14789 - Procyon: New Candidate for the Dynamo Clinical Trial

Cycle: 24, Proposal Category: GO

(Availability Mode: AVAILABLE)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Thomas R. Ayres (PI) (Contact)	**University of Colorado at Boulder**	**thomas.ayres@colorado.edu**

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
10	(1) HD61421 NONE WAVE	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	07-Sep-2016 18:36:23.0	yes
11	(1) HD61421 NONE WAVE	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	07-Sep-2016 18:36:25.0	yes

4 Total Orbits Used

ABSTRACT

This is the second year of a joint Chandra/HST program to follow the evolution of the high-energy (X-ray and UV) activity cycles of the nearby mid-F subgiant Procyon. This bright star has high-energy attributes that are similar to the Sun, yet it is a hotter star, at the edge of the region in the H-R diagram where surface convection occurs (the power source for stellar magnetic activity). The HST part is to record STIS UV spectra of the bright star on a semi-annual basis at high echelle resolution and high S/N, especially to capture the FUV Fe XII 124,134 nm coronal forbidden lines, which can tie together the non-simultaneous Chandra X-ray and HST pointings; as well as to record other key high-energy species like Si IV, C IV, and N V. The latter display Doppler-shifted, bimodal distorted emission profiles that signify high-powered dynamics in the interface regions of the stellar

atmosphere between the super-hot corona (>1 MK) and the cold photosphere (<6000 K). The associated flows are a hot topic in contemporary solar physics, and one focus of a new space-based solar imaging spectrometer called IRIS. The solar and stellar FUV views are strongly complementary. The HST part of the program has two general objectives: (1) follow changes in the FUV spectra associated with any slowly evolving X-ray activity cycle of Procyon; and (2) combine the multiple epochs of echelle spectra to provide the highest possible S/N for identifying weak, but diagnostically important, emission lines (absorption, in some cases), and for decomposing the high-temperature line profiles (e.g., Si IV, C IV) into multiple dynamical components (which are though to be symptomatic of coronal heating and cooling processes).

OBSERVING DESCRIPTION

The proposed STIS observations of Procyon are straightforward. There are two identical visits of two orbits each, with a BETWEEN constraint specified to ensure scheduling at about a half-year separation, which is adequate timing to follow starpot cycle variations (which occur on timescales of roughly a decade, at least for the Sun).

In each visit, the optically bright target is acquired by direct imaging with the CCD through the F25ND5 filter. The remainder of the first orbit is occupied by a high-res FUV echelle exposure with setting E140H-1307 through the 0.2x0.2 photometric aperture. A peak-up is not needed because the CCD ACQ is accurate enough for centering in the photometric slot. During the occultaion period, a 100s wavecal is taken in H-1307, followed by a 100s wavecal in E140H-1486. The second orbit begins with a second high-res FUV echelle exposure of the target, now with H-1489, but again through the 0.2x0.2 aperture. Together, these two settings cover the range from below Lyman Alpha (121 nm) out to beyond the C IV doublet at 155 nm, where the rising F-type photospheric continuum begins to overwhelm the faint subcoronal emission line spectrum. The two settings overlap in the key 140 nm region which contains the prominent Si IV doublet, as well as a density-sensitive multiplet of semi-permitted O IV. At the end of the second orbit, a brief NUV high-res echelle exposure is taken with setting E230H-2762 to capture the important chromospheric emission doublet of Mg II at 280 nm. Owing to the brightness of Procyon at these wavelengths, the observation must be taken through the ND2 slit, which requires a prior peak-up (in this case in dispersed light with G430M-4451). In the occultation period following, a 250s wavecal is taken in H-2762. The purpose of the deeper-than-normal wavecals is to ensure that the dispersion properties of the spectrometer are accurately recorded under the same conditions as the science exposures, to take full advantage of the STIS capabilities to measure small differential velocity shifts between emission lines formed in different environments in the stellar outer atmosphere, a major scientific goal of the project. The nonstandard wavecals are forced to be adjacent to the respective science exposures by a "SEQ NON-INT" pairing. Because the GO-specified wavelength calibrations can substitute for the normal brief AUTO-WAVECALs, the latter are turned off in the three science exposures.

