



13938 - Alpha Centauri at a Crossroads

Cycle: 22, Proposal Category: GO

(Availability Mode: AVAILABLE)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
10	(1) HD128620 (2) HD128621-1	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	13-Oct-2014 21:05:39.0	yes
11	(1) HD128620 (3) HD128621-2	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	13-Oct-2014 21:05:43.0	yes

4 Total Orbits Used

ABSTRACT

Nearby Alpha Centauri AB (G2V+K1V) contains the two best characterized solar-like dwarf stars, which also have the best studied multi-MK coronal X-ray activity cycles, extending back to the 1970's. Objective is to continue tracking the evolving multi-decadal high-energy narrative of Alpha Cen with semiannual X-ray pointings in Chandra Cycles 16-18, as the system reaches a coronal crossroads: solar twin A rising toward starspot cycle maximum, K-type companion B sinking into a minimum. HST/STIS UV spectra will support and leverage the X-ray measurements by probing chromospheric and subcoronal dynamics, with connection to the corona through the FUV Fe XII 1242 forbidden line. Only Chandra can resolve the AB X-ray pair as the Alpha Cen orbit also reaches a crossroads in 2016 (only 4" separation), and only HST/STIS can measure the bright Alpha Cen

stars with sufficient UV spectral resolution and wavelength coherence. What's more, the recent validation of the STIS NDA,B,C long slits for echelle use now make feasible NUV E230H measurements (e.g., of key chromospheric tracers Mg II 2800 and Mg I 2852) which heretofore were not practical in a long-term program of this nature.

OBSERVING DESCRIPTION

The STIS observations are straightforward. Alpha Cen falls in the HST Continuous Viewing Zone numerous times during the year, allowing the two stars to be captured in a single visit of just two orbits. Two such visits (four orbits total), about six months apart, are contemplated for Cycle 22, compatible with the semiannual pointings by Chandra. There is no need to strictly coordinate the FUV and X-ray visits, because the FUV Fe XII 1242 coronal forbidden line can tie the STIS observation into the X-ray framework.

In each HST/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 a 1500 s exposure with the E140M-1425 medium-res echelle through the photometric slot (0.2x0.2), which delivers $R=40,000$ and good sensitivity (peak $S/N=30$ per resol at the tops of the important Si IV and C IV resonance lines). The exposure depth is sufficient to capture the key Fe XII 1242 coronal forbidden line, which as mentioned earlier is used to tie the STIS FUV measurements into the X-ray timeline. 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-4194, then an E230H exposure (setting 2812) is taken through that slit, for 500 s. Previously, this exposure would have to have been done with ND2 and 4x the exposure duration. The setting covers the key chromospheric Mg II 2800 resonance lines (and Mg I 2852), a new focus of the joint program with Chandra.

After the Alp Cen A exposures are completed, a ~4" offset maneuver is performed to B, and a peak-up is performed in dispersed light (G430L-4300) with 0.3x0.05ND3 to precisely locate the target. This particular slit was chosen because the default peak-up sweeps out a sufficient area (0.3"x0.3") to capture the B component, given that the time-dependent separation of the binary companions is accurately known to ~0.1", based on orbital reconstructions to fit ten years of positional measurements by Chandra. Given that the AB orbital separation is changing relatively rapidly in the present epoch, Alp Cen B was specified as two separate targets, with different offsets, to reflect the orbital evolution over the six months between the two STIS visits. Similarly, although Alp Cen A is specified as a single target, the position and proper motion for Cycle 22 were updated based on combining the orbital and proper motion solutions derived from the Chandra positions. This strategy has worked well for the post-SM4 STIS visits to AB.

Proposal 13938 (STScI Edit Number: 1, Created: Monday, October 13, 2014 8:05:45 PM EST) - Overview

