# 18106 - Stellar Initial Mass Function and Dark Matter from [OII] and Paschen-alpha Emission Maps Of the Giant Dragon Arc in the Hubble Frontier Fields Galaxy Cluster Abell 370

Cycle: 33, Proposal Category: GO

(Availability Mode: SUPPORTED)

**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 | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS | 6 | 12-Jun-2026 10:00:53.0 | yes |

6 Total Orbits Used

**ABSTRACT**

The ~30 arcsecond Dragon arc at z=0.72 created by the Abell 370 cluster is the most prolific known source of microlensing events of individual stars at a cosmological distance. A total of ~50 stars have been detected across only two ultra-deep UV-optical HST and two shallow JWST visits. Recent work finds that the observed microlensing events may exhibit a broad bias towards the negative-parity side of the critical curve, which holds the promise to distinguish among forms of substructure produced by different dark-matter candidates. Improved constraints on the location of the cluster's critical curve, however, are needed. Furthermore, the microlensing events, if they can be combined with a spatially resolved recent star-formation history, will yield constraints on the upper-end of the initial-mass function (IMF) across the giant arc.

Here we propose to take advantage of a pair of coincidences between the WFC3 UVIS F645N filter and [OII] nebular emission from the Dragon arc at z=0.72, and between the JWST NIRCam F323N filter and Paschen alpha emission. Since nebular emission is not, as a rule, found at the same locations as star-forming clumps visible in broadband images, the proposed data yield a new and independent set of constraints on the path of the critical curve. Pairs of counterimages of HII regions identified by their [OII] / Paschen alpha ratio will precisely bracket the location of the critical curve. Moreover, the fluxes of HII regions should not be affected by stellar microlensing, so we can, for the first time, unambiguously detect the existence of millilensing due to dark-matter subhalos in a cluster.

**OBSERVING DESCRIPTION**

The program will acquire a total of five orbits of WFC3 UVIS F645N narrow-band and a single orbit of WFC3 UVIS F625W observations of the Abell 370 galaxy-cluster field. The WFC3 UVIS F645N narrowband filter will have sensitivity to [OII] 3726, 3729 nebular emission from the Dragon arc at z=0.72. Coordinated JWST NIRCam F323N imaging corresponds to Paschen alpha emission from the arc. After subtracting continuum emission estimated from F625W for the WFC3 UVIS imaging, these will allow which will enable identification of counterimages of HII regions which constrain the location of the critical curve.

For scheduling flexiblity, the total of six orbits are broken into a set of three two-orbit visits. Each visit include four dithered exposures. POS TARGS are used to accomplish dithering across the full set of three visits for F645N.

Visit 2 differs from Visit 1 and Visit 3. The first orbit consists of the four F625W exposures, and the second of four F645N exposures.
For each filter, we use the POS TARG values for the WFC3-UVIS-DITHER-BOX from https://hst-docs.stsci.edu/wfc3ihb/appendix-c-dithering-and-mosaicking/c-2-wfc3-patterns

The FLASH level is set to 17 for the F645N exposures, and FLASH is set to 3 for the F625W exposures.

We use the UVIS1-FIX aperture to target the center of the Dragon Arc so that the arc falls away from the chip gap at all roll angles.

Preferred orient is 85.2, 175.2, 265.2, or 355.2 to match diffraction spike orientation of archival F625W observations for improved subtraction.

Orients are set to be the same for three visits.

## Visit

**Proposal 18106, WFC3 UVIS F625W + F645N (01), implementation** Fri Jun 12 14:00:54 GMT 2026

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

*Comments: preferred orient is 85.2, 175.2, 265.2, or 355.2 to match diffraction spike orientation of archival F625W observations for improved subtraction*

## Fixed Targets

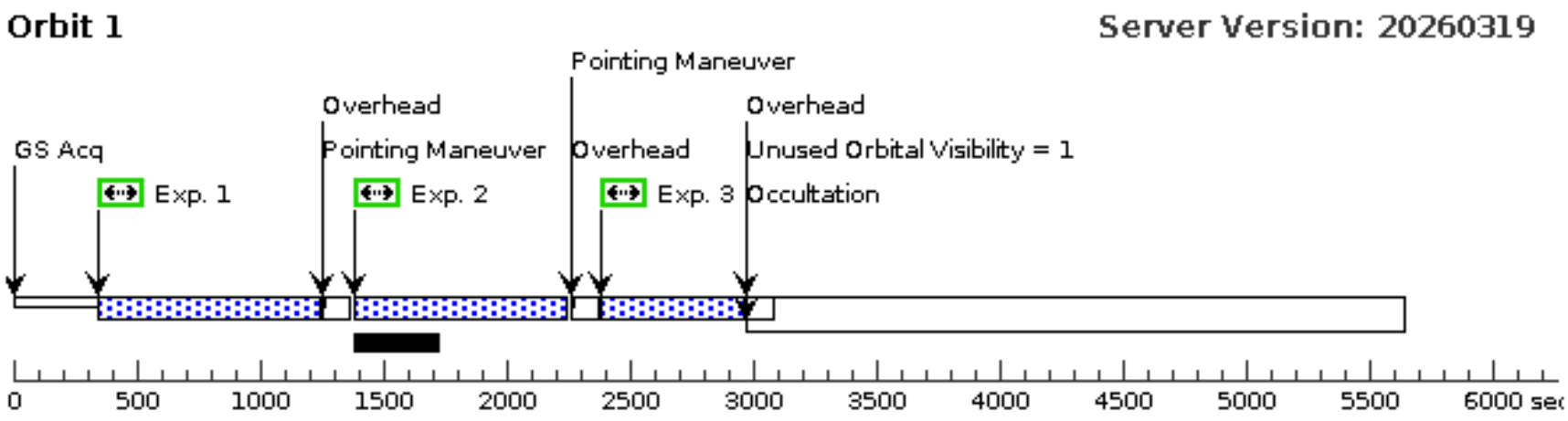
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (3) | ABELL-370-DRAGON-ARC | RA: 02 39 53.0548 (39.9710617d)<br>Dec: -01 35 6.09 (-1.58502d)<br>Equinox: J2000 | Epoch of Position: 2000 | V=27 | Reference Frame: ICRS |

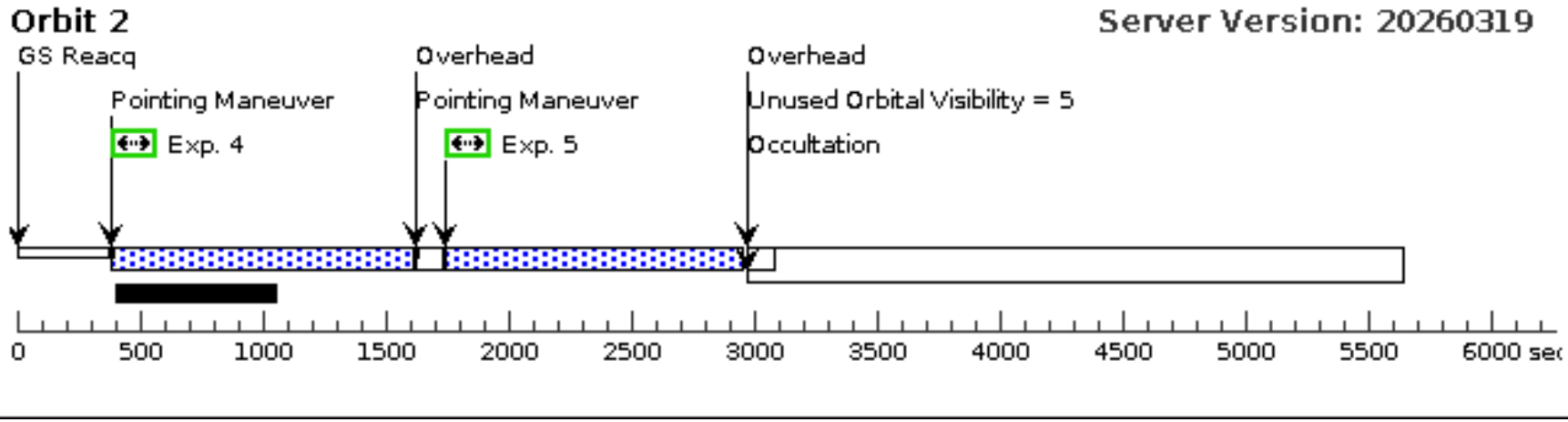
*Comments:*
*Category=CLUSTER OF GALAXIES*
*Description=[GRAVITATIONAL LENS]*

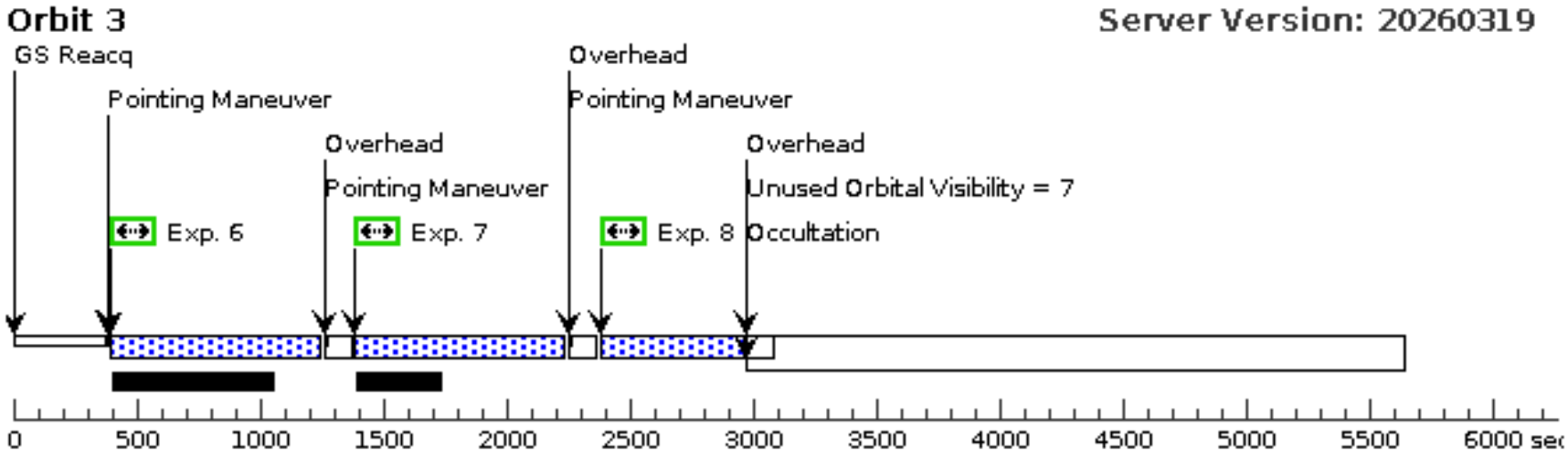
## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0,0 | | 867 Secs (867 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 2 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.158,0.070 | | 867 Secs (867 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 3 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F625W | FLASH=3 | POS TARG 0,0 | | 548 Secs (548 Secs) | |
| | | | | | | | | *[==>]* | ***[1]*** |
| 4 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.099,0.165 | | 1214 Secs (1214 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |
| 5 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG -0.059,0.095 | | 1214 Secs (1214 Secs) | |
| | | | | | | | | *[==>]* | ***[2]*** |
| 6 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.092,0.098 | | 854 Secs (854 Secs) | |
| | | | | | | | | *[==>]* | ***[3]*** |
| 7 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.251,0.169 | | 854 Secs (854 Secs) | |
| | | | | | | | | *[==>]* | ***[3]*** |
| 8 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F625W | FLASH=3 | POS TARG 0.158,0.070 | | 548 Secs (548 Secs) | |
| | | | | | | | | *[==>]* | ***[3]*** |
| 9 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.191,0.263 | | 848 Secs (848 Secs) | |
| | | | | | | | | *[==>]* | ***[4]*** |
| 10 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.033,0.193 | | 848 Secs (848 Secs) | |
| | | | | | | | | *[==>]* | ***[4]*** |
| 11 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F625W | FLASH=3 | POS TARG 0.099,0.165 | | 548 Secs (548 Secs) | |
| | | | | | | | | *[==>]* | ***[4]*** |
| 12 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.185,0.197 | | 1214 Secs (1214 Secs) | |
| | | | | | | | | *[==>]* | ***[5]*** |
| 13 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.343,0.267 | | 1214 Secs (1214 Secs) | |
| | | | | | | | | *[==>]* | ***[5]*** |
| 14 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.284,0.362 | | 847 Secs (847 Secs) | |
| | | | | | | | | *[==>]* | ***[6]*** |
| 15 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F645N | FLASH=17 | POS TARG 0.125,0.292 | | 847 Secs (847 Secs) | |
| | | | | | | | | *[==>]* | ***[6]*** |
| 16 | | (3) ABELL-370-DRAGON-ARC | WFC3/UVIS, ACCUM, UVIS1-FIX | F625W | FLASH=3 | POS TARG -0.059,0.095 | | 548 Secs (548 Secs) | |
| | | | | | | | | *[==>]* | ***[6]*** |

