17220 - Are There Two Classes of Lyman-Leaky Galaxies?

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Timothy M. Heckman (PI) (Contact)	**The Johns Hopkins University**
Dr. Sanchayeeta Borthakur (CoI)	Arizona State University
Prof. John Chisholm (CoI)	University of Texas at Austin
Prof. Mauro Giavalisco (CoI)	University of Massachusetts - Amherst
Dr. Alaina L. Henry (CoI)	Space Telescope Science Institute
Prof. Anne Jaskot (CoI)	Williams College
Prof. Goeran Oestlin (CoI) (ESA Member)	Stockholm University
Dr. Roderik Overzier (CoI)	Observatorio Nacional
Prof. Daniel Schaerer (CoI) (ESA Member)	University of Geneva, Department of Astronomy
Dr. Zhiyuan Ji (CoI)	University of Arizona
Dr. Claus Leitherer (CoI)	Space Telescope Science Institute
Dr. Bingjie Wang (CoI)	The Pennsylvania State University
Dr. Xinfeng Xu (CoI)	The Johns Hopkins University
Prof. Matthew James Hayes (CoI) (ESA Member)	Stockholm University
Ms. Sophia R Flury (CoI)	University of Massachusetts - Amherst

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) J0121+0614	COS/FUV COS/NUV	4	26-Jun-2023 15:00:19.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
02	(2) J0219-0523	COS/FUV COS/NUV	2	26-Jun-2023 15:00:20.0	yes
03	(3) J1145+3350	COS/FUV COS/NUV	2	26-Jun-2023 15:00:20.0	yes
04	(4) J1230+3657	COS/FUV COS/NUV	2	26-Jun-2023 15:00:21.0	yes
05	(5) J2338-0302	COS/FUV COS/NUV	2	26-Jun-2023 15:00:21.0	yes
06	(5) J2338-0302	COS/FUV COS/NUV	1	26-Jun-2023 15:00:22.0	yes
07	(2) J0219-0523	COS/FUV COS/NUV	1	26-Jun-2023 15:00:22.0	yes

14 Total Orbits Used

ABSTRACT

The largest uncertainty in understanding the Epoch of Reionization (EOR) concerns the physical processes that enable Lyman Continuum (LyC) photons to escape the ISM in EOR galaxies. In recent years there has been significant progress in finding leaky galaxies at both low ($z < 0.4$) and moderate ($z \sim 3$) redshifts. At low-z most of the known leaky galaxies are relatively low-mass galaxies hosting intense starbursts.

However, there are now three examples at low-z that are dramatically different: they have relatively large stellar masses and SFRs and very compact sizes (leading extremely large values of SFR/Area). They are so disjoint in their properties from other low-z leaky galaxies that the physical processes that enable the LyC leakage are almost certainly different. Intruigingly, they are actually quite similar to known leaky galaxies at $z \sim 3$ in terms of mass and SFR.

In this proposal we request time to observe five new potential members of this class of massive compact leaky starbursts, selected to have the same properties as the three currently-known examples. Our goals are to directly detect escaping LyC radiation, quantify its escape fraction, ascertain whether these galaxies show the other UV properties associated with leakiness, and improve our knowledge of their demographics.

These galaxies can significantly broaden our horizons in understanding the full range of processes that enable the escape of LyC radiation. They may also represent the best local analogs to the most massive/luminous EOR galaxies, which may have been major contributors to reionization, and which will be the brightest EOR galaxies (allowing the most detailed studies with JWST).

OBSERVING DESCRIPTION

Observing Description

1. Sample Selection

We have used the SDSS DR12, GALEX-GR6, and WISE catalogs to identify galaxies meeting the following criteria: z > 0.25, stellar mass > 10^10 solar masses, strong [SII] deficiency, far-UV flux > 10^-16 erg cm^-2 s^-1 Ang^-1, and u-band half-light radius < 0.5 arcsec, no sign of an AGN. This results in a sample of 5 targets.

2. Observational Set-up

We will aquire two types of data:

We will perform COS target acquistion images using the standard near-UV imaging mode. This methofd produces the most reliable results for target centering in the COS primary science aperture (PSA), We will use the PSA MIRROR A mode. The images will be of sufficient quality for us to measure the size and structure of the starburst and assess the relationship between the escape of LyC radiation and starburst compactness and/or SFR/area.

We will use the COS G140L 800 grating to collect data below the Lyman limit.

3. Required Exposure Times

The exposure times were calculated uisng the on-line STScI COS Exposure Time Calculator. We first used the GALEX FUV and NUV fluxes to estimate a flux at 1000 (1+z) Ang. We corrected this for aperture effects by assuming that the relative flux inside the COS aperture to the total is the same as the same ratio derived from SDSS u--band images. This method has proved reliable in the past.

G140L: The intrinsic amplitude of the Lyman break in the stellar population (no ISM) is typically a factor of 2 to 3. Our goal is to reach a relative escape fraction of 10% at a 3-sigma confidence level. This implies measuing the LyC at a flux level of 3 to 5% of the flux at 1000(1+z) Ang. These measurements will be made by smoothing the data and measuring the flux in a window extending from the Lyman break to roughlly 20 to 80 Ang blueward (depending on the redshift of the galaxy). Based on ETC simulations, the required exposure times require 2 to 4 orbits per galaxy.

NUV ACQ Images: We have used the GALEX NUV fluxes and the SDSS u-band half-light radius. We aim for a total S/N of 40 to be able to accurately measure the NUV size. This implies exposure times of roughly 300 sec per target.

Visit

Proposal 17220, J0121+0614 (01), scheduling Mon Jun 26 19:00:22 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

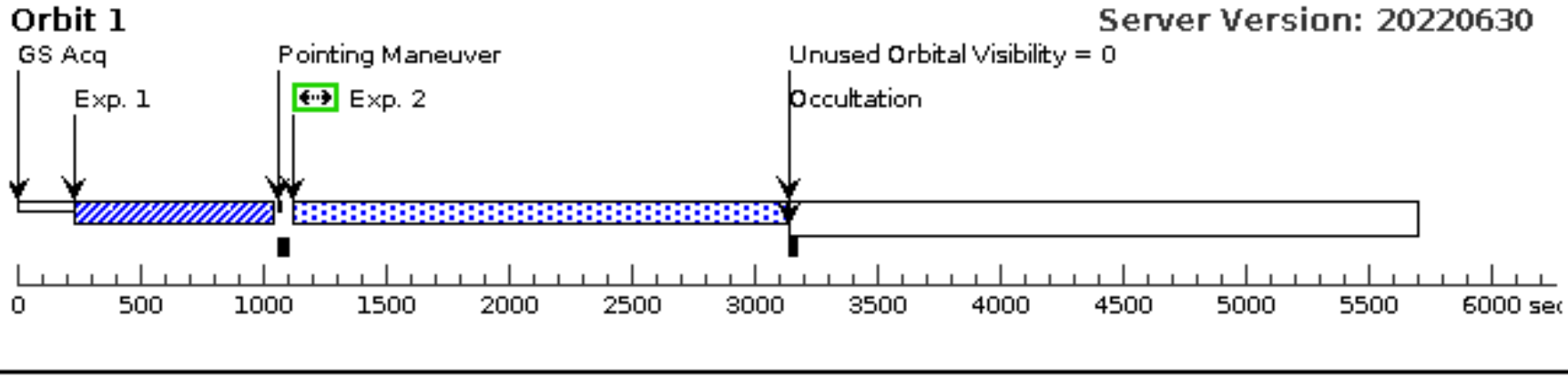
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J0121+0614	RA: 01 21 17.9000 (20.3245833d) Dec: +06 14 56.90 (6.24914d) Equinox: J2000		V=19.4+/-0.1	Reference Frame: ICRS

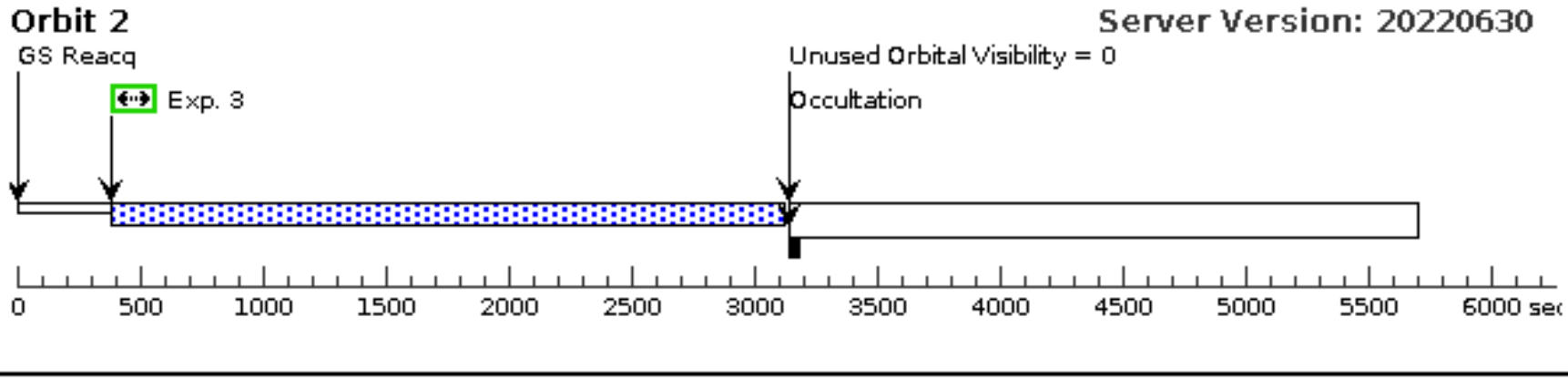
Comments:
Category=GALAXY
Description=[STARBURST]
Extended=NO

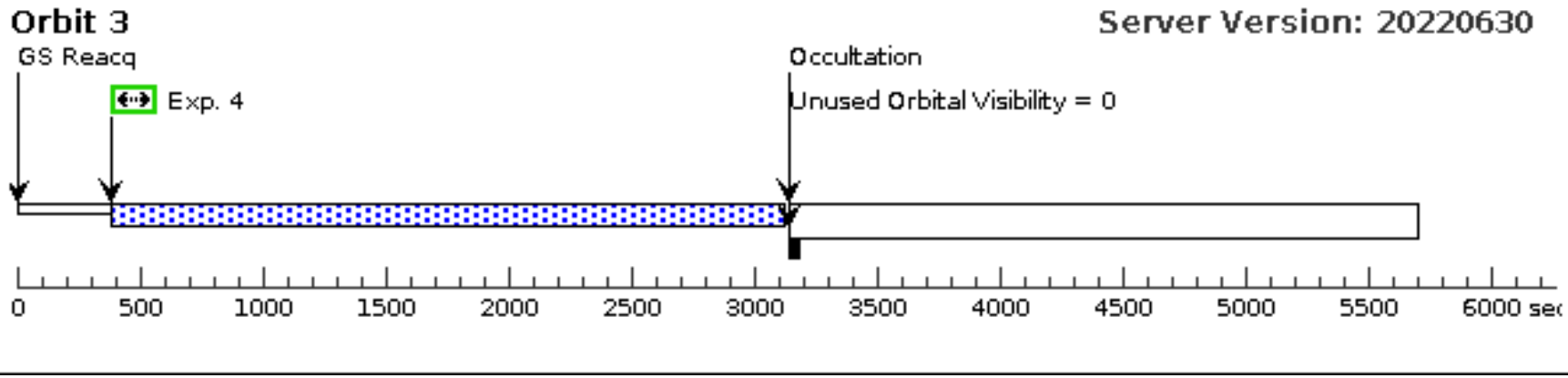
Exposures

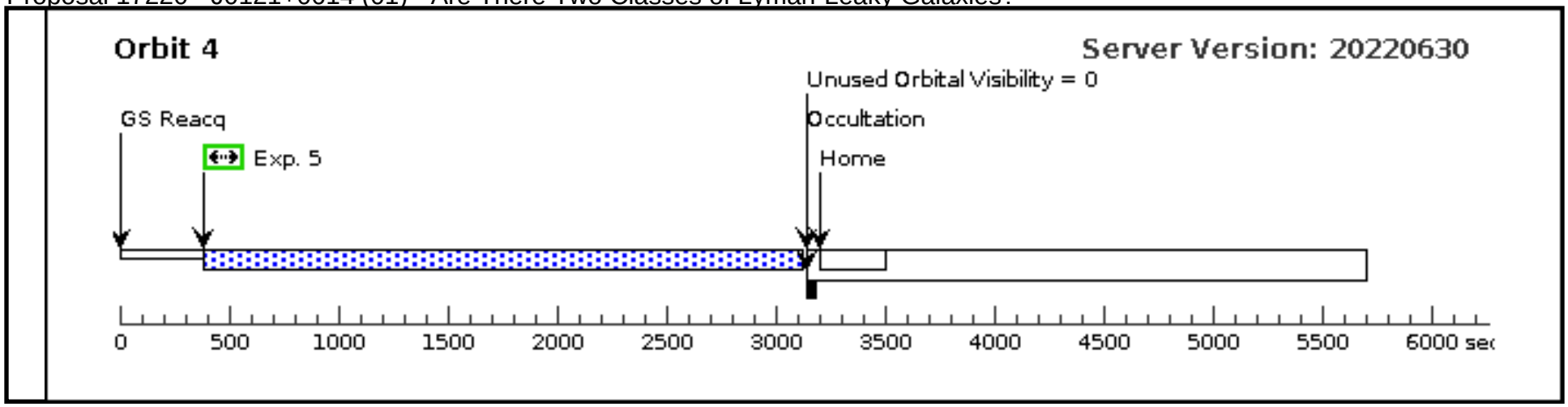
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ (1821005)	(1) J0121+0614	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				300 Secs (300 Secs) *[==>]*	***[1]***
2	G140La (1820864)	(1) J0121+0614	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=1; BUFFER-TIME=10000; FLASH=YES			100 Secs (1802 Secs) *[==>1802.0 Secs]*	***[1]***
3	G140Lb (1820864)	(1) J0121+0614	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=2; BUFFER-TIME=10000; FLASH=YES			2469 Secs (2689 Secs) *[==>2689.0 Secs]*	***[2]***
4	G140Lc (1820864)	(1) J0121+0614	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=3; BUFFER-TIME=10000; FLASH=YES			2469 Secs (2689 Secs) *[==>2689.0 Secs]*	***[3]***
5	G140Ld (1820864)	(1) J0121+0614	COS/FUV, TIME-TAG, PSA	G140L 800 A	FP-POS=4; BUFFER-TIME=10000; FLASH=YES			2469 Secs (2689 Secs) *[==>2689.0 Secs]*	***[4]***

Orbit Structure








Orbit 4
Server Version: 20220630
Unused Orbital Visibility = 0
GS Reacq
Occultation
Exp. 5
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Proposal 17220 - J0219--0523 (02) - Are There Two Classes of Lyman-Leaky Galaxies?

Visit

Proposal 17220, J0219--0523 (02), failed Mon Jun 26 19:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(J0219--0523 (02)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave. See the COS Instrument Handbook for exceptions that may apply to observations with G130M/1291 or G160M.

Fixed Targets

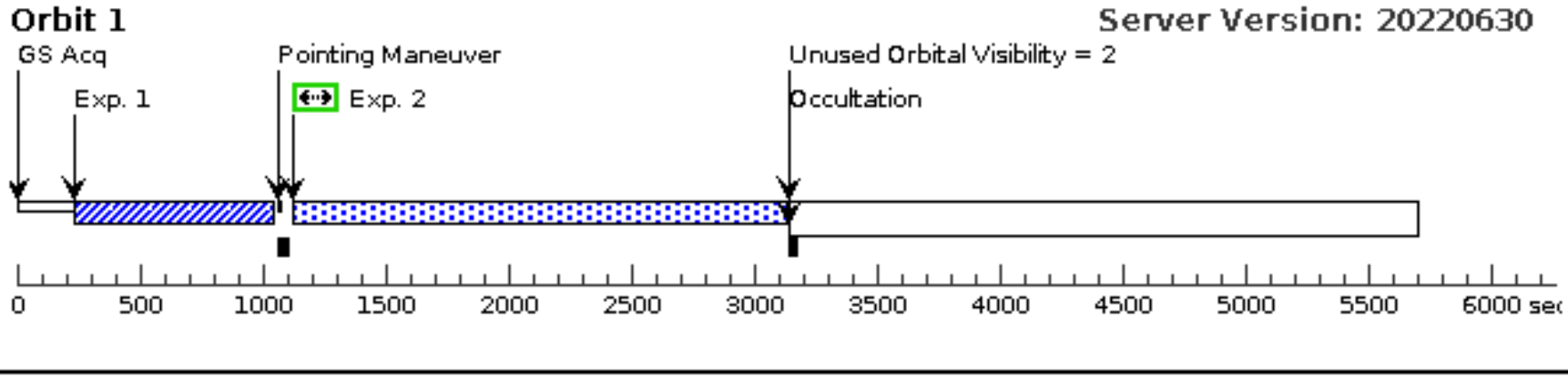
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	J0219-0523	RA: 02 19 24.4800 (34.8520000d) Dec: -05 23 35.20 (-5.39311d) Equinox: J2000		V=19.4+/-0.1	Reference Frame: ICRS

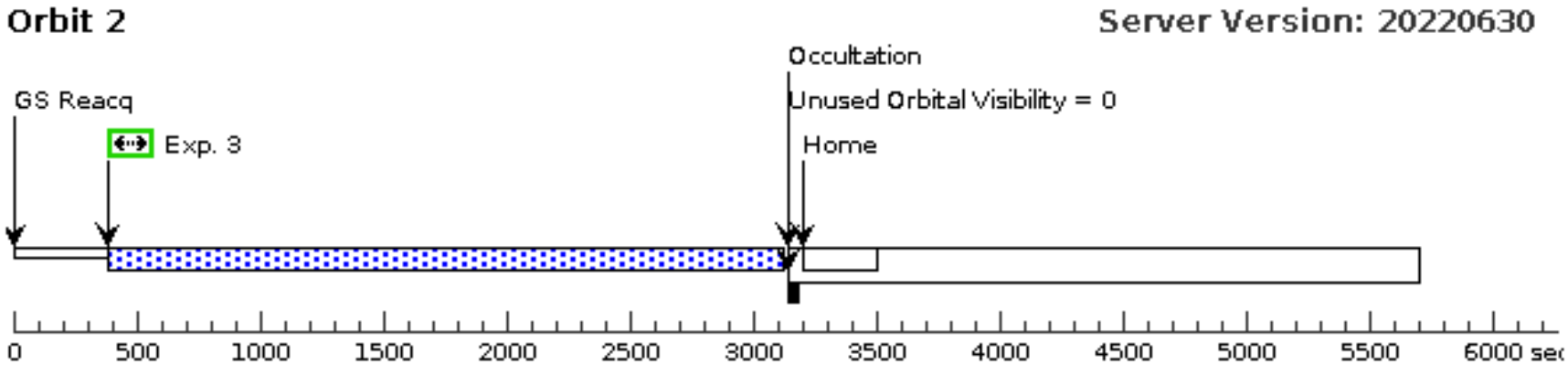
Comments:
Category=GALAXY
Description=[STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	J0219-0523 (1821006)	(2) J0219-0523	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				300 Secs (300 Secs) *[==>]*	***[1]***
2	(1820866)	(2) J0219-0523	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10000; FP-POS=1; FLASH=YES			1800 Secs (1800 Secs) *[==>]*	***[1]***
3	(1820866)	(2) J0219-0523	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10000; FP-POS=4; FLASH=YES			2500 Secs (2689 Secs) *[==>2689.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 17220, J1145+33 (03), scheduling Mon Jun 26 19:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(J1145+33 (03)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave. See the COS Instrument Handbook for exceptions that may apply to observations with G130M/1291 or G160M.

