# 14888 - Initial Reconaissance of a Transiting Rocky Planet in a Nearby M-Dwarf's Habitable Zone

Cycle: 24, Proposal Category: GO

(JWST Initative)

(Availability Mode: AVAILABLE)

**INVESTIGATORS**



| *Name* | *Institution* | *E-Mail* |
|---|---|---|
| **Dr. Jason A. Dittmann (PI) (Contact)** | **Massachusetts Institute of Technology** | **jason.dittmann@gmail.com** |
| Prof. David Charbonneau (CoI) | Harvard University | dcharbonneau@cfa.harvard.edu |
| Dr. Jonathan Irwin (CoI) | Smithsonian Institution Astrophysical Observatory | jirwin@cfa.harvard.edu |
| Dr. Zach K. Berta-Thompson (CoI) | University of Colorado at Boulder | zachory.bertathompson@colorado.edu |
| Dr. Elisabeth R. Newton (CoI) | Massachusetts Institute of Technology | ernewton@mit.edu |
| Dr. Xavier Bonfils (CoI) (ESA Member) | Universite de Grenoble I | xavier.bonfils@obs.ujf-grenoble.fr |
| Dr. Nicola Astudillo-Defru (CoI) (ESA Member) | Observatoire de Geneve | nicola.astudillo@unige.ch |
| Ms. Hannah Diamond-Lowe (CoI) | Harvard University | hdiamondlowe@cfa.harvard.edu |



**VISITS**

| *Visit* | *Targets used in Visit* | *Configurations used in Visit* | *Orbits Used* | *Last Orbit Planner Run* | *OP Current with Visit?* |
|---|---|---|---|---|---|
| 01 | (1) GJ-3053 | WFC3/IR | 4 | 13-Sep-2017 20:02:08.0 | yes |
| 05 | (1) GJ-3053 | WFC3/IR | 4 | 13-Sep-2017 20:02:37.0 | yes |
| 03 | (1) GJ-3053<br>WAVE | STIS/CCD<br>STIS/FUV-MAMA | 1 | 13-Sep-2017 20:02:41.0 | yes |

| *Visit* | *Targets used in Visit* | *Configurations used in Visit* | *Orbits Used* | *Last Orbit Planner Run* | *OP Current with Visit?* |
|---|---|---|---|---|---|
| 06 | (1) GJ-3053<br>WAVE | STIS/CCD<br>STIS/FUV-MAMA | 1 | 13-Sep-2017 20:02:42.0 | yes |

10 Total Orbits Used

**ABSTRACT**

The composition of a terrestrial planet's atmosphere is the end result of accretion, coupled with ongoing processes such as atmospheric escape, outgassing from the interior, and planetary surface processes. We have just discovered a transiting terrestrial planet in a small nearby star's habitable zone. Due to the proximity of the host star and the size of the transit depth, possible constituents for this planet's atmosphere can be detected with the Hubble Space Telescope. Here we propose to use STIS to obtain observations of the host star at Lyman-alpha. A detection of the host star at Lyman-alpha wavelengths will pave the way for observations of Lyman-alpha transits in Cycle 25. The stellar activity UV is an important constraint for future atmospheric modeling, atmospheric escape, and interpreting possible future detections of Oxygen and ozone with JWST or future ELTs. We also propose to obtain two transit observations with WFC3/IR to search for absorption features from a cloud-free, hydrogen rich atmosphere. Detection of a low mean molecular weight atmosphere means future observations should span a broad wavelength range, while a high mean molecular weight atmosphere means future observations should go deeper over a more narrow wavelength range. The results of this Hubble/STIS and Hubble/WFC3 investigation would inform the optimal strategy to observe this object in Cycle 25 and for JWST's GTO program (to be proposed in April 2017 and finalized September 2017).

**OBSERVING DESCRIPTION**

We will observe two transits of the terrestrial planet LHS 1140b with WFC3/IR grism spectroscopy. LHS 1140b resides in the habitable zone of its host star and has a 24.73712 +/- 0.00025 day period. This, combined with the visibility window of HST, means that there are only 2 transits visible with HST before the Cycle 25 proposal deadline, and only one additional transit visible with HST before the Cycle 25 mid-cycle proposal deadline.

We will observe two transits of the rocky exoplanet LHS 1140b with WFC3/IR grism spectroscopy. The core science observations consist of continuous high-cadence spectra, taken during the transit with the G141 grism. We will use these data to measure the wavelength-dependent transit depth from 1.1 to 1.7 microns in order to determine if LHS 1140's atmosphere is dominated by hydrogen.

We will use a spatial scan for the transit observations, to maximize duty cycle and to mitigate flat-fielding uncertainties by averaging over many

pixels. We have chosen a scan rate of 0.14"/second to maintain a similar S/N ratio as observations of GJ 1214b performed by Kreidberg et al. (2014). The scan speed is slow enough, and the observing field sparse enough, that LHS 1140's spectrum will not overlap with other stars in the field, given our mild ORIENT constraints.

During the first orbit of each visit (which is usually discarded from transit science observations), we will gather direct images as well as deep imaging spectra in stare-mode (without a spatial scan).

Visits 3 and 4 are deep UV exposures designed to determine if LHS 1140 (the host star) emits at Ly-alpha. These observations are not connected to Visits 1 or 2 in any way and can be scheduled any time out of transit.

**The Following Items Need Particular PC/CS Attention**
PHASE constraints are included that amount to an available range of 60 minutes per 24.73712 day orbital period for the planet. This constraint ensures that the 3rd orbit in each transit observation is during mid-transit. The orbital ephemeris is up-to-date and will not change before these observations are performed, as no more transits are visible from ground-based facilities.

## Visit

**Proposal 14888, Visit 1 - WFC3/IR (01), completed** Thu Sep 14 00:02:43 GMT 2017

**Diagnostic Status: Warning**

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 23D TO 187 D; ORIENT 203D TO 7 D; Period 24.73712 D AND ZERO-PHASE HJD2456915.6997

*Comments: The phase constraint on the first direct image in this visit is designed such that the 3rd orbit overlaps the transit of LHS 1140b. If need be to enable scheduling, the phase or orient constraints could be relaxed slightly.*

## Diagnostics

(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): EXPOSURE WITH SAA CONTOUR 11 WILL EXECUTE ON GYRO
(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): EXPOSURE WITH SAA CONTOUR 11 WILL EXECUTE ON GYRO
(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): EXPOSURE WITH SAA CONTOUR 11 WILL EXECUTE ON GYRO
(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): EXPOSURE WITH SAA CONTOUR 11 WILL EXECUTE ON GYRO
(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN
(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN
(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN
(Visit 1 - WFC3/IR (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

## Patterns

| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (1) | Pattern Type=WFC3-IR-DITHER-LINE<br>Purpose=DITHER<br>Number Of Points=2<br>Point Spacing=0.636<br>Line Spacing= | Coordinate Frame=POS-TARG<br>Pattern Orientation=41.788<br>Angle Between Sides=<br>Center Pattern=false | | (1) |

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | GJ-3053 | RA: 00 44 59.3100 (11.2471250d)<br>Dec: -15 16 18.00 (-15.27167d)<br>Equinox: J2000 | Proper Motion RA: 310.15 mas/yr<br>Proper Motion Dec: -594.8 mas/yr<br>Parallax: 0.0802"<br>Epoch of Position: 2000<br>Radial Velocity: -13.23661 km/sec | V=14.15+/-0.06<br>H = 9.092 +/- 0.026,<br>K = 8.821 +/- 0.024 | Reference Frame: ICRS |

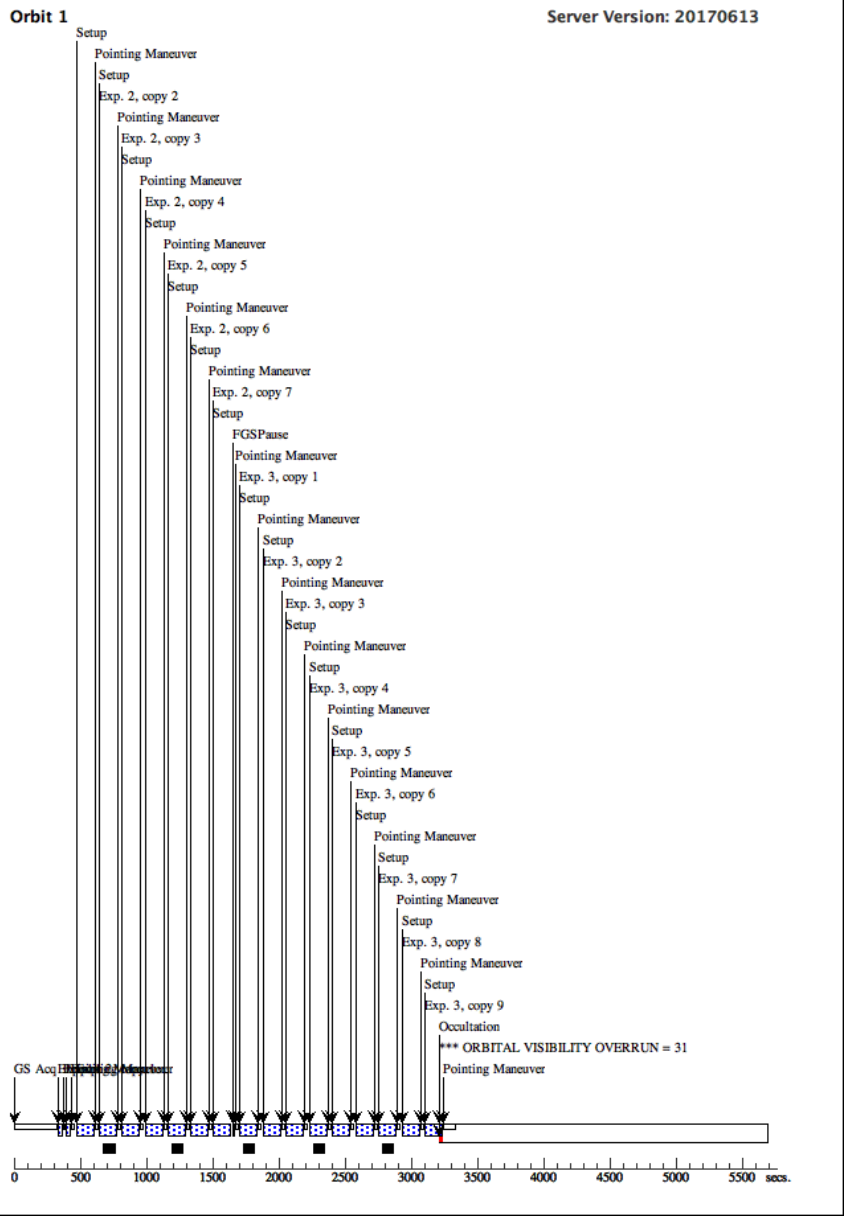
*Comments: This object was generated by the target selector and retrieved from the SIMBAD database. The position, proper motion, and the parallax was obtained from Winters et al. (2016). The error on the position was taken from 2MASS, which is tied to the ICRS.*
*Extended=NO*

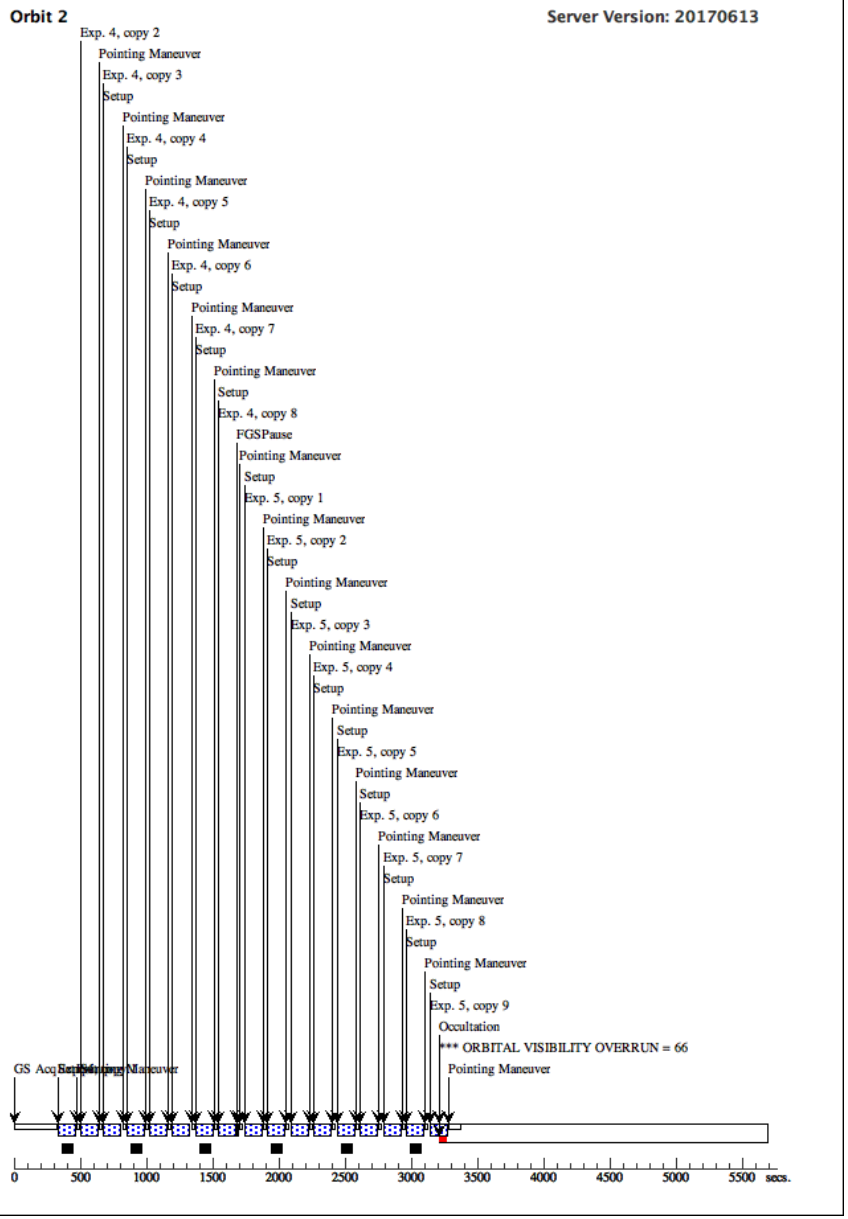
**Exposures**

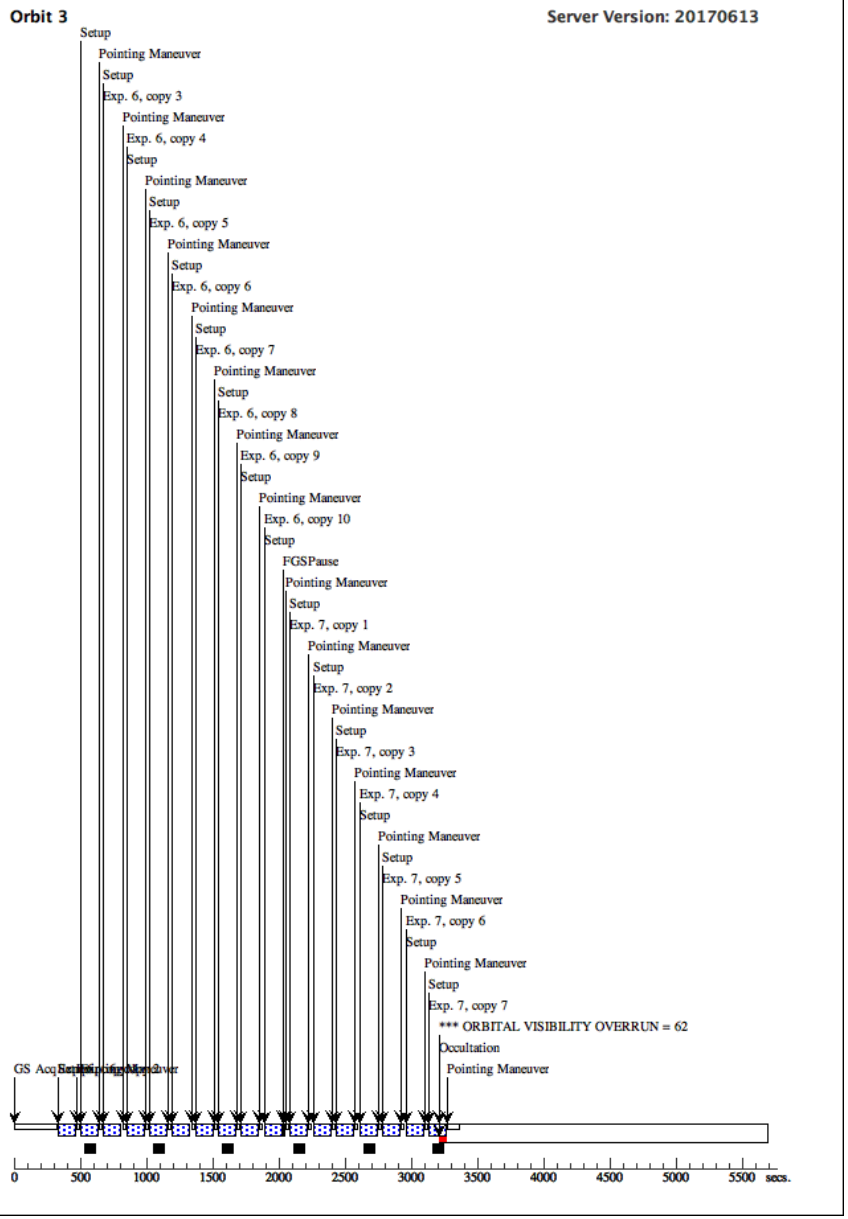
| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | LHS 1140 direct image | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM512 | F130N | NSAMP=3;<br>SAMP-SEQ=RAPID | PHASE 0.99337478 TO 0.99495 | Sequence 1-3 Non-Int in Visit 1 - WFC3/IR (01)<br>Pattern 1, Exps 1-1 in Sequence 1-3 Non-Int in Visit 1 - WFC3/IR (01) (1) | 2.559081 Secs (5.118 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[1]*** |
| 2 | LHS 1140 Grism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1,90.0 Degrees,Forward | Sequence 1-3 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 7 (721.9 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]*<br>*[==>(Copy 7)]* | ***[1]*** |
| 3 | LHS 1140 Grism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1,90.0 Degrees,Forward;<br>SAA CONTOUR 11 | Sequence 1-3 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 9 (928.158 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]*<br>*[==>(Copy 7)]*<br>*[==>(Copy 8)]*<br>*[==>(Copy 9)]* | ***[1]*** |
| 4 | LHS 1140 Grism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1,90.0 Degrees,Forward;<br>NEW OBSET FULL ACQ | Sequence 4-5 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 8 (825.029 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]*<br>*[==>(Copy 7)]*<br>*[==>(Copy 8)]* | ***[2]*** |
| 5 | LHS 1140 Grism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1,90.0 Degrees,Forward;<br>SAA CONTOUR 11 | Sequence 4-5 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 9 (928.158 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]*<br>*[==>(Copy 7)]*<br>*[==>(Copy 8)]*<br>*[==>(Copy 9)]* | ***[2]*** |

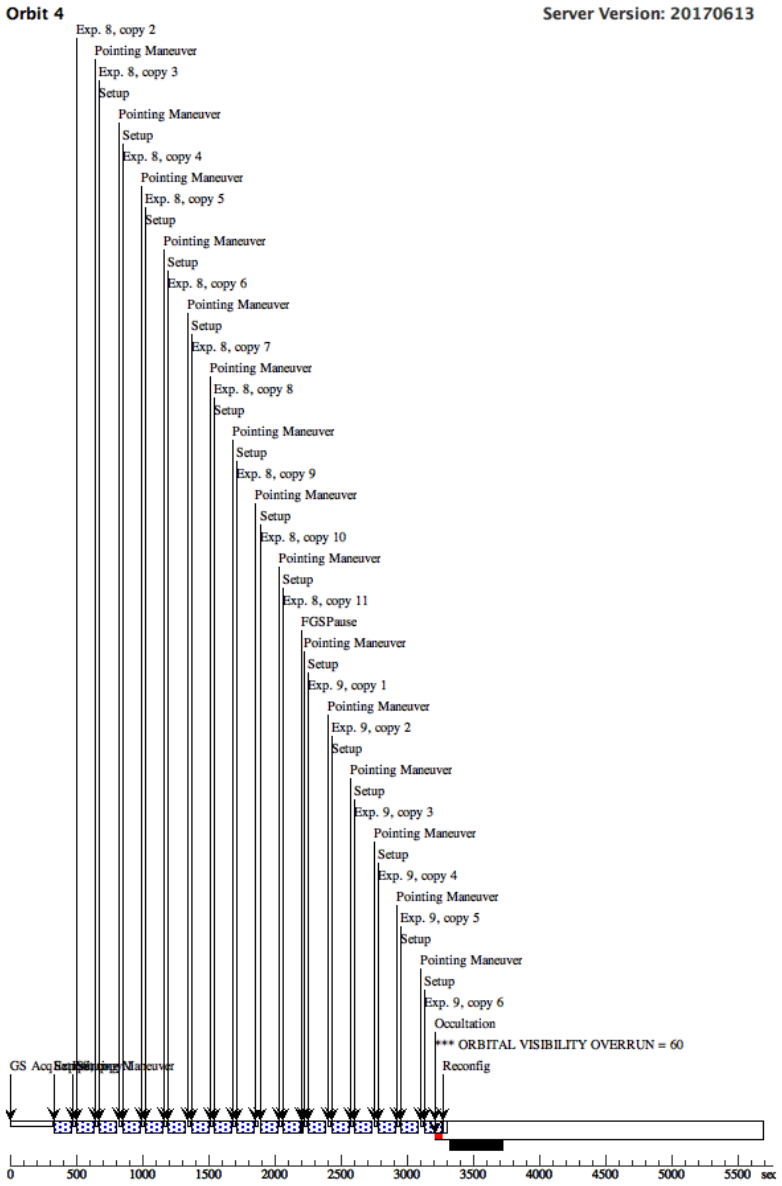
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | LHS 1140 G rism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 ,90.0 Degrees,Forward;<br>NEW OBSET FULL ACQ | Sequence 6-7 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 10 (1031.286 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]*<br>*[==>(Copy 7)]*<br>*[==>(Copy 8)]*<br>*[==>(Copy 9)]*<br>*[==>(Copy 10)]* | ***[3]*** |
| | 7 | LHS 1140 G rism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 ,90.0 Degrees,Forward;<br>SAA CONTOUR 11 | Sequence 6-7 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 7 (721.9 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]*<br>*[==>(Copy 7)]* | ***[3]*** |
| | 8 | LHS 1140 G rism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 ,90.0 Degrees,Forward;<br>NEW OBSET FULL ACQ | Sequence 8-9 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 11 (1134.415 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]*<br>*[==>(Copy 7)]*<br>*[==>(Copy 8)]*<br>*[==>(Copy 9)]*<br>*[==>(Copy 10)]*<br>*[==>(Copy 11)]* | ***[4]*** |
| | 9 | LHS 1140 G rism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 ,90.0 Degrees,Forward;<br>SAA CONTOUR 11 | Sequence 8-9 Non-Int in Visit 1 - WFC3/IR (01) | 103.128633 Secs X 6 (618.772 Secs)<br>*[==>(Copy 1)]*<br>*[==>(Copy 2)]*<br>*[==>(Copy 3)]*<br>*[==>(Copy 4)]*<br>*[==>(Copy 5)]*<br>*[==>(Copy 6)]* | ***[4]*** |

## Orbit Structure




Orbit 2
Server Version: 20170613
Exp. 4, copy 2
Pointing Maneuver
Exp. 4, copy 3
Setup
Pointing Maneuver
Exp. 4, copy 4
Setup
Pointing Maneuver
Exp. 4, copy 5
Setup
Pointing Maneuver
Exp. 4, copy 6
Setup
Pointing Maneuver
Exp. 4, copy 7
Setup
Pointing Maneuver
Setup
Exp. 4, copy 8
FGSPause
Pointing Maneuver
Setup
Exp. 5, copy 1
Pointing Maneuver
Exp. 5, copy 2
Setup
Pointing Maneuver
Setup
Exp. 5, copy 3
Pointing Maneuver
Exp. 5, copy 4
Setup
Pointing Maneuver
Setup
Exp. 5, copy 5
Pointing Maneuver
Setup
Exp. 5, copy 6
Pointing Maneuver
Exp. 5, copy 7
Setup
Pointing Maneuver
Exp. 5, copy 8
Setup
Pointing Maneuver
Setup
Exp. 5, copy 9
Occultation
*** ORBITAL VISIBILITY OVERRUN = 66
Pointing Maneuver
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 3
Server Version: 20170613
Setup
Pointing Maneuver
Setup
Exp. 6, copy 3
Pointing Maneuver
Exp. 6, copy 4
Setup
Pointing Maneuver
Setup
Exp. 6, copy 5
Pointing Maneuver
Setup
Exp. 6, copy 6
Pointing Maneuver
Setup
Exp. 6, copy 7
Pointing Maneuver
Setup
Exp. 6, copy 8
Pointing Maneuver
Exp. 6, copy 9
Setup
Pointing Maneuver
Exp. 6, copy 10
Setup
FGSPause
Pointing Maneuver
Setup
Exp. 7, copy 1
Pointing Maneuver
Setup
Exp. 7, copy 2
Pointing Maneuver
Setup
Exp. 7, copy 3
Pointing Maneuver
Exp. 7, copy 4
Setup
Pointing Maneuver
Setup
Exp. 7, copy 5
Pointing Maneuver
Exp. 7, copy 6
Setup
Pointing Maneuver
Setup
Exp. 7, copy 7
*** ORBITAL VISIBILITY OVERRUN = 62
Occultation
Pointing Maneuver
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 4
Server Version: 20170613
Exp. 8, copy 2
Pointing Maneuver
Exp. 8, copy 3
Setup
Pointing Maneuver
Setup
Exp. 8, copy 4
Pointing Maneuver
Exp. 8, copy 5
Setup
Pointing Maneuver
Setup
Exp. 8, copy 6
Pointing Maneuver
Setup
Exp. 8, copy 7
Pointing Maneuver
Exp. 8, copy 8
Setup
Pointing Maneuver
Setup
Exp. 8, copy 9
Pointing Maneuver
Setup
Exp. 8, copy 10
Pointing Maneuver
Setup
Exp. 8, copy 11
FGSPause
Pointing Maneuver
Setup
Exp. 9, copy 1
Pointing Maneuver
Exp. 9, copy 2
Setup
Pointing Maneuver
Setup
Exp. 9, copy 3
Pointing Maneuver
Setup
Exp. 9, copy 4
Pointing Maneuver
Exp. 9, copy 5
Setup
Pointing Maneuver
Setup
Exp. 9, copy 6
Occultation
*** ORBITAL VISIBILITY OVERRUN = 60
Reconfig
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

## Visit

**Proposal 14888, Visit 2 - WFC3/IR (05), implementation** Thu Sep 14 00:02:44 GMT 2017

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 23D TO 187 D; ORIENT 203D TO 7 D; Period 24.73712 D AND ZERO-PHASE HJD2456915.6997

*Comments: The phase constraint on the first direct image in this visit is designed such that the 3rd orbit overlaps the transit of LHS 1140b. If need be to enable scheduling, the phase or orient constraints could be relaxed slightly.*

## Patterns

| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (1) | Pattern Type=WFC3-IR-DITHER-LINE<br>Purpose=DITHER<br>Number Of Points=2<br>Point Spacing=0.636<br>Line Spacing= | Coordinate Frame=POS-TARG<br>Pattern Orientation=41.788<br>Angle Between Sides=<br>Center Pattern=false | | (1) |

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | GJ-3053 | RA: 00 44 59.3100 (11.2471250d)<br>Dec: -15 16 18.00 (-15.27167d)<br>Equinox: J2000 | Proper Motion RA: 310.15 mas/yr<br>Proper Motion Dec: -594.8 mas/yr<br>Parallax: 0.0802"<br>Epoch of Position: 2000<br>Radial Velocity: -13.23661 km/sec | V=14.15+/-0.06<br>H = 9.092 +/- 0.026,<br>K = 8.821 +/- 0.024 | Reference Frame: ICRS |

*Comments: This object was generated by the target selector and retrieved from the SIMBAD database. The position, proper motion, and the parallax was obtained from Winters et al. (2016). The error on the position was taken from 2MASS, which is tied to the ICRS.*
*Extended=NO*

**Exposures**

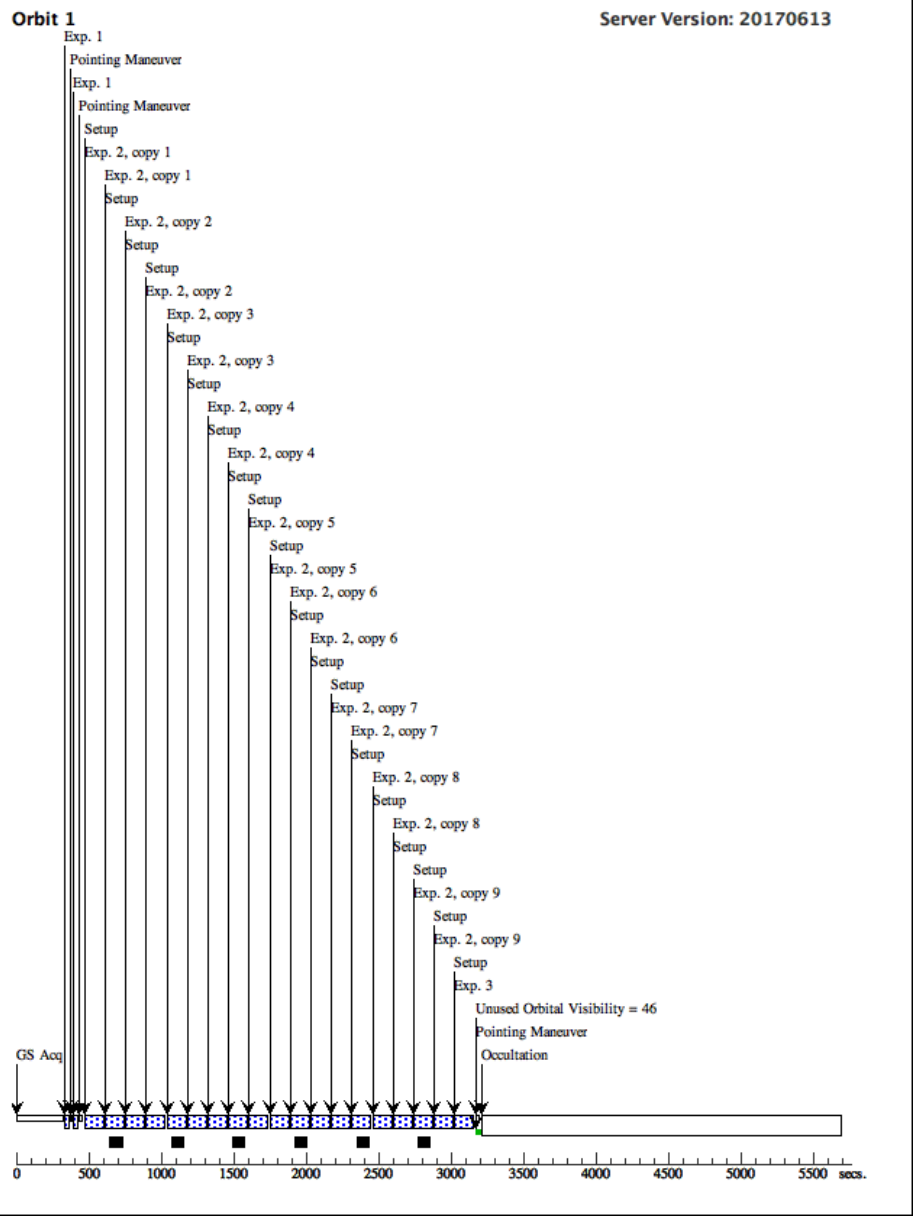
| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | LHS 1140 direct image | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM512 | F130N | NSAMP=3; SAMP-SEQ=RAPID | PHASE 0.99337478 TO 0.99469770 | Sequence 1-3 Non-Int in Visit 2 - WFC3/IR (05)<br>Pattern 1, Exps 1-1 in Sequence 1-3 Non-Int in Visit 2 - WFC3/IR (05) (1) | 2.559081 Secs (5.118 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[1]*** |
| 2 | LHS 1140 Grism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS10; NSAMP=15 | POS TARG 0,-9.5; SPATIAL SCAN 0.14,90.0 Degrees,Round trip | Sequence 1-3 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs X 9 (1856.315 Secs)<br>*[==>(Copy 1, Forward)]*<br>*[==>(Copy 1, Reverse)]*<br>*[==>(Copy 2, Forward)]*<br>*[==>(Copy 2, Reverse)]*<br>*[==>(Copy 3, Forward)]*<br>*[==>(Copy 3, Reverse)]*<br>*[==>(Copy 4, Forward)]*<br>*[==>(Copy 4, Reverse)]*<br>*[==>(Copy 5, Forward)]*<br>*[==>(Copy 5, Reverse)]*<br>*[==>(Copy 6, Forward)]*<br>*[==>(Copy 6, Reverse)]*<br>*[==>(Copy 7, Forward)]*<br>*[==>(Copy 7, Reverse)]*<br>*[==>(Copy 8, Forward)]*<br>*[==>(Copy 8, Reverse)]*<br>*[==>(Copy 9, Forward)]*<br>*[==>(Copy 9, Reverse)]* | ***[1]*** |
| 3 | LHS 1140 Grism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS10; NSAMP=15 | POS TARG 0,-9.5; SPATIAL SCAN 0.14,90.0 Degrees,Forward | Sequence 1-3 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs (103.129 Secs)<br>*[==>]* | ***[1]*** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4 | LHS 1140 G rism (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 4,90.0 Degrees,Round trip | Sequence 4-5 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs X 10 (2062.573 Secs)<br>*[==>(Copy 1, Forward)]*<br>*[==>(Copy 1, Reverse)]*<br>*[==>(Copy 2, Forward)]*<br>*[==>(Copy 2, Reverse)]*<br>*[==>(Copy 3, Forward)]*<br>*[==>(Copy 3, Reverse)]*<br>*[==>(Copy 4, Forward)]*<br>*[==>(Copy 4, Reverse)]*<br>*[==>(Copy 5, Forward)]*<br>*[==>(Copy 5, Reverse)]*<br>*[==>(Copy 6, Forward)]*<br>*[==>(Copy 6, Reverse)]*<br>*[==>(Copy 7, Forward)]*<br>*[==>(Copy 7, Reverse)]*<br>*[==>(Copy 8, Forward)]*<br>*[==>(Copy 8, Reverse)]*<br>*[==>(Copy 9, Forward)]*<br>*[==>(Copy 9, Reverse)]*<br>*[==>(Copy 10, Forward)]*<br>*[==>(Copy 10, Reverse)]* | ***[2]*** |
| | 5 | LHS 1140 G rism (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 4,90.0 Degrees,Forward | Sequence 4-5 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs (103.129 Secs)<br>*[==>]* | ***[2]*** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 6 | LHS 1140 G rism (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 4,90.0 Degrees,Round trip | Sequence 6-7 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs X 10 (2062.573 Secs)<br>*[==>(Copy 1, Forward)]*<br>*[==>(Copy 1, Reverse)]*<br>*[==>(Copy 2, Forward)]*<br>*[==>(Copy 2, Reverse)]*<br>*[==>(Copy 3, Forward)]*<br>*[==>(Copy 3, Reverse)]*<br>*[==>(Copy 4, Forward)]*<br>*[==>(Copy 4, Reverse)]*<br>*[==>(Copy 5, Forward)]*<br>*[==>(Copy 5, Reverse)]*<br>*[==>(Copy 6, Forward)]*<br>*[==>(Copy 6, Reverse)]*<br>*[==>(Copy 7, Forward)]*<br>*[==>(Copy 7, Reverse)]*<br>*[==>(Copy 8, Forward)]*<br>*[==>(Copy 8, Reverse)]*<br>*[==>(Copy 9, Forward)]*<br>*[==>(Copy 9, Reverse)]*<br>*[==>(Copy 10, Forward)]*<br>*[==>(Copy 10, Reverse)]* | ***[3]*** |
| | 7 | LHS 1140 G rism (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 4,90.0 Degrees,Forward | Sequence 6-7 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs (103.129 Secs)<br>*[==>]* | ***[3]*** |

