14847 - MULTIWAVELENGTH STUDY OF POWERFUL NEW JET ACTIVITY IN THE SYMBIOTIC SYSTEM R AQR

Cycle: 24, Proposal Category: GO

(Availability Mode: AVAILABLE)

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) V-R-AQR	WFC3/UVIS	3	18-Sep-2017 18:01:59.0	yes

3 Total Orbits Used

ABSTRACT

We propose to carry out coordinated high-spatial resolution Chandra ACIS-S and multiwavelength (UV-Optical) HST/WFC3 observations of R Aqr, a very active symbiotic interacting binary system. Our main goal is to study the physical characteristics of the multi-scale components of the powerful jet; from the vicinity of the central binary (within a few AU) to the jet-circumbinary material interaction region (2500 AU) and beyond, and

especially of the recently discovered new component of the inner jet (likely due to recent ejection of material). Our main goal is to gain new insight on early jet formation and propagation, including jet kinematics and precession.

OBSERVING DESCRIPTION

We plan to carry out HST WFC3 imaging of R Aqr, using the dither mode in several filters centered on spectral lines and in the continuum (see table below). The multiple exposures will allow us to remove the cosmic rays. Furthermore, the blend of short and long exposures will allow us to replace saturated regions, especially in the central region, with unsaturated signal from the short exposures. As a result, we'll be able to study the changes that have occurred since the 2013/14 HST observation, including in the central region, and in the inner and the extended jet structures and clumps.

We request a total of 3 orbits, in 1 visit. Our preference is to get the HST observation as close as possible to the Chandra observations, (at most within three months). If possible, we prefer that the observations are scheduled close or during the Mira star minimum (within +/-2 months), which is expected in early December 2016 in order reduce the contrast between the Mira-primary and inner jet structures. An alternative window would be later in the cycle (later then August 15 2017), because we would like to avoid the Mira maximum (which is in late May 2017).

We have selected a set of filters to separate line and continuum emission, to distinguish shocked from photoionized gas emission. Our aim is to determine the causes of shocks and the shock speed, and the nature of the photoionizing medium. Difference and ratio maps will reveal changes in local physical conditions. The [Mg II]2800A, H-alpha, [OII]3729A, and [OIII]5007A lines will provide information on the ionization state of the gas. The [SII]6731A/H-alpha ratio will allow us to identify shocked vs. ionized gas emission, e.g., the ratio will be 0.4 for shocked gas, and smaller for photoionized gas. The O[III] 4363A/5007A ratio gives the temperature, which further constrains either the shock speed or the ionizing spectrum. Observations with the F547M filter will allow for continuum estimations and subtraction.

We plan to carry out the observations in a 4-point dither mode to improve the sampling of the PSF, and to deal with cosmic rays. Although the pixel size for the WFC3/UVIS detector is 0.0395 arcsec/pixel, by using an appropriate dither pattern, we will aim to reach 0.025 arc-sec/pixel (5AU at 200 pc) , which will nearly double the number of pixels covering the regions of interest (when compared to the 2013/14 HST observations), and will better sample the PSF, allowing further enhancement in the resolution using PSF deconvolution techniques (e.g. Karovska et al. 2010, ApJ, 710, 132). We plan to analyze the data using standard HST analysis procedures, and the latest HST calibration. In addition, we will use deconvolution techniques, PSF simulation (e.g., TinyTim), and line-ratios analysis routines to extract the maximum spatial and spectral information contained in the observations. We will combine the results with those from the Chandra observations of the spatial/spectral distribution and characteristics of the X--

ray emission. The results will be used as inputs in our 3-D hydrodynamical models to determine the wind-accertion characteristics and the jet-ejection and propagation mechanisms in the system.

The exposure times were based on the online WFC3 ETC calculations. We will optimize the efficiency of the observing time by using subarray readouts (2048x2048 readout) to minimize the overheads, while still providing a 80"x80" field of view. We would like to review the exposures within a month of the planned observations, given that the emission from the system is variable (we do not expect that the changes would be substantial).

