11230 - HST FUV Observations of Brightest Cluster Galaxies: The Role of Star Formation in Cooling Flows and BCG Evolution

Cycle: 16, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Christopher P. O'Dea (PI)	**Rochester Institute of Technology**	**cposps@cis.rit.edu**
Dr. Stefi A. Baum (CoI)	Rochester Institute of Technology	Baum@cis.rit.edu
Dr. Alastair C. Edge (CoI) (ESA Member)	University of Durham	Alastair.Edge@Durham.ac.uk
Dr. Alice Quillen (CoI)	University of Rochester	aquillen@pas.rochester.edu
Mr. Jaehong Park (CoI)	University of Rochester	jaehong@pas.rochester.edu
Dr. Megan Donahue (CoI)	Michigan State University	donahue@pa.msu.edu
Prof. Mark Voit (CoI)	Michigan State University	voit@pa.msu.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) ZWCL3146	ACS/SBC	1	15-Dec-2008 21:11:35.0	yes
51	(1) ZWCL3146	ACS/SBC	1	15-Dec-2008 21:11:40.0	yes
02	(2) A1835	ACS/SBC	1	15-Dec-2008 21:11:43.0	yes
04	(4) ZWCL8193	ACS/SBC WFPC2	2	15-Dec-2008 21:11:49.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
11	(10) A1664	ACS/SBC WFPC2	2	15-Dec-2008 21:11:58.0	yes
08	(8) ZWCL0348	ACS/SBC	1	15-Dec-2008 21:12:02.0	yes
09	(9) A0011	ACS/SBC	1	15-Dec-2008 21:12:05.0	yes
10	(11) R2129+00	ACS/SBC	1	15-Dec-2008 21:12:08.0	yes

10 Total Orbits Used

ABSTRACT

The intracluster medium (ICM) now appears to be a very dynamic place where heating and cooling processes vie for dominance and an uneasy equilibrium is maintained. Since these same processes may operate during the process of galaxy formation, the centers of clusters of galaxies provide low redshift laboratories for studying the critical processes involved in galaxy formation and black hole growth. At the present time, the main questions are (1) How much gas is cooling out of the ICM? (2) How much star formation is ongoing? (3) What is the impact of the gas and star formation on the central BCG? In order to measure the current star formation in BCGs we have undertaken a program of Spitzer IRAC and MIPS observations. We are in process of obtaining observations of a sample of Brightest Cluster Galaxies in 70 clusters selected from the ROSAT all sky survey. In about 25% of the sources observed so far, we detect a mid-IR excess which we attribute to dust heated by star formation. We propose to obtain ACS/SBC observations of the Lyman Alpha emission line and the adjacent FUV continuum in 7 BCGs which are in cooling core clusters of galaxies and have a large mid-IR excess. We also propose WFPC2 F606W observations of the two clusters without high resolution imaging to allow us to image the dust on the same scale as the Far UV continuum. The FUV will allow us to confirm the presense of ongoing starformation in these BCGs and will allow us to rule out an AGN as the dominant contributer to the mid-IR. The morphology and spatial extent of the young stars and the heated dust and CO will constrain the spatial scale over which star formation occurs and thus where the cooling gas is deposited. The combination of our FUV and IR observations will allow us to estimate the star formation rates which must balance the rate at which cold gas is deposited in the BCG. Our proposed FUV observations will produce unique information about the cooling gas, the true mass accretion rates, and the star formation rates in BCGs and its effect on the galaxy.

OBSERVING DESCRIPTION

We wil obtain ACS/SBC observations of the Lyman alpha emission line and the adjacent FUV continuum in 7 cooling core clusters of galaxies. We have chosen clusters from the ROSAT Brightest Cluster Sample (BCS) (Ebeling et al 1998). We have picked clusters with extreme H-alpha luminosities (1E42-43 ergs/s) which are about one order of magnitude higher than those of A1795 and A2597 (Crawford et al 1999). The high H-alpha luminosities place the strongest demands on models for heating and cooling in the ICM, and the ionization of the nebulae.

We will observe each cluster in a filter which passes Lyman alpha and one which does not. The second filter will be used for the measurement of the FUV continuum and for continuum subtraction from the Lyman alpha image.

The F125LP filter is ideal for the Lyman alpha image since it does not include geocoronal Lyman alpha but passes extragalactic Lyman alpha, for $z>0.03$. The continuum filter is F140LP for $z < 0.11$, F150LP for $0.11< z < 0.19$, and F165LP for $0.19 < z < 0.31$,

The ACS/SBC is actually more sensitive than the STIS/FUV-MAMA that we used for A1795 and A2597. We have run a series of ETC calculations which show that our expected signal-to-noise ratio for the seven clusters is comparable to or better than the values we obtained for A1795 and A2597. In order to calculate the S/N we use the observed H-alpha flux for each cluster and estimate the expected Lyman-alpha flux and FUV continuum using the empirical relationships we found in A1795 and A2597 (O'Dea et al 2004). Our previous HST FUV observations detected all three central dominant galaxies (A426, A1795, and A2597 - Baum et al 2005; O'Dea eta l 2004). So we expect to detect the FUV emission in these clusters.

We will also obtain an observation in WFPC2 F606W for the two galaxies without such data - R1532+30 and Z8193. This will allow us to image the dust on the same scale as the FUV.

We have shifted the position of RXJ0821 ten arsec north to avoid a bright star to the south of the SBC FOV.

All observations are done with a 3 point dither.

