14874 - COS FUV Focus Sweep Program at LP4

Cycle: 24, Proposal Category: CAL/COS
(Availability Mode: RESTRICTED)

INVESTIGATORS

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>E-Mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Andrew J. Fox (PI) (ESA Member) (Contact)</td>
<td>Space Telescope Science Institute - ESA</td>
<td><a href="mailto:afox@stsci.edu">afox@stsci.edu</a></td>
</tr>
</tbody>
</table>

VISITS

<table>
<thead>
<tr>
<th>Visit</th>
<th>Targets used in Visit</th>
<th>Configurations used in Visit</th>
<th>Orbits Used</th>
<th>Last Orbit Planner Run</th>
<th>OP Current with Visit?</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>(1) V-KL-UMA DARK NONE</td>
<td>COS COS/FUV COS/NUV S/C</td>
<td>3</td>
<td>01-Dec-2016 21:08:10.0</td>
<td>yes</td>
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<tr>
<td>02</td>
<td>(2) AZV75 DARK NONE</td>
<td>COS COS/FUV COS/NUV S/C</td>
<td>2</td>
<td>01-Dec-2016 21:08:16.0</td>
<td>yes</td>
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</table>

5 Total Orbits Used

ABSTRACT

This program is designed to determine the best focus at COS FUV Lifetime Position 4 (LP4) for the G160M/1600 and G140L/1105 settings. The focus sweeps will scan at 200 focus step increments from -800 to +1000 from the current LP3 focus, a strategy designed to determine the best focus position to <1% accuracy. This strategy is based on the LENA2 program at LP3 (ID 13635), and on the LP4 focus sweep exploratory program (ID 14527), which obtained sweeps for G130M/1309 and G130M/1222. Both these earlier programs executed successfully.
OBSERVING DESCRIPTION

This program performs a focus sweep at LP4 with G160M/1600 (Visit 01) and G140L/1105 (FUVA only; Visit 02). LP4 is located at -5.0" in the XD direction relative to LP1. In each visit, initialization exposures are included after the ACQ/IMAGE to set up the correct instrument mode for the focus sweep. For the G140L visit on AZV75 an ACQ/SEARCH is included.

The aperture has to be manually moved by -2.52" (the offset from LP3 to LP4) using an aperture-placement command (XAPER) after the ACQ/IMAGE and instrument initialization. Each subsequent exposure in the focus sweep is given a POSTARG of -2.52", to match the position of the aperture.

The program uses special commanding to set the high voltage to the expected LP4 level, FUVA=163/FUVB=163. The commands use QESIPARMS keywords under "Engineering Requirements". The voltages are returned to their nominal levels at the end of the visits (FUVA=167/FUVB=175). For the G140L visit, only the FUVA voltage is changed since FUVB is not used.

Ray-trace predictions (courtesy Steve Penton) predict that the best-fit LP4 focus for:
- G160M/1600 should be +140 relative to LP3
- G140L/1105 should be +300 relative to LP3

The focus sweep going up to +1000 relative to LP3 is designed to cover a broad-enough region determine the focus-curve minimum.

The *absolute* focus positions covered by the sweep were verified: at LP3, G140L/1105 has a focus of -673 and G160M/1600 has a focus of -30, as determined from the flight software table. Sweeping from -800 to +1000 around these central focus positions is within the allowed range.
**Proposal 14874 - G160M_focus (01) - COS FUV Focus Sweep Program at LP4**

**Visit**

Proposal 14874, G160M_focus (01), implementation

Diagnostics Status: Warning

Scientific Instruments: COS, S/C, COS/FUV, COS/NUV

Special Requirements: SCHED 100%; BETWEEN 05-DEC-2016:00:00:00 AND 01-JAN-2017:00:00:00

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**Fixed Targets**

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Target Coordinates</th>
<th>Targ. Coord. Corrections</th>
<th>Fluxes</th>
<th>Miscellaneous</th>
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</thead>
<tbody>
<tr>
<td>(1)</td>
<td>V-KL-UMA</td>
<td>RA: 11 47 14.4900 (176.8103750d)</td>
<td>Proper Motion RA: 0.00333 sec of time/yr</td>
<td>V=13.28</td>
<td>Reference Frame: ICRS</td>
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<td></td>
<td>Alt Name1: FEIGE48</td>
<td>Dec: +61 15 31.80 (61.25883d)</td>
<td>Proper Motion Dec: 0</td>
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Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Extended=NO
### Exposure Schedule

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<tbody>
<tr>
<td>1</td>
<td>ACQ/IMAG E</td>
<td>V-KL-UMA</td>
<td>COS/NUV, ACQ/IMAGE, BOA</td>
<td>MIRRORA</td>
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<td>16 Secs (16 Secs)</td>
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<tr>
<td></td>
<td>(COS.ta.607 556)</td>
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<td></td>
<td></td>
<td></td>
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<td>[===&gt;]</td>
<td></td>
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<tr>
<td></td>
<td><strong>Comments:</strong> S/N=60 Exposure time and ETC calculation taken from LENA2 (Program 13635)</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Initialize G1</td>
<td>V-KL-UMA</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G160M 1600 A</td>
<td>FP-POS=3;</td>
<td>BUFFER-TIME=10 00; WAVECAL=NO; FLASH=NO</td>
<td></td>
<td>0.1 Secs (0.1 Secs)</td>
<td>[I]</td>
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<td></td>
<td>(1) V-KL-UMA</td>
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<td>[===&gt;]</td>
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<tr>
<td></td>
<td>60M/1600 at LP3</td>
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<tr>
<td></td>
<td>(COS.sp.608 219)</td>
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<tr>
<td></td>
<td><strong>Comments:</strong> Initializing G160M/1600 at nominal aperture and focus position</td>
<td></td>
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<tr>
<td>3</td>
<td>Place aperture</td>
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<td>COS, ALIGN/APER</td>
<td>XAPER=53; YAPER=0.0</td>
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<td></td>
<td></td>
<td>0.0 Secs (0 Secs)</td>
<td>[I]</td>
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<tr>
<td></td>
<td>at -5.0 arc sec in XD</td>
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<td></td>
<td>[===&gt;]</td>
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<tr>
<td></td>
<td><strong>Comments:</strong> XAPER=53 is the calculated offset from LP3 (at -2.5 arcsec) to LP4 (at -5.0 arcsec). 21 XAPER STEPS is 1&quot;, so an offset of -2.52&quot; is commanded by XAPER=+53</td>
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<tr>
<td>4</td>
<td>Adjust HV to LP4 values</td>
<td>DARK</td>
<td>S/C, DATA, NONE</td>
<td></td>
<td>SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 163; QESIPARM ENDC TSB 163</td>
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<td>39 Secs (39 Secs)</td>
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<tr>
<td></td>
<td><strong>Comments:</strong> Adjust HV (from starting values FUVA=167, FUVB=175) to values appropriate for the beginning of LP4 (FUVA=163, FUVB=163). HV is decreasing on both segments, so exposure time is 39 seconds.</td>
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<tr>
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<td>FOCUS=800</td>
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<td>[I]</td>
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<td></td>
<td>0</td>
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<td></td>
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<td>[===&gt;]</td>
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<tr>
<td>6</td>
<td>1600_f-800</td>
<td>V-KL-UMA</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G160M 1600 A</td>
<td>FP-POS=3;</td>
<td>POS TARG 0.0,-2.5 BUFFER-TIME=15 9</td>
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<td>600 Secs (600 Secs)</td>
<td>[I]</td>
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<tr>
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<td>(1) V-KL-UMA</td>
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<td>[===&gt;]</td>
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<td><strong>Comments:</strong> S/N=36 expected at wavelength 1607 A Exposure times taken from FENA3 and LENA2 programs (same configuration).</td>
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<td>[I]</td>
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<td>[===&gt;]</td>
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<tr>
<td>8</td>
<td>1600_f-600</td>
<td>V-KL-UMA</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G160M 1600 A</td>
<td>FP-POS=3;</td>
<td>SAME POS AS 6 BUFFER-TIME=15 9</td>
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<td>(1) V-KL-UMA</td>
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<tr>
<td>10</td>
<td>1600_f-400</td>
<td>V-KL-UMA</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G160M 1600 A</td>
<td>FP-POS=3;</td>
<td>SAME POS AS 6 BUFFER-TIME=15 9</td>
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<td>(1) V-KL-UMA</td>
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<td>11</td>
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<td>COS, ALIGN/OSM</td>
<td>FOCUS=200</td>
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<td>0 Secs (0 Secs)</td>
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<td>[===&gt;]</td>
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<tr>
<td></td>
<td>1600_f-200</td>
<td>(COS.sp.608 220)</td>
<td>(1) V-KL-UMA</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G160M 1600 A</td>
<td>FP-POS=3; BUFFER-TIME=15</td>
<td>SAME POS AS 6</td>
<td>690 Secs (690 Secs)</td>
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<td>13</td>
<td>Move to +20</td>
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<td>15</td>
<td>Move to +60</td>
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<td>FOCUS=+600</td>
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<td>16</td>
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<td>FOCUS=+800</td>
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<tr>
<td>17</td>
<td>Move to +100</td>
<td>DARK</td>
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<td>SAA CONTOUR 31; SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 167; QESIPARM ENDC TSB 175</td>
<td>0 Secs (0 Secs)</td>
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Comments: S/N=38 at wavelength 1607 A

13 Move to 0 NONE COS, ALIGN/OSM FOCUS=0 0 Secs (0 Secs)

14 1600_f-0 (COS.sp.608 220) (1) V-KL-UMA COS/FUV, TIME-TAG, PSA G160M 1600 A FP-POS=3; BUFFER-TIME=15 SAME POS AS 6 690 Secs (690 Secs)

15 Move to +20 NONE COS, ALIGN/OSM FOCUS=+200 0 Secs (0 Secs)

16 1600_f+200 (COS.sp.608 220) (1) V-KL-UMA COS/FUV, TIME-TAG, PSA G160M 1600 A FP-POS=3; BUFFER-TIME=15 SAME POS AS 6 690 Secs (690 Secs)

17 Move to +40 NONE COS, ALIGN/OSM FOCUS=+400 0 Secs (0 Secs)

18 1600_f+400 (COS.sp.608 221) (1) V-KL-UMA COS/FUV, TIME-TAG, PSA G160M 1600 A FP-POS=3; BUFFER-TIME=15 SAME POS AS 6 580 Secs (580 Secs)

Comments: S/N=35 at 1607 A

19 Move to +60 NONE COS, ALIGN/OSM FOCUS=+600 0 Secs (0 Secs)

20 1600_f+600 (COS.sp.608 221) (1) V-KL-UMA COS/FUV, TIME-TAG, PSA G160M 1600 A FP-POS=3; BUFFER-TIME=15 SAME POS AS 6 580 Secs (580 Secs)

21 Move to +80 NONE COS, ALIGN/OSM FOCUS=+800 0 Secs (0 Secs)

22 1600_f+800 (COS.sp.608 221) (1) V-KL-UMA COS/FUV, TIME-TAG, PSA G160M 1600 A FP-POS=3; BUFFER-TIME=15 SAME POS AS 6 580 Secs (580 Secs)

23 Move to +100 NONE COS, ALIGN/OSM FOCUS=+1000 0 Secs (0 Secs)

24 1600_f+1000 (COS.sp.608 221) (1) V-KL-UMA COS/FUV, TIME-TAG, PSA G160M 1600 A FP-POS=3; BUFFER-TIME=15 SAME POS AS 6 500 Secs (500 Secs)

25 Return to nominal HV DARK S/C, DATA, NONE SAA CONTOUR 31; SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 167; QESIPARM ENDC TSB 175 53 Secs (53 Secs)

Comments: Return from HV=163/163 to nominal HV=167/175.

