# 16048 - Extremely Metal Poor Galaxies: Understanding the Boundaries of Galaxy Evoution

Cycle: 27, Proposal Category: GO

(JWST Initative)

(Availability Mode: SUPPORTED)

**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) J1005+3722 | ACS/WFC | 2 | 31-Jan-2020 13:01:02.0 | yes |
| 02 | (1) J1005+3722 | ACS/WFC | 2 | 31-Jan-2020 13:01:03.0 | yes |
| 03 | (1) J1005+3722 | ACS/WFC | 2 | 31-Jan-2020 13:01:04.0 | yes |
| 04 | (1) J1005+3722 | ACS/WFC | 2 | 31-Jan-2020 13:01:04.0 | yes |
| 05 | (1) J1005+3722 | ACS/WFC | 2 | 31-Jan-2020 13:01:05.0 | yes |
| 06 | (1) J1005+3722 | ACS/WFC | 3 | 31-Jan-2020 13:01:06.0 | yes |

13 Total Orbits Used

**ABSTRACT**

After decades of fruitless searches, we are finally starting to find star-foming galaxies with exceptionally low gas-phase oxygen abundances in the nearby universe. Such galaxies have properties at the limit of what we expect from galaxy evoution models, providing unique boundary conditions for low-mass galaxies in the present-day universe. Termed 'extremely metal-poor' or XMP galaxies, with abundances <5% solar, these galaxies nearly ubiquitously disagree with expectations of the well-established luminosity-metallicity relation (LZR) of dwarf galaxies. There are two exceptions. The first is the nearby galaxy Leo P (D=1.6 Mpc), whose low abundance is consistent with inefficient star formation and metal-loss via galactic winds. The second is the newly discovered XMP galaxy J1005+3722. Tantalizingly close at 2.7 Mpc, the galaxy has a robust, direct-method oxygen abundance of 12+log(O/H) = 7.25 and, similar to Leo P, is consistent with the LZR.

We request HST ACS imaging of the stellar populations in J1005+3722 to derive the star formation and chemical enrichment history of the galaxy and determine whether (i) the galaxy has experienced constant or delayed star formation, and (ii) the low oxygen abundance is consistent with expectations from secular processes (i.e., low star formation rates and metal expulsion). J1005+3722 is in the expected abundance regime of galaxies at high-redshift that will be identified by JWST, but forever out-of-reach for detailed study. It is through the analysis possible on galaxies like J1005+3722 in the local universe, where the observations are best, that we build our foundational knowledge of metal-poor galaxies and help prepare for JWST.

**OBSERVING DESCRIPTION**

The goal of this proposal is to measure the distance, search for variable stars, and reconstruct and interpret the star formation history (SFH) and chemical enrichment history of the newly discovered XMP dwarf galaxy J1005+3722 from a deep color-magnitude diagram (CMD). Orbit allocation = 13 orbits.

Most visits span 2-orbits with the ACS with the final vist spanning 3-orbits; each orbit is split between one F606W and one F814W exposure (with no CR-splits). Small ditherings are performed between exposures in order to remove hot pixels and to smooth the detector response. We don't intend to cover the interchip gap. Ditherings are performed using POS-TARG, and following the basic UDF dither pattern, shifted around by 2-3 pix. The observations will complete a total of 4 uniquely positioned UDF dither patterns plus an additional set of F606W and F814W images with a POS-TARG offset of 0.05, 0.05.

The first visit is requested within a given range of orientations. This range has been chosen to minimize the impact of a bright foreground star on the

photometry of the galaxy and to ensure the galaxy is not impacted by the chip gap. Subsequent visits are requested to be obtained with the same ORIENT as the first visit in order to maximize the sky area covered at full depth.

We request the visits to be executed sequentially within a maximum time span of 3 days, ideally avoiding 12 hour intervals in the observations as this matches the cadence of the expected variable star light curves. The request sequence of data will ensure optimal sampling of the light curves of short period variable stars such as RR Lyrae, which will provide an independent constraint on the SFH of the galaxy, the main science goal of our progam.

## Visit

**Proposal 16048, Visit 01 (01), implementation** Fri Jan 31 18:01:06 GMT 2020

**Diagnostic Status: No Diagnostics**

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 358D TO 60 D; ORIENT 177D TO 235 D; ORIENT 315D TO 320 D; ORIENT 145D TO 156 D; SEQ 01,02,03,04,05,06 WITHIN 3 D

*Comments: We request a range of orientations in this first visit and the same orientation in the subsequent visits. Visits are also requested to be executed sequentially within a 3 day period.*

## Fixed Targets

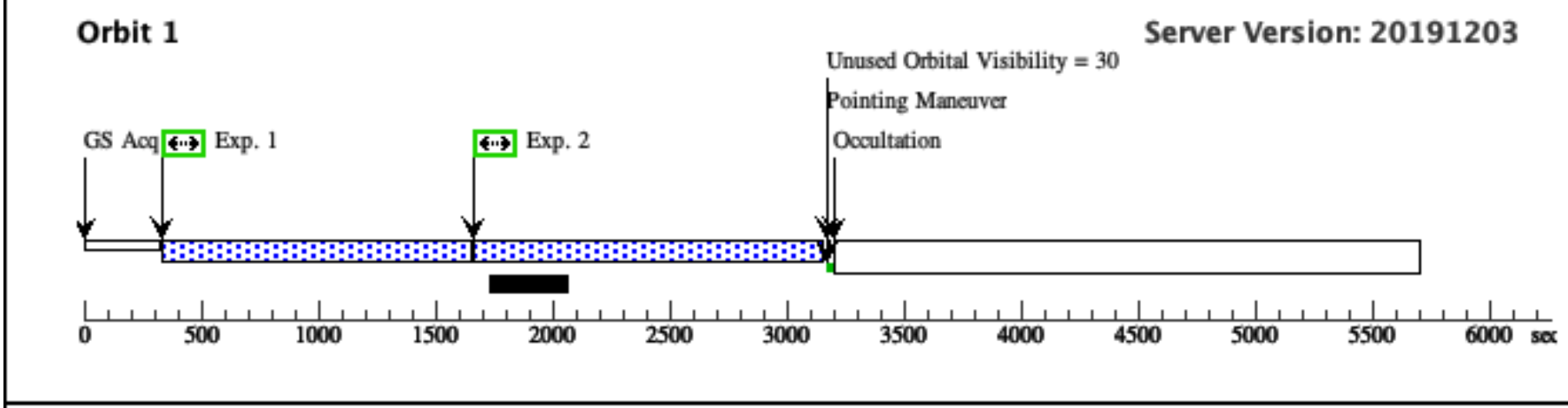
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | J1005+3722 | RA: 10 05 13.5500 (151.3064583d)<br>Dec: +37 22 53.15 (37.38143d)<br>Equinox: J2000 | | V=19 | Reference Frame: ICRS |