Visit

Proposal 11230, Visit 01, completed Tue Dec 16 02:12:11 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: PCS MODE FINE

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZWCL3146	RA: 10 23 39.6000 (155.9150000d) Dec: +04 11 12.00 (4.18667d) Equinox: J2000		V=17	Reference Frame: ICRS

Exposures

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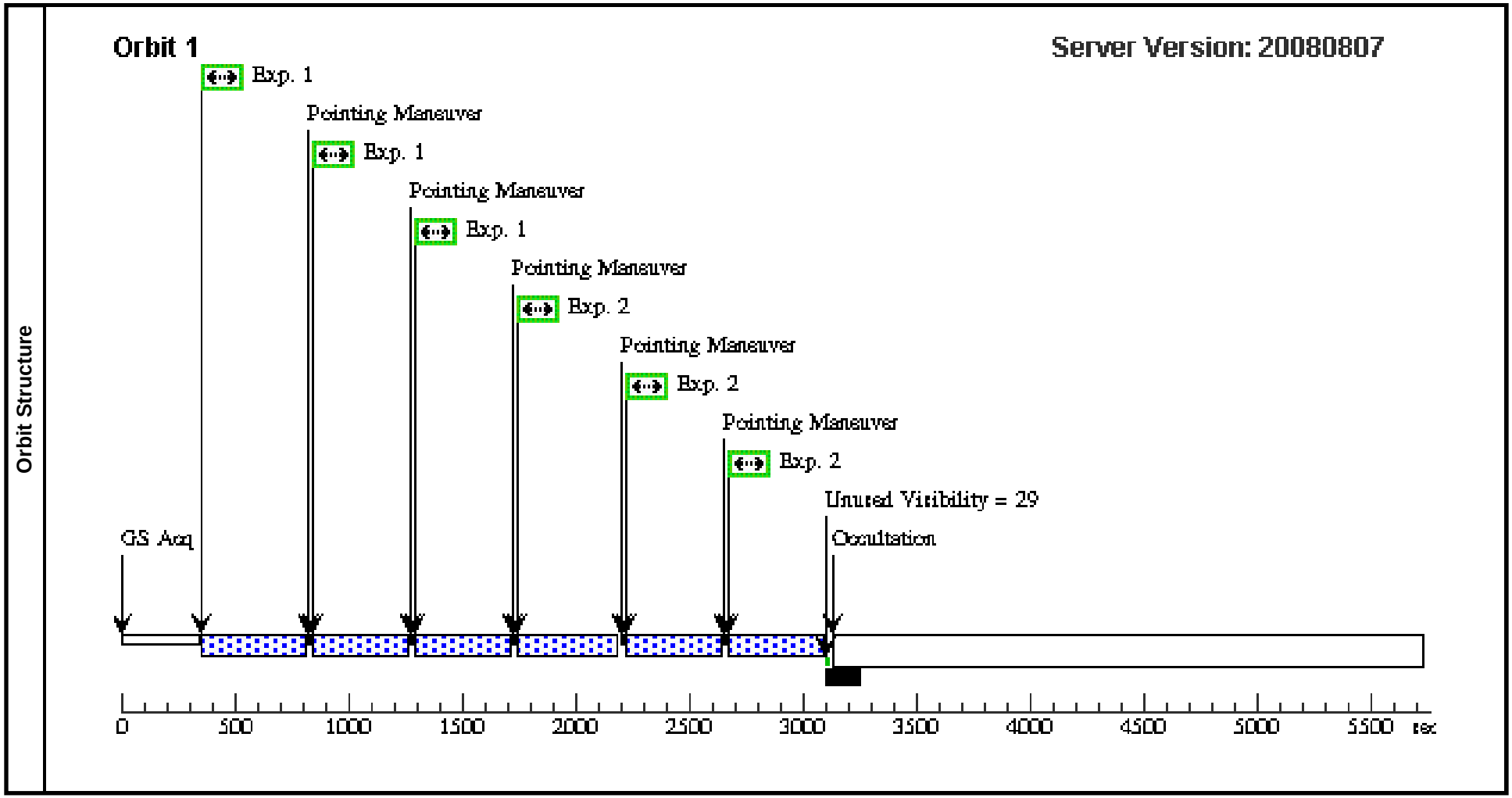
1		(1) ZWCL3146	ACS/SBC, ACCUM, SBC	F140LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(1) ZWCL3146	ACS/SBC, ACCUM, SBC	F165LP			Pattern 2-2 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***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Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Unused Vitibility = 29
GS Acq
Occultation
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1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11230, Visit 51 Tue Dec 16 02:12:12 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: PCS MODE FINE

Comments: HOPR repeat of visit 1

Patterns

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(1)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	ZWCL3146	RA: 10 23 39.6000 (155.9150000d) Dec: +04 11 12.00 (4.18667d) Equinox: J2000		V=17	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) ZWCL3146	ACS/SBC, ACCUM, SBC	F140LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(1) ZWCL3146	ACS/SBC, ACCUM, SBC	F165LP			Pattern 2-2 (1)	390.0 Secs	
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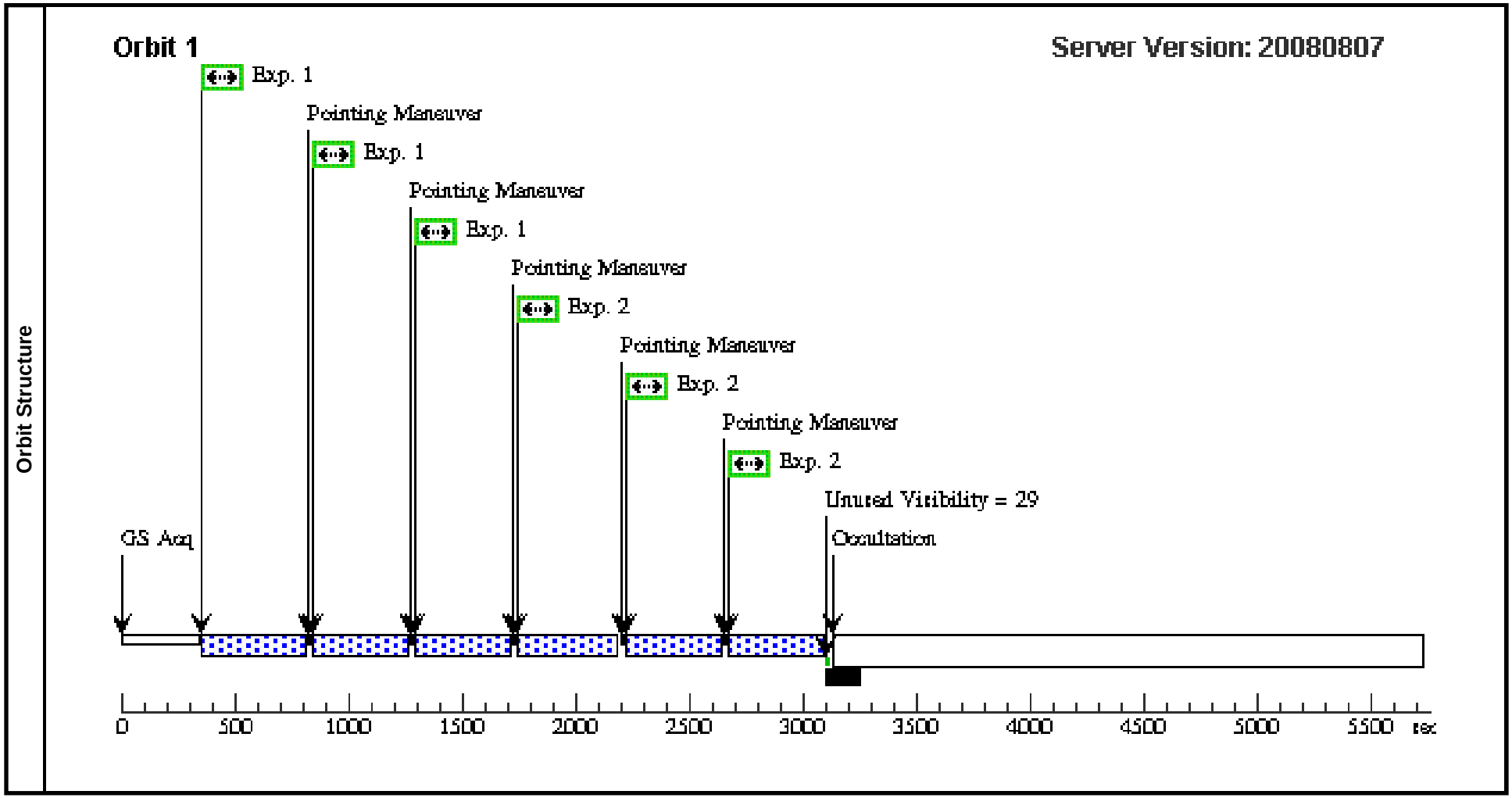
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Pointing Maneuver
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Exp. 1
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Exp. 2
Pointing Maneuver
Exp. 2
Unused Vitibility = 29
GS Acq
Occultation
0
500
1000
1500
2000
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3500
4000
4500
5000
5500
sec

Visit

Proposal 11230, Visit 02, completed Tue Dec 16 02:12:12 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Patterns

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(1)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	A1835	RA: 14 01 2.0000 (210.2583333d) Dec: +02 52 45.00 (2.87917d) Equinox: J2000		V=15	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) A1835	ACS/SBC, ACCUM, SBC	F140LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(2) A1835	ACS/SBC, ACCUM, SBC	F165LP			Pattern 2-2 (1)	390.0 Secs	
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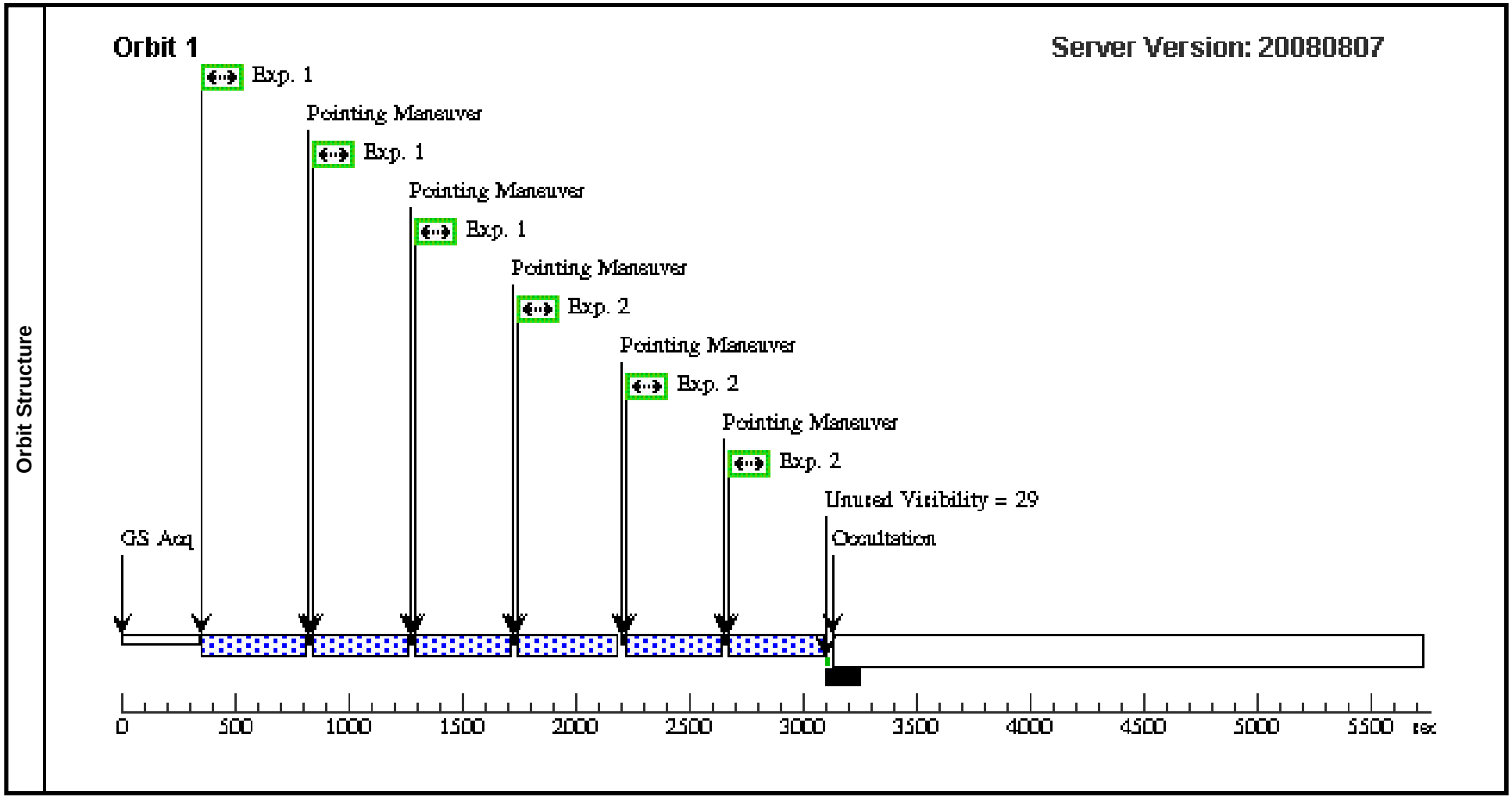
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Exp. 2
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Exp. 2
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GS Acq
Occultation
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500
1000
1500
2000
2500
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3500
4000
4500
5000
5500
sec

Visit

Proposal 11230, Visit 04, completed Tue Dec 16 02:12:13 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC, WFPC2

Special Requirements: (none)

Patterns

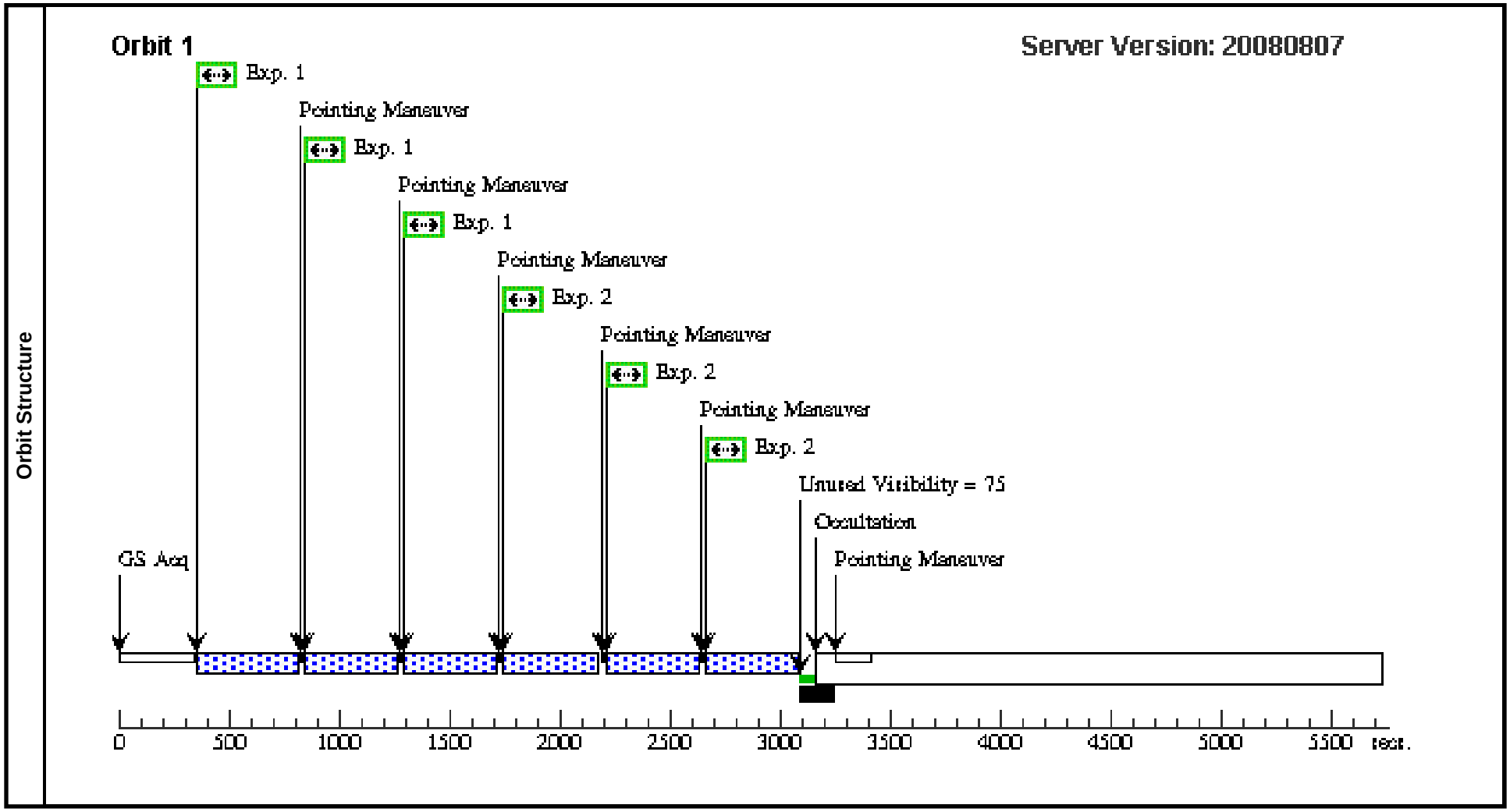
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	ZWCL8193	RA: 17 17 19.1000 (259.3295833d) Dec: +42 26 57.20 (42.44922d) Equinox: J2000		V=13	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(4) ZWCL8193	ACS/SBC, ACCUM, SBC	F140LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(4) ZWCL8193	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2-2 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
3		(4) ZWCL8193	WFPC2, IMAGE, WF3	F606W	CR-SPLIT=NO			700.0 Secs	
								[==>]	***[2]***
4		(4) ZWCL8193	WFPC2, IMAGE, WF3	F606W		POS TARG 0.498,0.498		600.0 Secs	
								[==>]	***[2]***
5		(4) ZWCL8193	WFPC2, IMAGE, WF3	F606W		POS TARG 0.996,0.996		600.0 Secs	
								[==>]	***[2]***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Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Unused Visibility = 75
Occultation
Pointing Maneuver
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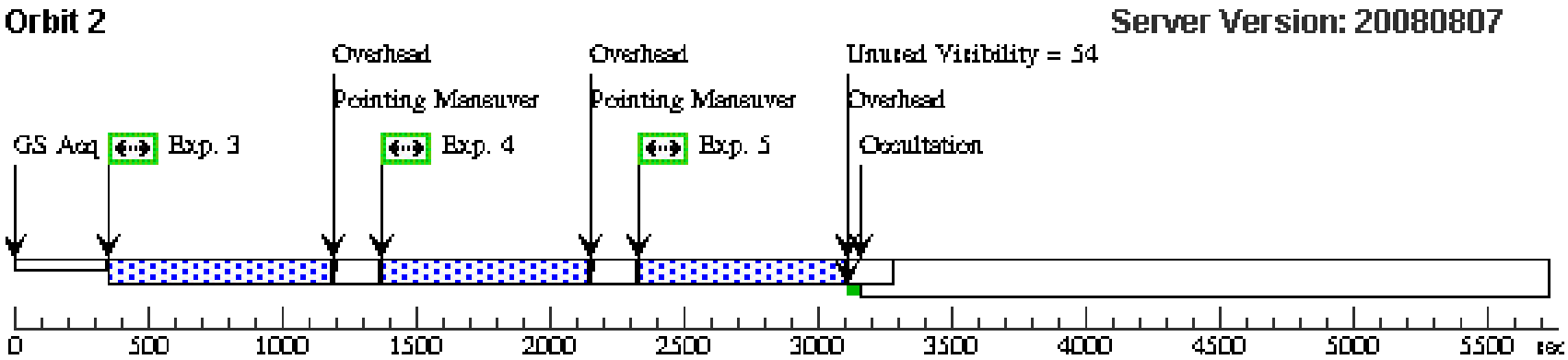
4500
5000
5500
sec.

Orbit Structure (continued)



Visit

Proposal 11230, Visit 11, completed Tue Dec 16 02:12:14 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC, WFPC2

Special Requirements: (none)

Patterns

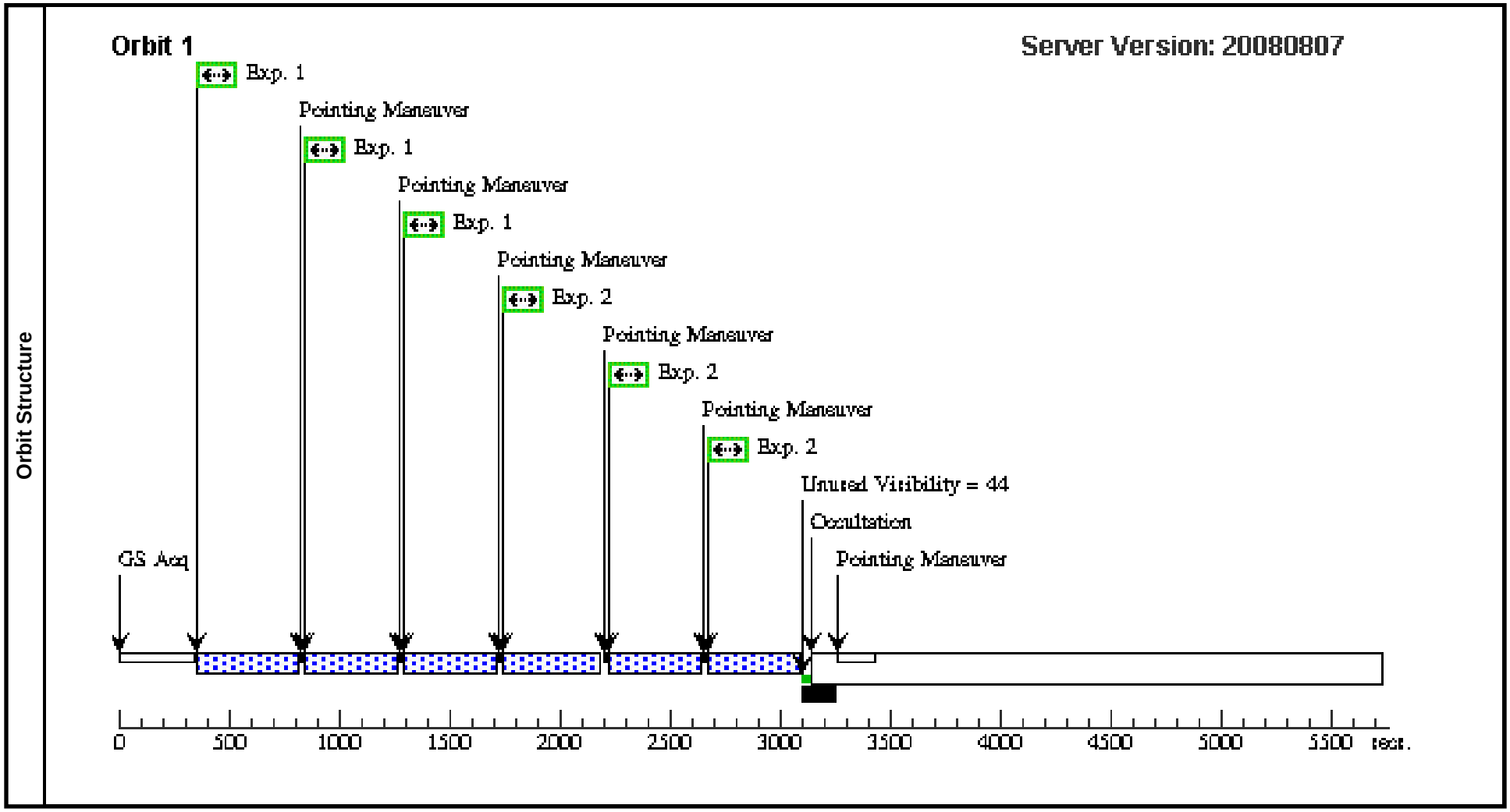
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(10)	A1664	RA: 13 03 42.5000 (195.9270833d) Dec: -24 14 41.00 (-24.24472d) Equinox: J2000		V=15.7	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(10) A1664	ACS/SBC, ACCUM, SBC	F125LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(10) A1664	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2-2 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
3		(10) A1664	WFPC2, IMAGE, WF3	F606W				600.0 Secs	
								[==>]	***[2]***
4		(10) A1664	WFPC2, IMAGE, WF3	F606W		POS TARG 0.498,0.498		600.0 Secs	
								[==>]	***[2]***
5		(10) A1664	WFPC2, IMAGE, WF3	F606W		POS TARG 0.996,0.996		600.0 Secs	
								[==>]	***[2]***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Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Unused Visibility = 44
Occultation
Pointing Maneuver
GS Acq
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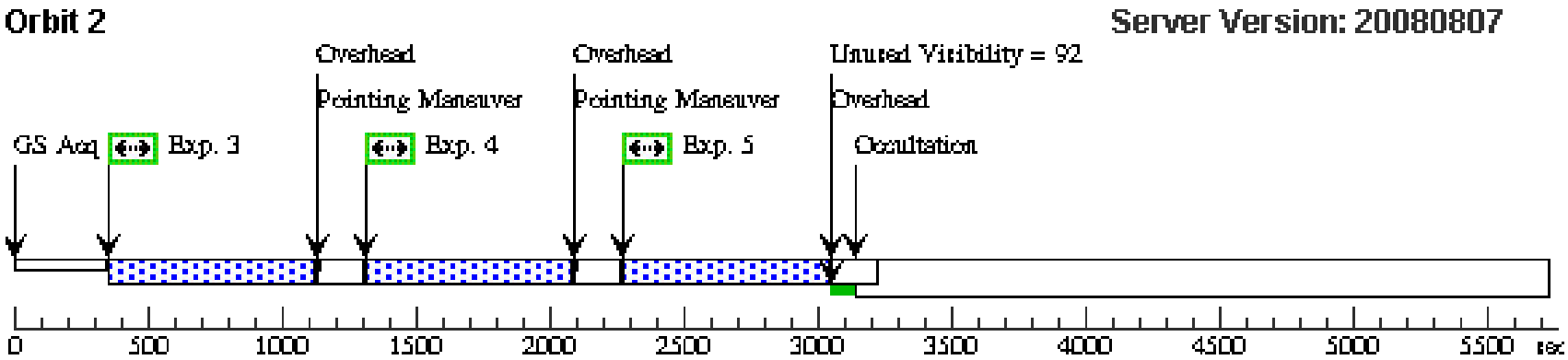
4500
5000
5500
sec.

Orbit Structure (continued)



Visit

Proposal 11230, Visit 08, completed Tue Dec 16 02:12:15 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(8)	ZWCL0348	RA: 01 06 49.3500 (16.7056250d) Dec: +01 03 22.60 (1.05628d) Equinox: J2000		V=19	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(8) ZWCL0348	ACS/SBC, ACCUM, SBC	F140LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(8) ZWCL0348	ACS/SBC, ACCUM, SBC	F165LP			Pattern 2-2 (1)	390.0 Secs	
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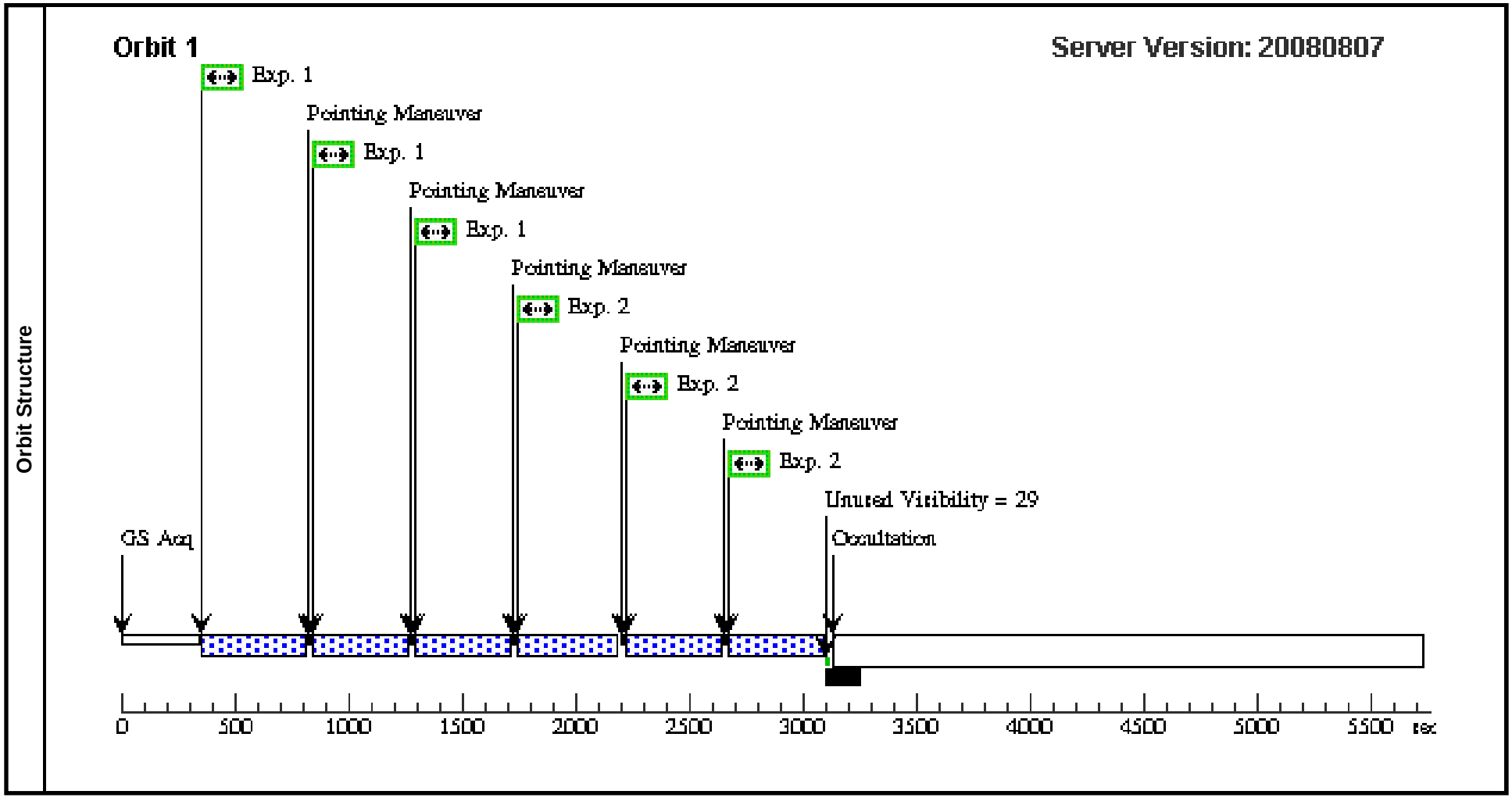
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Pointing Maneuver
Exp. 1
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Exp. 1
Pointing Maneuver
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Exp. 2
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Exp. 2
Unused Vitibility = 29
GS Acq
Occultation
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1000
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2000
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5000
5500
sec

Visit

Proposal 11230, Visit 09, completed Tue Dec 16 02:12:15 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(9)	A0011	RA: 00 12 33.8200 (3.1409167d) Dec: -16 28 6.50 (-16.46847d) Equinox: J2000		V=17.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(9) A0011	ACS/SBC, ACCUM, SBC	F125LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(9) A0011	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2-2 (1)	390.0 Secs	
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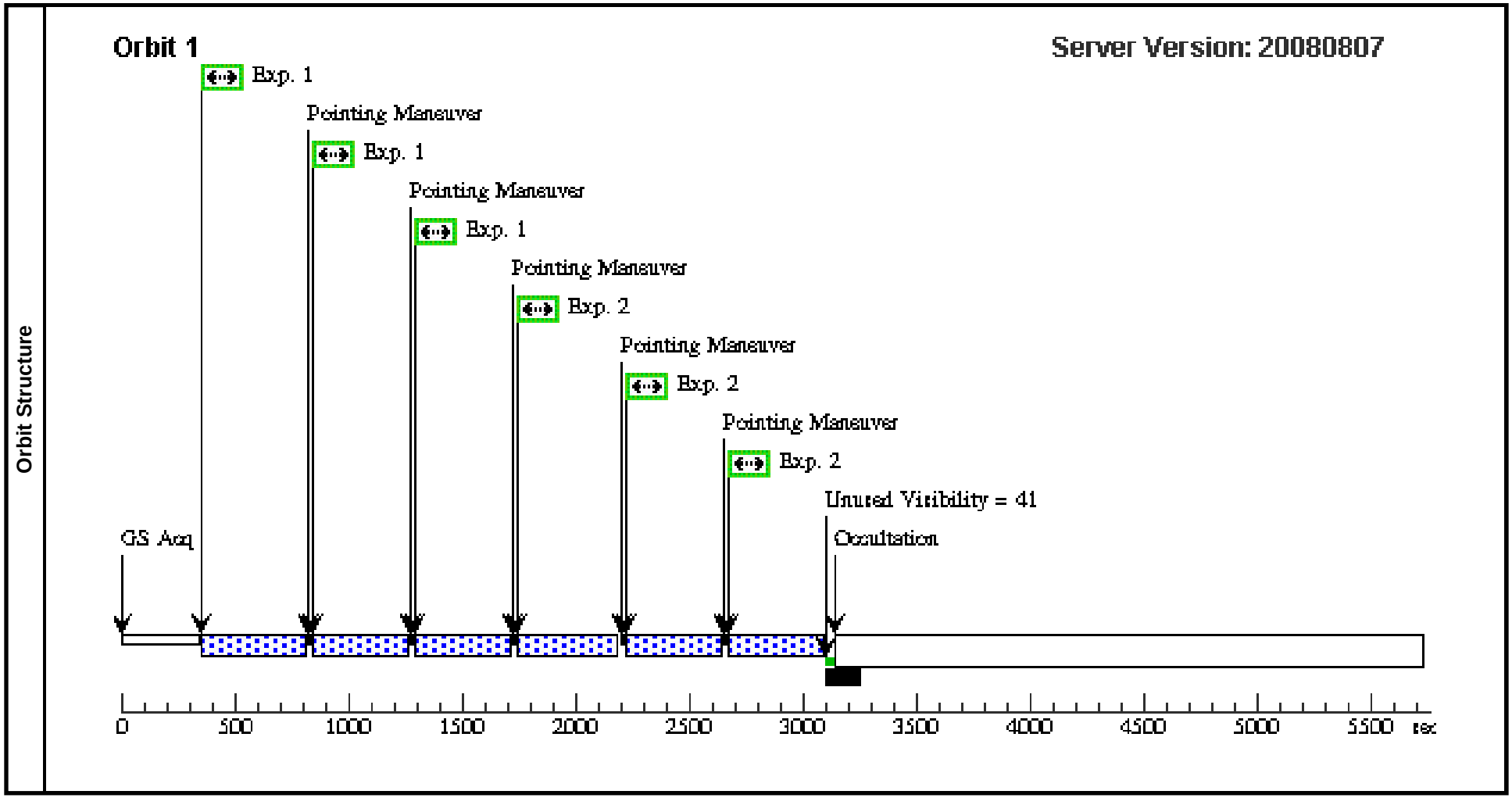
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Exp. 1
Pointing Maneuver
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Exp. 2
Pointing Maneuver
Exp. 2
Unused Vitibility = 41
GS Acq
Occultation
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1000
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4500
5000
5500
sec

Visit

Proposal 11230, Visit 10, completed Tue Dec 16 02:12:15 GMT 2008

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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Fixed Targets

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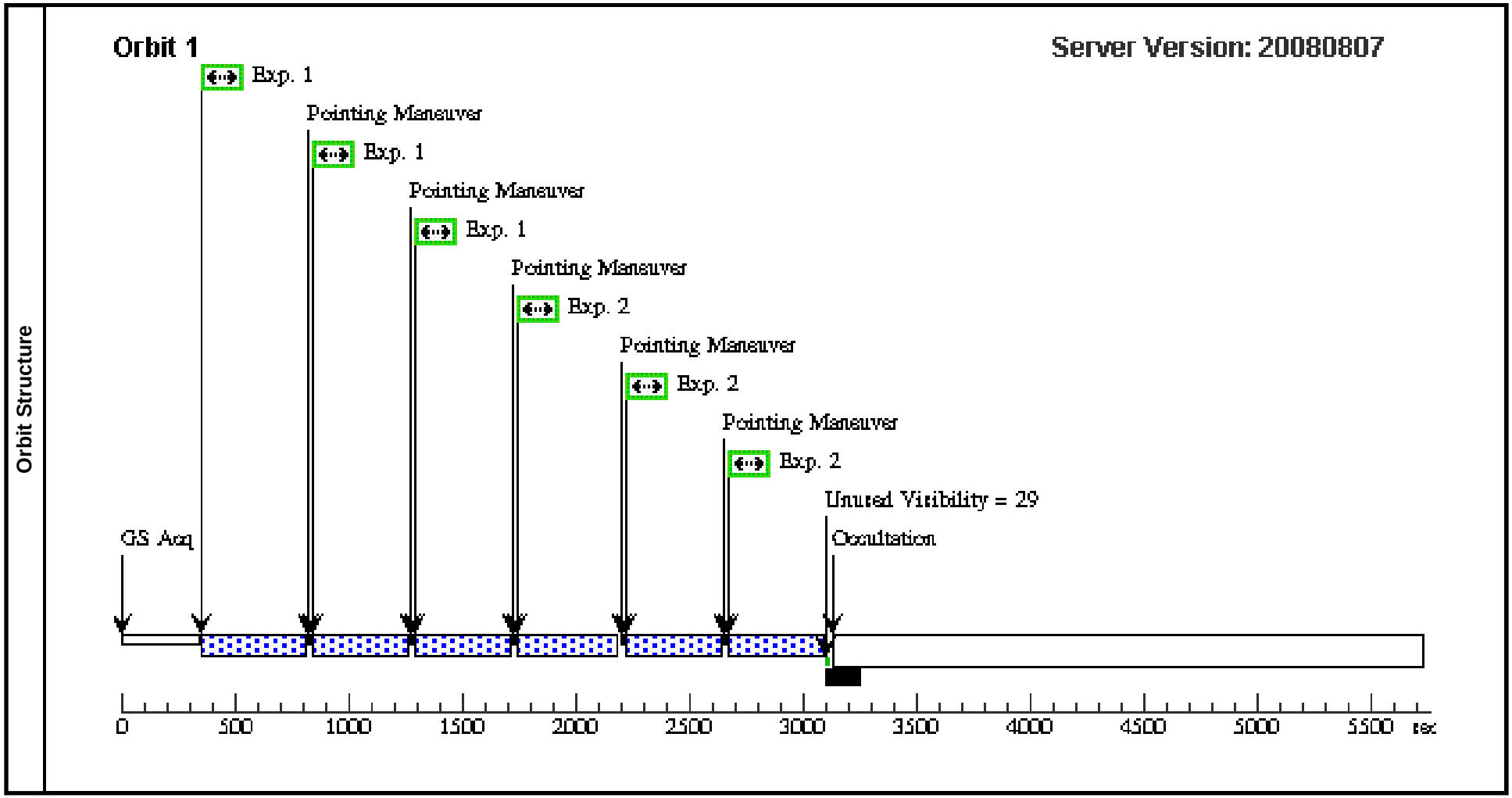
(11)	R2129+00	RA: 21 29 39.9000 (322.4162500d) Dec: +00 05 23.00 (.08972d) Equinox: J2000		V=18	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(11) R2129+00	ACS/SBC, ACCUM, SBC	F140LP			Pattern 1-1 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***
2		(11) R2129+00	ACS/SBC, ACCUM, SBC	F165LP			Pattern 2-2 (1)	390.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]*	***[1]***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Server Version: 20080807
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 1
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Pointing Maneuver
Exp. 2
Unused Vitibility = 29
GS Acq
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
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sec