17190 - Will the Recurrent Nova T Pyxidis Become a Type Ia Supernova?

Cycle: 30, Proposal Category: GO

(UV Initiative)

(Availability Mode: AVAILABLE)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Patrick Godon (PI) (Contact)	**Villanova University**	**patrick.godon@villanova.edu**
Prof. Edward M. Sion (CoI)	Villanova University	edward.sion@villanova.edu
Dr. Robert E. Williams (CoI)	Space Telescope Science Institute	wms@stsci.edu
Prof. Matthew James Darnley (CoI) (ESA Member)	Liverpool John Moores University	matt_darnley@icloud.com

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) NOVA-PYX-1890	COS/FUV	2	15-Feb-2023 16:00:20.0	yes
03	(1) NOVA-PYX-1890	S/C	1	15-Feb-2023 16:00:20.0	yes
04	(2) NOVA-PYX-1890-SAFE-TARGET	COS/FUV	2	15-Feb-2023 16:00:22.0	yes
02	(1) NOVA-PYX-1890 CCDFLAT	STIS/CCD	2	15-Feb-2023 16:00:23.0	yes

7 Total Orbits Used

ABSTRACT

The recurrent nova T Pyx has erupted six times since 1890. The last outburst in 2011 offered a unique opportunity to catch T Pyx with HST as it transited into quiescence. The system has now passed its nebular phase and settled into a deep quiescence state where the UV and optical emissions are dominated by the accretion disk. Earlier HST COS observations have provided FUV spectroscopy showing the decline phase and indicating that

T Pyx is accreting at a very high rate. As a result, the T Pyx WD might be growing in mass, and therefore may be on its way to explode as a Type Ia supernova (SN Ia).
HST STIS optical spectra were obtained during the nebular phase to study the expanding nebular material, but no STIS optical spectra have yet been obtained during the quiescent phase to help derive an accurate mass accretion rate: to model the disk properly UV and optical spectra must be collected because the inner disk dominates in the FUV and the outer disk dominates in the optical.
We request the first combined optical (STIS) and FUV (COS) spectroscopic observation of T Pyx during the deep quiescent phase to properly model the disk and derive an accurate mass accretion rate. In addition, we will measure the width and velocity of the hydrogen and helium lines to better model the inner disk (lines in emission) and outer disk (lines in absorption). These observations will assess whether the T Pyx WD mass is growing, and hence whether T Pyx is indeed a viable SN Ia progenitor. Even though SNe Ia are the tools used to demonstrate that the Universe is accelerating, the exact nature of SN Ia progenitors has not been confirmed.

OBSERVING DESCRIPTION

In order to obtain a broad spectral coverage of the target T Pyxidis (covering the UV and Optical), we request two sets of observations, each for 2 orbits, totalling 4 orbits.

The first set (visit) is configured in the COS/FUV Spectroscopic mode for two orbits.
The first orbit with the G140L spectral element centered at 1105 Angstrom.
The second orbit, following immediately the first COS one above, with the G130M spectral element centered at 1055 Angstrom. Both with the PSA Aperture.

The second set (visit) is configured in the (optical) STIS/CCD Spectroscopic mode for two orbits.
The first orbit with the G750L grating centered at 7751 Angstrom.
The second orbit, following immediately the first STIS one above, with the G430L grating centered at 4300 Angstrom. Both in ACCUM mode, with the 52x0.1E1 aperture.
The E1 aperture was chosen for STIS as the ETC warns about a low electron per pixel causing poor CTE.
Since we are using the G750L (7751) configuration we also added a flat field exposure (2 iteration) to allow for correction of the fringes appearing above 7000 Angstroms.

The two visits should ideally be spaced as close as possible in time, we request a separation between them of 1 orbit to one month (about 500 orbits) - the target luminosity is not expected to undergo any detectable change over this period of time (though over a few months to a year it may show a slight decrease).

