17475 - Probing the limits of nitrogenic ultraviolet emission in the most extreme nearby star-forming galaxies

Cycle: 31, 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) J024052.19-082827.4	COS/NUV	3	12-Jun-2024 13:01:31.0	yes
02	(1) J024052.19-082827.4	COS/FUV COS/NUV	3	12-Jun-2024 13:01:32.0	yes
03	(2) J084029.91+470710.2	COS/FUV COS/NUV	2	12-Jun-2024 13:01:33.0	yes
04	(3) J173501.25+570308.5	COS/FUV COS/NUV	2	12-Jun-2024 13:01:34.0	yes

10 Total Orbits Used

ABSTRACT

The unexpected discovery of prominent lines of doubly- and triply-ionized nitrogen in one of the most luminous galaxies at z~10 has dramatically demonstrated both the power and the challenge represented by JWST spectroscopy. The spectrum of GN-z11 dramatically yields both a super-solar estimate of N/O and a measurement of the electron density orders of magnitude larger than anticipated for normal star-forming systems. Yet beyond these facts, the nature of this object remains hotly debated - in particular, whether such features necessitate a supermassive black hole or whether they can be produced by extremely concentrated metal-poor star formation remains unclear. As for many of the other surprising high-ionization emission lines found at high-z, galaxies in the local Universe may represent our best hope of casting empirical light on such distant detections - yet few constraints on these lines are available in the local UV archive. Here we propose unique COS spectroscopic follow-up of both the crucial NIV] and NIII] transitions in the UV at moderately-high resolution, in a sample of compact star-forming galaxies with strong evidence of substantial N/O enhancement nearby. These spectra will probe the limits of these emission lines produced by intense star formation today. We will leverage the constraints on both multiplets to investigate nitrogen production in very young star-forming environments near the metallicity of GN-z11, and probe gas conditions across densities orders of magnitude higher than accessible in the optical. This is a prime opportunity for direct dialogue between JWST and HST observations, which can only be realized while HST/COS remains operational.

OBSERVING DESCRIPTION

This program will acquire NUV+FUV spectroscopy designed to constrain high-ionization nebular emission in N III] 1750 and N IV] 1483,1386 (as well as other UV emission lines where possible simultaneously) for three metal-poor galaxies with signatures of highly-ionized gas and relatively high nitrogen abundances in the optical. The targets are all covered by SDSS imaging and spectroscopy by selection and have GALEX imaging useful in observation planning.

Coordinates and acquisition: Each target is a compact source whose core (the target of our observations) is unresolved in ground-based imaging. The target coordinates are derived directly from the ICRS-aligned SDSS photometry. Following practices established in previous programs targeting similar objects, each target is acquired with a standard ACQ/IMAGE exposure, with exposure time chosen to deliver S/N=50 for a point source with an NUV AB magnitude equal to the faintest of the u-band fiber and cModel magnitudes (assuming a flat continuum in F_nu, appropriate for such sources). We confirm that all three have GALEX/NUV magnitudes in-excess of this conservative estimate; and to ensure detector safely, we likewise confirm that no warnings are raised for a Mirror A+PSA observation of a point source with the brightest GALEX/NUV magnitude among the three

(~17.7). Based upon previous observations of similar sources, we expect these targets to be more extended than a point source, but with FWHM at NUV wavelengths significantly smaller than 0.6"; given this, the large requested S/N provides an appropriate buffer to ensure accurate acquisition of such targets.

