15903 - Imaging a Nearby Red Giant Astrosphere

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Brian Erland Wood (PI) (Contact)	**Naval Research Laboratory**	**brian.wood@nrl.navy.mil**
Dr. Hans-Reinhard Mueller (CoI)	Dartmouth College	hans.mueller@dartmouth.edu
Dr. Graham M. Harper (CoI)	University of Colorado at Boulder	graham.harper@colorado.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) HD25025	WFC3/UVIS	3	09-Sep-2019 18:01:31.0	yes

3 Total Orbits Used

ABSTRACT

We propose to use WFC3/UVIS to make the first image of the astrosphere around a normal, non-pulsating red giant, specifically Gamma Eri (M1 III). This will allow a direct measurement of the wind's termination shock distance from the star, an excellent measure of the ISM pressure at the star, which is within the Local Bubble at a distance of d=62.3 pc. This would be the closest astrosphere to Earth ever imaged. The data will be used to test hydrodynamic models of the stellar-wind/ISM interaction, and we will look for signs of asymmetry in the astrosphere that could be indicative of asymmetries in the stellar wind outflow or effects of the ISM magnetic field. The only method for studying red giant astrospheres in the past has been spectroscopically, in absorption, and our chosen target is one of only three red giants with detected Mg II 2800 astrospheric absorption. Our proposed observation complements this previous HST/STIS observation nicely, as the UVIS/F275W exposure will be attempting to image the astrosphere in scattered Mg II emission.

OBSERVING DESCRIPTION

We will observe the astrosphere of Gamma Eri for 3 orbits with the F275W filter of WFC3/UVIS. Estimating exposure times requires first estimating Mg II surface brightness. To do this, we first measure the Mg II flux absorbed by the astrosphere in the previous HST/STIS spectrum shown in Figure 2: f=6.4e-14 ergs/cm2/s in the k line, f=3.2e-14 ergs/cm2/s in the h line. We then divide this by the size of the astrosphere on the sky, which based on Figure 4 we estimate to be about 400 arcsec^2. The wavelength integrated average Mg II surface brightness is therefore sigma=2.4e-16 ergs/cm2/s/arcsec^2 for both lines combined.

Taking into account overhead and our expected target visibility per orbit, we expect roughly 46 minutes per orbit to be available for target exposure time. Using the online WFC3 ETC, we find that in a 3 orbit observation (138 min), we can achieve an average signal-to-noise within a 25x25 pixel box (1" x 1") of S/N=5.0, which should be good enough for our purposes. We don't need particularly high spatial resolution, so even coarser binning could be used if necessary. The chosen F275W filter is the one that yields the best S/N, superior to the narrow F280N filter, for example.

We will use the WFC3-UVIS-MOS-DITH-LINE dither pattern, a pattern involving 6 positions that allows a final combined image that will fill in chip gaps, and we will do two separate exposures for each position. The combination will enable the removal of hot pixels, cosmic rays, and other artifacts. The aforementioned WFC3 ETC calculation includes a modest 10 e post-flash background enhancement to ensure acceptable charge transfer efficiency.

Visit

Proposal 15903, Visit 01 Mon Sep 09 22:01:32 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern		Exposures
(1)	Pattern Type=WFC3-UVIS-MOS-DITH-LINE Purpose=MOSAIC Number Of Points=3 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.754 Angle Between Sides= Center Pattern=true	Pattern Type=WFC3-UVIS-MOS-DITH-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.119 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=33.606 Angle Between Sides= Center Pattern=false	(1-2)

Fixed Targets

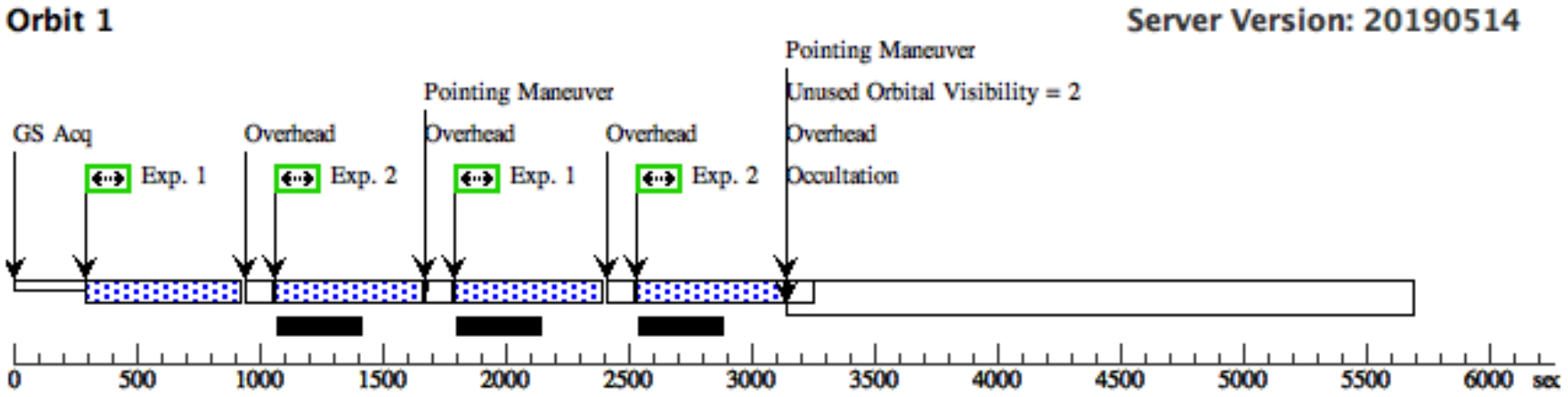
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD25025 Alt Name1: GAMMA-ERI	RA: 03 58 1.7664 (59.5073600d) Dec: -13 30 30.66 (-13.50852d) Equinox: J2000	Proper Motion RA: 61.57 mas/yr Proper Motion Dec: -113.11 mas/yr Parallax: 0.01604" Epoch of Position: 2000.0 Radial Velocity: 60.81 km/sec	V= 2.94+/-0.01 TYPE=M1III	Reference Frame: ICRS

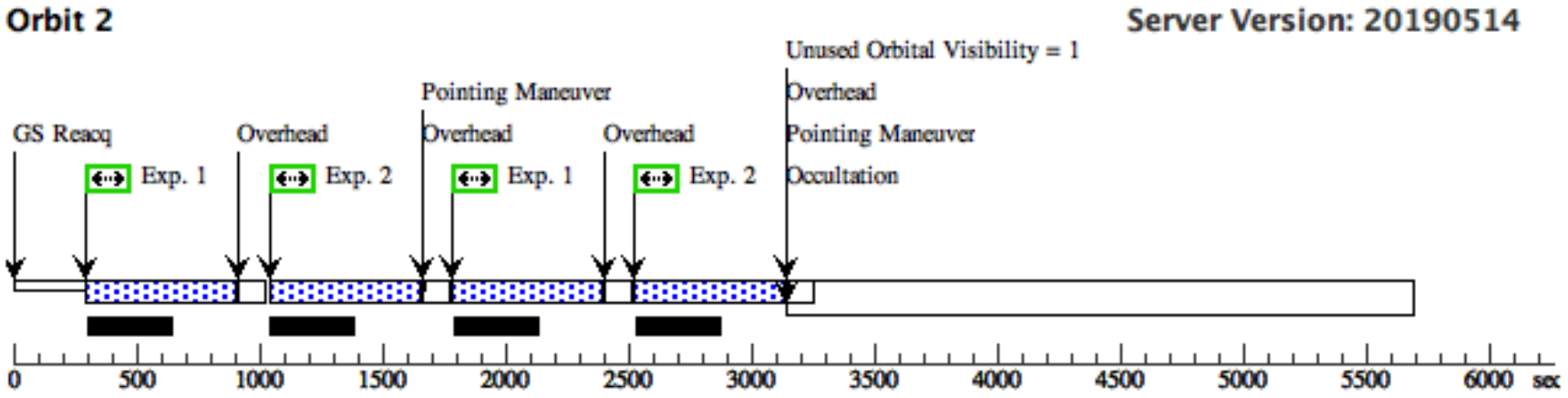
Comments:
Category=STAR
Description=[M III-I, SHOCK FRONT, WIND]

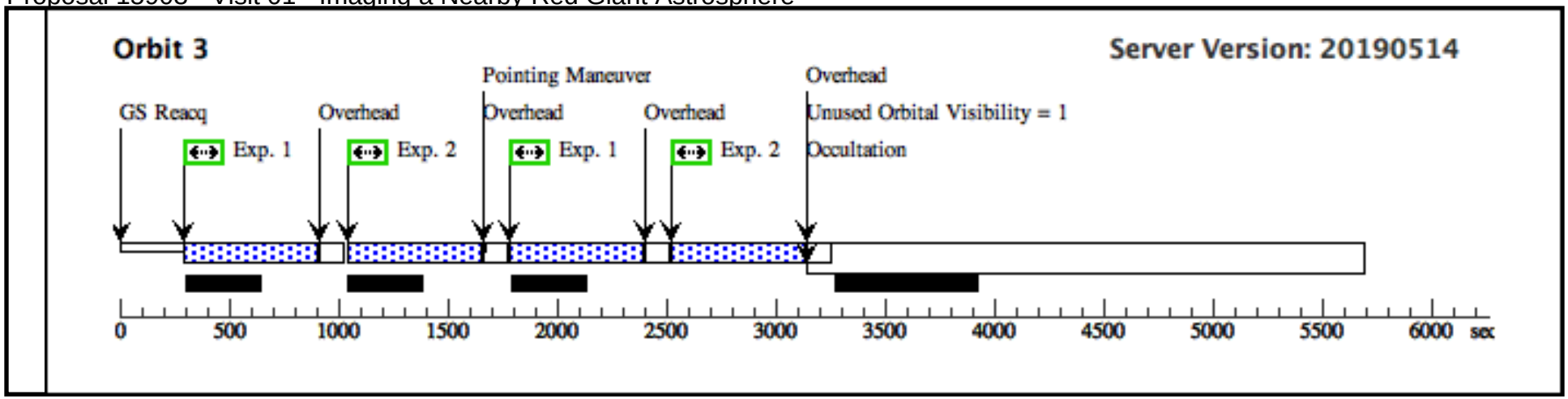
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(WFC3UVIS.im.1378482)	(1) HD25025	WFC3/UVIS, ACCUM, UVIS	F275W	FLASH=10		Pattern 1, Exps 1-2 in Visit 01 (1)	450 Secs (3638 Secs)	
								[==>601.0 Secs (Pattern 1,1)] *[==>601.0 Secs (Pattern 1,2)]*	***[1]***
								[==>609.0 Secs (Pattern 2,1)] *[==>609.0 Secs (Pattern 2,2)]*	***[2]***
								[==>609.0 Secs (Pattern 3,1)] *[==>609.0 Secs (Pattern 3,2)]*	***[3]***
2	(WFC3UVIS.im.1378482)	(1) HD25025	WFC3/UVIS, ACCUM, UVIS	F275W	FLASH=10		Pattern 1, Exps 1-2 in Visit 01 (1)	450 Secs (3638 Secs)	
								[==>601.0 Secs (Pattern 1,1)] *[==>601.0 Secs (Pattern 1,2)]*	***[1]***
								[==>609.0 Secs (Pattern 2,1)] *[==>609.0 Secs (Pattern 2,2)]*	***[2]***
								[==>609.0 Secs (Pattern 3,1)] *[==>609.0 Secs (Pattern 3,2)]*	***[3]***

Orbit Structure






Orbit 3
Server Version: 20190514
GS Reacq
Exp. 1
Overhead
Exp. 2
Pointing Maneuver
Overhead
Exp. 1
Overhead
Exp. 2
Overhead
Unused Orbital Visibility = 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec