



## 16444 - A bright arc behind an extreme cluster lens at $z=1.5$

Cycle: 28, Proposal Category: GO

(JWST Initiative)

(Availability Mode: SUPPORTED)

### INVESTIGATORS

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**VISITS**

| <i>Visit</i> | <i>Targets used in Visit</i> | <i>Configurations used in Visit</i> | <i>Orbits Used</i> | <i>Last Orbit Planner Run</i> | <i>OP Current with Visit?</i> |
|--------------|------------------------------|-------------------------------------|--------------------|-------------------------------|-------------------------------|
| 01           | (1) J2129-0126               | ACS/WFC                             | 2                  | 12-Jan-2021 16:00:21.0        | yes                           |
| 02           | (1) J2129-0126               | WFC3/IR                             | 1                  | 12-Jan-2021 16:00:22.0        | yes                           |

3 Total Orbits Used

**ABSTRACT**

In August 2020 we obtained spectroscopic confirmation of a gravitationally lensed arc at  $z=3.29$  which is exceptionally bright. At its redshift, or higher, it is the brightest arc known. The galaxy cluster responsible for the lensing is also extraordinary: The cluster redshift is  $z=1.5$  and the arc is seen at a large angular radius of 18", more extreme than any previously known cluster lens at these redshifts. The bright lensed source with a spectroscopically measured redshift provides a unique opportunity to use strong lensing to accurately constrain a cluster mass distribution at an early epoch where such measurements have previously not been possible. Through a modest investment of 3 HST orbits, this programme will both produce significant results on its own and be timely preparation for future observations of an extraordinary lensed source and lensing cluster in the coming JWST era.

**OBSERVING DESCRIPTION**

This program consists of 3 orbits of broad-band imaging.

Visit 1: ACS/WFC imaging. This is programmed as a 2-orbit visit, with one orbit in each of the F814W and F606W filters. A total of 4 frames are taken per filter, dithering along a line with a gap-crossing dither step for each additional frame. For both filters, the POS TARG option is used to implement an initial 10" offset. The purpose of this offset is to move the cluster center (which coincides with the provided J2000 target coordinates) somewhat closer to the center of the full WFC field, while still avoiding the part of the chip most affected by CTE effects. This offset is small enough that the bright lensed arc (18" from the cluster center) will still be on the same ACS chip as the cluster center for any ORIENT value.

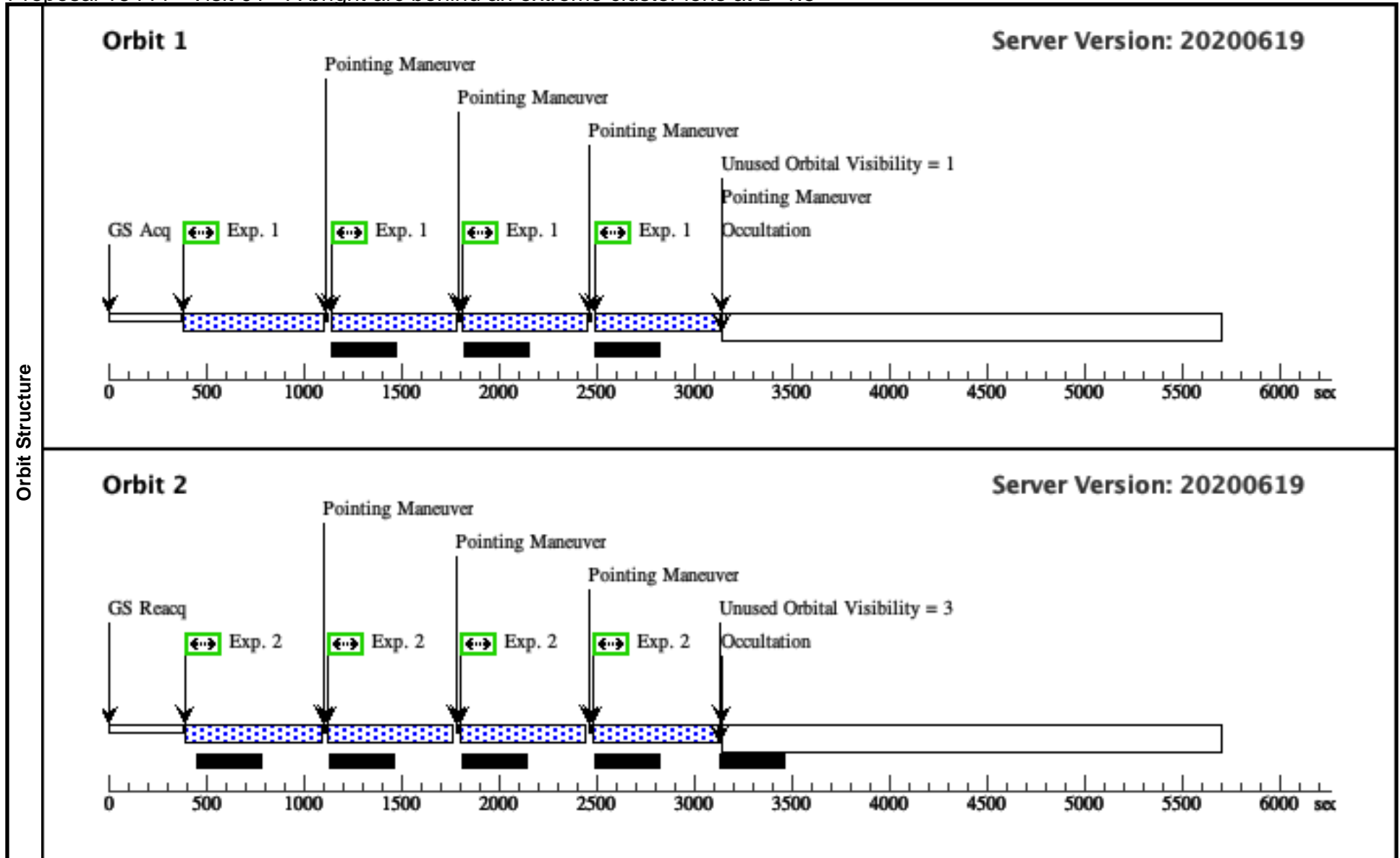
Visit 2: WFC3/IR imaging. This single-orbit visit is dedicated to WFC3-IR imaging in two filters, F125W and F160W, following the strategy of similar observations in program 15101. A total of 8 exposures are made - 4 per filter with small box dithers for PSF reconstruction. The pointing is centered on the cluster center.

Possible impact of potential reduced gyro operations: We do not require a specific roll angle for these observations. Also, the roll angles for the two separate visits need not be the same. This should maximise the schedulability of the observations, even for the case where the observing windows could become limited by reduced gyro mode. The impact of a reduced gyro mode on limiting the spatial scan speed should also not have a significant impact on our fixed target observations.

Proposal 16444 - Visit 01 - A bright arc behind an extreme cluster lens at z=1.5

Tue Jan 12 21:00:23 GMT 2021

| Visit         | <b>Proposal 16444, Visit 01, implementation</b><br><b>Diagnostic Status: No Diagnostics</b><br>Scientific Instruments: ACS/WFC<br>Special Requirements: (none) |  |  |                          |  |                       |                |                                     |  |       |
|---------------|--|--|--|--------------------------|--|-----------------------|----------------|-------------------------------------|--|-------|
|               | Patterns   | #  | Primary Pattern  | Secondary Pattern        | Exposures                              |                       |                |                                     |  |       |
|               | (1)  | Pattern Type=ACS-WFC-DITHER-LINE<br>Purpose=DITHER<br>Number Of Points=4<br>Point Spacing=3.034<br>Line Spacing= | Coordinate Frame=POS-TARG<br>Pattern Orientation=85.29<br>Angle Between Sides=<br>Center Pattern=false |                          | (1), (2)                               |                       |                |                                     |  |       |
| Fixed Targets | #  | Name   | Target Coordinates   | Targ. Coord. Corrections | Fluxes                                 | Miscellaneous         |                |                                     |  |       |
|               | (1)  | J2129-0126   | RA: 21 29 9.0400 (322.2876667d)<br>Dec: -01 26 32.10 (-1.44225d)<br>Equinox: J2000                     |                          | V=21.1<br>g=22.1,<br>r=21.1,<br>z=20.3 | Reference Frame: ICRS |                |                                     |  |       |
|               | <i>Comments:</i><br>Category=CLUSTER OF GALAXIES<br>Description=[GRAVITATIONAL LENS, HIGH REDSHIFT CLUSTER]  |  |  |                          |  |                       |                |                                     |  |       |
| Exposures     | #  | Label  | Target   | Config,Mode,Aperture     | Spectral Els.                          | Opt. Params.          | Special Reqs.  | Groups                              | Exp. Time (Total)/[Actual Dur.]  | Orbit |
|               | 1  |  | (1) J2129-0126   | ACS/WFC, ACCUM, WFC1-FIX | F606W                                  |                       | POS TARG 0,-10 | Pattern 1, Exps 1-1 in Visit 01 (1) | 513 Secs (2052 Secs)<br>[==>513 Secs (Pattern 1)]<br>[==>513 Secs (Pattern 2)]<br>[==>513 Secs (Pattern 3)]<br>[==>513 Secs (Pattern 4)]         | [1]   |
|               | 2  |  | (1) J2129-0126   | ACS/WFC, ACCUM, WFC1-FIX | F814W                                  |                       | POS TARG 0,-10 | Pattern 1, Exps 2-2 in Visit 01 (1) | 513 Secs (2068 Secs)<br>[==>517.0 Secs (Pattern 1)]<br>[==>517.0 Secs (Pattern 2)]<br>[==>517.0 Secs (Pattern 3)]<br>[==>517.0 Secs (Pattern 4)] | [2]   |



Proposal 16444 - Visit 02 - A bright arc behind an extreme cluster lens at z=1.5

Tue Jan 12 21:00:23 GMT 2021

| Visit         | <b>Proposal 16444, Visit 02, implementation</b><br><b>Diagnostic Status: No Diagnostics</b><br>Scientific Instruments: WFC3/IR<br>Special Requirements: (none) |  |   |                             |  |                                   |                                     |                                     |  |       |
|---------------|--|--|---|-----------------------------|--|-----------------------------------|-------------------------------------|-------------------------------------|--|-------|
|               | Patterns   | #  | Primary Pattern   | Secondary Pattern           | Exposures                              |                                   |                                     |                                     |  |       |
|               | (3)  | Pattern Type=WFC3-IR-DITHER-BOX-MIN<br>Purpose=DITHER<br>Number Of Points=4<br>Point Spacing=0.572<br>Line Spacing=0.365 | Coordinate Frame=POS-TARG<br>Pattern Orientation=18.528<br>Angle Between Sides=74.653<br>Center Pattern=false |                             | (1), (2)                               |                                   |                                     |                                     |  |       |
| Fixed Targets | #  | Name   | Target Coordinates  | Targ. Coord. Corrections    | Fluxes                                 | Miscellaneous                     |                                     |                                     |  |       |
|               | (1)  | J2129-0126   | RA: 21 29 9.0400 (322.2876667d)<br>Dec: -01 26 32.10 (-1.44225d)<br>Equinox: J2000                            |                             | V=21.1<br>g=22.1,<br>r=21.1,<br>z=20.3 | Reference Frame: ICRS             |                                     |                                     |  |       |
|               | <i>Comments:</i><br>Category=CLUSTER OF GALAXIES<br>Description=[GRAVITATIONAL LENS, HIGH REDSHIFT CLUSTER]  |  |   |                             |  |                                   |                                     |                                     |  |       |
| Exposures     | #  | Label  | Target  | Config,Mode,Aperture        | Spectral Els.                          | Opt. Params.                      | Special Reqs.                       | Groups                              | Exp. Time (Total)/[Actual Dur.]  | Orbit |
|               | 1  |  | (1) J2129-0126  | WFC3/IR, MULTIACCUM, IR-FIX | F125W                                  | NSAMP=12;<br>SAMP-SEQ=SPAR<br>S25 | POS TARG 0,0                        | Pattern 3, Exps 1-1 in Visit 02 (3) | 277.937956 Secs (1111.752 Secs)  | [1]   |
|               |  |  |   |                             |  |                                   |                                     |                                     | [==>(Pattern 1)]<br>[==>(Pattern 2)]<br>[==>(Pattern 3)]<br>[==>(Pattern 4)] |       |
| 2             |  | (1) J2129-0126   | WFC3/IR, MULTIACCUM, IR-FIX   | F160W                       | NSAMP=12;<br>SAMP-SEQ=SPAR<br>S25      | POS TARG 0,0                      | Pattern 3, Exps 2-2 in Visit 02 (3) | 277.937956 Secs (1111.752 Secs)     | [1]  |       |
|               |  |  |   |                             |  |                                   |                                     |                                     | [==>(Pattern 1)]<br>[==>(Pattern 2)]<br>[==>(Pattern 3)]<br>[==>(Pattern 4)] |       |