Observing plan: Our primary objective is nebular line measurement; our observations are thus in the low-S/N regime (<~5 /resel in the continuum). For each galaxy, we pick a grating setting that centers the crucial NIII] or NIV] lines of interest and additionally includes as many of the other nebular UV lines of interest (CIV, He II, OIII] in particular) as possible. Since these targets have also not been observed in the targeted UV regions prior, we adopt a conservative approach that 1) maximizes total exposure time on source while also 2) minimizing the likelihood of lost data due to partial buffer reads. Since we are in the low-SNR regime for all three targets, we only need to utilize2 FP-POS settings for G160M LP6 exposures and have no minimum for G185M. For the faintest source, J0240-0828, we are allocated 3 orbits per grating. To maximize integration time and minimize overheads, we adopt a long-dwell observing strategy that focuses on one grating per each of 2 visits and only changes the FP-POS between orbits. For J0240-0828, we fix the G185M observations at the bluest G185M/1890 FP-POS position (FP-POS=4) to capture as much of He II 1640 as possible. For the G160M visit, we observe at 3 FP-POS for better wavelength coverage (1,3,4). For the other objects, we simply observe at G185M FP-POS=3 and G160M FP-POS=1+4 (after confirming that the resulting small gap of unusable wavelengths in G160M then falls in a wavelength range that does not affect the target lines).

The buffer time is chosen to maximize the amount of the buffer that is read-out while also minimizing overheads. The G160M exposures always have an estimated buffer fill time (BFT) an order of magnitude higher than the exposure times even with a conservative estimate of the spectrum (flat in AB with magnitude set to the GALEX NUV magnitude). The G185M exposure BFTs are close to the length of the longer integrations; since readouts occur during occultation and thus efficiency is not a concern, we simply choose a buffer time for these exposures to 1/2xBFT to ensure all data is read-out.

Safety: The only BOT warnings generated are for the GSC2 check, which gathers the full light of each galaxy at V-band and assumes incorrectly that this light is in a O5V star. No GALEX BOT warnings are generated, even under the (conservative but incorrect) assumption that all of the GALEX NUV light is concentrated in an unresolved point source at COS resolution.

Visit

Proposal 17475, Visit 01, implementation Wed Jun 12 17:01:34 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV

Special Requirements: (none)

Fixed Targets

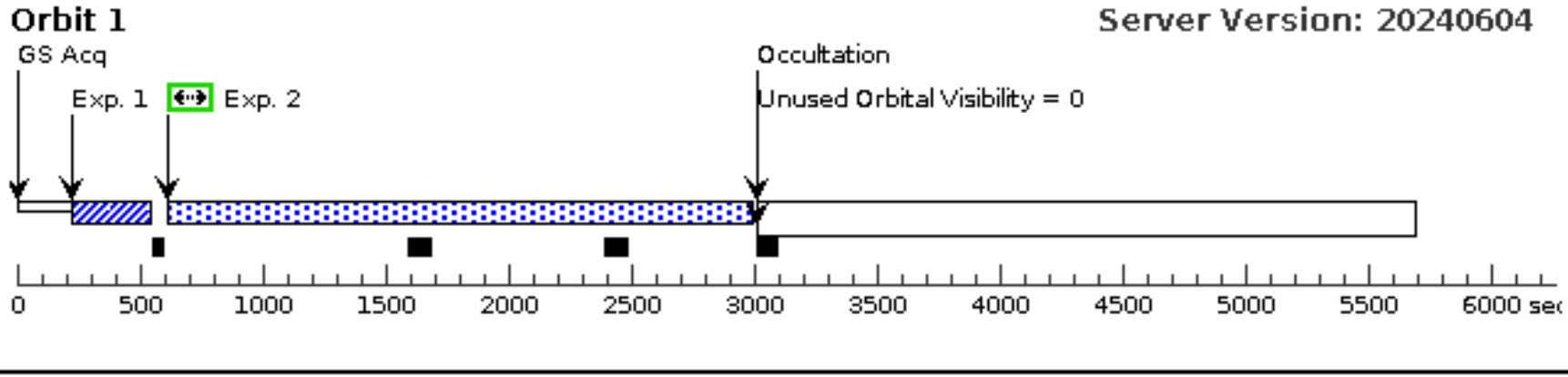
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J024052.19-082827.4	RA: 02 40 52.1900 (40.2174583d) Dec: -08 28 27.41 (-8.47428d) Equinox: J2000		V=19.9 umag=19.9, z=0.082	Reference Frame: ICRS

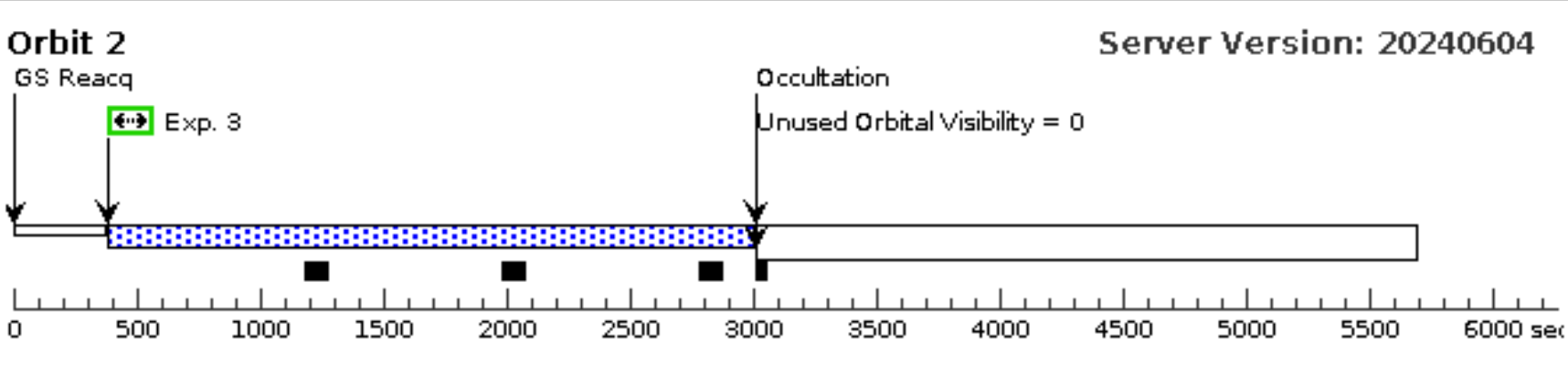
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STAR FORMING REGION]
Extended=NO

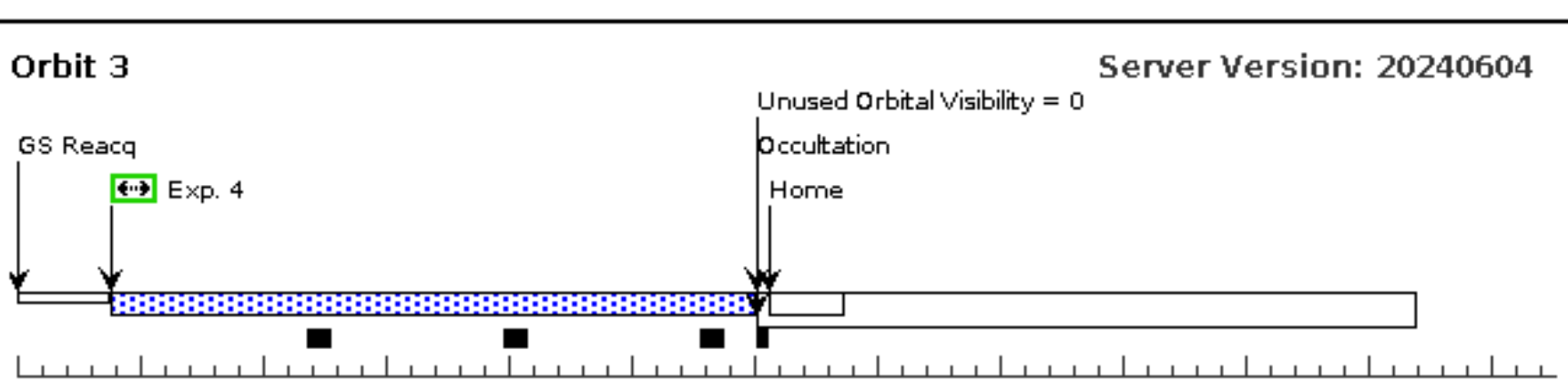
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1891240)	(1) J024052.19-082827.4	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				52 Secs (52 Secs) *[==>]*	*[1]*
2	(COS.sp.1891377)	(1) J024052.19-082827.4	COS/NUV, TIME-TAG, PSA	G185M 1890 A	FP-POS=4; BUFFER-TIME=800; FLASH=YES			2255 Secs (2193 Secs) *[==>2193.0 Secs]*	*[1]*
3	(COS.sp.1891377)	(1) J024052.19-082827.4	COS/NUV, TIME-TAG, PSA	G185M 1890 A	FP-POS=4; BUFFER-TIME=800; FLASH=YES			2716 Secs (2603 Secs) *[==>2603.0 Secs]*	*[2]*
4	(COS.sp.1891377)	(1) J024052.19-082827.4	COS/NUV, TIME-TAG, PSA	G185M 1890 A	FP-POS=4; BUFFER-TIME=800; FLASH=YES			2716 Secs (2603 Secs) *[==>2603.0 Secs]*	*[3]*

