# 13408 - Constraining the Physical Properties of LBV Nebulae in the Galactic Center Environment

Cycle: 21, Proposal Category: GO

(Availability Mode: SUPPORTED)


**INVESTIGATORS**

| *Name* | *Institution* | *E-Mail* |
|---|---|---|
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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) PISTOL | WFC3/IR | 1 | 14-Aug-2013 22:02:19.0 | yes |
| 02 | (2) G0.120-0.048 | WFC3/IR | 1 | 14-Aug-2013 22:02:30.0 | yes |
| 03 | (3) WR102KA | WFC3/IR | 4 | 14-Aug-2013 22:03:05.0 | yes |

6 Total Orbits Used


**ABSTRACT**

The Galactic center (GC) is the most extreme site of massive star formation in the Galaxy, owing to the unusually dense reservoir of molecular gas that comprises the central ~500 pc. As a result, the region contains several massive starburst clusters and largest known concentration of ultra-rare luminous blue variable (LBV) stars, unstable hot supergiants experiencing super-Eddington eruptions that hurl massive nebulae into space and deliver copious amounts of mechanical energy to the ISM. Of particular interest, there are several extraordinary hot supergiants in the GC whose massive expanding LBV nebulae afford us the opportunity to study the evolution of such structures in the unique GC environment, where the dense ISM, extreme UV field, and ferocious ambient stellar winds are expected to have significant influence over the morphological evolution of LBV

mass ejections. We propose to diagnose the physical properties of known LBV nebulae in the GC by measuring the morphology and mass of their warm gas component and its physical relation to the photo-ionized component. To achieve this, we will perform WFC3 narrowband imaging of collisionally-ionized [FeII] emission and photo-ionized HI (Paschen-beta). The imaging will be supplemented with ground-based spectroscopy, which will provide the chemical and kinematical information neccessary to derive the physical properties of the nebulae from the WFC3 images.

**OBSERVING DESCRIPTION**

We will be obtaining narrowband images of three emission-line nebulae in the Galactic center region with WFC3/IR in the F164N (FeII line) and F167N (continuum) filters. The targets are named 'Pistol', 'G0.120-0.048', and 'WR102ka'. Images in the F128N (Paschen-beta line) and F130N (continuum) filters will also be obtained for WR102ka only.

The stellar fields in the Galactic center are extremely crowded. Our goal is to subtract off stellar continuum images from the emission-line images so that the nebulae can be isolated from the crowded field stars and studied in detail.

Each target will be observed using the WFC3-IR-DITHER-LINE-3PT pattern. The dither pattern provides ample improvement of the PSF for our purposes, and allows for effective removal of hot pixels and cosmic rays. The MULTIACCUM STEP50/NSAMP=13 exposure parameters will be used for the F164N/F167N imaging, which achieves our required signal-to-noise and allows the dither sequences to pack neatly into 1 orbit for each object; for the F128N/F130N images of WR102ka, we will use STEP200/NSAMP=14 for the same reasons.

For the Pistol and G0.120-0.048 fields, both of which contain multiple targets of interest, we require specific roll angles (between 255 and 271 deg) in order to include all sources of interest in the image frame. There is no roll angle restriction for WR 102ka.

Fine guidance is a firm requirement, so multiple guide stars should be selected carefully (make sure the stars are single).

## Visit

**Proposal 13408, Pistol-F164N-F167N (01), implementation** Thu Aug 15 02:03:19 GMT 2013

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR

Special Requirements: PCS MODE FINE; ORIENT 255D TO 271 D

## 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) |

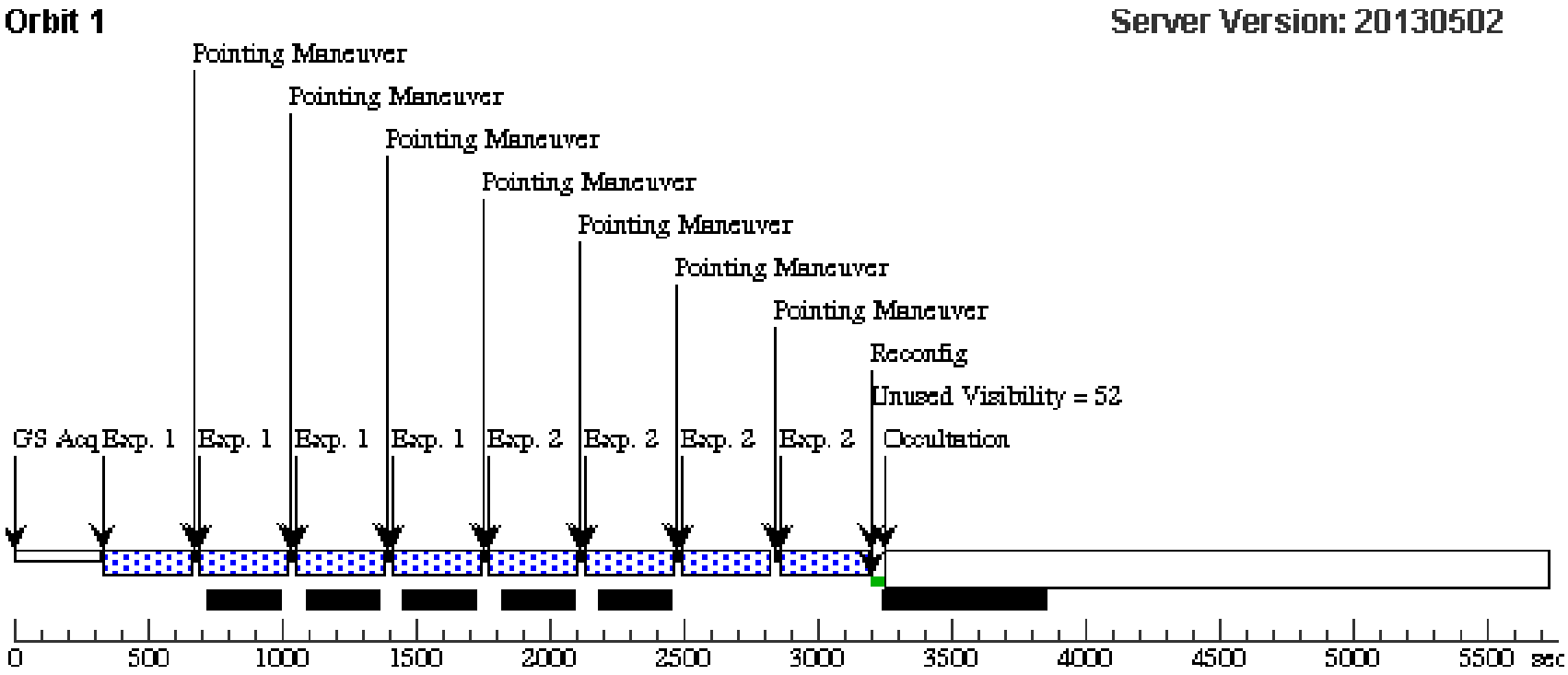
## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | PISTOL | RA: 17 46 15.0220 (266.5625917d)<br>Dec: -28 49 20.41 (-28.82234d)<br>Equinox: J2000 | | V=30+/-5<br>K=7.3 | Reference Frame: ICRS |

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | (1) PISTOL | WFC3/IR, MULTIACCUM, IR-FIX | F164N | NSAMP=11;<br>SAMP-SEQ=STEP50 | | Pattern 3, Exps 1-1 in Pistol-F164N-F167N (01) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[1]*** |
| 2 | | (1) PISTOL | WFC3/IR, MULTIACCUM, IR-FIX | F167N | NSAMP=11;<br>SAMP-SEQ=STEP50 | | Pattern 3, Exps 2-2 in Pistol-F164N-F167N (01) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[1]*** |

Orbit Structure



## Visit

**Proposal 13408, G0.120-0.048-F164N-F167N (02), implementation** Thu Aug 15 02:03:21 GMT 2013

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR

Special Requirements: PCS MODE FINE; ORIENT 255D TO 271 D

## Patterns

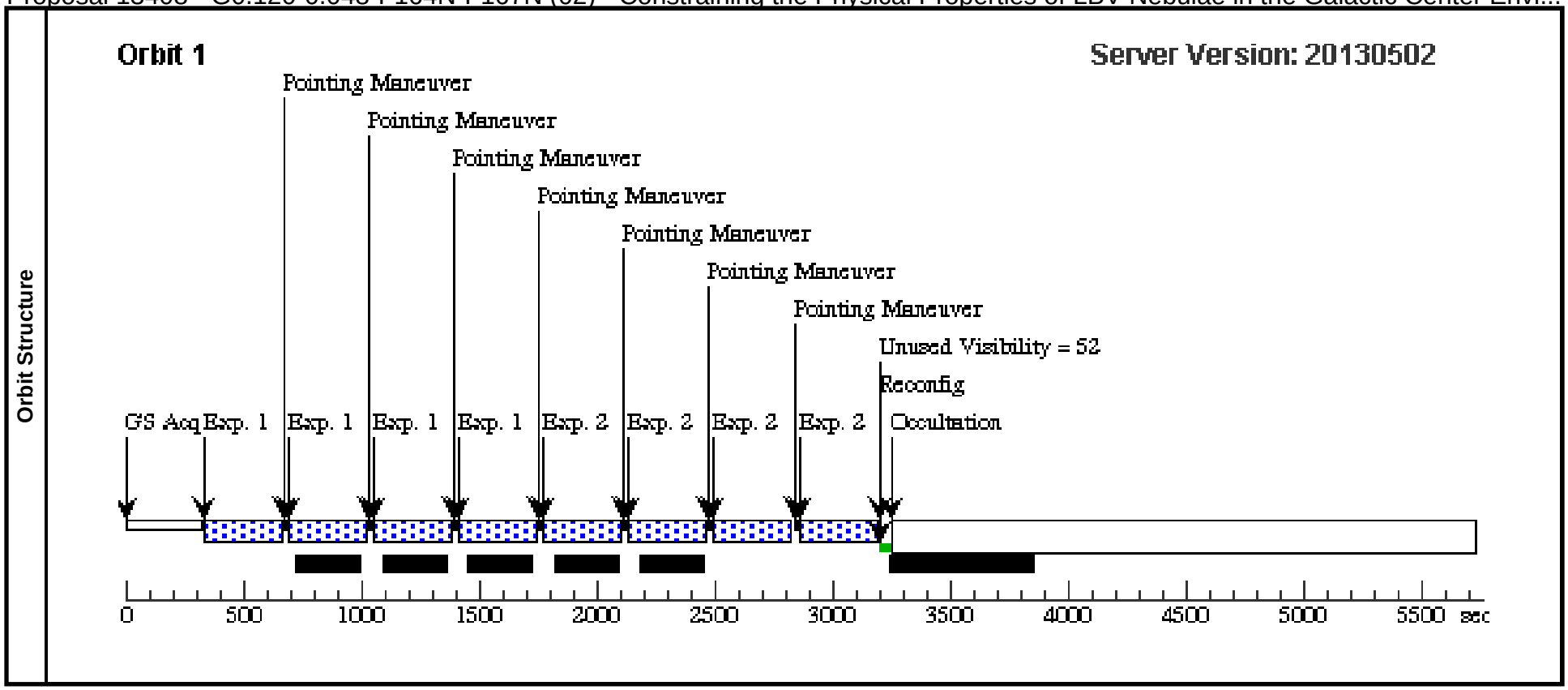
| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (3) | Pattern Type=WFC3-IR-DITHER-BOX-MIN<br>Purpose=DITHER<br>Number Of Points=4<br>Point Spacing=0.572<br>Line Spacing=0.365 | Coordinate Frame=POS-TARG<br>Pattern Orientation=18.528<br>Angle Between Sides=74.653<br>Center Pattern=false | | (1), (2) |

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (2) | G0.120-0.048 | RA: 17 46 5.7860 (266.5241083d)<br>Dec: -28 51 25.66 (-28.85713d)<br>Equinox: J2000 | | V=30+/-5<br>K=9.5 | Reference Frame: ICRS |

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | (2) G0.120-0.048 | WFC3/IR, MULTIACCUM, IR-FIX | F164N | NSAMP=11;<br>SAMP-SEQ=STEP50 | | Pattern 3, Exps 1-1 in G0.120-0.048-F164N-F167N (02) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[1]*** |
| 2 | | (2) G0.120-0.048 | WFC3/IR, MULTIACCUM, IR-FIX | F167N | NSAMP=11;<br>SAMP-SEQ=STEP50 | | Pattern 3, Exps 2-2 in G0.120-0.048-F164N-F167N (02) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[1]*** |


Orbit Structure
Orbit 1
Server Version: 20130502
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
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Pointing Maneuver
Unused Visibility = 52
Reconfig
GS Acq
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Exp. 2
Exp. 2
Exp. 2
Exp. 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