Orbit Structure

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GS Reacq
Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
Unused Orbital Visibility = 7
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Exp. 7
Exp. 8
Occultation
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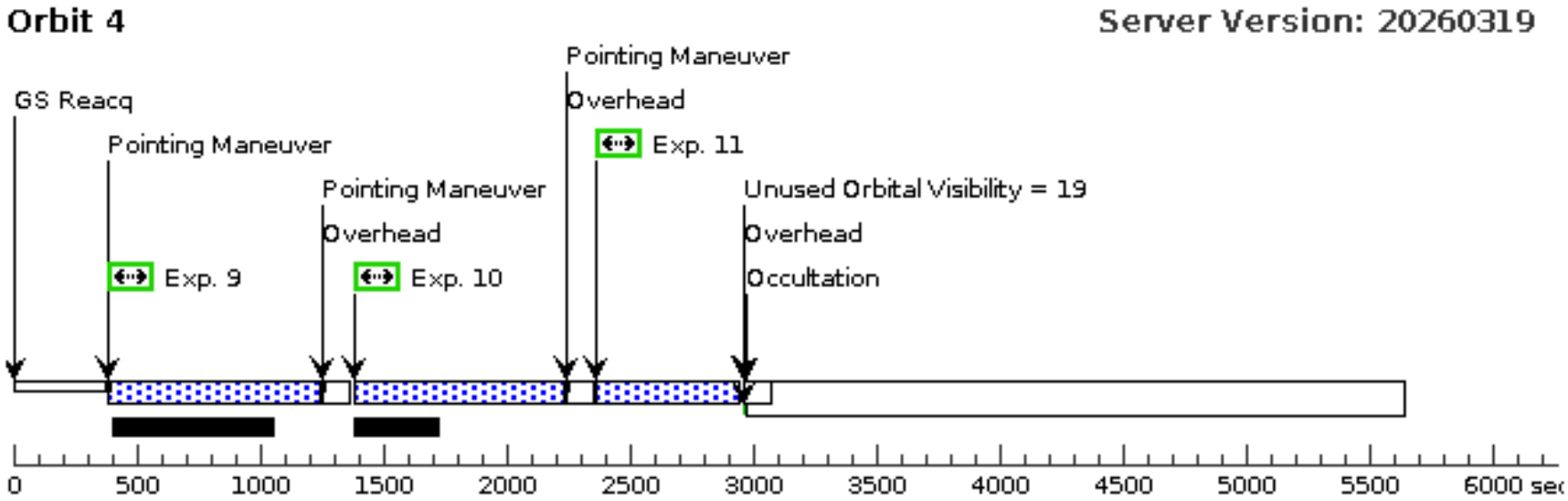
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Pointing Maneuver
GS Reacq
Overhead
Pointing Maneuver
Exp. 11
Pointing Maneuver
Unused Orbital Visibility = 19
Overhead
Overhead
Exp. 9
Exp. 10
Occultation
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5000
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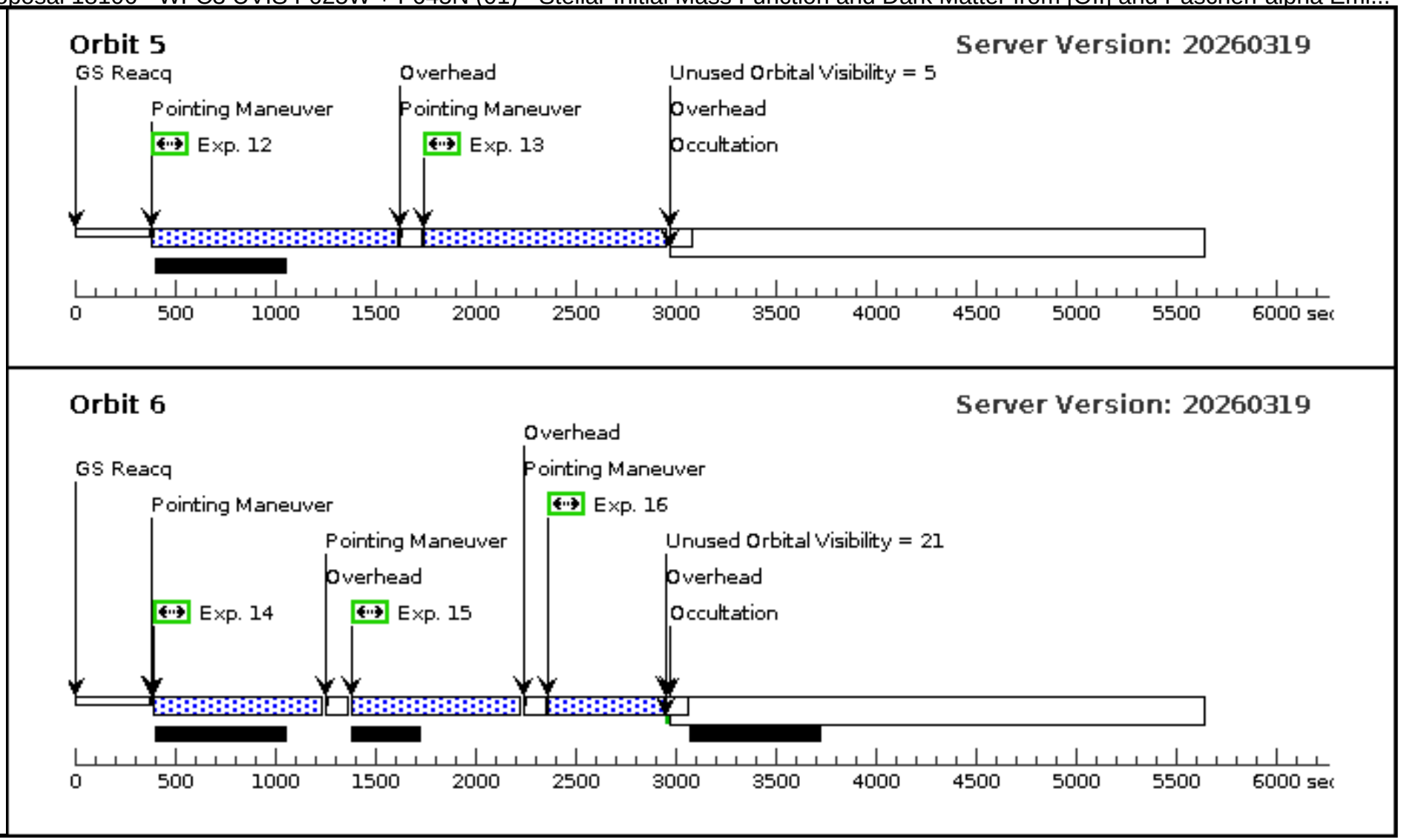
Orbit 5
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GS Reacq
Pointing Maneuver
Exp. 12
Overhead
Pointing Maneuver
Exp. 13
Unused Orbital Visibility = 5
Overhead
Occultation
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6000 sec
Orbit 6
Server Version: 20260319
GS Reacq
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Exp. 14
Pointing Maneuver
Overhead
Exp. 15
Overhead
Pointing Maneuver
Exp. 16
Unused Orbital Visibility = 21
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Occultation
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