



12871 - When Giants Collide: Mapping the Mass in the Cluster Merger Abell 2146

Cycle: 20, 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	(1) ABELL2146	ACS/WFC	4	11-Jul-2012 21:42:37.0	yes
02	(1) ABELL2146	ACS/WFC	4	11-Jul-2012 21:43:01.0	yes

ABSTRACT

Galaxy cluster mergers are critical for our understanding of dark matter, as shown with the Bullet Cluster (1E0657-56). These violent events result in a separation of the dark matter in these systems from the hot X-ray emitting plasma, the dominant baryonic component. Our proposed target, Abell 2146, is an extraordinary post-merger system, discovered using Chandra X-ray observations. It is a unique system, presenting two unambiguous shock fronts that allow us to estimate that the collision between the two clusters occurred $\sim 0.1\text{--}0.2$ Gyr ago. We propose ACS/WFC observations of this system, from which we will obtain a high-resolution map of the total mass distribution, using gravitational lensing analysis of distant background galaxies. By comparing this mass map with our X-ray images, and with the locations of cluster galaxy populations, we will study dark matter and test gravity on cluster scales. We will map the detailed mass substructure in the clusters, essential to our understanding of their formation, facilitated by the exquisite resolution of HST. We will use the window that HST provides in conjunction with gravitational lensing, to reveal the dark matter haloes that harbour cluster members in this extreme environment, studying their characteristic mass and size, and the physical processes at play.

OBSERVING DESCRIPTION

The primary goal of our programme is to map the mass in the system Abell 2146 using gravitational lensing, and measure if the centroids of the mass are offset from the peaks in our X-ray image, containing most of the luminous mass. We will also map the mass substructure in this system using gravitational flexion, which is especially sensitive to gradients in the mass distribution.

Required pointings: Gravitational shear is a non-local statistic and as such we require observations in a wide region about the possible locations of the centroid of the weak lensing signal. We therefore request two pointings, one centred on each of the centroids of the galaxy distributions. A section of the shear field between the subcluster and primary cluster locations will be observed with both pointings, therefore further increasing the signal-to-noise in the inner regions, where we see elongated background galaxies consistent with the expected direction of the shear field.

Required filters: In order to accurately determine the lensed background galaxy population and to remove both foreground objects and the cluster member galaxies, we require imaging in 3 filters. The signal-to-noise of the mass reconstruction is greatly reduced (Clowe & Schneider 2001) if non-lensed dwarf galaxies cannot be removed from the population. We propose to observe Abell 2146 with the F814W, F606W and F435W filters. These have been successfully used to remove dwarf galaxies while maintaining a high number density of background galaxies (~ 90 arcmin²) in observations of the Bullet Cluster (Clowe et al. 2006), which is close in redshift to Abell 2146.

Required depth: Our target sensitivity for this programme is defined by the need to get shape measurements for ~ 90 background galaxies arcmin² to measure the weak lensing peak centroids accurately. To do this we need to obtain photometry at a S/N= 10 at IF814W = 27.5 for a galaxy, which we can get in 2 orbits with the F814W filter (calculated from both the ACS ETC, and from Clowe's experience with the Bullet Cluster dataset). For colour selection, a single orbit in F435W and F606W will provide us with the necessary photometric S/N.

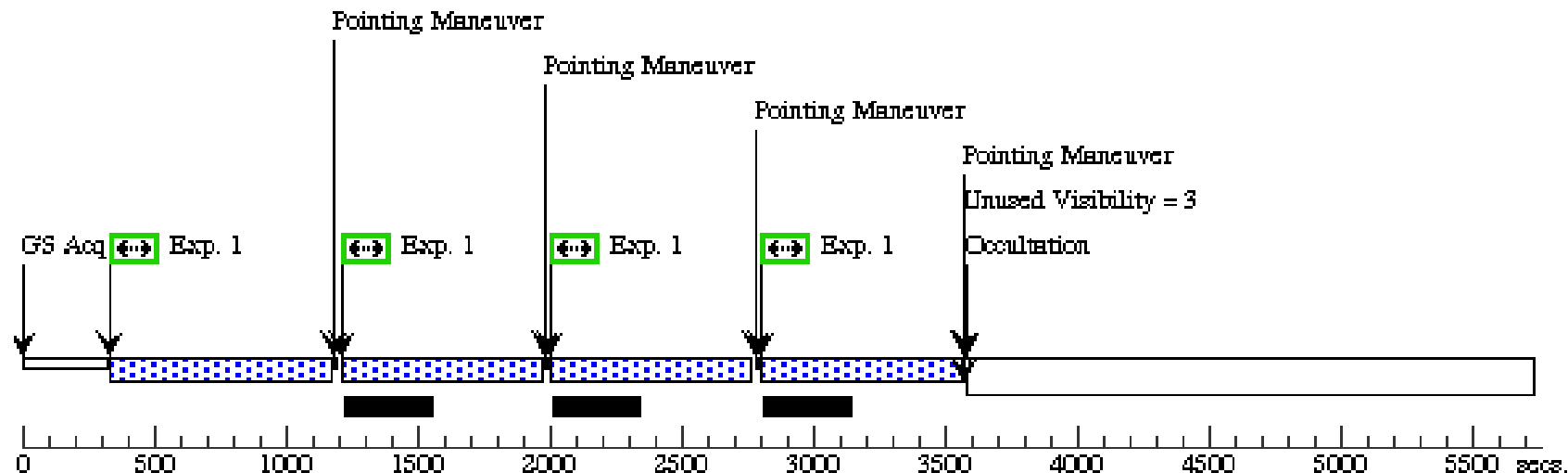
Dithering pattern: Our observing plan is to take 4 exposures per orbit, with a small offset between the first two images, a chip gap spanning offset before the 3rd image, and another small offset for the fourth image. We will schedule each pointing as a block of 4 orbits to take all the filters for that pointing in the same visit. The other pointing for the cluster will need to be constrained to occur at a similar rotation angle as the first (or 90 degrees to it).

Proposal 12871 - Tile Visit 01 - When Giants Collide: Mapping the Mass in the Cluster Merger Abell 2146

Visit	Proposal 12871, Tile Visit 01					Thu Jul 12 01:43:12 GMT 2012				
	Diagnostic Status: Warning									
	Scientific Instruments: ACS/WFC									
	Special Requirements: ORIENT 310D TO 330 D; ORIENT 130D TO 150 D									
Diagnostics	(Exposure 1 (Pattern 1, Exps 1-1 in Tile Visit 01) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes									
	(Exposure 2 (Pattern 1, Exps 2-2 in Tile Visit 01) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes									
	(Exposure 3 (Pattern 1, Exps 3-3 in Tile Visit 01) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes									
	(Exposure 4 (Pattern 1, Exps 4-4 in Tile Visit 01) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes									
Patterns	#	Primary Pattern				Secondary Pattern				Exposures
	(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=6.10486 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=91.16385 Angle Between Sides= Center Pattern=true			Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=3.085553 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.38997 Angle Between Sides= Center Pattern=false			(1), (2), (3), (4)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	ABELL2146	RA: 15 56 3.2415 (239.0135062d) Dec: +66 22 10.22 (66.36951d) Equinox: J2000			V=16 flux of brightest cluster galaxy		Reference Frame: ICRS		
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F814W		POS TARG 0.0,-93.82200482232652	Pattern 1, Exps 1-1 i n Tile Visit 01 (1)	500 Secs [==>635.0 Secs (Pattern 1,1)] [==>635.0 Secs (Pattern 1,2)] [==>635.0 Secs (Pattern 2,1)] [==>635.0 Secs (Pattern 2,2)]	[1]
	2		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F814W		POS TARG 0.0,-93.82200482232652	Pattern 1, Exps 2-2 i n Tile Visit 01 (1)	500 Secs [==>684.0 Secs (Pattern 1,1)] [==>684.0 Secs (Pattern 1,2)] [==>684.0 Secs (Pattern 2,1)] [==>684.0 Secs (Pattern 2,2)]	[2]
	3		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.0,-93.82200482232652	Pattern 1, Exps 3-3 i n Tile Visit 01 (1)	500 Secs [==>670.0 Secs (Pattern 1,1)] [==>670.0 Secs (Pattern 1,2)] [==>670.0 Secs (Pattern 2,1)] [==>670.0 Secs (Pattern 2,2)]	[3]
	4		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F435W		POS TARG 0.0,-93.82200482232652	Pattern 1, Exps 4-4 i n Tile Visit 01 (1)	500 Secs [==>668.0 Secs (Pattern 1,1)] [==>668.0 Secs (Pattern 1,2)] [==>668.0 Secs (Pattern 2,1)] [==>668.0 Secs (Pattern 2,2)]	[4]

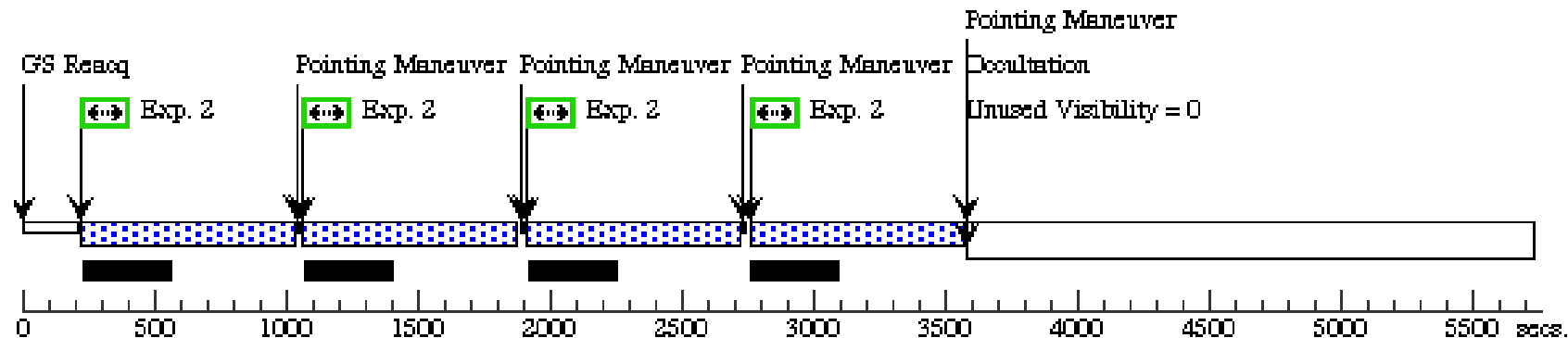
Orbit 1

Server Version: 20120604



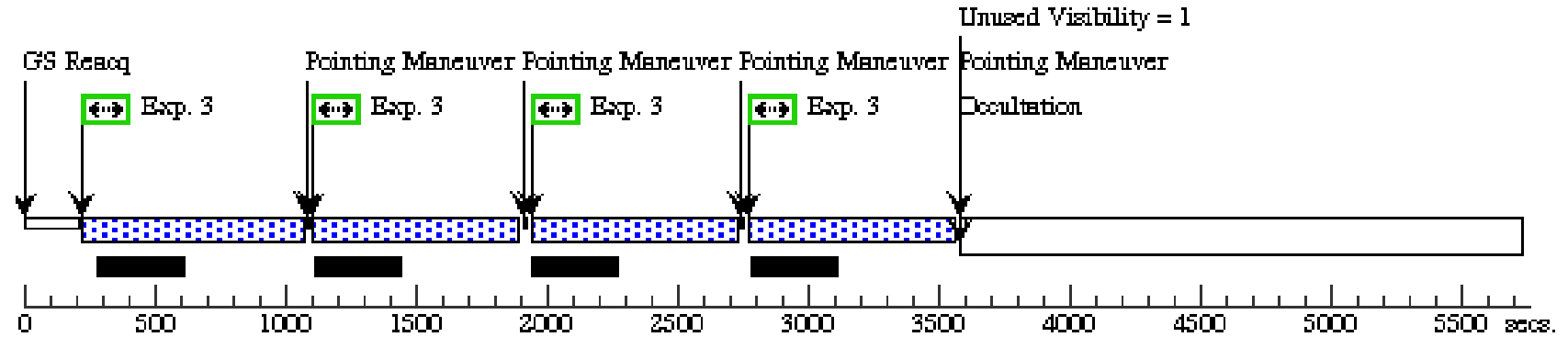
Orbit 2

Server Version: 20120604



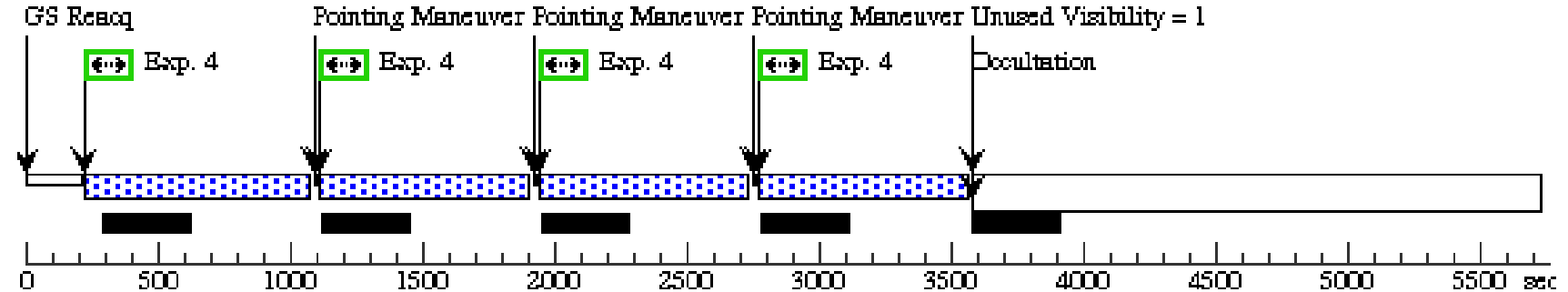
Orbit 3

Server Version: 20120604



Orbit 4

Server Version: 20120604



Proposal 12871 - Tile Visit 02 - When Giants Collide: Mapping the Mass in the Cluster Merger Abell 2146

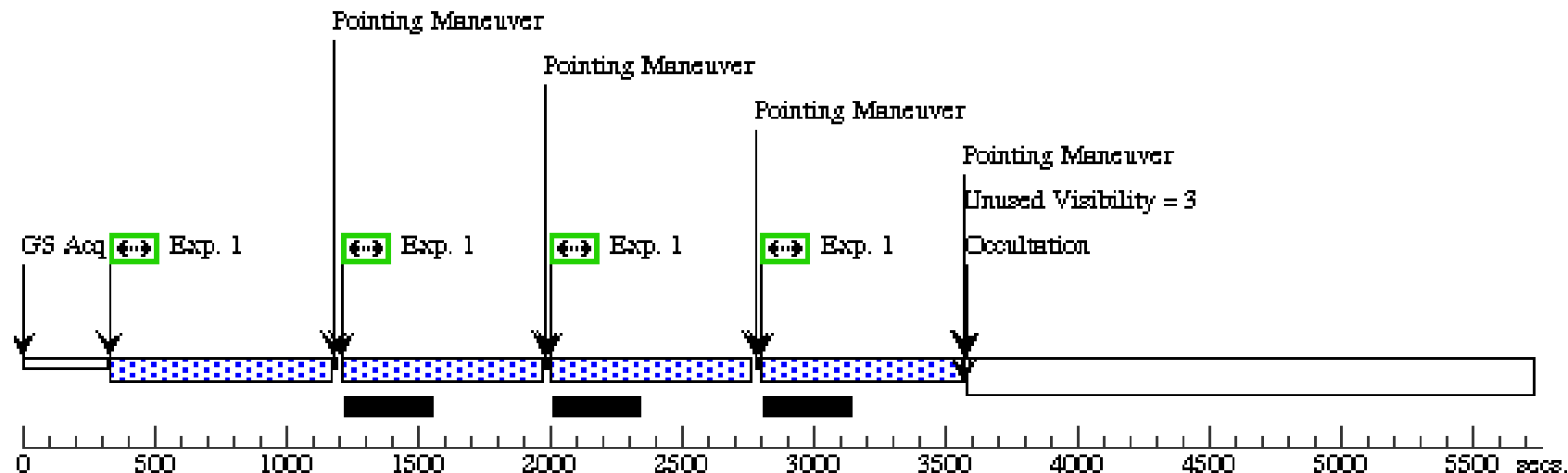
Visit	Proposal 12871, Tile Visit 02 Diagnostic Status: Warning Scientific Instruments: ACS/WFC Special Requirements: SAME ORIENT AS 01					Thu Jul 12 01:43:18 GMT 2012	
	Diagnostics (Tile Visit 02) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE (Tile Visit 02) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE (Tile Visit 02) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE (Tile Visit 02) Warning (Orbit Planner): PATTERN POSITION OUTSIDE APERTURE (Exposure 1 (Pattern 1, Exps 1-1 in Tile Visit 02) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes (Exposure 2 (Pattern 1, Exps 2-2 in Tile Visit 02) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes (Exposure 3 (Pattern 1, Exps 3-3 in Tile Visit 02) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes (Exposure 4 (Pattern 1, Exps 4-4 in Tile Visit 02) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes						
Patterns	#	Primary Pattern		Secondary Pattern		Exposures	
	(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=6.10486 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=91.16385 Angle Between Sides= Center Pattern=true	Pattern Type=LINE Purpose=DITHER Number Of Points=2 Point Spacing=3.085553 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.38997 Angle Between Sides= Center Pattern=false	(1), (2), (3), (4)	
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	
	(1)	ABELL2146	RA: 15 56 3.2415 (239.0135062d) Dec: +66 22 10.22 (66.36951d) Equinox: J2000		V=16 flux of brightest cluster galaxy	Reference Frame: ICRS	

Proposal 12871 - Tile Visit 02 - When Giants Collide: Mapping the Mass in the Cluster Merger Abell 2146

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F814W		POS TARG 0.0,93.8 2200482232652	Pattern 1, Exps 1-1 i n Tile Visit 02 (1)	500 Secs [==>635.0 Secs (Pattern 1,1)] [==>635.0 Secs (Pattern 1,2)] [==>635.0 Secs (Pattern 2,1)] [==>635.0 Secs (Pattern 2,2)]	[1]
	2		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F814W		POS TARG 0.0,93.8 2200482232652	Pattern 1, Exps 2-2 i n Tile Visit 02 (1)	500 Secs [==>684.0 Secs (Pattern 1,1)] [==>684.0 Secs (Pattern 1,2)] [==>684.0 Secs (Pattern 2,1)] [==>684.0 Secs (Pattern 2,2)]	[2]
	3		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.0,93.8 2200482232652	Pattern 1, Exps 3-3 i n Tile Visit 02 (1)	500 Secs [==>670.0 Secs (Pattern 1,1)] [==>670.0 Secs (Pattern 1,2)] [==>670.0 Secs (Pattern 2,1)] [==>670.0 Secs (Pattern 2,2)]	[3]
	4		(1) ABELL2146	ACS/WFC, ACCUM, WFC	F435W		POS TARG 0.0,93.8 2200482232652	Pattern 1, Exps 4-4 i n Tile Visit 02 (1)	500 Secs [==>668.0 Secs (Pattern 1,1)] [==>668.0 Secs (Pattern 1,2)] [==>668.0 Secs (Pattern 2,1)] [==>668.0 Secs (Pattern 2,2)]	[4]

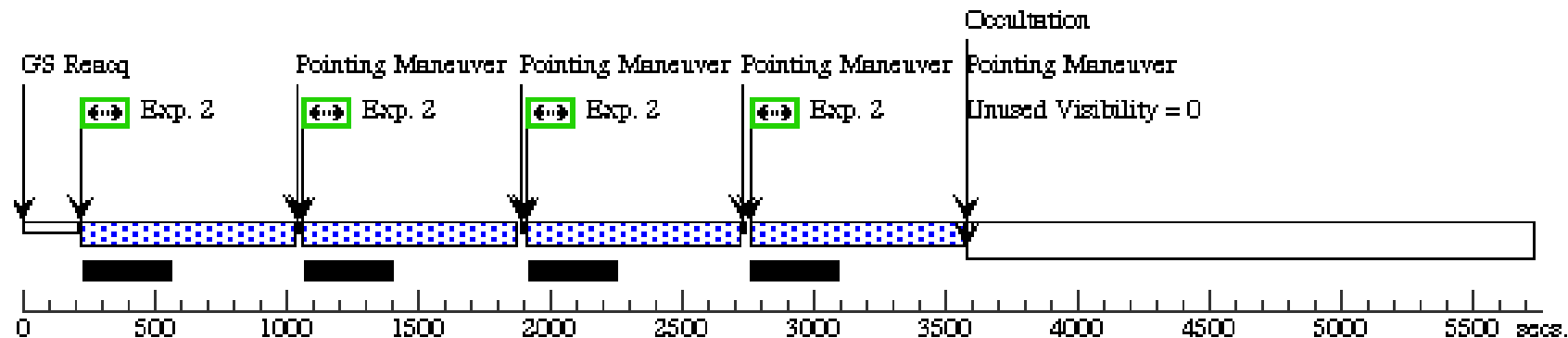
Orbit 1

Server Version: 20120604



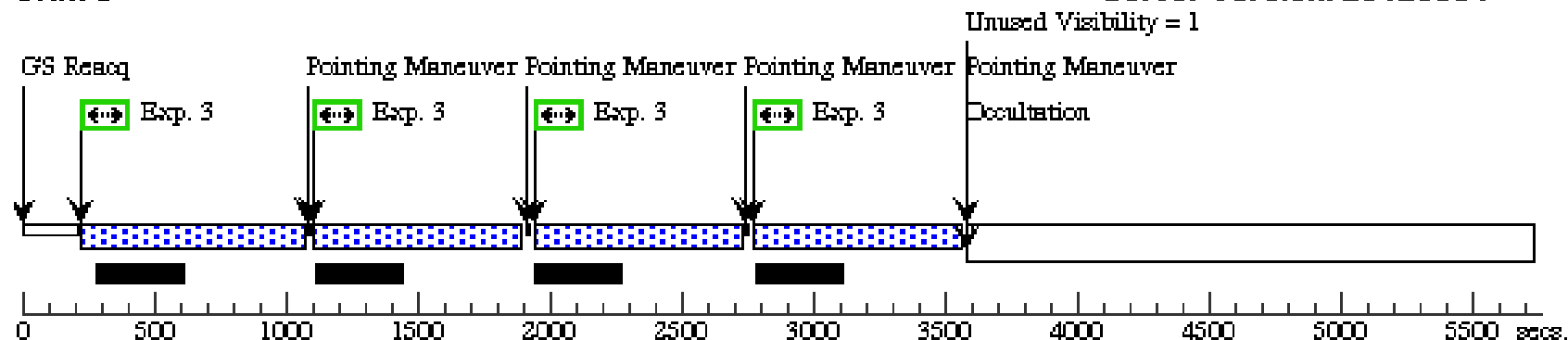
Orbit 2

Server Version: 20120604



Orbit 3

Server Version: 20120604



Orbit 4

Server Version: 20120604

