11221 - A Dark Core in Abell 520

Cycle: 16, 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) ABELL-0520-1 (2) ABELL-0520-2 (3) ABELL-0520-3	WFPC2	6	18-Jan-2008 04:20:22.0	yes
02	(4) ABELL-0520-4 (5) ABELL-0520-5 (6) ABELL-0520-6	WFPC2	6	18-Jan-2008 04:20:31.0	yes
03	(7) ABELL-0520-7 (8) ABELL-0520-8 (9) ABELL-0520-9	WFPC2	6	18-Jan-2008 04:20:42.0	yes

18 Total Orbits Used

ABSTRACT

We have recently disocovered that the rich cluster Abell 520 exhibits truly extreme multi-wavelength characteristics. The data indicate that the cluster is the site of a major merger. Our weak lensing analysis, based on a deep CFHT image, suggests the presence of a massive dark core that coincides with the central X-ray emission peak, while being largely devoid of galaxies. Although a displacement between the X-ray gas and the galaxy/dark matter distribution may be expected in a merger (e.g. as in the bullet cluster), the dark matter peak without galaxies cannot be easily explained within the current collisionless dark matter paradigm. A higher resolution mass map is required to make further progress, as it will enable us to examine the detailed structure of the dark matter distribution, as well as improve the significance of the dark peak. We propose a 3 x 3 WFPC2 mosaic of interlaced images, where each pointing consists of two sets of F814W exposures offset by 5.5 pixels. This will precisely pinpoint the locations of the highest lensing peaks, enhance the comparison with the Chandra X-ray data, and test physical and geometrical models for the spatial and thermal structure of this remarkable cluster derived from our suite of gas+dark matter simulations of head-on/off-axis cluster mergers.

OBSERVING DESCRIPTION

A detailed map of the matter distribution is a crucial component in our analysis of Abell 520, as the dynamical tracers that are usually employed are no longer accurate. Based on our experience with HST WFPC2 observations we know that by constructing an interlaced image from four half-orbit exposures in the F814W filter (using a 45 degree parallelogram box pattern), we can reach an effective number density of ~ 100 galaxies arcmin^{-2} (Hoekstra 2000). We therefore request for 2 orbits per
pointing.

We choose to observe using the F814W filter, because it is the broadest and most sensitive for detecting the high redshift galaxies needed in our lensing analysis.

The layout of the mosaic was chosen to provide adequate coverage of the most interesting ground-based lensing features, as well as to provide a minimum 5" overlap among the various mosaic tiles, and a larger overlap in the region of the central dark peak.

The chief goal of the parallelogram dither pattern is to produce images that can be interlaced in a 4x4 pattern without any interpolation. This means that if we start with four images, each pixel in each image becomes a pixel in a new interlaced image that has four times the number of pixels. We finally came up with a 4-point box (45 degree parallelogram) pattern spread over two orbits, which is shown in the a520-dither.gif file. From position 1-2 and 3-4 the dither is 2.5x2.5 (=3.54 linear) pixels, and from position 2-3 the dither is 0x3.5 pixels. If we have thought this through correctly, this pattern should allow us to produce the desired 4x4 interlace. In case the dither between orbits is not close to a half-integral value, we can treat each pair of images separately, producing two independent 2x2 interlaced images.

Using this pattern, none of the images have an integral pixel offset from the others. This makes cosmic ray removal more complicated. Neither of us have used drizzle, but if the drizzle software can produce masks for each of its input images prior to combining them, we could use drizzle to reject cosmic rays. Alternatively, we could write a small software program which produces cosmic rays masks for the individual half-integer offset images by considering all four.

In designing the layout of the mosaic, we have assumed that we cannot rely on WF4 because of the unstable bias levels. The fidelity of the mass reconstruction would suffer severely from holes in our mosaic. However, by positioning the mosaic along the major axis of the cluster mass distribution, all 4 peaks fit into the field, even if we can only use WF2 and WF3.

Visit

Proposal 11221, Visit 01 Fri Jan 18 09:20:48 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: ORIENT 255.0D TO 265.0 D; GROUP 01,02,03 WITHIN 7.0D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=BOX	Coordinate Frame=POS-TARG		(1), (2), (3)
	Purpose=DITHER	Pattern Orientation=45.0		
	Number Of Points=4	Angle Between Sides=135.0		
	Point Spacing=0.35355	Center Pattern=false		
	Line Spacing=0.35			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ABELL-0520-1	RA: 04 54 17.8190 (73.5742458d) Dec: +02 56 27.61 (2.94100d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS
(2)	ABELL-0520-2	RA: 04 54 12.1170 (73.5504875d) Dec: +02 56 2.66 (2.93407d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS
(3)	ABELL-0520-3	RA: 04 54 19.8990 (73.5829125d) Dec: +02 54 40.26 (2.91118d) Equinox: J2000		V=19+/-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) ABELL-0520-1	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 1-1 (1)	1100.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[2]***
2		(2) ABELL-0520-2	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 2-2 (1)	1100.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[3]***
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[4]***
3		(3) ABELL-0520-3	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 3-3 (1)	1100.0 Secs	
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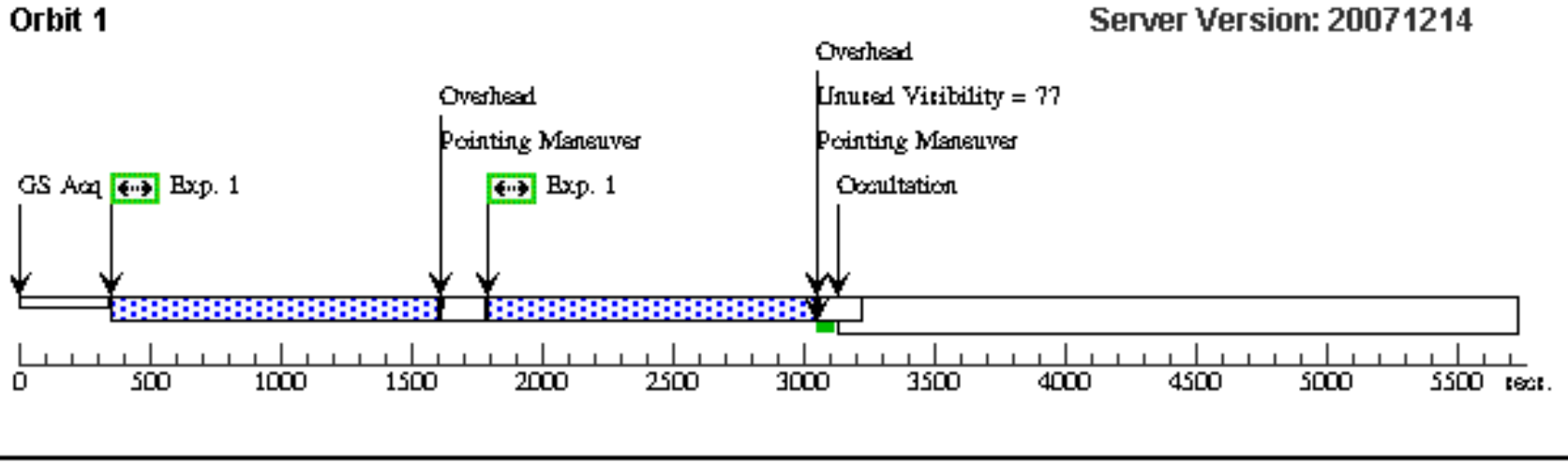
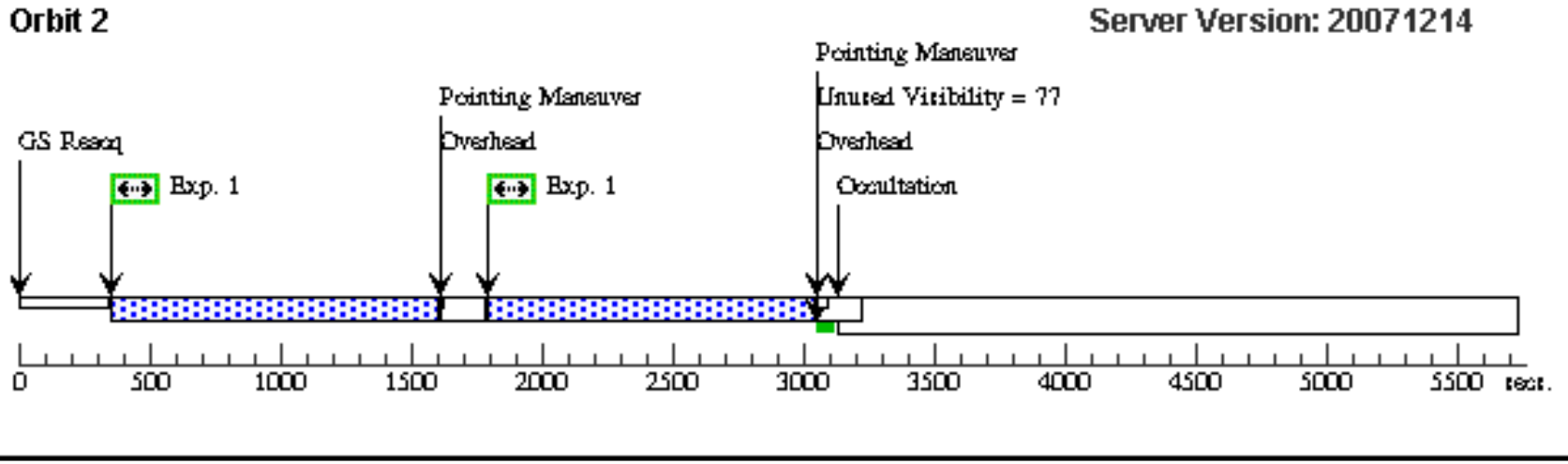
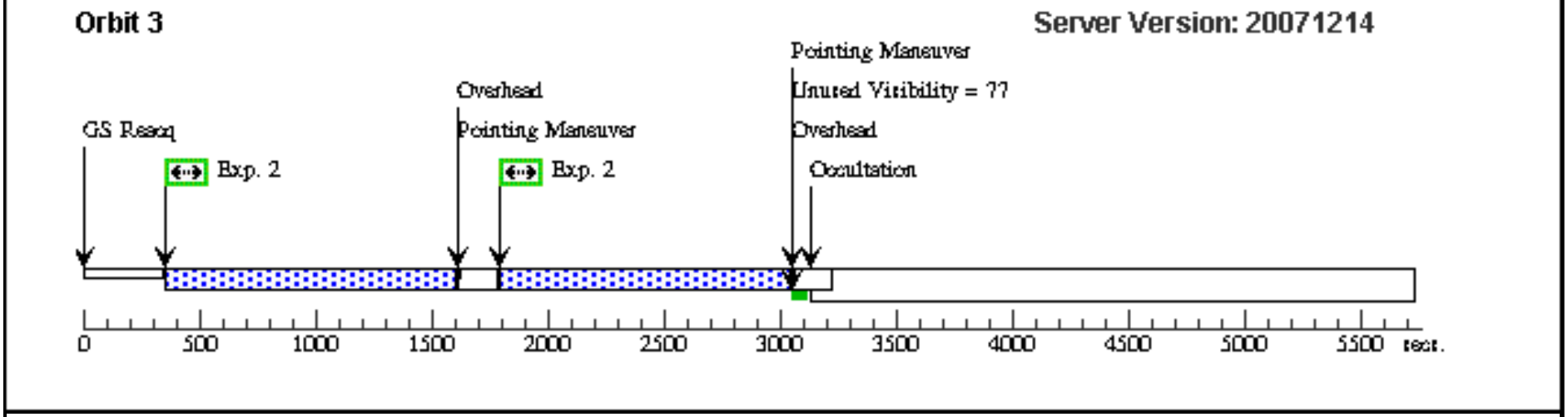
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[6]***

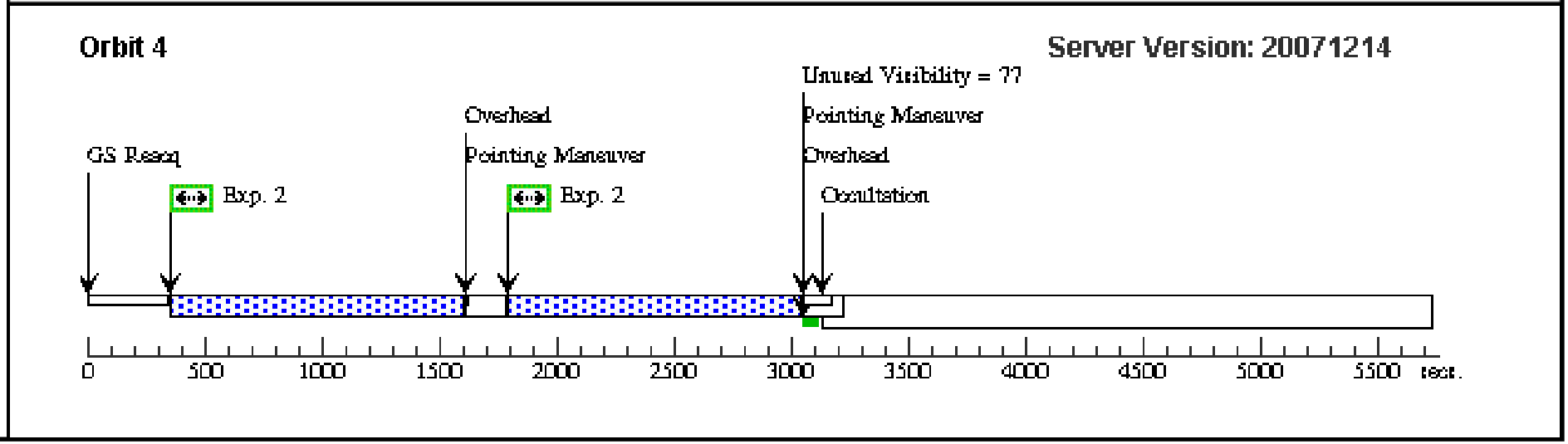
Orbit Structure





Orbit Structure (continued)





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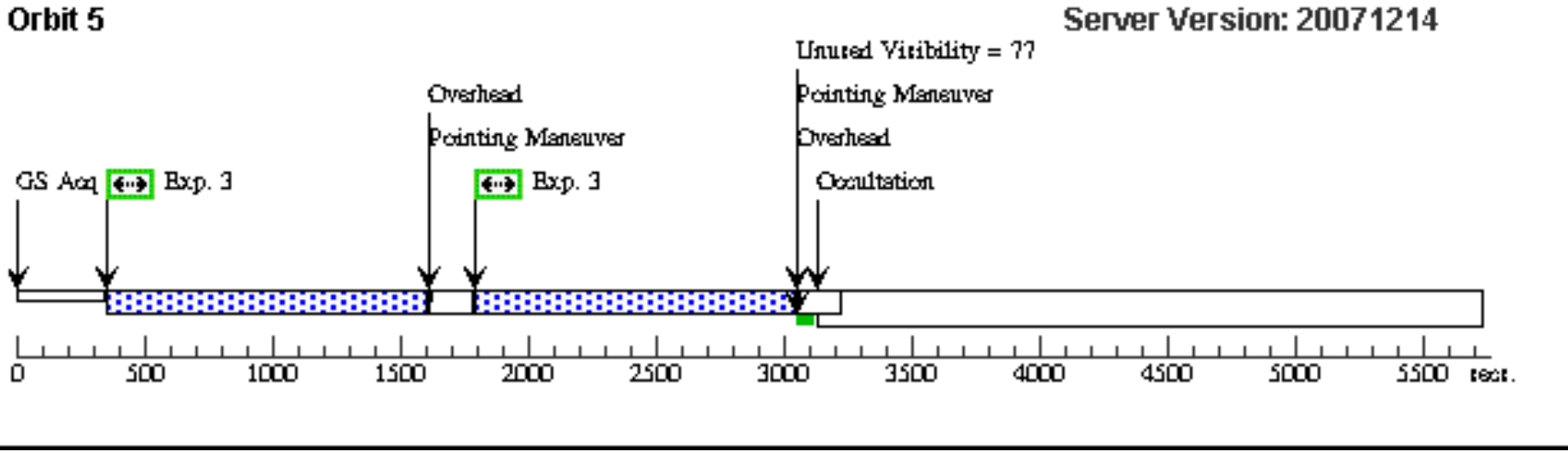

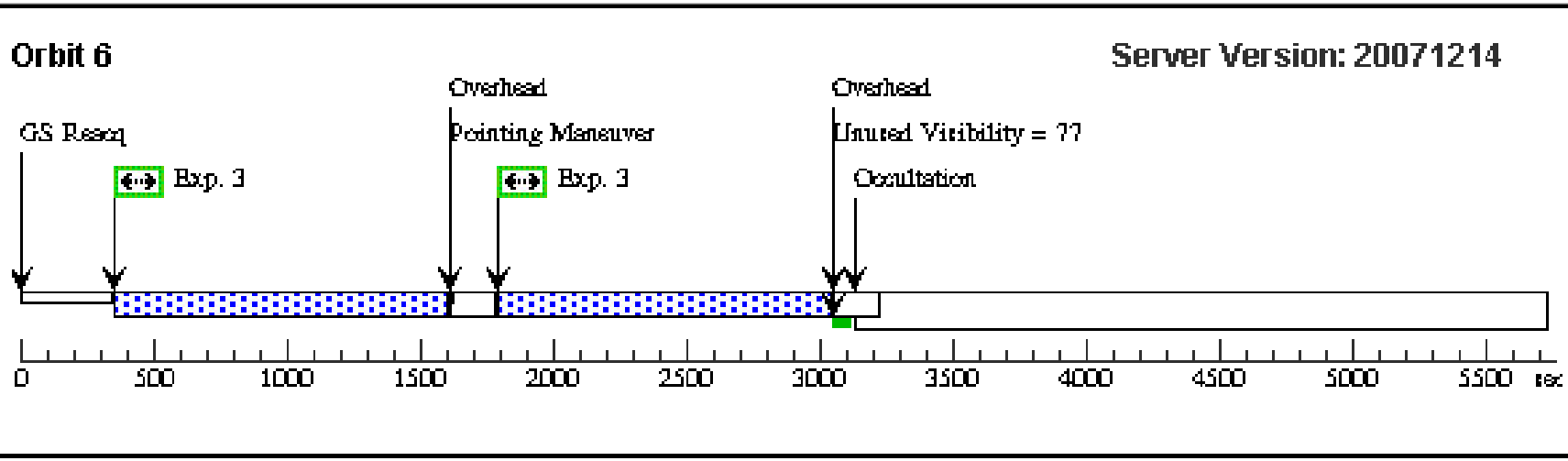

Visit

Proposal 11221, Visit 02 Fri Jan 18 09:20:49 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: SAME ORIENT AS 01

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=BOX	Coordinate Frame=POS-TARG		(1), (2), (3)
	Purpose=DITHER	Pattern Orientation=45.0		
	Number Of Points=4	Angle Between Sides=135.0		
	Point Spacing=0.35355	Center Pattern=false		
	Line Spacing=0.35			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	ABELL-0520-4	RA: 04 54 16.2980 (73.5679083d) Dec: +02 53 50.99 (2.89750d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS
(5)	ABELL-0520-5	RA: 04 54 8.4510 (73.5352125d) Dec: +02 55 15.89 (2.92108d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS
(6)	ABELL-0520-6	RA: 04 54 5.0500 (73.5210417d) Dec: +02 54 25.63 (2.90712d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(4) ABELL-0520-4	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 1-1 (1)	1100.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[2]***
2		(5) ABELL-0520-5	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 2-2 (1)	1100.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[3]***
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[4]***
3		(6) ABELL-0520-6	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 3-3 (1)	1100.0 Secs	
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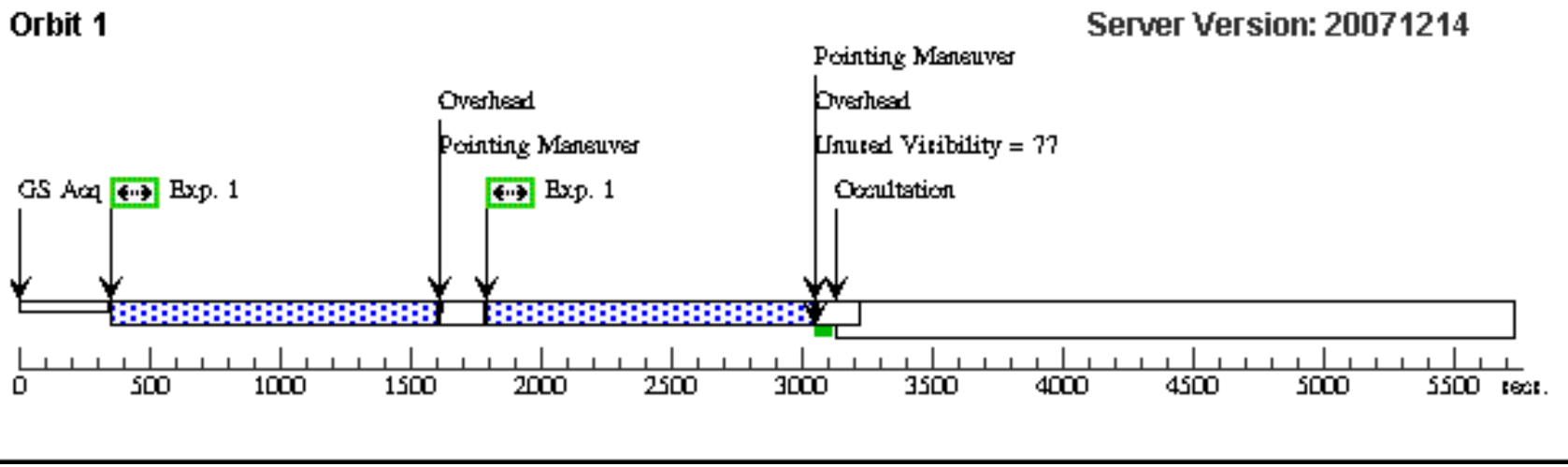
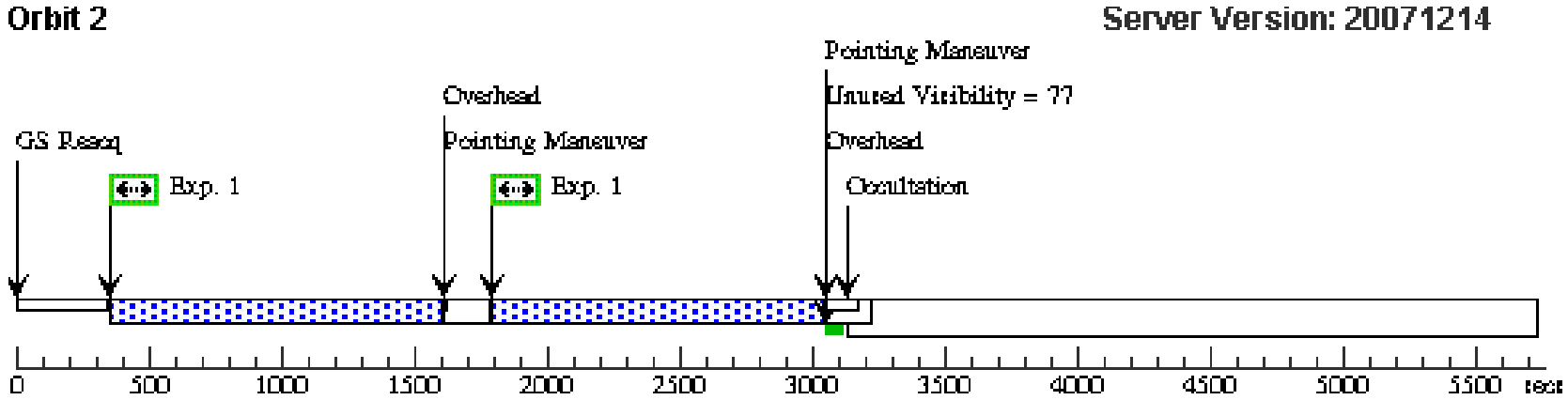
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[6]***

Orbit Structure





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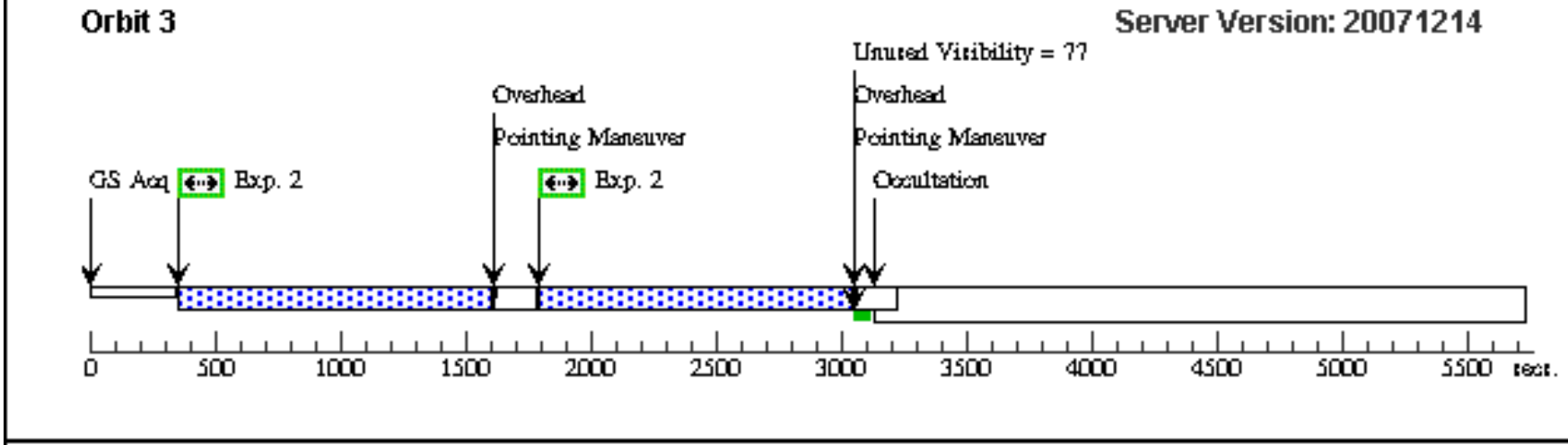

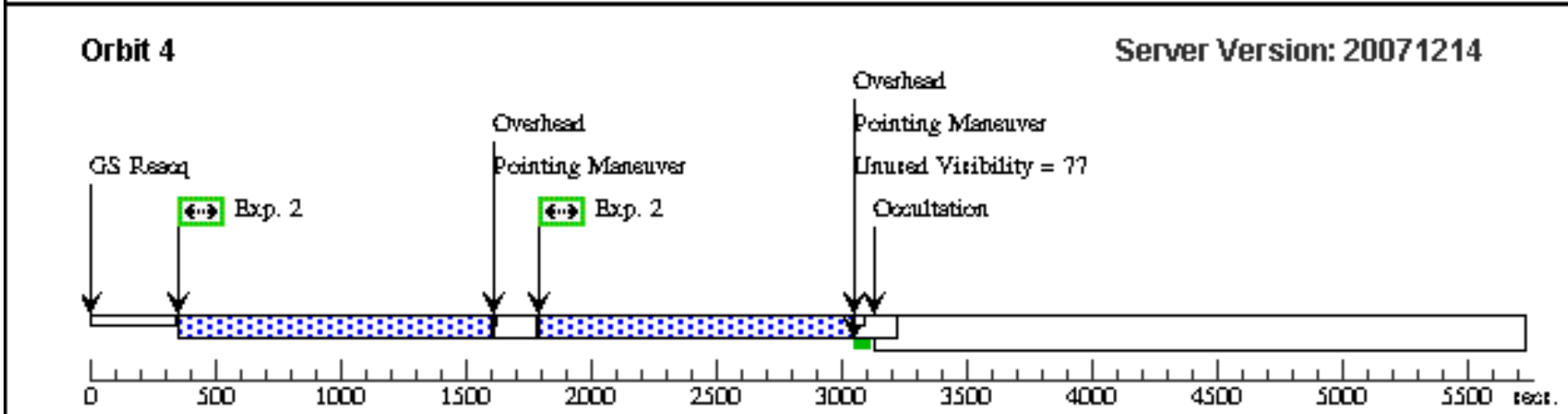

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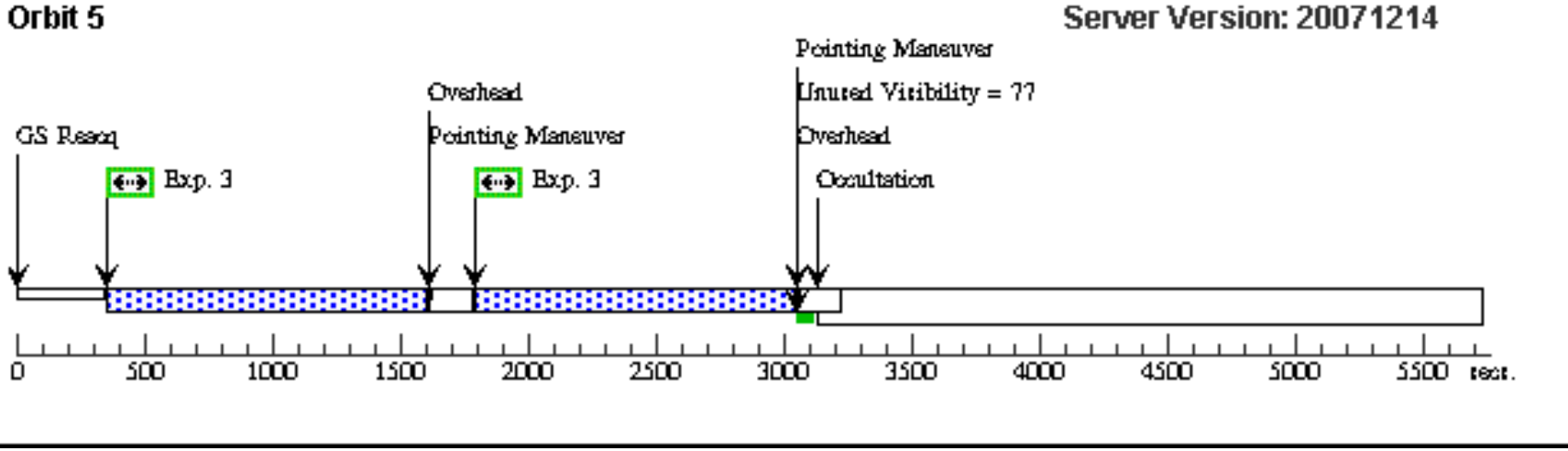

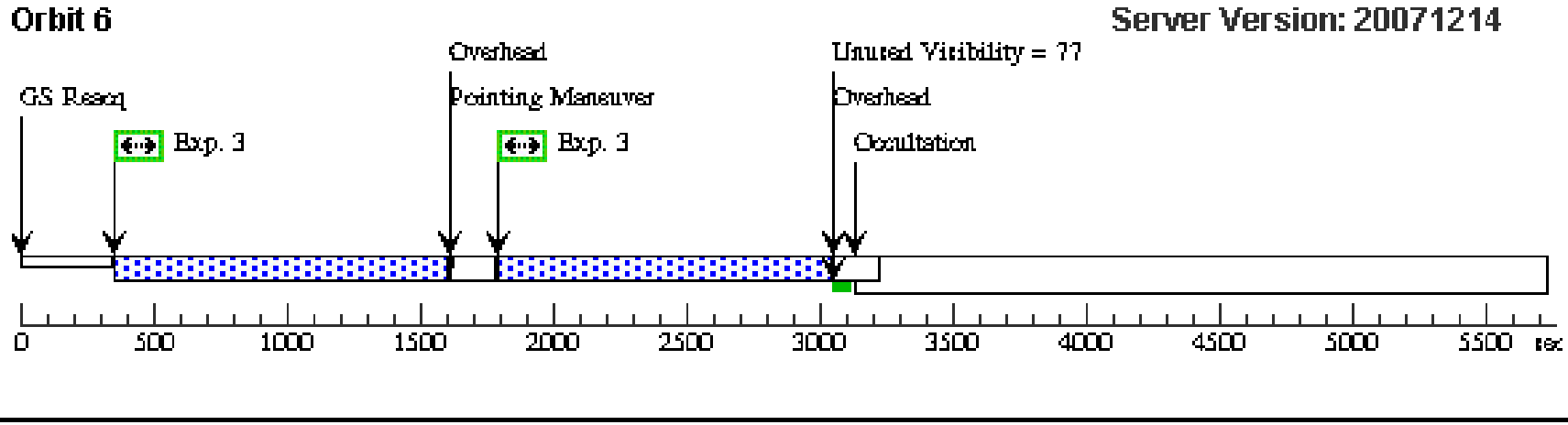

Visit

Proposal 11221, Visit 03 Fri Jan 18 09:20:50 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: SAME ORIENT AS 01

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=BOX	Coordinate Frame=POS-TARG		(1), (2), (3)
	Purpose=DITHER	Pattern Orientation=45.0		
	Number Of Points=4	Angle Between Sides=135.0		
	Point Spacing=0.35355	Center Pattern=false		
	Line Spacing=0.35			

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	ABELL-0520-7	RA: 04 54 11.3880 (73.5474500d) Dec: +02 53 17.83 (2.88829d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS
(8)	ABELL-0520-8	RA: 04 54 5.7730 (73.5240542d) Dec: +02 52 52.14 (2.88115d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS
(9)	ABELL-0520-9	RA: 04 54 5.5680 (73.5232000d) Dec: +02 51 23.24 (2.85646d) Equinox: J2000		V=19+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(7) ABELL-0520-7	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 1-1 (1)	1100.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[2]***
2		(8) ABELL-0520-8	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 2-2 (1)	1100.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[3]***
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[4]***
3		(9) ABELL-0520-9	WFPC2, IMAGE, WF4-FIX	F814W	CR-SPLIT=NO		Pattern 3-3 (1)	1100.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[5]***
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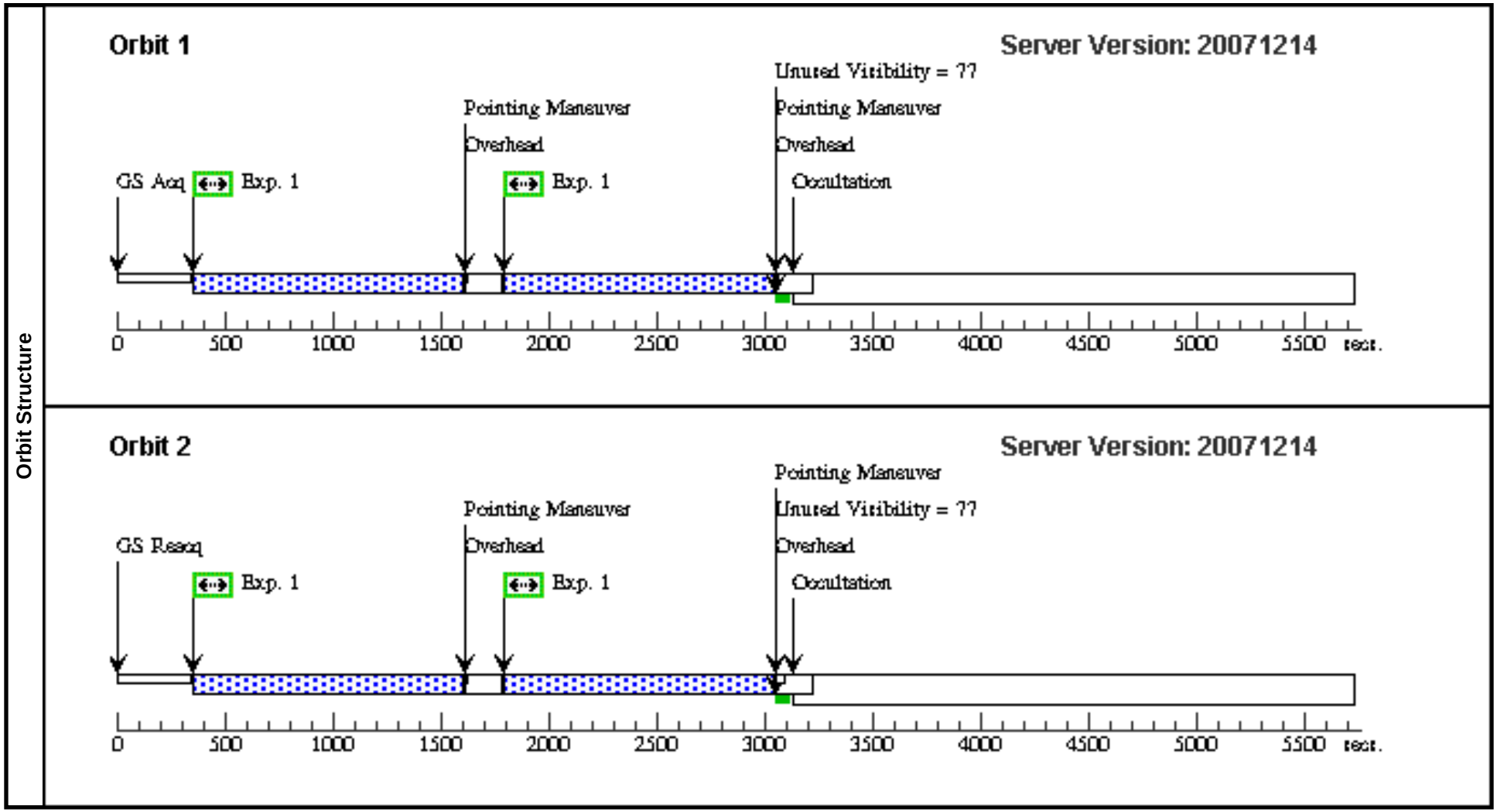
Orbit Structure
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Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
GS Acq
Exp. 1
Exp. 1
Occultation
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1000
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2000
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3500
4000
4500
5000
5500
sec.
Orbit 2
Server Version: 20071214
Pointing Maneuver
Unused Visibility = ??
Pointing Maneuver
Overhead
GS Reacq
Overhead
Exp. 1
Exp. 1
Occultation
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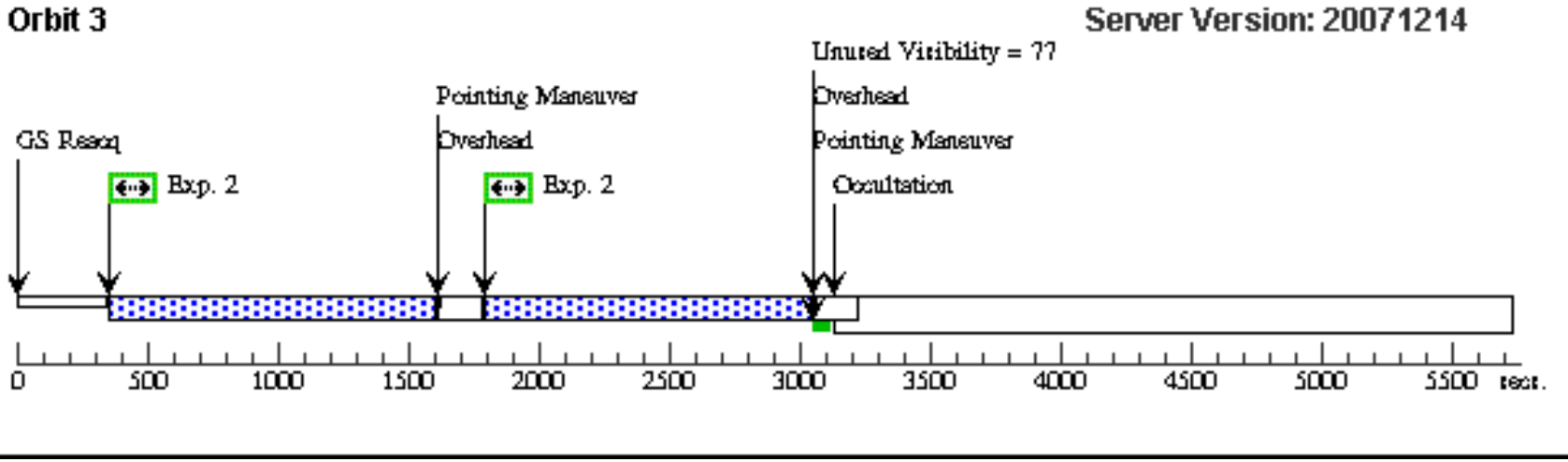
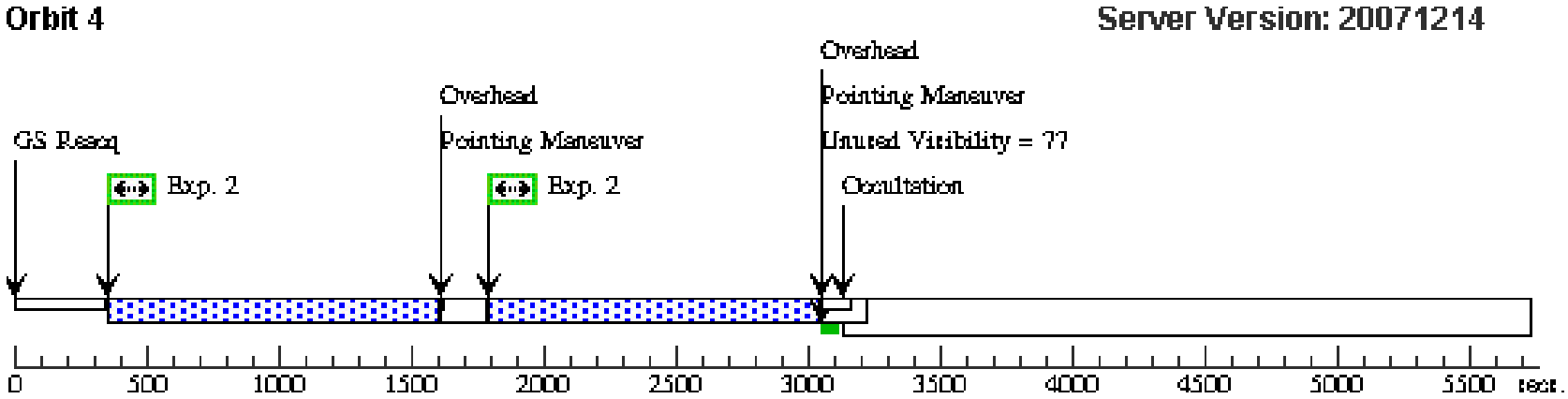
sec.

Orbit Structure (continued)





Orbit Structure (continued)