17705 - UV STIS Spectroscopy of the MgII nebula around Eta Carinae

Cycle: 32, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Nathan Smith (PI) (Contact)	**University of Arizona**
Dr. Jon A. Morse (CoI)	California Institute of Technology

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) ETA-CAR-NWOFF (3) ETA-CAR	STIS/CCD	4	25-Apr-2025 10:00:12.0	yes
02	(2) ETA-CAR-SEOFF (3) ETA-CAR	STIS/CCD	4	25-Apr-2025 10:00:13.0	yes

8 Total Orbits Used

ABSTRACT

This proposal seeks to obtain deep STIS spectra of the extended ultraviolet Mg II emission recently discovered around the supermassive star Eta Carinae, with the longslit oriented across the flow direction, in both poles of the bipolar Homunculus Nebula. This will measure the expansion speed and velocity dispersion of this warm neutral gas, which will be combined with published proper-motion measurements to determine its tilt angle and deprojected outflow speed, and thus the 3D outflow structure. While density and mass-loss rate from Mg II emission alone are uncertain, spatially resolved velocity structure can be translated to approximate relative density and outflow speed as a function of latitude. These provide a unique probe of the radius, surface gravity, temperature, and rotation rate of the star that launched this wind. This is critical information for piecing together the physical properties of the unstable LBV star in the decades leading up to its eruption, and vital for constraining the physical interaction if it was a

stellar merger event. LBVs more generally are hypothesized to be the products of mass transfer and mergers, but Eta Car is the only one for which this detailed pre-eruption information can be derived observationally. Understanding outer material into which ejecta expand is critical for the extended Eta Car system and hydrodynamics of bipolar nebulae more generally.

OBSERVING DESCRIPTION

Observational goal is to obtain long-slit STIS spectra of the Mg II 2800 AA line from ejecta immediately outside the bipolar Homunculus nebula in order to measure radial velocities along the slit, and hence, 3D kinematics in combination with proper motions already punlished. The STIS spectra use 4 CVZ orbits at each of two positions, 8 orbits total. Each position ois a separate visit. The slit centers are offset to the SE and NW (in the two polar directions) and the slit orientation is roughly perpendicular to the polar axis of the nebula, cutting across the polar axis. For each visit, we acquire on the central star, and then offset to the NW or SE. We do not perform a peakup, since the targets are nebulous and spread over a few arcsec.

Visit

Proposal 17705, STIS NWOFF (01), implementation Fri Apr 25 14:00:14 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: CVZ; ORIENT 84D TO 89 D

Comments: STIS spectrum with slit oriented roughly perpendicular to the polar axis, offset to NW

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.1	Center Pattern=false		
	Line Spacing=			