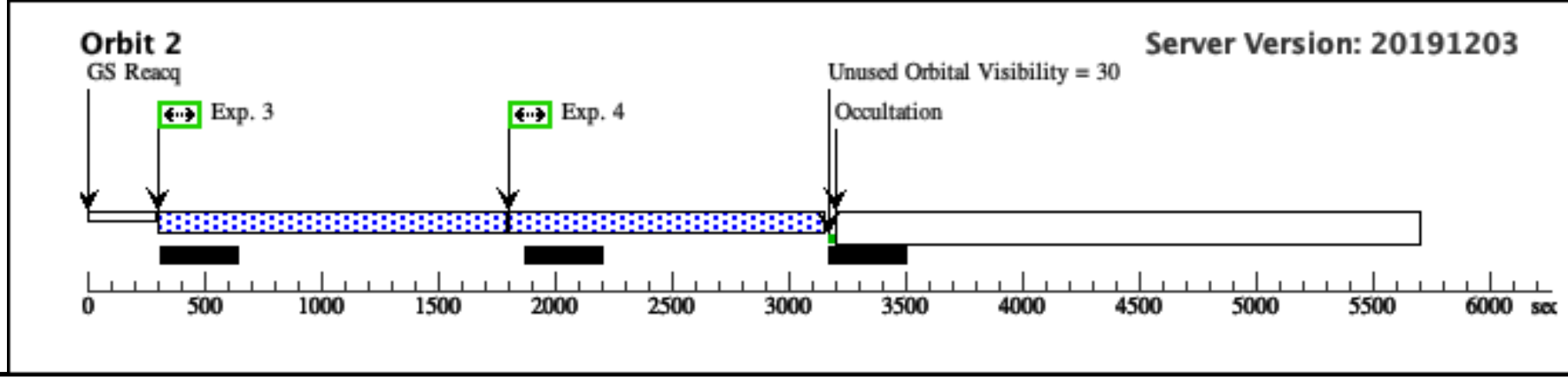
*Comments:*
*Category=GALAXY*
*Description=[AMORPHOUS IRREGULAR, STAR FORMING REGION]*
*Extended=NO*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F606W-1 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | | | 1115 Secs (1115 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 2 | F814W-1 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | | | 1309 Secs (1309 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 3 | F814W-2 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.148,0.086 | | 1368 Secs (1368 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |
| 4 | F606W-2 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.148,0.086 | | 1169 Secs (1169 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |

Orbit Structure



## Visit

**Proposal 16048, Visit 02 (02), implementation** Fri Jan 31 18:01:07 GMT 2020

**Diagnostic Status: No Diagnostics**

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 01 BY 4 H TO 3 D

*Comments: Please avoid scheduling windows in increments of 12 hours after previous visit.*

## Fixed Targets

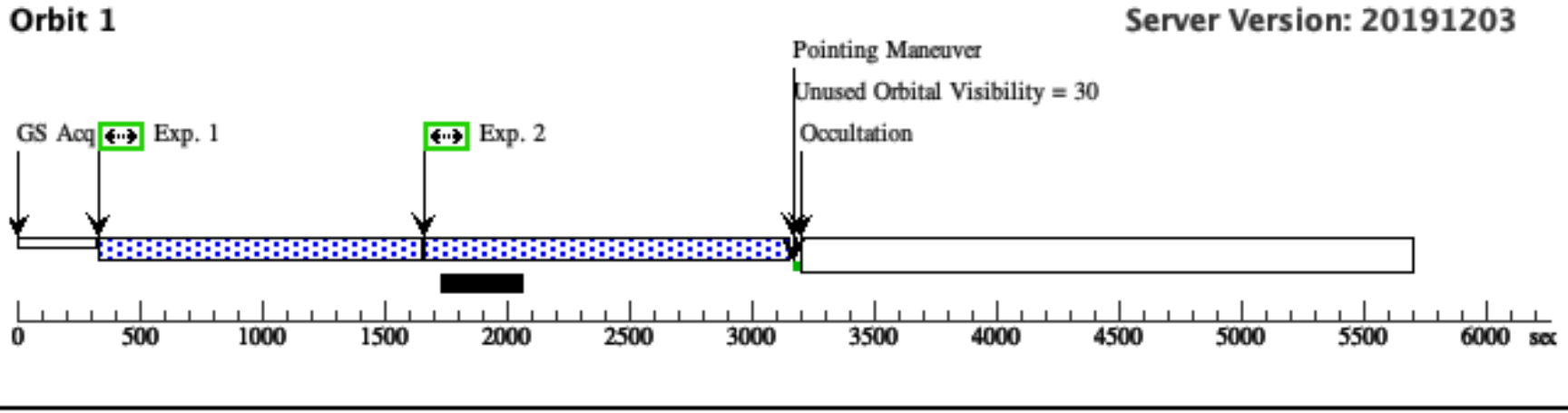
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | J1005+3722 | RA: 10 05 13.5500 (151.3064583d)<br>Dec: +37 22 53.15 (37.38143d)<br>Equinox: J2000 | | V=19 | Reference Frame: ICRS |

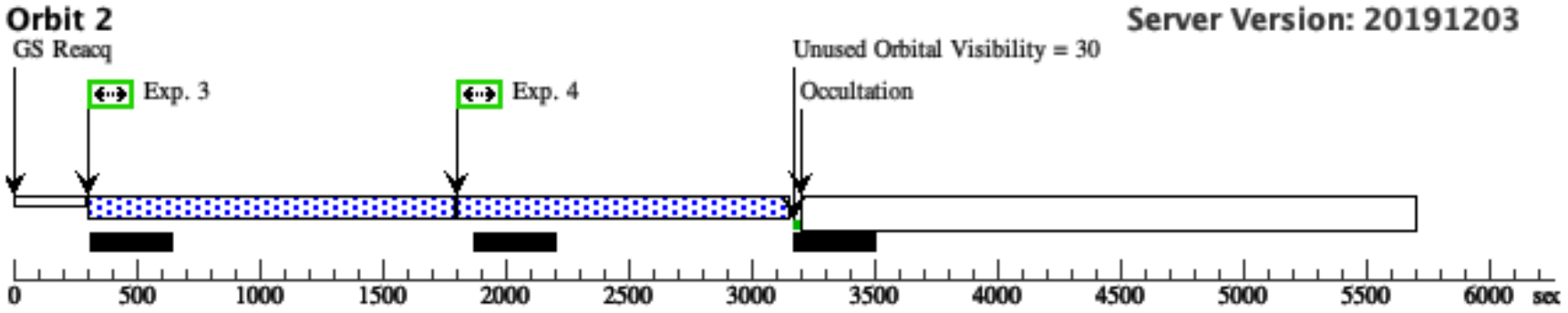
*Comments:*
*Category=GALAXY*
*Description=[AMORPHOUS IRREGULAR, STAR FORMING REGION]*
*Extended=NO*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F606W-3 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.222,0.240 | | 1115 Secs (1115 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 2 | F814W-3 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.222,0.240 | | 1309 Secs (1309 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 3 | F814W-4 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.074,0.154 | | 1368 Secs (1368 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |
| 4 | F606W-4 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.074,0.154 | | 1169 Secs (1169 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |

Orbit Structure



## Visit

**Proposal 16048, Visit 03 (03), implementation** Fri Jan 31 18:01:07 GMT 2020

**Diagnostic Status: No Diagnostics**

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 02 BY 4 H TO 3 D

*Comments: Please avoid scheduling windows in increments of 12 hours after previous visit.*

## Fixed Targets

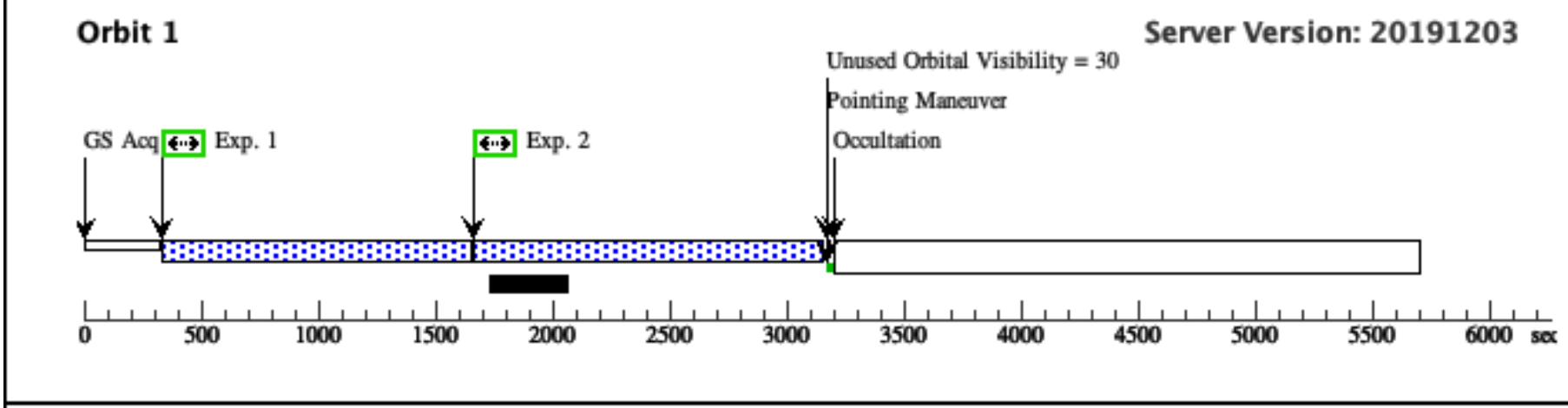
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | J1005+3722 | RA: 10 05 13.5500 (151.3064583d)<br>Dec: +37 22 53.15 (37.38143d)<br>Equinox: J2000 | | V=19 | Reference Frame: ICRS |

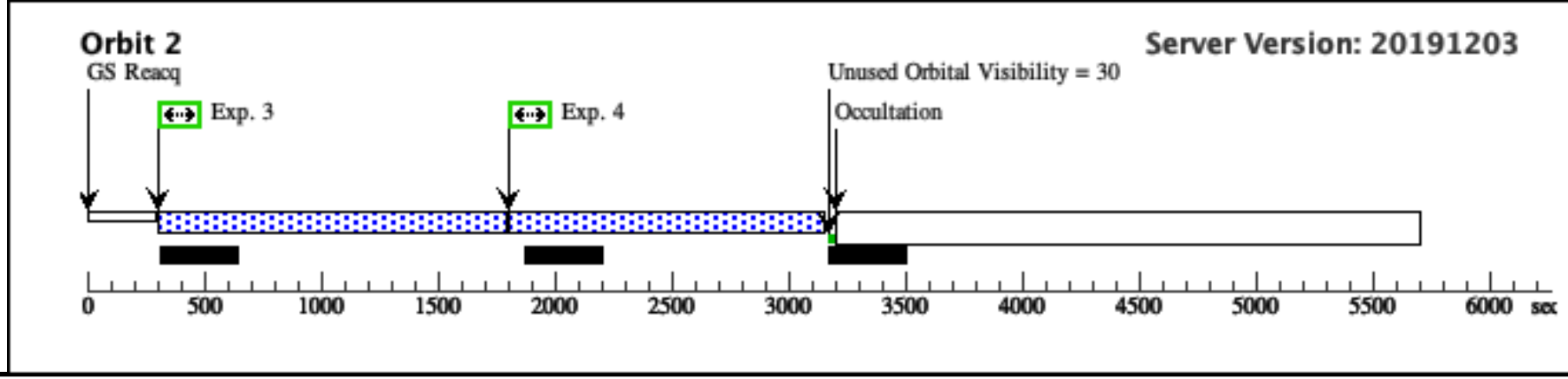
*Comments:*
*Category=GALAXY*
*Description=[AMORPHOUS IRREGULAR, STAR FORMING REGION]*
*Extended=NO*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F606W-5 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.085,0.105 | | 1115 Secs (1115 Secs)<br>*[==>]* | *[1]* |
| 2 | F814W-5 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.085,0.105 | | 1309 Secs (1309 Secs)<br>*[==>]* | *[1]* |
| 3 | F814W-6 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.233,0.191 | | 1368 Secs (1368 Secs)<br>*[==>]* | *[2]* |
| 4 | F606W-6 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.233,0.191 | | 1169 Secs (1169 Secs)<br>*[==>]* | *[2]* |

Orbit Structure



## Visit

**Proposal 16048, Visit 04 (04), implementation** Fri Jan 31 18:01:07 GMT 2020

**Diagnostic Status: No Diagnostics**

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 03 BY 4 H TO 3 D

*Comments: Please avoid scheduling windows in increments of 12 hours after previous visit.*

## Fixed Targets

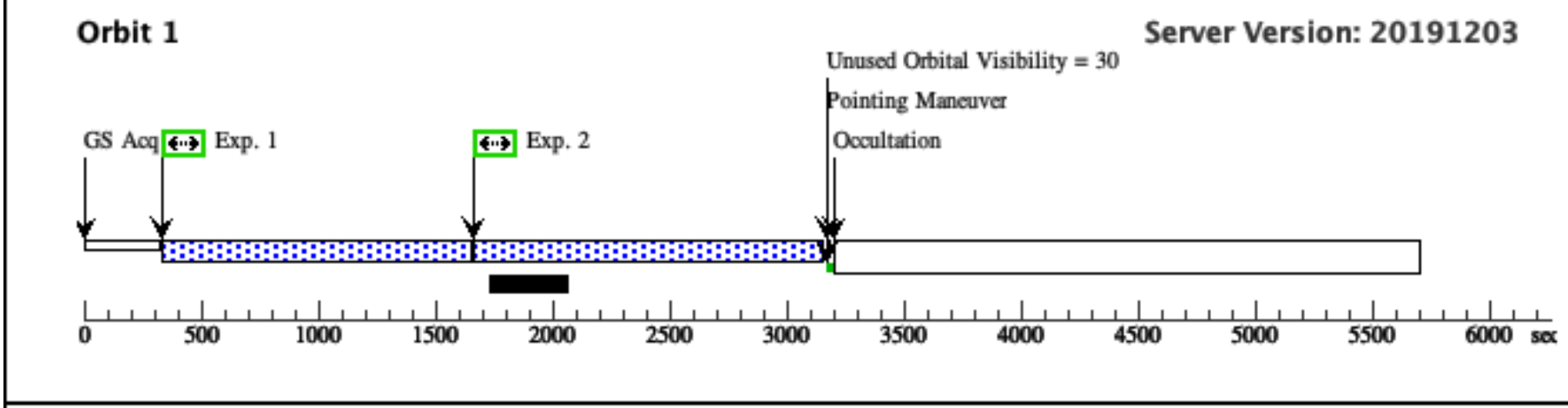
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | J1005+3722 | RA: 10 05 13.5500 (151.3064583d)<br>Dec: +37 22 53.15 (37.38143d)<br>Equinox: J2000 | | V=19 | Reference Frame: ICRS |

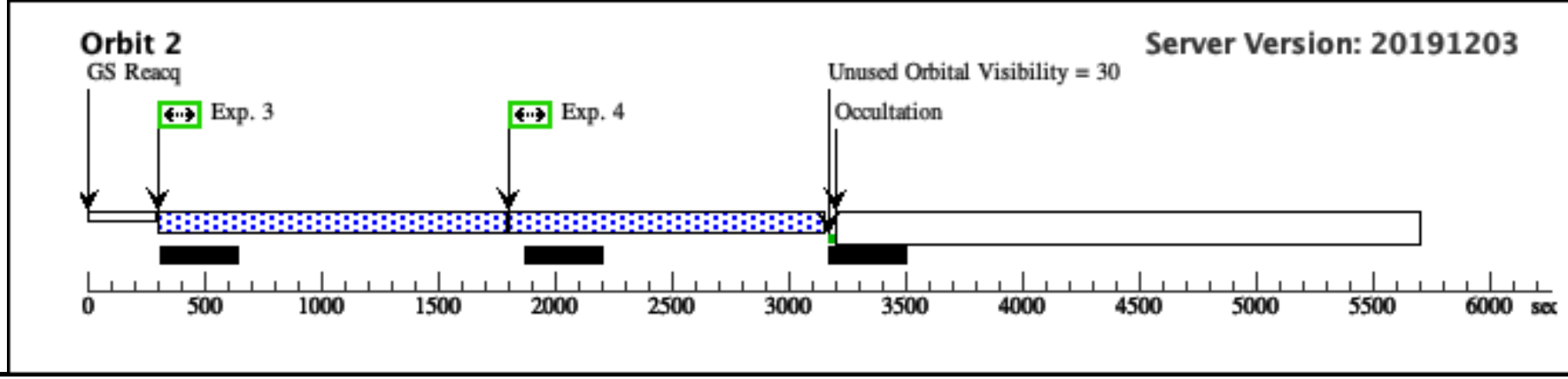
*Comments:*
*Category=GALAXY*
*Description=[AMORPHOUS IRREGULAR, STAR FORMING REGION]*
*Extended=NO*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F606W-7 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.307,0.345 | | 1115 Secs (1115 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 2 | F814W-7 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.307,0.345 | | 1309 Secs (1309 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 3 | F814W-8 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.159,0.259 | | 1368 Secs (1368 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |
| 4 | F606W-8 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.159,0.259 | | 1169 Secs (1169 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |

Orbit Structure



## Visit

**Proposal 16048, Visit 05 (05), implementation** Fri Jan 31 18:01:07 GMT 2020

**Diagnostic Status: No Diagnostics**

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 04 BY 4 H TO 3 D

*Comments: Please avoid scheduling windows in increments of 12 hours after previous visit.*

## Fixed Targets

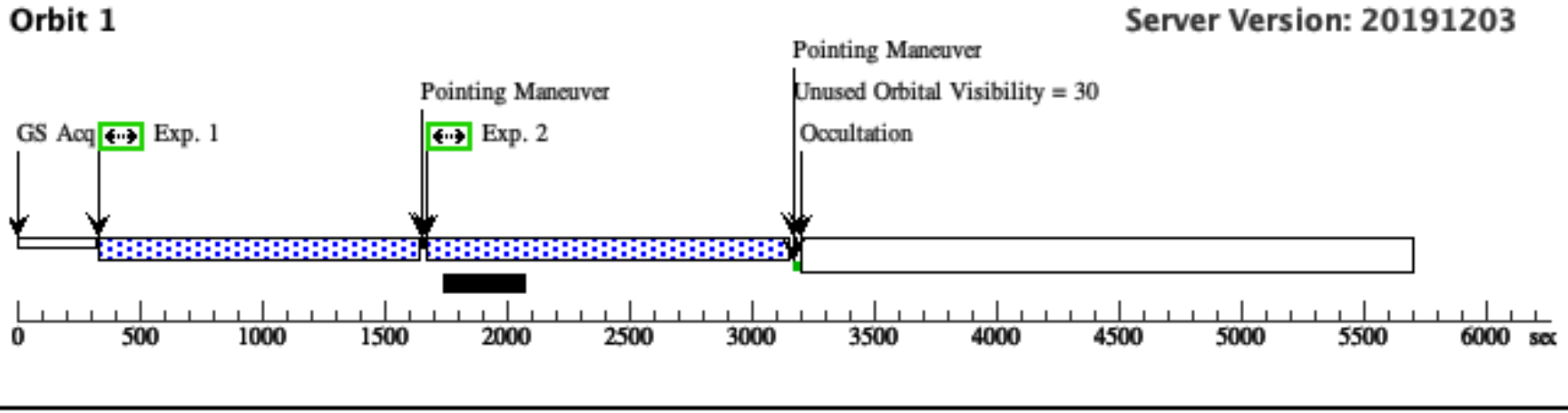
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | J1005+3722 | RA: 10 05 13.5500 (151.3064583d)<br>Dec: +37 22 53.15 (37.38143d)<br>Equinox: J2000 | | V=19 | Reference Frame: ICRS |

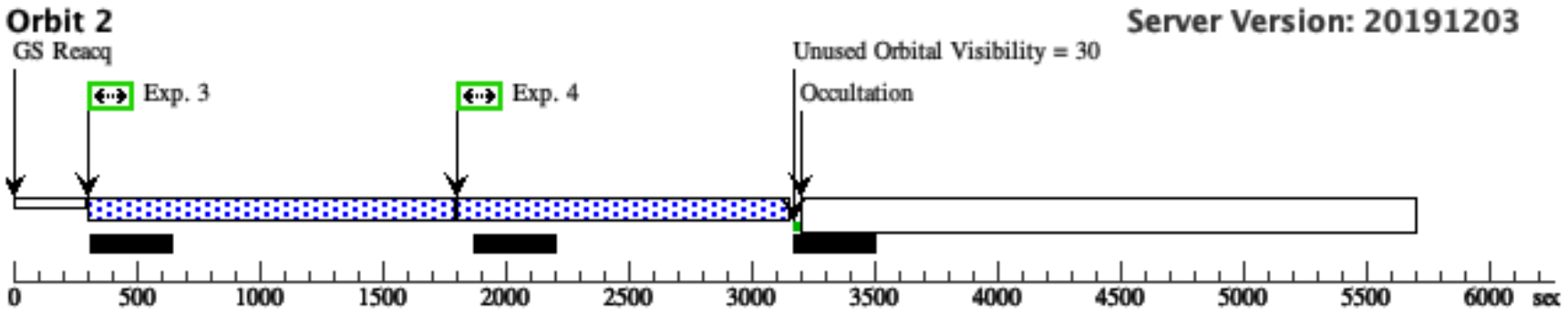
*Comments:*
*Category=GALAXY*
*Description=[AMORPHOUS IRREGULAR, STAR FORMING REGION]*
*Extended=NO*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F606W-9 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.805,0.0 | | 1105 Secs (1105 Secs)<br>*[==>]* | *[1]* |
| 2 | F814W-9 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.085,0.0 | | 1299 Secs (1299 Secs)<br>*[==>]* | *[1]* |
| 3 | F814W-10 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.233,0.086 | | 1368 Secs (1368 Secs)<br>*[==>]* | *[2]* |
| 4 | F606W-10 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.233,0.086 | | 1169 Secs (1169 Secs)<br>*[==>]* | *[2]* |

Orbit Structure



## Visit

**Proposal 16048, Visit 06 (06), implementation** Fri Jan 31 18:01:07 GMT 2020

**Diagnostic Status: No Diagnostics**

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 01; AFTER 05 BY 4 H TO 3 D

*Comments: Please avoid scheduling windows in increments of 12 hours after previous visit.*

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | J1005+3722 | RA: 10 05 13.5500 (151.3064583d)<br>Dec: +37 22 53.15 (37.38143d)<br>Equinox: J2000 | | V=19 | Reference Frame: ICRS |

*Comments:*
*Category=GALAXY*
*Description=[AMORPHOUS IRREGULAR, STAR FORMING REGION]*
*Extended=NO*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F606W-11 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.307,0.240 | | 1115 Secs (1115 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 2 | F814W-11 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.307,0.240 | | 1309 Secs (1309 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 3 | F814W-12 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.159,0.154 | | 1368 Secs (1368 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |
| 4 | F606W-12 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.159,0.154 | | 1169 Secs (1169 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |
| 5 | F606W-13 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F606W | | POS TARG 0.0,0.105 | | 1141 Secs (1141 Secs) | |
| | | | | | | | | *[==>]* | ***[3]*** |
| 6 | F814W-13 | (1) J1005+3722 | ACS/WFC, ACCUM, WFCENTER | F814W | | POS TARG 0.0,0.105 | | 1371 Secs (1371 Secs) | |
| | | | | | | | | *[==>]* | ***[3]*** |

Orbit Structure