



13291 - Resolving internal structures of the progenitors of early-type galaxies in a vigorously forming cluster at $z=2.5$

Cycle: 21, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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	(3) USS1558-003-POS3	WFC3/IR	2	22-Jul-2013 21:25:20.0	yes
02	(5) USS1558-003-POS5	ACS/WFC	2	22-Jul-2013 21:25:29.0	yes
03	(2) USS1558-003-POS2	WFC3/IR	2	22-Jul-2013 21:25:38.0	yes
04	(4) USS1558-003-POS4	ACS/WFC	2	22-Jul-2013 21:25:44.0	yes
05	(1) USS1558-003-POS1	WFC3/IR	2	22-Jul-2013 21:25:52.0	yes

10 Total Orbits Used

ABSTRACT

In our recent near-infrared narrow-band imaging surveys, we have identified the densest complex of H α emitters associated to a radio galaxy at $z=2.5$. Together with a large statistical excess of massive red galaxies (Distant Red Galaxies: DRGs), this region is probably the best candidate of a proto-cluster which is destined to evolve to a rich galaxy cluster today dominated by early-type galaxies. Therefore we are surely witnessing the clustered vigorous formation of the progenitors of present-day early-type galaxies. As such, this proto-cluster serves us the unique opportunity to investigate the physical processes in their formation and early evolution, and its environmental dependence for the first time. Note that because our targets are strongly clustered, we can efficiently make a statistical sample with a small number of pointings hence a relatively short investment of time. By spatially resolving the morphologies and internal structures of these galaxies by the proposed high-resolution HST imaging with ACS/F814W and WFC3/F160W, we will focus on the following critical issues;

- (1) first appearance of the morphology-density relation,
- (2) identification of the progenitors of massive, quiescent, compact galaxies,
- (3) environmental dependence of the mass-size relation, and
- (4) frequency of clumps/mergers and the mode of star formation (compactness/dustiness).

The proposed observations will shed light on the physical processes "in action" on the progenitors of massive early-type galaxies in clusters for the first time.

OBSERVING DESCRIPTION

We will conduct the primary observation in the proto-cluster USS 1558-003 at $z=2.53$ in 3 pointings with WFC3/IR and F160W filter and in 2 pointings with ACS/WFC and F814W filter. To fully cover the three groups where H α emitters (HAEs) and DRGs are clustered without any space, we request the observation conducting all the exposures with the specific values of ORIENT.

We request 5 visits with 2 orbits each. Our priority of the visits is as follows; (1st) POS3 with WFC3, (2nd) POS5 with ACS, (3rd) POS2 with WFC3, (4th) POS4 with ACS, and (5th) POS1 with WFC3.

As described in scientific justification of phase-I proposal, one of our main objectives is to measure the profile of stellar component and then derive the morphology and size of HAEs in the proto-cluster environment at $z=2.53$.

We require the depth of at least ~ 27.5 (27.0) ABmag in ACS/F814W (WFC3/F160W) for point source, respectively, which are comparable to the

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wide survey data of CANDELS. The required depth is justified by the paper of van der Wel et al. (2012). They measured the structural parameters of H(F160W)-selected galaxies by fitting Sersic profile to CANDELS data, and investigated systematic and random uncertainties in structural parameters as a function of H(F160W) magnitude of galaxy for CANDELS wide survey data. According to Table 3 of van der Wel et al. (2012), structural parameters can be measured accurately for star-forming galaxies with Sersic index $n < 3$ down to 25 ABmag in H(F160W). Therefore, the depth comparable to the CANDELS data is crucial to accomplish our objectives.

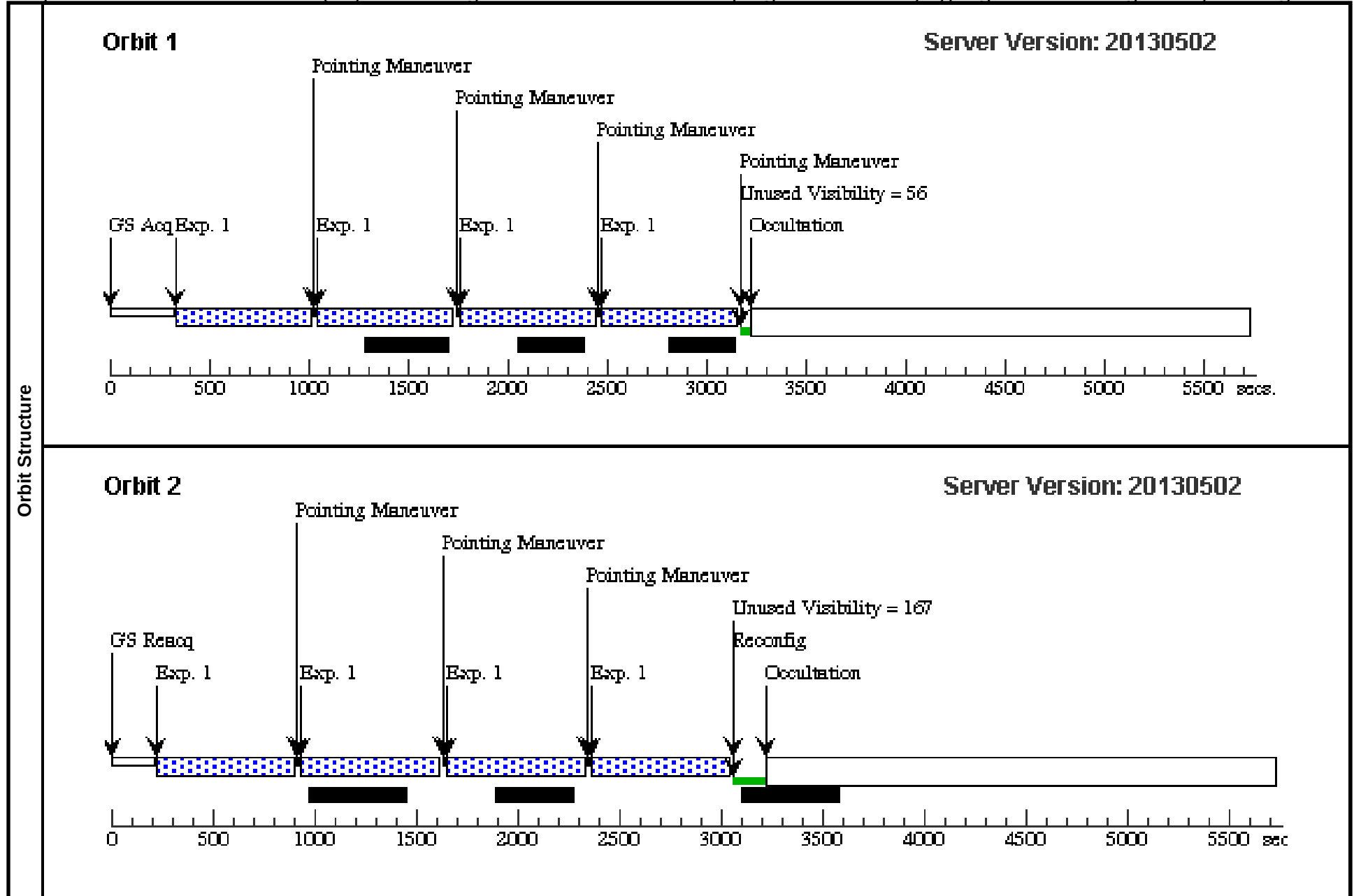
According to Exposure Time Calculators, 5000 sec on-source exposure with ACS/F814W reaches 27.4 ABmag in 5-sigma for point source in the case measured within a 0.25"-radius aperture, while 4520 sec on-source exposure with WFC3/F160W reaches 27.0 ABmag in 5-sigma. The estimation is conducted under the assumption of the background levels that standard zodiacal (earth shine) light normalizations is average. Since our target is located at declination of -00:28:48.0, it can be observed for 54 minutes per one orbit. Thus, taking account of the orbit visibility, the required exposure time per one pointing in ACS/F814W (WFC3/F160W) is 5000 (5208) seconds in total with 4 exposures in 4 dithered points, respectively, which requires the 2 orbits per one pointing in both ACS/F814W and WFC3/F160W. Note that obtaining as deep near-infrared data as possible is desirable for us to measure the structural parameters of stellar component for less massive HAEs at $z=2.53$. We also make sure that almost all of HAEs we have found in the proto-cluster have magnitudes ranging between 21.7-25.0 ABmag in z' -band (Subaru/Suprime-Cam) and 20.0-24.5 ABmag in H-band (Subaru/MOIRCS).

Regarding the Charge Transfer Efficiency (CTE) effect, we make sure that the estimated background of ACS images is greater than 20 electrons for the exposure time we plan.

We will conduct a standard calibration, so no data is required for special calibration.

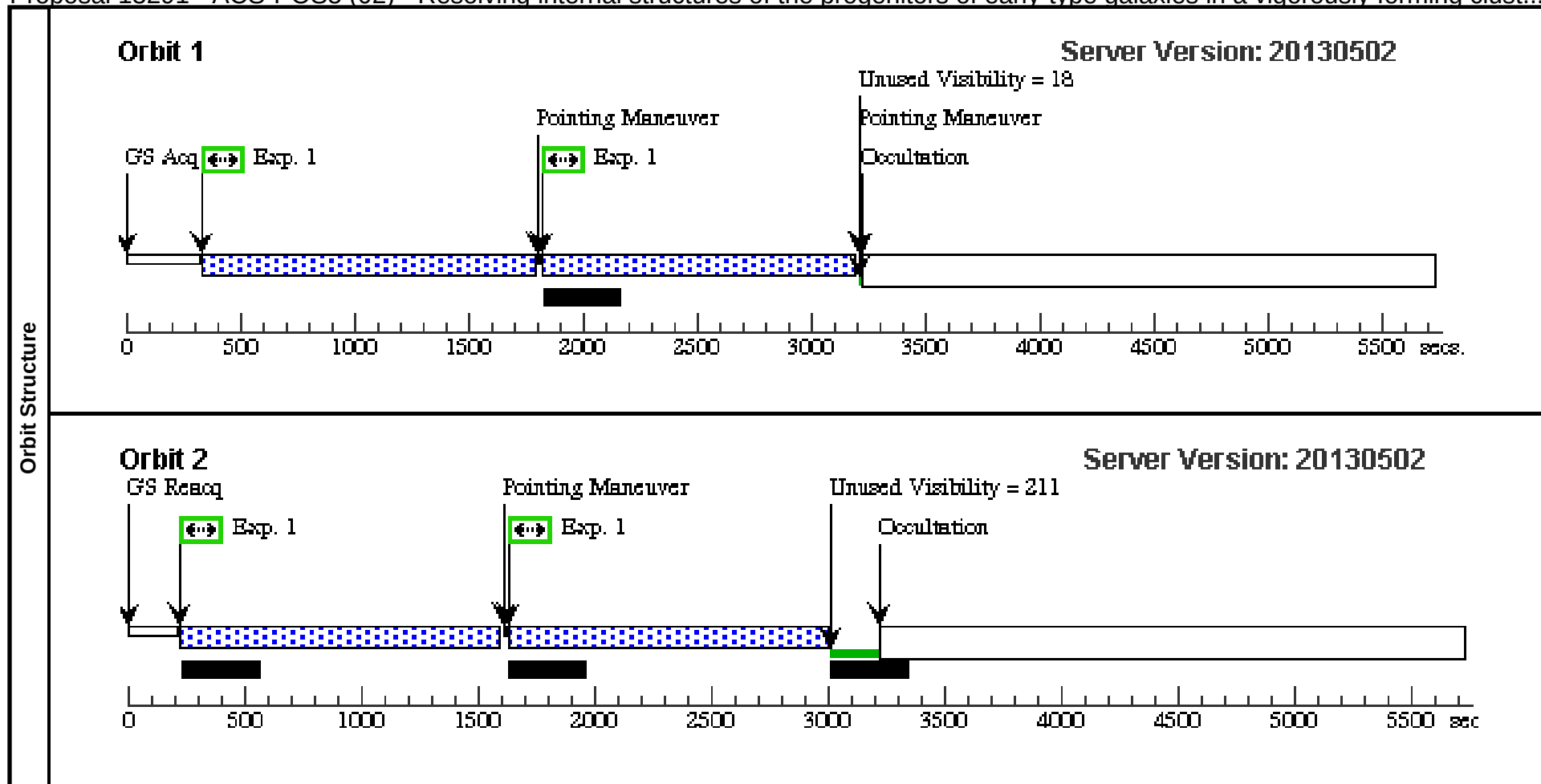
Proposal 13291 - WFC3-POS3 (01) - Resolving internal structures of the progenitors of early-type galaxies in a vigorously forming clus...

Visit	Proposal 13291, WFC3-POS3 (01), implementation Tue Jul 23 01:26:00 GMT 2013									
	Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: ORIENT 135D TO 135 D; ORIENT 315D TO 315 D <i>Comments: In this visit, the WFC3 observations with F160W are carried out at three pointings.</i>									
Patterns	#	Primary Pattern				Secondary Pattern				Exposures
	(3)	Pattern Type=WFC3-IR-DITHER-BLOB Coordinate Frame=POS-TARG Pattern Orientation=41.859 Purpose=DITHER Angle Between Sides= Number Of Points=2 Center Pattern=true Point Spacing=5.183 Line Spacing=				Pattern Type=WFC3-IR-DITHER-BOX-MIN Coordinate Frame=POS-TARG Pattern Orientation=18.528 Purpose=DITHER Angle Between Sides=74.653 Number Of Points=4 Center Pattern=false Point Spacing=0.572 Line Spacing=0.365				(1)
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(3)	USS1558-003-POS3	RA: 16 01 12.3350 (240.3013958d) Dec: -00 30 58.40 (-.51622d) Equinox: J2000				V=(?) Magnitudes for our main targets, Halpha emitters at z=2.53, range between 21.7-25.0 ABmag in z'-band and 20.0-24.5 ABmag in H-band.		Reference Frame: ICRS	
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	WFC3 F160W (POS3 with 8-point dither)	(3) USS1558-003-POS3	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=14; SAMP-SEQ=SPARS50		Pattern 3, Exps 1-1 in WFC3-POS3 (01) (3)	652.938154 Secs (5223.505 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 1,3)] [=>(Pattern 1,4)] [=>(Pattern 2,1)] [=>(Pattern 2,2)] [=>(Pattern 2,3)] [=>(Pattern 2,4)]	 [1] [2]



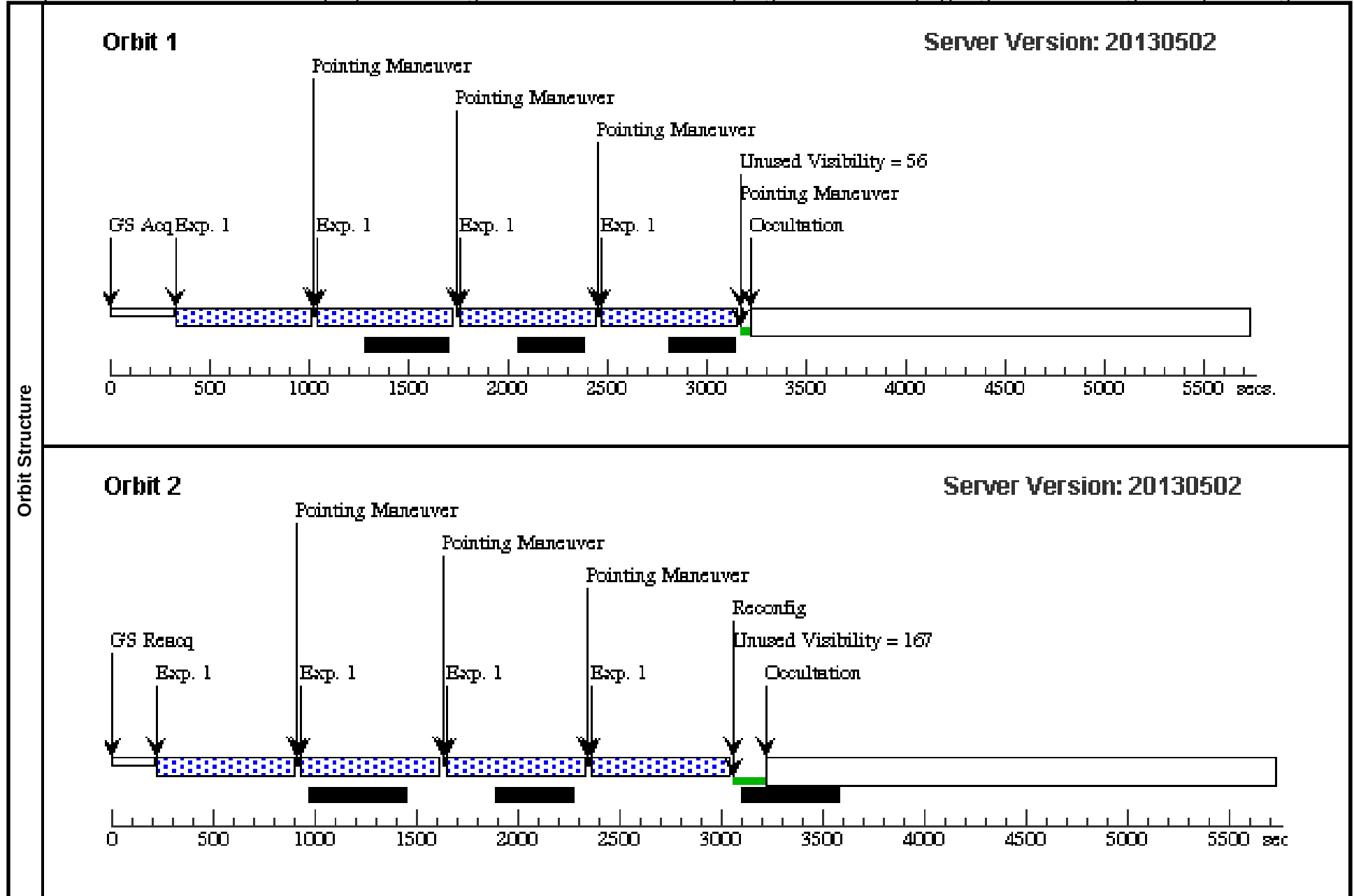
Proposal 13291 - ACS-POS5 (02) - Resolving internal structures of the progenitors of early-type galaxies in a vigorously forming clust...

Visit	Proposal 13291, ACS-POS5 (02), implementation Tue Jul 23 01:26:03 GMT 2013									
	Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC Special Requirements: ORIENT 90D TO 90 D; ORIENT 270D TO 270 D; ORIENT 0D TO 0 D; ORIENT 180D TO 180 D <i>Comments: In this visit, the ACS observations with F814W are carried out at two pointings.</i>									
Patterns	#	Primary Pattern				Secondary Pattern				Exposures
	(2)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187				Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=true				(1)
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(5)	USS1558-003-POS5	RA: 16 01 14.2340 (240.3093083d) Dec: -00 31 0.88 (-.51691d) Equinox: J2000				V=(?) Magnitudes for our main targets, Halpha emitters at z=2.53, range between 21.7-25.0 ABmag in z'-band and 20.0-24.5 ABmag in H-band.		Reference Frame: ICRS	
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	ACS F814W	(5) USS1558-003-P	ACS/WFC, ACCUM, WFCENTER	F814W			Pattern 2, Exps 1-1 in ACS-POS5 (02) (2)	1250 Secs (5000 Secs)	
		(POS5 with 4-point dither)	OS5						[=>(Pattern 1)]	[1]
									[=>(Pattern 2)]	
									[=>(Pattern 3)]	
									[=>(Pattern 4)]	[2]



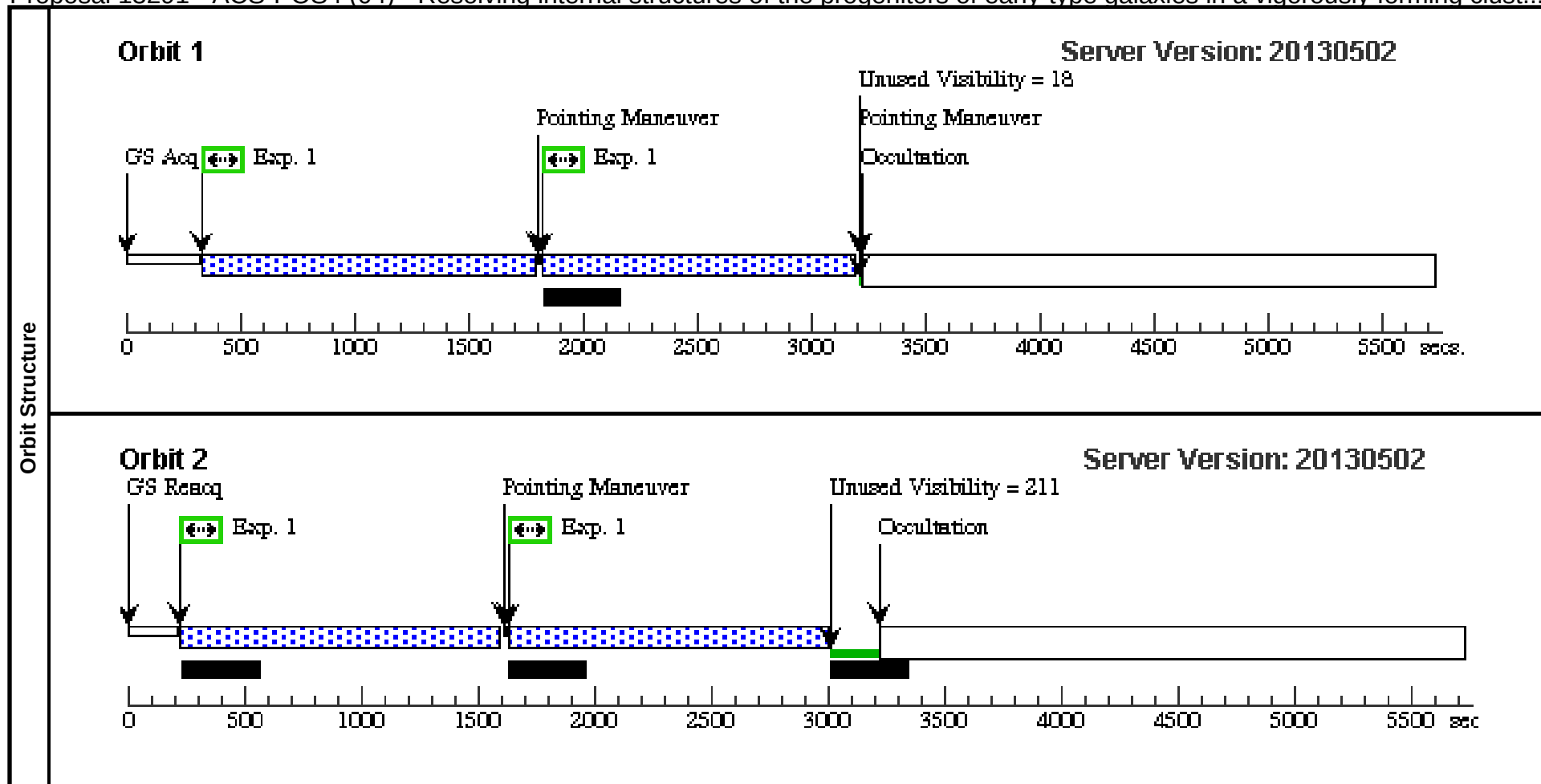
Proposal 13291 - WFC3-POS2 (03) - Resolving internal structures of the progenitors of early-type galaxies in a vigorously forming clus...

Visit	Proposal 13291, WFC3-POS2 (03) Tue Jul 23 01:26:04 GMT 2013									
	Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: SAME ORIENT AS 01 <i>Comments: In this visit, the WFC3 observations with F160W are carried out at three pointings.</i>									
Patterns	#	Primary Pattern				Secondary Pattern				Exposures
	(3)	Pattern Type=WFC3-IR-DITHER-BLOB Coordinate Frame=POS-TARG Pattern Orientation=41.859 Purpose=DITHER Angle Between Sides= Number Of Points=2 Center Pattern=true Point Spacing=5.183 Line Spacing=				Pattern Type=WFC3-IR-DITHER-BOX-MIN Coordinate Frame=POS-TARG Pattern Orientation=18.528 Purpose=DITHER Angle Between Sides=74.653 Number Of Points=4 Center Pattern=false Point Spacing=0.572 Line Spacing=0.365				(1)
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(2)	USS1558-003-POS2	RA: 16 01 17.6170 (240.3234042d) Dec: -00 29 21.55 (-.48932d) Equinox: J2000				V=(?) Magnitudes for our main targets, Halpha emitters at z=2.53, range between 21.7-25.0 ABmag in z'-band and 20.0-24.5 ABmag in H-band.		Reference Frame: ICRS	
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	WFC3 F160W (POS2 with 8-point dither)	(2) USS1558-003-POS2	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 3, Exps 1-1 in WFC3-POS2 (03) (3)	652.938154 Secs (5223.505 Secs) [==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 1,3)] [==>(Pattern 1,4)] [==>(Pattern 2,1)] [==>(Pattern 2,2)] [==>(Pattern 2,3)] [==>(Pattern 2,4)]	 [1] [2]



Proposal 13291 - ACS-POS4 (04) - Resolving internal structures of the progenitors of early-type galaxies in a vigorously forming clust...

Visit	Proposal 13291, ACS-POS4 (04) Tue Jul 23 01:26:05 GMT 2013 Diagnostic Status: No Diagnostics Scientific Instruments: ACS/WFC Special Requirements: SAME ORIENT AS 02 <i>Comments: In this visit, the ACS observations with F814W are carried out at two pointings.</i>									
Patterns	#	Primary Pattern				Secondary Pattern			Exposures	
	(2)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187 Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=true							(1)	
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(4)	USS1558-003-POS4	RA: 16 01 16.3930 (240.3183042d) Dec: -00 28 4.43 (-.46790d) Equinox: J2000				V=(?) Magnitudes for our main targets, Halpha emitters at z=2.53, range between 21.7-25.0 ABmag in z'-band and 20.0-24.5 ABmag in H-band.		Reference Frame: ICRS	
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	ACS F814W	(4) USS1558-003-P	ACS/WFC, ACCUM, WFCENTER	F814W			Pattern 2, Exps 1-1 in ACS-POS4 (04) (2)	1250 Secs (5000 Secs)	
		(POS4 with 4-point dither)	OS4						[=>(Pattern 1)]	[1]
									[=>(Pattern 2)]	
									[=>(Pattern 3)]	
									[=>(Pattern 4)]	[2]



Proposal 13291 - WFC3-POS1 (05) - Resolving internal structures of the progenitors of early-type galaxies in a vigorously forming clus...

Visit	Proposal 13291, WFC3-POS1 (05) Tue Jul 23 01:26:06 GMT 2013									
	Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: SAME ORIENT AS 01 <i>Comments: In this visit, the WFC3 observations with F160W are carried out at three pointings.</i>									
Patterns	#	Primary Pattern				Secondary Pattern				Exposures
	(3)	Pattern Type=WFC3-IR-DITHER-BLOB Coordinate Frame=POS-TARG Pattern Orientation=41.859 Purpose=DITHER Angle Between Sides= Number Of Points=2 Center Pattern=true Point Spacing=5.183 Line Spacing=				Pattern Type=WFC3-IR-DITHER-BOX-MIN Coordinate Frame=POS-TARG Pattern Orientation=18.528 Purpose=DITHER Angle Between Sides=74.653 Number Of Points=4 Center Pattern=false Point Spacing=0.572 Line Spacing=0.365				(1)
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(1)	USS1558-003-POS1	RA: 16 01 17.5480 (240.3231167d) Dec: -00 27 25.60 (-.45711d) Equinox: J2000				V=(?) Magnitudes for our main targets, Halpα emitters at z=2.53, range between 21.7-25.0 ABmag in z'-band and 20.0-24.5 ABmag in H-band.		Reference Frame: ICRS	
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	WFC3 F160W (POS1 with 8-point dither)	(1) USS1558-003-POS1	WFC3/IR, MULTIACCUM, IR-FIX	F160W	NSAMP=14; SAMP-SEQ=SPAR S50		Pattern 3, Exps 1-1 in WFC3-POS1 (05) (3)	652.938154 Secs (5223.505 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 1,3)] [=>(Pattern 1,4)] [=>(Pattern 2,1)] [=>(Pattern 2,2)] [=>(Pattern 2,3)] [=>(Pattern 2,4)]	 [1] [2]