## Visit

**Proposal 13408, WR102ka-F164N-F167N-F128N-F130N (03), implementation** Thu Aug 15 02:03:22 GMT 2013

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR

Special Requirements: PCS MODE FINE

## 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), (5-6) |
| (4) | Pattern Type=WFC3-IR-DITHER-BLOB<br>Purpose=DITHER<br>Number Of Points=2<br>Point Spacing=5.183<br>Line Spacing= | Coordinate Frame=POS-TARG<br>Pattern Orientation=41.859<br>Angle Between Sides=<br>Center Pattern=true | 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 | (3), (4) |

## Fixed Targets

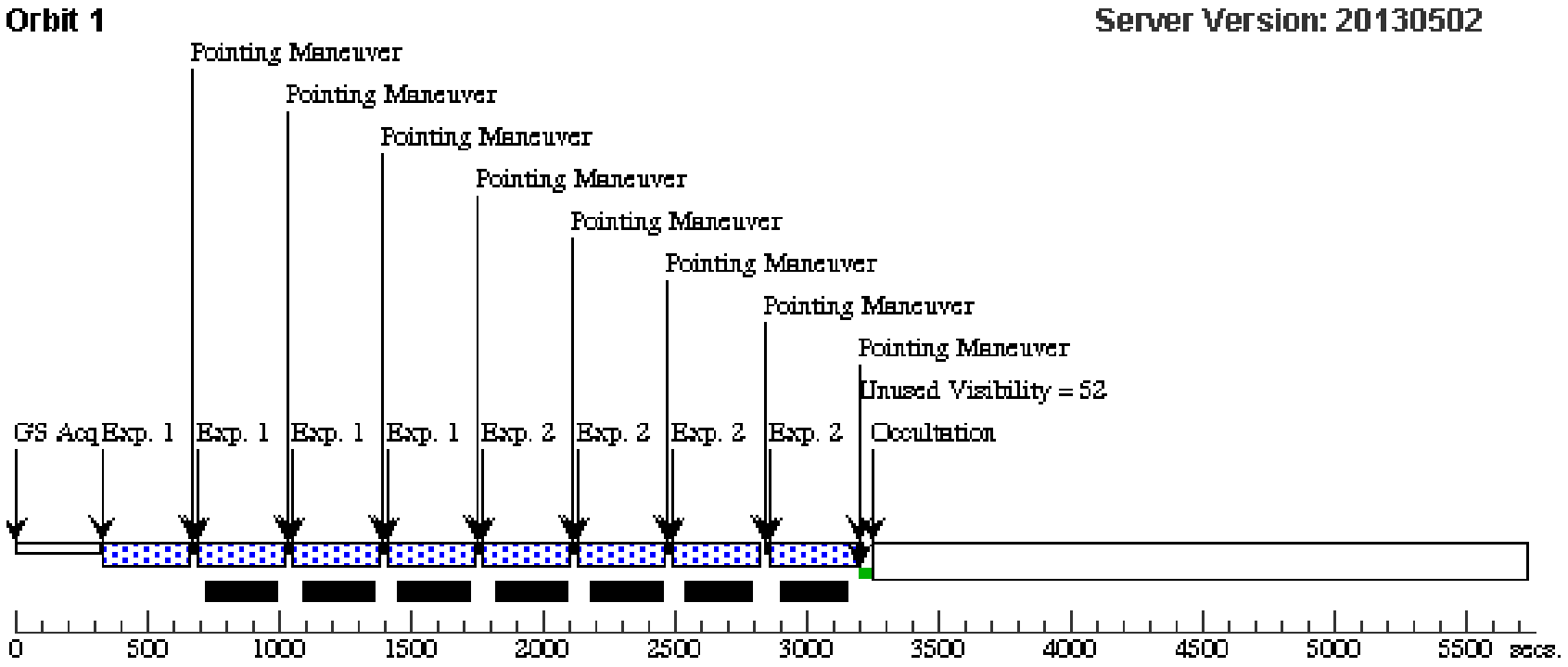
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (3) | WR102KA | RA: 17 46 18.1200 (266.5755000d)<br>Dec: -29 01 36.60 (-29.02683d)<br>Equinox: J2000 | | V=30+/-5<br>K=8.8 | Reference Frame: ICRS |

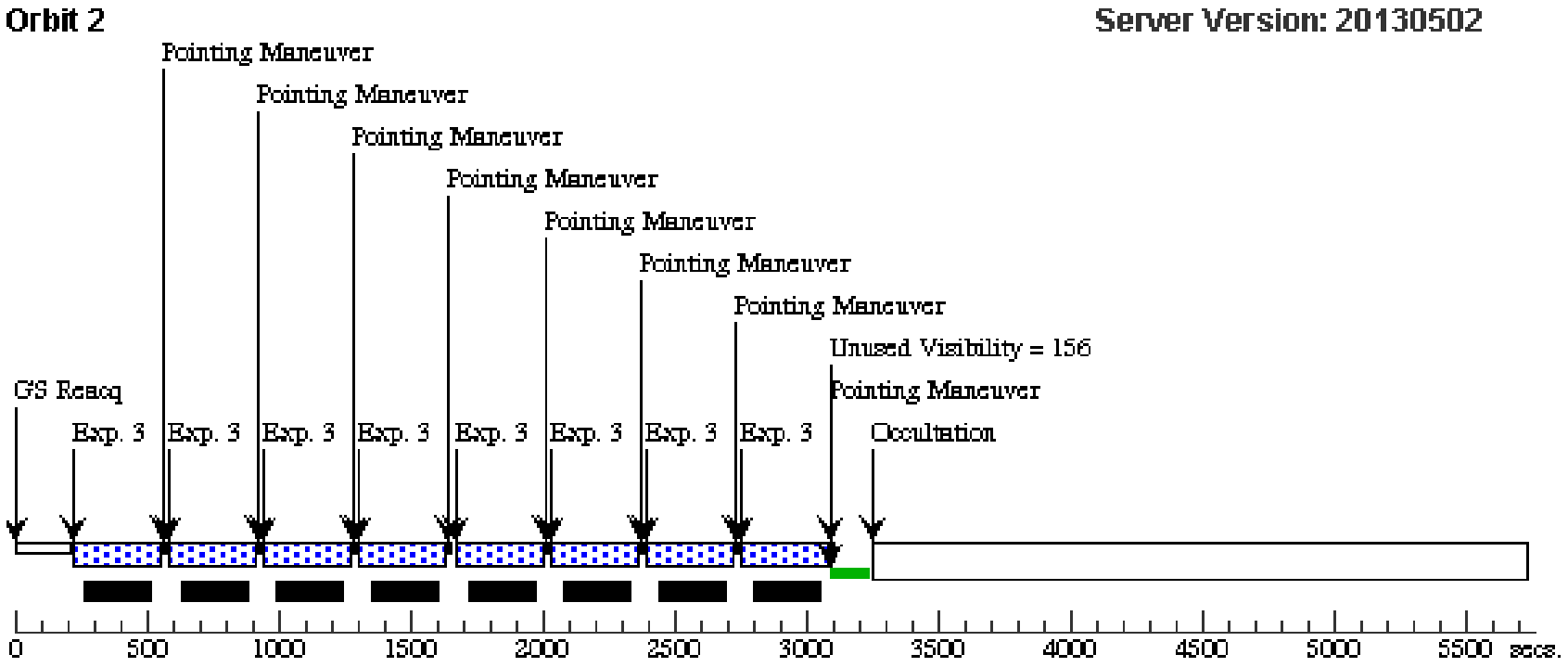
*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*

**Exposures**

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | (3) WR102KA | WFC3/IR, MULTIACCUM, IR-FIX | F164N | NSAMP=11; SAMP-SEQ=STEP50 | | Pattern 3, Exps 1-1 in WR102ka-F164N-F167N-F128N-F130N (03) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[1]*** |
| 2 | | (3) WR102KA | WFC3/IR, MULTIACCUM, IR-FIX | F167N | NSAMP=11; SAMP-SEQ=STEP50 | | Pattern 3, Exps 2-2 in WR102ka-F164N-F167N-F128N-F130N (03) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[1]*** |
| 3 | | (3) WR102KA | WFC3/IR, MULTIACCUM, IR-FIX | F128N | NSAMP=11; SAMP-SEQ=STEP50 | | Pattern 4, Exps 3-3 in WR102ka-F164N-F167N-F128N-F130N (03) (4) | 299.232481 Secs (2393.86 Secs)<br>*[==>(Pattern 1,1)]*<br>*[==>(Pattern 1,2)]*<br>*[==>(Pattern 1,3)]*<br>*[==>(Pattern 1,4)]*<br>*[==>(Pattern 2,1)]*<br>*[==>(Pattern 2,2)]*<br>*[==>(Pattern 2,3)]*<br>*[==>(Pattern 2,4)]* | ***[2]*** |
| 4 | | (3) WR102KA | WFC3/IR, MULTIACCUM, IR-FIX | F130N | NSAMP=11; SAMP-SEQ=STEP50 | | Pattern 4, Exps 4-4 in WR102ka-F164N-F167N-F128N-F130N (03) (4) | 299.232481 Secs (2393.86 Secs)<br>*[==>(Pattern 1,1)]*<br>*[==>(Pattern 1,2)]*<br>*[==>(Pattern 1,3)]*<br>*[==>(Pattern 1,4)]*<br>*[==>(Pattern 2,1)]*<br>*[==>(Pattern 2,2)]*<br>*[==>(Pattern 2,3)]*<br>*[==>(Pattern 2,4)]* | ***[3]*** |
| 5 | | (3) WR102KA | WFC3/IR, MULTIACCUM, IR-FIX | F128N | SAMP-SEQ=STEP50; NSAMP=11 | | Pattern 3, Exps 5-6 in WR102ka-F164N-F167N-F128N-F130N (03) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[4]*** |
| 6 | | (3) WR102KA | WFC3/IR, MULTIACCUM, IR-FIX | F130N | SAMP-SEQ=STEP50; NSAMP=11 | | Pattern 3, Exps 5-6 in WR102ka-F164N-F167N-F128N-F130N (03) (3) | 299.232481 Secs (1196.93 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[4]*** |

Orbit Structure




Orbit 2
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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
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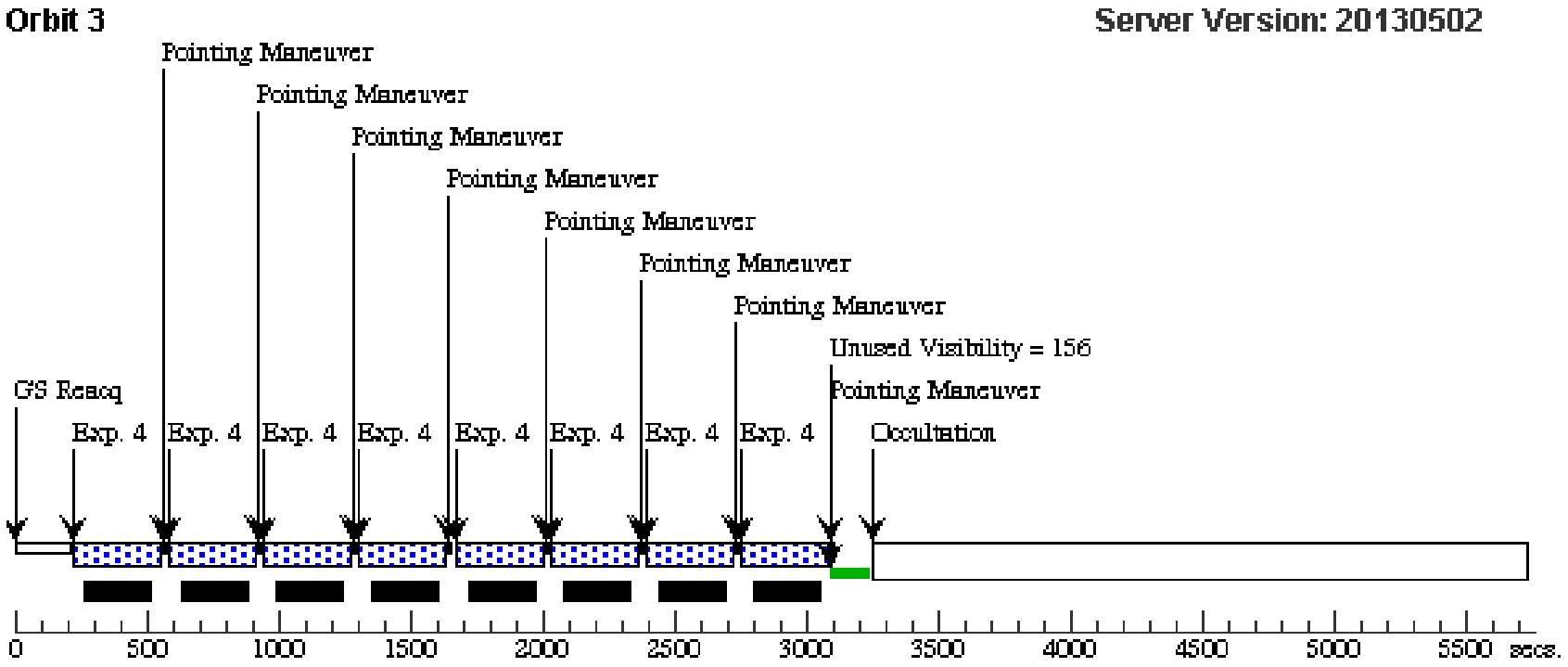
Pointing Maneuver
Unused Visibility = 156
Pointing Maneuver
GS Reacq
Exp. 3
Exp. 3
Exp. 3
Exp. 3
Exp. 3
Exp. 3
Exp. 3
Exp. 3
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 3
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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 156
Pointing Maneuver
GS Reacq
Exp. 4
Exp. 4
Exp. 4
Exp. 4
Exp. 4
Exp. 4
Exp. 4
Exp. 4
Occultation
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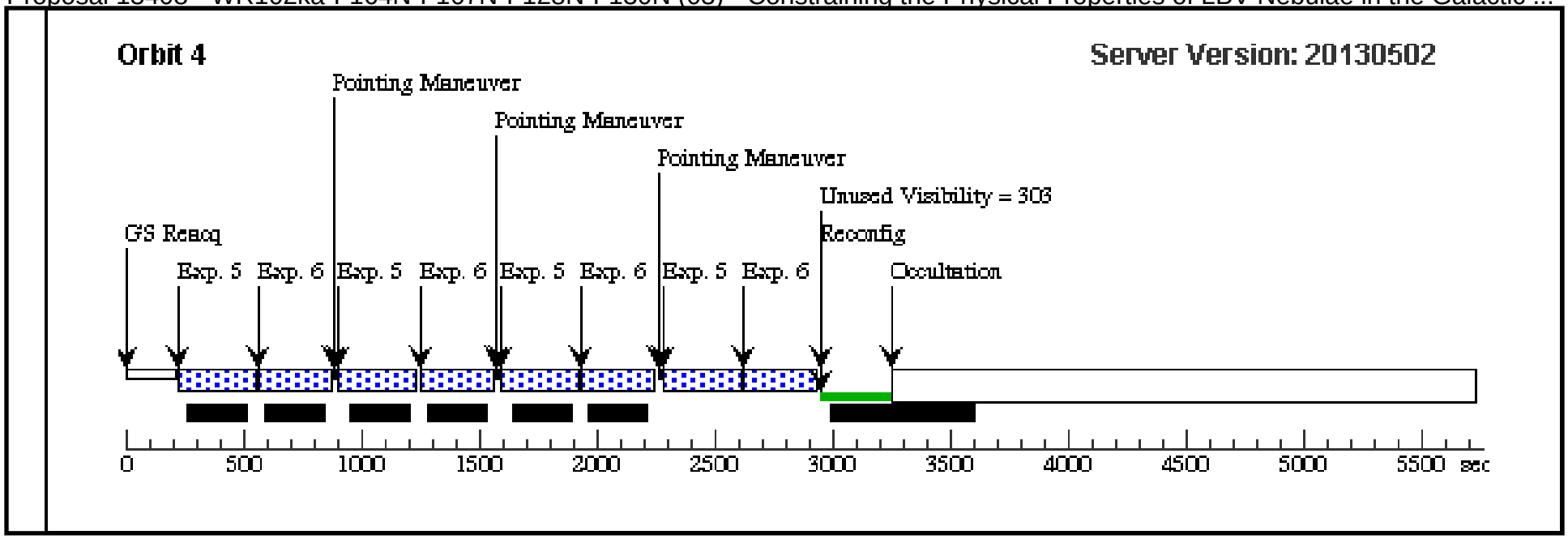
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 4
Server Version: 20130502
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 308
GS Reacq
Reconfig
Exp. 5
Exp. 6
Exp. 5
Exp. 6
Exp. 5
Exp. 6
Exp. 5
Exp. 6
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec