, TIME-TAG, PSA	MIRRORA	BUFFER-TIME=1000.0; EXTENDED=YES; FLASH=NO			100 Secs *[==>]*	 ***[3]***

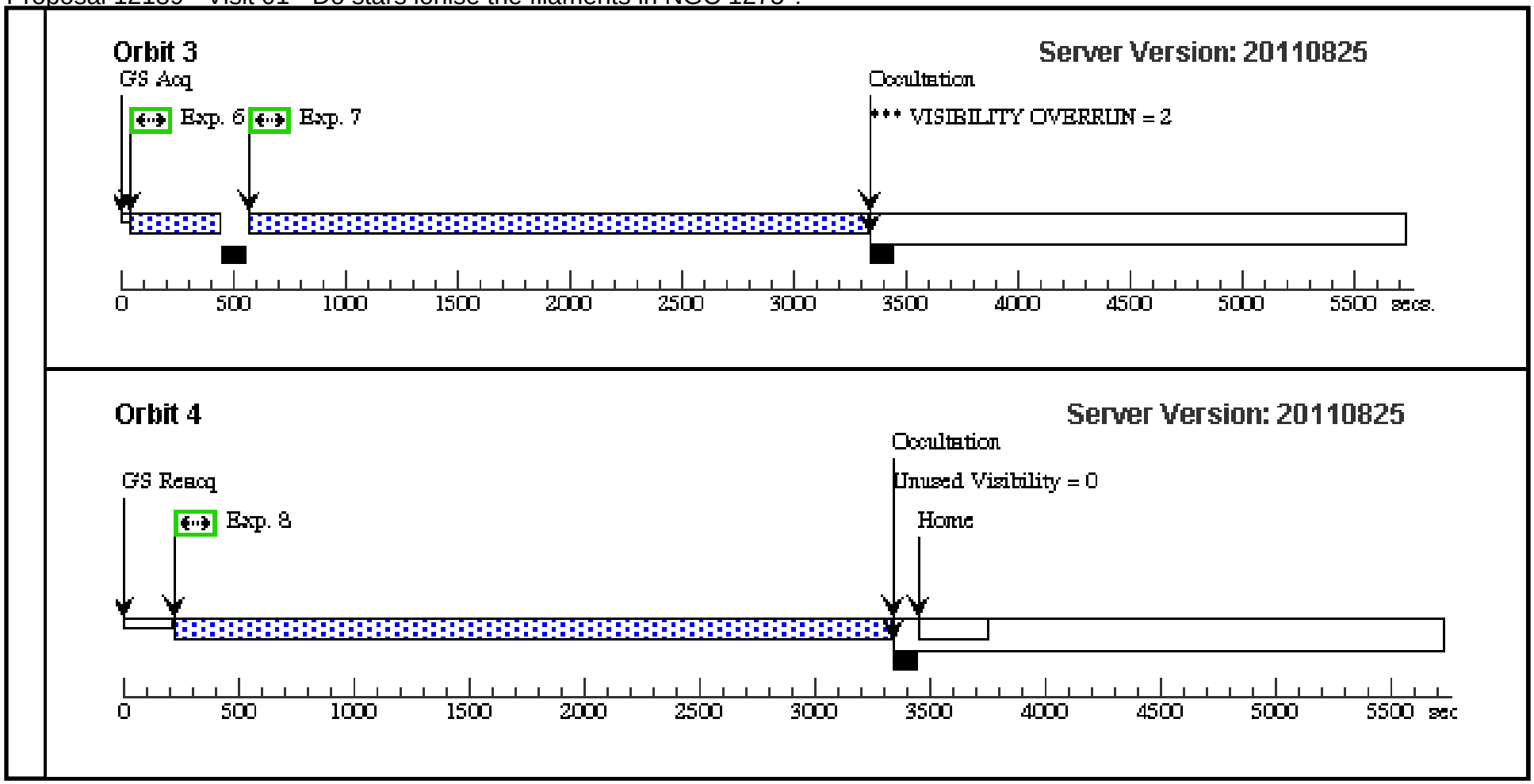
Comments: From NGC1275-P3 we point towards our third and last target NGC1275-P2 in this visit, prior to the spectrum we take a 100 sec NUV image (see comments for exposure2 in visit1).

	7	(2) NGC1275-P2	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2582.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH	2582 Secs *[==>]*	***[3]***
	Comments: Following the 100 sec NUV image we take a FUV spectrum of NGC1275-P2. The total integration time on this target is 2 orbits minus overheads.						
	8	(2) NGC1275-P2	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=3055.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH	3055 Secs *[==>]*	***[4]***
	Comments: We continue to observe on NGC1275-P2, until the end of the fourth orbit.						

Orbit Structure



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Orbit 4
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Occultation
Unused Visibility = 0
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Proposal 12189 - Visit 02 - Do stars ionise the filaments in NGC 1275 ?

Visit

Proposal 12189, Visit 02, completed Thu Nov 17 02:01:35 GMT 2011

Diagnostic Status: Warning

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Diagnostics

(Visit 02) Warning (Form): If the target coordinates are not known to 0.4" (or better) an ACQ/SEARCH should precede the ACQ/IMAGE.

(Visit 02) Warning (Orbit Planner): VISIBILITY OVERRUN

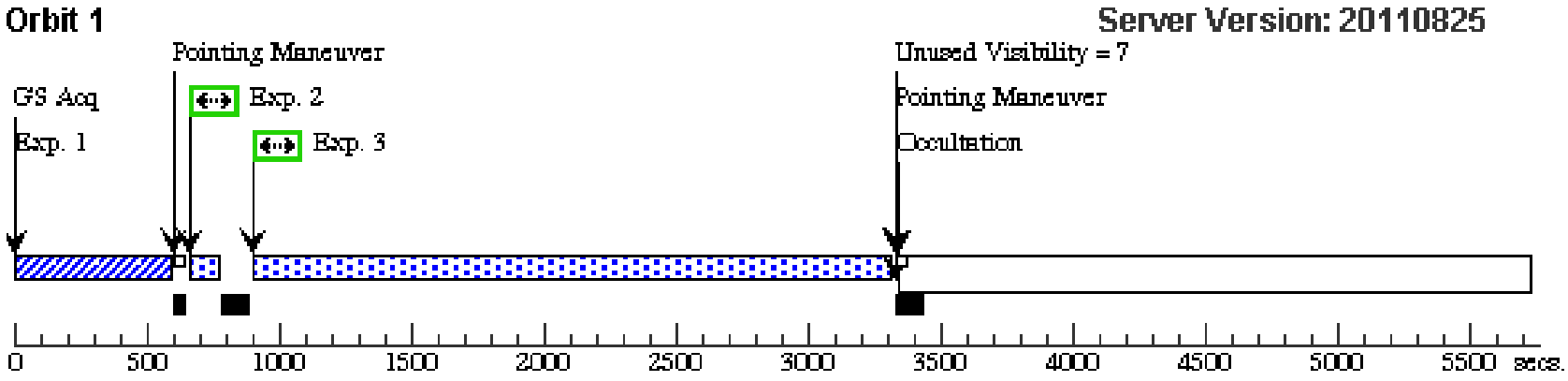
Fixed Targets

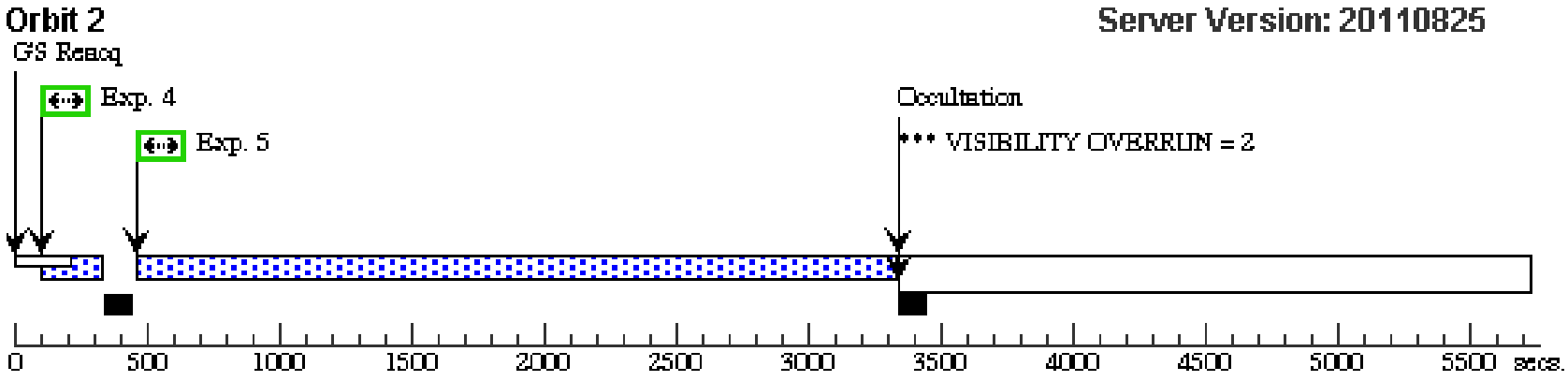
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC1275-P1	Offset from NCJ1045244 by	Redshift: 0.01756	V=12.48+/-0.2	Offset Position (NGC1275-P1)
	Alt Name1: N1275-SW	RA Offset: 4.046 Secs		SURF_CONT(1500)=0.5e-16	Reference Frame: ICRS
		Dec Offset: -48.94 Arcsec			
Comments: The V magnitude given above corresponds to the total integrated V-magnitude of NGC1275. The FUV surface brightness, as estimated from H-alpha measurements, at our proposed positions is much lower and is given in the other fluxes box i.e. F(FUV)= 0.5e-16 erg/s/cm2/A/arcsec2.					
(5)	NGC1275-P5	Offset from NCJ1045244 by	Redshift: 0.01756	V=12.48+/-0.2	Offset Position (NGC1275-P5)
	Alt Name1: N1275-E3	RA Offset: 7.01 Secs		SURF_CONT(1500)=1.0e-16	Reference Frame: ICRS
		Dec Offset: 5.76 Arcsec			
Comments: The V magnitude given above corresponds to the total integrated V-magnitude of NGC1275. The FUV surface brightness, as estimated from H-alpha measurements, at our proposed positions is much lower and is given in the other fluxes box i.e. F(FUV)= 1.0e-16 erg/s/cm2/A/arcsec2.					
(7)	NCJ1045244	RA: 03 19 41.7123 (49.9238012d)		V=14.659+/-0.1	Reference Frame: ICRS
	Alt Name1: STAR-5	Dec: +41 30 36.65 (41.51018d)		GALEX(NUV) = 20.19 +- 0.05 mag	
		Equinox: J2000			
Comments: This object was generated by the targetselector and retrieved from the GSC 2.3 database.					

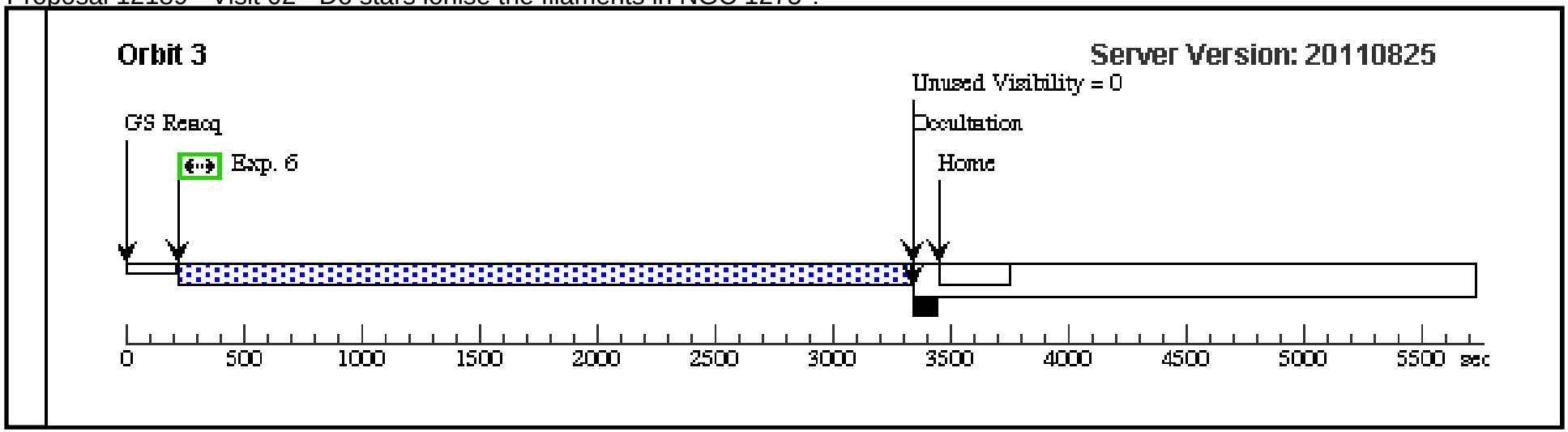
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(7) NCJ1045244	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				100 Secs *[==>]*	 ***[1]***
Comments: Acquisition of star5. This target will be used as the offset-reference (see comments exposure1 in visit1). *Star5 has been investigated for propermotion, see comments exposure1 in visit1.* *This acquisition of star5 will be followed by two offset pointings to NGC1275-P5 (1 orbit) and NGC1275-P1 (2 orbits) for a total of 3 orbits.*									
2		(5) NGC1275-P5	COS/NUV, TIME-TAG, PSA	MIRRORA	BUFFER-TIME=100.0; EXTENDED=YES; FLASH=NO			100 Secs *[==>]*	 ***[1]***
Comments: From ACQ/IMAGE on STAR5 we point towards our first target NGC1275-P5 in this visit, prior to the spectrum we take a 100 sec NUV image (see comments for exposure2 in visit1).									
3		(5) NGC1275-P5	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2240.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			2240 Secs *[==>]*	 ***[1]***
Comments: Following the 100 sec NUV image we take a FUV spectrum of NGC1275-P5. The total integration time on this target is 1 orbit minus overheads.									
4		(1) NGC1275-P1	COS/NUV, TIME-TAG, PSA	MIRRORA	BUFFER-TIME=100.0; EXTENDED=YES; FLASH=NO			100 Secs *[==>]*	 ***[2]***
Comments: From NGC1275-P5 we point towards our second and last target NGC1275-P1 in this visit, prior to the spectrum we take a 100 sec NUV image (see comments for exposure2 in visit1).									
5		(1) NGC1275-P1	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2693.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			2693 Secs *[==>]*	 ***[2]***
Comments: Following the 100 sec NUV image we take a FUV spectrum of NGC1275-P1. The total integration time on this target is 2 orbits minus overheads.									
6		(1) NGC1275-P1	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=3055.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			3055 Secs *[==>]*	 ***[3]***
Comments: We continue to observe on NGC1275-P1, until the end of the third orbit.									

Orbit Structure



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4500
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Proposal 12189 - Visit 52 - Do stars ionise the filaments in NGC 1275 ?

Visit

Proposal 12189, Visit 52 Thu Nov 17 02:01:36 GMT 2011

Diagnostic Status: Warning

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Diagnostics

(Visit 52) Warning (Orbit Planner): VISIBILITY OVERRUN

(Visit 52) Warning (Form): If the target coordinates are not known to 0.4" (or better) an ACQ/SEARCH should precede the ACQ/IMAGE.

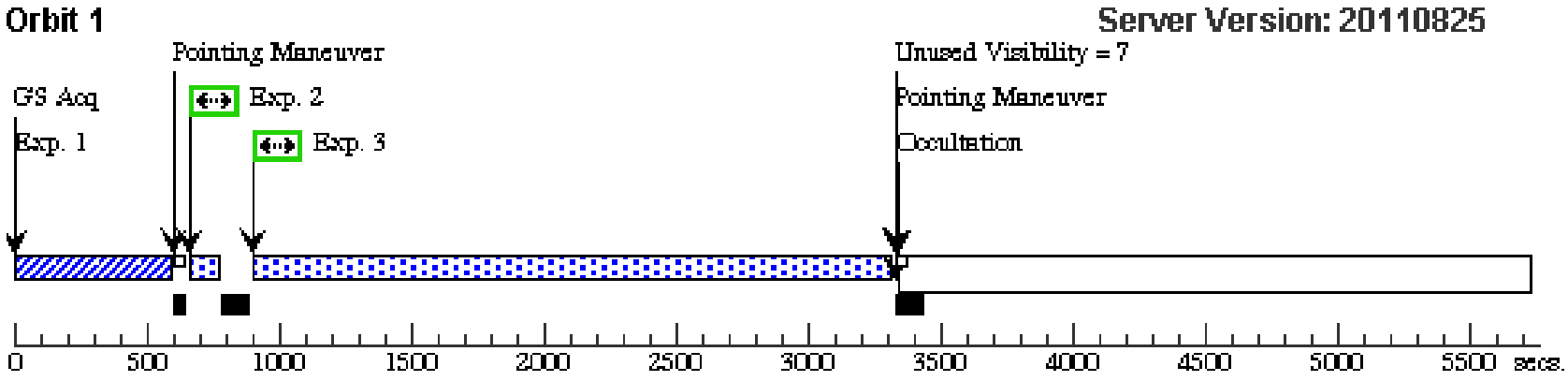
Fixed Targets

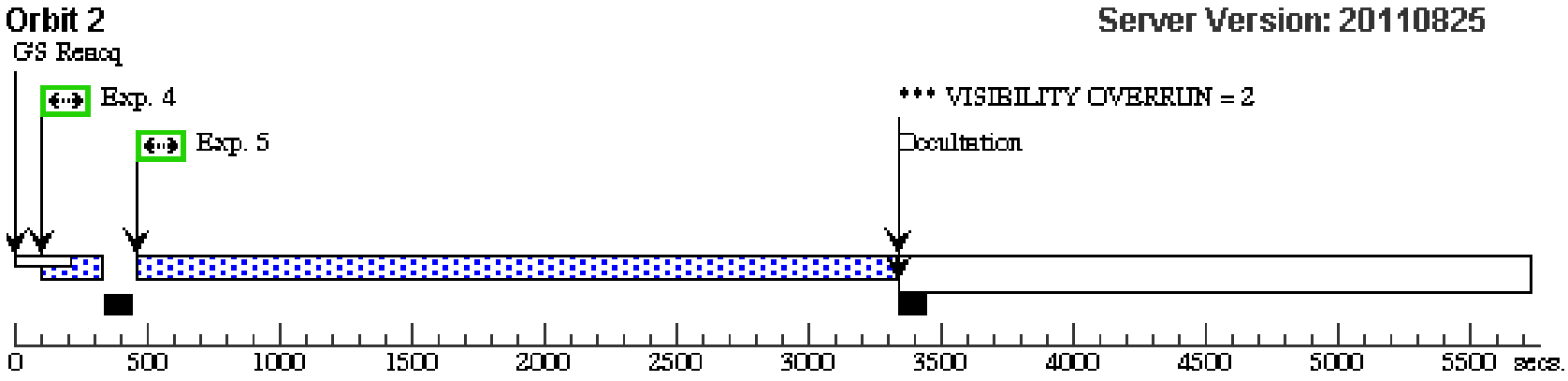
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC1275-P1	Offset from NCJ1045244 by	Redshift: 0.01756	V=12.48+/-0.2	Offset Position (NGC1275-P1)
	Alt Name1: N1275-SW	RA Offset: 4.046 Secs		SURF_CONT(1500)=0.5e-16	Reference Frame: ICRS
		Dec Offset: -48.94 Arcsec			
Comments: The V magnitude given above corresponds to the total integrated V-magnitude of NGC1275. The FUV surface brightness, as estimated from H-alpha measurements, at our proposed positions is much lower and is given in the other fluxes box i.e. F(FUV)= 0.5e-16 erg/s/cm2/A/arcsec2.					
(5)	NGC1275-P5	Offset from NCJ1045244 by	Redshift: 0.01756	V=12.48+/-0.2	Offset Position (NGC1275-P5)
	Alt Name1: N1275-E3	RA Offset: 7.01 Secs		SURF_CONT(1500)=1.0e-16	Reference Frame: ICRS
		Dec Offset: 5.76 Arcsec			
Comments: The V magnitude given above corresponds to the total integrated V-magnitude of NGC1275. The FUV surface brightness, as estimated from H-alpha measurements, at our proposed positions is much lower and is given in the other fluxes box i.e. F(FUV)= 1.0e-16 erg/s/cm2/A/arcsec2.					
(7)	NCJ1045244	RA: 03 19 41.7123 (49.9238012d)		V=14.659+/-0.1	Reference Frame: ICRS
	Alt Name1: STAR-5	Dec: +41 30 36.65 (41.51018d)		GALEX(NUV) = 20.19 +- 0.05 mag	
		Equinox: J2000			
Comments: This object was generated by the targetselector and retrieved from the GSC 2.3 database.					

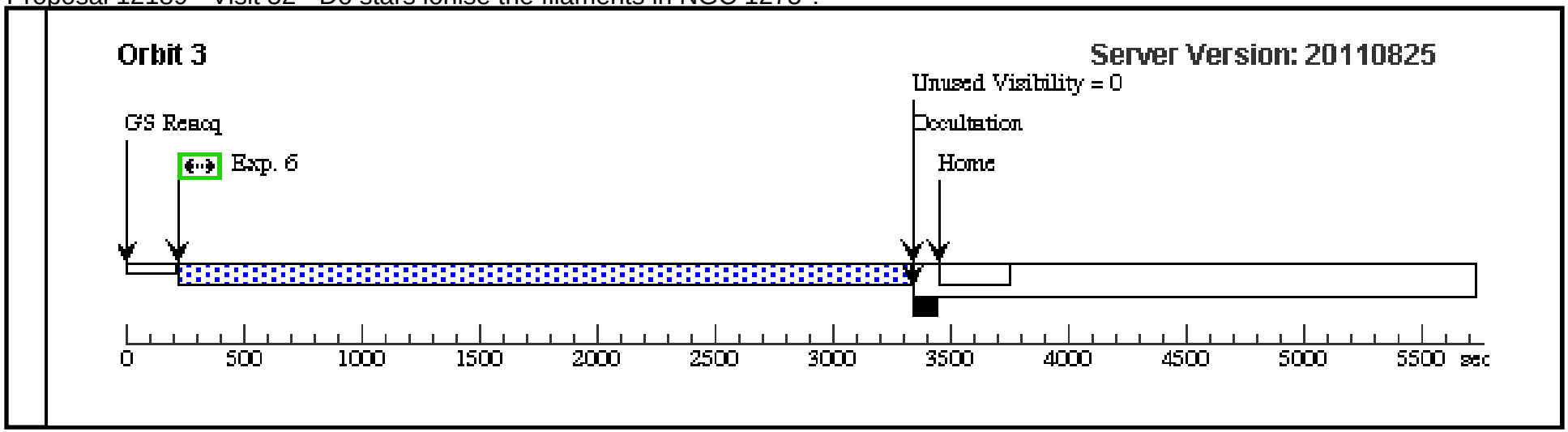
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(7) NCJ1045244	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				100 Secs *[==>]*	 ***[1]***
Comments: Acquisition of star5. This target will be used as the offset-reference (see comments exposure1 in visit1). *Star5 has been investigated for propermotion, see comments exposure1 in visit1.* *This acquisition of star5 will be followed by two offset pointings to NGC1275-P5 (1 orbit) and NGC1275-P1 (2 orbits) for a total of 3 orbits.*									
2		(5) NGC1275-P5	COS/NUV, TIME-TAG, PSA	MIRRORA	BUFFER-TIME=100.0; EXTENDED=YES; FLASH=NO			100 Secs *[==>]*	 ***[1]***
Comments: From ACQ/IMAGE on STAR5 we point towards our first target NGC1275-P5 in this visit, prior to the spectrum we take a 100 sec NUV image (see comments for exposure2 in visit1).									
3		(5) NGC1275-P5	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2240.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			2240 Secs *[==>]*	 ***[1]***
Comments: Following the 100 sec NUV image we take a FUV spectrum of NGC1275-P5. The total integration time on this target is 1 orbit minus overheads.									
4		(1) NGC1275-P1	COS/NUV, TIME-TAG, PSA	MIRRORA	BUFFER-TIME=100.0; EXTENDED=YES; FLASH=NO			100 Secs *[==>]*	 ***[2]***
Comments: From NGC1275-P5 we point towards our second and last target NGC1275-P1 in this visit, prior to the spectrum we take a 100 sec NUV image (see comments for exposure2 in visit1).									
5		(1) NGC1275-P1	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2693.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			2693 Secs *[==>]*	 ***[2]***
Comments: Following the 100 sec NUV image we take a FUV spectrum of NGC1275-P1. The total integration time on this target is 2 orbits minus overheads.									
6		(1) NGC1275-P1	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=3055.0; EXTENDED=YES; FLASH=YES; FP-POS=3; SEGMENT=BOTH			3055 Secs *[==>]*	 ***[3]***
Comments: We continue to observe on NGC1275-P1, until the end of the third orbit.									

Orbit Structure



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