Visit

Proposal 14847, Visit 01, implementation Mon Sep 18 22:02:02 GMT 2017

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Diagnostics

(Exposure 9 (Pattern 2, Exps 9-9 in Visit 01)) Warning (Form): POS TARG & PATTERN should be used carefully with WFC3 quad filters to avoid placing the target on the vignetted part of the field of view or moving it to another quadrant.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=SPIRAL	Coordinate Frame=POS-TARG		(2-8), (9)
	Purpose=DITHER	Pattern Orientation=46.86		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.145	Center Pattern=false		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V-R-AQR	RA: 23 43 49.4616 (355.9560900d)		V=9.0+/-3.0	Reference Frame: ICRS
		Dec: -15 17 4.20 (-15.28450d)			
		Equinox: J2000			

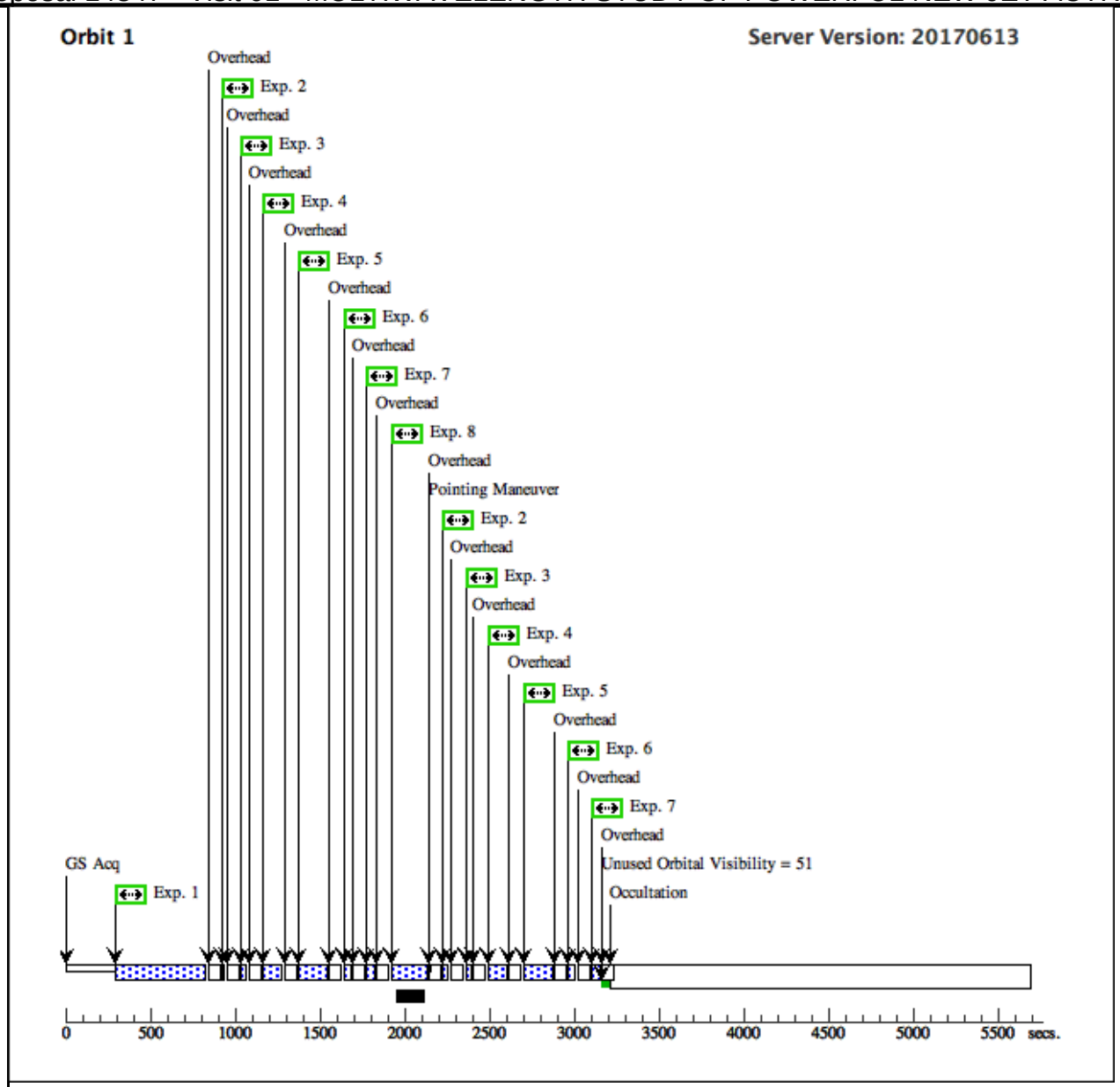
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

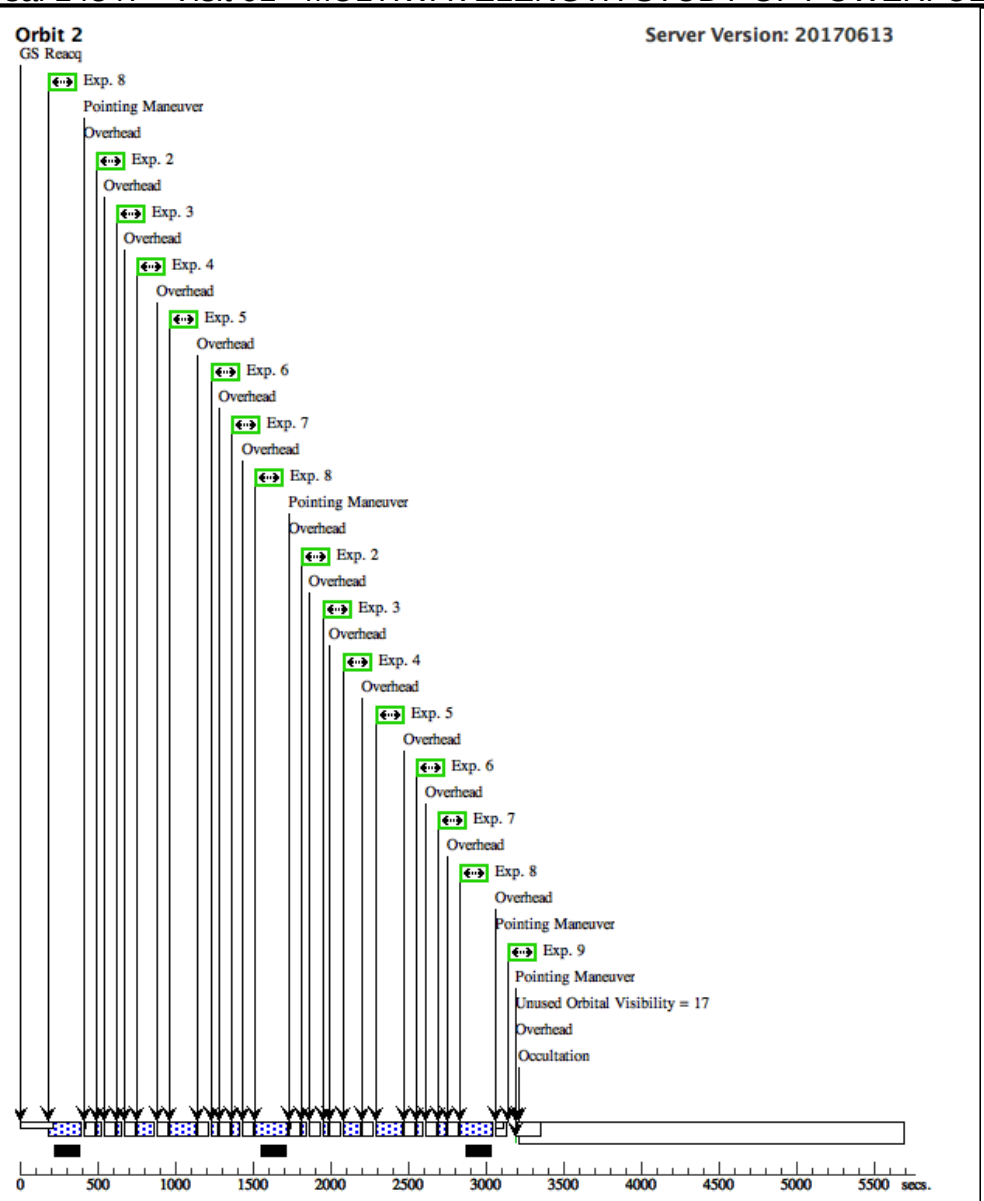
Exposures

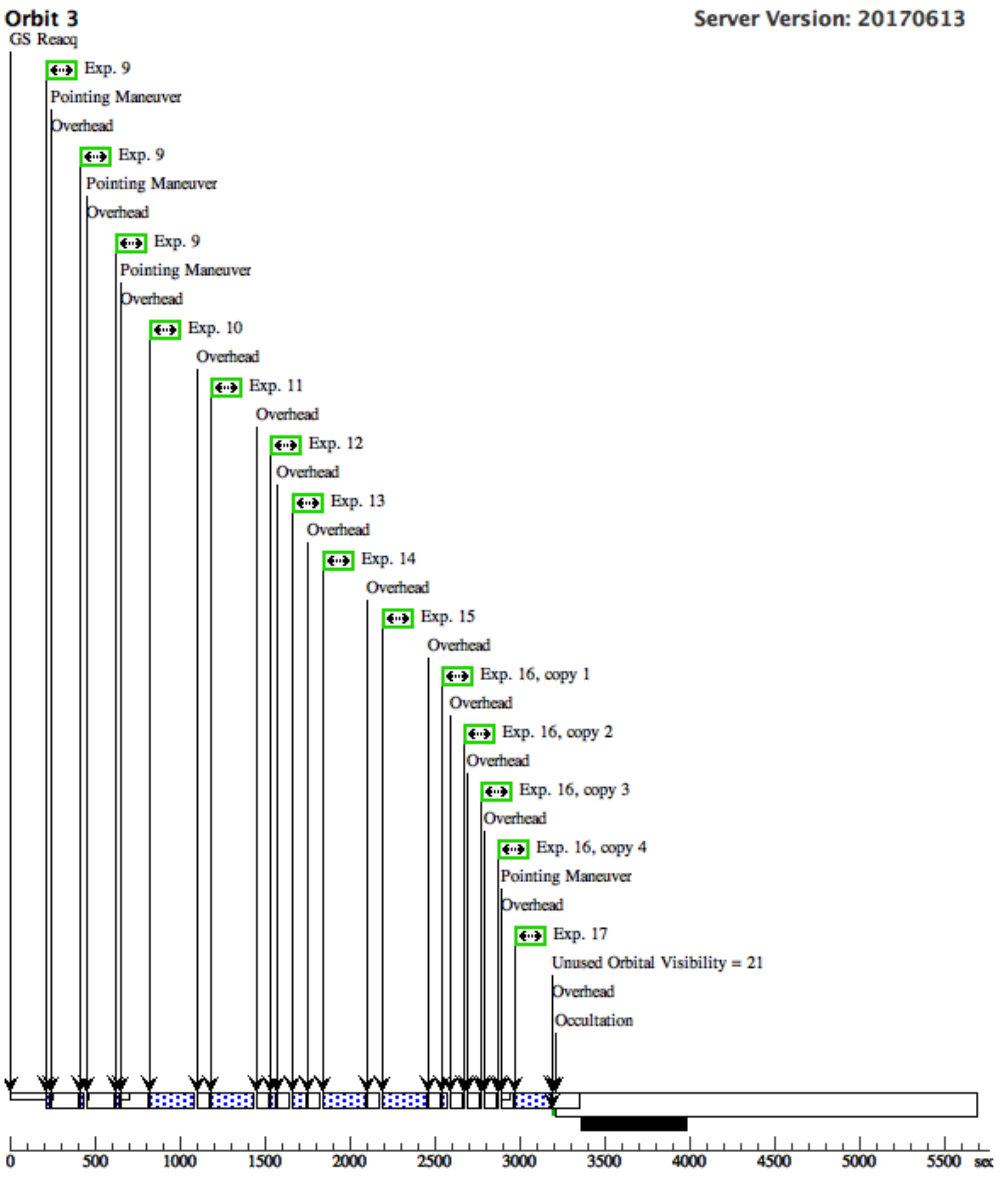
#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=11			500 Secs (500 Secs)	
								[==>]	***[1]***
2	(WFC3UVIS.im.780074)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=11		Pattern 2, Exps 2-8 in Visit 01 (2)	15 Secs (60 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
3	(WFC3UVIS.im.780075)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11; BLADE=A		Pattern 2, Exps 2-8 in Visit 01 (2)	5 Secs (20 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
4	(WFC3UVIS.im.832643)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F373N	FLASH=11		Pattern 2, Exps 2-8 in Visit 01 (2)	100 Secs (400 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
5	(WFC3UVIS.im.832644)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F280N	FLASH=11		Pattern 2, Exps 2-8 in Visit 01 (2)	140 Secs (560 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
6	(WFC3UVIS.im.780078)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F656N	FLASH=11; BLADE=A		Pattern 2, Exps 2-8 in Visit 01 (2)	20 Secs (80 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
7	(WFC3UVIS.im.780079)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F673N	FLASH=11; BLADE=A		Pattern 2, Exps 2-8 in Visit 01 (2)	20 Secs (80 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
8	(WFC3UVIS.im.780140)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F275W	FLASH=11		Pattern 2, Exps 2-8 in Visit 01 (2)	180 Secs (720 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[2]***
								[==>(Pattern 4)]	
9	(WFC3UVIS.im.780080)	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ437N	FLASH=11; BLADE=A		Pattern 2, Exps 9-9 in Visit 01 (2)	15 Secs (60 Secs)	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	