Orbit Structure







Visit

Proposal 17475, Visit 02, implementation Wed Jun 12 17:01:34 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Diagnostics

(Visit 02) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS

Fixed Targets

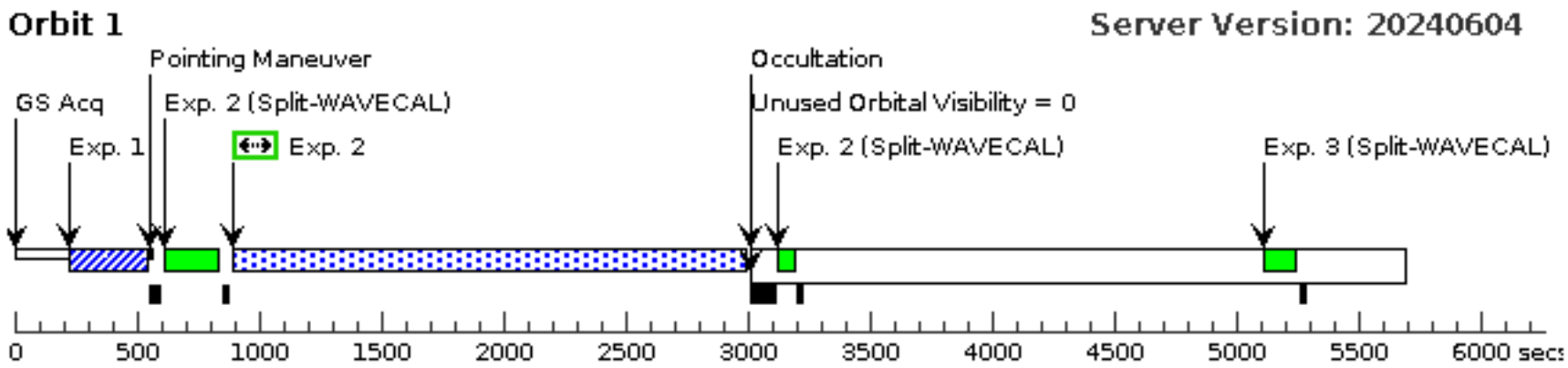
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	J024052.19-082827.4	RA: 02 40 52.1900 (40.2174583d) Dec: -08 28 27.41 (-8.47428d) Equinox: J2000		V=19.9 umag=19.9, z=0.082	Reference Frame: ICRS

