16994 - Alpha Centauri and Environs

Cycle: 30, Proposal Category: GO

(Availability Mode: AVAILABLE)

INVESTIGATORS

Name	*Institution*
Dr. Thomas R. Ayres (PI) (Contact)	**University of Colorado at Boulder**

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
10	(1) HD128620 (2) HD128621 WAVE	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	10-May-2023 09:00:15.0	yes
11	(1) HD128620 (2) HD128621 WAVE	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	10-May-2023 09:00:17.0	yes

4 Total Orbits Used

ABSTRACT

(Note: this is the HST part of a joint Chandra/HST project: the original Chandra proposal abstract follows.)

Chandra has been tracking coronal activity cycles of late-type stars via high-contrast soft X-rays, jointly with HST to capture UV tracers. Objective is to provide fundamental observational constraints for contemporary and future studies of the underlying magnetic Dynamo, whose inner workings remain elusive. The Sun's high-energy modulations play an important "Space Weather" role in our heliosphere, as do stellar counterparts for their exoplanets. 3-year time-domain campaign (jointly with HST) is proposed for iconic Alpha Centauri, already followed by HRC-I since 2006. The

Alpha Cen field also is rich in serendipitous sources, including flaring red dwarfs and several possibly cycling F-K stars.

OBSERVING DESCRIPTION

Impact of Reduced Gyro Mode

Main impact of RGM would be on the CVZ orbits requested for the target Alpha Cen A+B, together with an orientation constraint for one of the ND-filtered long-slit exposures, to avoid having both stars (currently only ~8" apart) fall on the slit at the same time. If RGM becomes necessary in Cycle 30, the observing program would be modified as follows: (1) the two NUV echelle exposures would be eliminated (one of which uses the problematic long-slit); (2) the FUV exposure times would be reduced to allow the 2-orbit pointing to be carried out in non-CVZ time, to increase scheduling opportunities. The loss in science from dropping the NUV exposures would be minor, because the FUV spectral region is the highest priority in terms of its potential information content. Also, the reduced FUV exposures would have minimal impact, because the two nearby sun-like dwarfs are bright at the short wavelengths.

Phase II Observing Description (for normal 3-gyro operations)

The high southern declination Alpha Cen system falls in the HST Continuous Viewing Zone numerous times during the year, allowing the two stars to be captured in a single visit of two orbits. Two such visits are planned for Cycle 30, compatible with the semiannual pointings by Chandra. There is no need to strictly coordinate the FUV and X-ray pointings, because the FUV Fe XII 124 nm coronal forbidden line can tie the STIS observation into the X-ray timeline.

In each STIS visit, the binary companions are observed sequentially, beginning with Alp Cen A, brighter of the two. The target is acquired with the CCD and F25ND5, followed by an exposure with the E140M-1425 medium-res echelle through the photometric slot (0.2x0.2), which delivers R=40,000 and good sensitivity (peak S/N=40 per resol at the tops of the important Si IV 140 nm and C IV 155 nm resonance doublets). A peak-up is not needed because the CCD ACQ is accurate enough for centering in the photometric slot. The exposure depth is sufficient to capture the key Fe XII 124 nm coronal forbidden line, which as mentioned earlier is used to tie the STIS FUV measurements into the X-ray time series. The combination of resolution, spectral coverage, and sensitivity of E140M for A has proven successful in previous incarnations of this program. Following the E140M exposure, a peak-up is performed with the 31x0.05NDC slit in dispersed visible light with the CCD and G430M; then an

E230H-2713 exposure is taken through the ND long slit. This setting captures the key chromospheric Mg II 280 nm resonance doublet.

After the Alp Cen A exposures, a 7.6" offset manuever to B is performed, followed by a CCD ACQ through F25ND5. The time-dependent separation of the binary companions is accurately known (to ~0.1"), based on orbital reconstructions of ten years of positional measurements by Chandra. Similarly, the coordinates and (an effective) proper motion of Alp Cen A were updated for the first year of the 3-year program (in Cycle 29), based on combining the orbital and proper motion solutions derived from the Chandra positions to trace out A's trajectory across the sky. The specified coordinates, for epoch 2020.43, and predicted proper motions should be good for several Cycles.

After the CCD-ACQ of B, an E230H-2713 is taken, again to cover the important Mg II region. The 0.2x0.09 spectroscopic aperture can be used, because the previously measured Global Count Rate with this setting is below the bright limit, and B is only minimally variable in the continuum light that dominates that setting (the Mg II lines can be more variable, but do not contribute signifcantly to the total flux in that region; and do not approach the local bright limit). A peak-up ensures maximum throughput. Following the NUV exposure, an E140M-1425 exposure is taken through the 0.2x0.2 photometric aperture, to maximize sensitivity without significant loss of resolution, and minimize the influence of breathing effects. The entire FUV+NUV sequence for both stars requires two CVZ orbits.

Because a tall slit is used for A, an ORIENT constraint is specified to avoid having both targets fall on the slit simultaneously, and consequently corrupt the echellegram with overlapping spectra (and possibly also violate the global limits). The constraint is not severe, however, because the NDC slit is only 0.05" wide and the separation of the stars will be ~8" in 2023. A +/- 4 degree avoidance zone (+/- 0.5" pivot from B) should be sufficient to exclude B and any possible scattered light. The ORIENT avoidance zones for 2023 are listed in the Visit-level specifications (the PA of B relative to A is ~ +3 deg East of North in 2023). There are numerous CVZ windows throughout the year that satisfy the ORIENT constraint, and allow spacing the visits about 6 months apart (specified by an "After Visit" constraint).

Non-standard lamp exposures, uniformly 45s, are used for the FUV and NUV settings of both stars to provide accurate zero-point wavelength shifts for the respective echellegrams. The lamp output has faded over the years, and the default wavecals are no longer able to provide the desired accuracy. The deeper-than-normal wavecals ensure that the dispersion properties of the spectrometer are accurately monitored, to take full advantage of STIS's ability 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 non-standard 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 respective science exposures.

Visit

Proposal 16994, Visit 10, implementation Wed May 10 13:00:18 GMT 2023

Diagnostic Status: No Diagnostics

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

Special Requirements: CVZ; ORIENT 52D TO 224 D; ORIENT 232D TO 359.99 D; ORIENT 0D TO 44 D

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD128620	RA: 14 39 25.7700 (219.8573750d)	Proper Motion RA: -3.80 arcsec/yr	V=+0.01+/-0.1	Reference Frame: ICRS
	Alt Name1: ALP-CEN-A	Dec: -60 49 56.50 (-60.83236d)	Proper Motion Dec: +0.22 arcsec/yr		
		Equinox: J2000	Parallax: 0.747"		
			Epoch of Position: 2020.43		
			Radial Velocity: -24 km/sec		

Comments: Target coords for 2020.43 based on Chandra X-ray position in that epoch. Proper motion of Alpha Cen A, which is strongly influenced by the relative AB orbit, was derived from recent trajectory of A on sky tracked by Chandra.
Category=STAR
Description=[CORONA, G V-IV]
Extended=NO

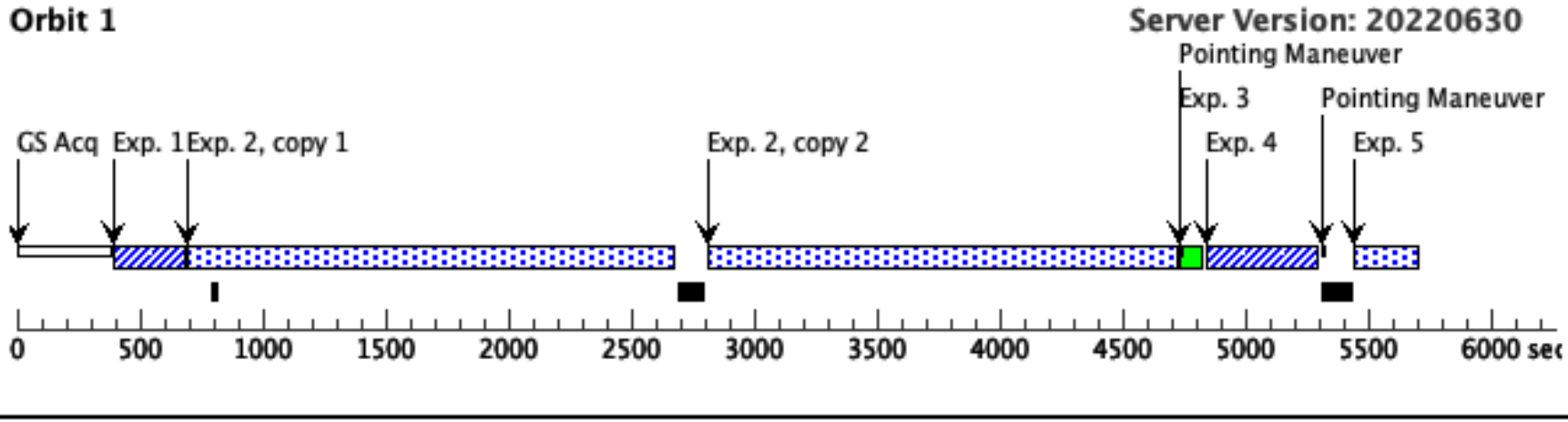
(2)	HD128621	Offset from HD128620		V=1.33+/-0.1	Offset Position (HD128621)
	Alt Name1: ALP-CEN-B	RA Offset: 0.051 Secs			
		Dec Offset: 7.6 Arcsec			

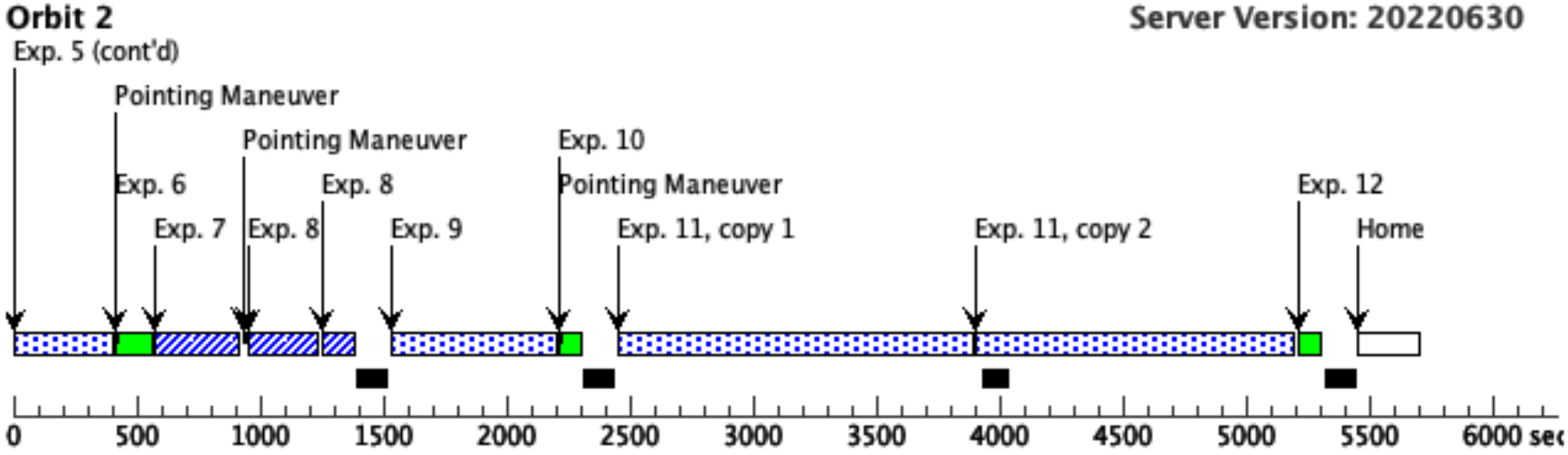
Comments: Offset of B relative to A, for 2023.25, was determined from the empirical ephemeris, designed to closely match the relative orbit as recorded by Chandra's High Resoultion Camera in recent years.
Category=STAR
Description=[CORONA, K V-IV]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(STIS.im.11 84308)	(1) HD128620	STIS/CCD, ACQ, F25ND5	MIRROR		GS ACQ SCENARIO BASE1BE		0.1 Secs (0.1 Secs) *[==>]*	 ***[1]***
Comments: Castelli-Kurucz Models G2V 5750 4.5, renormalized to vegamag = 0.01 in filter Johnson/V: SNR~140 in 0.1 s; time to saturation 0.6 s.									
2	(STIS.sp.11 84381)	(1) HD128620	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A	WAVECAL=NO		Sequence 2-3 Non-Int in Visit 10	1900 Secs X 2 (3800 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	 ***[1]***
Comments: Input=special ETC file for ALP-CEN-A from previous STIS echelle spectra; exposure time= 1.5 ks at Si IV 139 nm gives peak SNR~40 (per resol) with 0.2x0.2 aperture. No LCR or GCR issues.									
3		WAVE	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A			Sequence 2-3 Non-Int in Visit 10	45 Secs (45 Secs) *[==>]*	 ***[1]***
Comments: Deeper than normal wavecal to determine accurate zero-point shift.									
4	(STIS.sp.11 84256)	(1) HD128620	STIS/CCD, ACQ/PEAK, 31X0.05NDC	G430M 4451 A				0.1 Secs (0.1 Secs) *[==>]*	 ***[1]***
Comments: Dispersed light peak-up; Castelli-Kurucz Model G2V 5750 4.5, renormalized to vegamag = 0.01 in filter Johnson/V: in 0.1 s with NDA, GCR= 2780k e-.									
5	(STIS.sp.11 84194)	(1) HD128620	STIS/NUV-MAMA, ACCUM, 31X0.05NDC	E230H 2713 A	WAVECAL=NO		Sequence 5-6 Non-Int in Visit 10	500 Secs (500 Secs) *[==>]*	 ***[1]***
Comments: ETC GCR~135k for Castelli-Kurucz Model G2V 5750 4.5, renormalized to vegamag = 0.01 in filter Johnson/V. Measured GCR~110k for several exposures in similar setting H-2812 with NDC; H-2713 GCR should be less because NUV continuum is falling toward shorter wavelengths.									
6		WAVE	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A			Sequence 5-6 Non-Int in Visit 10	45 Secs (45 Secs) *[==>]*	 ***[2]***
Comments: Deeper than normal wavecal to determine accurate zero-point shift.									
7	(STIS.im.11 84300)	(2) HD128621	STIS/CCD, ACQ, F25ND5	MIRROR				0.1 Secs (0.1 Secs) *[==>]*	 ***[2]***
Comments: Castelli-Kurucz Models K2V 4750 4.5, renormalized to vegamag = 1.33 in filter Johnson/V: SNR~74 in 0.1 s; time to saturation 1.7 s.									
8	(STIS.sp.11 84373)	(2) HD128621	STIS/CCD, ACQ/PEAK, 0.2X0.09	G430M 3936 A				0.1 Secs (0.1 Secs) *[==>]*	 ***[2]***
Comments: Dispersed light peak-up; Castelli-Kurucz Models K2V 4750 4.5, renormalized to vegamag = 1.33 in filter Johnson/V: 5470k e- in 0.1 s; time to saturation 0.9 s.									
9	(STIS.sp.11 84211)	(2) HD128621	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A	WAVECAL=NO		Sequence 9-10 Non-Int in Visit 10	500 Secs (500 Secs) *[==>]*	 ***[2]***
Comments: GCR= 73k from ETC run for Castelli-Kurucz Model K2V 4750 4.5, renormalized to vegamag = 1.33 in filter Johnson/V. Variability expected to be very low in the K-dwarf continuum, which dominates the H-2713 setting. Measured GCRs from ocre10050, ocre11050, octr10050, and od5c10050 (same setting and slit) are 126k+/-13k.									
10		WAVE	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A			Sequence 9-10 Non-Int in Visit 10	45 Secs (45 Secs) *[==>]*	 ***[2]***
Comments: Deeper than normal wavecal to determine accurate zero-point shift.									
11	(STIS.sp.11 84375)	(2) HD128621	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A	WAVECAL=NO		Sequence 11-12 Non-Int in Visit 10	1278 Secs X 2 (2556 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	 ***[2]***
Comments: Based on new FUV spectrum of ALP-CEN-B from 4 years of STIS measurements. No LCR or GCR issues.									
12		WAVE	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A			Sequence 11-12 Non-Int in Visit 10	45 Secs (45 Secs) *[==>]*	 ***[2]***
Comments: Deeper than normal wavecal to determine accurate zero-point shift.									

Orbit Structure





Visit

Proposal 16994, Visit 11, implementation Wed May 10 13:00:18 GMT 2023

Diagnostic Status: No Diagnostics

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

Special Requirements: CVZ; ORIENT 52D TO 224 D; ORIENT 232D TO 359.99 D; ORIENT 0D TO 44 D; AFTER 10 BY 120 D TO 240 D

Fixed Targets

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	Alt Name1: ALP-CEN-A	Dec: -60 49 56.50 (-60.83236d)	Proper Motion Dec: +0.22 arcsec/yr		
		Equinox: J2000	Parallax: 0.747"		
			Epoch of Position: 2020.43		
			Radial Velocity: -24 km/sec		

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Comments: Castelli-Kurucz Models G2V 5750 4.5, renormalized to vegamag = 0.01 in filter Johnson/V: SNR~140 in 0.1 s; time to saturation 0.6 s.									
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Comments: GCR= 73k from ETC run for Castelli-Kurucz Model K2V 4750 4.5, renormalized to vegamag = 1.33 in filter Johnson/V. Variability expected to be very low in the K-dwarf continuum, which dominates the H-2713 setting. Measured GCRs from ocre10050, ocre11050, octr10050, and od5c10050 (same setting and slit) are 126k+/-13k.									
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Orbit Structure