15280 - Spatially resolved rest-UV spectroscopy of a prototypical quasar driven superwind at low-z

Cycle: 25, Proposal Category: GO

(UV Initiative)

(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	(1) J135648.92+102533.84-REF-STAR (2) J135646.10+102609.0-NUCLEUS	COS/FUV COS/NUV	2	13-Mar-2018 12:02:28.0	yes
02	(1) J135648.92+102533.84-REF-STAR (2) J135646.10+102609.0-NUCLEUS	COS/FUV COS/NUV	2	13-Mar-2018 12:02:29.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
03	(1) J135648.92+102533.84-REF-STAR (3) J135646.10+102609.0-BUBBLE	COS/FUV COS/NUV	1	13-Mar-2018 12:02:30.0	yes

5 Total Orbits Used

ABSTRACT

Powerful galaxy-wide winds launched by quasars are thought to be a common evolutionary phase of massive galaxies, but observations of this phenomena are scarce. We have conducted a multi-wavelength observational campaign for J1356+1026, a poster-child obscured quasar driving a superwind at z=0.123. J1356+1026 is driving a nuclear molecular outflow and an extended ionized outflow observed as an [OIII] emitting bubble at ~10 kpc that is spatially coincident with soft X-ray emission. Quasar-driven winds carry material at a wide range of densities and temperatures making it difficult to measure their energetics and the dominant phases are unknown. Here we propose spatially resolved rest-UV spectroscopy by acquiring circum-nuclear absorption spectra of J1356+1026 and emission spectra of its off-nucleus bubble using COS+G140L. The circum-nuclear spectrum will provide measurements of the outflow velocity through blueshifted absorption while the off-nuclear spectrum of the bubble will measure the ionization state and mechanisms of the outflow through powerful UV diagnostic lines. Together, these spectra will enable a more complete mass, energy and momentum accounting of a spatially resolved quasar driven superwind for the first time. Furthermore, detection of shocked gas through OVI emission will enable us to infer properties of the enigmatic volume-filling, low density component of the wind. To our knowledge, this will be the first spatially resolved rest UV spectroscopy of a quasar wind and the proposed observations will serve as a pilot to guide future HST proposals.

OBSERVING DESCRIPTION

Our program goal is to obtain UV spectroscopy of the outflows being driven by J1356+1026 at z=0.123 to enable powerful UV diagnostics of the physical conditions of the outflowing gas.

The wide wavelength coverage and moderate resolution of COS+G140L is ideally matched to our goal of obtaining UV spectra of J1356+1026. At z=0.123, the G140L spectrum will include intermediate and high ionization lines such as SiIV, CIV, NV, and OVI in addition lower ionization features such as CII, SiII, and SiIII. In addition, the COS primary science aperture is 2.5" in diameter which corresponds to 5.5 kpc at z=0.123. This is sufficient to include the majority of the light from both the nucleus which hosts the luminous AGN and the bubble with one pointing each. The

COS aperture at these pointings is shown in Figure 1 panels C and D of the Phase I proposal. Based on the estimates from our phase 1 proposal, the nuclear pointing will require 4 orbits and the off-nuclear bubble pointing will require 1 orbit. The five orbit program will be split between two 2 orbit visits for the nucleus and a single 1 orbit visit for the bubble. One 2 orbit visit will observe the nucleus in G140L/1280 in all four FP-POS positions and the second will similarly observe G140L/1105 in all four FP-POS positions. The 1 orbit visit will observe the nucleus in G140L/1105 in all four FP-POS positions which provides coverage of all features of interest at z=0.123.

J1356+1026 exhibits two nuclei, and though the targetted North nucleus is dominant in the blue, the irregular shape makes target acquisition with an offset star preferred. In order to place the nucleus in the COS aperture, we will acquire a nearby offset star with nuv magnitude 19.5 for 35 seconds, ensuring a total S/N of 50 based on the COS NUV acquisition ETC. We will then perform a 54" offset to place the nucleus in the aperture and acquire the proposed G140L nuclear spectra. We will acquire the bubble similarly.

The bubble exhibits a clear ridge and spatial orientation and we will set the orient so that the COS spatial axis runs along the ridge (North-South) to within +/- 5 deg as described in Phase I. We therefore place an orient requirement of 130-140 deg on visit 2.

Visit

Proposal 15280, Visit 01, implementation Tue Mar 13 16:02:31 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

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

(Exposure 2 (Visit 01)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

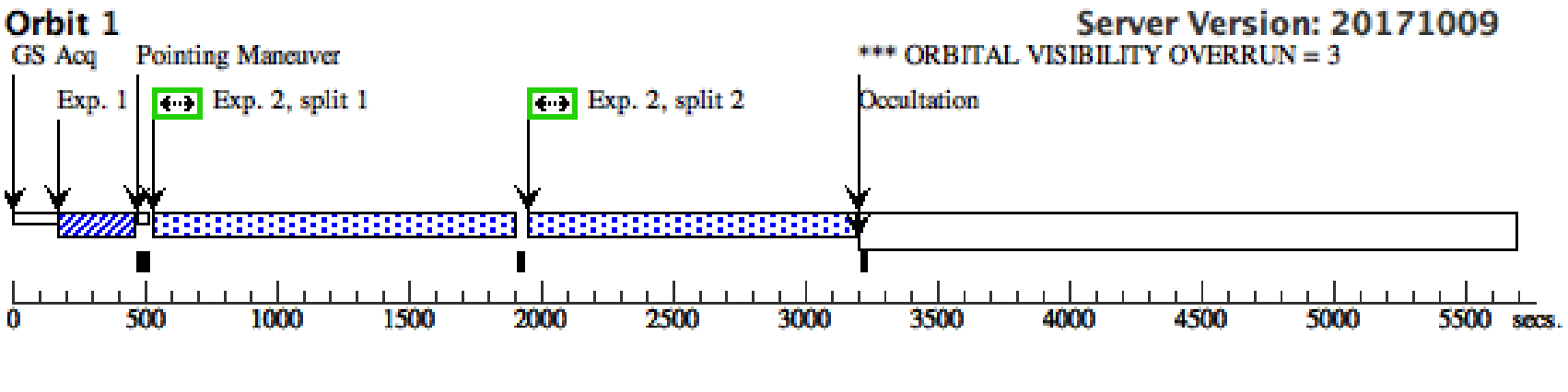
Fixed Targets

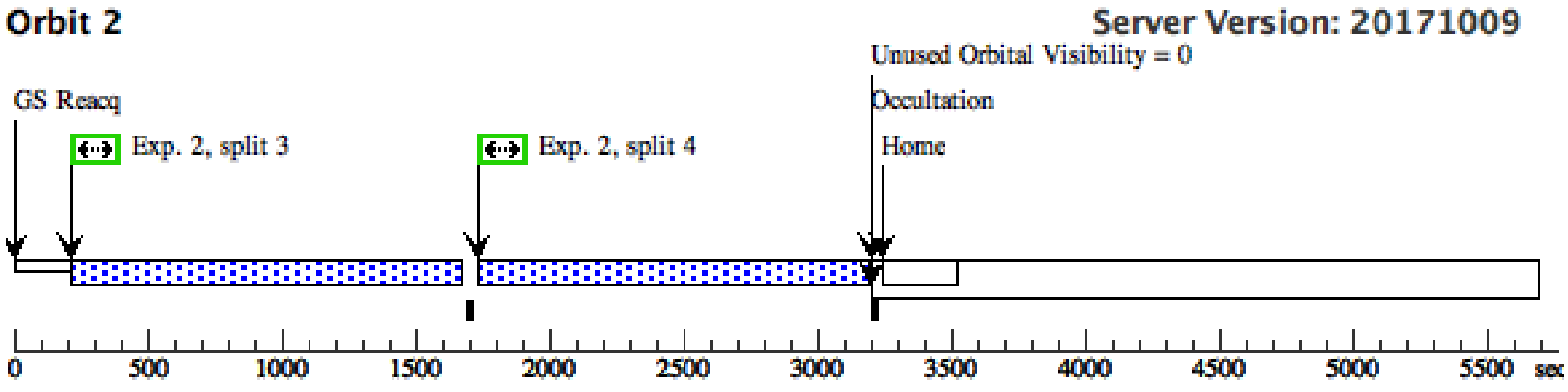
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J135648.92+102533.84-REF-STAR	RA: 13 56 48.9220 (209.2038417d) Dec: +10 25 33.84 (10.42607d) Equinox: J2000		V=16.0+/-0.05	Reference Frame: ICRS
Comments: *Category=STAR* *Description=[A4-A9 III-I]* *Extended=NO*					
(2)	J135646.10+102609.0-NUCLEUS Alt Name1: 2MASXJ13564607+1026088 Alt Name2: IRAS13543+1040	Offset from J135648.92+102533.84-REF-STAR RA Offset: -0.011522853053581156 Degrees Dec Offset: 0.0097974354333 Degrees	Redshift: 0.1231	V=16.0+/-0.1 fuv=18.5	Offset Position (J135646.10+102609.0-NUCLEUS)
Comments: *Category=GALAXY* *Description=[INTERACTING GALAXY, NLR, NUCLEUS, QUASAR]* *Extended=YES*					

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1012162)	(1) J135648.92+102533.84-REF-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				35 Secs (35 Secs)	
								[==>]	***[1]***
2	(COS.sp.1012174)	(2) J135646.10+102609.0-NUCLEUS	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=13533; FP-POS=ALL			900 Secs (5200 Secs)	
								[==>1191.0 Secs (Split 1)] *[==>1191.0 Secs (Split 2)]*	***[1]***
								[==>1409.0 Secs (Split 3)] *[==>1409.0 Secs (Split 4)]*	***[2]***

Orbit Structure





Visit

Proposal 15280, Visit 02, implementation Tue Mar 13 16:02:31 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(Exposure 2 (Visit 02)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

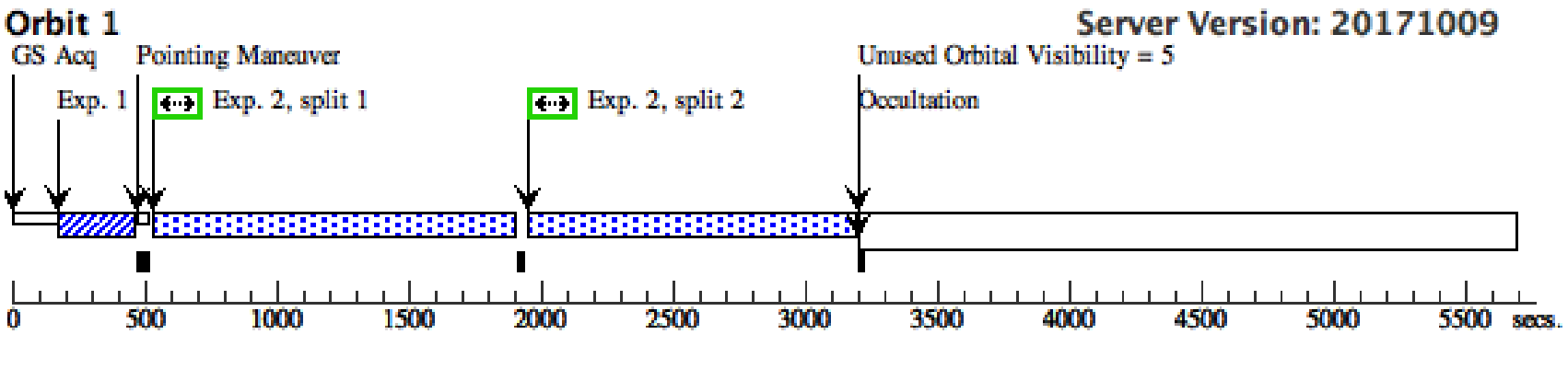
Fixed Targets

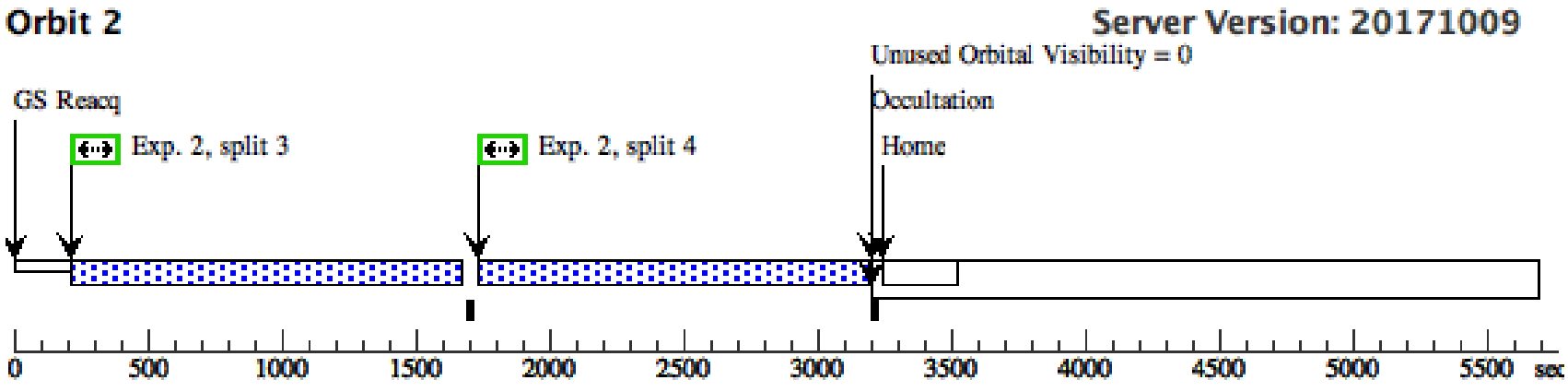
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J135648.92+102533.84-REF-STAR	RA: 13 56 48.9220 (209.2038417d) Dec: +10 25 33.84 (10.42607d) Equinox: J2000		V=16.0+/-0.05	Reference Frame: ICRS
Comments: *Category=STAR* *Description=[A4-A9 III-I]* *Extended=NO*					
(2)	J135646.10+102609.0-NUCLEUS Alt Name1: 2MASXJ13564607+1026088 Alt Name2: IRAS13543+1040	Offset from J135648.92+102533.84-REF-STAR RA Offset: -0.011522853053581156 Degrees Dec Offset: 0.0097974354333 Degrees	Redshift: 0.1231	V=16.0+/-0.1 fuv=18.5	Offset Position (J135646.10+102609.0-NUCLEUS)
Comments: *Category=GALAXY* *Description=[INTERACTING GALAXY, NLR, NUCLEUS, QUASAR]* *Extended=YES*					

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1012162)	(1) J135648.92+102533.84-REF-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				35 Secs (35 Secs) *[==>]*	 ***[1]***
2	(COS.sp.1012180)	(2) J135646.10+102609.0-NUCLEUS	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=13533; FP-POS=ALL			900 Secs (5192 Secs) *[==>1187.0 Secs (Split 1)]* *[==>1187.0 Secs (Split 2)]* *[==>1409.0 Secs (Split 3)]* *[==>1409.0 Secs (Split 4)]*	 ***[1]*** ***[2]***

Orbit Structure





Visit

Proposal 15280, Visit 03, implementation Tue Mar 13 16:02:31 GMT 2018

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: ORIENT 130D TO 140 D

Diagnostics

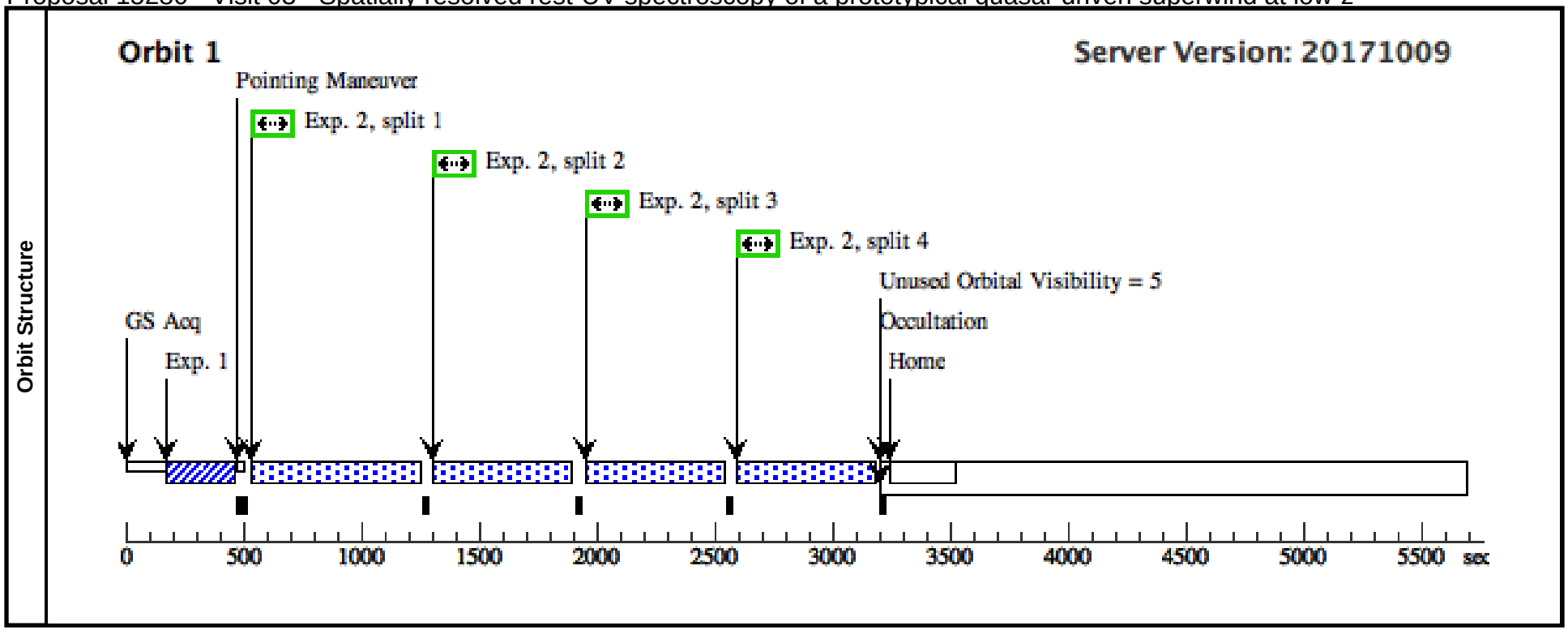
(Exposure 2 (Visit 03)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J135648.92+102533.84-REF-STAR	RA: 13 56 48.9220 (209.2038417d) Dec: +10 25 33.84 (10.42607d) Equinox: J2000		V=16.0+/-0.05	Reference Frame: ICRS
Comments: *Category=STAR* *Description=[A4-A9 III-I]* *Extended=NO*					
(3)	J135646.10+102609.0-BUBBLE	Offset from J135648.92+102533.84-REF-STAR RA Offset: -0.0116950084391152 Degrees Dec Offset: 0.008461330739799567 Degrees	Redshift: 0.1231	V=21+/-0.1	Offset Position (J135646.10+102609.0-BUBBLE)
Comments: *Category=EXT-MEDIUM* *Description=[EMISSION LINE NEBULA, KNOT, NLR]* *Extended=YES*					

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1012162)	(1) J135648.92+102533.84-REF-STAR	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				35 Secs (35 Secs)	
								[==>]	***[1]***
2	(COS.sp.1012180)	(3) J135646.10+102609.0-BUBBLE	COS/FUV, TIME-TAG, PSA	G140L 1105 A	FP-POS=ALL; BUFFER-TIME=13533			550 Secs (2164 Secs)	
								[==>541.0 Secs (Split 1)] *[==>541.0 Secs (Split 2)]* *[==>541.0 Secs (Split 3)]* *[==>541.0 Secs (Split 4)]*	***[1]***


Orbit Structure
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Server Version: 20171009
Pointing Maneuver
Exp. 2, split 1
Exp. 2, split 2
Exp. 2, split 3
Exp. 2, split 4
Unused Orbital Visibility = 5
Occultation
GS Acq
Exp. 1
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec