



## 11648 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at $z>2$

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
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### VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) HIGHZ-CLUSTER-1	WFC3/IR	5	31-Aug-2009 21:25:51.0	yes
02	(2) HIGHZ-CLUSTER-2	WFC3/IR	5	31-Aug-2009 21:26:24.0	yes
03	(3) HIGHZ-CLUSTER-3	WFC3/IR	4	31-Aug-2009 21:26:53.0	yes
04	(4) HIGHZ-CLUSTER-4	WFC3/IR	4	31-Aug-2009 21:27:13.0	yes

18 Total Orbits Used

## **ABSTRACT**

We propose to obtain deep WFC3+G141 grism observations to spectroscopically confirm a remarkable  $z > 2$  cluster of galaxy candidate. Over a  $1000 \text{ arcmin}^2$  field imaged with Spitzer's IRAC we have discovered a compact ( $< 30''$  diameter) concentration of extremely red galaxies with a factor of  $> 40$  overdensity over the adjacent field. Among these galaxies for which we can derive meaningful photometric redshifts, 17 are consistent with  $z_{\text{phot}} = 2-2.5$ , making it very likely that the concentration is a real cluster at such high redshift. This is further supported by a 3.5 sigma detection of extended X-Ray emission on XMM-Newton data, by a likely color magnitude sequence of red galaxies, and by the presence of a giant galaxy consistent with a BCG at the cluster redshift. The general faintness of the red galaxies in all optical bands and their high redshifts prevent confirmation of this cluster with ordinary optical spectroscopy. The WFC3 camera with G141 grism provides the only way to confirm this record high- $z$  cluster and measure its redshift from spectral breaks typical of old stellar populations. Our deep integrations will reveal redshifts for at least 19 ultra-red galaxies in the area and of a similar number of bluer galaxies at the cluster redshift. Knowledge of the cluster redshift based on the HST spectra will allow us to reach important scientific aims: find the most distant X ray emitting evolved galaxy cluster, determine membership of the other galaxies from photometric SED analysis, study their stellar population properties, characterize the color-magnitude relation with constraints on the formation redshift. The proposed observations will establish a first  $z > 2$  benchmark for cluster field comparisons of galaxy formation at this highest redshift and will firmly establish the progenitors of local rich Abell clusters.

## **OBSERVING DESCRIPTION**

The project is taking a 18 orbit long WFC3/IR+G141 spectroscopy at the location of a concentration of red high redshift galaxies

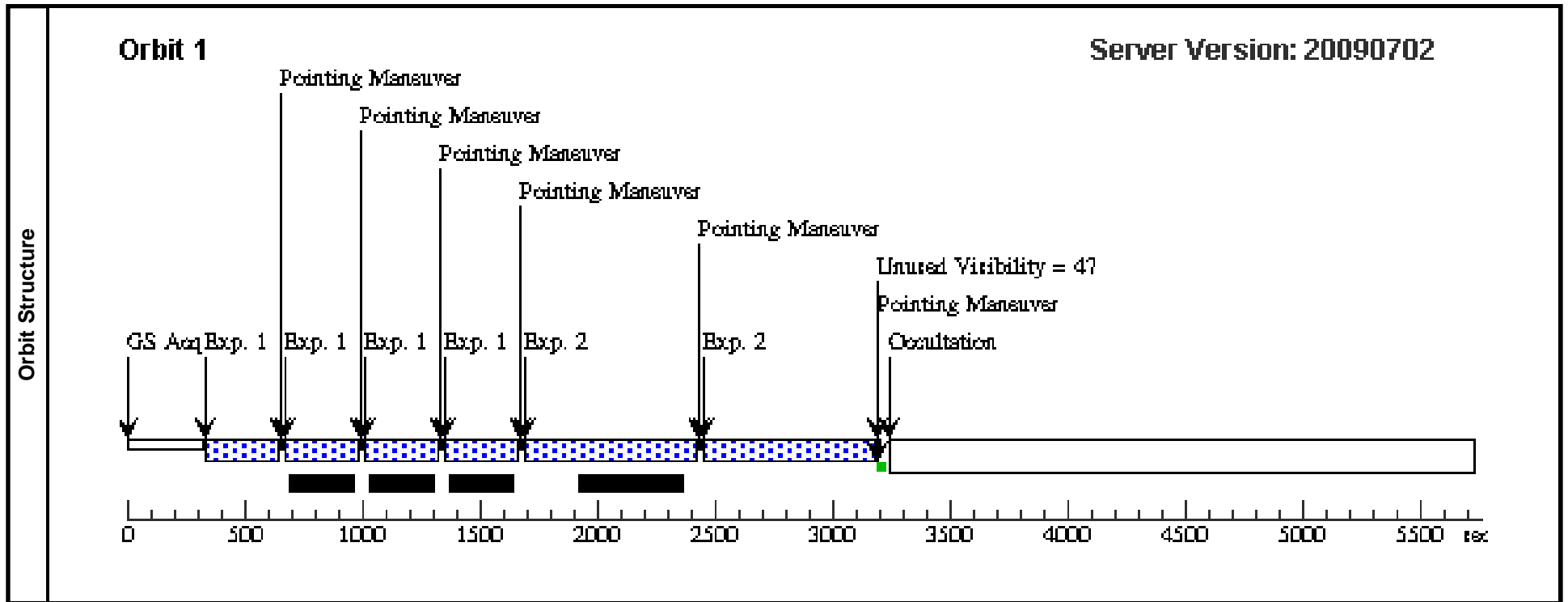
Proposal 11648 - Visit 01 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at z>2

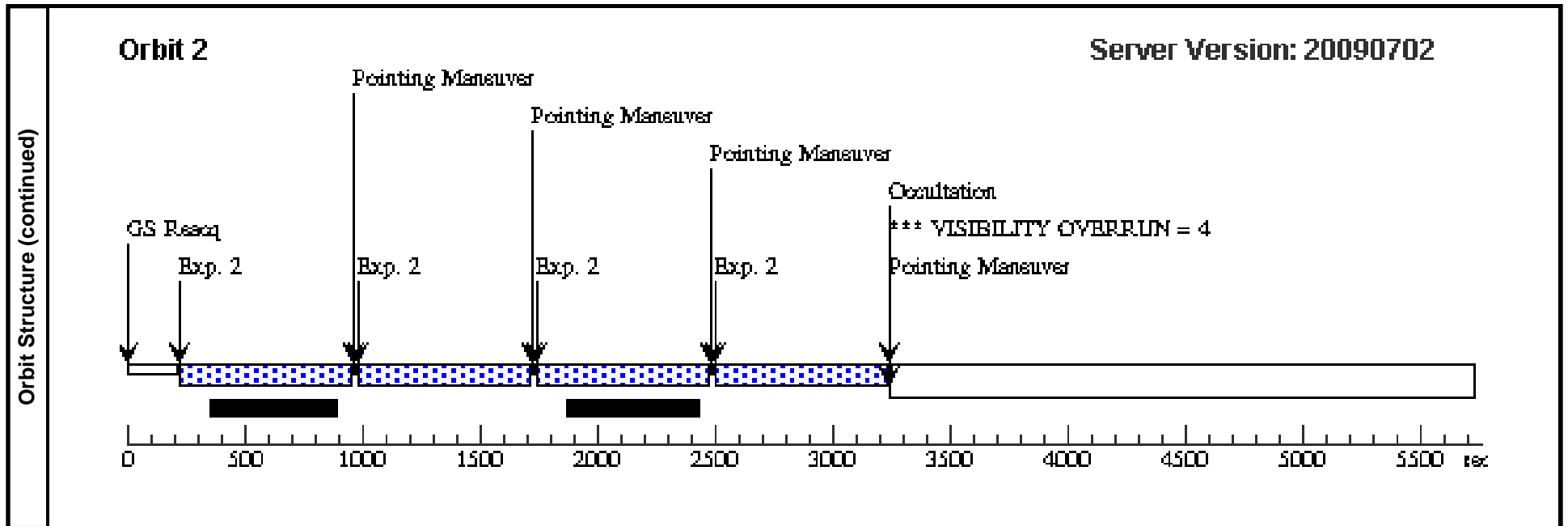
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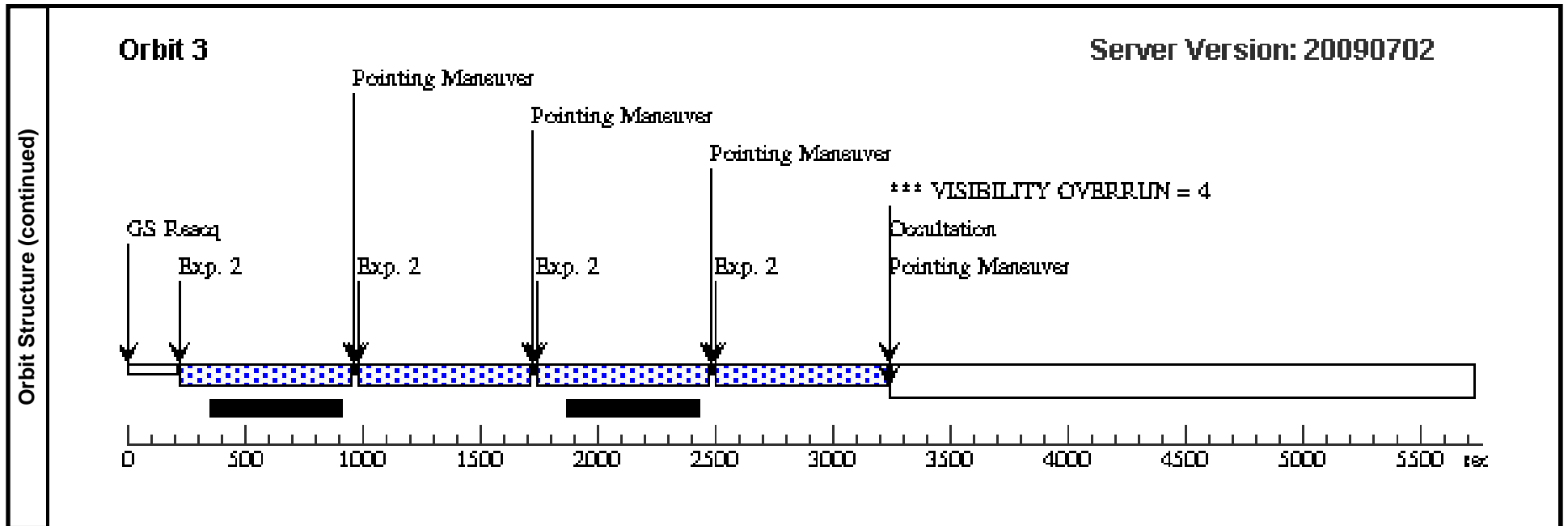
<b>Visit</b>	<b>Proposal 11648, Visit 01, implementation</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: WFC3/IR Special Requirements: ORIENT 130.9D TO 130.9 D										
	<b>Diagnosics</b> (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 01) Warning (Orbit Planner): VISIBILITY OVERRUN										
<b>Patterns</b>	<b>#</b>	<b>Primary Pattern</b>				<b>Secondary Pattern</b>			<b>Exposures</b>		
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(2)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=4 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=true				(1)					
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>		<b>Targ. Coord. Corrections</b>		<b>Fluxes</b>	<b>Miscellaneous</b>			
	(1)	HIGHZ-CLUSTER-1	RA: 14 49 15.5802 (222.3149175d) Dec: +08 56 16.34 (8.93787d) Equinox: J2000				V=28	Reference Frame: ICRS			
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time/[Actual Dur.]</b>		<b>Orbit</b>
	1		(1) HIGHZ-CLUSTER-1	WFC3/IR, MULTIACCUM, G141-REF	F140W	NSAMP=12; SAMP-SEQ=SPAR S25		Pattern 2, Exps 1-1 (2)	[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	

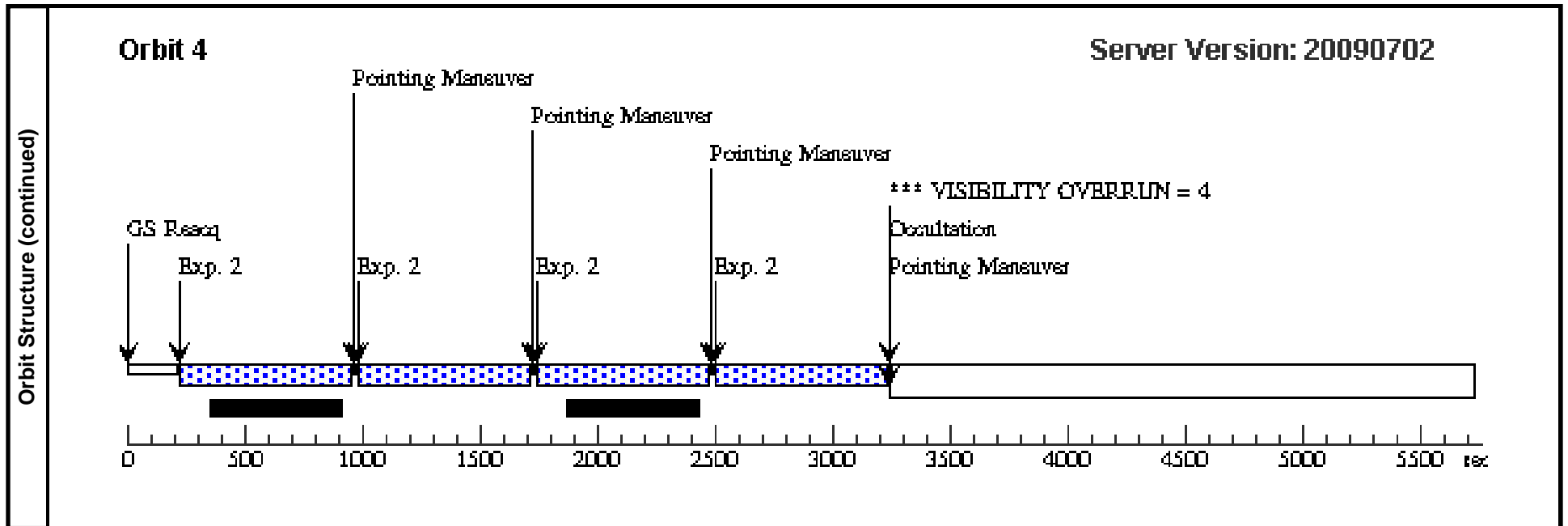
Proposal 11648 - Visit 01 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at  $z > 2$

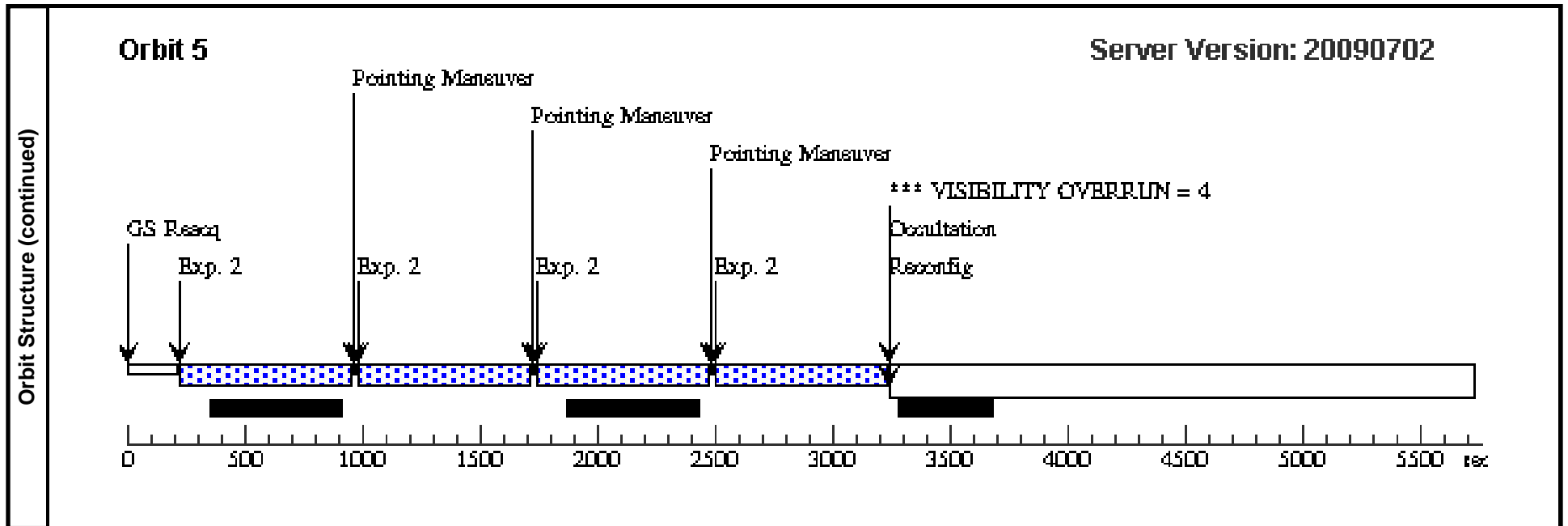
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									[==>(Pattern 9)]	[3]
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									[==>(Pattern 17)]	[5]
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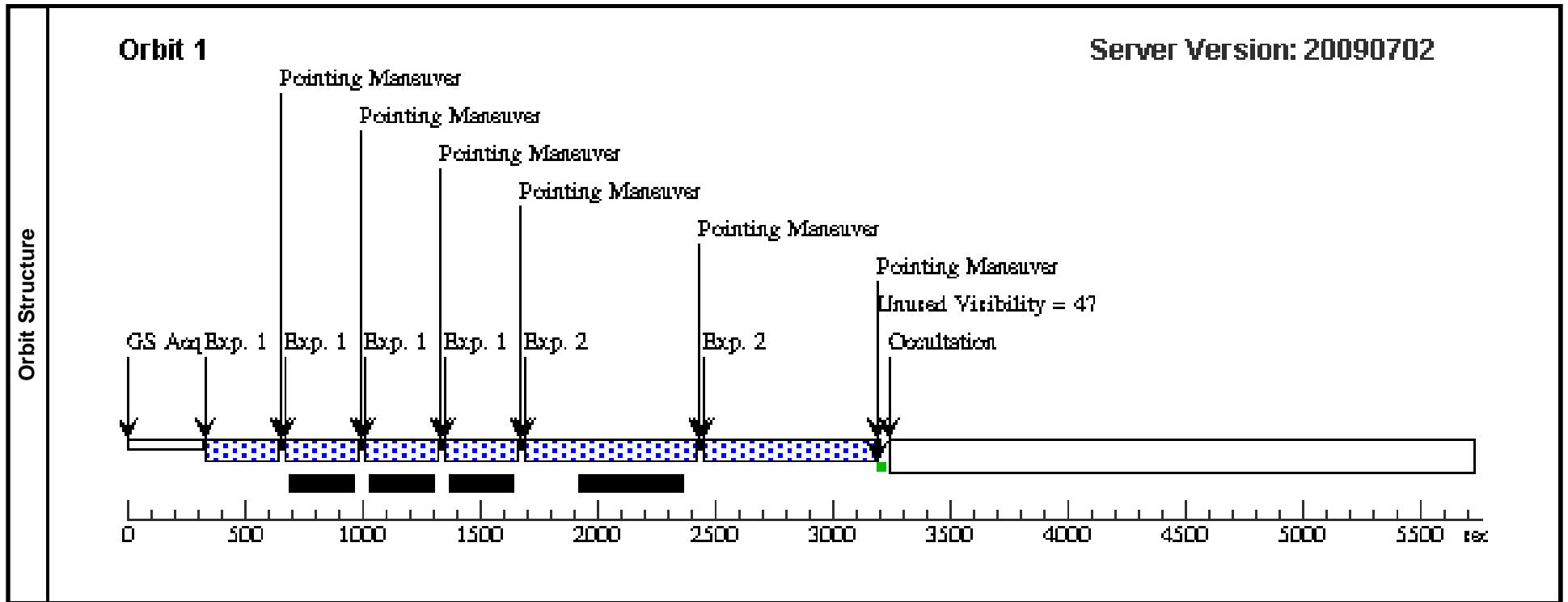
Proposal 11648 - Visit 02 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at z>2

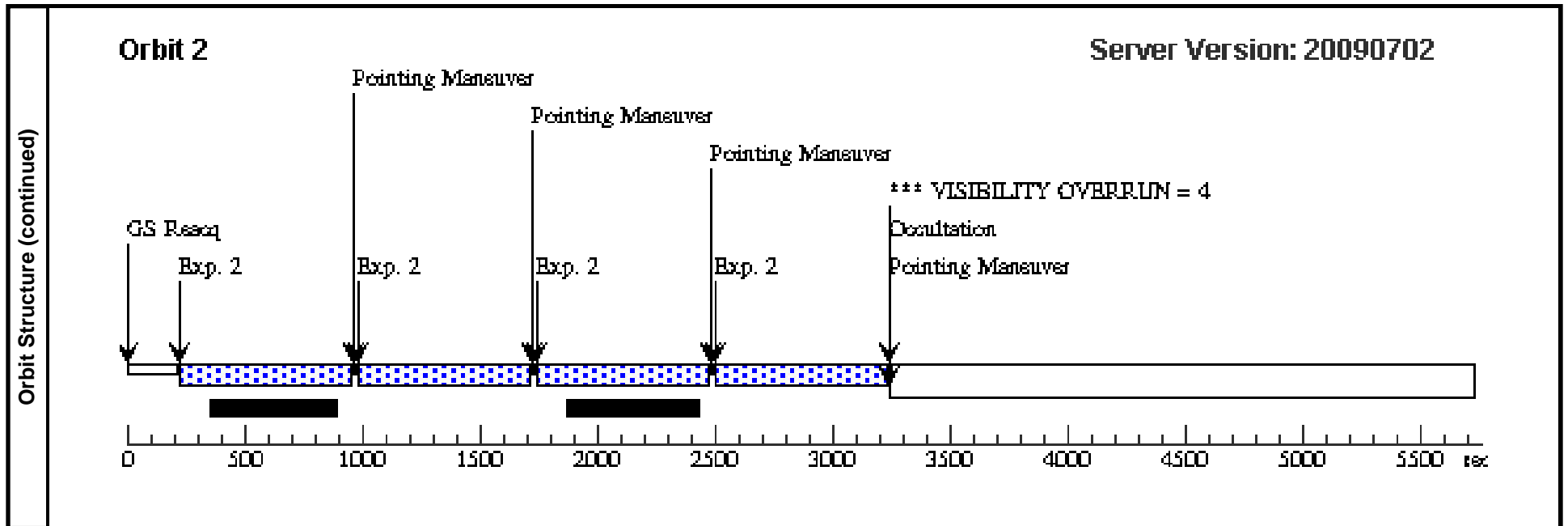
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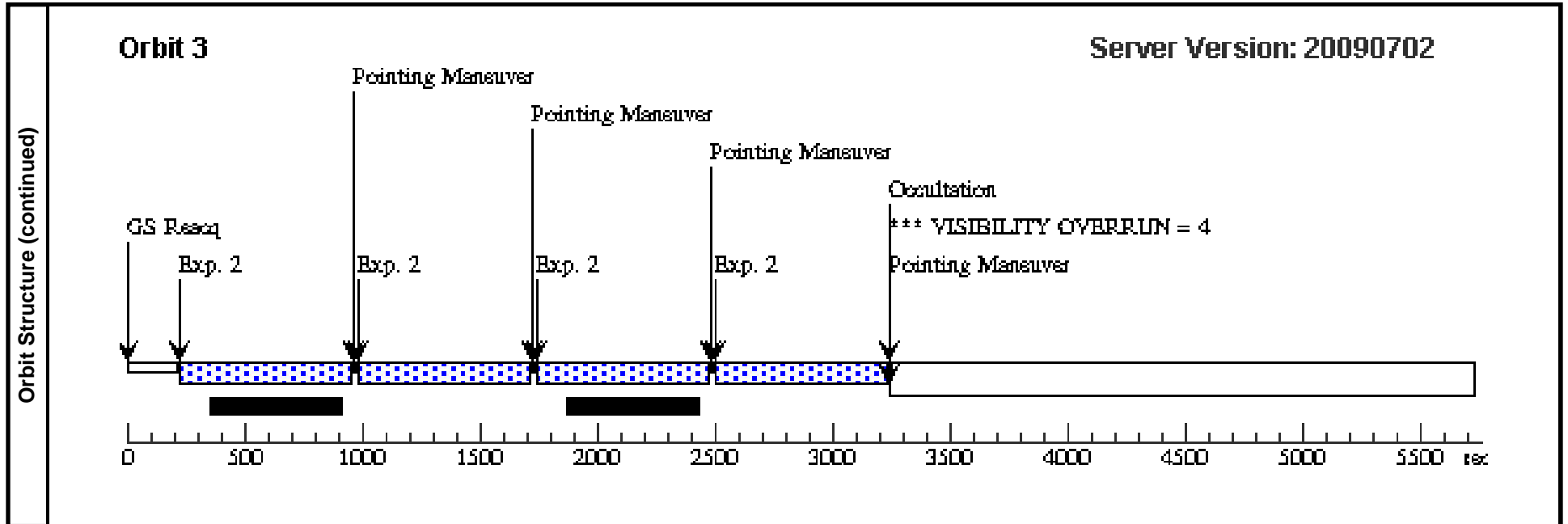
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	<b>Diagnostics</b>	(Visit 02) Warning (Orbit Planner): VISIBILITY OVERRUN								
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(Visit 02) Warning (Orbit Planner): VISIBILITY OVERRUN										
<b>Patterns</b>	<b>#</b>	<b>Primary Pattern</b>				<b>Secondary Pattern</b>				<b>Exposures</b>
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<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Fluxes</b>	<b>Miscellaneous</b>	
	(2)	HIGHZ-CLUSTER-2	RA: 14 49 14.9255 (222.3121896d) Dec: +08 56 7.41 (8.93539d) Equinox: J2000					V=28	Reference Frame: ICRS	
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time/[Actual Dur.]</b>	<b>Orbit</b>
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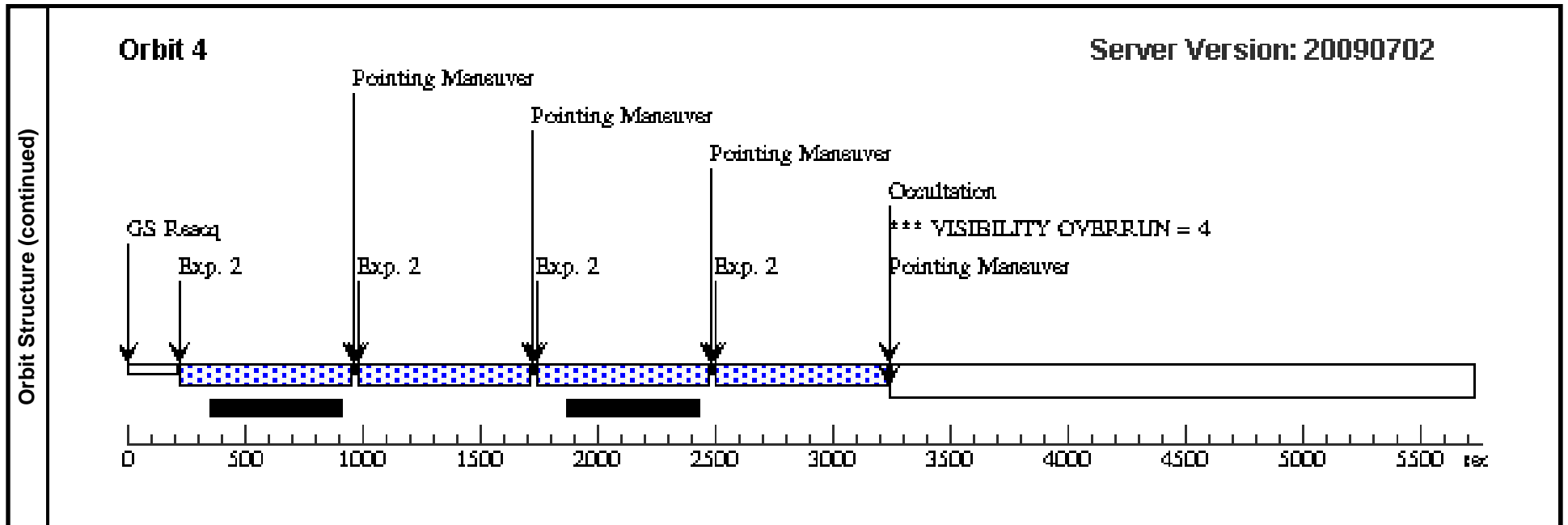
Proposal 11648 - Visit 02 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at z>2

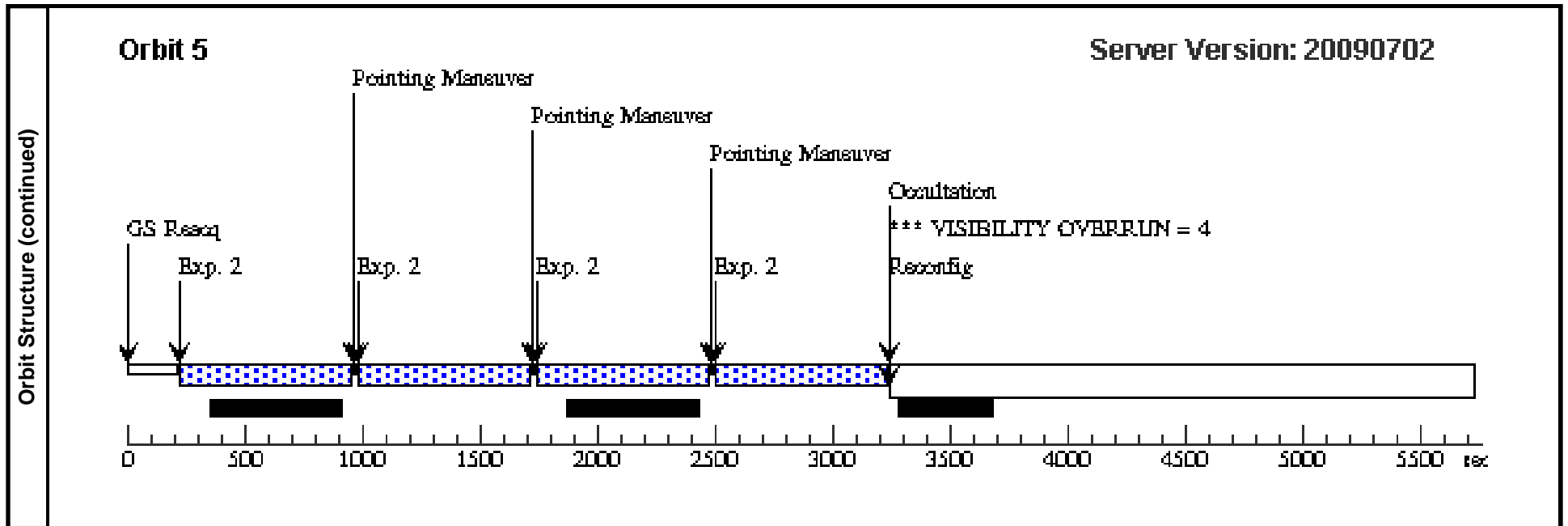
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures (continued)	2	(2) HIGHZ-CLUST ER-2	WFC3/IR, MULTIACCUM, IR	G141	NSAMP=13; SAMP-SEQ=STEP1 00		Pattern 1, Exps 2-2 (1)	[==>(Pattern 1)]	[1]
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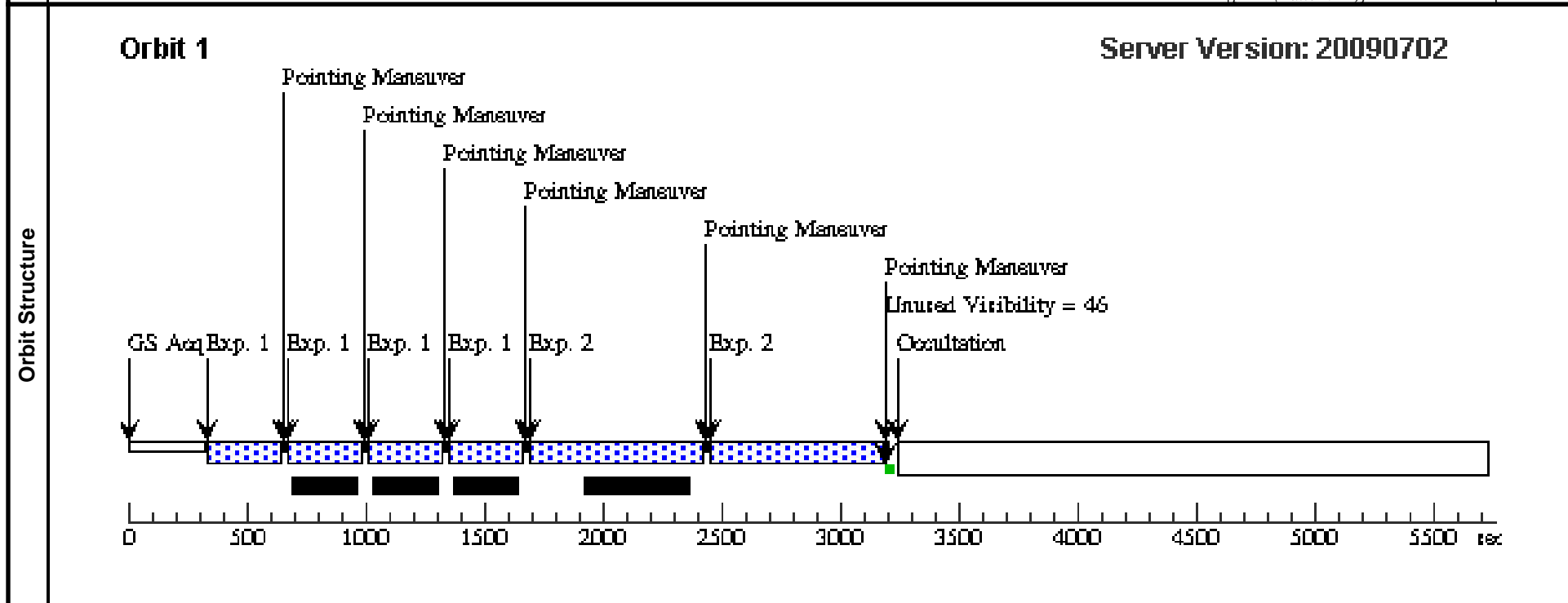
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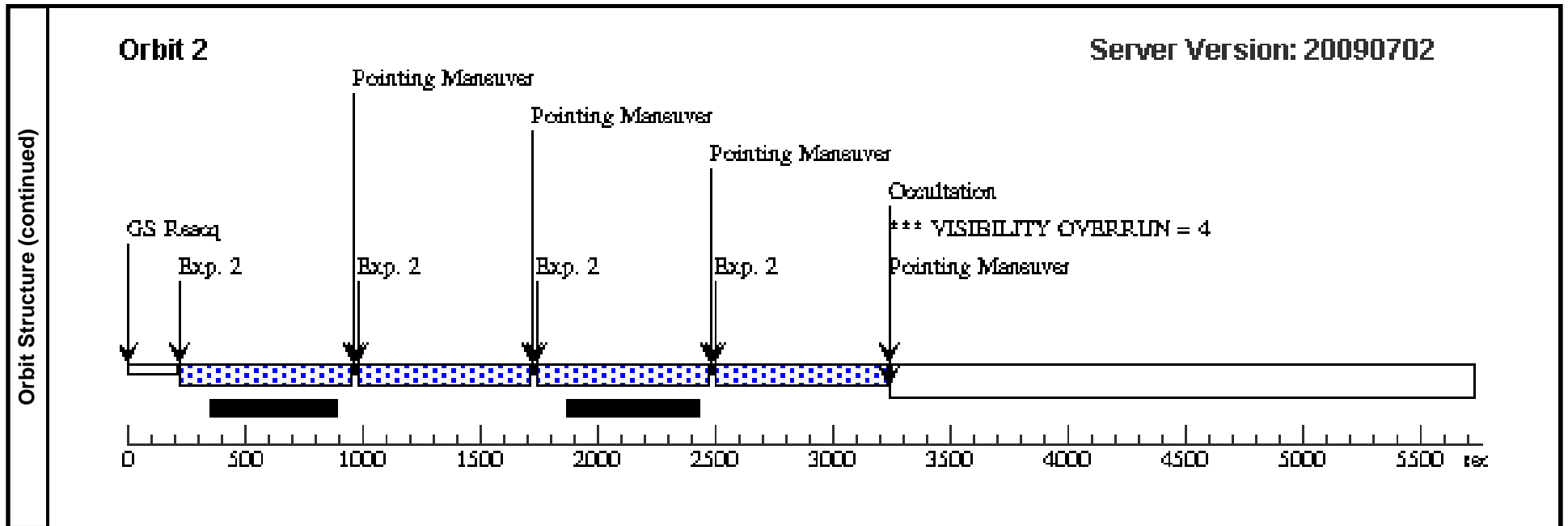
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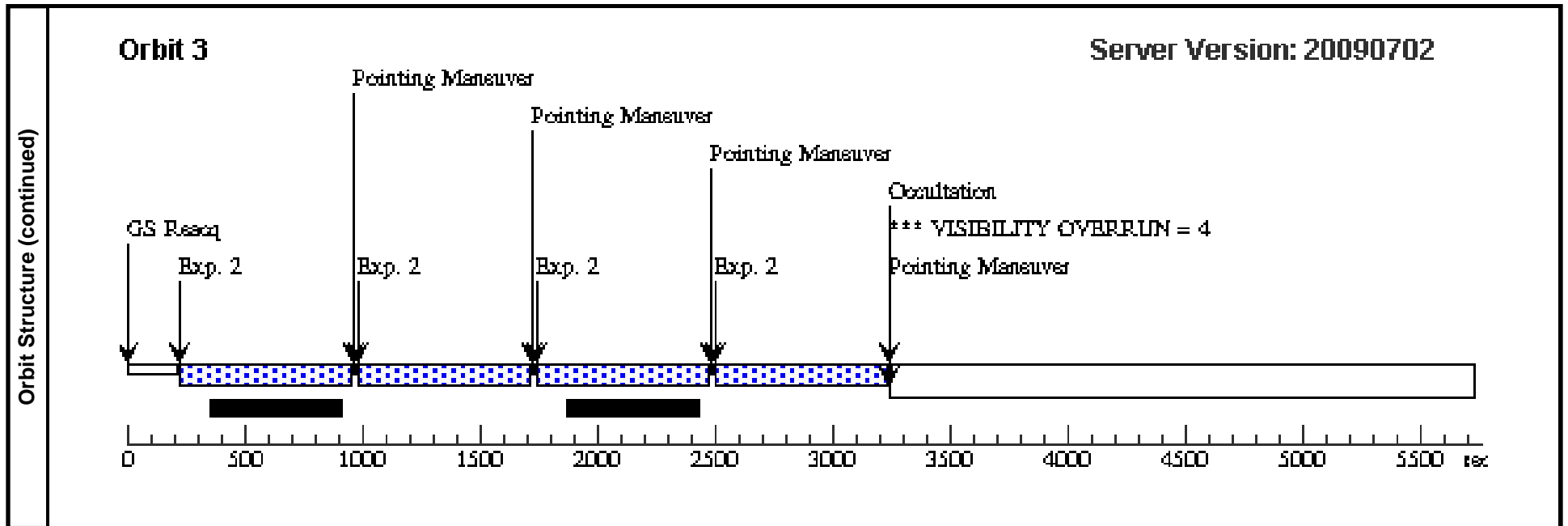
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<b>Patterns</b>		<b>#</b>	<b>Primary Pattern</b>				<b>Secondary Pattern</b>				<b>Exposures</b>
	(2)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=4 Point Spacing=0.636 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=true								(1)	
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<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Fluxes</b>	<b>Miscellaneous</b>		
	(3)	HIGHZ-CLUSTER-3	RA: 14 49 15.2260 (222.3134417d) Dec: +08 56 5.90 (8.93497d) Equinox: J2000					V=28	Reference Frame: ICRS		
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time/[Actual Dur.]</b>		<b>Orbit</b>
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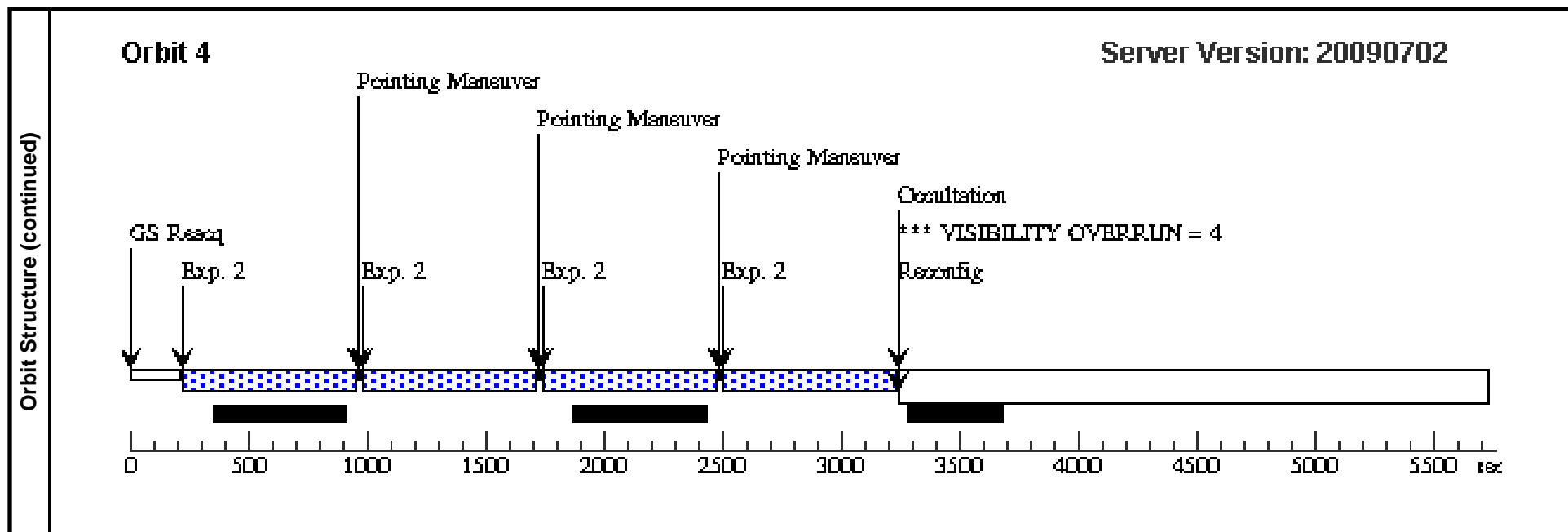
Proposal 11648 - Visit 03 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at z>2

