# 11137 - First Accurate Geometric Distance to a Galactic Wolf-Rayet Star: Knots in the Ejecta M1-67

Cycle: 16, 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) WR124 | WFPC2 | 2 | 01-Feb-2008 21:00:56.0 | yes |

2 Total Orbits Used


**ABSTRACT**

M 1-67 is the youngest known ejection nebula surrounding a Population I Wolf-Rayet star, in this case the WN8 star WR 124. Our deep H-alpha HST/WFPC2 image of this object in March 1997 revealed, for the first time in such a nebula, numerous bright, mostly unresolved knots (typical diameters 0.1-0.2") often surrounded by what appear to be their own local spherical diffuse 'wind' bubbles. We propose to obtain a second epoch H-alpha image of M 1-67, essentially repeating the Epoch1 instrumental set-up. By measuring the proper motions of the knots, we will derive a relatively precise and assumption-free geometric distance (thus also a luminosity) to a Galactic Wolf-Rayet star, the first of its kind. This will help to confirm the suspected runaway status of WR 124 and shed new light on the nature of progenitors of gamma-ray bursts. Moreover, we intend to

document and measure the anticipated morphology/brightness changes in the fine-stucture features of the nebula over the 11-year interval, as they relate to wind-embedded shocks. This will provide important input for interaction models of a stellar wind with circumstellar matter.

**OBSERVING DESCRIPTION**

The main goal of this program is to measure proper motions of the knots in the emission nebula around WR 124, by comparing the previously obtained images to the newly acquired set.

We will attempt to match our Epoch1 WFPC2 F656N (net H_alpha) image as closely as feasible to minimize potential instrumental anomalies. We plan to obtain a sequence of four 17.5-min exposures in a two-dimensional 4-point dither pattern through the F656N filter to ensure a reasonable match with the 4 x 41.7min exposures from Epoch1.

The lower S/N ratio in the combined Epoch2 image will have a minimal impact on the measured proper motions, since the bright knots and the surrounding halos will be detected at the estimated S/N~50 (per pixel) and S/N~20-30/pix, respectively. This should be adequate for precise positioning of the features and relative photometry.

The chances of success are enhanced by the relatively high S/N that is attained for the brightest knots in the Epoch2 and Epoch1 images, plus the availability of numerous field stars spread across the nebula region, that will be used for the astrometry.

For a staightforward astrometric comparison of Epoch1 to Epoch2 we shall use the optimally stacked individual exposures. However, for Epoch2 (i.e., for the present program) we also plan to implement a dither pattern in order to try to resolve the knots and their halos.

**REAL TIME JUSTIFICATION**

N/A

**CALIBRATION JUSTIFICATION**

N/A

**ADDITIONAL COMMENTS**

In order to match the Epoch1 images as closely as possible, we planned to request a specific orientation of WFPC2 - see our comment in the 'Visit 01' folder.

## Visit

**Proposal 11137, Visit 01, implementation** Sat Feb 02 02:01:01 GMT 2008

**Diagnostic Status: No Diagnostics**

Scientific Instruments: WFPC2

Special Requirements: ORIENT 182.6D TO 184.6 D

*Comments: This comment concerns the 'ORIENT' requirrement:*
*in order to achieve the highest possible astrometric accuracy, we would like to orient the newly acquired images in accordance with the 2500sec exposures from GO-6787. Our calculations show that we should request ORIENT = 92.6D TO 94.6D. However, this creates the 'Unschedulable visit' problem. Hence, we submit this proposal imposing no limits on 'ORIENT', hoping to find a plausible solution during the final processing of this draft at STScI.*

## Patterns

| # | Primary Pattern | | Secondary Pattern | Exposures |
|---|---|---|---|---|
| (1) | Pattern Type=WFPC2-BOX | Coordinate Frame=POS-TARG | | (1) |
| | Purpose=DITHER | Pattern Orientation=26.56505 | | |
| | Number Of Points=4 | Angle Between Sides=143.1301 | | |
| | Point Spacing=0.559017 | Center Pattern=false | | |
| | Line Spacing=0.559017 | | | |

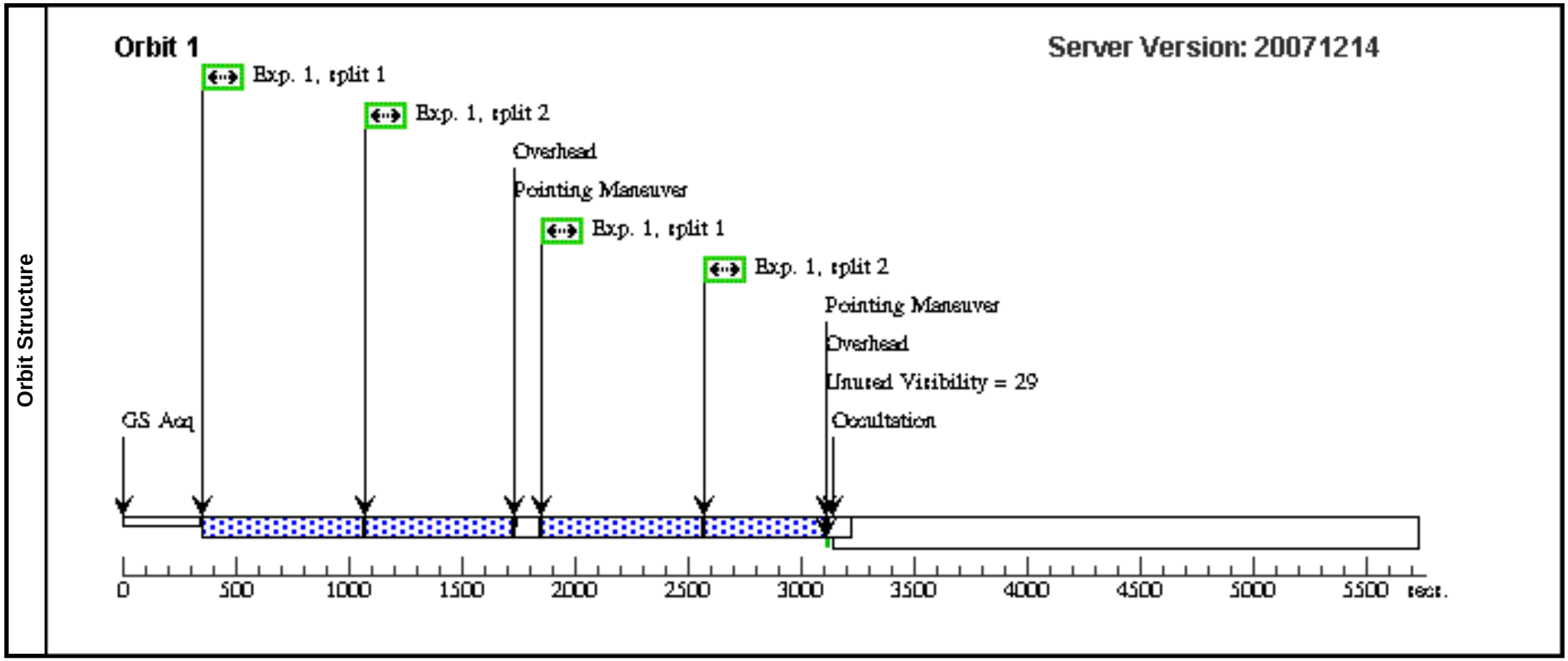
## Fixed Targets

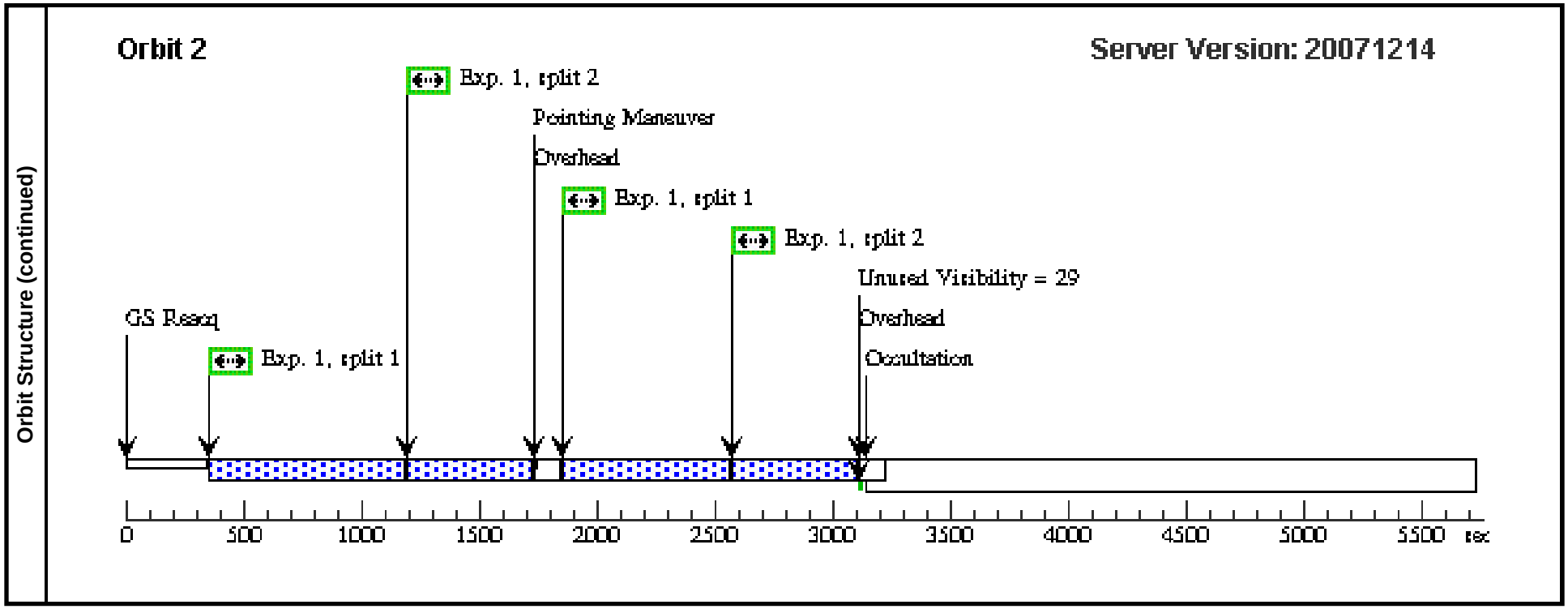
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | WR124 | RA: 19 11 30.8767 (287.8786529d) | | V=11.08+/-0.05 | Reference Frame: SIMBAD |
| | Alt Name1: BAC209 | Dec: +16 51 38.16 (16.86060d) | | | |
| | Alt Name2: HIP94289 | Equinox: J2000 | | | |

*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/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | dither-box | (1) WR124 | WFPC2, IMAGE, WFALL-FIX | F656N | CR-SPLIT=DEF; CLOCKS=YES | | Pattern 1-1 (1) | 1100.0 Secs | |
| | | | | | | | | *[==>500.0 Secs (Pattern 1, Split 1)]* | ***[1]*** |
| | | | | | | | | *[==>600.0 Secs (Pattern 1, Split 2)]* | |
| | | | | | | | | *[==>500.0 Secs (Pattern 2, Split 1)]* | |
| | | | | | | | | *[==>500.0 Secs (Pattern 2, Split 2)]* | |
| | | | | | | | | *[==>600.0 Secs (Pattern 3, Split 1)]* | ***[2]*** |
| | | | | | | | | *[==>500.0 Secs (Pattern 3, Split 2)]* | |
| | | | | | | | | *[==>500.0 Secs (Pattern 4, Split 1)]* | |
| | | | | | | | | *[==>500.0 Secs (Pattern 4, Split 2)]* | |


Orbit Structure
Orbit 1
Server Version: 20071214
Exp. 1, split 1
Exp. 1, split 2
Overhead
Pointing Maneuver
Exp. 1, split 1
Exp. 1, split 2
Pointing Maneuver
Overhead
Unused Visibility = 29
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec.


Orbit Structure (continued)
Orbit 2
Server Version: 20071214
Exp. 1, split 2
Pointing Maneuver
Overhead
Exp. 1, split 1
Exp. 1, split 2
Unused Visibility = 29
Overhead
Occultation
GS Reacq
Exp. 1, split 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec