# 14705 - Confirming interstellar C60+ using a new method for high signal-to-noise NIR STIS spectroscopy

Cycle: 24, Proposal Category: GO

(Availability Mode: AVAILABLE)

**INVESTIGATORS**



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|---|---|---|
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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) BD+63-1964<br>CCDFLAT<br>WAVE | STIS/CCD | 2 | 03-Jan-2017 21:03:04.0 | yes |
| 02 | (2) 69-CYG<br>CCDFLAT | STIS/CCD | 1 | 03-Jan-2017 21:03:08.0 | yes |

3 Total Orbits Used

**ABSTRACT**

Due to recent advances in laboratory spectroscopy, the first detection of a large molecule has been claimed in the diffuse interstellar medium: C60+ (ionized Buckminsterfullerene). If confirmed, the detection of C60+ will constitute a major breakthrough in interstellar chemistry and may provide, for the first time, an insight into the true chemical complexity of the diffuse ISM. Confirming the presence of C60+ rests on a rigorous detection of the weaker absorption lines of this molecule at 9365 and 9428 Angstroems - a region of the spectrum heavily obscured in ground based studies due to telluric water vapour absorption. We seek to demonstrate for the first time the feasibility of long-slit STIS scan exposures to reach an unprecedented signal-to-noise ratio >500 in the near-IR. These observations will eliminate the need for error-prone telluric cancellation methods, allowing us to search for and measure the weak C60+ features with sufficient accuracy to confirm or reject the recently claimed C60+ discovery. If successful, our CCD fringing reduction strategy would be a major breakthrough for precise spectroscopic observations of various astrophysical phenomena in this previously less well-explored wavelength region.

**OBSERVING DESCRIPTION**

The target star will be acquired in the middle of the 52x0.1" slit (at row 512) then exposed while scanning the star up the slit by 15" to row 812 (at a rate not exceeding the maximal FGS tracking rate of 4.8"/sec). After readout, a second science exposure will be performed with the scan direction reversed, to move the star back to row 512. Next, a sequence of two contemporaneous flat-field exposures will be obtained (without moving the slit mechanism), to ensure the closest alignment between the flat and science exposures. Use of the 0.1" slit for both science and flat-field exposures will ensure closely similar optical illumination, necessary for optimal fringe removal. Two more science exposures will be obtained with the sequence reversed -- scanning the star from the middle of the CCD down to row 212, then back up to row 512, followed by two more flat-field exposures. This (up-down-down-up) scan sequence was chosen to reduce the chances of losing the star out of the slit during the scan, in case the 52x0.1" aperture is not completely straight. Additional fringe flats will be obtained during occultation to improve the flat-field statistics. The entire sequence is repeated in Orbit 2. Visit 2 is for observations of a standard star and follows a similar pattern.

An additional 'long scan', traversing the entire length of the slit, will be performed for the standard star using leftover time in orbit 3. This will test the possibility for further improvements in science exposure fringing and illumination characteristics (beyond that already offered by our program), but suffers a greater risk of loosing the star off the slit.

The exposure time is set to reach a target S/N > 500 per exposure, so that the sequence of 8 science exposures will result in total counts equivalent to S/N > 1000.

Both science and standard stars are spatially well-isolated, and no surrounding objects exist within 50" that might introduce contamination into our long-slit observations.

## Visit

**Proposal 14705, Visit 01, implementation** Wed Jan 04 02:03:09 GMT 2017

**Diagnostic Status: No Diagnostics**

Scientific Instruments: STIS/CCD

Special Requirements: (none)

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | BD+63-1964 | RA: 23 17 21.5612 (349.3398383d) | Proper Motion RA: -7.86 mas/yr | V=8.5 | Reference Frame: ICRS |
| | | Dec: +64 07 16.17 (64.12116d) | Proper Motion Dec: -0.71 mas/yr | J=6.9 | |
| | | Equinox: J2000 | Epoch of Position: 2000 | | |

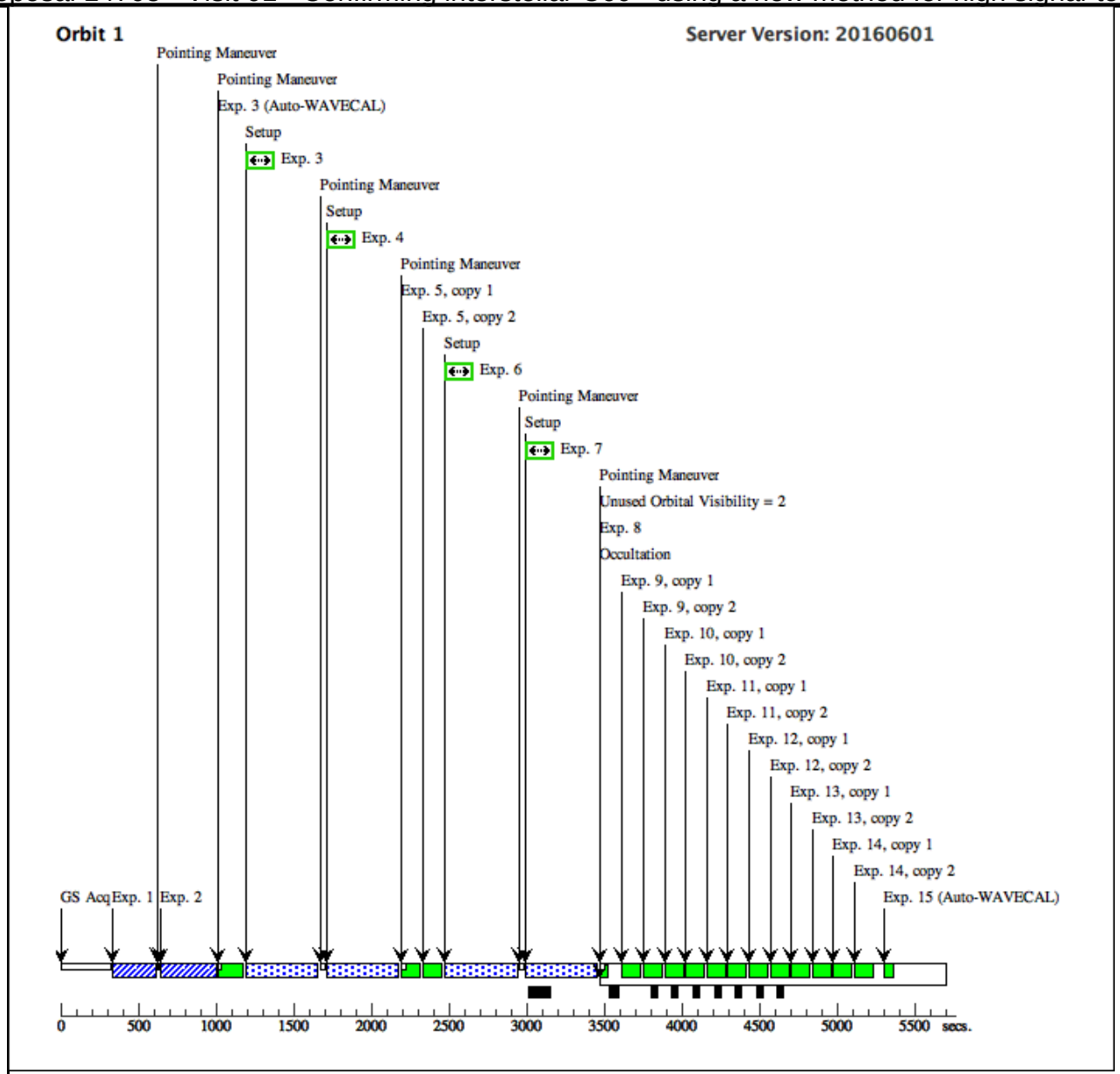
*Comments: Extended=NO*

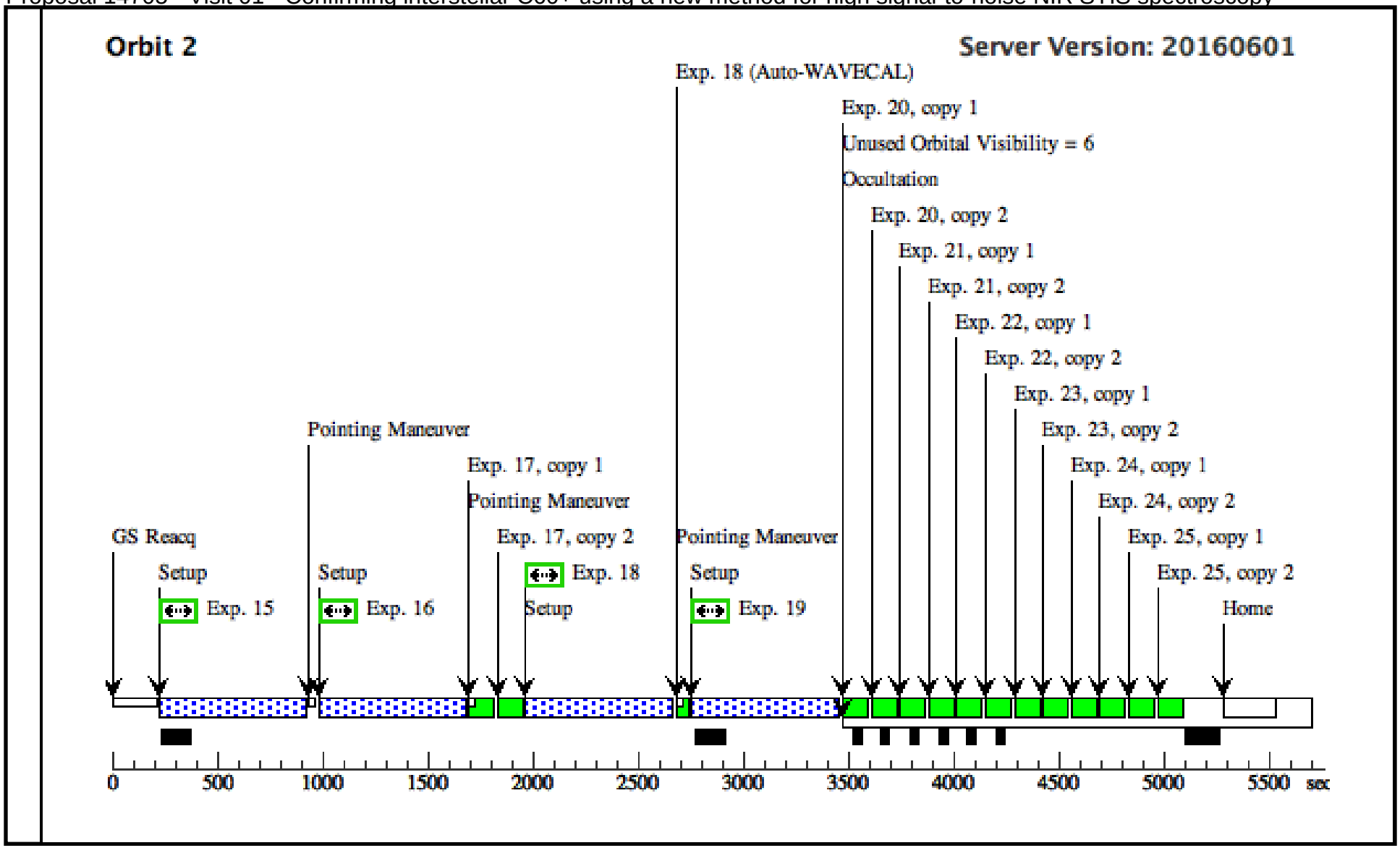
**Exposures**

| # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ACQ BD63 (STIS.ta.824383) | (1) BD+63-1964 | STIS/CCD, ACQ, F28X50OIII | MIRROR | | | | 1 Secs (1 Secs)<br>*[==>]* | *[1]* |
| 2 | ACQ-peak BD63 (STIS.sp.824396) | (1) BD+63-1964 | STIS/CCD, ACQ/PEAK, 52X0.1 | G750M 5734 A | | | | 1.5 Secs (1.5 Secs)<br>*[==>]* | *[1]* |
| 3 | BD63 scan up (STIS.sp.824397) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG null,-12; SPATIAL SCAN 0.0848,90.0 Degrees,Forward | | 425 Secs (425 Secs)<br>*[==>]* | *[1]* |
| 4 | BD63 scan up (STIS.sp.824397) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG null,-12; SPATIAL SCAN 0.0848,90.0 Degrees,Forward | | 425 Secs (425 Secs)<br>*[==>]* | *[1]* |
| 5 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 6 | BD63 scan up (STIS.sp.824397) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-12; SPATIAL SCAN 0.0848,90.0 Degrees,Forward | | 425 Secs (425 Secs)<br>*[==>]* | *[1]* |
| 7 | BD63 scan up (STIS.sp.824397) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-12; SPATIAL SCAN 0.0848,90.0 Degrees,Forward | | 425 Secs (425 Secs)<br>*[==>]* | *[1]* |
| 8 | Extra wavecal | WAVE | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | 10 Secs (10 Secs)<br>*[==>]* | *[1]* |
| 9 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 10 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 11 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 12 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 13 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 14 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 15 | BD63 scan up (STIS.sp.826621) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG null,-12; SPATIAL SCAN 0.0546,90.0 Degrees,Forward | | 660 Secs (660 Secs)<br>*[==>]* | *[2]* |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 16 | BD63 scan up (STIS.sp.826621) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG null,-12; SPATIAL SCAN 0.0 546,90.0 Degrees,Forward | 660 Secs (660 Secs)<br>*[==>]* | ***[2]*** |
| | 17 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[2]*** |
| | 18 | BD63 scan up (STIS.sp.826621) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-12; SPATIAL SCAN 0.0 546,90.0 Degrees,Forward | 660 Secs (660 Secs)<br>*[==>]* | ***[2]*** |
| | 19 | BD63 scan up (STIS.sp.826621) | (1) BD+63-1964 | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-12; SPATIAL SCAN 0.0 546,90.0 Degrees,Forward | 660 Secs (660 Secs)<br>*[==>]* | ***[2]*** |
| | 20 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[2]*** |
| | 21 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[2]*** |
| | 22 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[2]*** |
| | 23 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[2]*** |
| | 24 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[2]*** |
| | 25 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[2]*** |

**Orbit Structure**

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Unused Orbital Visibility = 6
Occultation
Exp. 20, copy 2
Exp. 21, copy 1
Exp. 21, copy 2
Exp. 22, copy 1
Exp. 22, copy 2
Exp. 23, copy 1
Exp. 23, copy 2
Exp. 24, copy 1
Exp. 24, copy 2
Exp. 25, copy 1
Exp. 25, copy 2
Home
Pointing Maneuver
Exp. 17, copy 1
Pointing Maneuver
Exp. 17, copy 2
Pointing Maneuver
GS Reacq
Setup
Exp. 15
Setup
Exp. 16
Exp. 18
Setup
Setup
Exp. 19
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

## Visit

**Proposal 14705, Visit 02, completed** Wed Jan 04 02:03:09 GMT 2017

**Diagnostic Status: No Diagnostics**

Scientific Instruments: STIS/CCD

Special Requirements: (none)

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (2) | 69-CYG | RA: 21 25 47.0256 (321.4459400d) | Proper Motion RA: 7.49 mas/yr | V=5.94 | Reference Frame: ICRS |
| | | Dec: +36 40 2.58 (36.66738d) | Proper Motion Dec: -9.65 mas/yr | J=6.0 | |
| | | Equinox: J2000 | Epoch of Position: 2000 | | |

*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*
*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 69-Cyg (STIS.ta.826582) | (2) 69-CYG | STIS/CCD, ACQ, F25ND5 | MIRROR | | | | 5 Secs (5 Secs)<br>*[==>]* | *[1]* |
| 2 | ACQ-peak 69-Cyg (STIS.sp.826586) | (2) 69-CYG | STIS/CCD, ACQ/PEAK, 52X0.1 | G750M 5734 A | | | | 0.5 Secs (0.5 Secs)<br>*[==>]* | *[1]* |
| 3 | 69-Cyg scan up (STIS.sp.826611) | (2) 69-CYG | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | SPATIAL SCAN 0.075,90.0 Degrees,Forward | | 200 Secs (200 Secs)<br>*[==>]* | *[1]* |
| 4 | 69-Cyg scan down (STIS.sp.826611) | (2) 69-CYG | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | SPATIAL SCAN 0.075,90.0 Degrees,Reverse | | 200 Secs (200 Secs)<br>*[==>]* | *[1]* |
| 5 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 6 | 69-Cyg scan down (STIS.sp.826611) | (2) 69-CYG | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-15;<br>SPATIAL SCAN 0.075,90.0 Degrees,Reverse | | 200 Secs (200 Secs)<br>*[==>]* | *[1]* |
| 7 | 69-Cyg scan up (STIS.sp.826611) | (2) 69-CYG | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-15;<br>SPATIAL SCAN 0.075,90.0 Degrees,Forward | | 200 Secs (200 Secs)<br>*[==>]* | *[1]* |
| 8 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 9 | 69-Cyg scan down long (STIS.sp.826611) | (2) 69-CYG | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-25;<br>SPATIAL SCAN 0.27777,90.0 Degrees,Reverse | | 180 Secs (180 Secs)<br>*[==>]* | *[1]* |
| 10 | 69-Cyg scan up long (STIS.sp.826611) | (2) 69-CYG | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | CR-SPLIT=NO; GAIN=4 | POS TARG 0,-25;<br>SPATIAL SCAN 0.27777,90.0 Degrees,Forward | | 180 Secs (180 Secs)<br>*[==>]* | *[1]* |
| 11 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 12 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 13 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 14 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |
| 15 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M 9336 A | | | | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | *[1]* |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M<br>9336 A | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[1]*** |
| 17 | Flats | CCDFLAT | STIS/CCD, ACCUM, 52X0.1 | G750M<br>9336 A | *[==>(Copy 1)]*<br>*[==>(Copy 2)]* | ***[1]*** |

**Orbit Structure**