11641 - Super star clusters in the starburst core of M82

Cycle: 17, Proposal Category: GO

(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) M82-A2 (2) M82-A1-OFFSET	STIS/CCD	4	15-Jun-2009 21:11:26.0	yes
02	(1) M82-A2 (2) M82-A1-OFFSET	STIS/CCD	4	15-Jun-2009 21:11:44.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
03	(1) M82-A2 (2) M82-A1-OFFSET	STIS/CCD	4	15-Jun-2009 21:11:56.0	yes
04	(1) M82-A2 (2) M82-A1-OFFSET	STIS/CCD	4	15-Jun-2009 21:12:12.0	yes

16 Total Orbits Used

ABSTRACT

M82 is the archetype starburst galaxy and the nearest (3.6 Mpc) analogue to the star-forming galaxies identified at high-z. No other galaxy affords the opportunity to study an active starburst at such high spatial resolution, and with such a wealth of complimentary data available in the literature. In our cycle 10 STIS programme, we carried out the first spectroscopic study of a cluster in the core of the M82 starburst. Intriguingly, we found this young (6.5 Myr) cluster to be surrounded by a compact (4.5 pc), high-pressure HII region, whose evolution appears to have been significantly affected by the high ambient pressures found in this region of the starburst. We therefore propose to obtain spatially resolved STIS spectroscopy of a sample of star clusters within the starburst core, distributed over a range of ambient conditions. Together with measuring accurate ages, masses, sizes, and extinctions of the star clusters, we will also measure the properties of their immediate environments (gas dynamics, pressures/densities, excitations). Only with the spatial resolution of STIS can we isolate individual clusters in the crowded starburst core of M82, where the background is also bright and highly variable.

The data from this proposal will uniquely chart relationships between SSCs and the ISM in their immediate vicinities. By so doing, they will provide the first systematic measurements of how SSCs transmit their power to their surroundings, and ultimately to the starburst-powered galactic wind.

OBSERVING DESCRIPTION

M82 is the nearest giant starburst where multiple SSCs are optically accessible within the starburst zone, and is therefore the most important laboratory we possess for examining intense star formation. We plan to use STIS to observe a sample of SSCs and their immediate environments in

the core of the M82 starburst, thereby increasing the number of core star clusters with spectroscopic observations by a factor of 2-3. For these clusters we have accurate astrometry derived from HST ACS imaging and ground-based data, and B-band (F435W) magnitudes and visual extinctions from Mayya et al. (2008). Magnitudes of our selected clusters range between B=18.4-19.7 mag. The 52"x0.1" slit gives a resolution, perpendicular to the dispersion direction, of 1.8 pc at the distance of M82 and takes nearly full advantage of HST's spatial resolution.

We will orient the spectrograph slit to cover 3-4 individual clusters in the brightest starburst clump (clump A) with one pointing. Regardless of the individual clusters themselves, positioning the slit across clump A is a major advantage in understanding how the inter-cluster medium is evolving in this unique environment. Here there are many densely packed clusters and a high X-ray brightness, and we believe this clump to be base of the current wind (Westmoquette et al. 2007).

Two grating settings will be used: G430L to cover the blue spectral region from 2900-5700 Angstroms (primarily absorption lines and the Balmer jump), and G750M centred at 6768 Angstroms to cover the H-alpha, [NII], and [SII] emission line region. The 0.1" slit yields a spectral resolution of 2.5 pixels (or 6.7 Angstroms in the G430L grating and 1.4~ Angstroms in the G750M grating), which is necessary both to perform accurate spectral synthesis on the spectra, and to isolate the targeted clusters within the crowded field.

For exposure time estimates, we used the following STIS ETC settings: we assume an extended source of 0.3" radius and take B-band magnitudes measured from Mayya et al. (2008; measured using aperture photometry on the ACS F435W image), together with an B0V template spectrum (representing the expected dominant stellar type in the core region). We adopt a characteristic visual extinction (A_V) of 5 mag for the whole of the starburst core (Westmoquette et al. 2007). Our S/N requirements are driven by our previous experience with similar STIS observations, with spectral synthesis techniques and with being able to accurately measure the line profile shapes: we require a mean S/N of ~30-40 per spectral resolution element in the 3800-4800 Angstroms range and ~10 in the red. Thus, we find that for the G430L spectrum, we will require 43000 sec (12 orbits), and 14000 sec (4 orbits) for the G750M spectrum. This is consistent with our previous experience. Including overheads, our total request comes to 16 orbits, of which we have been allocated all 16. These will be split into 4 visits of 4 orbits each.

Since the cluster we wish to centre the slit on is very near (~1.5") to the bright cluster A1, we will initially centre on cluster A1 then offset to our target cluster.

Because of our ORIENT requirements, we cannot (according to Sect 4.1 of the Call for Proposals) take advantage of the fact that M82 lies in the Continuous Viewing Zone (CVZ).

Visit

Proposal 11641, Visit 01, implementation Tue Jun 16 01:12:17 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: ORIENT 89.5D TO 90.5 D; ORIENT 269.5D TO 270.5 D

Comments: G430L visit 1

1. Acquire brightest target in region (M82 A1)
2. Offset to cluster A2 and peak up
3. science exposure following a 3-point dither along the length of the slit - END ORBIT 1
4. peak up and science sequence for each following orbit

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(3), (6)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			
(2)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(4), (7)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82-A2	Offset from M82-A1-OFFSET by		V=(?)	Offset Position (M82-A2)
		RA Offset: 0.285 Secs		B=19.66 mag,	Reference Frame: ICRS
		Dec Offset: -0.2 Arcsec		E(B-V)~1.35	

Comments: This is the target star cluster (cluster A2)
To centre on it, we need to offset from cluster A1 - the brightest source.

(2)	M82-A1-OFFSET	RA: 09 55 53.3200 (148.9721667d)		V=17.23+/-0.1	Reference Frame: ICRS
		Dec: +69 40 50.30 (69.68064d)			
		Equinox: J2000			

Comments: Cluster A1: to acquire then offset to cluster A2

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	G430L Acquisition	(2) M82-A1-OFFSET	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			20 Secs	
								[==>]	***[1]***

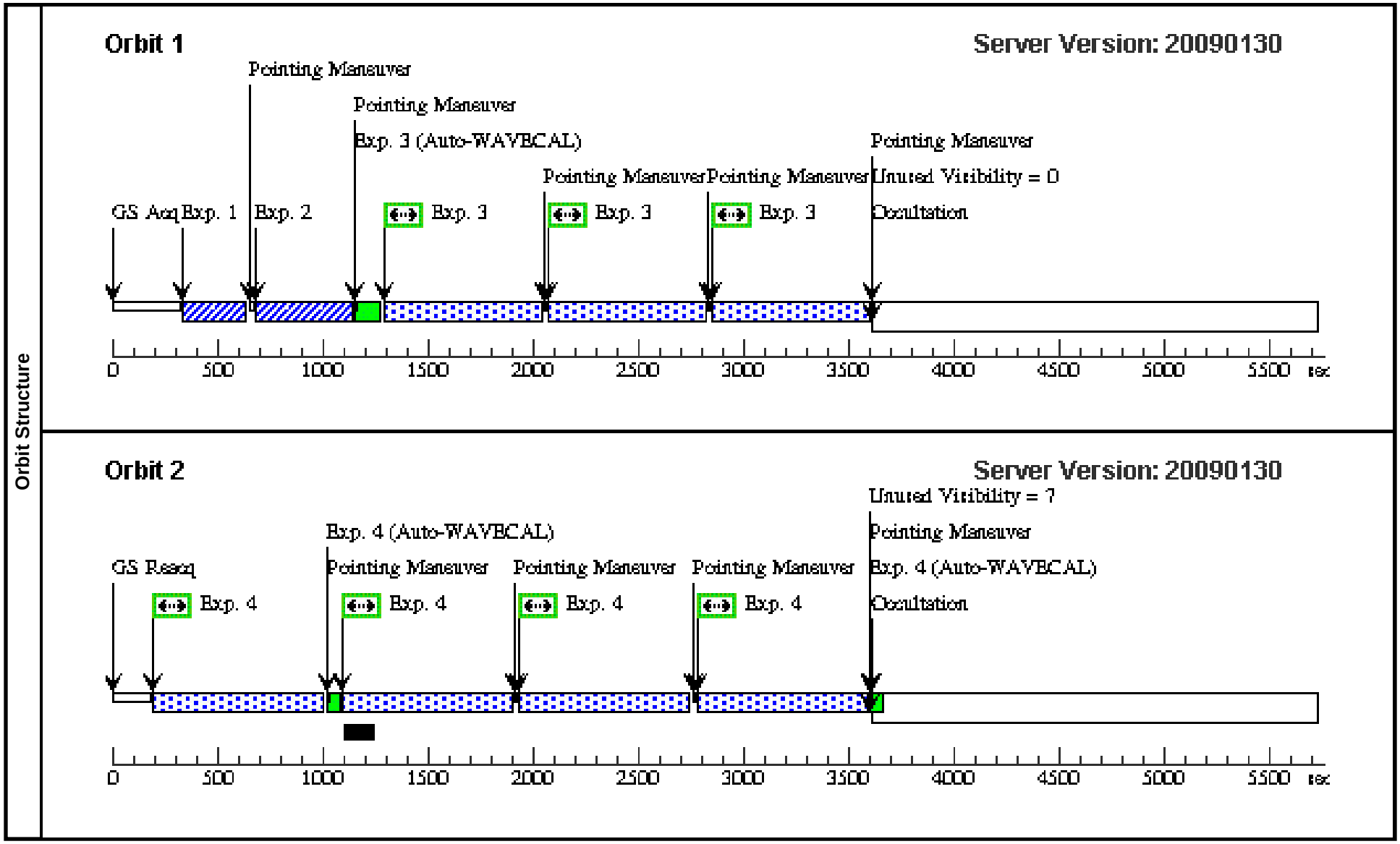
Comments: point source acquisition using the long-pass filter

2	G430L Peak Up	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs	
								[==>]	***[1]***

Comments: PeakUp with the 52x0.1E1 mask and the mirror

Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
3	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 1, Exps 3-3 (1)	710 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
4	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 2, Exps 4-4 (2)	775 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
5	G430L Peak Up	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs *[==>]*	***[3]***
Comments: PeakUp with the 52x0.1E1 mask and the mirror									
6	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 1, Exps 6-6 (1)	855 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[3]***
7	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 2, Exps 7-7 (2)	775 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[4]***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Pointing Maneuver
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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 0
GS Acq
Exp. 1
Exp. 2
Exp. 3
Exp. 3
Exp. 3
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec
Orbit 2
Server Version: 20090130
Unused Visibility = 7
Exp. 4 (Auto-WAVECAL)
Pointing Maneuver
GS Reacq
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Exp. 4 (Auto-WAVECAL)
Exp. 4
Exp. 4
Exp. 4
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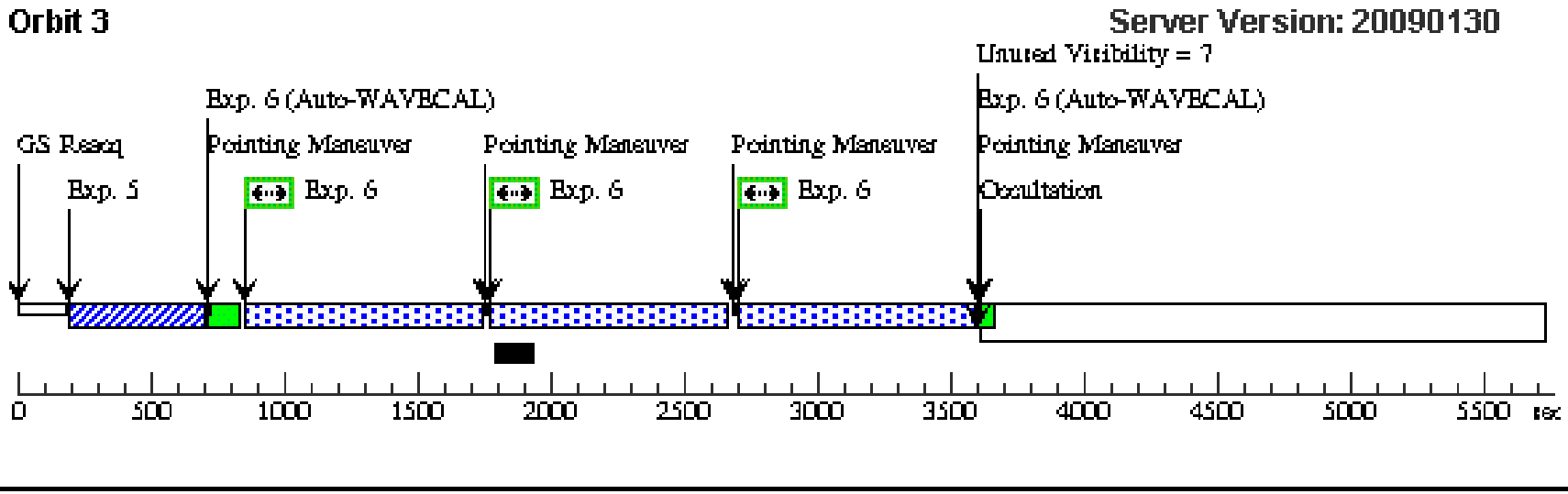
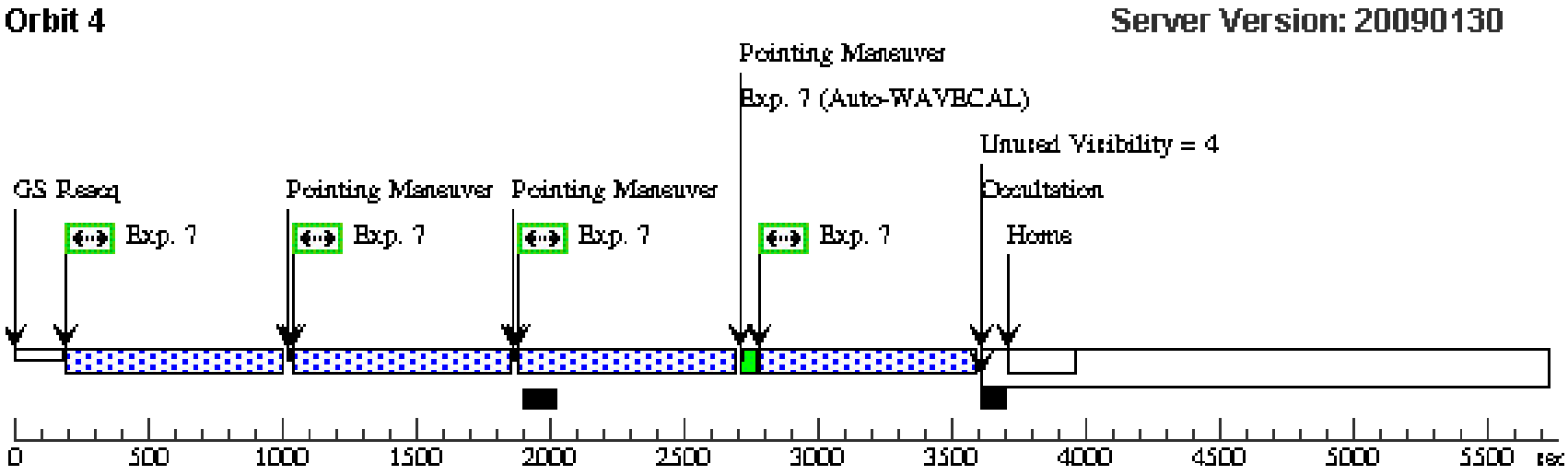
sec

Orbit Structure (continued)





Visit

Proposal 11641, Visit 02, implementation Tue Jun 16 01:12:19 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SAME ORIENT AS 01

Comments: G430L visit 2

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(3), (6)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			
(2)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(4), (7)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82-A2	Offset from M82-A1-OFFSET by		V=(?)	Offset Position (M82-A2)
		RA Offset: 0.285 Secs		B=19.66 mag,	Reference Frame: ICRS
		Dec Offset: -0.2 Arcsec		E(B-V)~1.35	
Comments: This is the target star cluster (cluster A2) To centre on it, we need to offset from cluster A1 - the brightest source.					
(2)	M82-A1-OFFSET	RA: 09 55 53.3200 (148.9721667d)		V=17.23+/-0.1	Reference Frame: ICRS
		Dec: +69 40 50.30 (69.68064d)			
		Equinox: J2000			
Comments: Cluster A1: to acquire then offset to cluster A2					

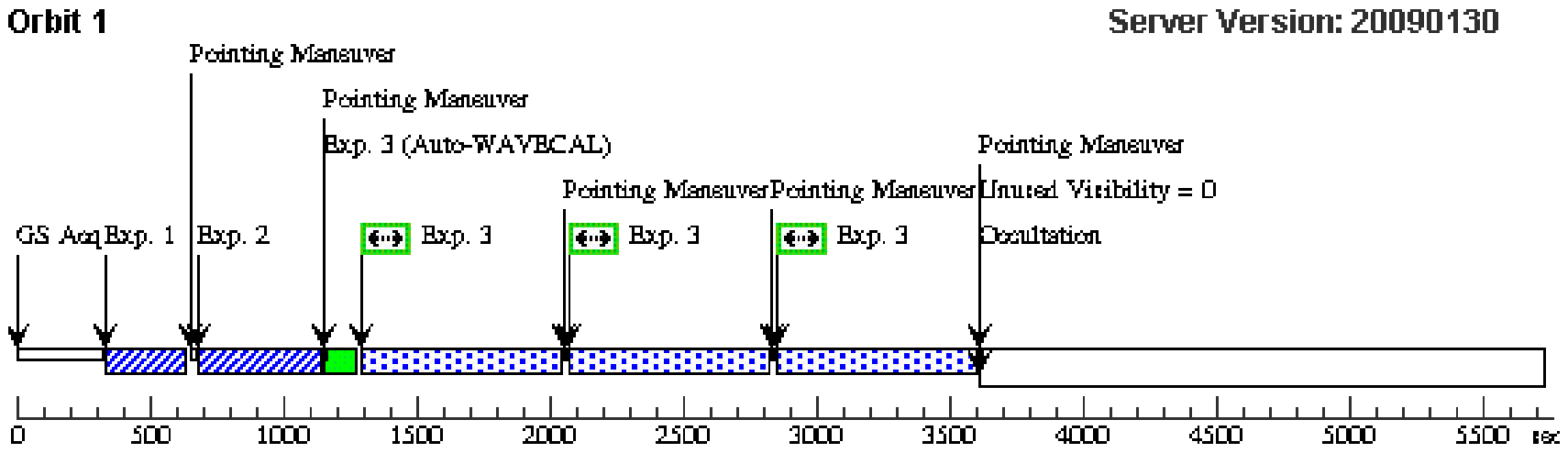
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	G430L Acquisition	(2) M82-A1-OFFSET	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			20 Secs	
								[==>]	***[1]***
Comments: point source acquisition using the long-pass filter									
2	G430L Peak Up	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs	
								[==>]	***[1]***
Comments: PeakUp with the 52x0.1 mask and the mirror									
3	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 1, Exps 3-3 (1)	710 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	

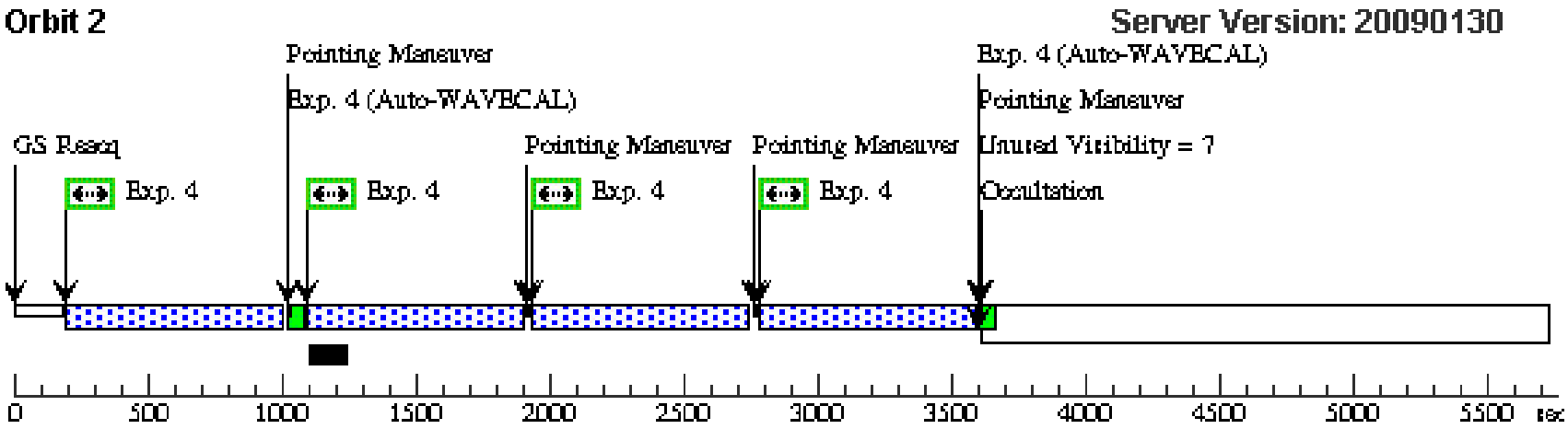
Exposures (continued)

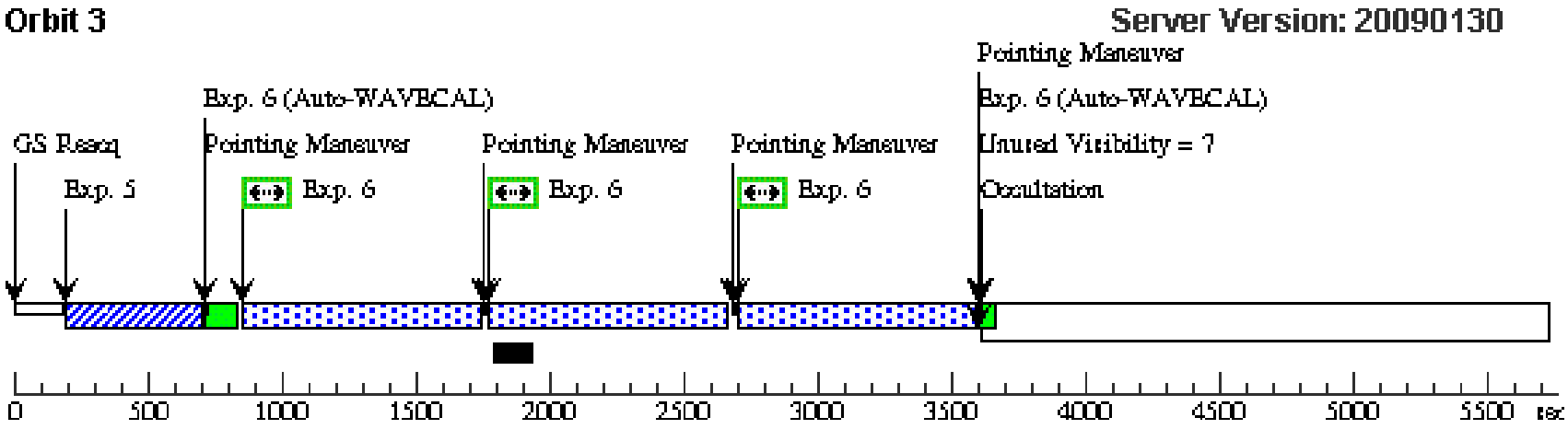
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
4	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 2, Exps 4-4 (2)	775 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
5	G430L Peak Up	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs *[==>]*	***[3]***
Comments: PeakUp with the 52x0.1 mask and the mirror									
6	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 1, Exps 6-6 (1)	855 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[3]***
7	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 2, Exps 7-7 (2)	775 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[4]***

Orbit Structure



Orbit Structure (continued)





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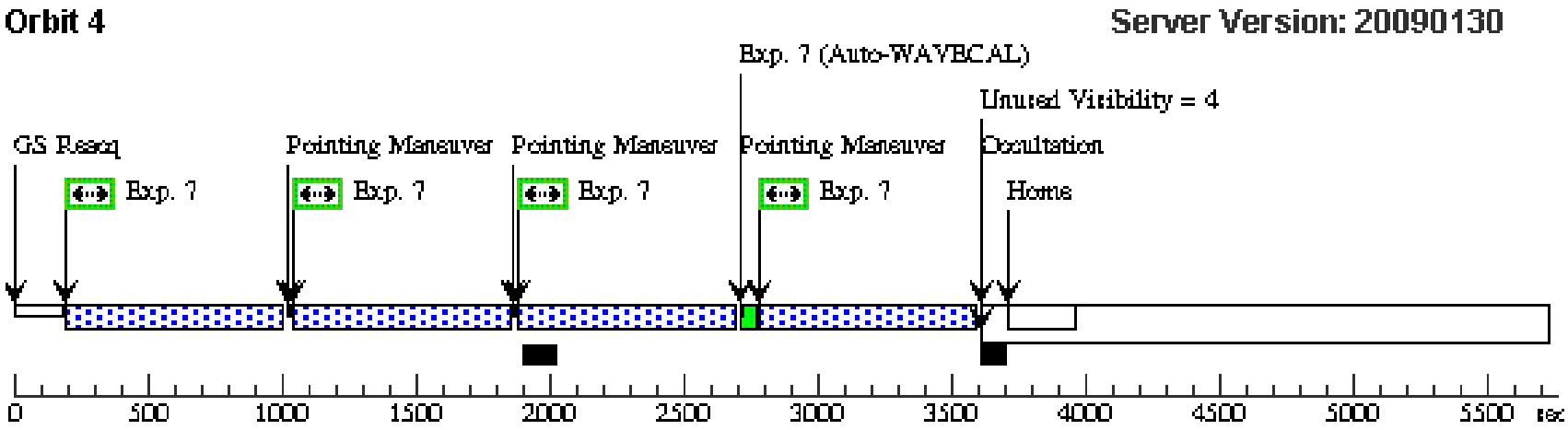


Visit

Proposal 11641, Visit 03, implementation Tue Jun 16 01:12:20 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SAME ORIENT AS 01

Comments: G430L visit 3

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(3), (6)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			
(2)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(4), (7)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82-A2	Offset from M82-A1-OFFSET by		V=(?)	Offset Position (M82-A2)
		RA Offset: 0.285 Secs		B=19.66 mag,	Reference Frame: ICRS
		Dec Offset: -0.2 Arcsec		E(B-V)~1.35	
Comments: This is the target star cluster (cluster A2) To centre on it, we need to offset from cluster A1 - the brightest source.					
(2)	M82-A1-OFFSET	RA: 09 55 53.3200 (148.9721667d)		V=17.23+/-0.1	Reference Frame: ICRS
		Dec: +69 40 50.30 (69.68064d)			
		Equinox: J2000			
Comments: Cluster A1: to acquire then offset to cluster A2					

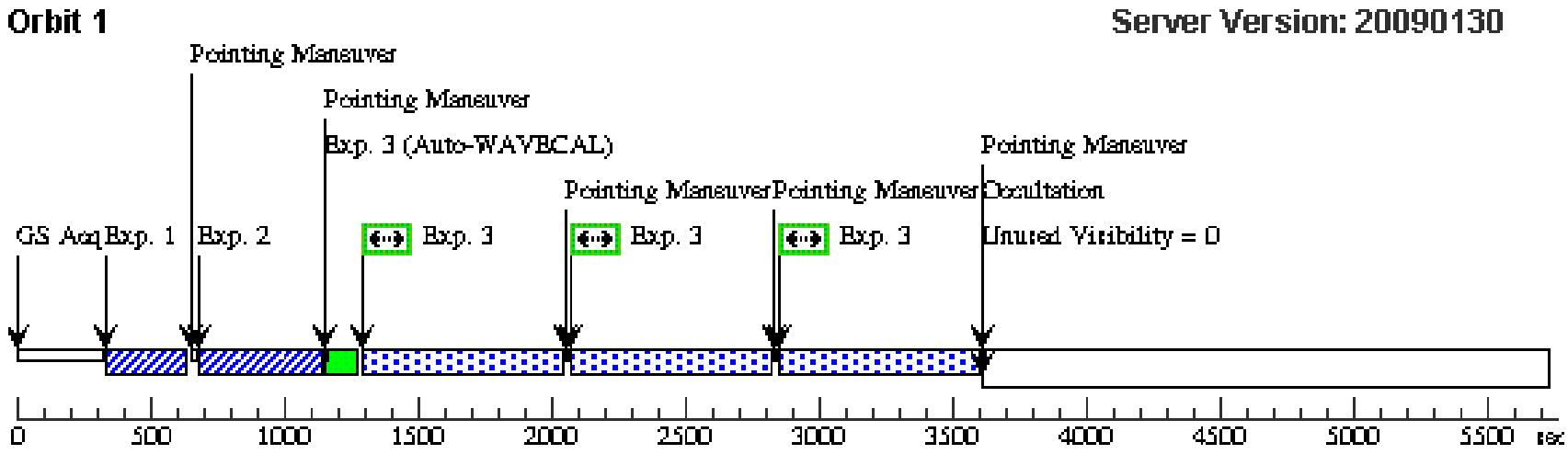
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	G430L Acquisition	(2) M82-A1-OFFSET	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			20 Secs	
								[==>]	***[1]***
Comments: point source acquisition using the long-pass filter									
2	G430L Peak Up	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs	
								[==>]	***[1]***
Comments: PeakUp with the 52x0.1 mask and the mirror									
3	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 1, Exps 3-3 (1)	710 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	

Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
4	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 2, Exps 4-4 (2)	775 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
5	G430L Peak Up	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs *[==>]*	***[3]***
Comments: PeakUp with the 52x0.1 mask and the mirror									
6	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 1, Exps 6-6 (1)	855 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[3]***
7	G430L Science dither 1	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G430L 4300 A	CR-SPLIT=NO		Pattern 2, Exps 7-7 (2)	775 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[4]***

Orbit Structure



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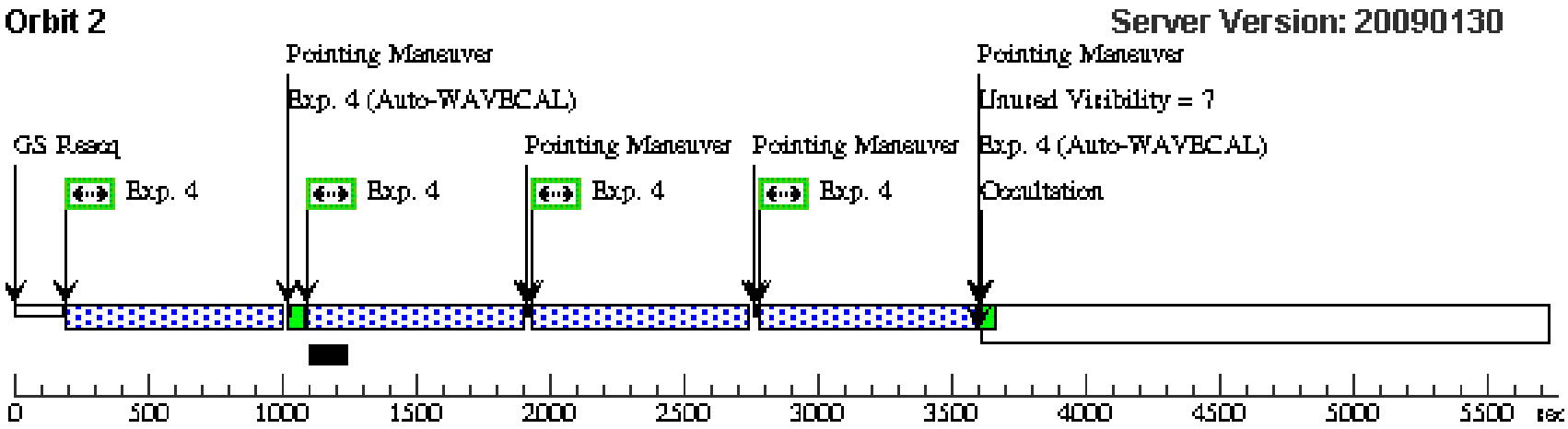

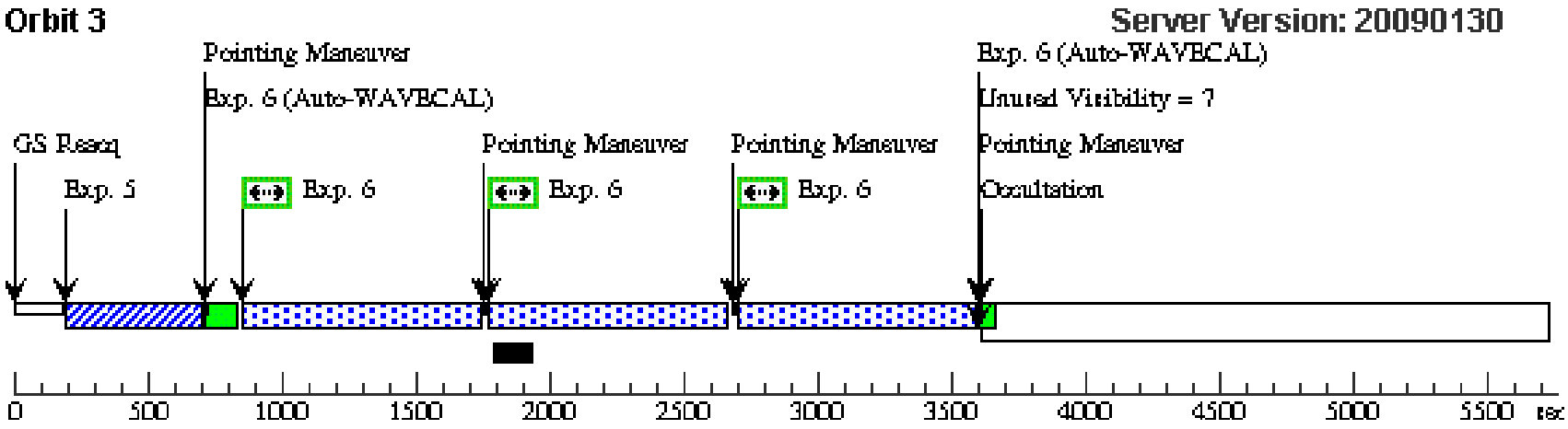

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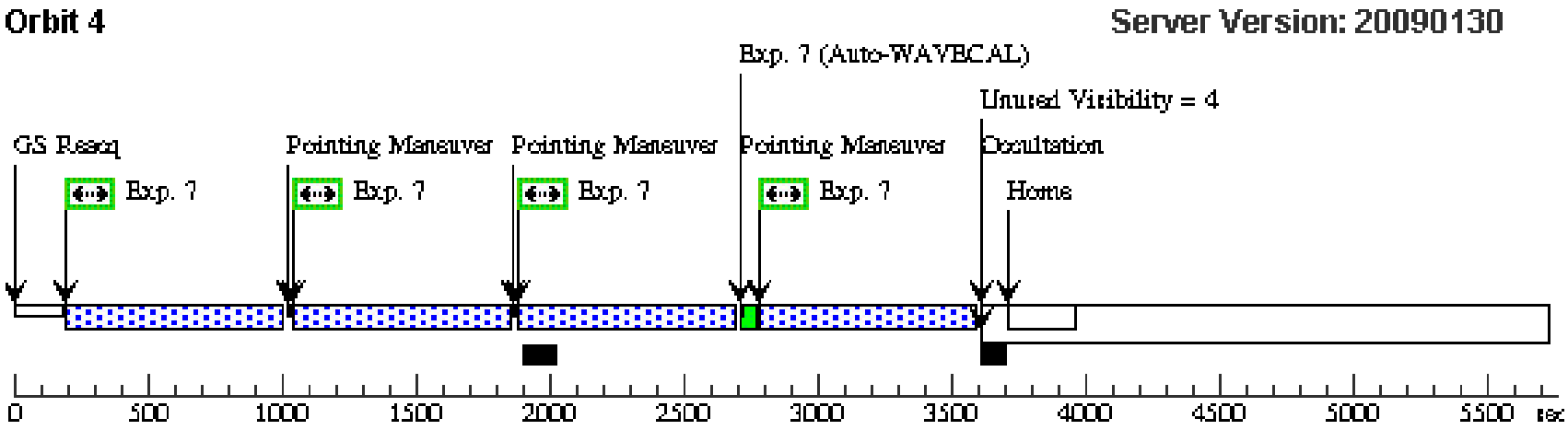


Visit

Proposal 11641, Visit 04, implementation Tue Jun 16 01:12:21 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SAME ORIENT AS 01

Comments: G750M setting, 4 orbits

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(3), (6)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			
(2)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(4), (7)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=4	Angle Between Sides=		
	Point Spacing=0.415	Center Pattern=true		
	Line Spacing=			

Fixed Targets

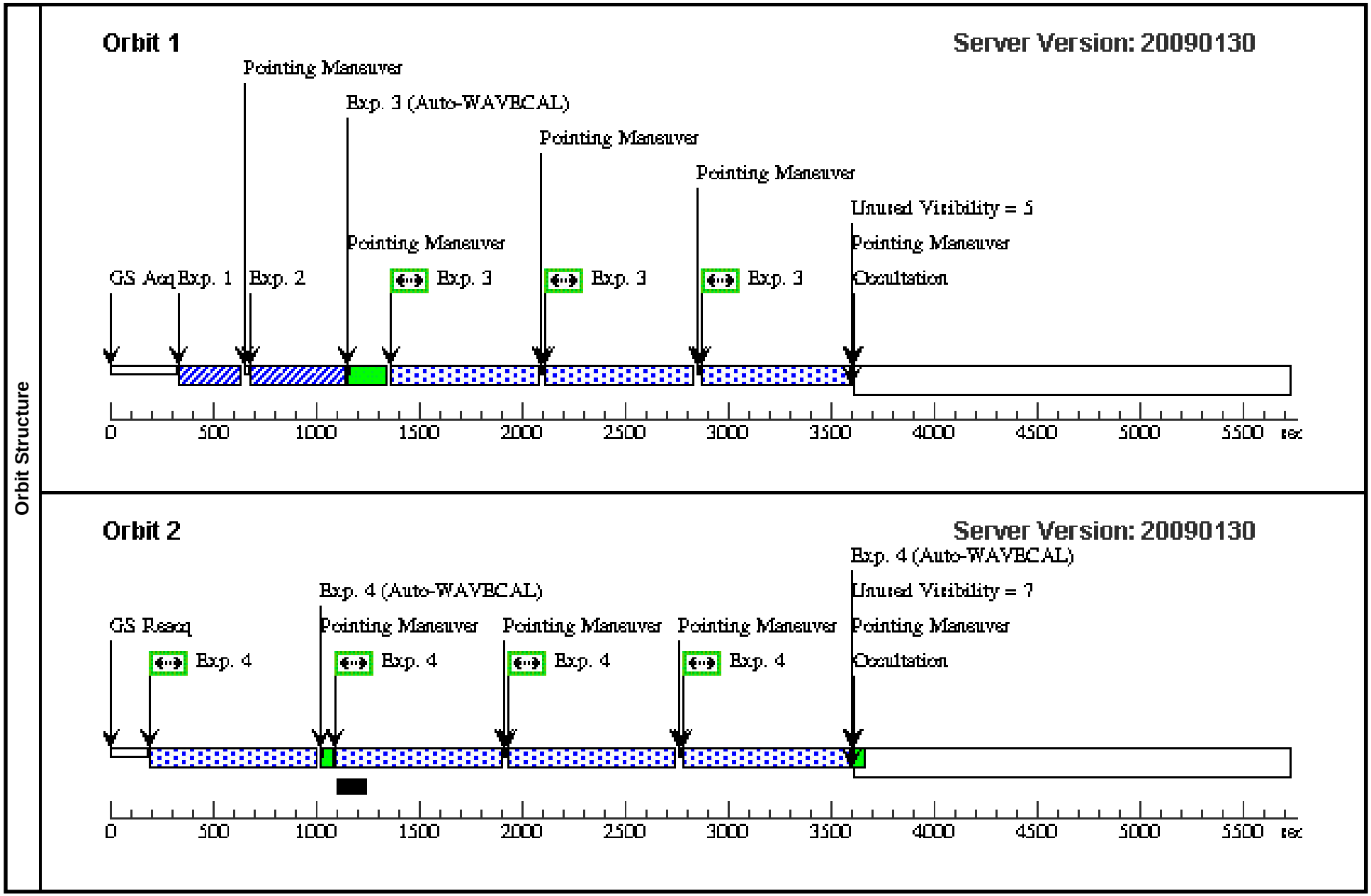
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82-A2	Offset from M82-A1-OFFSET by		V=(?)	Offset Position (M82-A2)
		RA Offset: 0.285 Secs		B=19.66 mag,	Reference Frame: ICRS
		Dec Offset: -0.2 Arcsec		E(B-V)~1.35	
Comments: This is the target star cluster (cluster A2) To centre on it, we need to offset from cluster A1 - the brightest source.					
(2)	M82-A1-OFFSET	RA: 09 55 53.3200 (148.9721667d)		V=17.23+/-0.1	Reference Frame: ICRS
		Dec: +69 40 50.30 (69.68064d)			
		Equinox: J2000			
Comments: Cluster A1: to acquire then offset to cluster A2					

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	G750M Acquisition	(2) M82-A1-OFFSET	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			20 Secs	
								[==>]	***[1]***
2	G750M PeakUp	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs	
								[==>]	***[1]***
Comments: PeakUp with the 52x0.1 mask and the mirror									
3	G750M Science	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G750M 6768 A	CR-SPLIT=NO		Pattern 1, Exps 3-3 (1)	685 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	

Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
4	G750M Science	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G750M 6768 A	CR-SPLIT=NO		Pattern 2, Exps 4-4 (2)	775 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
5	G750M PeakUp	(1) M82-A2	STIS/CCD, ACQ/PEAK, 52X0.1E1	MIRROR				20 Secs	
								[==>]	***[3]***
Comments: PeakUp with the 52x0.1 mask and the mirror									
6	G750M Science	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G750M 6768 A	CR-SPLIT=NO		Pattern 1, Exps 6-6 (1)	810 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[3]***
7	G750M Science	(1) M82-A2	STIS/CCD, ACCUM, 52X0.1E1	G750M 6768 A	CR-SPLIT=NO		Pattern 2, Exps 7-7 (2)	775 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[4]***


Orbit Structure
Orbit 1
Server Version: 20090130
Pointing Maneuver
Exp. 3 (Auto-WAVECAL)
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 5
Pointing Maneuver
GS Acq
Exp. 1
Exp. 2
Exp. 3
Exp. 3
Exp. 3
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec
Orbit 2
Server Version: 20090130
Exp. 4 (Auto-WAVECAL)
Unused Visibility = 7
Exp. 4 (Auto-WAVECAL)
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
GS Reacq
Exp. 4
Exp. 4
Exp. 4
Exp. 4
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Orbit Structure (continued)