	10	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11	240 Secs (240 Secs) *[==>]*	 ***[3]***
	11	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F373N	FLASH=11	240 Secs (240 Secs) *[==>]*	 ***[3]***
	12	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F502N	FLASH=11	2 Secs (2 Secs) *[==>]*	 ***[3]***
	13	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F547M	FLASH=11	60 Secs (60 Secs) *[==>]*	 ***[3]***
	14	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F656N	FLASH=11	240 Secs (240 Secs) *[==>]*	 ***[3]***
	15	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F673N	FLASH=11	240 Secs (240 Secs) *[==>]*	 ***[3]***
	16	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F547M	FLASH=11; BLADE=A	0.5 Secs X 4 (2 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]*	 ***[3]***
	17	(1) V-R-AQR	WFC3/UVIS, ACCUM, UVIS-QUAD-SUB	FQ437N	FLASH=11	180 Secs (180 Secs) *[==>]*	 ***[3]***

Orbit Structure




Orbit 2
Server Version: 20170613
GS Reacq
Exp. 8
Pointing Maneuver
Overhead
Exp. 2
Overhead
Exp. 3
Overhead
Exp. 4
Overhead
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Exp. 8
Pointing Maneuver
Overhead
Exp. 2
Overhead
Exp. 3
Overhead
Exp. 4
Overhead
Exp. 5
Overhead
Exp. 6
Overhead
Exp. 7
Overhead
Exp. 8
Overhead
Pointing Maneuver
Exp. 9
Pointing Maneuver
Unused Orbital Visibility = 17
Overhead
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 3
Server Version: 20170613
GS Reacq
Exp. 9
Pointing Maneuver
Overhead
Exp. 9
Pointing Maneuver
Overhead
Exp. 9
Pointing Maneuver
Overhead
Exp. 10
Overhead
Exp. 11
Overhead
Exp. 12
Overhead
Exp. 13
Overhead
Exp. 14
Overhead
Exp. 15
Overhead
Exp. 16, copy 1
Overhead
Exp. 16, copy 2
Overhead
Exp. 16, copy 3
Overhead
Exp. 16, copy 4
Pointing Maneuver
Overhead
Exp. 17
Unused Orbital Visibility = 21
Overhead
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec