17186 - The Origins and Evolution of Helium Atmosphere White Dwarfs

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) SDSS-J170727.10+203153.2	COS/FUV	3	27-Sep-2022 14:01:12.0	yes
02	(1) SDSS-J170727.10+203153.2	COS/FUV	3	27-Sep-2022 14:01:14.0	yes
03	(2) SDSS-J141127.11+035429.6	COS/FUV	3	27-Sep-2022 14:01:18.0	yes
04	(2) SDSS-J141127.11+035429.6	COS/FUV	1	27-Sep-2022 14:01:19.0	yes

10 Total Orbits Used

ABSTRACT

Aims: The proposed observations will conduct the first UV investigation helium atmosphere white dwarfs found within the "DB gap", and will determine their physical parameters.

Context: The origin and evolution of helium atmosphere white dwarfs (DBs) is poorly constrained.

White dwarfs are structurally simple; they consist of an electron degenerate core surrounded by an insulating blanket of hydrogen (DA) and/or helium (DB). Their evolution is dominated by secular cooling. The DB gap is a temperature range between 45,000 and 30,000 K where mostly DA white dwarfs are found. There is no readily apparent reason why this should be, so theories of white dwarf formation and evolution have been forced to scenarios that explain this gap. The Sloan Digital Sky Survey has revealed a population of DB white dwarfs that lie within this gap.
Little is known about these objects besides their optical temperatures. The fundamental physical properties and chemical abundances of these objects can be used to test competing theories of white dwarf formation and evolution, leading to a better understanding of the white dwarf population and the final stages of stellar evolution.

Methods: The proposal presents justification for COS observations of 2 DB white dwarfs with temperatures between 45,000 and 30,000 K. The observations will determine accurate effective temperatures, surface gravities and chemical abundances for each.

OBSERVING DESCRIPTION

The proposed observations will conduct the first UV investigation of helium atmosphere white dwarfs found within the "DB gap", and will determine their physical parameters. The scientific goal is to constrain theories of the origins and evolution of white dwarf stars.

We have two targets: SDSSJ170727.11+203153.25 and SDSSJ141127.09+035429.70. These targets were chosen from the sample of DB stars in Genest-Beaulieu & Bergeron (2019). SDSSJ170727 has a temperature of 44000 K and is near the blue edge of the DB gap. SDSSJ141127, with a temperature of 35600 K, is near the red edge of the DB gap.

The observations are relatively straight forward. We have selected the gratings and central wavelengths to detect photospheric lines of hydrogen, carbon, oxygen, silicon and other elements in the spectra of the two targets.
White dwarf stars are known for their nearly pure photospheres of either hydrogen or helium, at least at optical wavelengths. The UV wavelength range, however, contains numerous sensistive transitions that are important for determining trace abundances of the elements of interest. Given the limits on Lyman alpha observations with G130M, we have decided to iinclude a hydrogen line at 1025 Angstroms. The G130M grating with a central

wavelength of 1096 Angstroms will access HI 1025 Angstroms, CII 1037 Angstroms, CIII 1175 Angstroms, CI 1993 Angstroms, and Si II at 1193 Angstroms. G130M with a central wavelength of 1222 Angstroms will cover SiII 1260,
1264 Angstroms, OII 1305 Angstroms, and CII 1335 Angstroms,

The limitations of the response of G160M at certain wavelengths were not as significant to our science as first anticipated, so we have included this grating. G160M with a central wavelength of 1589 Angstroms will cover
HeII 1640 as well as SiII lines at 1533 Angstroms.

Measuring the strengths of photospheric lines from different transitions such as CII and CIII can be an important diagnostic for temperature. A second method to determine temperature is these hot objects is to measure the slope of
the UV continuum. G140L combined with the G130M and G160M grating observations will result in a detailed measurement of the
UV flux. between 916 nad 2148 Angstroms. The temperature determined from these measurements will confirm the effective temperatures of the two targets.

We have use the COS Spectroscopy Target Acquisiton and COS Spectroscopy Exposure Time SImulators to determine our exposure times. Our targets do not exceed the brightness limits for COS, and are isolated with good coordinates.
For target acquistion, we determined the time required to reach a signal to noise of at least 40. White dwarf stars are faint and can have high proper motions. GAIA has reduced this issue by determining many proper motions.
However, to be safe, we will acquire our targets using ACQ/SEARCH, ACQ/PEAKXD, and ACQ/PEAKD. For our science observations, we have determined exposure times to achieve a S/N of 15-20 at a wavelngth of 1150 Angstroms for the G130M
grating, and a S/N of 15-20 at 1500 Angstroms for the G160M and G140L gratings.

The science observations will be done in TIME-TAG mode. This will enable us to search for any variability. Neither star is known to be a large amplitude variable. However, SDSSJ141127 is close to the suspected temperature for
the initiation of gmode pulsations in helium atmosphere whtie dwarfs. The amplitudes of these possible pulsations is very small (less than 1 ppt).

