17230 - COS NUV Special Target Acquisition Program to Check Lamp-Object Separation

Cycle: 30, Proposal Category: CAL/COS
(Calibration)
(Availability Mode: RESTRICTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) HD-6655	COS/NUV	1	16-Nov-2022 08:00:38.0	yes

1 Total Orbits Used

ABSTRACT

NUV imaging and spectroscopic acquisitions rely on the known separation between the astrophysical source and the calibration lamp as seen on the detector. That separation must be measured externally (on sky) and that has not been measured since SMOV. If that separation has changed and that change is not reflected in the flight software then NUV acquisitions would be off-center by the same amount. The principal effect of the unintended offset would be flux loss. Without the test we are hereby proposing we would not be able to distinguish this flux loss from other effects that factor into the Time Dependent Sensitivity (TDS) correction. After more than 12 years of lamp degradation it makes sense to check the separation. This

one-time program tests that NUV acquisitions are still centered by comparing them to a lamp-independent flux-centered acquisition. The proposal description explains the observing design.

A more detailed description:
This program compares the results of three different ways to do acquisitions: (1) ACQ/IMAGE, (2) NUV spectroscopic acq (ACQ/PEAKXD followed by ACQ/PEAKD), and (3) manually computing the flux-weighted centroid after flux is vignetted by POSTARGs. After (1) and (2) we take verification spectra with the lamp on. These spectra can be used to measure the target-lamp separation. (3) is not really an acquisition but rather a simulation of an acquisition in the sense that we are collecting the data needed for flux centroiding, but the FSW will not actually compute the centroiding and move the telescope. I will compute the centroiding and compare it to where (1) and (2) placed the target. The reason for doing (3) is precisely because it does not use the lamp. Flux centroiding is a completely independent way of establishing where the center of the aperture is, and we can then compare it to (1) and (2) to see if the lamp-dependent methods are working. When the FSW executes a flux-centroided acquisition (NUV ACQ/SEARCH, NUV ACQ/PEAKD and all FUV acqs) the lamp is turned off. If the lamp were on its light would be a constant contribution to every dwell point, since the lamp does not get vignetted by POSTARG. That would just add floor counts which would then be subtracted by the centroiding algorithm, but the noise associated with it would remain.

For details on which FSW routines and parameters are involved see the ISR by Penton and Sahnow (2022 in prep.) and references therein.

OBSERVING DESCRIPTION
We perform three acquisition tests, which must yield the same result in order to verify that NUV acquisition is working:
0 - NUV ACQ/SEARCH
1 - NUV ACQ/IMAGE
2 - NUV spectroscopic ACQ/PEAKXD and ACQ/PEAKD
3 - Manually compute the flux weighted centroid of an aperture sweep, thus simulating the way spectroscopic acquisition works.
ACQ/IMAGE and NUV ACQ/PEAKXD work by measuring the separation between the lamp light and the astronomical light, and moving the telescope so that the separation becomes a pre-determined value.
ACQ/PEAKD and manual centroiding work by assuming that if the astronomical source is offset a given amount in either direction from the center the same amount of flux would be blocked for either direction, and that therefore we can calculate the center of the aperture by flux weighted centroiding.

The exposures in this visit accomplish the following

ACQ/SEARCH
01.001 ACQ/SEARCH acquisition

ACQ/IMAGE
01.002 -ACQ/IMAGE acquisition
01.003 - NUV spectrum to ascertain the position after ACQ/IMAGE

NUV SPECTROSCOPIC ACQUISITION
01.004 - ACQ/PEAKXD
01.005 - ACQ/PEAKD
01.006 - NUV spectrum to ascertain the position after spectroscopic acquisition by cross-correlating with 01.002

Manual centroiding
01.007 - 01.020 XD direction aperture flux sweep
01.021 - 01.034 AD direction aperture flux sweep

For the aperture sweep see ISR COS-2010-10, Figures 7 and 8.

FLASH and WAVECAL are turned off in the aperture flux sweep exposures because those spectra are never reduced and turning them off saves overhead time. Only the total raw counts matter there. This is also how it is done in an actual flux-centroided acquisition (NUV ACQ/PEAKD and all FUV acqs.). If the lamp were on it would bias the flux centroiding because the lamp light does not get vignetted in the same way that the astronomical target light does.

Note on target:
HD 6655 is the target used in the COS NUV wavelength monitoring programs, most recently PID 16330. It has an abundance of absorption lines, and that makes the cross-correlation needed to find out the offset between two spectra easier to do. In our repertoire of calibration targets it is the only target that is known to have an abundance of NUV lines and that is visible in late summer to early fall, when we want to run this program.

Note on grating/cenwave choice:
Two factors guided the grating/cenwave selection. First, it must be a cenwave for which we have a reliable SED for the target, either from previous spectra or a model. Second, it must be a cenwave that is recommended for NUV spectroscopic acquisition (IHB 2.9). Unfortunately those two things are mutually exclusive. This target has several COS spectra at cenwave 2217, but that is not allowed for acquisition. The closest cenwave that is allowed, and also in the middle of the wavelength range for all NUV cenwaves is 2250. Because of the gap between the 3 NUV stripes we can't extrapolate even though these cenwaves are only 30 angstroms apart. The solution is to use a model spectrum of the same spectral type (F8V) and normalize it to the known magnitude (B=8.57). The model does not have the many absorption lines present in the actual c2217 spectrum, and for c2217 that made a difference of SN~7 per resel at 90s for the real spectrum (COS.sp.1813724) versus SN~8 for the model (COS.sp.1816671), so the model is slightly brighter. For c2250 using the model COS.sp.1816672 yields SN~8 per resel as well, so we can expect that if a real spectrum were available the SN would be about 7.

Note on schedulability:
This visit is unusual in that it requires schedulability 40. The extra time is needed because of the recommendation for a repeated acquisition starting with ACQ/SEARCH. As noted in PID 16330, this target is known to have guide star problems. The NUV wavelength monitors, which also use the same target, also have schedulability 40 and have been run with that value for the past several cycles.

Visit

Proposal 17230, Visit 01, pi Wed Nov 16 13:00:40 GMT 2022

Diagnostic Status: Warning

Scientific Instruments: COS/NUV

Special Requirements: SCHED 40%

Comments: See visit description under proposal level description.

Diagnostics

(Visit 01) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE
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Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD-6655	RA: 01 05 18.2073 (16.3258637d) Dec: -72 33 14.47 (-72.55402d) Equinox: J2000	Proper Motion RA: 49.5 mas/yr Proper Motion Dec: -120.0 mas/yr Epoch of Position: 2000 Radial Velocity: 19.5 km/sec	V=8.05+/-0.05	Reference Frame: ICRS

Comments: This object was generated by the target selector and retrieved from the SIMBAD database.
Category=STAR
Description=[F3-F9]
Extended=NO

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	ACQ/SEARCH with BOA MIRRORA (COS.ta.1816694)	(1) HD-6655	COS/NUV, ACQ/SEARCH, BOA	MIRRORA	SCAN-SIZE=2		Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	*[1]*
2	ACQ/IMAGE with BOA MIRRORA (COS.ta.1816694)	(1) HD-6655	COS/NUV, ACQ/IMAGE, BOA	MIRRORA			Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	*[1]*
3	Spectrum after ACQ/IMAGE G225M/2250 (COS.sp.1816672)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3		Sequence 1-34 Non-Int in Visit 01	90 Secs (90 Secs) *[==>]*	*[1]*
	*Comments: COS.sp.1816672 yields mean SN~7 per resel. For the purpose of determining the location of the spectrum in the detector the rawtag trace will be heavily smoothed, usually by gaussian smooth sigma=10. For low SN and/or highly structured data that is roughly equivalent to binning by 10 (10 wiggles become one wiggle). That yields SN~20, which in the past was enough to cross-correlate the location of the spectrum (7 * 10^.5 = 22.13). Also see note in proposal description about ETC calculatons and cenwave choice.*								
4	ACQ/PEAKXD G225M/2250 (COS.sa.1816674)	(1) HD-6655	COS/NUV, ACQ/PEAKXD, PSA	G225M 2250 A			Sequence 1-34 Non-Int in Visit 01	7 Secs (7 Secs) *[==>]*	*[1]*
	Comments: Note different exposure time. In NUV dispersed light acquisitions PEAKXD only uses one stripe whereas PEAKD and ACQ/SEARCH use all three.								
5	ACQ/PEAKD G225M/2250 (COS.sa.1816675)	(1) HD-6655	COS/NUV, ACQ/PEAKD, PSA	G225M 2250 A	NUM-POS=5; STEP-SIZE=0.9; CENTER=DEF		Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	*[1]*
6	Spectrum after PEAK(X)D G225M/2250 (COS.sp.1816672)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=S0200D035	QESIPARM USELAMP LINE2; QESIPARM CURRENT MEDIUM	Sequence 1-34 Non-Int in Visit 01	90 Secs (90 Secs) *[==>]*	*[1]*
	Comments: Identical to 01.003. *COS.sp.1816672 yields mean SN~7 per resel. For the purpose of determining the location of the spectrum in the detector the rawtag trace will be heavily smoothed, usually by gaussian smooth sigma=10. For low SN and/or highly structured data that is roughly equivalent to binning by 10 (10 wiggles become one wiggle). That yields SN~20, which in the past was enough to cross-correlate the location of the spectrum (7 * 10^.5 = 22.13). Also see note in proposal description about ETC calculatons and cenwave choice.*								
7	XD +0.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,0.25	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	*[1]*
	Comments: Total (not resel) flux SN ~ 60 when adding all 3 stripes. *Here we are using a spectroscopic acquisition ETC because we care about the total SN, not SN per resel. We are simulating an acquisition, and therefore we should use the ETC mode that tells us how many counts are necessary for acquisition.*								
8	XD +0.5 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,0.5	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	*[1]*

	9	XD +0.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,0.75	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	10	XD +1.0 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; WAVECAL=NO; FLASH=NO	POS TARG 0,1.0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	11	XD +1.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,1.25	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	12	XD +1.50 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,1.50	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	13	XD +1.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,1.75	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	14	XD -0.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,-0.25	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	15	XD -0.5 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,-0.5	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	16	XD -0.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,-0.75	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	17	XD -1.0 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,-1.0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***

	18	XD -1.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,-1.25	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	19	XD -1.50 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,-1.50	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	20	XD -1.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0,-1.75	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	21	AD +0.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0.25,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	22	AD +0.5 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0.5,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	23	AD +0.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 0.75,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	24	AD +1.0 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 1.0,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	25	AD +1.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 1.25,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	26	AD +1.50 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 1.50,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***

	27	AD +1.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG 1.75,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	28	AD -0.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG -0.25,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	29	AD -0.5 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG -0.5,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	30	AD -0.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG -0.75,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	31	AD -1.0 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG -1.0,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	32	AD -1.25 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG -1.25,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	33	AD -1.50 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG -1.50,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***
	34	AD -1.75 (COS.sa.1816675)	(1) HD-6655	COS/NUV, TIME-TAG, PSA	G225M 2250 A	BUFFER-TIME=725; FP-POS=3; FLASH=NO; WAVECAL=NO	POS TARG -1.75,0	Sequence 1-34 Non-Int in Visit 01	6 Secs (6 Secs) *[==>]*	***[1]***

Orbit Structure