After the peak-up on B, a 1500 s E140H-1307 exposure through the photometric aperture is taken, followed by an E140H-1486 exposure also for 1500 s. This is a departure from the previous exclusive use of E140M for B in the previous Alp Cen campaigns, but is dictated by recently published results from 4 years of STIS observations of B (Ayres 2014, AJ), which show that its FUV "hot lines" (like Si IV and C IV) are narrower than those of A, and display smaller Doppler shifts. Thus, B would benefit from the higher resolution measurements, with more precise wavelength scales, of E140H. The specified pair of exposures is the minimum required to cover the key region from Si III 1206 up to beyond the C IV 1550 doublet, with overlapping coverage in the important Si IV 1400 region. By using the 0.2x0.2 photometric aperture, sensitivity is maximized without significantly sacrificing resolution. The 2x higher exposure depth for B in the key 1307/1489 overlap region reflects the fact that, despite being chromospherically more active than A, B is fainter in apparent flux due mainly to its smaller size; and further, B has been declining in activity the past several years as it falls to a starspot minimum (while A has been climbing to a peak of its own). After the E140H exposures, a pair of E230H's are taken (settings 2713 & 2862), for 750 s each. The 0.2x0.09 spectroscopic aperture can be used for 2713, because the predicted Global Count Rate is 7% 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 significantly to the total flux in that region; and do not approach the local bright limit). However, the continuum light picks up significantly in the 2862 setting and NDA must be used to keep the GCR below the limit. (Technically, the 0.1x0.03 "Jenkins" slit also would be an option to bring the GCR below the limit, but that aperture requires an expensive double peak-up, and previous experience has shown that even with the peak-up, the effective throughputs can be quite unreliable. NDA appears to be much more reproducible, even though its nominal throughput is lower.) Because of the use of NDA for the H-2862 exposure, a prior peak-up in that aperture must be performed. The pair of exposures allows for similar spectral coverage as the E230H-2812 for A (i.e., up to Mg I 2852), but also achieves enhanced S/N at the Mg II lines by the deeper effective exposure with H-2713 together with the spectral overlap, and thus mitigation of fixed pattern noise, with H-2852. The whole sequence requires two CVZ orbits per visit.

Also, since tall apertures are being exploited for both stars, an ORIENT constraint must be specified to avoid the situation where both targets fall on the slit simultaneously, and consequently corrupt the echellegram with overlapping spectra (and possibly also violate the bright limits). The constraint is not severe, however, since the slits are only 0.05" wide and the separation of the stars is somewhat more than 4". A +/- 10 degree avoidance zone (+/- 0.75" pivot away from other star) should be sufficient to exclude the other star and any possible scattered light. The ORIENT avoidance zones are 154+/-10 degrees and 334+/-10 degrees for visit 10 (early-2015), and 161+/-10 degrees and 341+/-10 degrees for Visit 11 (mid-2015). There are CVZ windows for both visits, early-January and mid-August, respectively, following the most recent Cycle 21 Alp Cen observations (Visit 11 of program 13465, in July 2014) by the desired approximately half year.

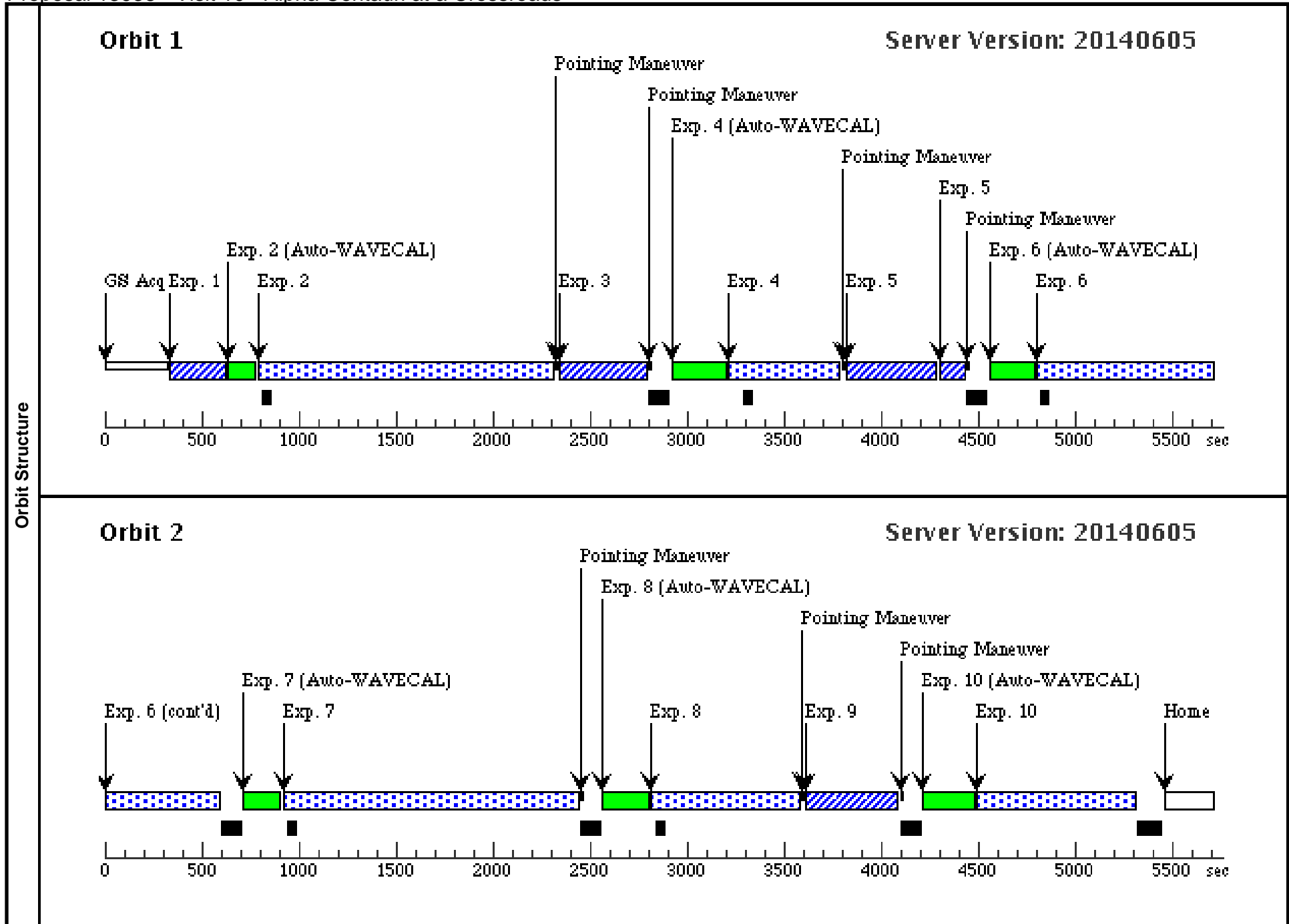
Proposal 13938 - Visit 10 - Alpha Centauri at a Crossroads

Tue Oct 14 01:05:45 GMT 2014

Visit	Proposal 13938, Visit 10 Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: CVZ; ORIENT 0D TO 144 D; ORIENT 164D TO 324 D; ORIENT 344D TO 359.99 D; BETWEEN 06-JAN-2015:00:00:00 AND 08-JAN-2015:23:59:59 <i>Comments: This is first CVZ opportunity roughly 6 months after final Visit of program 13465 (of which this is continuation), consistent with ORIENT constraints</i>					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HD128620 Alt Name1: ALP-CEN-A	RA: 14 39 28.6608 (219.8694200d) Dec: -60 49 57.68 (-60.83269d) Equinox: J2000	Proper Motion RA: -3.83 arcsec/yr Proper Motion Dec: +0.36 arcsec/yr Parallax: 0.747" Epoch of Position: 2015.00 Radial Velocity: 24 km/sec	V=+0.01+/-0.1 FUV peak fluxes are 5E-12 per Angstrom (excluding Lyman-alpha, which is ~ 8E-11)	Reference Frame: ICRS
	<i>Comments: The target coords for epoch 2015.0 were based on a global orbital + proper-motion fit to ten years of Chandra HRC positions, accounting for parallax in each epoch. Alpha Cen AB are moving toward a close approach (on the sky) in 2016, consequently the orbital motion of A has a significant influence on its apparent proper motion.</i>					
	(2)	HD128621-1 Alt Name1: ALP-CEN-B	Offset from HD128620 RA Offset: -0.527 Secs Dec Offset: 1.33 Arcsec		V=1.33+/-0.1	Offset Position (HD128621-1)
	<i>Comments: Offset of B relative to A determined from the slightly modified ephemeris, which closely matches the relative orbit as recorded by Chandra HRC in recent years.</i>					

Proposal 13938 - Visit 10 - Alpha Centauri at a Crossroads

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	(STIS.ta.640 577)	(1) HD128620	STIS/CCD, ACQ, F25ND5	MIRROR		GS ACQ SCENARI O BASE1B3	0.1 Secs (0.1 Secs) [==>]	[1]	
	<i>Comments: Castelli-Kurucz Model:G2V; V=+0.01; Optimum SNR = 169; time to sat 0.6 s</i>									
	2	(STIS.sp.64 0578)	(1) HD128620	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A			1500 Secs (1500 Secs) [==>]	[1]	
	<i>Comments: Input=special file for ALP-CEN-A based on 4 years of STIS E140M observations; Exposure time= 1.5 ks at Si IV 139 nm gives SNR = 30 (per resol); no LCR or GCR issues</i>									
	3	(STIS.sp.64 0583)	(1) HD128620	STIS/CCD, ACQ/PEAK, 31X0.05NDC	G430M 4194 A			0.1 Secs (0.1 Secs) [==>]	[1]	
	<i>Comments: dispersed light peak-up assuming Castelli-Kurucz Model G2V, V=+0.01 mag; in 0.1 s, 1600k e-. ETC calculation done with ND2 slit, then scaled to NDC aperture by factor x4.</i>									
	4	(STIS.sp.64 0585)	(1) HD128620	STIS/NUV-MAMA, ACCUM, 31X0.05NDC	E230H 2812 A			500 Secs (500 Secs) [==>]	[1]	
	<i>Comments: special input file for ALP-CEN-A, based on new reduction of earlier high-res NUV data; Exposure time= 500 s with 0.2x0.2 aper gives GCR=3271k; x0.0417 (for NDC at 280 nm)=136k; below GCR bright limit; no LCR issues</i>									
	5	(STIS.sp.64 0591)	(2) HD128621-1	STIS/CCD, ACQ/PEAK, 0.3X0.05ND	G430L 4300 A			0.1 Secs (0.1 Secs) [==>]	[1]	
	<i>Comments: dispersed light peak-up assuming Castelli-Kurucz Model K0V, V=1.33 mag; in 0.1 s, 96k e-</i>									
6	(STIS.sp.64 0596)	(2) HD128621-1	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A			1500 Secs (1500 Secs) [==>]	[1]		
<i>Comments: based on new E140M spectrum of ALP-CEN-B from 4 years of STIS measurements. No LCR or GCR issues.</i>										
7	(STIS.sp.64 0597)	(2) HD128621-1	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1489 A			1500 Secs (1500 Secs) [==>]	[2]		
<i>Comments: based on new E140M spectrum of ALP-CEN-B from 4 years of STIS measurements. No LCR or GCR issues.</i>										
8	(STIS.sp.64 0598)	(2) HD128621-1	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2713 A			750 Secs (750 Secs) [==>]	[2]		
<i>Comments: Based on post-SM4 NUV high-res spectrum of ALP-CEN-B, supplemented with average of selected IUE LW spectra for wavelengths > 285 nm. GCR= 185k from ETC run; variability expected to be very low in the K-dwarf continuum, which dominates the H-2713 setting.</i>										
9	(STIS.sp.64 0599)	(2) HD128621-1	STIS/CCD, ACQ/PEAK, 31X0.05NDA	G430M 4194 A			0.1 Secs (0.1 Secs) [==>]	[2]		
<i>Comments: dispersed light peak-up assuming Castelli-Kurucz Model K0V, V=1.33 mag; in 0.1 s, with 0.2x0.2 slit, 15,472k e-, scaled to NDA x0.25= 3868k e-.</i>										
10	(STIS.sp.64 0620)	(2) HD128621-1	STIS/NUV-MAMA, ACCUM, 31X0.05NDA	E230H 2862 A			750 Secs (750 Secs) [==>]	[2]		
<i>Comments: based on new NUV high-res spectrum of ALP-CEN-B; for 0.2x0.2 aper, GCR= 346k, scaled to NDA x0.225 (280 nm)= 78k GCR. No LCR or GCR issues.</i>										



Proposal 13938 - Visit 11 - Alpha Centauri at a Crossroads

Tue Oct 14 01:05:45 GMT 2014

Visit	Proposal 13938, Visit 11 Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: CVZ; ORIENT 0D TO 151 D; ORIENT 171D TO 331 D; ORIENT 351D TO 359.99 D; BETWEEN 10-AUG-2015:00:00:00 AND 13-AUG-2015:23:59:59 <i>Comments: This is first CVZ opportunity roughly 6 months after Visit 10, consistent with ORIENT constraints</i>					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	HD128620 Alt Name1: ALP-CEN-A	RA: 14 39 28.6608 (219.8694200d) Dec: -60 49 57.68 (-60.83269d) Equinox: J2000	Proper Motion RA: -3.83 arcsec/yr Proper Motion Dec: +0.36 arcsec/yr Parallax: 0.747" Epoch of Position: 2015.00 Radial Velocity: 24 km/sec	V=+0.01+/-0.1 FUV peak fluxes are 5E-12 per Angstrom (excluding Lyman-alpha, which is ~ 8E-11)	Reference Frame: ICRS
	<i>Comments: The target coords for epoch 2015.0 were based on a global orbital + proper-motion fit to ten years of Chandra HRC positions, accounting for parallax in each epoch. Alpha Cen AB are moving toward a close approach (on the sky) in 2016, consequently the orbital motion of A has a significant influence on its apparent proper motion.</i>					
	(3)	HD128621-2 Alt Name1: ALP-CEN-B	Offset from HD128620 RA Offset: -0.487 Secs Dec Offset: 1.82 Arcsec		V=1.33+/-0.1	Offset Position (HD128621-2)
	<i>Comments: Offset of B relative to A determined from the slightly modified ephemeris, which closely matches the relative orbit as recorded by Chandra HRC in recent years.</i>					