Visit

Proposal 17186, 170727 1640 (01), implementation Tue Sep 27 18:01:20 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: (none)

Diagnostics

(170727 1640 (01)) 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

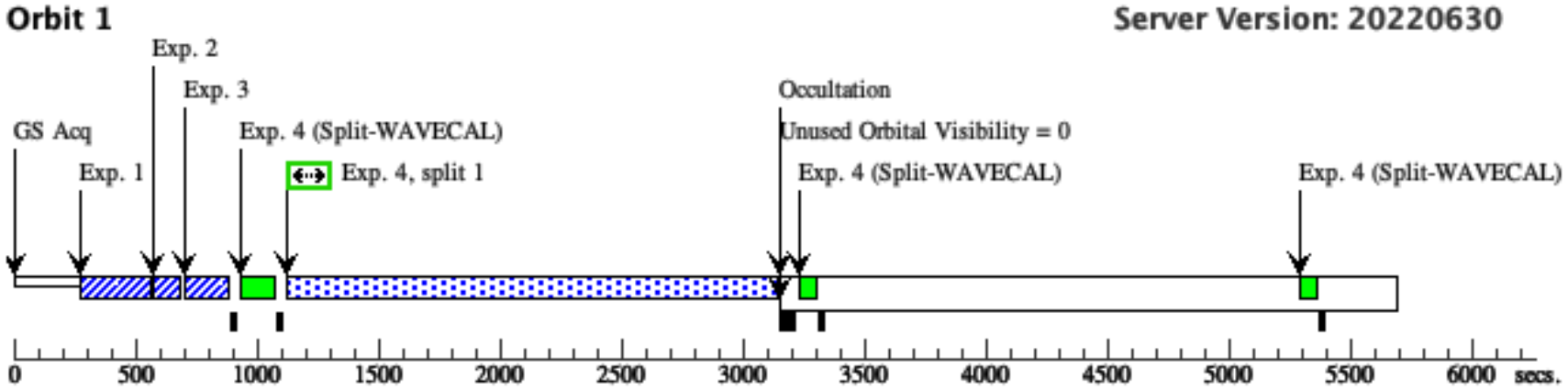
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J170727.10+203153.2	RA: 17 07 27.1085 (256.8629521d) Dec: +20 31 53.27 (20.53146d) Equinox: J2000	Proper Motion RA: 0.329 mas/yr Proper Motion Dec: -0.007802000095580297 arcsec/yr Parallax: 0.0015367" Epoch of Position: 2000	V=17.9+/-0.2 G=18.403	Reference Frame: ICRS

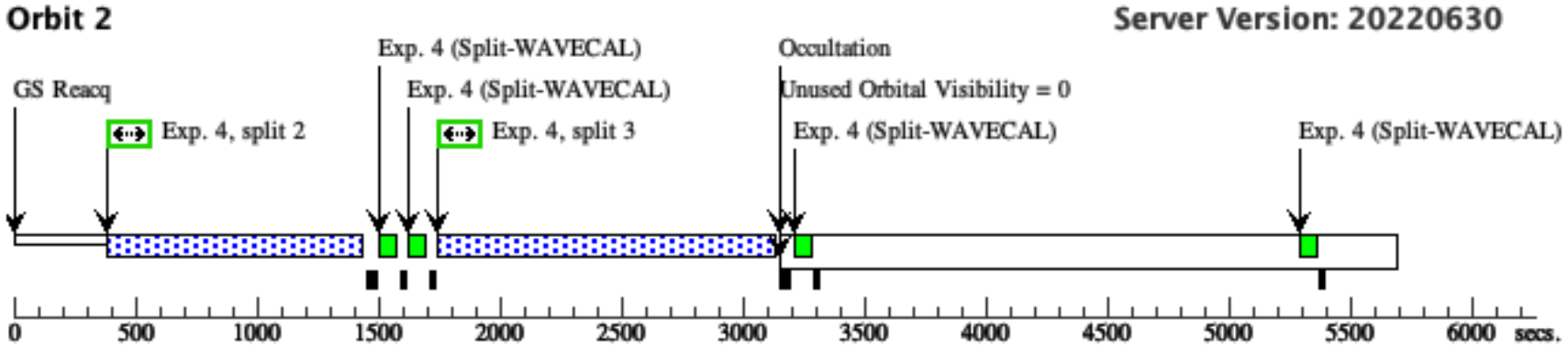
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[DB]
Extended=NO