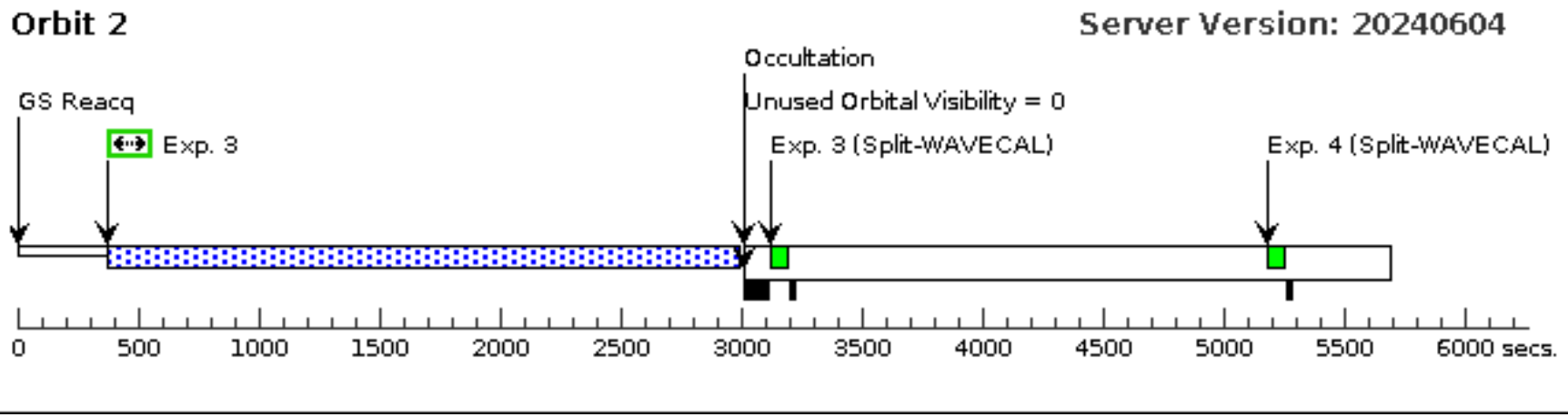
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STAR FORMING REGION]
Extended=NO

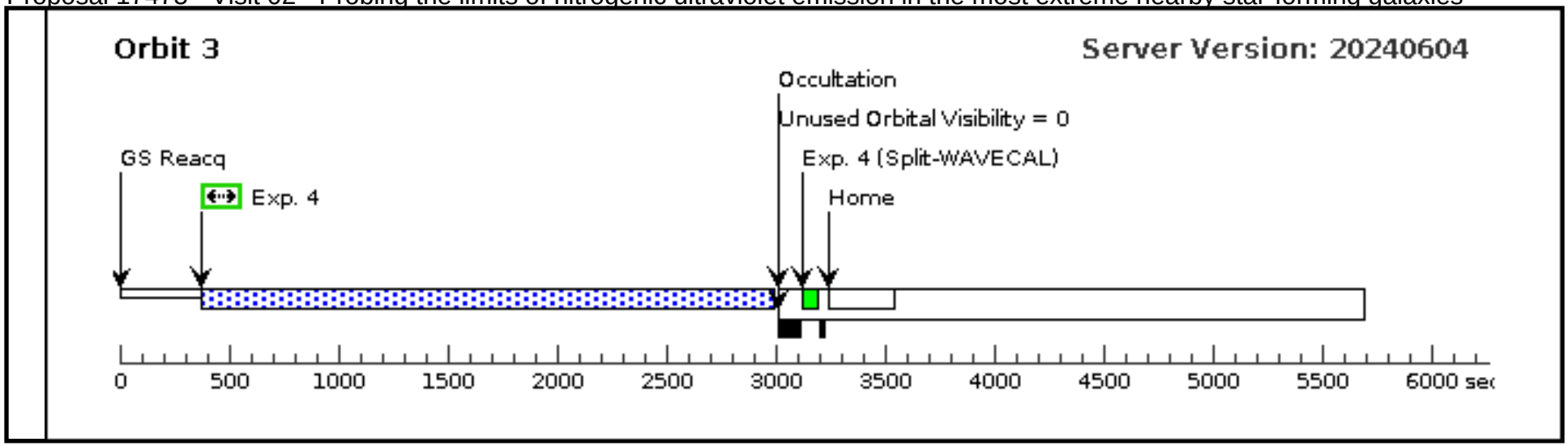
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1891240)	(1) J024052.19-082827.4	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				53 Secs (53 Secs) *[==>]*	***[1]***
2	(COS.sp.1891385)	(1) J024052.19-082827.4	COS/FUV, TIME-TAG, PSA	G160M 1589 A	FP-POS=3; BUFFER-TIME=2115			2115 Secs (2053 Secs) *[==>2053.0 Secs]*	***[1]***
3	(COS.sp.1891385)	(1) J024052.19-082827.4	COS/FUV, TIME-TAG, PSA	G160M 1589 A	FP-POS=1; BUFFER-TIME=2683			2683 Secs (2570 Secs) *[==>2570.0 Secs]*	***[2]***
4	(COS.sp.1891385)	(1) J024052.19-082827.4	COS/FUV, TIME-TAG, PSA	G160M 1589 A	FP-POS=4; BUFFER-TIME=2683			2683 Secs (2570 Secs) *[==>2570.0 Secs]*	***[3]***

Orbit Structure



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Exp. 4
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1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17475, Visit 03, implementation Wed Jun 12 17:01:34 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

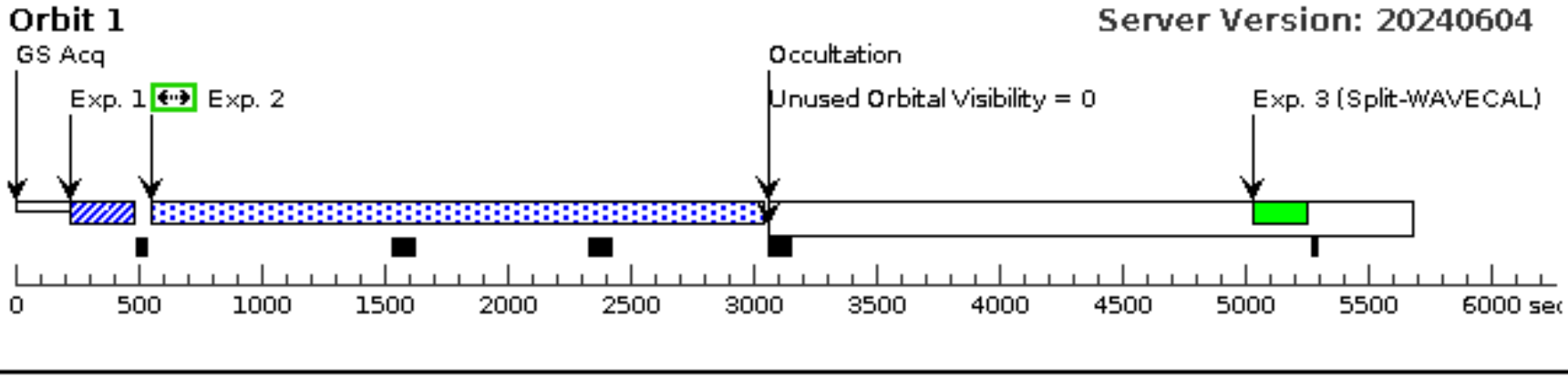
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	J084029.91+470710.2	RA: 08 40 29.9100 (130.1246250d) Dec: +47 07 10.25 (47.11951d) Equinox: J2000		V=18.5 umag=18.9, z=0.042	Reference Frame: ICRS

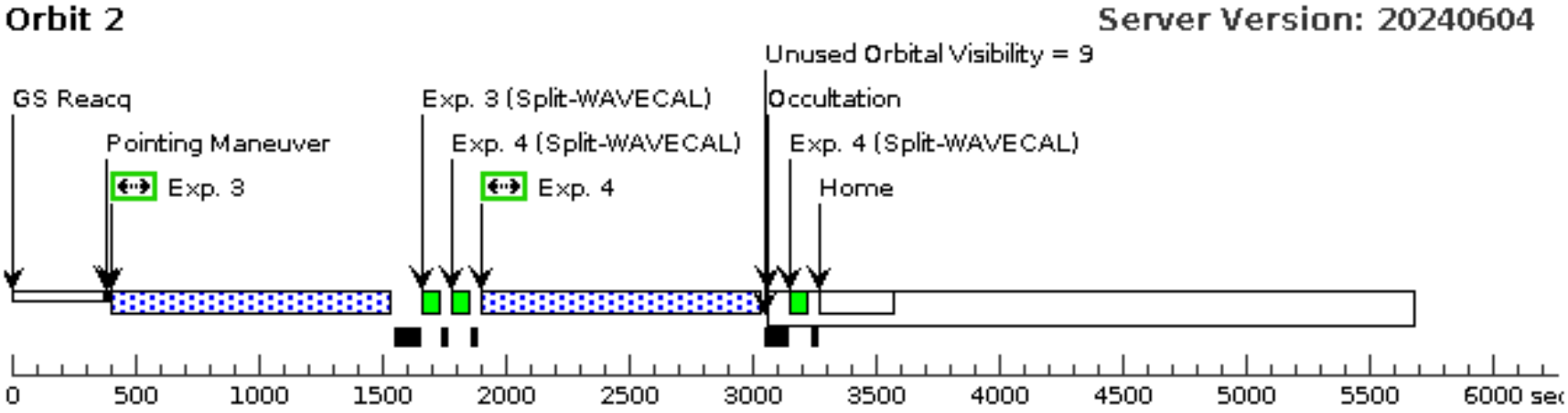
Comments:
Category=GALAXY
Description=[DWARF COMPACT, STAR FORMING REGION]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1891327)	(2) J084029.91+470710.2	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				22 Secs (22 Secs) *[==>]*	***[1]***
2	(COS.sp.1891379)	(2) J084029.91+470710.2	COS/NUV, TIME-TAG, PSA	G185M 1817 A	FP-POS=3; BUFFER-TIME=800; FLASH=YES			2443 Secs (2305 Secs) *[==>2305.0 Secs]*	***[1]***
3	(COS.sp.1891380)	(2) J084029.91+470710.2	COS/FUV, TIME-TAG, PSA	G160M 1589 A	FP-POS=1; BUFFER-TIME=1124			1234 Secs (1083 Secs) *[==>1083.0 Secs]*	***[2]***
4	(COS.sp.1891380)	(2) J084029.91+470710.2	COS/FUV, TIME-TAG, PSA	G160M 1589 A	FP-POS=4; BUFFER-TIME=1235			1235 Secs (1084 Secs) *[==>1084.0 Secs]*	***[2]***

Orbit Structure





Visit

Proposal 17475, Visit 04, implementation Wed Jun 12 17:01:34 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	J173501.25+570308.5	RA: 17 35 1.2500 (263.7552083d) Dec: +57 03 8.57 (57.05238d) Equinox: J2000		V=17.7 umag=18.1, z=0.047	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[DWARF COMPACT, STAR FORMING REGION]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1891358)	(3) J173501.25+570308.5	COS/NUV, ACQ/IMAGE, PSA	MIRRORA				11 Secs (11 Secs) *[==>]*	*[1]*
2	(COS.sp.1891381)	(3) J173501.25+570308.5	COS/NUV, TIME-TAG, PSA	G185M 1835 A	FP-POS=3; BUFFER-TIME=8000; FLASH=YES			2580 Secs (2364 Secs) *[==>2364.0 Secs]*	*[1]*
3	(COS.sp.1891382)	(3) J173501.25+570308.5	COS/FUV, TIME-TAG, PSA	G160M 1600 A	FP-POS=1; BUFFER-TIME=1182			1292 Secs (1069 Secs) *[==>1069.0 Secs]*	*[2]*
4	(COS.sp.1891382)	(3) J173501.25+570308.5	COS/FUV, TIME-TAG, PSA	G160M 1600 A	FP-POS=4; BUFFER-TIME=1292			1292 Secs (1069 Secs) *[==>1069.0 Secs]*	*[2]*

Orbit Structure