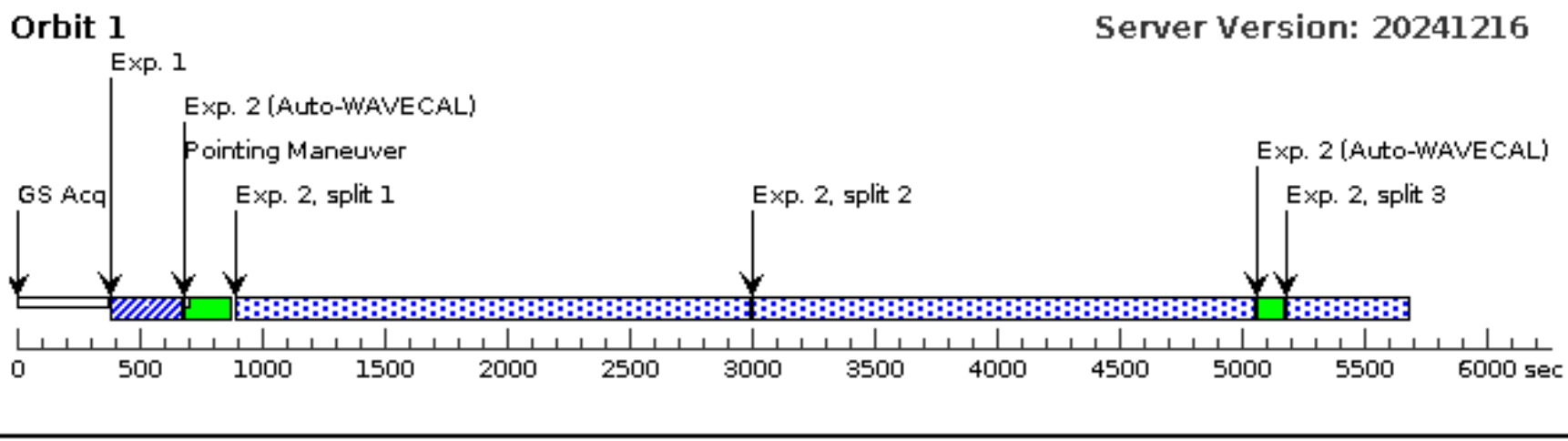
Fixed Targets

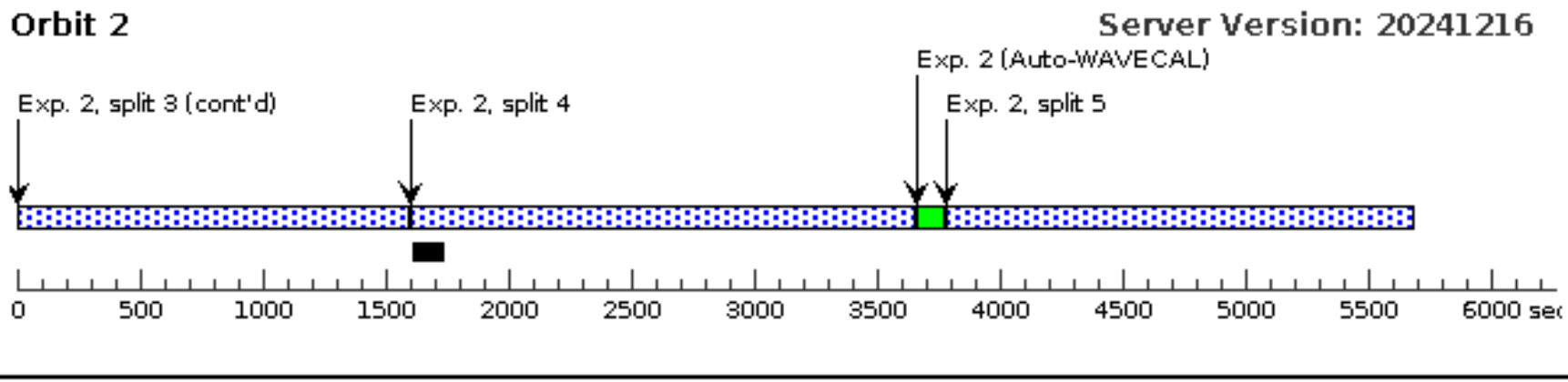
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ETA-CAR-NWOFF	Offset from ETA-CAR		V=6.21	Offset Position (ETA-CAR-NWOFF)
		RA Offset: -0.0025 Degrees			
		Dec Offset: 8.2 Arcsec			
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=ISM* *Description=[BIPOLAR OUTFLOW]* *Extended=YES*					
(3)	ETA-CAR	RA: 10 45 3.5460 (161.2647750d)		V=6.21	Reference Frame: ICRS
		Dec: -59 41 3.95 (-59.68443d)			
		Equinox: J2000			
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. *Category=STAR* *Description=[CIRCUMSTELLAR MATTER, ETA CARINAE STAR]* *Extended=YES*					

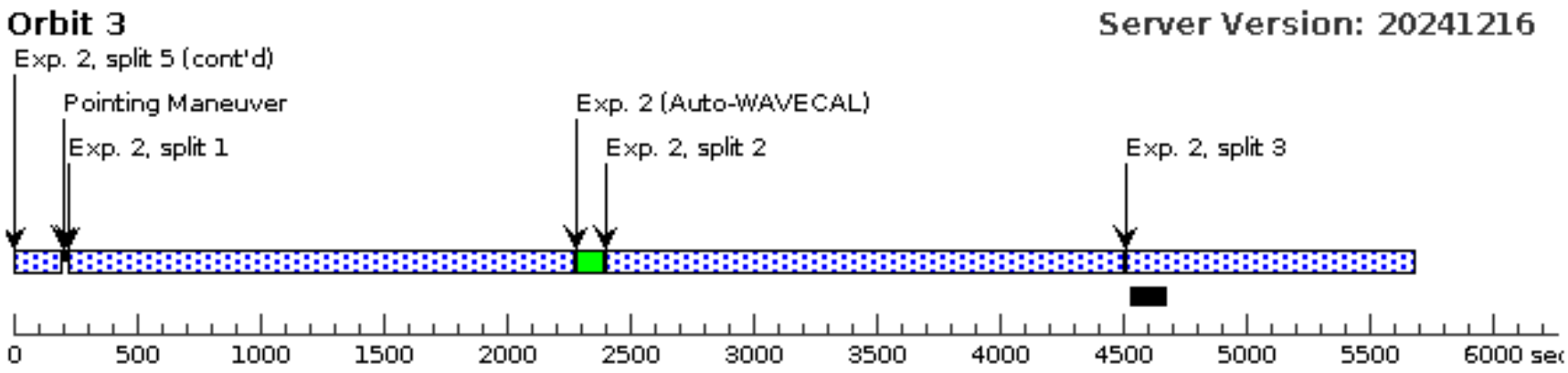
Exposures

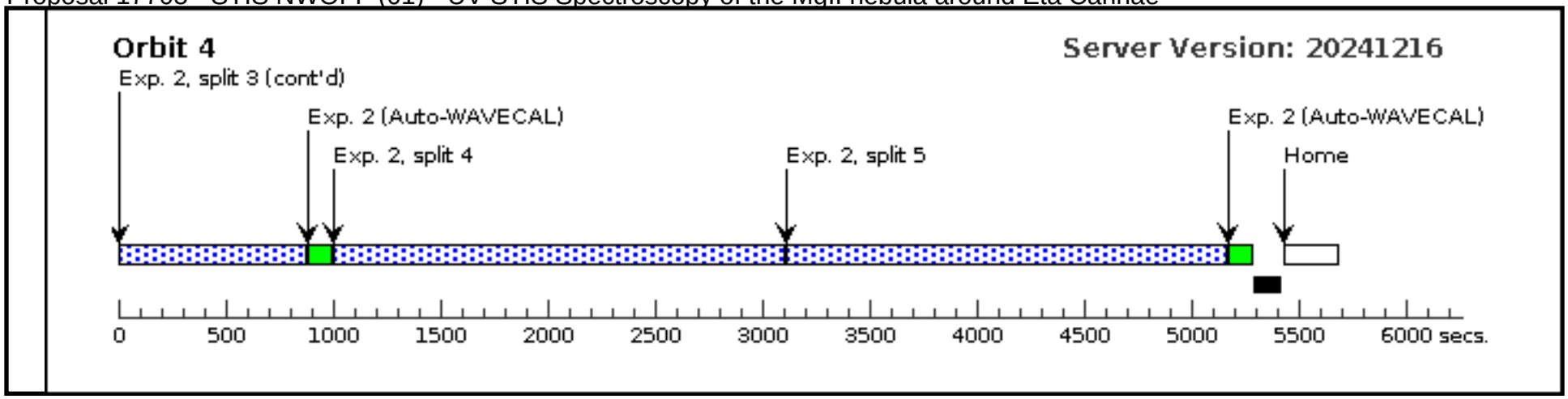
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(3) ETA-CAR	STIS/CCD, ACQ, F25ND3	MIRROR				0.2 Secs (0.2 Secs)	
								[==>]	***[1]***
2		(1) ETA-CAR-NWOFF	STIS/CCD, ACCUM, 52X0.5	G230MB 2794 A	CR-SPLIT=5	POS TARG 0.0,0.0	Pattern 1, Exps 2-2 in STIS NWOFF (01) (1)	10080 Secs (20160 Secs)	
								[==>(Pattern 1, Split 1)]	***[1]***
								[==>(Pattern 1, Split 2)]	
								[==>(Pattern 1, Split 3)]	
								[==>(Pattern 1, Split 4)]	***[2]***
								[==>(Pattern 1, Split 5)]	
								[==>(Pattern 2, Split 1)]	***[3]***
								[==>(Pattern 2, Split 2)]	
								[==>(Pattern 2, Split 3)]	
								[==>(Pattern 2, Split 4)]	***[4]***
								[==>(Pattern 2, Split 5)]	

Orbit Structure








Orbit 4
Server Version: 20241216
Exp. 2, split 3 (cont'd)
Exp. 2 (Auto-WAVECAL)
Exp. 2, split 4
Exp. 2, split 5
Exp. 2 (Auto-WAVECAL)
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 secs.

Visit

Proposal 17705, STIS NWOFF (02), implementation Fri Apr 25 14:00:14 GMT 2025

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: CVZ; ORIENT 84D TO 89 D

Comments: STIS spectrum with slit oriented roughly perpendicular to the polar axis, offset to NW

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=2	Angle Between Sides=		
	Point Spacing=0.1	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	ETA-CAR-SEOFF	Offset from ETA-CAR		V=6.21	Offset Position (ETA-CAR-SEOFF)
		RA Offset: 0.0025 Degrees			
		Dec Offset: -8.6 Arcsec			

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=ISM
Description=[BIPOLAR OUTFLOW]
Extended=YES

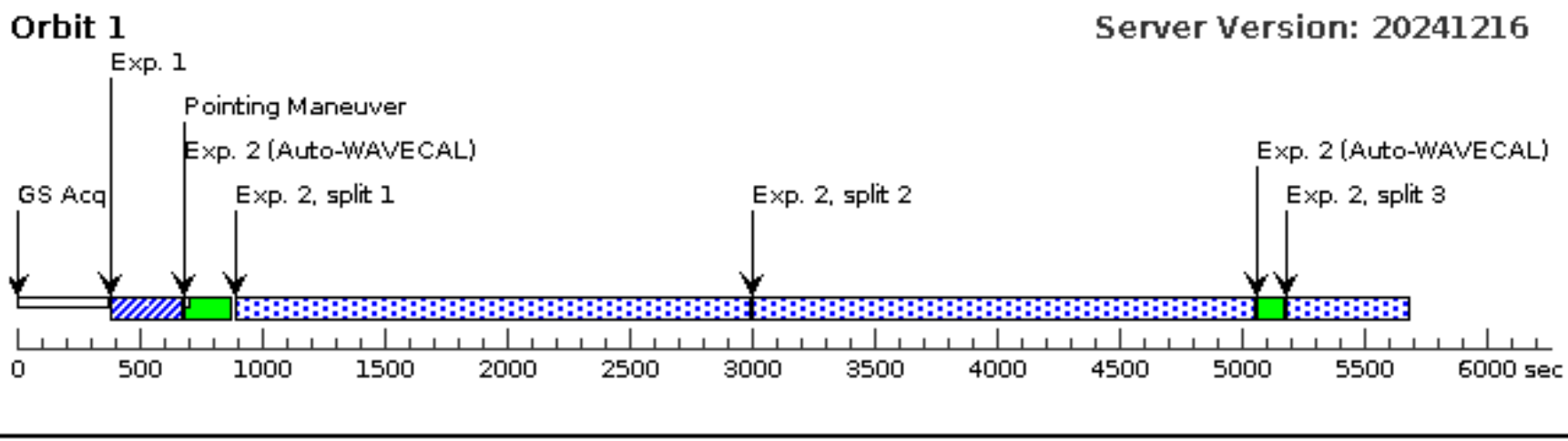
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	ETA-CAR	RA: 10 45 3.5460 (161.2647750d)		V=6.21	Reference Frame: ICRS
		Dec: -59 41 3.95 (-59.68443d)			
		Equinox: J2000			

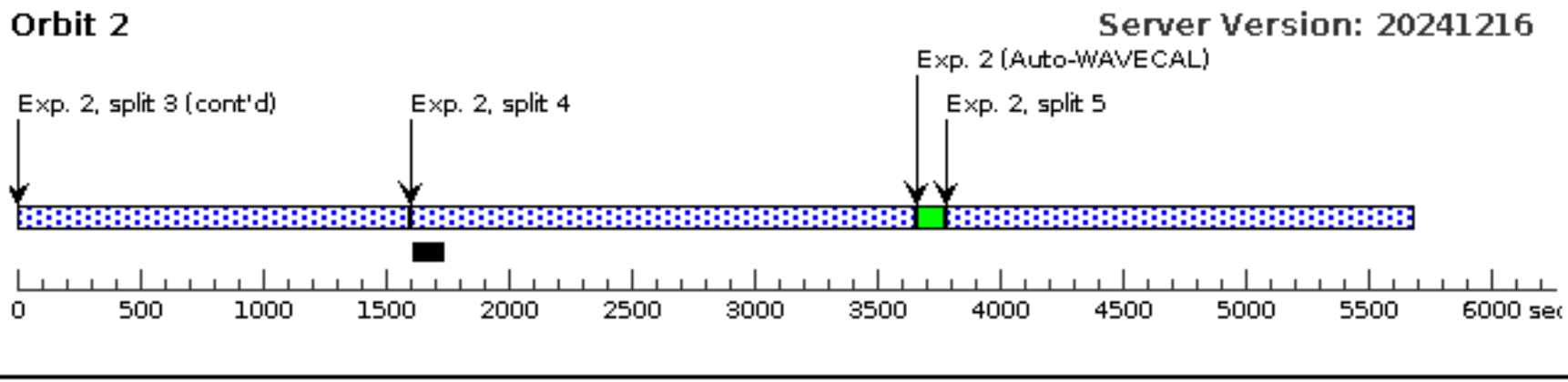
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=STAR
Description=[CIRCUMSTELLAR MATTER, ETA CARINAE STAR]
Extended=YES

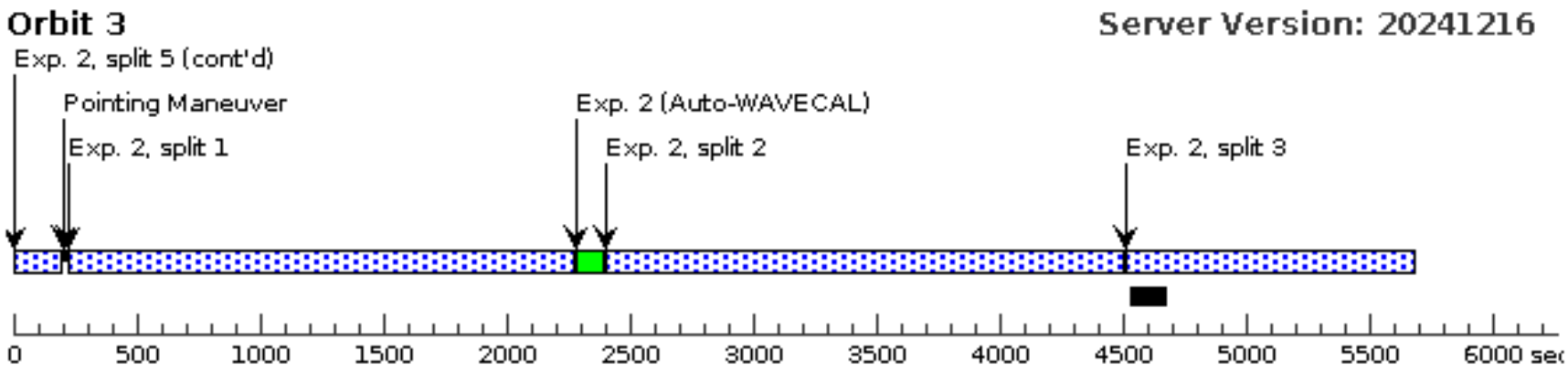
Exposures

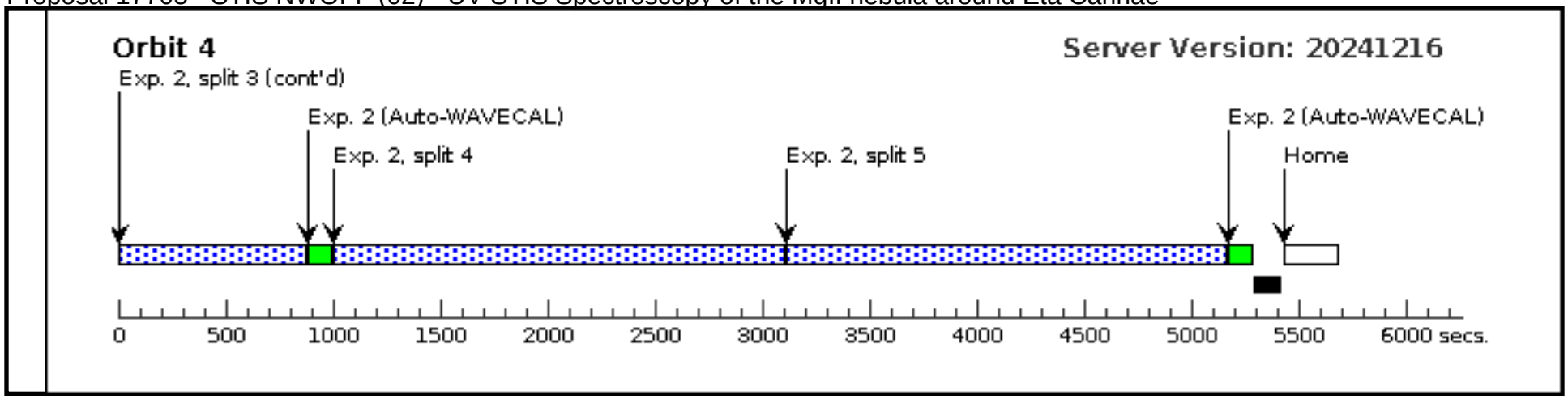
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acquisition	(3) ETA-CAR	STIS/CCD, ACQ, F25ND3	MIRROR				0.2 Secs (0.2 Secs)	
								[==>]	***[1]***
2		(2) ETA-CAR-SEOFF	STIS/CCD, ACCUM, 52X0.5	G230MB 2794 A	CR-SPLIT=5	POS TARG 0.0,0.0	Pattern 1, Exps 2-2 in STIS NWOFF (02) (1)	10080 Secs (20160 Secs)	
								[==>(Pattern 1, Split 1)]	
								[==>(Pattern 1, Split 2)]	***[1]***
								[==>(Pattern 1, Split 3)]	
								[==>(Pattern 1, Split 4)]	
								[==>(Pattern 1, Split 5)]	***[2]***
								[==>(Pattern 2, Split 1)]	
								[==>(Pattern 2, Split 2)]	***[3]***
								[==>(Pattern 2, Split 3)]	
								[==>(Pattern 2, Split 4)]	
								[==>(Pattern 2, Split 5)]	***[4]***

Orbit Structure








Orbit 4
Server Version: 20241216
Exp. 2, split 3 (cont'd)
Exp. 2 (Auto-WAVECAL)
Exp. 2, split 4
Exp. 2, split 5
Exp. 2 (Auto-WAVECAL)
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 secs.