# 12005 - Unveiling the Dusty Starburst Galaxy Hosting GRB080607

Cycle: 17, Proposal Category: GO/DD

(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) GRB080607 | WFC3/IR | 4 | 28-Aug-2009 21:02:13.0 | yes |

4 Total Orbits Used


**ABSTRACT**

GRB 080607 at redshift z = 3.0363 is a unique case of a highly extinguished (A_V ~ 3 mag) afterglow that was yet sufficiently bright for high-quality spectroscopy. The ISM properties revealed by our afterglow spectrum are unprecedented among GRB host galaxies, including an enormous dust and gas surface mass density (~ 400 M_sun/pc^2), the first detection of CO molecules, and roughly solar metallicity. Contrary to the common expectation of GRBs occurring preferentially in low-mass and low-metallicity environments, the observed large metal and dust content, together with

the mass-metallicity relation known for z=2-3 galaxies, imply that the host galaxy is massive and intrinsically luminous. Identifying the host galaxy of this event is critical for connecting our spectroscopy to the rest of the poorly-understood dark burst population with suppressed optical afterglow light. Despite our large investments in optical and NIR imaging at ground-based telescopes to date, the host of GRB 080607 has eluded detection to an unobscured limiting UV luminosity of ~ 0.07 L*. The lack of bright emission suggests that the dust seen in the afterglow spectrum reflects the global dust content throughout the host ISM. Otherwise, it would imply the presence of highly metal-enriched regions in a low-mass galaxy, challenging the validity of our current understanding of star formation at high redshift.

The low sky background and high spatial resolution make HST and WFC3/IR the only instrument available to unveil the morphology and stellar counterpart of the dusty host galaxy of GRB 080607. Here we request Director's Discretionary time to obtain deep near-infrared images of the field surrounding GRB 080607, using WFC3 and the IR channel with the F160W filter. The proposed imaging program will allow us to investigate whether the host of GRB 080607 is a dusty luminous galaxy or a faint dwarf galaxy with patchy dust clouds, and to examine the significance of dust enshrouded star formation at z~3.

The extraordinary ISM properties observed around GRB 080607 have stimulated a considerable amount of interest not only in the GRB community but also among observers and theorists who study star formation both in the nearby universe and at high redshift. We believe the proposed WFC3/IR imaging data will have high impact in the broader astrophysics community.

**OBSERVING DESCRIPTION**

We aim to obtain deep near-infrared images of the field surrounding GRB080607 at redshift z=3.036, using the IR channel in Wide Field Camera 3 (WFC3) with the F160W filter. At z=3, the observed F160W band corresponds to rest-frame 4000 Ang. Our early-time afterglow spectrum has revealed a large amount of dust (A_V ~ 3 mag) and chemically enriched ISM of near solar metallicity in the host galaxy. The observed large metal and dust content, together with the mass-metallicity relation known for star-forming galaxies at z=2-3, imply that the host galaxy is massive and intrinsically luminous. However, because of the substantial extinction, we expect the host galaxy to be faint in the F160W bandpass. We estimate that an L* galaxy at z=3 with E(B-V)=0.8 dust extinction would have AB(F160W)=27.3.

To improve the spatial sampling of distant faint galaxies, we adopt the WFC3-IR-DITHER-BOX-MIN dither pattern with sub-integer pixel offsets. The host galaxy will be identified based on its coincident position with the optical transient.

## Visit

**Proposal 12005, Visit 01** Sat Aug 29 01:02:19 GMT 2009

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFC3/IR

Special Requirements: (none)

## Patterns

| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (1) | 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), (3) |

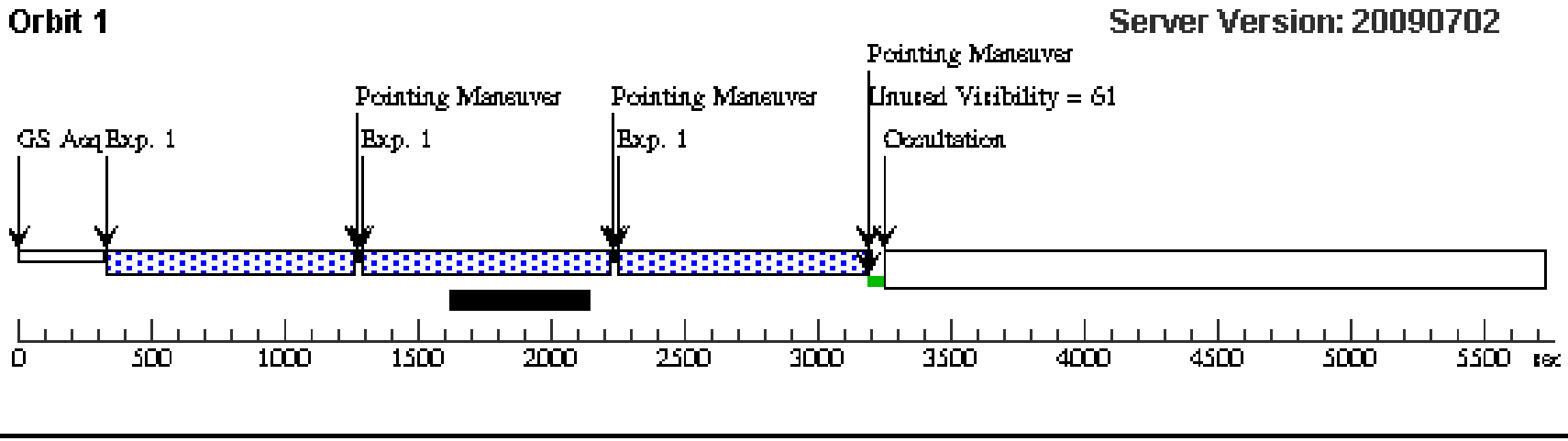
## Fixed Targets

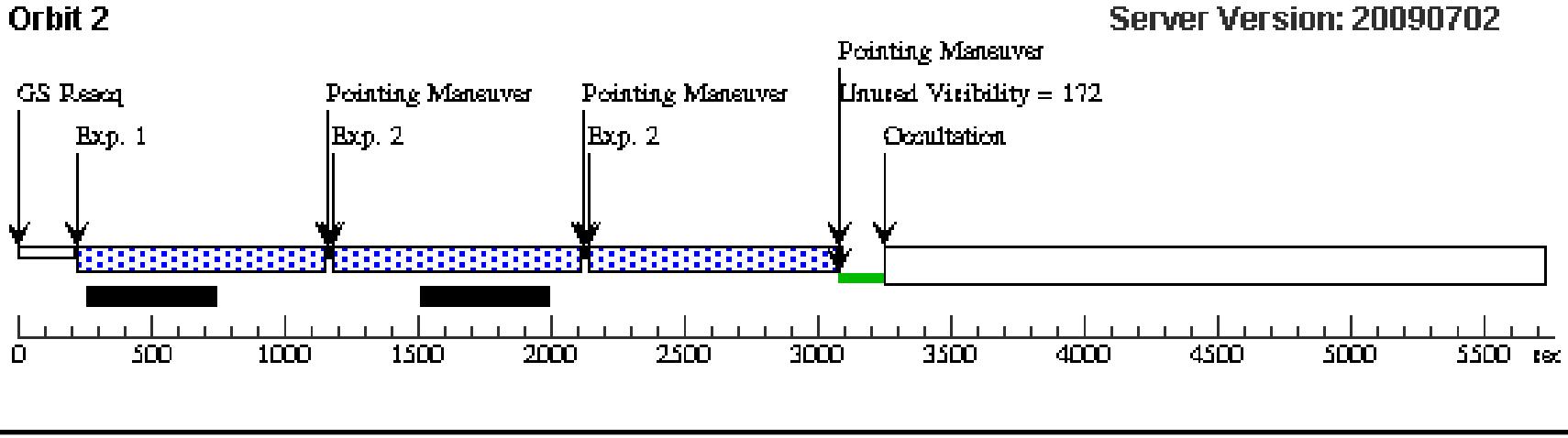
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | GRB080607 | RA: 12 59 48.2400 (194.9510000d)<br>Dec: +15 55 5.74 (15.91826d)<br>Equinox: J2000 | | V=29+/-0.5 | Reference Frame: ICRS |

## Exposures

| # | Label | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | (1) GRB080607 | WFC3/IR, MULTIACCUM, IR-FIX | F160W | NSAMP=15;<br>SAMP-SEQ=STEP100 | | Pattern 1, Exps 1-1 (1) | *[==>(Pattern 1)]*<br>*[==>(Pattern 2)]*<br>*[==>(Pattern 3)]* | ***[1]*** |
| | | | | | | | | *[==>(Pattern 4)]* | ***[2]*** |
| 2 | | (1) GRB080607 | WFC3/IR, MULTIACCUM, IR-FIX | F160W | NSAMP=15;<br>SAMP-SEQ=STEP100 | | Pattern 1, Exps 2-2 (1) | *[==>(Pattern 1)]*<br>*[==>(Pattern 2)]* | ***[2]*** |
| | | | | | | | | *[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[3]*** |
| 3 | | (1) GRB080607 | WFC3/IR, MULTIACCUM, IR-FIX | F160W | NSAMP=15;<br>SAMP-SEQ=STEP100 | | Pattern 1, Exps 3-3 (1) | *[==>(Pattern 1)]* | ***[3]*** |
| | | | | | | | | *[==>(Pattern 2)]*<br>*[==>(Pattern 3)]*<br>*[==>(Pattern 4)]* | ***[4]*** |

Orbit Structure



Orbit Structure (continued)