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Exposures (continued)	2	(3) HIGHZ-CLUST ER-3	WFC3/IR, MULTIACCUM, IR	G141	NSAMP=13; SAMP-SEQ=STEP1 00		Pattern 3, Exps 2-2 (3)	[==>(Pattern 1)]	[1]
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Proposal 11648 - Visit 04 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at z>2

Tue Sep 01 01:27:30 GMT 2009

<b>Visit</b>	<b>Proposal 11648, Visit 04, implementation</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: WFC3/IR Special Requirements: ORIENT 150.2D TO 150.2 D										
	<b>Diagnostics</b>	(Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN (Visit 04) Warning (Orbit Planner): VISIBILITY OVERRUN									
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<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>			<b>Targ. Coord. Corrections</b>		<b>Fluxes</b>	<b>Miscellaneous</b>		
	(4)	HIGHZ-CLUSTER-4	RA: 14 49 14.9450 (222.3122708d) Dec: +08 56 21.63 (8.93934d) Equinox: J2000					V=28	Reference Frame: ICRS		
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time/[Actual Dur.]</b>		<b>Orbit</b>
	1		(4) HIGHZ-CLUSTER-4	WFC3/IR, MULTIACCUM, G141-REF	F140W	NSAMP=12; SAMP-SEQ=SPAR S25		Pattern 2, Exps 1-1 (2)	[=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]		[1]

Proposal 11648 - Visit 04 - WFC3 spectroscopy of an X-ray luminous galaxy cluster at z>2

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures (continued)	2	(4) HIGHZ-CLUST ER-4	WFC3/IR, MULTIACCUM, IR	G141	NSAMP=13; SAMP-SEQ=STEP1 00		Pattern 3, Exps 2-2 (3)	[==>(Pattern 1)]	[1]
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