Proposal 13938 - Visit 11 - Alpha Centauri at a Crossroads

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
Exposures	1	(STIS.ta.640 577)	(1) HD128620	STIS/CCD, ACQ, F25ND5	MIRROR		GS ACQ SCENARI O BASE1B3	0.1 Secs (0.1 Secs) [==>]	[1]	
	<i>Comments: Castelli-Kurucz Model:G2V; V=+0.01; Optimum SNR = 169; time to sat 0.6 s</i>									
	2	(STIS.sp.64 0578)	(1) HD128620	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140M 1425 A			1500 Secs (1500 Secs) [==>]	[1]	
	<i>Comments: Input=special file for ALP-CEN-A based on 4 years of STIS E140M observations; Exposure time= 1.5 ks at Si IV 139 nm gives SNR = 30 (per resol); no LCR or GCR issues</i>									
	3	(STIS.sp.64 0583)	(1) HD128620	STIS/CCD, ACQ/PEAK, 31X0.05NDC	G430M 4194 A			0.1 Secs (0.1 Secs) [==>]	[1]	
	<i>Comments: dispersed light peak-up assuming Castelli-Kurucz Model G2V, V=+0.01 mag: in 0.1 s, 1600k e-. ETC calculation done with ND2 slit, then scaled to NDC aperture by factor x4.</i>									
	4	(STIS.sp.64 0585)	(1) HD128620	STIS/NUV-MAMA, ACCUM, 31X0.05NDC	E230H 2812 A			500 Secs (500 Secs) [==>]	[1]	
	<i>Comments: special input file for ALP-CEN-A, based on new reduction of earlier high-res NUV data; Exposure time= 500 s with 0.2x0.2 aper gives GCR=3271k; x0.0417 (for NDC at 280 nm)=136k; below GCR bright limit; no LCR issues</i>									
	5	(STIS.sp.64 0591)	(3) HD128621-2	STIS/CCD, ACQ/PEAK, 0.3X0.05ND	G430L 4300 A			0.1 Secs (0.1 Secs) [==>]	[1]	
	<i>Comments: dispersed light peak-up assuming Castelli-Kurucz Model K0V, V=1.33 mag: in 0.1 s, 96k e-</i>									
6	(STIS.sp.64 0596)	(3) HD128621-2	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1307 A			1500 Secs (1500 Secs) [==>]	[1]		
<i>Comments: based on new E140M spectrum of ALP-CEN-B from 4 years of STIS measurements. No LCR or GCR issues.</i>										
7	(STIS.sp.64 0597)	(3) HD128621-2	STIS/FUV-MAMA, ACCUM, 0.2X0.2	E140H 1489 A			1500 Secs (1500 Secs) [==>]	[2]		
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<i>Comments: Based on post-SM4 NUV high-res spectrum of ALP-CEN-B, supplemented with average of selected IUE LW spectra for wavelengths > 285 nm. GCR= 185k from ETC run; variability expected to be very low in the K-dwarf continuum, which dominates the H-2713 setting.</i>										
9	(STIS.sp.64 0599)	(3) HD128621-2	STIS/CCD, ACQ/PEAK, 31X0.05NDA	G430M 4194 A			0.1 Secs (0.1 Secs) [==>]	[2]		
<i>Comments: dispersed light peak-up assuming Castelli-Kurucz Model K0V, V=1.33 mag: in 0.1 s, with 0.2x0.2 slit, 15,472k e-, scaled to NDA x0.25= 3868k e- .</i>										
10	(STIS.sp.64 0620)	(3) HD128621-2	STIS/NUV-MAMA, ACCUM, 31X0.05NDA	E230H 2862 A			750 Secs (750 Secs) [==>]	[2]		
<i>Comments: based on new NUV high-res spectrum of ALP-CEN-B; for 0.2x0.2 aper, GCR= 346k, scaled to NDA x0.225 (280 nm)= 78k GCR. No LCR or GCR issues.</i>										