Fixed Targets

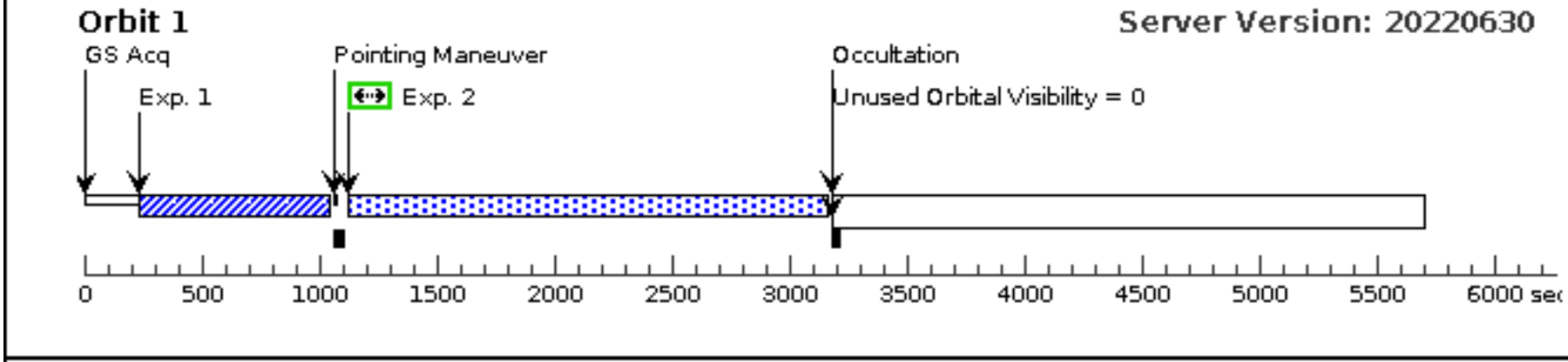
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	J1145+3350	RA: 11 45 16.5000 (176.3187500d) Dec: +33 50 51.70 (33.84769d) Equinox: J2000		V=20.1+/-0.1	Reference Frame: ICRS

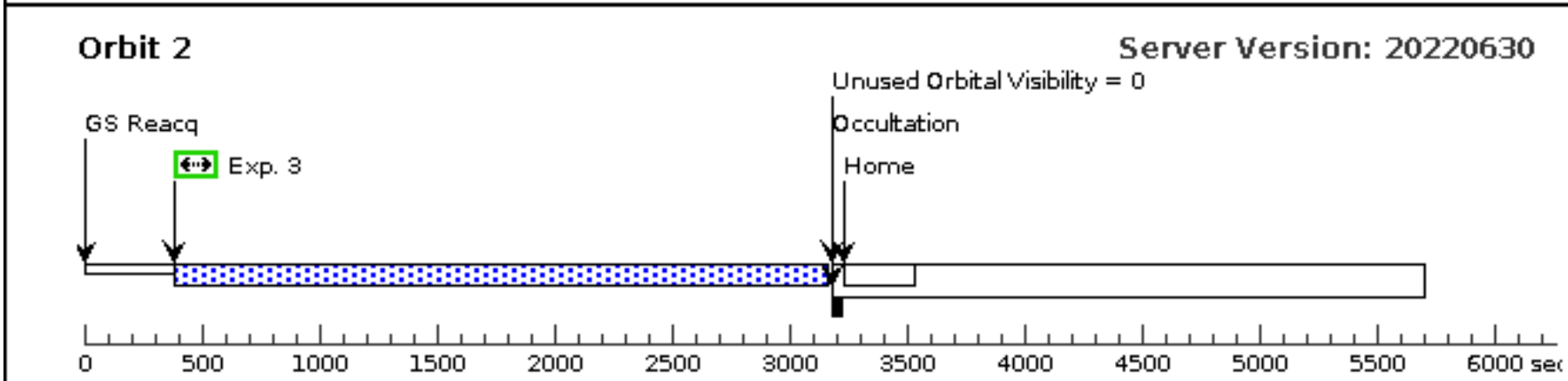
Comments:
Category=GALAXY
Description=[STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1821007)	(3) J1145+3350	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				300 Secs (300 Secs) *[==>]*	***[1]***
2	(1820870)	(3) J1145+3350	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10000; FP-POS=1; FLASH=YES			1600 Secs (1837 Secs) *[==>1837.0 Secs]*	***[1]***
3	(1820870)	(3) J1145+3350	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10000; FP-POS=4; FLASH=YES			2700 Secs (2724 Secs) *[==>2724.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 17220, J1230+3657 (04), scheduling Mon Jun 26 19:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(J1230+3657 (04)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave. See the COS Instrument Handbook for exceptions that may apply to observations with G130M/1291 or G160M.

Fixed Targets

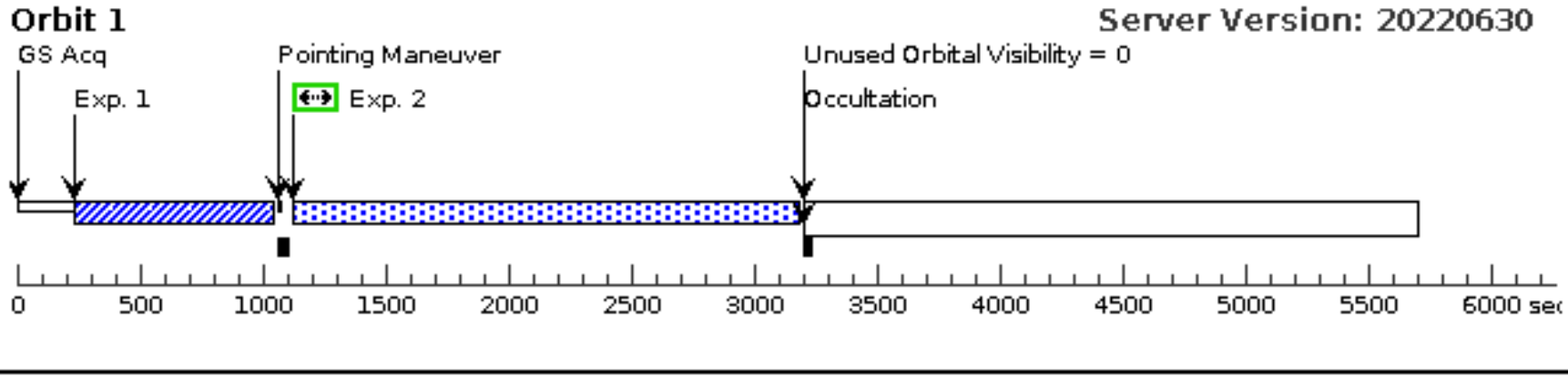
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	J1230+3657	RA: 12 30 54.8600 (187.7285833d) Dec: +36 57 20.20 (36.95561d) Equinox: J2000		V=20.2+/-0.1	Reference Frame: ICRS

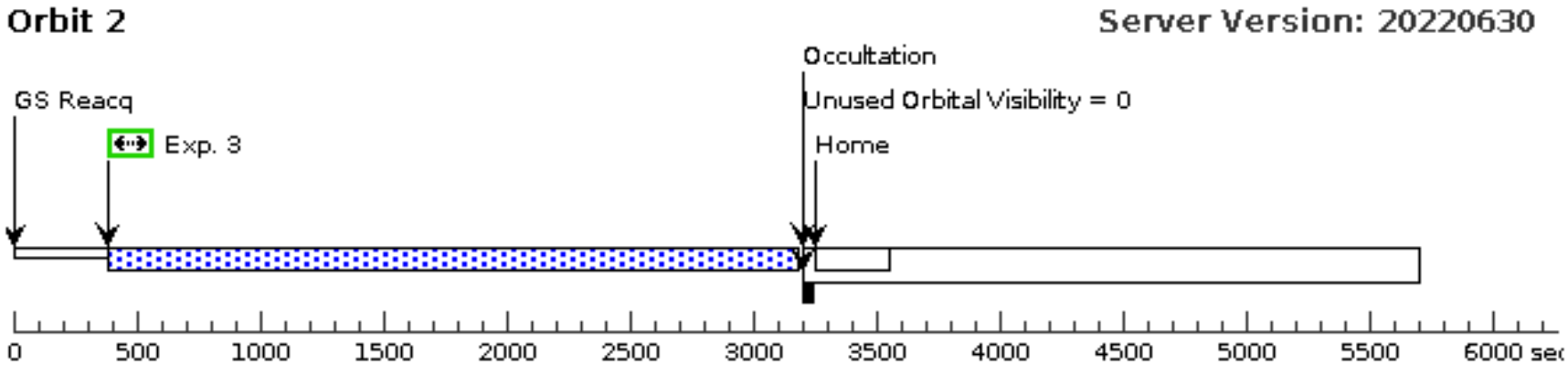
Comments:
Category=GALAXY
Description=[STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1821008)	(4) J1230+3657	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				300 Secs (300 Secs) *[==>]*	***[1]***
2	(1820871)	(4) J1230+3657	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000; FP-POS=1; FLASH=YES			1600 Secs (1857 Secs) *[==>1857.0 Secs]*	***[1]***
3	(1820871)	(4) J1230+3657	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000; FP-POS=4; FLASH=YES			3000 Secs (2744 Secs) *[==>2744.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 17220, J2348-03 (05), failed Mon Jun 26 19:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(J2348-03 (05)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave. See the COS Instrument Handbook for exceptions that may apply to observations with G130M/1291 or G160M.

Fixed Targets

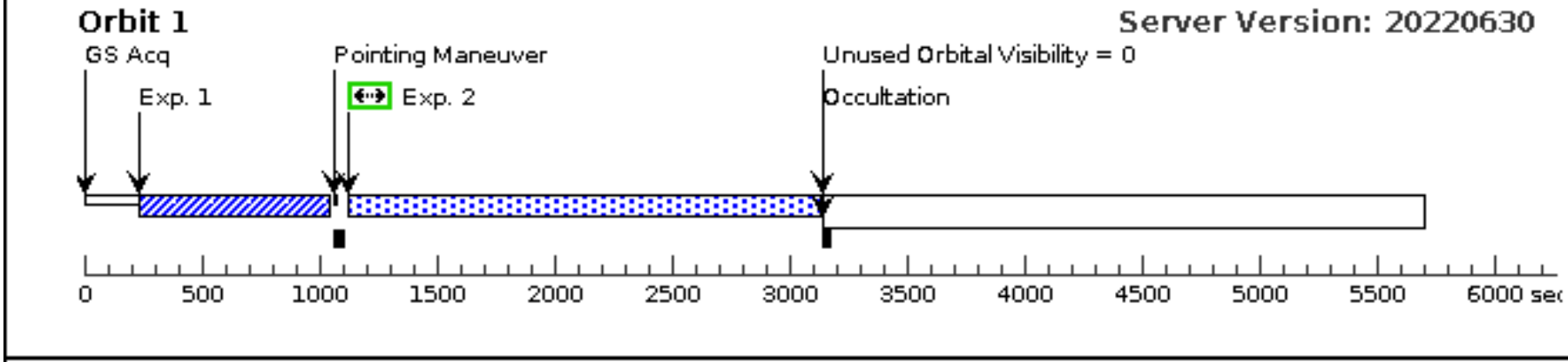
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	J2338-0302	RA: 23 48 31.1000 (357.1295833d) Dec: -03 02 41.00 (-3.04472d) Equinox: J2000		V=19.5+/-0.1	Reference Frame: ICRS

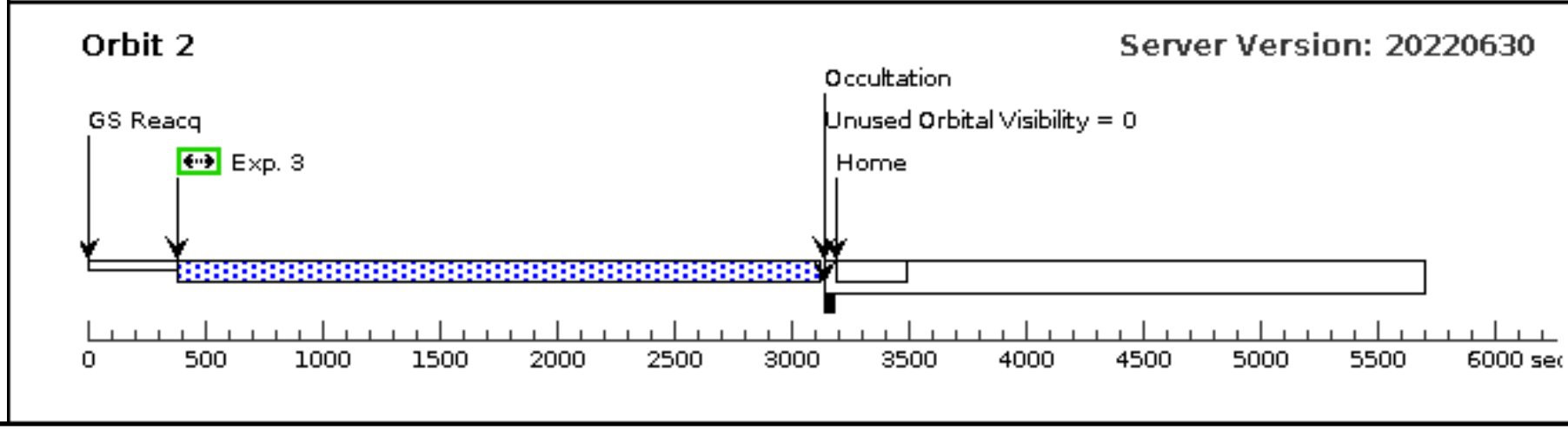
Comments:
Category=GALAXY
Description=[STARBURST]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1821009)	(5) J2338-0302	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				300 Secs (300 Secs) *[==>]*	***[1]***
2	(1820872)	(5) J2338-0302	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10000; FP-POS=1; FLASH=YES			1500 Secs (1799 Secs) *[==>1799.0 Secs]*	***[1]***
3	(1820872)	(5) J2338-0302	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10000; FP-POS=4; FLASH=YES			3000 Secs (2686 Secs) *[==>2686.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 17220, Re-do of visit 5 (06) Mon Jun 26 19:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: HOPR filed for guide star acquistion failure at start of orbit 2 for visit 5.

Diagnostics

(Re-do of visit 5 (06)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave. See the COS Instrument Handbook for exceptions that may apply to observations with G130M/1291 or G160M.

(Exposure 1 (Re-do of visit 5 (06))) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 2 (Re-do of visit 5 (06))) Warning (Form): Sensitive exposures should have an ETC run number provided.

Fixed Targets

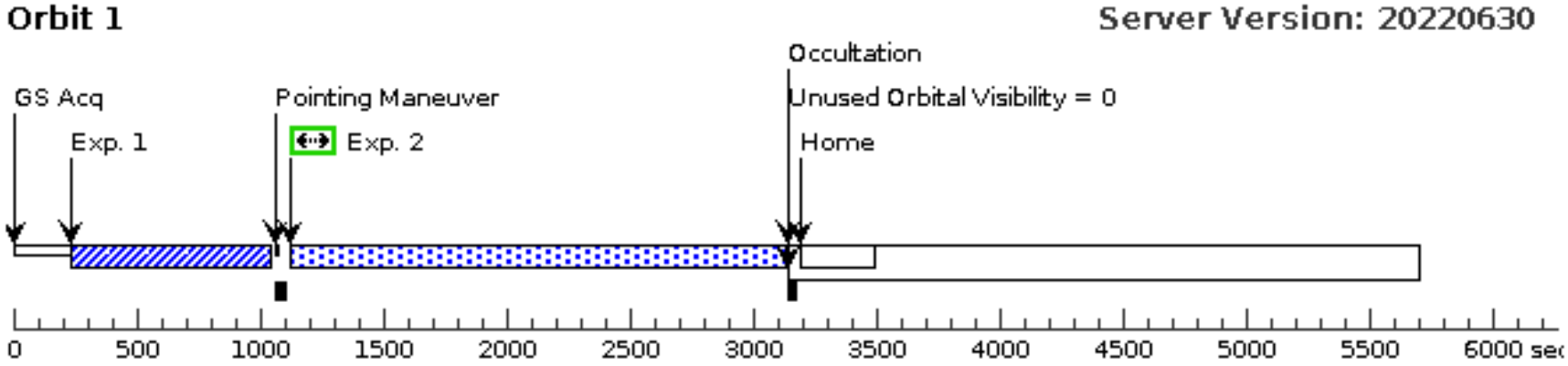
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	J2338-0302	RA: 23 48 31.1000 (357.1295833d) Dec: -03 02 41.00 (-3.04472d) Equinox: J2000		V=19.5+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[STARBURST]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(5) J2338-0302	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				300 Secs (300 Secs)	
								[==>]	***[1]***
2		(5) J2338-0302	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10000; FP-POS=4			1799 Secs (1799 Secs)	
								[==>]	***[1]***

Orbit Structure



Visit

Proposal 17220, Redo of visit 2 (07) Mon Jun 26 19:00:23 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Comments: Guide star acquistion failed before start of orbit 2. HOPR filed.

Diagnostics

(Redo of visit 2 (07)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions when observing at a given COS cenwave. See the COS Instrument Handbook for exceptions that may apply to observations with G130M/1291 or G160M.

(Exposure 1 (Redo of visit 2 (07))) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Exposure 2 (Redo of visit 2 (07))) Warning (Form): Sensitive exposures should have an ETC run number provided.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	J0219-0523	RA: 02 19 24.4800 (34.8520000d) Dec: -05 23 35.20 (-5.39311d) Equinox: J2000		V=19.4+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[STARBURST]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) J0219-0523	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				300 Secs (300 Secs)	
								[==>]	***[1]***
2		(2) J0219-0523	COS/FUV, TIME-TAG, PSA	G140L 800 A	BUFFER-TIME=10 000; FP-POS=4			1800 Secs (1800 Secs)	
								[==>]	***[1]***

Orbit Structure