Proposal 14789 - Visit 10 - Procyon: New Candidate for the Dynamo Clinical Trial

Visit

Proposal 14789, Visit 10, implementation Wed Sep 07 22:36:26 GMT 2016

Diagnostic Status: Error

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

Special Requirements: BETWEEN 01-APR-2017:00:00:00 AND 30-APR-2017:00:00:00

Comments: The BETWEEN range given below is about 6 months prior to the narrower (3-day) visibility window in OCT 2017. This is the only pair of six-month-separated visibilities in Cycle 24, consistent with the desired starspot cycle monitoring interval.

Diagnostics

(Exposure 3 (Sequence 2-3 Non-Int in Visit 10)) Error (Form): Target NONE is no longer a valid selection

(Exposure 3 (Sequence 2-3 Non-Int in Visit 10)) Error (Form): This attribute cannot have this value due to other choices: Calibration_Target=NONE
Calibration Target 'NONE' only allowed in engineering proposals unless LAMP is TUNGSTEN

(Exposure 3 (Sequence 2-3 Non-Int in Visit 10)) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=LAMP=LINE
Lamps except TUNGSTEN not allowed in non-engineering proposals.

(Exposure 3 (Sequence 2-3 Non-Int in Visit 10)) Error (Form): LINE is not a valid selection

(Exposure 3 (Sequence 2-3 Non-Int in Visit 10)) Error (Form): LINE is not a valid selection

Fixed Targets

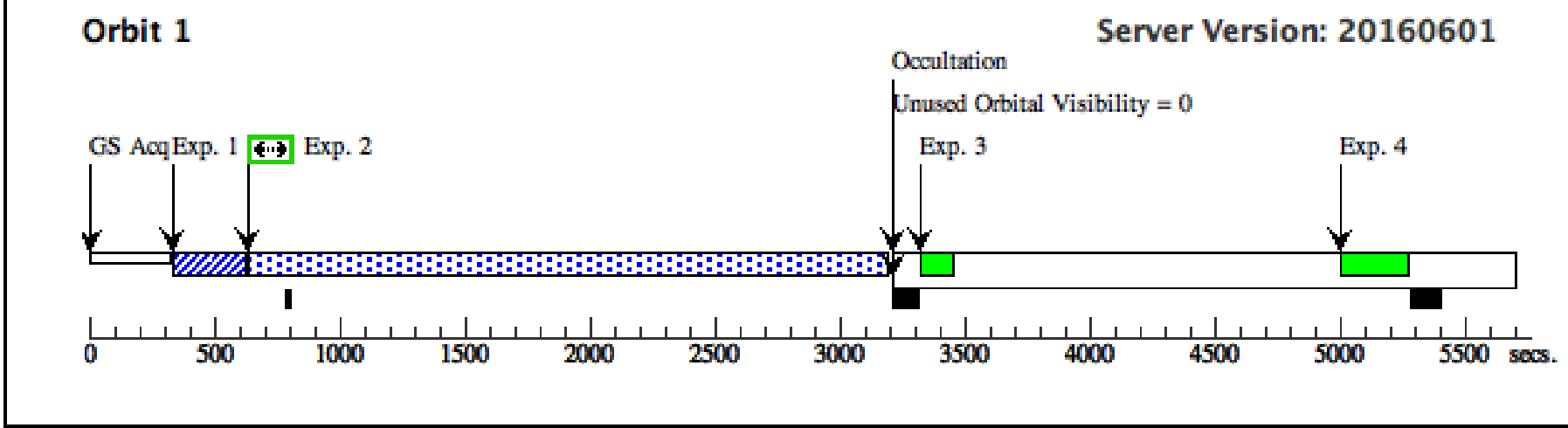
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD61421	RA: 07 39 17.2823 (114.8220096d)	Proper Motion RA: -0.7146 arcsec/yr	V=+0.37+/-0.1	Reference Frame: ICRS
	Alt Name1: ALP-CMI	Dec: +05 13 11.81 (5.21995d)	Proper Motion Dec: -1.0368 arcsec/yr		
		Equinox: J2000	Parallax: 0.285"		
			Epoch of Position: 2017.50		
			Radial Velocity: -3.2 km/sec		

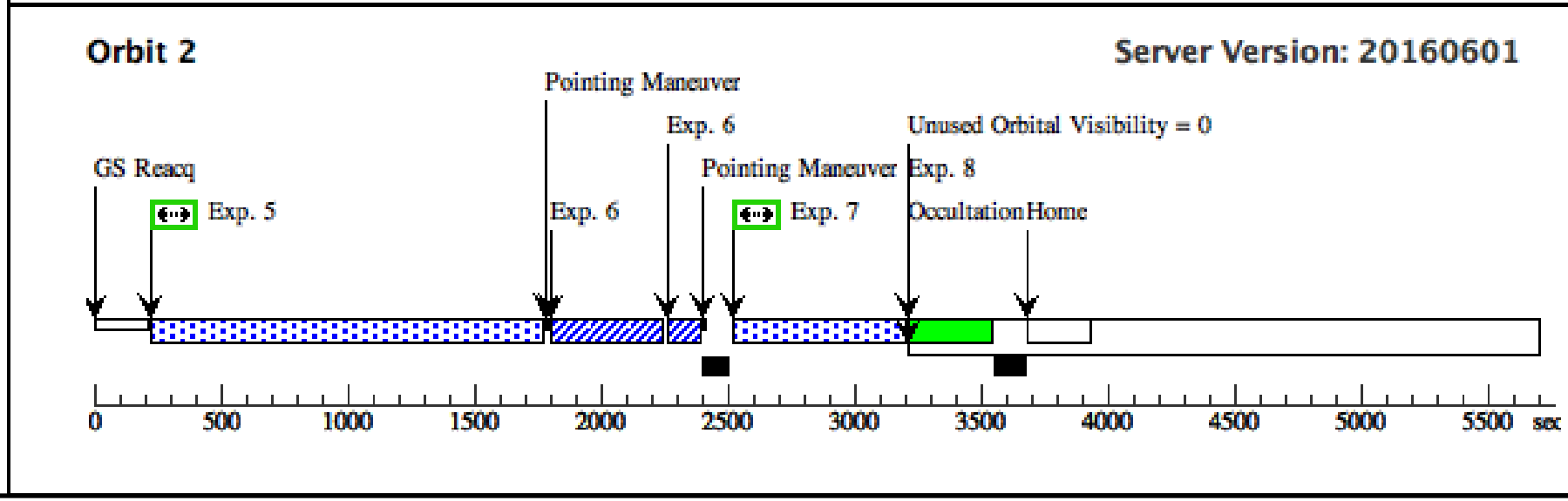
Comments: The target coords for epoch 2017.5 were taken from SIMBAD, in the ICRS frame.
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.ta.743 495)	(1) HD61421	STIS/CCD, ACQ, F25ND5	MIRROR		GS ACQ SCENARIO BASE1B3		0.1 Secs (0.1 Secs)	
								[==>]	***[1]***
	Comments: Castelli-Kurucz Model:F5V; V=+0.37; Optimum SNR = 95; time to sat 3.2 s								
2	(STIS.sp.74 3498)	(1) HD61421	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A	WAVECAL=NO		Sequence 2-3 Non-Int in Visit 10	2423 Secs (2423 Secs)	
								[==>]	***[1]***
	Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~25 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues								
3		NONE	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1307 A	LAMP=LINE	QESIPARM TARG TYPE HITM2	Sequence 2-3 Non-Int in Visit 10	100 Secs (100 Secs)	
								[==>]	***[1]***
	Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~25 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues								
4		WAVE	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1489 A			Sequence 4-5 Non-Int in Visit 10	100 Secs (100 Secs)	
								[==>]	***[1]***
	Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~35 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues								
5	(STIS.sp.74 3499)	(1) HD61421	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1489 A	WAVECAL=NO		Sequence 4-5 Non-Int in Visit 10	1521 Secs (1521 Secs)	
								[==>]	***[2]***
	Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~35 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues								
6	(STIS.sp.74 3497)	(1) HD61421	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	G430M 4451 A				0.1 Secs (0.1 Secs)	
								[==>]	***[2]***
	Comments: dispersed light peak-up assuming Castelli-Kurucz Model F5V, V=+0.37 mag: in 0.1 s, 479k e- with ND2 slit								
7	(STIS.sp.74 3502)	(1) HD61421	STIS/NUV-MAMA, ACCUM, 0.2X0.05ND	E230H 2762 A	WAVECAL=NO		Sequence 7-8 Non-Int in Visit 10	500 Secs (500 Secs)	
								[==>]	***[2]***
	Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 750 s at Mg II 279 nm gives peak SNR~32 (per resol) with ND2 aperture; no LCR or GCR issues								
8		WAVE	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2762 A			Sequence 7-8 Non-Int in Visit 10	250 Secs (250 Secs)	
								[==>]	***[2]***
	Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 750 s at Mg II 279 nm gives peak SNR~32 (per resol) with ND2 aperture; no LCR or GCR issues								

Orbit Structure





Visit

Proposal 14789, Visit 11, implementation Wed Sep 07 22:36:26 GMT 2016

Diagnostic Status: Error

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

Special Requirements: BETWEEN 26-OCT-2017:00:00:00 AND 28-OCT-2017:23:00:00

Comments: The BETWEEN range given below for the narrow OCT visibility window is approximately 6 months after the broader window in APR 2017.

Diagnostics

(Exposure 3 (Sequence 2-3 Non-Int in Visit 11)) Error (Form): LINE is not a valid selection

(Exposure 3 (Sequence 2-3 Non-Int in Visit 11)) Error (Form): Target NONE is no longer a valid selection

(Exposure 3 (Sequence 2-3 Non-Int in Visit 11)) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=LAMP=LINE
Lamps except TUNGSTEN not allowed in non-engineering proposals.

(Exposure 3 (Sequence 2-3 Non-Int in Visit 11)) Error (Form): This attribute cannot have this value due to other choices: Calibration_Target=NONE
Calibration Target 'NONE' only allowed in engineering proposals unless LAMP is TUNGSTEN

(Exposure 3 (Sequence 2-3 Non-Int in Visit 11)) Error (Form): LINE is not a valid selection

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
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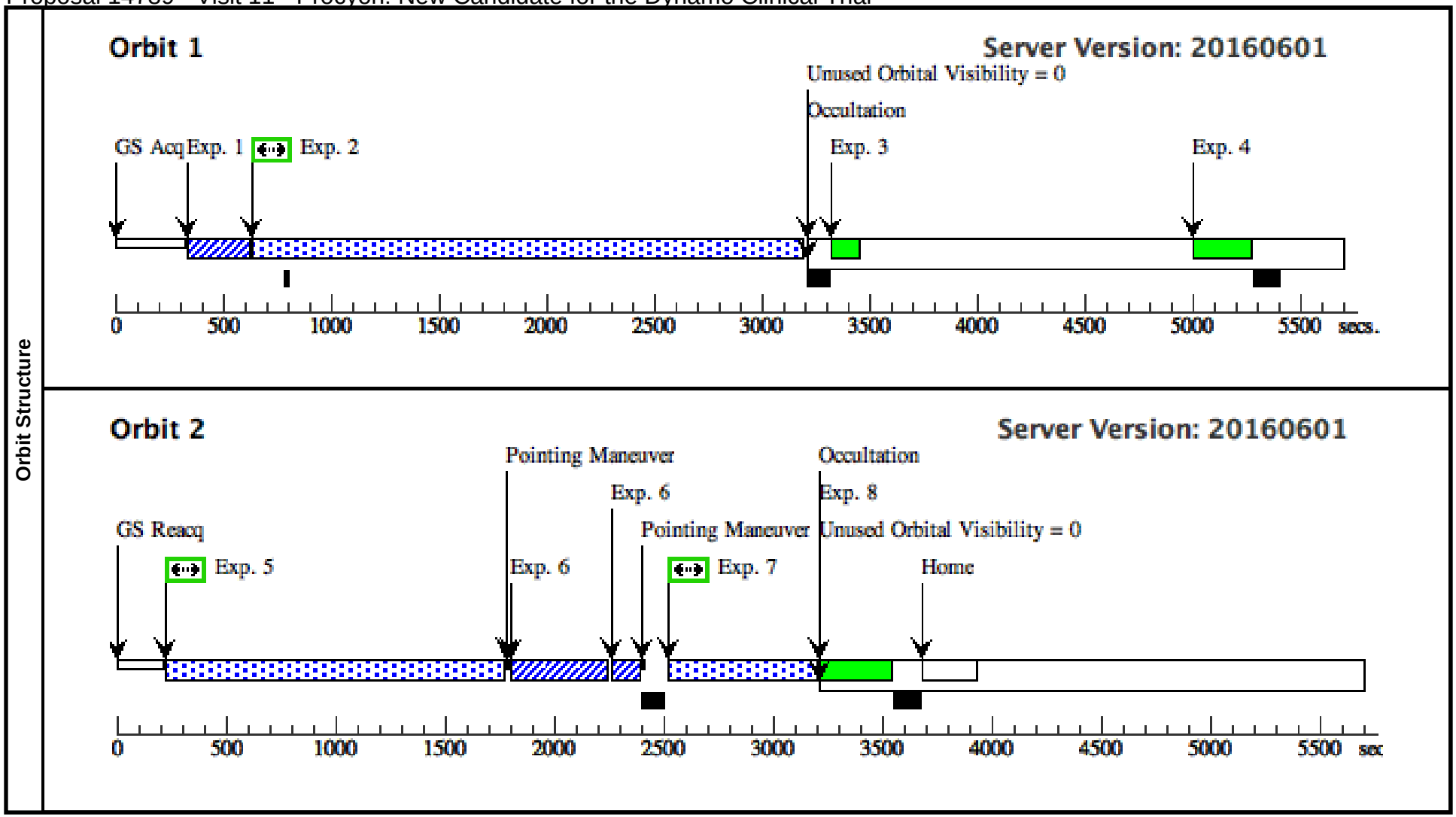
	Alt Name1: ALP-CMI	Dec: +05 13 11.81 (5.21995d)	Proper Motion Dec: -1.0368 arcsec/yr		
		Equinox: J2000	Parallax: 0.285"		
			Epoch of Position: 2017.50		
			Radial Velocity: -3.2 km/sec		