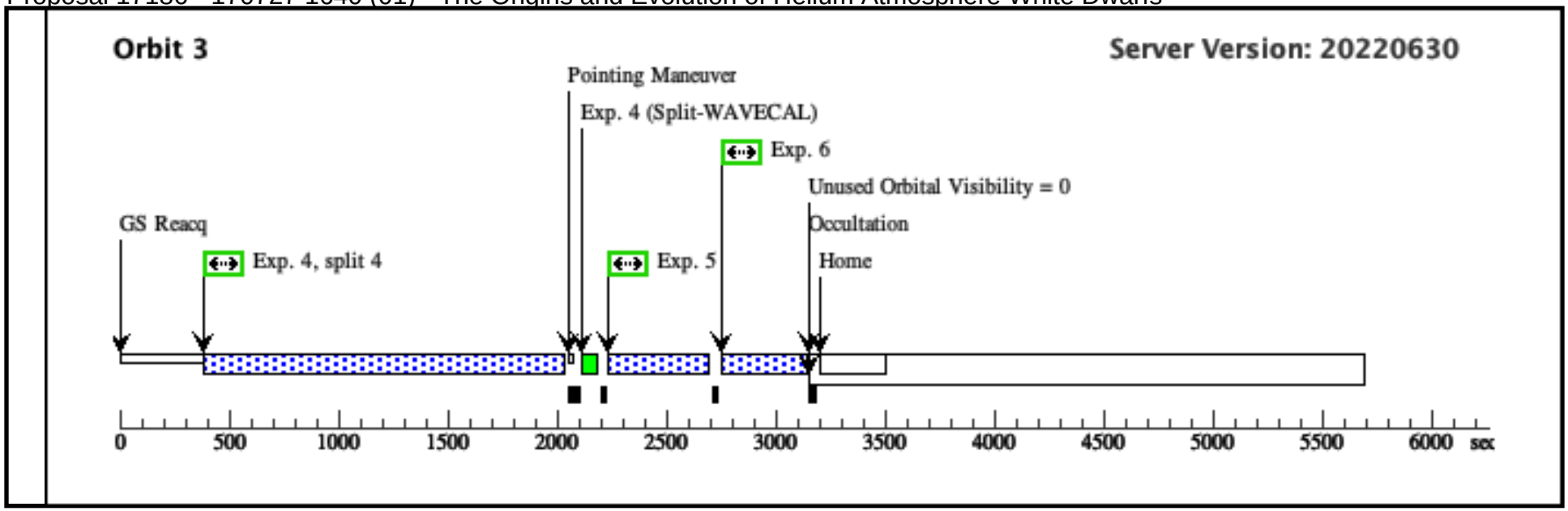
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Search (1809558)	(1) SDSS-J170727.10+203153.2	COS/FUV, ACQ/SEARCH, PSA	G160M 1589 A	CENTER=FLUX-WT; SCAN-SIZE=2; SEGMENT=BOTH; STEP-SIZE=1.767			6.0 Secs (6 Secs) *[==>]*	 ***[1]***
2	170727peakxd (1809558)	(1) SDSS-J170727.10+203153.2	COS/FUV, ACQ/PEAKXD, PSA	G160M 1589 A	SEGMENT=BOTH; CENTER=FLUX-WT; NUM-POS=3; STEP-SIZE=1.3			6.0 Secs (6 Secs) *[==>]*	 ***[1]***
3	170727peakd (1809558)	(1) SDSS-J170727.10+203153.2	COS/FUV, ACQ/PEAKD, PSA	G160M 1589 A	CENTER=FLUX-WT-FLR; NUM-POS=5; SEGMENT=BOTH; STEP-SIZE=0.9			6.0 Secs (6 Secs) *[==>]*	 ***[1]***
4	G160M 1589 (1810306)	(1) SDSS-J170727.10+203153.2	COS/FUV, TIME-TAG, PSA	G160M 1589 A	BUFFER-TIME=4255; SEGMENT=BOTH; FP-POS=ALL			1000 Secs (5913 Secs) *[==>1969.0 Secs (Split 1)]* *[==>(Split 2)]* *[==>1344.0 Secs (Split 3)]* *[==>1600.0 Secs (Split 4)]*	 ***[1]*** ***[2]*** ***[3]***
5	G140L 12801 (1809809)	(1) SDSS-J170727.10+203153.2	COS/FUV, TIME-TAG, PSA	G140L 1280 A	SEGMENT=BOTH; BUFFER-TIME=2789; FP-POS=1			200 Secs (200 Secs) *[==>]*	 ***[3]***
6	G140L 128012 (1809809)	(1) SDSS-J170727.10+203153.2	COS/FUV, TIME-TAG, PSA	G140L 1280 A	FP-POS=2; SEGMENT=BOTH; BUFFER-TIME=2789			200 Secs (335 Secs) *[==>335.0 Secs]*	 ***[3]***

Orbit Structure






Orbit 3
Server Version: 20220630
Pointing Maneuver
Exp. 4 (Split-WAVECAL)
Exp. 6
Unused Orbital Visibility = 0
GS Reacq
Occultation
Exp. 4, split 4
Exp. 5
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 17186, 17027 G130M (02), implementation Tue Sep 27 18:01:20 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: (none)

Diagnostics

(17027 G130M (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

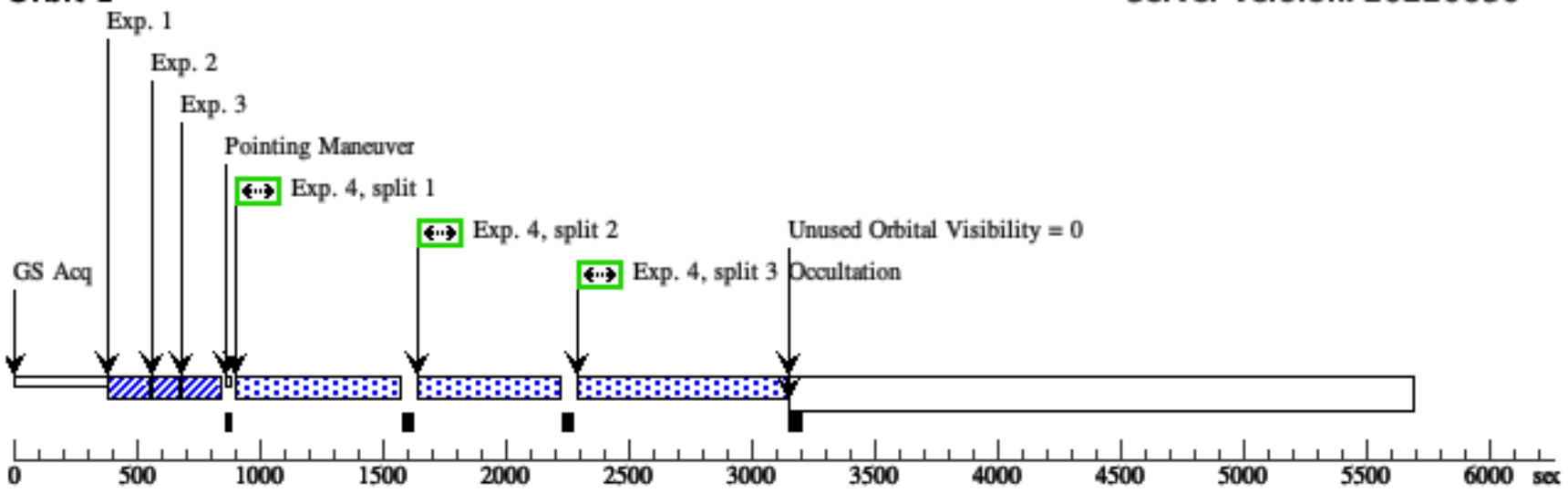
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SDSS-J170727.10+203153.2	RA: 17 07 27.1085 (256.8629521d) Dec: +20 31 53.27 (20.53146d) Equinox: J2000	Proper Motion RA: 0.329 mas/yr Proper Motion Dec: -0.007802000095580297 arcsec/yr Parallax: 0.0015367" Epoch of Position: 2000	V=17.9+/-0.2 G=18.403	Reference Frame: ICRS

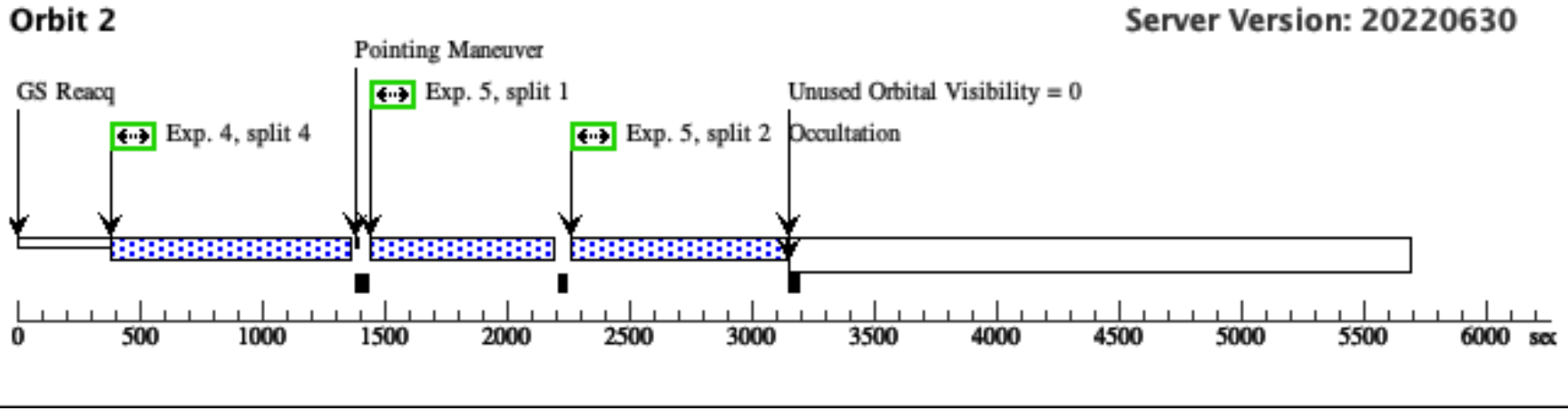
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[DB]
Extended=NO

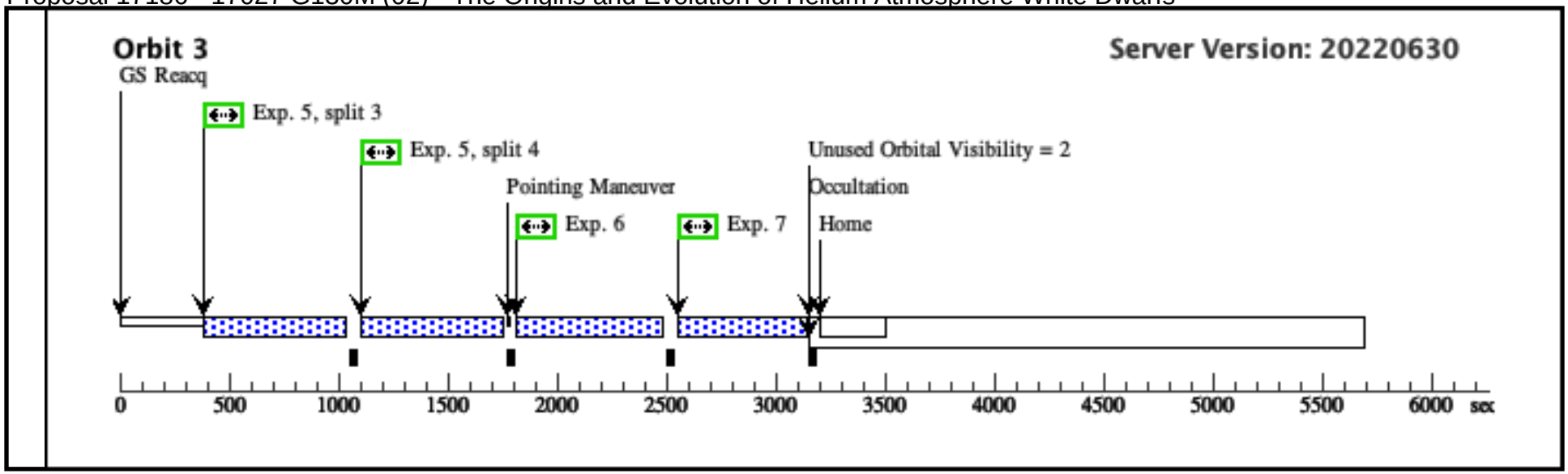
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Search (1809813)	(1) SDSS-J170727.10+203153.2	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	CENTER=FLUX-WT; SCAN-SIZE=2; SEGMENT=BOTH; STEP-SIZE=1.767			2.5 Secs (2.5 Secs) *[==>]*	*[1]*
2	Peakxd (1809813)	(1) SDSS-J170727.10+203153.2	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A	SEGMENT=BOTH; NUM-POS=3; STEP-SIZE=1.3; CENTER=FLUX-WT			2.5 Secs (2.5 Secs) *[==>]*	*[1]*
3	Peakd (1809813)	(1) SDSS-J170727.10+203153.2	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	CENTER=FLUX-WT-FLR; NUM-POS=5; SEGMENT=BOTH; STEP-SIZE=0.9			2.5 Secs (2.5 Secs) *[==>]*	*[1]*
4	G130M 1222 (1810310)	(1) SDSS-J170727.10+203153.2	COS/FUV, TIME-TAG, PSA	G130M 1222 A	SEGMENT=BOTH; FP-POS=ALL; BUFFER-TIME=2205			525 Secs (2772 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>797.0 Secs (Split 3)]* *[==>925.0 Secs (Split 4)]*	*[1]* *[2]*
5	G130M 1096 (1809816)	(1) SDSS-J170727.10+203153.2	COS/FUV, TIME-TAG, PSA	G130M 1096 A	BUFFER-TIME=2736; FP-POS=ALL; SEGMENT=BOTH			600 Secs (2625 Secs) *[==>(Split 1)]* *[==>825.0 Secs (Split 2)]* *[==>(Split 3)]* *[==>(Split 4)]*	*[2]* *[3]*
6	G140L 1280 (18809806)	(1) SDSS-J170727.10+203153.2	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=2729; SEGMENT=BOTH; FP-POS=3			420 Secs (420 Secs) *[==>]*	*[3]*
7	G140L 12804 (1809806)	(1) SDSS-J170727.10+203153.2	COS/FUV, TIME-TAG, PSA	G140L 1280 A	SEGMENT=BOTH; BUFFER-TIME=2729; FP-POS=4			420 Secs (533 Secs) *[==>533.0 Secs]*	*[3]*

Orbit Structure






Orbit 3
Server Version: 20220630
GS Reacq
Exp. 5, split 3
Exp. 5, split 4
Unused Orbital Visibility = 2
Pointing Maneuver
Occultation
Exp. 6
Exp. 7
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 17186, 141127 G130 and G160 (03), implementation Tue Sep 27 18:01:20 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: (none)

Fixed Targets

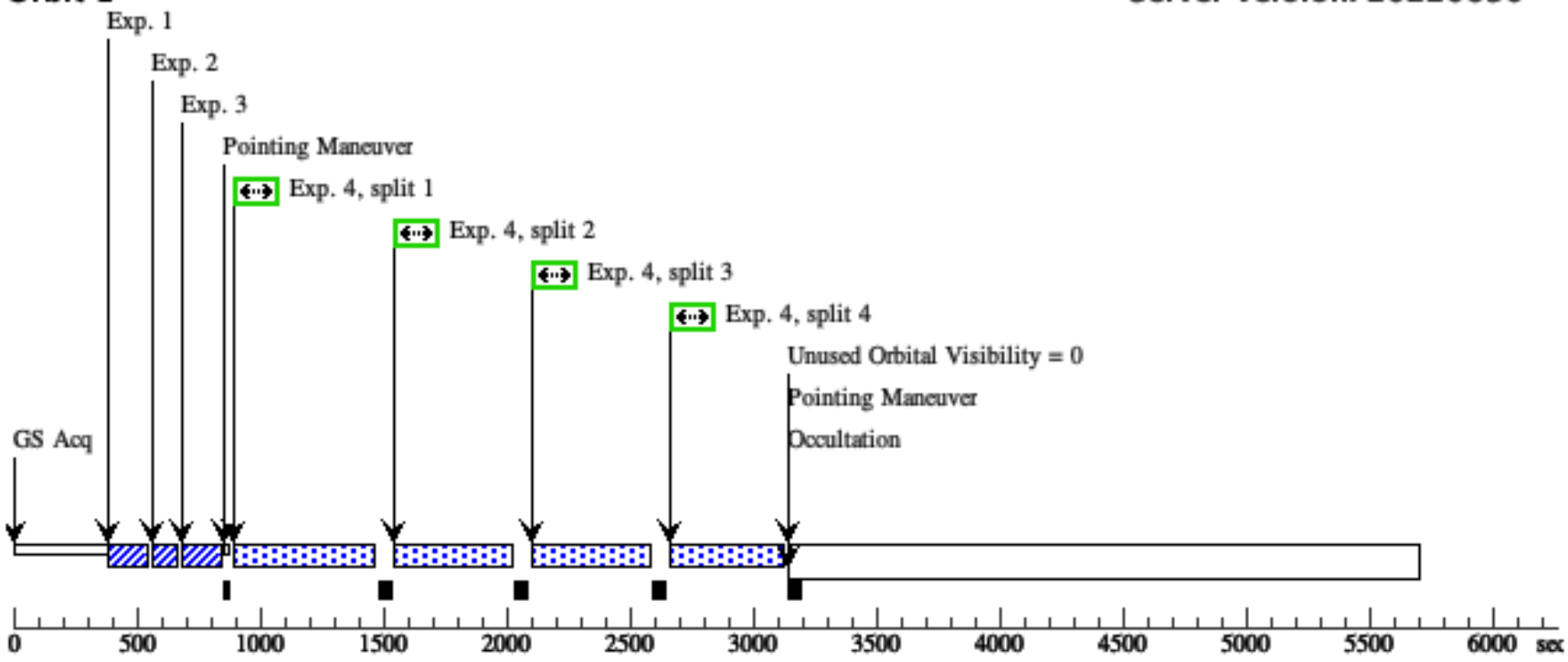
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSS-J141127.11+035429.6	RA: 14 11 27.1130 (212.8629708d) Dec: +03 54 29.62 (3.90823d) Equinox: J2000	Proper Motion RA: -40.831 mas/yr Proper Motion Dec: 0.007218 arcsec/yr Parallax: 0.0032967" Epoch of Position: 2000	V=16.8+/-0.2 u=16.7, g=16.95	Reference Frame: ICRS

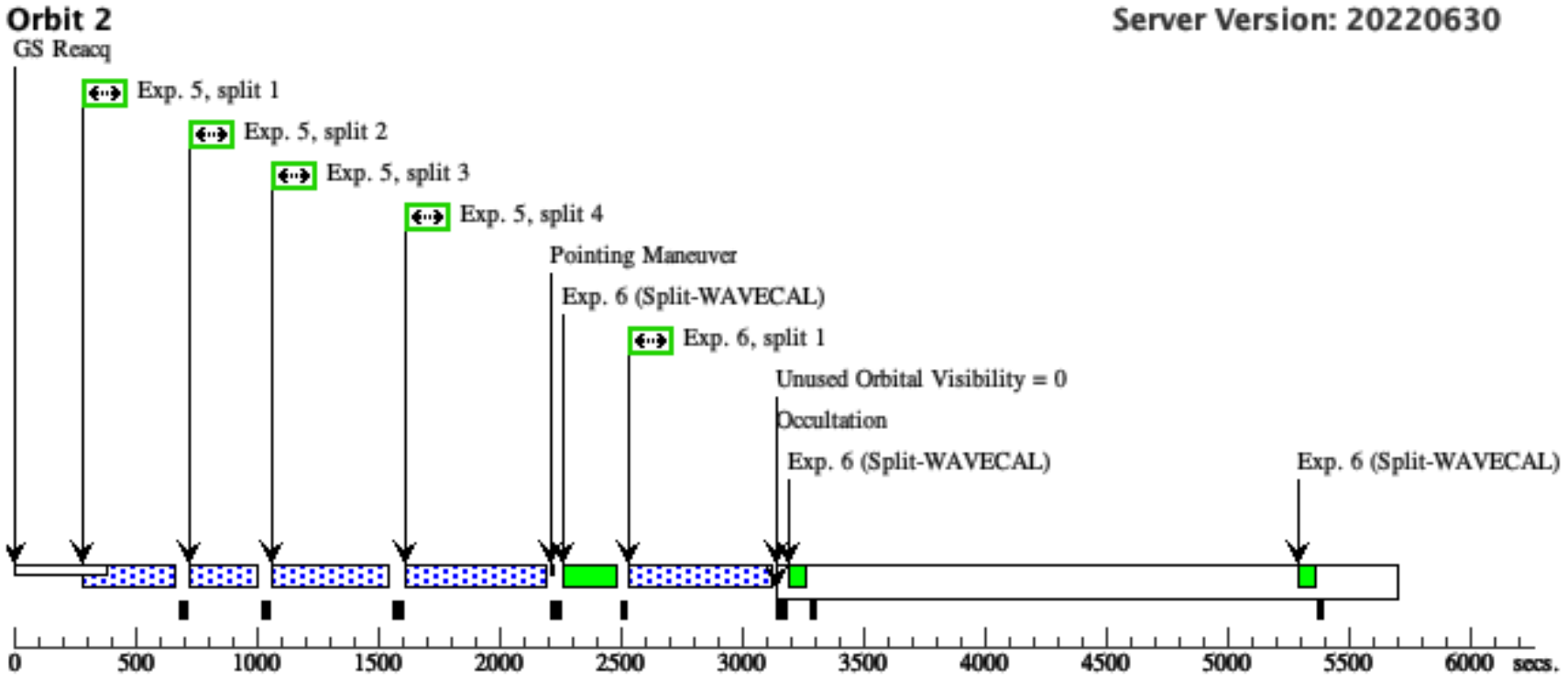
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[DB]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Search (1809846)	(2) SDSS-J141127.11+035429.6	COS/FUV, ACQ/SEARCH, PSA	G130M 1291 A	CENTER=FLUX-WT; SCAN-SIZE=2; SEGMENT=BOTH; STEP-SIZE=1.767			2.0 Secs (2 Secs) *[==>]*	***[1]***
2	Peakxd (1809846)	(2) SDSS-J141127.11+035429.6	COS/FUV, ACQ/PEAKXD, PSA	G130M 1291 A	SEGMENT=BOTH; CENTER=FLUX-WT; NUM-POS=3; STEP-SIZE=1.3			2.0 Secs (2 Secs) *[==>]*	***[1]***
3	Peakd (1809846)	(2) SDSS-J141127.11+035429.6	COS/FUV, ACQ/PEAKD, PSA	G130M 1291 A	CENTER=FLUX-WT-FLR; SEGMENT=BOTH; NUM-POS=5.0; STEP-SIZE=0.9			2.0 Secs (2 Secs) *[==>]*	***[1]***
4	G130M 1222 (1809848)	(2) SDSS-J141127.11+035429.6	COS/FUV, TIME-TAG, PSA	G130M 1222 A	BUFFER-TIME=1141; FP-POS=ALL; SEGMENT=BOTH			425 Secs (1685 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>410.0 Secs (Split 4)]*	***[1]***
5	G130M 1096 (1089851)	(2) SDSS-J141127.11+035429.6	COS/FUV, TIME-TAG, PSA	G130M 1096 A	BUFFER-TIME=1744; FP-POS=ALL; SEGMENT=BOTH			225 Secs (1400 Secs) *[==>(Split 1)]* *[==>(Split 2)]* *[==>425.0 Secs (Split 3)]* *[==>525.0 Secs (Split 4)]*	***[2]***
6	G160M (1810404)	(2) SDSS-J141127.11+035429.6	COS/FUV, TIME-TAG, PSA	G160M 1589 A	BUFFER-TIME=2096; FP-POS=ALL; SEGMENT=BOTH			500 Secs (2506 Secs) *[==>538.0 Secs (Split 1)]* *[==>(Split 2)]* *[==>(Split 3)]* *[==>968.0 Secs (Split 4)]*	***[2]*** ***[3]***

Orbit Structure

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GS Reacq
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Exp. 5, split 2
Exp. 5, split 3
Exp. 5, split 4
Pointing Maneuver
Exp. 6 (Split-WAVECAL)
Exp. 6, split 1
Unused Orbital Visibility = 0
Occultation
Exp. 6 (Split-WAVECAL)
Exp. 6 (Split-WAVECAL)
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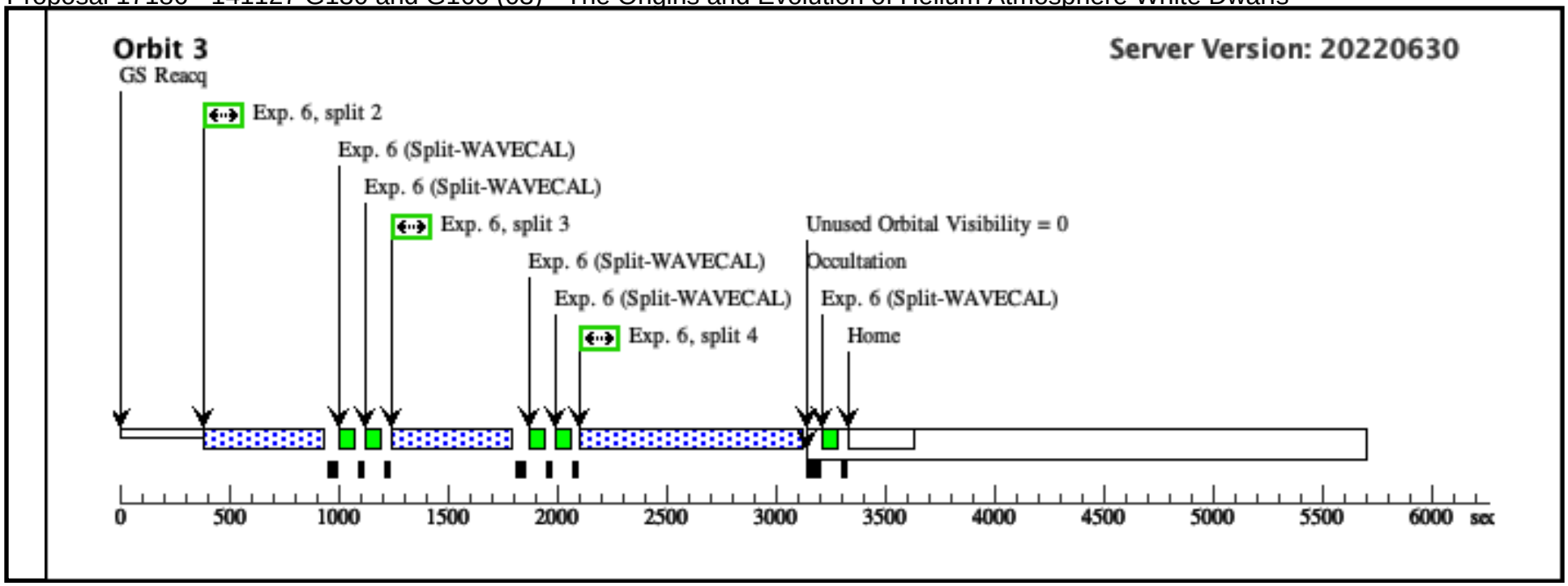
secs.


Orbit 3
Server Version: 20220630
GS Reacq
Exp. 6, split 2
Exp. 6 (Split-WAVECAL)
Exp. 6 (Split-WAVECAL)
Exp. 6, split 3
Exp. 6 (Split-WAVECAL)
Exp. 6 (Split-WAVECAL)
Exp. 6, split 4
Unused Orbital Visibility = 0
Occultation
Exp. 6 (Split-WAVECAL)
Home
0
500
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2000
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3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 17186, 141127 G140L (04), implementation Tue Sep 27 18:01:20 GMT 2022

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSS-J141127.11+035429.6	RA: 14 11 27.1130 (212.8629708d) Dec: +03 54 29.62 (3.90823d) Equinox: J2000	Proper Motion RA: -40.831 mas/yr Proper Motion Dec: 0.007218 arcsec/yr Parallax: 0.0032967" Epoch of Position: 2000	V=16.8+/-0.2 u=16.7, g=16.95	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[DB]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1811110)	(2) SDSS-J141127.11+035429.6	COS/FUV, ACQ/SEARCH, PSA	G140L 1280 A	CENTER=FLUX-WT; SCAN-SIZE=2; SEGMENT=BOTH; STEP-SIZE=1.767			6 Secs (6 Secs) *[==>]*	***[1]***
2	(1811110)	(2) SDSS-J141127.11+035429.6	COS/FUV, ACQ/PEAKXD, PSA	G140L 1280 A	CENTER=FLUX-WT; SEGMENT=BOTH; NUM-POS=3; STEP-SIZE=1.3			6 Secs (6 Secs) *[==>]*	***[1]***
3	(1811110)	(2) SDSS-J141127.11+035429.6	COS/FUV, ACQ/PEAKD, PSA	G140L 1280 A	CENTER=FLUX-WT-FLR; NUM-POS=5; SEGMENT=BOTH; STEP-SIZE=0.9			6 Secs (6 Secs) *[==>]*	***[1]***
4	G140L 1280 (1811111)	(2) SDSS-J141127.11+035429.6	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=1458; FP-POS=ALL; SEGMENT=BOTH			450 Secs (1696 Secs) *[==>432.0 Secs (Split 1)]* *[==>432.0 Secs (Split 2)]* *[==>432.0 Secs (Split 3)]* *[==>400.0 Secs (Split 4)]*	***[1]***

Orbit Structure