Max HV change is 175 - 163 = 12
Exposure time = 39 + ceiling(1.1*12) = 53 seconds
Proposal 14874 - G140L_focus (02) - COS FUV Focus Sweep Program at LP4

Visit
Proposal 14874, G140L_focus (02), implementation
Diagnostic Status: Warning
Scientific Instruments: COS, S/C, COS/FUV, COS/NUV
Special Requirements: SCHED 80%; BETWEEN 05-DEC-2016:00:00:00 AND 01-JAN-2017:00:00:00
Comments: Target count rates:
In the G140L/1105 setting the target's local count rate in each focus sweep exposure is 0.75 cts/sec/pix, above the local limit of 0.67 cts/sec/pix. This violation happens where the P-Cygni profile from N V falls. In this kind of star the strength of the P-Cygni emission does not tend to increase (the "absorption" is variable). This target was observed in safely in FENA3 with the same exposure time of 200s.

Diagnostics
(G140L_focus (02)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE
(G140L_focus (02)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE NO ORIENT
(G140L_focus (02)) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.

Fixed Targets
# Name Target Coordinates Targ. Coord. Corrections Fluxes Miscellaneous
(2) AZV75 RA: 00 50 32.3900 (12.6349583d) Epoch of Position: 2000 V=12.79 Reference Frame: ICRS
Dec: -72 52 36.50 (-72.87681d)
Equinox: J2000
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. Extended=NO
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</thead>
<tbody>
<tr>
<td>1</td>
<td>ACQ/SEARCH (COS tu.607 440)</td>
<td>(2) AZV75</td>
<td>COS/NUV, ACQ/SEARCH, BOA</td>
<td>MIRRORA</td>
<td>SCAN-SIZE=2; STEP-SIZE=1.767; CENTER=FLUX-W T</td>
<td></td>
<td></td>
<td>7.3 Secs (7.3 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>2</td>
<td>ACQ/IMAG (COS tu.607 440)</td>
<td>(2) AZV75</td>
<td>COS/NUV, ACQ/IMAGE, BOA</td>
<td>MIRRORA</td>
<td></td>
<td></td>
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<td>15 Secs (15 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>3</td>
<td>Initialize G1 (COS sp.608 224)</td>
<td>(2) AZV75</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G140L 1105 A</td>
<td>FP-POS=3; BUFFER-TIME=10 00; WAVECAL=NO; FLASH=NO</td>
<td></td>
<td></td>
<td>0.1 Secs (0.1 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>4</td>
<td>Place aperture at -5.0 arc sec in XD</td>
<td>NONE</td>
<td>COS, ALIGN/APER</td>
<td>XAPER=53; YAPER=0.0</td>
<td></td>
<td></td>
<td></td>
<td>0.0 Secs (0 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>5</td>
<td>Adjust HV to LP4 value</td>
<td>DARK</td>
<td>S/C, DATA, NONE</td>
<td>SAA CONTOUR 31; SPEC COM INSTR ELHVADJPROF; QESIPARM ENDC TSA 163</td>
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<td>39 Secs (39 Secs)</td>
<td>[1]</td>
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<tr>
<td>6</td>
<td>Move to -80 0</td>
<td>NONE</td>
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<td>FOCUS=-800</td>
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<td>0 Secs (0 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>7</td>
<td>1105_f-800 (COS sp.608 224)</td>
<td>(2) AZV75</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G140L 1105 A</td>
<td>BUFFER-TIME=10 00; FP-POS=3</td>
<td>SAME POS AS 7</td>
<td></td>
<td>200 Secs (200 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>8</td>
<td>Move to -60 0</td>
<td>NONE</td>
<td>COS, ALIGN/OSM</td>
<td>FOCUS=-600</td>
<td></td>
<td></td>
<td></td>
<td>0 Secs (0 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>9</td>
<td>1105_f-600 (COS sp.608 224)</td>
<td>(2) AZV75</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G140L 1105 A</td>
<td>BUFFER-TIME=10 00; FP-POS=3</td>
<td>SAME POS AS 7</td>
<td></td>
<td>200 Secs (200 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>10</td>
<td>Move to -40 0</td>
<td>NONE</td>
<td>COS, ALIGN/OSM</td>
<td>FOCUS=-400</td>
<td></td>
<td></td>
<td></td>
<td>0 Secs (0 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>11</td>
<td>1105_f-400 (COS sp.608 224)</td>
<td>(2) AZV75</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G140L 1105 A</td>
<td>BUFFER-TIME=10 00; FP-POS=3</td>
<td>SAME POS AS 7</td>
<td></td>
<td>200 Secs (200 Secs)</td>
<td>[1]</td>
</tr>
<tr>
<td>12</td>
<td>Move to -20 0</td>
<td>NONE</td>
<td>COS, ALIGN/OSM</td>
<td>FOCUS=-200</td>
<td></td>
<td></td>
<td></td>
<td>0 Secs (0 Secs)</td>
<td>[1]</td>
</tr>
</tbody>
</table>

Comments: Exposure time and ETC calculation taken from LENA2 (Program 13635).

Comments: Setting configuration of G140L/1105 at nominal aperture and focus position.

Comments: Adjust HV from starting value FUVA=167 to value appropriate for the beginning of LP4 (FUVA=163). HV is decreasing so exposure time is 39 seconds.

Comments: Exposure times taken from FENA3 and LENA2 programs (same configuration).

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Comments: Exposure time and ETC calculation taken from LENA2 (Program 13635).

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Comments: Exposure time and ETC calculation taken from LENA2 (Program 13635).
<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
<th>Offset</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Move to -100</td>
<td>0</td>
<td>COS, ALIGN/OSM (2) AZV75</td>
</tr>
<tr>
<td>14</td>
<td>Move to 0</td>
<td>NONE</td>
<td>COS, ALIGN/OSM (2) AZV75</td>
</tr>
<tr>
<td>15</td>
<td>Move to +0</td>
<td>NONE</td>
<td>COS, ALIGN/OSM (2) AZV75</td>
</tr>
<tr>
<td>16</td>
<td>Move to +200</td>
<td>NONE</td>
<td>COS, ALIGN/OSM (2) AZV75</td>
</tr>
<tr>
<td>17</td>
<td>Move to +400</td>
<td>NONE</td>
<td>COS, ALIGN/OSM (2) AZV75</td>
</tr>
<tr>
<td>18</td>
<td>Move to +600</td>
<td>NONE</td>
<td>COS, ALIGN/OSM (2) AZV75</td>
</tr>
<tr>
<td>19</td>
<td>Move to +800</td>
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<tr>
<td>20</td>
<td>Move to +1000</td>
<td>NONE</td>
<td>COS, ALIGN/OSM (2) AZV75</td>
</tr>
</tbody>
</table>

Comments: Return to focus offset=0 (LP3 focus) for extra exposure.

Proposal 14874 - G140L focus (02) - COS FUV Focus Sweep Program at LP4
<table>
<thead>
<tr>
<th>31</th>
<th>1105_f+0</th>
<th>(2) AZV75</th>
<th>COS/FUV, TIME-TAG, PSA</th>
<th>G140L</th>
<th>BUFFER-TIME=100; SAME POS AS 7</th>
<th>100 Secs (100 Secs)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(COS.sp.608 224)</td>
<td>1105 A</td>
<td>FP-POS=3</td>
<td></td>
<td></td>
<td>[==&gt;]</td>
</tr>
</tbody>
</table>

Comments: Return from FUVA HV=163 to nominal HV=167

Max HV change is 167 - 163 = 4
Exposure time = 39 + ceiling(1.1*4) = 44 seconds

<table>
<thead>
<tr>
<th>32</th>
<th>Return to nominal HV</th>
<th>DARK</th>
<th>S/C, DATA, NONE</th>
<th>SAA CONTOUR 31; SPEC COM INSTR ELHVADJPROP; QESIPARM ENDC TSA 167</th>
<th>44 Secs (44 Secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[==&gt;]</td>
<td>[2]</td>
</tr>
</tbody>
</table>

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