Comments: The target coords for epoch 2017.5 were taken from SIMBAD, in the ICRS frame.
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.ta.743495)	(1) HD61421	STIS/CCD, ACQ, F25ND5	MIRROR		GS ACQ SCENARIO BASE1B3		0.1 Secs (0.1 Secs)	
								[==>]	***[1]***
Comments: Castelli-Kurucz Model:F5V; V=+0.37; Optimum SNR = 95; time to sat 3.2 s									
2	(STIS.sp.743498)	(1) HD61421	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A	WAVECAL=NO		Sequence 2-3 Non-Int in Visit 11	2423 Secs (2423 Secs)	
								[==>]	***[1]***
Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~25 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues									
3		NONE	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1307 A	LAMP=LINE	QESIPARM TARGYPE HITM2	Sequence 2-3 Non-Int in Visit 11	100 Secs (100 Secs)	
								[==>]	***[1]***
Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~25 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues									
4		WAVE	STIS/FUV-MAMA, ACCUM, 0.2X0.09	E140H 1489 A			Sequence 4-5 Non-Int in Visit 11	100 Secs (100 Secs)	
								[==>]	***[1]***
Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~35 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues									
5	(STIS.sp.743499)	(1) HD61421	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1489 A	WAVECAL=NO		Sequence 4-5 Non-Int in Visit 11	1521 Secs (1521 Secs)	
								[==>]	***[2]***
Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 2 ks at Si IV 139 nm gives peak SNR~35 (per resol) with 0.2x0.2 aperture; no LCR or GCR issues									
6	(STIS.sp.743497)	(1) HD61421	STIS/CCD, ACQ/PEAK, 0.2X0.05ND	G430M 4451 A				0.1 Secs (0.1 Secs)	
								[==>]	***[2]***
Comments: dispersed light peak-up assuming Castelli-Kurucz Model F5V, V=+0.37 mag: in 0.1 s, 479k e- with ND2 slit									
7	(STIS.sp.743502)	(1) HD61421	STIS/NUV-MAMA, ACCUM, 0.2X0.05ND	E230H 2762 A	WAVECAL=NO		Sequence 7-8 Non-Int in Visit 11	500 Secs (500 Secs)	
								[==>]	***[2]***
Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 750 s at Mg II 279 nm gives peak SNR~32 (per resol) with ND2 aperture; no LCR or GCR issues									
8		WAVE	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2762 A			Sequence 7-8 Non-Int in Visit 11	250 Secs (250 Secs)	
								[==>]	***[2]***
Comments: Input=special ETC file for ALP-CMI from ASTRAL catalog; exposure time= 750 s at Mg II 279 nm gives peak SNR~32 (per resol) with ND2 aperture; no LCR or GCR issues									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Exp. 3
Exp. 4
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4500
5000
5500
secs.
Orbit 2
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Pointing Maneuver
Occultation
Exp. 6
Exp. 8
GS Reacq
Pointing Maneuver
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Exp. 6
Exp. 7
Home
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sec