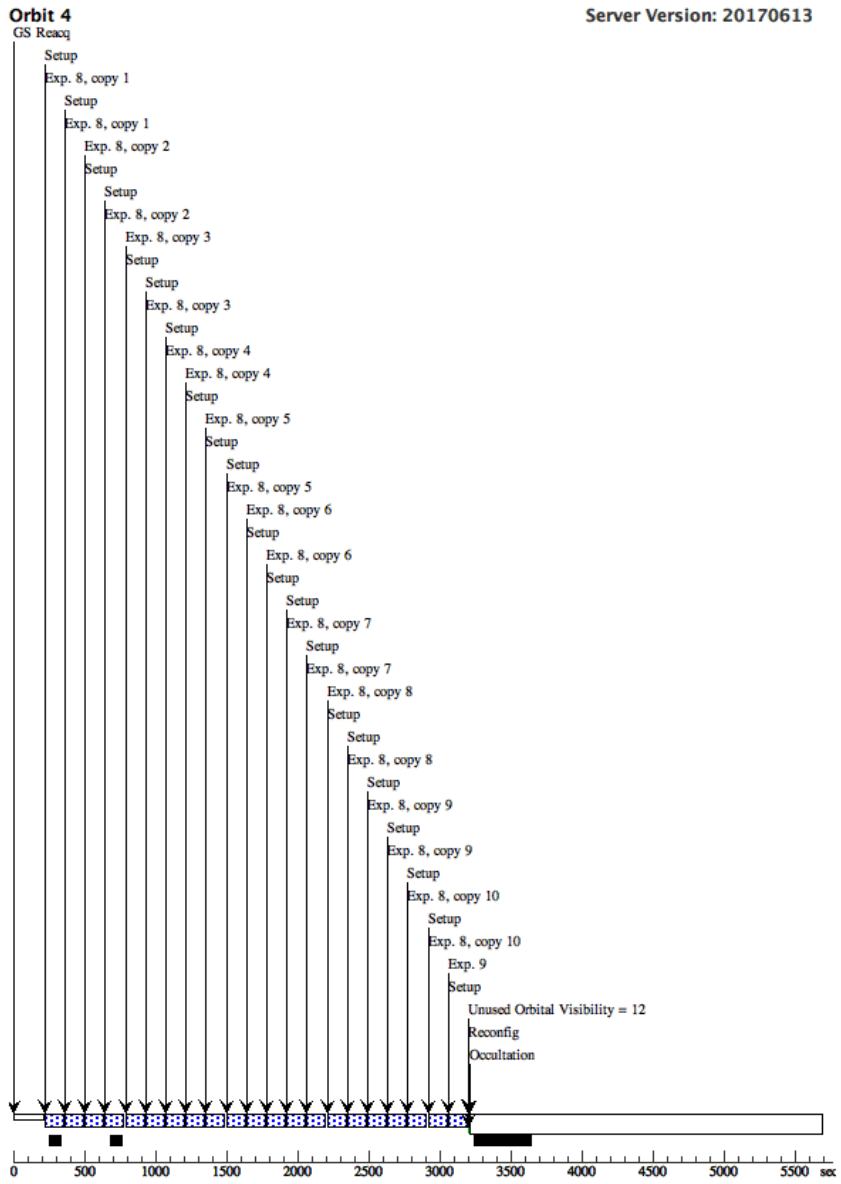
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 8 | LHS 1140 G rism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 4,90.0 Degrees,Round trip | Sequence 8-9 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs X 10 (2062.573 Secs) | |
| | | | | | | | | | *[==>(Copy 1, Forward)]*<br>*[==>(Copy 1, Reverse)]*<br>*[==>(Copy 2, Forward)]*<br>*[==>(Copy 2, Reverse)]*<br>*[==>(Copy 3, Forward)]*<br>*[==>(Copy 3, Reverse)]*<br>*[==>(Copy 4, Forward)]*<br>*[==>(Copy 4, Reverse)]*<br>*[==>(Copy 5, Forward)]*<br>*[==>(Copy 5, Reverse)]*<br>*[==>(Copy 6, Forward)]*<br>*[==>(Copy 6, Reverse)]*<br>*[==>(Copy 7, Forward)]*<br>*[==>(Copy 7, Reverse)]*<br>*[==>(Copy 8, Forward)]*<br>*[==>(Copy 8, Reverse)]*<br>*[==>(Copy 9, Forward)]*<br>*[==>(Copy 9, Reverse)]*<br>*[==>(Copy 10, Forward)]*<br>*[==>(Copy 10, Reverse)]* | ***[4]*** |
| | 9 | LHS 1140 G rism | (1) GJ-3053 | WFC3/IR, MULTIACCUM, GRISM256 | G141 | SAMP-SEQ=SPARS 10;<br>NSAMP=15 | POS TARG 0,-9.5;<br>SPATIAL SCAN 0.1 4,90.0 Degrees,Forward | Sequence 8-9 Non-Int in Visit 2 - WFC3/IR (05) | 103.128633 Secs (103.129 Secs) | |
| | | | | | | | | | *[==>]* | ***[4]*** |

**Orbit Structure**




Orbit 2
Server Version: 20170613
GS Reacq
Setup
Exp. 4, copy 1
Setup
Exp. 4, copy 1
Exp. 4, copy 2
Setup
Exp. 4, copy 2
Setup
Exp. 4, copy 3
Setup
Setup
Exp. 4, copy 3
Setup
Exp. 4, copy 4
Exp. 4, copy 4
Setup
Setup
Exp. 4, copy 5
Exp. 4, copy 5
Setup
Setup
Exp. 4, copy 6
Setup
Exp. 4, copy 6
Setup
Exp. 4, copy 7
Setup
Exp. 4, copy 7
Exp. 4, copy 8
Setup
Exp. 4, copy 8
Setup
Setup
Exp. 4, copy 9
Setup
Exp. 4, copy 9
Setup
Exp. 4, copy 10
Setup
Exp. 4, copy 10
Exp. 5
Setup
Pointing Maneuver
Unused Orbital Visibility = 12
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 3
Server Version: 20170613
GS Reacq
Setup
Exp. 6, copy 1
Exp. 6, copy 1
Setup
Setup
Exp. 6, copy 2
Setup
Exp. 6, copy 2
Setup
Exp. 6, copy 3
Setup
Exp. 6, copy 3
Setup
Exp. 6, copy 4
Setup
Exp. 6, copy 4
Setup
Exp. 6, copy 5
Exp. 6, copy 5
Setup
Setup
Exp. 6, copy 6
Setup
Exp. 6, copy 6
Setup
Exp. 6, copy 7
Setup
Exp. 6, copy 7
Setup
Exp. 6, copy 8
Setup
Exp. 6, copy 8
Setup
Exp. 6, copy 9
Exp. 6, copy 9
Setup
Exp. 6, copy 10
Setup
Exp. 6, copy 10
Setup
Setup
Exp. 7
Pointing Maneuver
Unused Orbital Visibility = 12
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 4
Server Version: 20170613
GS Reacq
Setup
Exp. 8, copy 1
Setup
Exp. 8, copy 1
Exp. 8, copy 2
Setup
Setup
Exp. 8, copy 2
Exp. 8, copy 3
Setup
Setup
Exp. 8, copy 3
Setup
Exp. 8, copy 4
Exp. 8, copy 4
Setup
Exp. 8, copy 5
Setup
Setup
Exp. 8, copy 5
Exp. 8, copy 6
Setup
Exp. 8, copy 6
Setup
Setup
Exp. 8, copy 7
Setup
Exp. 8, copy 7
Exp. 8, copy 8
Setup
Setup
Exp. 8, copy 8
Setup
Exp. 8, copy 9
Setup
Exp. 8, copy 9
Setup
Exp. 8, copy 10
Setup
Exp. 8, copy 10
Exp. 9
Setup
Unused Orbital Visibility = 12
Reconfig
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

## Visit

**Proposal 14888, Visit 3 - STIS UV (03), completed** Thu Sep 14 00:02:44 GMT 2017

**Diagnostic Status: Warning**

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

Special Requirements: Period 24.73712 D AND ZERO-PHASE HJD2456915.6997

*Comments: In this UV observation, we will measure the Lyman-alpha flux from the host star. Very loose timing requirements are needed for the STIS/UV visits -- we simply want to observe far from times of the known planet's transit.*

## Diagnostics

(Visit 3 - STIS UV (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

## Fixed Targets

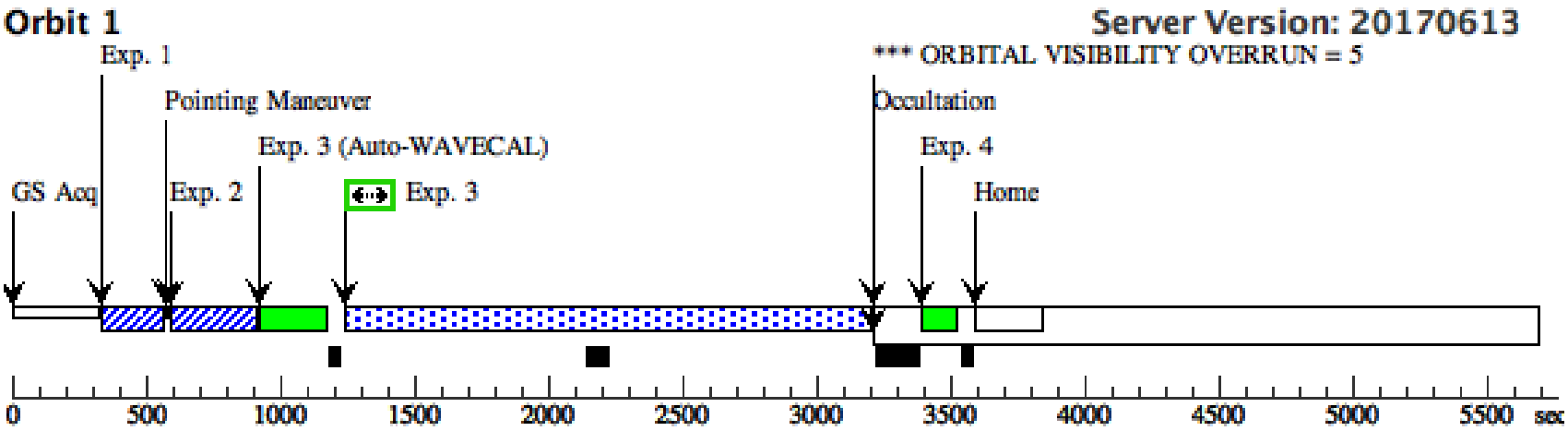
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | GJ-3053 | RA: 00 44 59.3100 (11.2471250d)<br>Dec: -15 16 18.00 (-15.27167d)<br>Equinox: J2000 | Proper Motion RA: 310.15 mas/yr<br>Proper Motion Dec: -594.8 mas/yr<br>Parallax: 0.0802"<br>Epoch of Position: 2000<br>Radial Velocity: -13.23661 km/sec | V=14.15+/-0.06<br>H = 9.092 +/- 0.026,<br>K = 8.821 +/- 0.024 | Reference Frame: ICRS |

*Comments: This object was generated by the target selector and retrieved from the SIMBAD database. The position, proper motion, and the parallax was obtained from Winters et al. (2016). The error on the position was taken from 2MASS, which is tied to the ICRS.*
*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 (STIS.ta.847728) | (1) GJ-3053 | STIS/CCD, ACQ, F28X50LP | MIRROR | ACQTYPE=POINT | PHASE 0.1 TO 0.9 | Sequence 1-4 Non-Int in Visit 3 - STIS UV (03) | 1.0 Secs (1 Secs)<br>*[==>]* | ***[1]*** |
| *Comments: The ETC quotes a time to saturation of 5.04s for the F28X50LP filter, and a time of 0.0270s to reach S/N=40. Our 1.0s exposure time for the ACQ should reach 20% of saturation.* | | | | | | | | | |
| 2 | ACQ/PEAK (STIS.ta.848127) | (1) GJ-3053 | STIS/CCD, ACQ/PEAK, 52X0.05 | MIRROR | | | Sequence 1-4 Non-Int in Visit 3 - STIS UV (03) | 2.0 Secs (2 Secs)<br>*[==>]* | ***[1]*** |
| *Comments: The ETC lists a time to saturation through the 52X0.05 slit of 11.08s and a total count rate of 57433e/s. With our 2.0s exposures, we should reach 114,000 source electrons, sufficient for peak-up but still well below saturation.* | | | | | | | | | |
| 3 | Science (STIS.sp.847746) | (1) GJ-3053 | STIS/FUV-MAMA, TIME-TAG, 52X0.05 | G140M 1222 A | BUFFER-TIME=900 | | Sequence 1-4 Non-Int in Visit 3 - STIS UV (03) | 1960 Secs (1944 Secs)<br>*[==>1944.0 Secs ]* | ***[1]*** |
| 4 | Wave-Cal | WAVE | STIS/FUV-MAMA, ACCUM, 52X0.05 | G140M 1222 A | | | Sequence 1-4 Non-Int in Visit 3 - STIS UV (03) | 82 Secs (82 Secs)<br>*[==>]* | ***[1]*** |

Orbit Structure



## Visit

**Proposal 14888, Visit 4 - STIS UV (06), completed** Thu Sep 14 00:02:44 GMT 2017

**Diagnostic Status: Warning**

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

Special Requirements: Period 24.73712 D AND ZERO-PHASE HJD2456915.6997

*Comments: In this UV observation, we will measure the Lyman-alpha flux from the host star. Very loose timing requirements are needed for the STIS/UV visits -- we simply want to observe far from times of the known planet's transit.*

## Diagnostics

(Visit 4 - STIS UV (06)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | GJ-3053 | RA: 00 44 59.3100 (11.2471250d)<br>Dec: -15 16 18.00 (-15.27167d)<br>Equinox: J2000 | Proper Motion RA: 310.15 mas/yr<br>Proper Motion Dec: -594.8 mas/yr<br>Parallax: 0.0802"<br>Epoch of Position: 2000<br>Radial Velocity: -13.23661 km/sec | V=14.15+/-0.06<br>H = 9.092 +/- 0.026,<br>K = 8.821 +/- 0.024 | Reference Frame: ICRS |

*Comments: This object was generated by the target selector and retrieved from the SIMBAD database. The position, proper motion, and the parallax was obtained from Winters et al. (2016). The error on the position was taken from 2MASS, which is tied to the ICRS.*
*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 (STIS.ta.847728) | (1) GJ-3053 | STIS/CCD, ACQ, F28X50LP | MIRROR | ACQTYPE=POINT | PHASE 0.1 TO 0.9 | Sequence 1-4 Non-Int in Visit 4 - STIS UV (06) | 1.0 Secs (1 Secs)<br>*[==>]* | ***[1]*** |
| *Comments: The ETC quotes a time to saturation of 5.04s for the F28X50LP filter, and a time of 0.0270s to reach S/N=40. Our 1.0s exposure time for the ACQ should reach 20% of saturation.* | | | | | | | | | |
| 2 | ACQ/PEAK (STIS.ta.848127) | (1) GJ-3053 | STIS/CCD, ACQ/PEAK, 52X0.05 | MIRROR | | | Sequence 1-4 Non-Int in Visit 4 - STIS UV (06) | 2.0 Secs (2 Secs)<br>*[==>]* | ***[1]*** |
| *Comments: The ETC lists a time to saturation through the 52X0.05 slit of 11.08s and a total count rate of 57433e/s. With our 2.0s exposures, we should reach 114,000 source electrons, sufficient for peak-up but still well below saturation.* | | | | | | | | | |
| 3 | Science (STIS.sp.847746) | (1) GJ-3053 | STIS/FUV-MAMA, TIME-TAG, 52X0.05 | G140M 1222 A | BUFFER-TIME=900 | | Sequence 1-4 Non-Int in Visit 4 - STIS UV (06) | 1960 Secs (1944 Secs)<br>*[==>1944.0 Secs ]* | ***[1]*** |
| 4 | Wave-Cal | WAVE | STIS/FUV-MAMA, ACCUM, 52X0.05 | G140M 1222 A | | | Sequence 1-4 Non-Int in Visit 4 - STIS UV (06) | 82 Secs (82 Secs)<br>*[==>]* | ***[1]*** |

Orbit Structure