Since T Pyx is a variable (a recurrent nova), we will request the AAVSO to monitor it to make sure it doesn't (unexpectedly) erupt (its last eruption was 11 years ago, and the time between eruptions is 20-40 years). Such eruptions have short timescales (days) and may require the safe target offset procedure (STOP) to which we will fully comply (the AAVSO can provide photometric monitoring for more than 7 consecutive days leading to the HST observations and within 24 hours of the target being observed by HST - for the two visits).

Visit

Proposal 17190, COS FUV (01), implementation Wed Feb 15 21:00:24 GMT 2023

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: ORIENT 215D TO 55 D

Comments: This should be scheduled in evening-local time. Flags need to be cleared during the work day. Weekends are to be avoided since the CS must clear the target within 24 hours of HST execution.

Diagnostics

(COS FUV (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

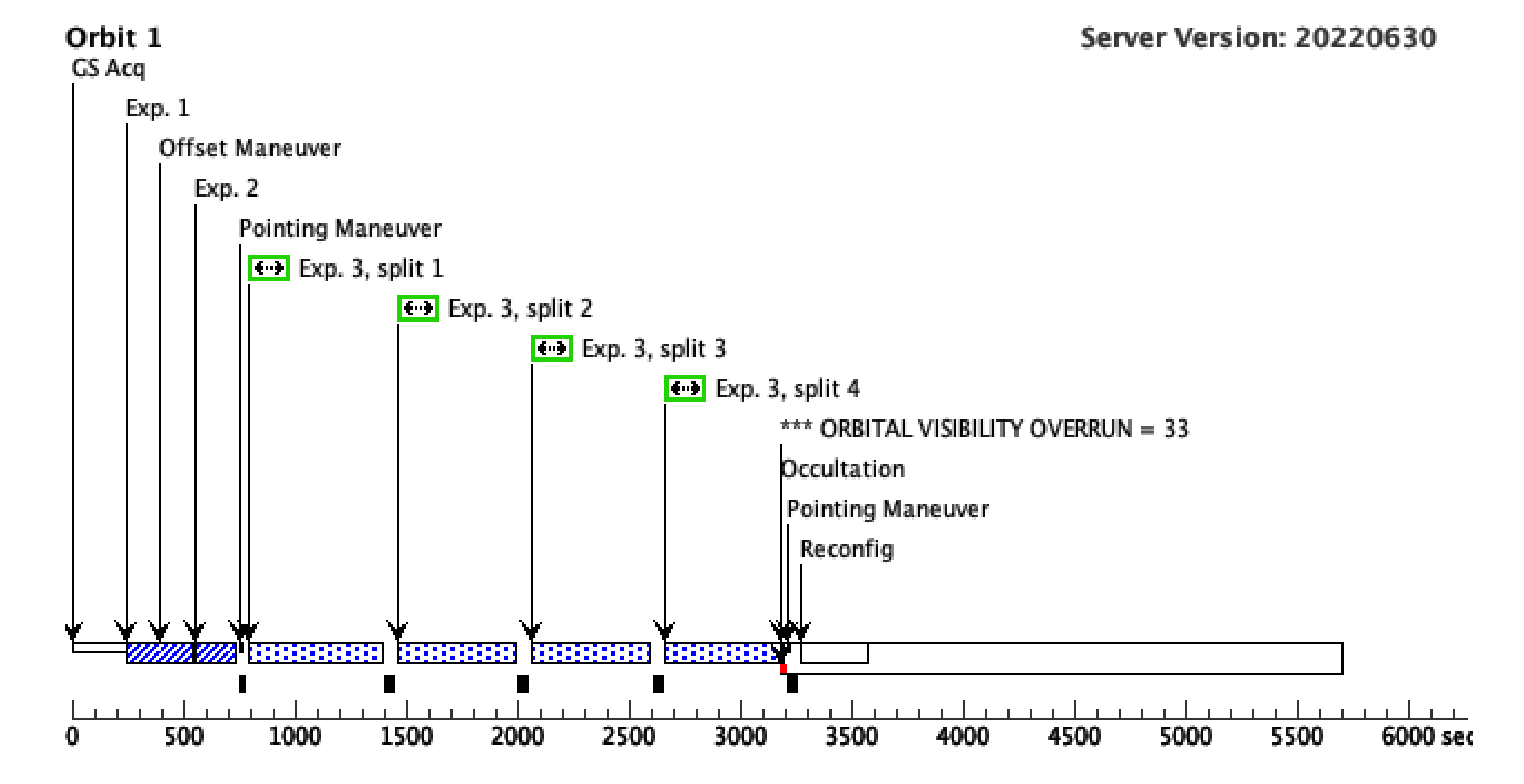
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NOVA-PYX-1890	RA: 09 04 41.5062 (136.1729425d) Dec: -32 22 47.50 (-32.37986d) Equinox: J2000	Proper Motion RA: -2.486 mas/yr Proper Motion Dec: 0.152 mas/yr Parallax: 0.3467E-3" Epoch of Position: 2020	V=15.1+/-0.6	Reference Frame: ICRS

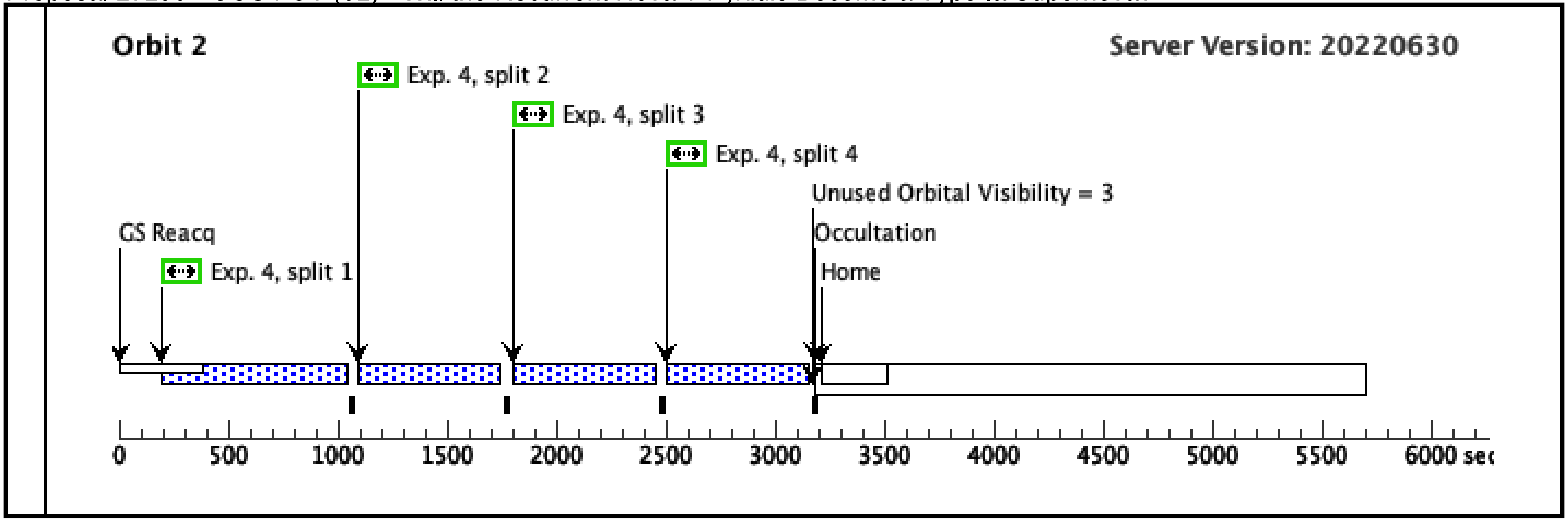
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, RECURRENT NOVA]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (COS.sa.1808486)	(1) NOVA-PYX-1890	COS/FUV, ACQ/PEAKXD, PSA	G140L 1105 A	LIFETIME-POS=LP4	USE OFFSET V01SAF		7.4 Secs (7.4 Secs) *[==>]*	*[1]*
2	PEAKD (COS.sa.1808486)	(1) NOVA-PYX-1890	COS/FUV, ACQ/PEAKD, PSA	G140L 1105 A	NUM-POS=5.0; STEP-SIZE=0.9; CENTER=FLUX-WT-FLR; LIFETIME-POS=LP4	USE OFFSET V01SAF		7.4 Secs (7.4 Secs) *[==>]*	*[1]*
3	COS G140L 1105 (COS.sp.1808489)	(1) NOVA-PYX-1890	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=2000; FP-POS=ALL; LIFETIME-POS=LP3	USE OFFSET V01SAF		550 Secs (1912 Secs) *[==>478.0 Secs (Split 1)]* *[==>478.0 Secs (Split 2)]* *[==>478.0 Secs (Split 3)]* *[==>478.0 Secs (Split 4)]*	*[1]*
4	COS G130M 1055 (COS.sp.1808496)	(1) NOVA-PYX-1890	COS/FUV, TIME-TAG, PSA	G130M 1055 A	BUFFER-TIME=8000; FP-POS=ALL; LIFETIME-POS=LP2	USE OFFSET V01SAF		550 Secs (2404 Secs) *[==>601.0 Secs (Split 1)]* *[==>601.0 Secs (Split 2)]* *[==>601.0 Secs (Split 3)]* *[==>601.0 Secs (Split 4)]*	*[2]*

Orbit Structure




Orbit 2
Server Version: 20220630
Exp. 4, split 2
Exp. 4, split 3
Exp. 4, split 4
Unused Orbital Visibility = 3
GS Reacq
Occultation
Exp. 4, split 1
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Proposal 17190 - S/C Visit for Visit 01 (03) - Will the Recurrent Nova T Pyxidis Become a Type Ia Supernova?

Visit

Proposal 17190, S/C Visit for Visit 01 (03) Wed Feb 15 21:00:24 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: S/C

Special Requirements: ORIENT 215D TO 55 D

Comments: This visit allocates and sets up the safe position offset slot for Visit 01 which will use that slot. This S/C visit should go earlier in the week while visit 01 will be at least 3 days later. The S/C visit will contain only 1 exposure.

Fixed Targets

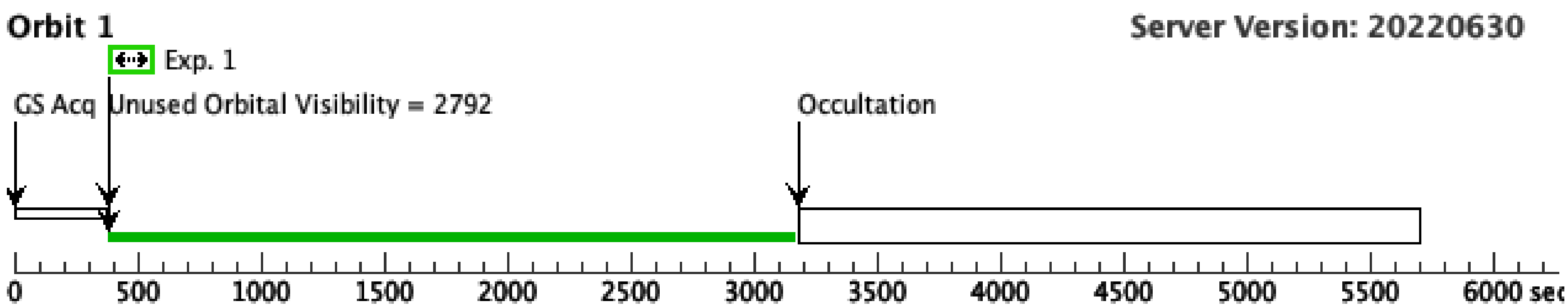
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NOVA-PYX-1890	RA: 09 04 41.5062 (136.1729425d) Dec: -32 22 47.50 (-32.37986d) Equinox: J2000	Proper Motion RA: -2.486 mas/yr Proper Motion Dec: 0.152 mas/yr Parallax: 0.3467E-3" Epoch of Position: 2020	V=15.1+/-0.6	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, RECURRENT NOVA]
Extended=NO

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) NOVA-PYX-1890	S/C, DATA, V1			POS TARG 229.1328,-241.0575; SAVE OFFSET V01SAF; SPEC COM INSTR ECSLOTSET; QESIPARM ANGLE 1.3; QESIPARM DIST 9.494		5 Secs (5 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 17190, BOP Visit for Visit 01 (04) Wed Feb 15 21:00:24 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/FUV

Special Requirements: ORIENT 215D TO 55 D

Comments: This visit is for BOP checking the safe target only and should not execute onboard HST

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NOVA-PYX-1890	RA: 09 04 41.5062 (136.1729425d) Dec: -32 22 47.50 (-32.37986d) Equinox: J2000	Proper Motion RA: -2.486 mas/yr Proper Motion Dec: 0.152 mas/yr Parallax: 0.3467E-3" Epoch of Position: 2020	V=15.1+/-0.6	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, RECURRENT NOVA]
Extended=NO

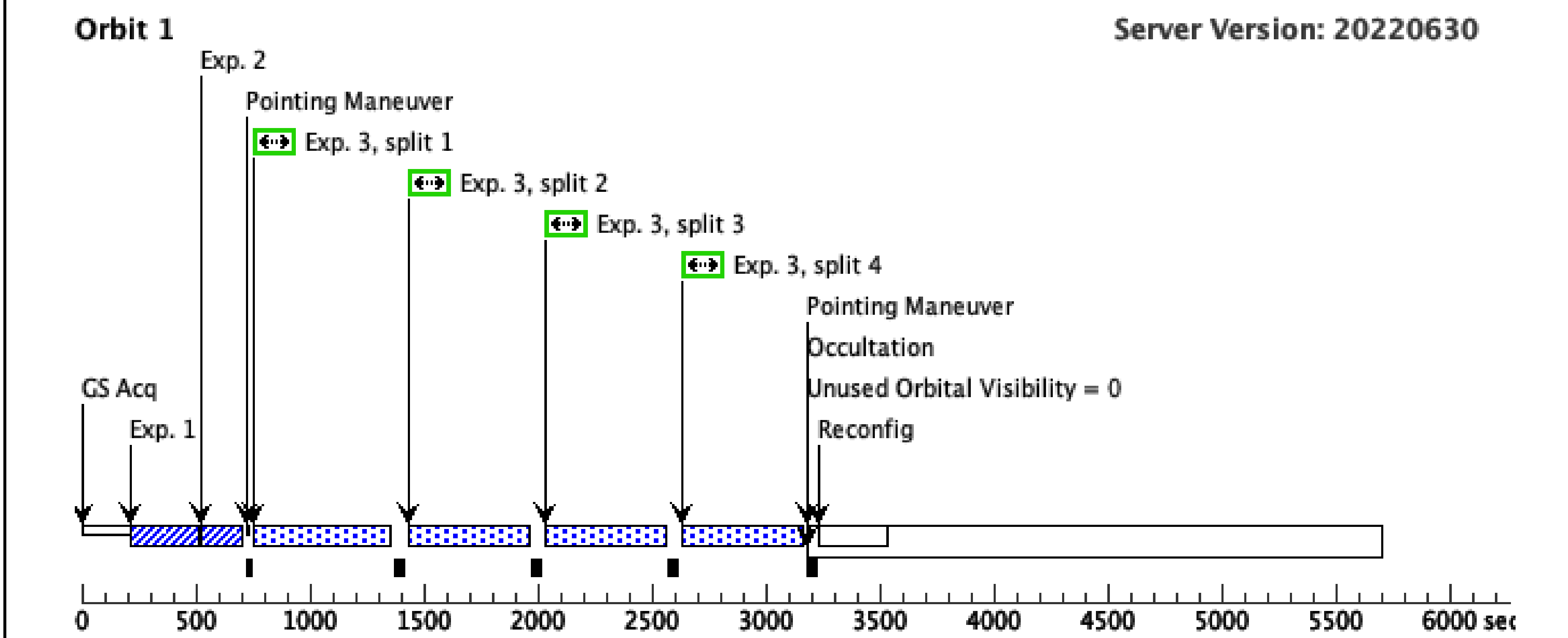
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NOVA-PYX-1890-SAFE-TARGET	Offset from NOVA-PYX-1890 RA Offset: 0.01 Secs Dec Offset: 9.492 Arcsec		V=15.1+/-0.6	Offset Position (NOVA-PYX-1890-SAFE-TARGET)

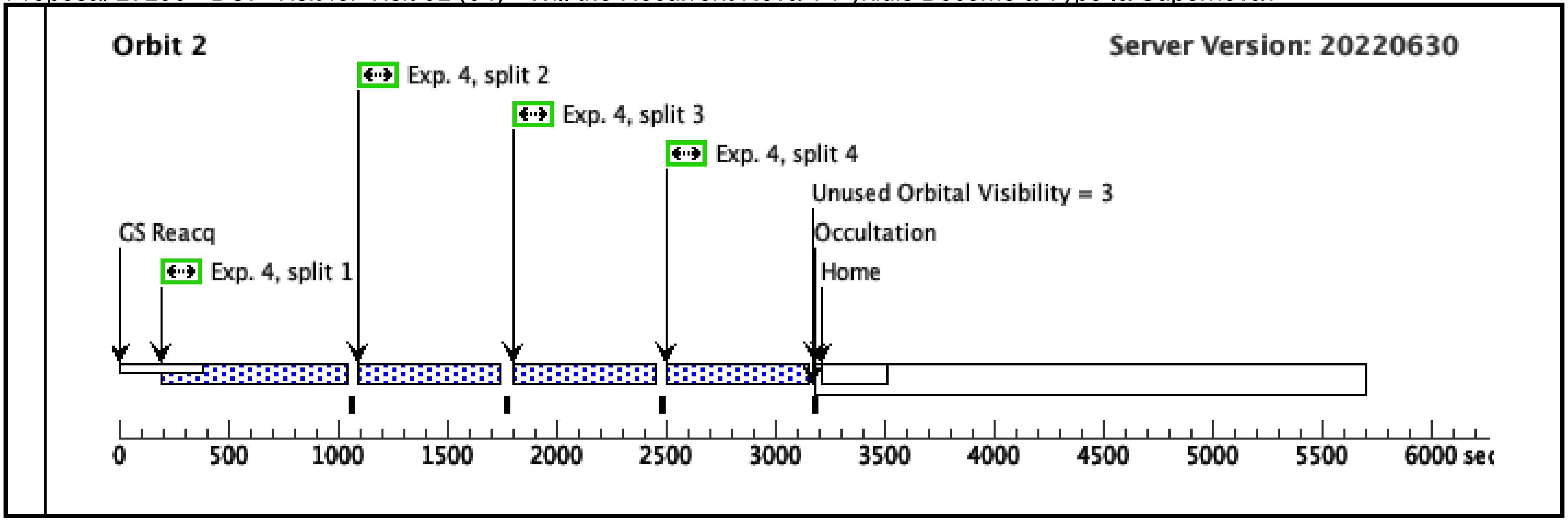
Comments: This target is a blank piece of sky which is the bright object safe pointing and is 9.494 arcseconds away at a PA 1.3 degrees from NOVA-PYX-1890
Category=UNIDENTIFIED
Description=[BLANK FIELD]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Target Acquisition (COS.sa.1808486)	(2) NOVA-PYX-1890-SAFE-TARGET	COS/FUV, ACQ/PEAKXD, PSA	G140L 1105 A	LIFETIME-POS=LP4			7.4 Secs (7.4 Secs) *[==>]*	*[1]*
2	PEAKD (COS.sa.1808486)	(2) NOVA-PYX-1890-SAFE-TARGET	COS/FUV, ACQ/PEAKD, PSA	G140L 1105 A	NUM-POS=5.0; STEP-SIZE=0.9; CENTER=FLUX-WT-FLR; LIFETIME-POS=LP4			7.4 Secs (7.4 Secs) *[==>]*	*[1]*
3	COS G140L 1105 (COS.sp.1808489)	(2) NOVA-PYX-1890-SAFE-TARGET	COS/FUV, TIME-TAG, PSA	G140L 1105 A	BUFFER-TIME=2000; FP-POS=ALL; LIFETIME-POS=LP3			550 Secs (1912 Secs) *[==>478.0 Secs (Split 1)]* *[==>478.0 Secs (Split 2)]* *[==>478.0 Secs (Split 3)]* *[==>478.0 Secs (Split 4)]*	*[1]*
4	COS G130M 1055 (COS.sp.1808496)	(2) NOVA-PYX-1890-SAFE-TARGET	COS/FUV, TIME-TAG, PSA	G130M 1055 A	BUFFER-TIME=8000; FP-POS=ALL; LIFETIME-POS=LP2			550 Secs (2404 Secs) *[==>601.0 Secs (Split 1)]* *[==>601.0 Secs (Split 2)]* *[==>601.0 Secs (Split 3)]* *[==>601.0 Secs (Split 4)]*	*[2]*

Orbit Structure





Orbit 2
Server Version: 20220630
Exp. 4, split 2
Exp. 4, split 3
Exp. 4, split 4
Unused Orbital Visibility = 3
GS Reacq
Occultation
Exp. 4, split 1
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17190, STIS CCD Optical (02), implementation Wed Feb 15 21:00:24 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: AFTER 01 BY 1 Orbits TO 500 Orbits

Fixed Targets

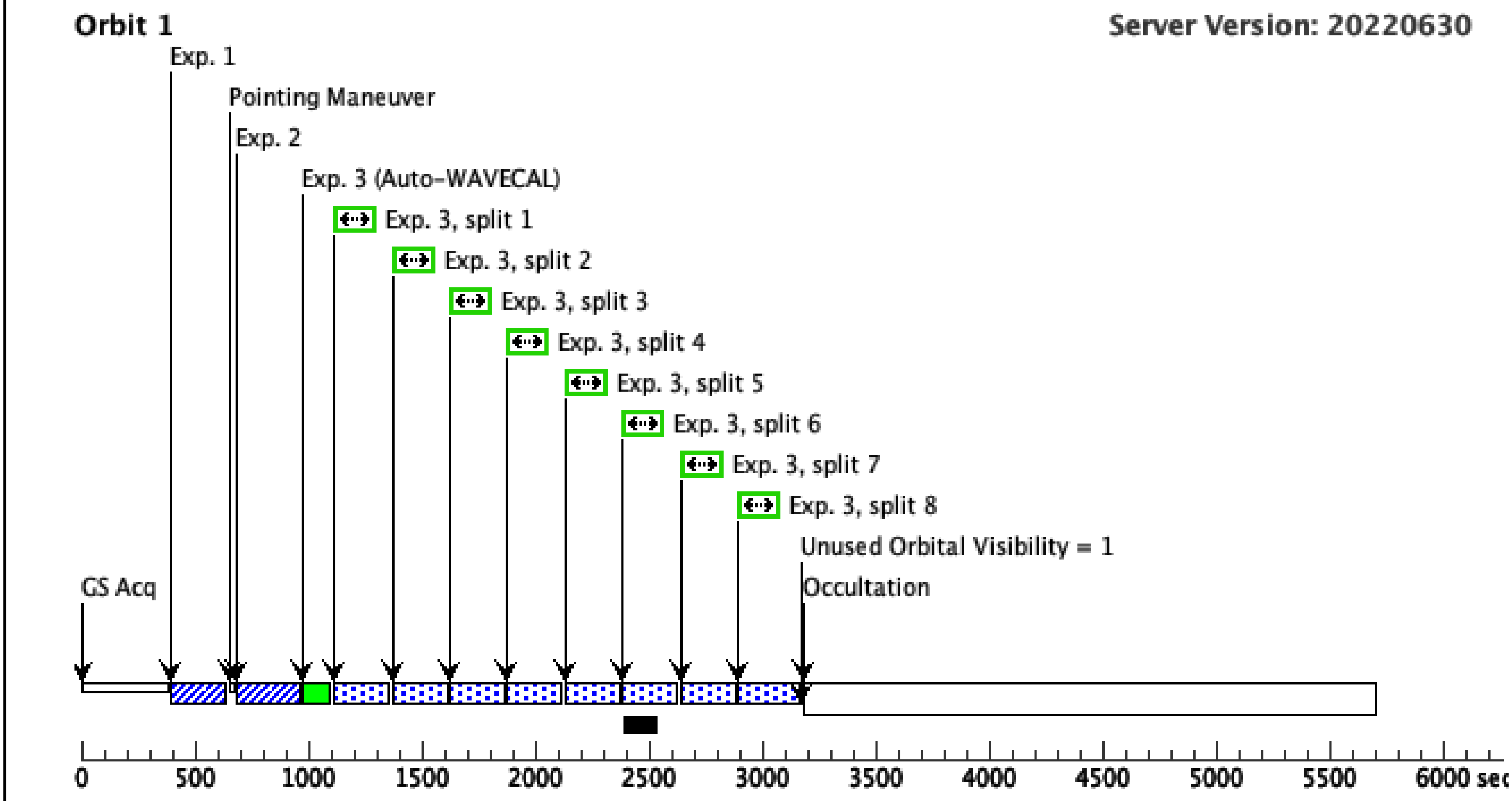
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NOVA-PYX-1890	RA: 09 04 41.5062 (136.1729425d) Dec: -32 22 47.50 (-32.37986d) Equinox: J2000	Proper Motion RA: -2.486 mas/yr Proper Motion Dec: 0.152 mas/yr Parallax: 0.3467E-3" Epoch of Position: 2020	V=15.1+/-0.6	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[ACCRETION DISK, RECURRENT NOVA]
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 (STIS.ta.1808604)	(1) NOVA-PYX-1890	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			5 Secs (5 Secs) *[==>]*	*[1]*
2	ACQ/PEAK (STIS.ta.1809521)	(1) NOVA-PYX-1890	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				5 Secs (5 Secs) *[==>]*	*[1]*
3	STIS G430L 4300 (STIS.sp.1809802)	(1) NOVA-PYX-1890	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=8			2200 Secs (1699.4 Secs) *[==>209.2 Secs (Split 1)]* *[==>209.2 Secs (Split 2)]* *[==>209.2 Secs (Split 3)]* *[==>209.2 Secs (Split 4)]* *[==>209.2 Secs (Split 5)]* *[==>209.2 Secs (Split 6)]* *[==>209.2 Secs (Split 7)]* *[==>235.0 Secs (Split 8)]*	*[1]*
4	STIS G750L 7751 (STIS.sp.1809803)	(1) NOVA-PYX-1890	STIS/CCD, ACCUM, 52X0.1E1	G750L 7751 A	CR-SPLIT=8			2200 Secs (2340.4 Secs) *[==>302.2 Secs (Split 1)]* *[==>302.2 Secs (Split 2)]* *[==>302.2 Secs (Split 3)]* *[==>302.2 Secs (Split 4)]* *[==>302.2 Secs (Split 5)]* *[==>302.2 Secs (Split 6)]* *[==>302.2 Secs (Split 7)]* *[==>225.0 Secs (Split 8)]*	*[2]*
5	Flat Field	CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	*[2]*

Orbit Structure



Proposal 17190 - STIS CCD Optical (02) - Will the Recurrent Nova T Pyxidis Become a Type Ia Supernova?