# 14186 - Mapping dust extinction properties across the IC 63 photodissociation region

Cycle: 23, 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) IC-63 | WFC3/IR<br>WFC3/UVIS | 2 | 24-Jul-2015 22:18:45.0 | yes |
| 02 | (1) IC-63 | WFC3/IR<br>WFC3/UVIS | 2 | 24-Jul-2015 22:18:48.0 | yes |

4 Total Orbits Used

**ABSTRACT**

Dust plays a crucial role in the chemical and dynamical evolution of the ISM. Its physical and chemical properties are however not well constrained. Photo-dissociation regions (PDRs), located at the interface between H II regions and molecular clouds, are ideal objects to study the properties and

evolution of dust grains, because physical conditions within them change on very short length scales. In order to determine how the dust extinction parameters vary across a PDR, we propose to map the IC 63 PDR from the UV to the near infrared at high resolution with HST WFC3, similarly to the approach taken in the Panchromatic Hubble Andromeda Treasury (PHAT). These observations will allow us to derive simultaneously stellar (spectral type, effective temperature and luminosity) and extinction parameters (Av, Rv) for many background stars behind IC 63. The spectral type will identify prime candidates for followup HST UV/spectroscopy, whereas extinction parameter maps will reveal for the first time the extinction variations across a PDR. We will gain valuable information on how the grain size distribution and optical properties of dust are affected by the strong density gradient and the sharp changes in the physical conditions, such as radiation field, typical of PDRs. The results of this study will bring new constraints on the modeling of dust formation and processing in the ISM. Moreover, this analysis combined with ancillary data from Spitzer and Herschel will give for the first time a complete view of dust within a PDR.

**OBSERVING DESCRIPTION**

Our observations cover a WFC3 field centered on the IC 63 reflection nebula. The coverage of the observations is 162x162 arcsec and 123x136 arcsec for the UVIS and IR channel respectively. The set of 7 filters used in this program (F275W, F336W, F475W, F625W, F814W for the UVIS channel and F110W and F160W for the IR channel) has been defined to optimally extract dust extinction parameters by fitting stellar spectral energy distributions. To maximize the observed area of the PDR, an orientation angle of 216 degrees is required.

This extinction mapping technique needs numerous and spatially well-sampled sightlines on IC 63, putting a strong constraint on the depth of the observations: the final extinction map pixel (~10 arcsec) has to contain at least a dozen of individual sources.

The program consists in two visits, each of two orbits. The first orbit includes most of our UV exposures (2x600s in F275W and 2x650s in F336W). That first orbit ends with a 5s guard exposure in F475W to retrieve information about the brightest sources. The second orbit contains 4x449s exposures in F814W and our observations in F160W. We use MULTIACCUM STEP50 sequences with NSAMP = 13 (for a total of 2x400s) to observe the infrared sources on a wide magnitude range.
The second visit starts with 4x420s exposures in F625W and 2x350s in F110W (STEP50 NSAMP=12). Those infrared exposures are separated from the F160W observations to avoid persistence. That is also why we impose the second visit to happen at least 2 days after the first visit. A 5s guard exposure is also taken in F814W. The last orbit includes 4x450s exposures in F475W and two additional 349s exposures in F275W.

To step over macroscopic features of the detector (such as the UVIS chip gap) and to aid in cosmic ray removal, we adopt a gap line dither pattern for

most of the UVIS exposures (no dithering is used for the guard exposures). However to keep the effects of IR persistence localized, we use a small line pattern in the IR.

## Visit

**Proposal 14186, First visit (01)** Sat Jul 25 02:18:50 GMT 2015

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR, WFC3/UVIS

Special Requirements: ORIENT 216D TO 216 D

## Patterns

| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (1) | Pattern Type=WFC3-UVIS-GAP-LINE<br>Purpose=MOSAIC<br>Number Of Points=2<br>Point Spacing=2.414<br>Line Spacing= | Coordinate Frame=POS-TARG<br>Pattern Orientation=85.759<br>Angle Between Sides=<br>Center Pattern=false | | (1-2), (4) |
| (2) | 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 | | (5) |

## Fixed Targets

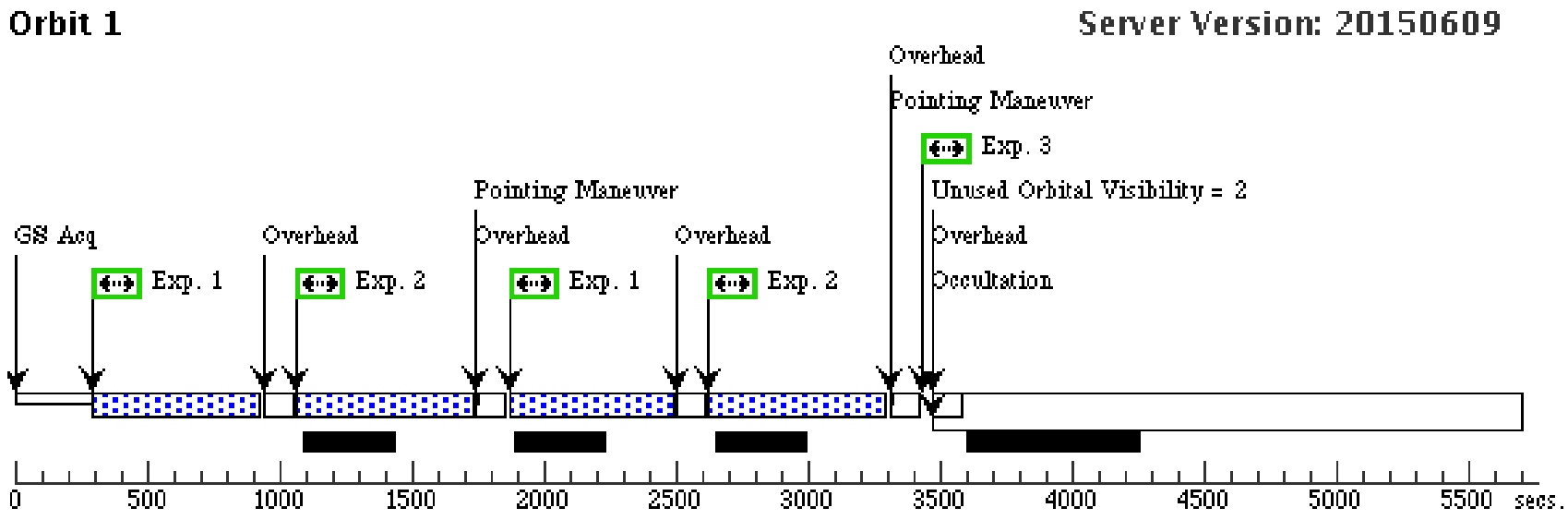
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | IC-63 | RA: 00 59 4.8572 (14.7702383d)<br>Dec: +60 53 55.42 (60.89873d)<br>Equinox: J2000 | | V=15.26 | Reference Frame: SIMBAD |

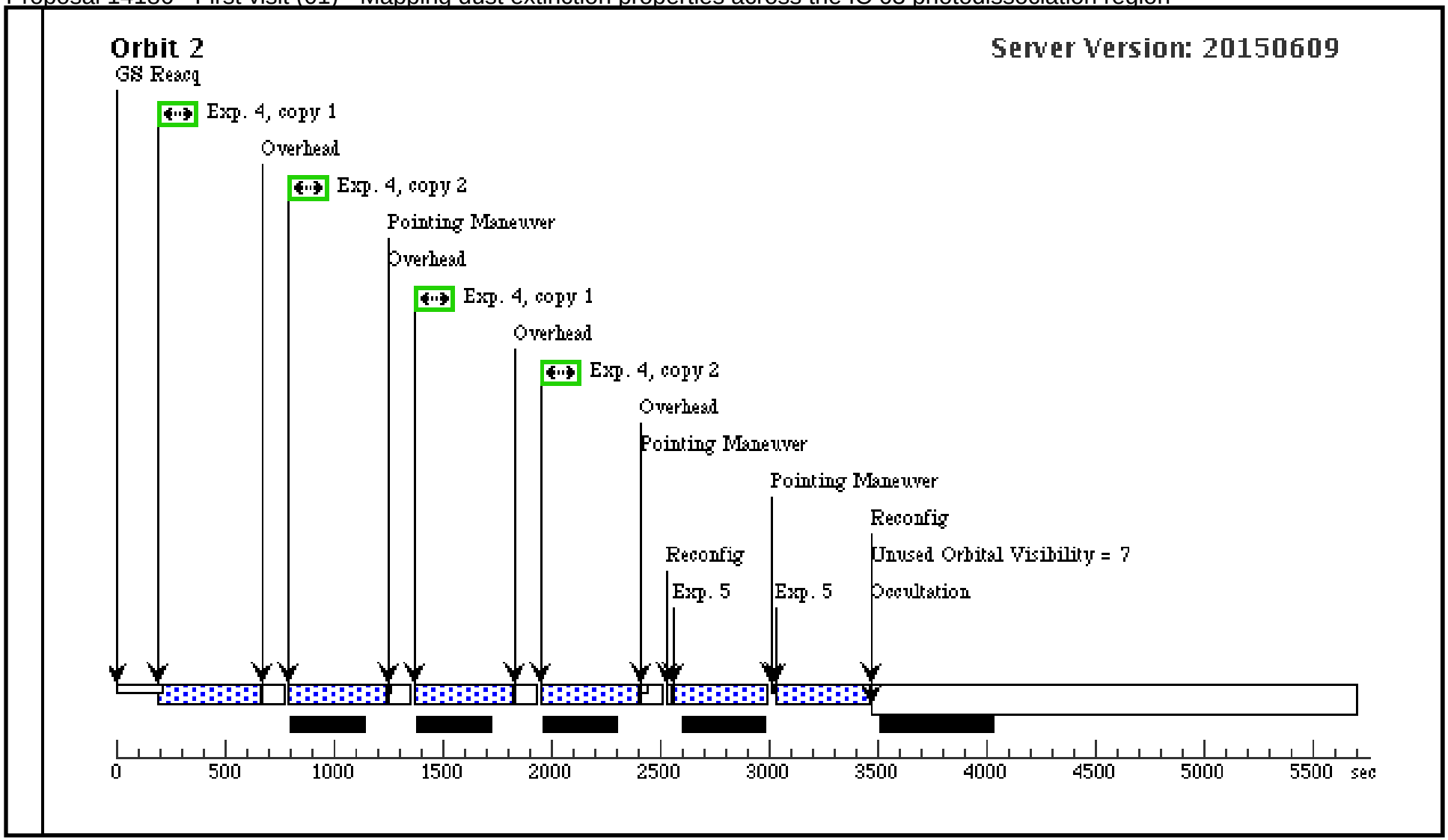
*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F275W-1 | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS-FIX | F275W | CR-SPLIT=NO;<br>FLASH=10 | POS TARG 0.23497 375345510974,-35.8 23189160689175 | Pattern 1, Exps 1-2 in First visit (01) (1) | 600 Secs (1200 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[1]*** |
| 2 | F336W-1 | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS-FIX | F336W | CR-SPLIT=NO;<br>FLASH=10 | POS TARG 0.23497 375345510974,-35.8 23189160689175 | Pattern 1, Exps 1-2 in First visit (01) (1) | 650 Secs (1300 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[1]*** |
| 3 | F475W-guard | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS-FIX | F475W | CR-SPLIT=NO;<br>FLASH=11 | POS TARG 0.23497 375345510974,-35.8 23189160689175 | | 5 Secs (5 Secs)<br>*[==>]* | ***[1]*** |
| 4 | F814W-1 | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS-FIX | F814W | CR-SPLIT=NO;<br>FLASH=2 | POS TARG 0.23497 375345510974,-35.8 23189160689175 | Pattern 1, Exps 4-4 in First visit (01) (1) | 449 Secs X 2 (1796 Secs)<br>*[==>(Pattern 1, Copy 1)]*<br>*[==>(Pattern 1, Copy 2)]*<br>*[==>(Pattern 2, Copy 1)]*<br>*[==>(Pattern 2, Copy 2)]* | ***[2]*** |
| 5 | F160W-1 | (1) IC-63 | WFC3/IR, MULTIACCUM, IR-UVIS | F160W | NSAMP=13;<br>SAMP-SEQ=STEP50 | POS TARG 12.9948 5326496644,-6.2686 90824596547 | Pattern 2, Exps 5-5 in First visit (01) (2) | 399.233383 Secs (798.467 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[2]*** |

Orbit Structure

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Server Version: 20150609
GS Reacq
Exp. 4, copy 1
Overhead
Exp. 4, copy 2
Pointing Maneuver
Overhead
Exp. 4, copy 1
Overhead
Exp. 4, copy 2
Overhead
Pointing Maneuver
Pointing Maneuver
Reconfig
Reconfig
Unused Orbital Visibility = 7
Exp. 5
Exp. 5
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

## Visit

**Proposal 14186, Visit 02** Sat Jul 25 02:18:50 GMT 2015

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR, WFC3/UVIS

Special Requirements: ORIENT 216D TO 216 D; AFTER 01 BY 2 D TO 50 D

## Patterns

| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (1) | Pattern Type=WFC3-UVIS-GAP-LINE<br>Purpose=MOSAIC<br>Number Of Points=2<br>Point Spacing=2.414<br>Line Spacing= | Coordinate Frame=POS-TARG<br>Pattern Orientation=85.759<br>Angle Between Sides=<br>Center Pattern=false | | (1), (4-5) |
| (2) | 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 | | (2) |

## Fixed Targets

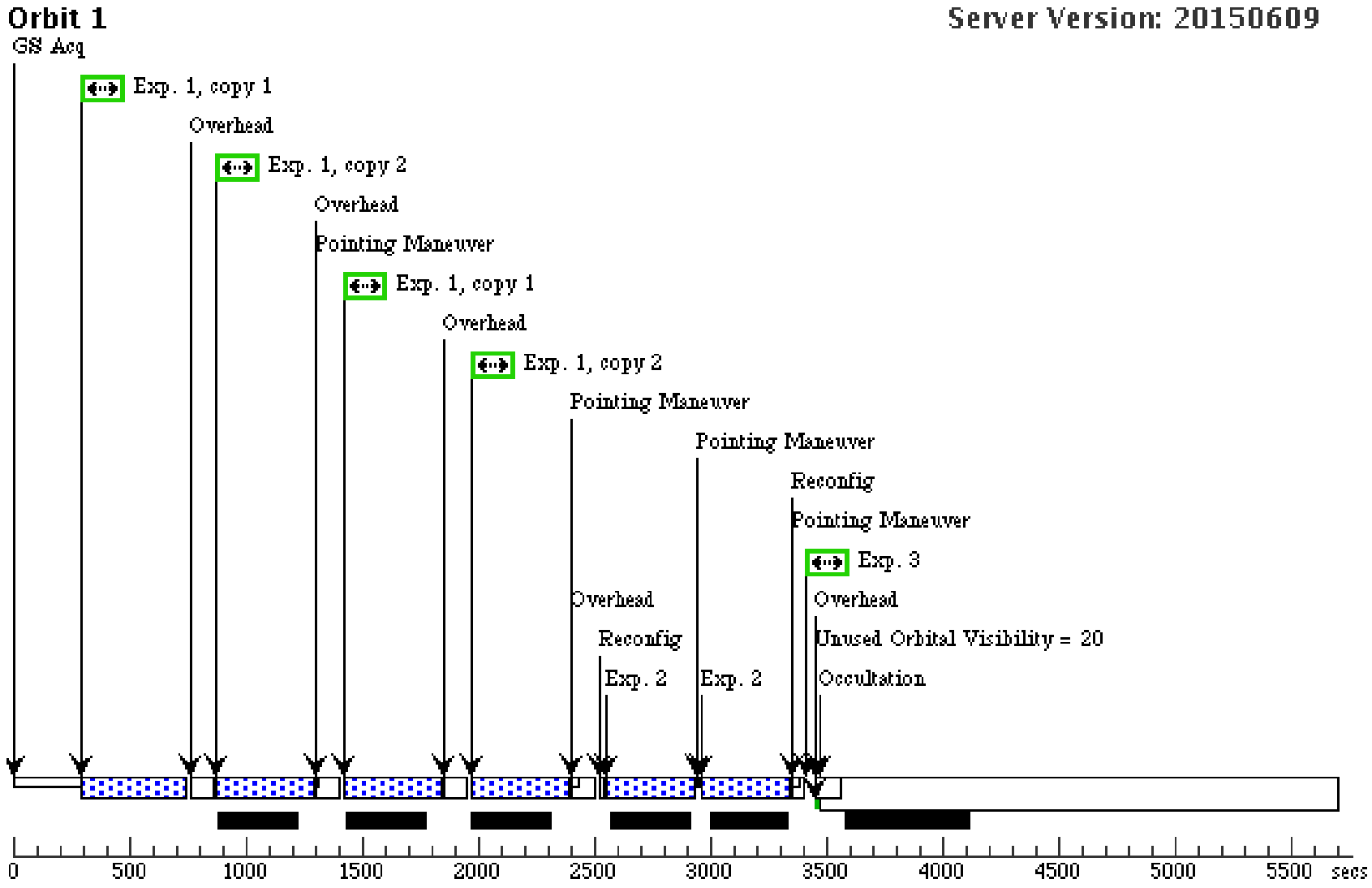
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | IC-63 | RA: 00 59 4.8572 (14.7702383d)<br>Dec: +60 53 55.42 (60.89873d)<br>Equinox: J2000 | | V=15.26 | Reference Frame: SIMBAD |

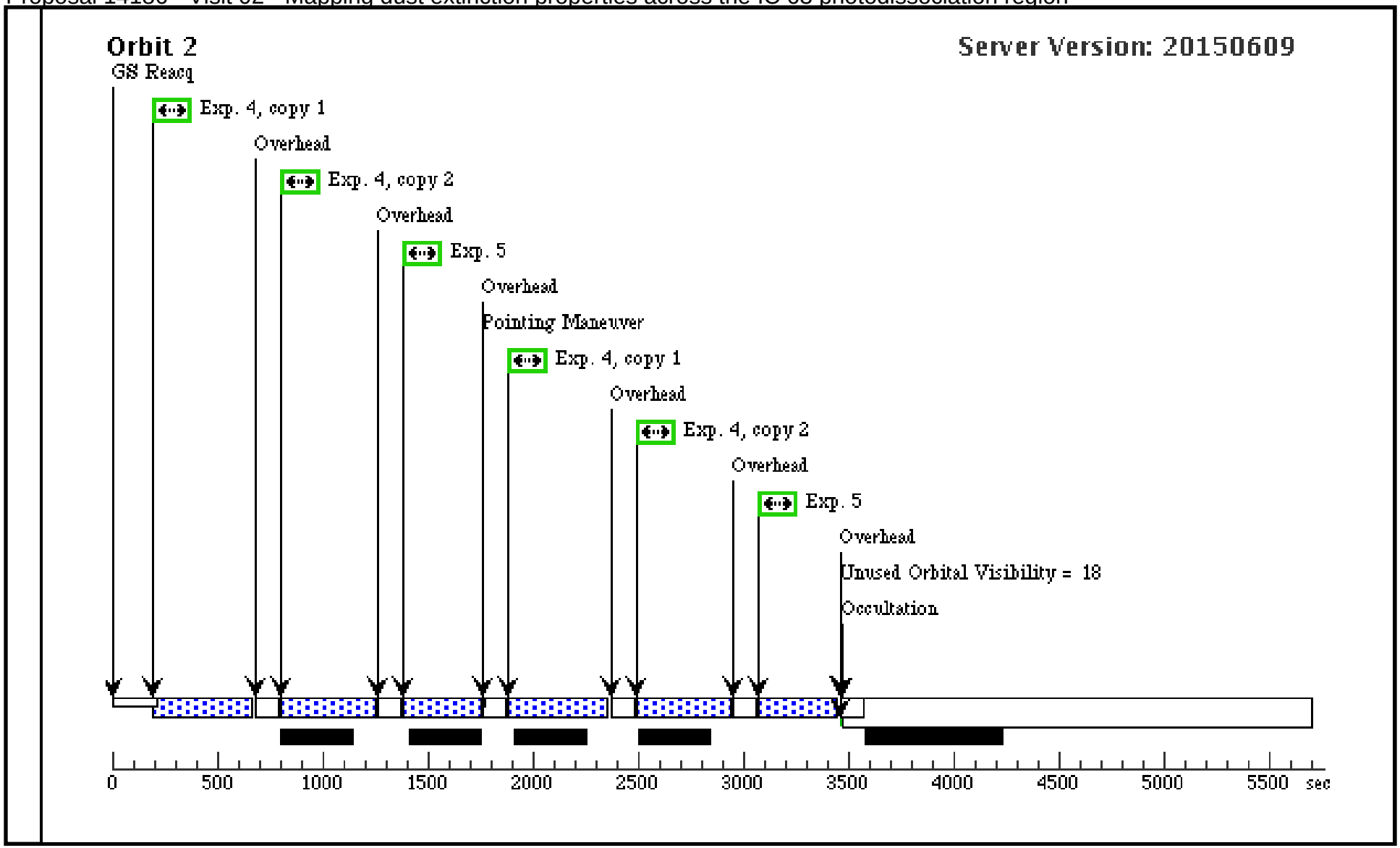
*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | F625W-1 | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS-FIX | F625W | CR-SPLIT=NO | POS TARG 0.23497375345510974,-35.823189160689175 | Pattern 1, Exps 1-1 in Visit 02 (1) | 420 Secs X 2 (1680 Secs)<br>*[==>(Pattern 1, Copy 1)]*<br>*[==>(Pattern 1, Copy 2)]*<br>*[==>(Pattern 2, Copy 1)]*<br>*[==>(Pattern 2, Copy 2)]* | ***[1]*** |
| 2 | F110W-1 | (1) IC-63 | WFC3/IR, MULTIACCUM, IR-UVIS | F110W | NSAMP=12; SAMP-SEQ=STEP50 | POS TARG 12.99485326496644,-6.268690824596547 | Pattern 2, Exps 2-2 in Visit 02 (2) | 349.232932 Secs (698.466 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[1]*** |
| 3 | F814W-guard | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS | F814W | CR-SPLIT=NO; FLASH=11 | POS TARG 0.23497375345510974,-35.823189160689175 | | 5 Secs (5 Secs)<br>*[==>]* | ***[1]*** |
| 4 | F475W-1 | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS-FIX | F475W | CR-SPLIT=NO; FLASH=3 | POS TARG 0.23497375345510974,-35.823189160689175 | Pattern 1, Exps 4-5 in Visit 02 (1) | 450 Secs X 2 (1800 Secs)<br>*[==>(Pattern 1, Copy 1)]*<br>*[==>(Pattern 1, Copy 2)]*<br>*[==>(Pattern 2, Copy 1)]*<br>*[==>(Pattern 2, Copy 2)]* | ***[2]*** |
| 5 | F275W-2 | (1) IC-63 | WFC3/UVIS, ACCUM, UVIS-FIX | F275W | CR-SPLIT=NO; FLASH=11 | POS TARG 0.23497375345510974,-35.823189160689175 | Pattern 1, Exps 4-5 in Visit 02 (1) | 349 Secs (698 Secs)<br>*[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[2]*** |

Orbit Structure




Orbit 2
Server Version: 20150609
GS Reacq
Exp. 4, copy 1
Overhead
Exp. 4, copy 2
Overhead
Exp. 5
Overhead
Pointing Maneuver
Exp. 4, copy 1
Overhead
Exp. 4, copy 2
Overhead
Exp. 5
Overhead
Unused Orbital Visibility = 18
Occultation
0
500
1000
1500
2000
2500
3000
3500
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sec