17521 - A multiwavelength study of protoplanetary disk ionization

Cycle: 31, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Catherine Espaillat (PI) (Contact)	**Boston University**
Dr. Thanawuth Thanathibodee (CoI)	Chulalongkorn University
Dr. Melissa McClure (CoI) (ESA Member)	Universiteit Leiden
Dr. Enrique Macias (CoI) (ESA Member)	European Southern Observatory - Germany
Dr. Nuria Calvet (CoI)	University of Michigan
Dr. Mark Reynolds (CoI)	The Ohio State University
James Babb (CoI)	Smithsonian Institution Astrophysical Observatory
Peigen Yan (CoI)	Smithsonian Institution Astrophysical Observatory
Dr. Ramiro Franco-Hernandez (CoI)	Universidad de Guadalajara
Caeley Pittman (CoI)	Boston University

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) V-SZ-CHA CCDFLAT	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	02-Aug-2024 16:00:33.0	yes
02	(2) ASS-CHA-T-2-54 CCDFLAT	ACS/SBC STIS/CCD STIS/NUV-MAMA	2	02-Aug-2024 16:00:34.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
03	(3) V-TW-HYA CCDFLAT	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	02-Aug-2024 16:00:35.0	yes

6 Total Orbits Used

ABSTRACT

We aim to determine whether the magnetorotational instability (MRI) could be the elusive driver of turbulent accretion in protoplanetary disks. To accomplish this, we will measure the amount of X-ray induced disk ionization in a sample of three protoplanetary disks, leveraging the unique synergy provided by Chandra, HST, and JWST to simultaneously measure X-ray through UV luminosities and the fluxes of mid-infrared [Ne II] and [Ne III] fine structure lines. When combined with thermochemical modeling, these simultaneous Chandra, HST, and JWST observations will characterize the high-energy radiation spectrum impinging on the disk and lead to a measurement of the disk ionization fraction, which will test if the MRI is responsible for accretion in protoplanetary disks.

OBSERVING DESCRIPTION

We request a total of 6 orbits with HST, two per object. We calculate exposure times using existing HST data for our targets and the appropriate ETC. We request simultaneous observations with Chandra and JWST taken within 1 hr of the HST observations since the Ne line luminosities are expected to change within 1 hr in response to a change in the X-ray luminosity. Since this program requires coordinated observations between three telescopes, if there are fewer observing windows due to failure of a gyro, that would make this program very difficult to schedule.

For SZ Cha and TW Hya, we will use STIS to cover the FUV. T54 is very faint in the FUV, and we will use ACS. For SZ Cha, we will use the G140L grating. Given the brightness of TW Hya, we will use the E140M grating. For each, we will begin with a brief image with the F28X50OIII filter for target acquisition. We will observe T54 with ACS SBC and PR130L. The overhead for guide star and target acquisition is ~10 minutes. T54 will also need a short (< 1 min) FUV image with the F140LP filter on the SBC for wavelength calibration. Using archival STIS FUV data of SZ Cha and TW Hya and ACS data of T 54, we estimate reaching SNR~10 in the FUV continuum with 1 orbit per target.

Each object will need MAMA NUV spectra to measure the mass accretion rates, so we choose the G230L gratings covering 1570 - 3180 Angstroms. Obtaining nearly simultaneous optical and NIR spectra is crucial to measure the extinction precisely and accurately calculate the NUV excess above

the stellar photosphere. We will use the CCD G430L grating (2900 - 5700 Angstroms) and the CCD G750L grating (5240-11490 Angstroms). In addition, we will obtain contemporaneous fringe flats to correct the spectra beyond 7000 Angstroms where severe fringing occurs. Low resolution is sufficient for this study since we are not attempting to measure individual FUV to optical lines in detail. Using archival STIS NUV and CCD data of SZ Cha and TW Hya, we will achieve SNR~15 in the NUV continuum and SNR>50 in the optical with 1 orbit per target. For T 54, there are no HST NUV or CCD observations and so we created a synthetic NUV and optical spectrum using the accretion shock model and optical photometry. In 1 orbit, we will achieve an SNR of >50 for the optical and NIR observations and SNR~15 for the NUV observations.

We have considered the typical ranges seen in CTTS variability and checked the brightness limits of MAMA and the saturation levels of the CCD. Our targets fall within the acceptable limits for variable objects. We will enable TIME-TAG to test for short-scale variability by tracking every photon's position and detection time.

Visit

Proposal 17521, SZ Cha (01), scheduling Fri Aug 02 20:00:36 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA

Special Requirements: BETWEEN 2025.153:00:00:00 AND 2025.153:07:42:56; BETWEEN 2025.153:17:17:55 AND 2025.155:22:50:05; BETWEEN 2025.156:09:52:58 AND 2025.158:14:35:07; BETWEEN 2025.159:00:16:31 AND 2025.160:00:00:00

Comments: This is a joint HST, JWST, Chandra proposal and these HST observations should be scheduled to be as simultaneous as possible with the JWST and Chandra observations of this target. In the approved proposal, we requested within 1 hour.

Fixed Targets

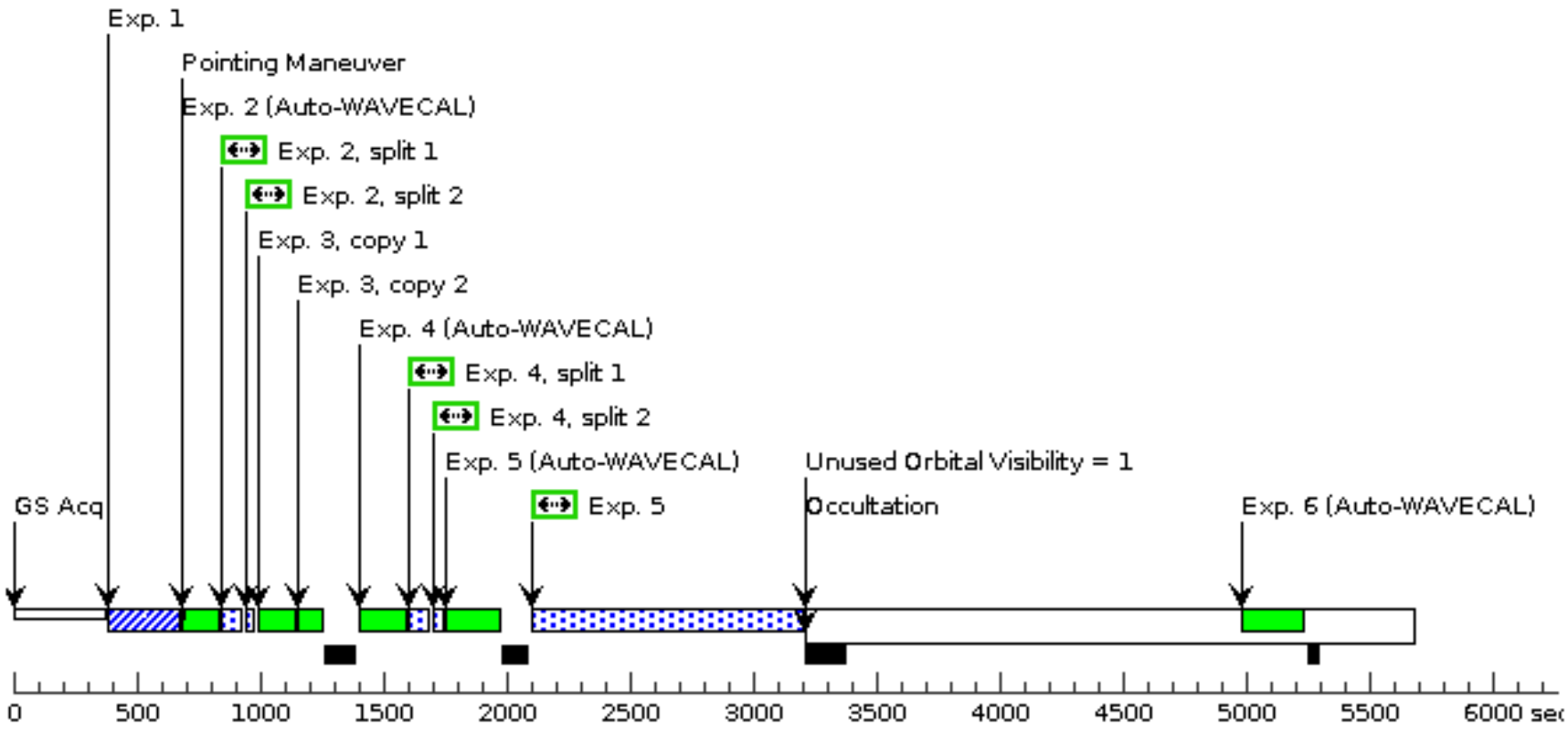
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-SZ-CHA	RA: 10 58 16.6399 (164.5693329d) Dec: -77 17 17.15 (-77.28810d) Equinox: J2000	Proper Motion RA: -0.007109330835855404 sec of time/yr Proper Motion Dec: 0.0020299999999999997 arcsec/yr Epoch of Position: 2015.5	V=12.68	Reference Frame: ICRS

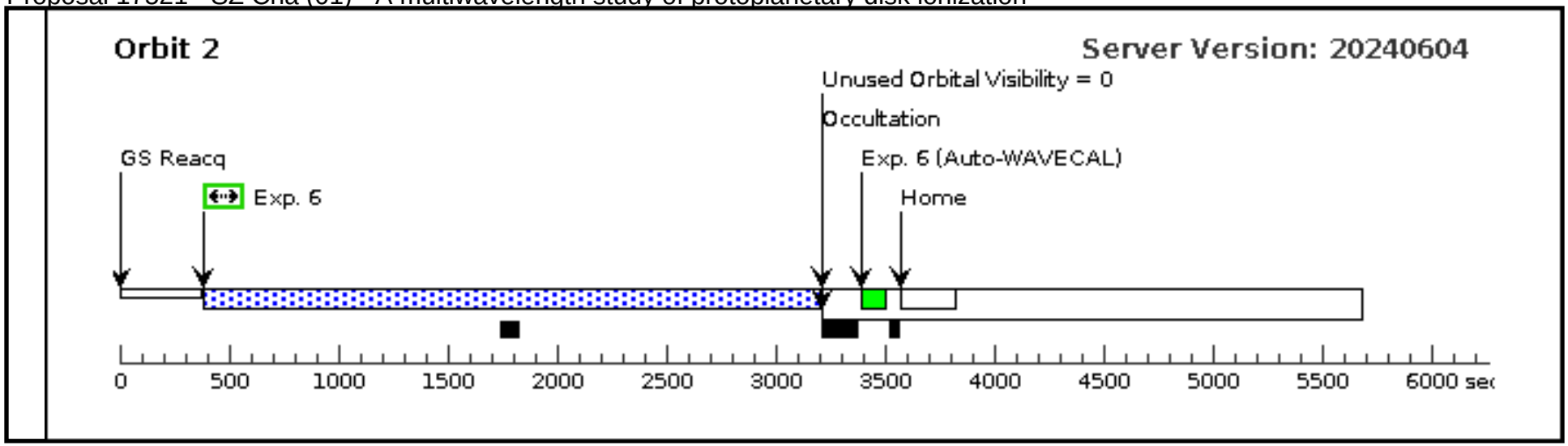
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[T TAURI STAR]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) V-SZ-CHA	STIS/CCD, ACQ, F28X50OIII	MIRROR	ACQTYPE=POINT			4 Secs (4 Secs) *[==>]*	 ***[1]***
2		(1) V-SZ-CHA	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=2			1 Secs (0.2 Secs) *[==>0.1 Secs (Split 1)]* *[==>0.1 Secs (Split 2)]*	 ***[1]***
3		CCDFLAT	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
4		(1) V-SZ-CHA	STIS/CCD, ACCUM, 52X2	G430L 4300 A	CR-SPLIT=2			63 Secs (0.2 Secs) *[==>0.1 Secs (Split 1)]* *[==>0.1 Secs (Split 2)]*	 ***[1]***
5	(STIS.sp.19 24638)	(1) V-SZ-CHA	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=11 20			900 Secs (1060 Secs) *[==>1060.0 Secs]*	 ***[1]***
6	(STIS.sp.19 24639)	(1) V-SZ-CHA	STIS/FUV-MAMA, TIME-TAG, 52X2	G140L 1425 A	BUFFER-TIME=13 23			3000 Secs (2770 Secs) *[==>2770.0 Secs]*	 ***[2]***

Orbit Structure




Orbit 2
Server Version: 20240604
Unused Orbital Visibility = 0
Occultation
GS Reacq
Exp. 6
Exp. 6 (Auto-WAVECAL)
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17521, T 54 (02), completed Fri Aug 02 20:00:36 GMT 2024

Diagnostic Status: Warning

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, ACS/SBC

Special Requirements: (none)

Comments: This is a joint HST, JWST, Chandra proposal and these HST observations should be scheduled to be as simultaneous as possible with the JWST and Chandra observations of this target. In the approved proposal, we requested within 1 hour.

Diagnostics

(T 54 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(T 54 (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

Fixed Targets

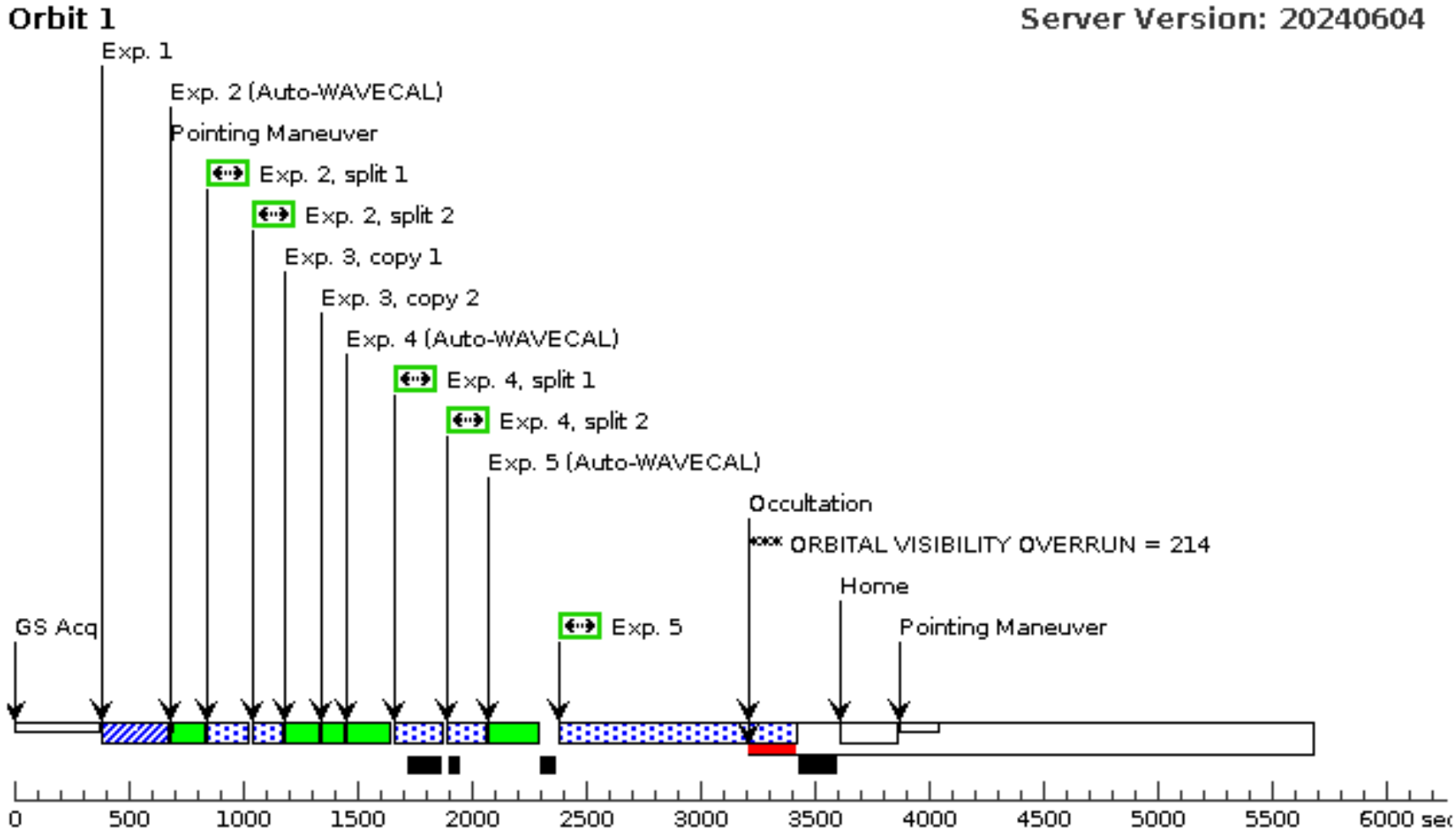
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	ASS-CHA-T-2-54	RA: 11 12 42.5584 (168.1773267d) Dec: -77 22 22.93 (-77.37304d) Equinox: J2000	Proper Motion RA: -0.007255788389042874 sec of time/yr Proper Motion Dec: 7.0E-4 arcsec/yr Epoch of Position: 2015.5	V=11.103	Reference Frame: ICRS

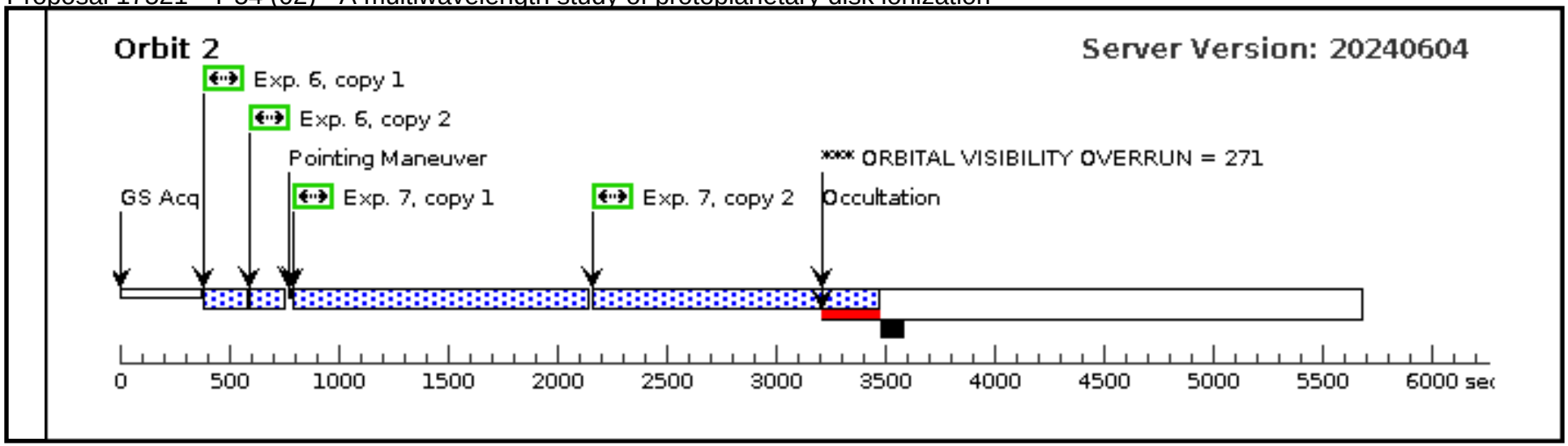
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[T TAURI STAR]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) ASS-CHA-T-2-54	STIS/CCD, ACQ, F28X50OIII	MIRROR	ACQTYPE=POINT			4 Secs (4 Secs) *[==>]*	***[1]***
2		(2) ASS-CHA-T-2-54	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=2			1 Secs (197 Secs) *[==>98.5 Secs (Split 1)]* *[==>98.5 Secs (Split 2)]*	***[1]***
3		CCDFLAT	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
4		(2) ASS-CHA-T-2-54	STIS/CCD, ACCUM, 52X2	G430L 4300 A	CR-SPLIT=2			63 Secs (259 Secs) *[==>129.5 Secs (Split 1)]* *[==>129.5 Secs (Split 2)]*	***[1]***
5	(STIS.sp.1924643)	(2) ASS-CHA-T-2-54	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=1095			900 Secs (998 Secs) *[==>998.0 Secs]*	***[1]***
6	(ACS.im.1924397)	(2) ASS-CHA-T-2-54	ACS/SBC, ACCUM, SBC	F140LP				108 Secs X 2 (272 Secs) *[==>136.0 Secs (Copy 1)]* *[==>136.0 Secs (Copy 2)]*	***[2]***
7	(ACS.sp.1924356)	(2) ASS-CHA-T-2-54	ACS/SBC, ACCUM, SBC	PR130L				1258 Secs X 2 (2572 Secs) *[==>1286.0 Secs (Copy 1)]* *[==>1286.0 Secs (Copy 2)]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20240604
Exp. 6, copy 1
Exp. 6, copy 2
Pointing Maneuver
*** ORBITAL VISIBILITY OVERRUN = 271
GS Acq
Exp. 7, copy 1
Exp. 7, copy 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17521, TW Hya (03), implementation Fri Aug 02 20:00:36 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA

Special Requirements: BETWEEN 2025.021:11:47:50 AND 2025.023:16:50:51; BETWEEN 2025.024:05:15:50 AND 2025.026:08:18:55; BETWEEN 2025.026:20:22:19 AND 2025.027:00:00:00

Comments: This is a joint HST, JWST, Chandra proposal and these HST observations should be scheduled to be as simultaneous as possible with the JWST and Chandra observations of this target. In the approved proposal, we requested within 1 hour.

Fixed Targets

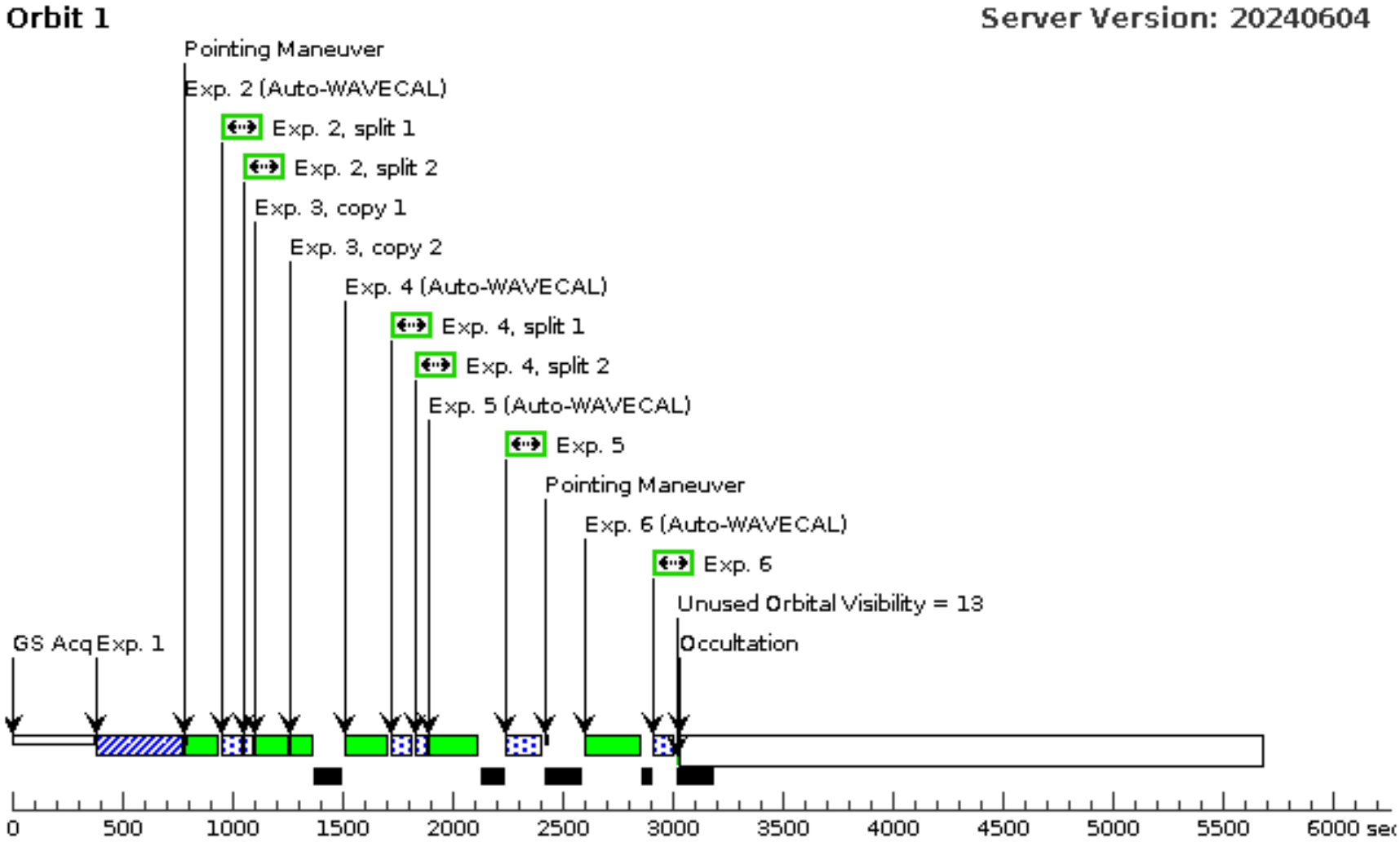
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	V-TW-HYA	RA: 11 01 51.8195 (165.4659146d) Dec: -34 42 17.25 (-34.70479d) Equinox: J2000	Proper Motion RA: -0.005539415026890248 sec of time/yr Proper Motion Dec: -0.013899999999011925 arcsec/yr Epoch of Position: 2015.5	V=10.5	Reference Frame: ICRS

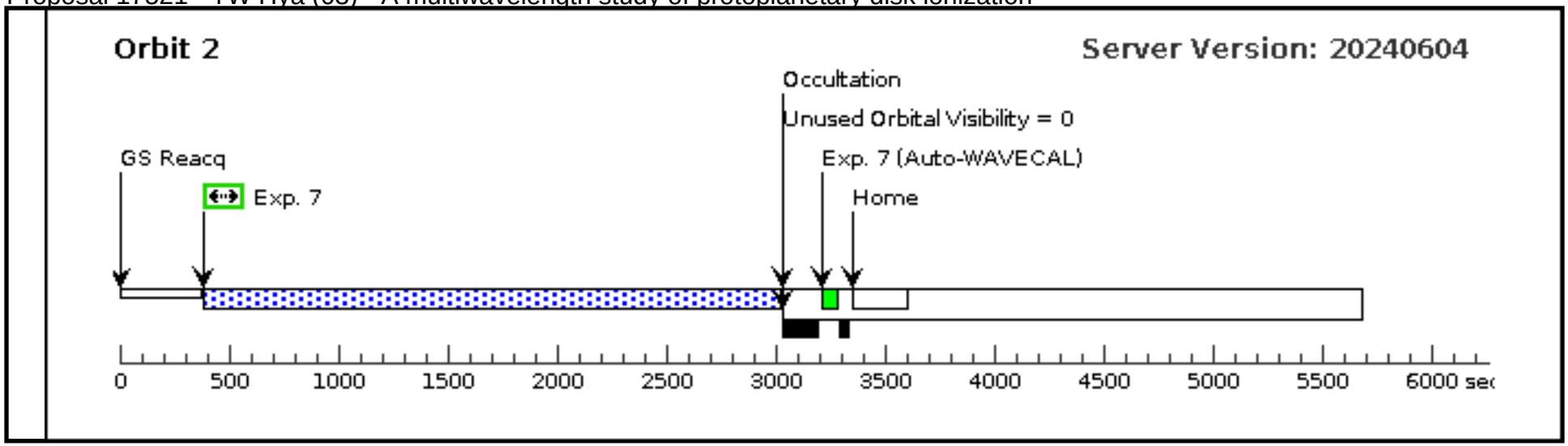
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[T TAURI STAR]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) V-TW-HYA	STIS/CCD, ACQ, F28X50OIII	MIRROR	ACQTYPE=POINT			30 Secs (30 Secs) *[==>]*	***[1]***
2		(3) V-TW-HYA	STIS/CCD, ACCUM, 52X2	G750L 7751 A	CR-SPLIT=2			1 Secs (11 Secs) *[==>5.5 Secs (Split 1)]* *[==>5.5 Secs (Split 2)]*	***[1]***
3		CCDFLAT	STIS/CCD, ACCUM, 0.3X0.09	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
4		(3) V-TW-HYA	STIS/CCD, ACCUM, 52X2	G430L 4300 A	CR-SPLIT=2			20 Secs (30 Secs) *[==>15.0 Secs (Split 1)]* *[==>15.0 Secs (Split 2)]*	***[1]***
5	(STIS.sp.1923511)	(3) V-TW-HYA	STIS/NUV-MAMA, TIME-TAG, 52X2	G230L 2376 A	BUFFER-TIME=261.0			150 Secs (123 Secs) *[==>123.0 Secs]*	***[1]***
6	(STIS.sp.1923510)	(3) V-TW-HYA	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A	BUFFER-TIME=1988			100 Secs (73 Secs) *[==>73.0 Secs]*	***[1]***
7	(STIS.sp.1923510)	(3) V-TW-HYA	STIS/FUV-MAMA, TIME-TAG, 0.2X0.2	E140M 1425 A	BUFFER-TIME=1988			3058 Secs (2624 Secs) *[==>2624.0 Secs]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20240604
Occultation
Unused Orbital Visibility = 0
GS Reacq
Exp. 7 (Auto-WAVECAL)
Exp. 7
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec