11679 - Probing The Globular Cluster / Low Mass X-ray Binary Connection in Early-type Galaxies At Low X-ray Luminosities

Cycle: 17, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Craig L. Sarazin (PI)	**The University of Virginia**	**sarazin@virginia.edu**
Dr. Gregory R. Sivakoff (CoI)	The Ohio State University Research Foundation	sivakoff@astronomy.ohio-state.edu
Dr. Andres Jordan (CoI)	Smithsonian Institution Astrophysical Observatory	ajordan@cfa.harvard.edu
Dr. Adrienne M. Juett (CoI)	NASA Goddard Space Flight Center	Adrienne.M.Juett@nasa.gov

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) NGC-4278-MOSAIC-4	ACS/WFC	1	30-Dec-2009 21:00:53.0	yes
02	(2) NGC-3379-CENTER-FIELD	ACS/WFC	1	30-Dec-2009 21:00:58.0	yes
03	(2) NGC-3379-CENTER-FIELD	ACS/WFC	1	30-Dec-2009 21:01:02.0	yes
04	(2) NGC-3379-CENTER-FIELD	ACS/WFC	1	30-Dec-2009 21:01:05.0	yes
05	(2) NGC-3379-CENTER-FIELD	ACS/WFC	1	30-Dec-2009 21:01:08.0	yes
06	(2) NGC-3379-CENTER-FIELD	ACS/WFC	1	30-Dec-2009 21:01:11.0	yes

6 Total Orbits Used

ABSTRACT

Combined high-resolution images from Hubble and Chandra (CXO) have revolutionized our understanding of extragalactic low-mass X-ray binaries (LMXBs) and globular clusters (GCs), yet their connection in early-type galaxies has remained unstudied at the luminosities of the Galactic LMXBs in GCs. NGC 3379 and NGC 4278 are be the first prototypical elliptical galaxies with complete, deep CXO observations enabling the study of LMXBs at lower luminosities. We propose completing mosaic ACS observations of both galaxies (5 fields per galaxy) that will provide the most comprehensive view into the connection between GCs and LMXBs in early-type galaxies. We will detect ~860 and ~270 GCs in all of NGC 4278 and NGC 3379, respectively. These two galaxies will have among the greatest number of detected GC-LMXBs to date (~130 & 50) and will include the faintest GC-LMXBs in a normal early-type galaxy. We will measure the fraction of GCs which contain LMXBs, as a function of X-ray luminosity, galactocentric distance, color, and GC half-light radius. Using the radial profiles of optical light, GCs, and LMXBs, we will determine the percentage of field LMXBs which may have originated in GCs. We will use the measured GC properties over the entire extent of both galaxies to constrain theories of GC formation and evolution. This is a resubmission of an approved Cycle 15 program (10835) which was only partially completed.

OBSERVING DESCRIPTION

Our science goal is to obtain a nearly complete census of GCs in each of the galaxies. In what follows we detail our observation strategy, which is almost unchanged from that of the ACS Virgo Cluster Survey (Cote et al. 2004) and the ACS Fornax Cluster Survey (Jord´an et al. 2005). To achieve our science goals, we require exposure times of t=680 sec in F475W and 1150 sec in F850LP, or one orbit per field per galaxy, in the outskirts of the galaxy. Since the higher surface brightness at the centers of the galaxies require additional time to achieve the same depth, we have added a centrally placed single orbit observation per galaxy. Each series will be split using a line dither pattern to optimize the rejection of hot pixels and cosmic rays.

At declinations of ~29 and ~12deg, the target visibility for our galaxies is 53 and 52 min. Each field will be observed in a single orbit. For the flanking fields, we will have two F475W and two F850LP exposures. For the central field in NGC 3379, there will be two F475W and three F850LP exposures, with a short 90 sec F850LP is included to guard against possible saturation of the galaxy nucleus,

When these observations are complete, we will have observed five fields in each galaxy, each

field requiring one orbit. The 2×2 mosaic plus 1 overlapping central field, will provide complete

coverage of galactocentric distance out to 3.2'. We will also have partial coverage of galactocentric distance out to 4.5'. The isophotal 25 mag/arcsec2 surface will be completely covered in both galaxies.

For NGC 4278, we request that the observation of the unobserved field match within a few degrees of the existing observations. For NGC 3379, our central field has no restrictions in the ORIENT value. We prefer that the orientation angles of the 2×2 mosaic match within a few degrees of the orientation angle of the central field. This preference allows for the largest coverage by the flanking fields and full registration of each field with the central field observation. For both galaxies, these scheduling requests can be filled for ~ 3 months. This requirement could be relaxed if scheduling difficulties arise.

ADDITIONAL COMMENTS

For NGC 4278, we request that the orientation angle of the one remaining field match within a few degrees of the orientation angle of the previous central ACS observation.

For NGC 3379, we request that the orientation angles of the 2×2 mosaic match within a few degrees of the orientation angle of the central field.

If the ACS repair should fail or not be done, these observations would be done with the WFC3 UVIS camera. The smaller FOV (16200×16200 for the WFC3 UVIS rather than 20200×20200 for the ACS/WFC) would reduce somewhat the coverage of the outer parts of the galaxies (see Figure 1), but would still cover the 25 mag arcsec 2 isophote. The positions would be changed so that the 2×2 mosaic overlapped. At wavelengths above 400 nm, the WFC3 is somewhat less sensitive than the ACS/WFC. If the observations were moved to the WFC3 UVIS camera, we would use the F475X and F814W filters, rather than the F475W and F850LP. The increased throughput and width of these filters would allow us to reach almost the same limiting magnitude in a single orbit for each observation.

Visit

Proposal 11679, Visit 01, implementation Thu Dec 31 02:01:14 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 249.0D TO 284.7 D

Patterns

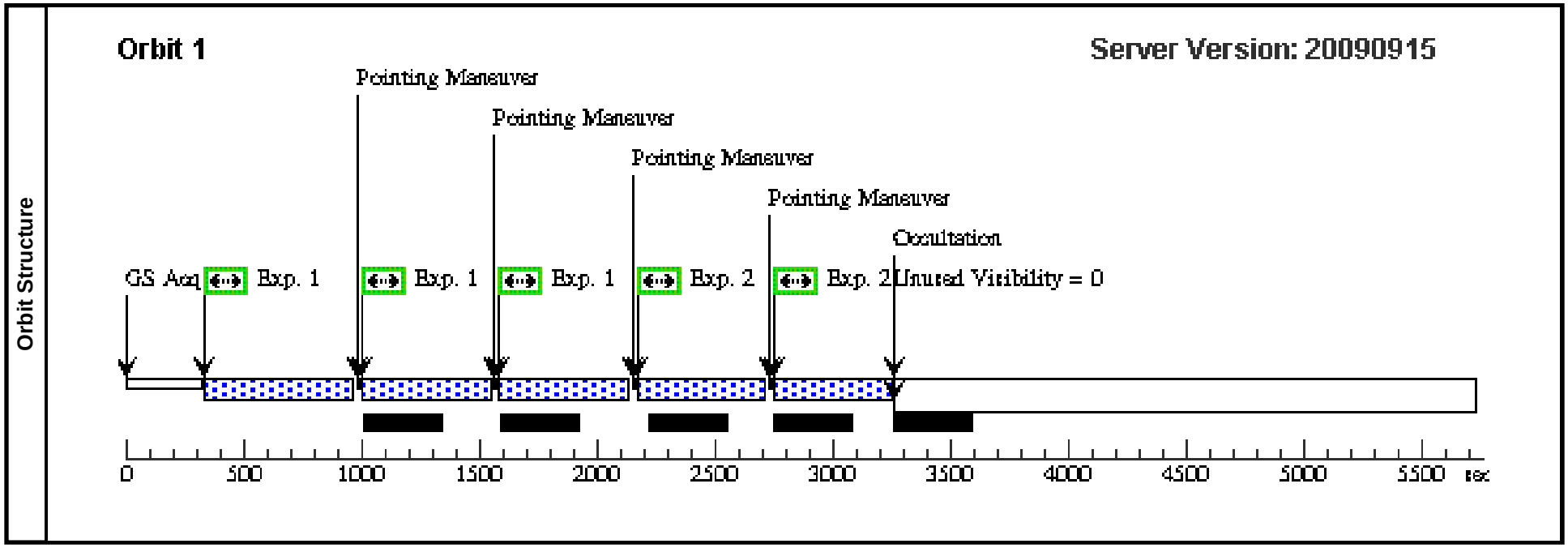
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(2)
(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC-4278-MOSAIC-4	RA: 12 20 16.0000 (185.0666667d) Dec: +29 18 13.00 (29.30361d) Equinox: J2000		V=(?) V=23.6, magnitude is that of a typical globular cluster in NGC 4278	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	NGC4278_F850LP_M3	(1) NGC-4278-MOSAIC-4	ACS/WFC, ACCUM, WFCENTER	F850LP	CR-SPLIT=NO	GS ACQ SCENARIO BASE1B3	Pattern 2, Exps 1-1 (2)	429 Secs *[==>429.0 Secs (Pattern 1)]* *[==>429.0 Secs (Pattern 2)]* *[==>429.0 Secs (Pattern 3)]*	***[1]***
2	NGC4278_F475W_M3	(1) NGC-4278-MOSAIC-4	ACS/WFC, ACCUM, WFCENTER	F475W	CR-SPLIT=NO		Pattern 1, Exps 2-2 (1)	379 Secs *[==>379.0 Secs (Pattern 1)]* *[==>379.0 Secs (Pattern 2)]*	***[1]***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Exp. 1
Exp. 2
Exp. 2
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sec

Visit

Proposal 11679, Visit 02, implementation Thu Dec 31 02:01:15 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

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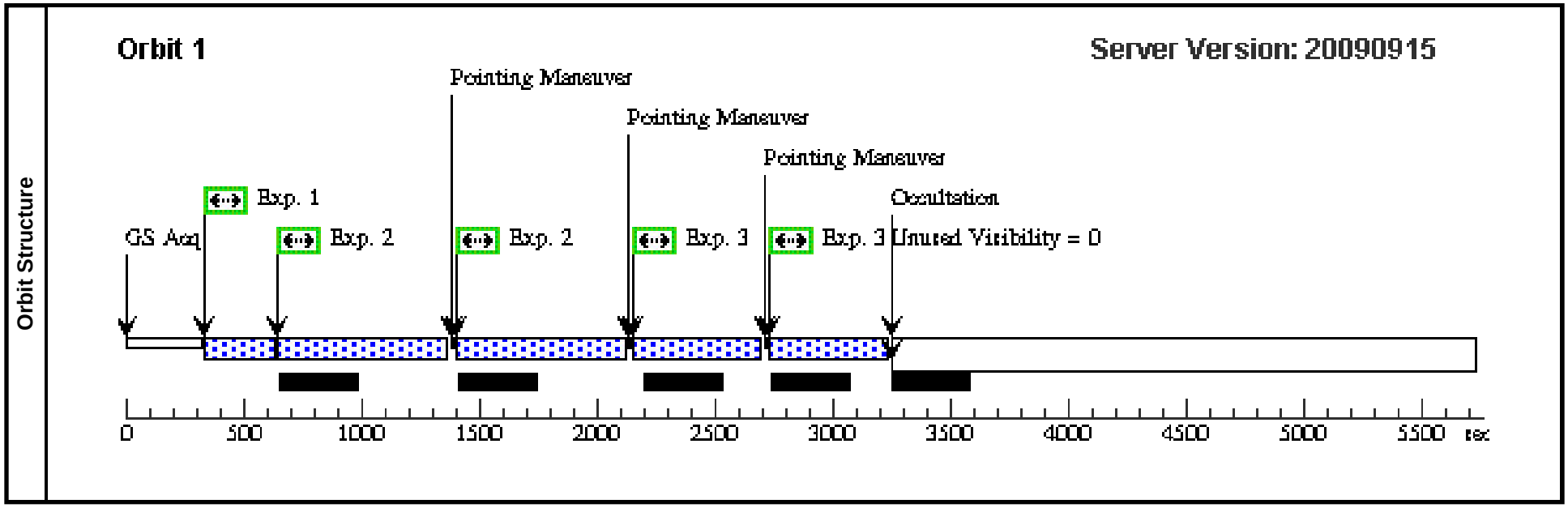
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-3379-CENTER-FIELD	RA: 10 47 49.6000 (161.9566667d) Dec: +12 34 53.90 (12.58164d) Equinox: J2000		V=(?) V=22.9, magnitude is that of a typical globular cluster in NGC 3379	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	NGC3379_F850LP_Cs	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F850LP	CR-SPLIT=NO			91 Secs *[==>91.0 Secs]*	***[1]***
2	NGC3379_F850LP_C	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F850LP	CR-SPLIT=NO		Pattern 1, Exps 2-2 (1)	597 Secs *[==>597.0 Secs (Pattern 1)]* *[==>597.0 Secs (Pattern 2)]*	***[1]***
3	NGC3379_F475W_C	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F475W	CR-SPLIT=NO		Pattern 1, Exps 3-3 (1)	380 Secs *[==>380.0 Secs (Pattern 1)]* *[==>380.0 Secs (Pattern 2)]*	***[1]***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Visit

Proposal 11679, Visit 03, implementation Thu Dec 31 02:01:16 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 02

Patterns

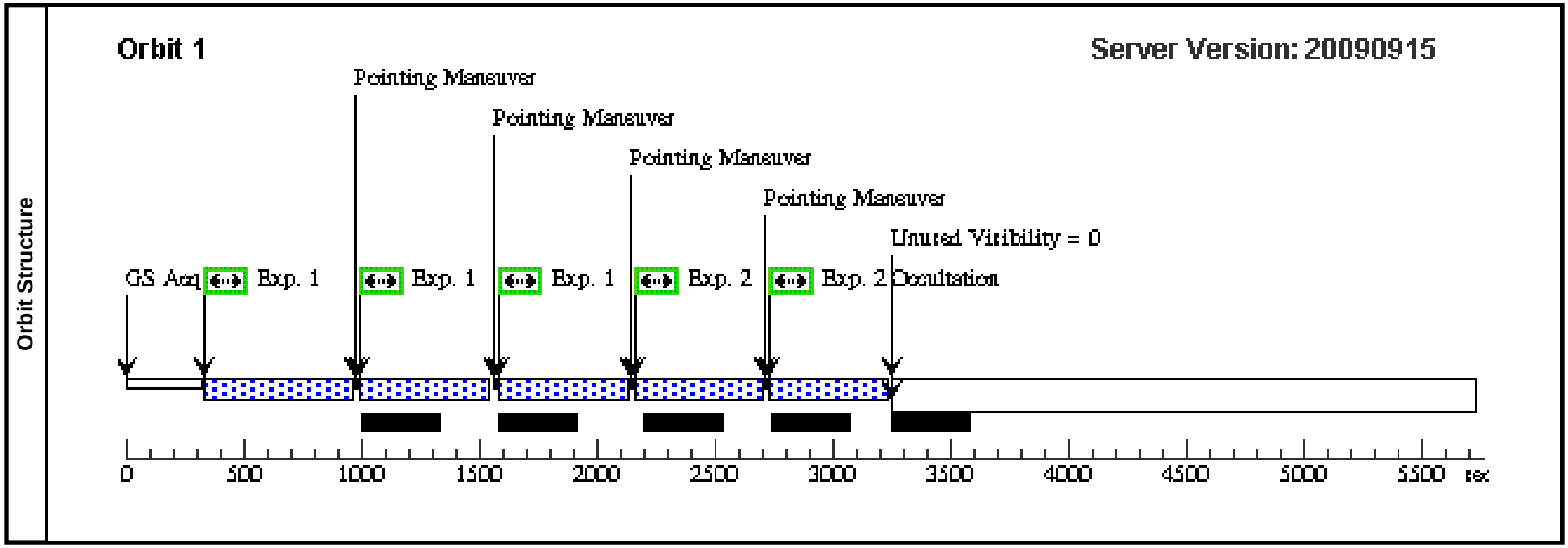
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(2)
(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-3379-CENTER-FIELD	RA: 10 47 49.6000 (161.9566667d) Dec: +12 34 53.90 (12.58164d) Equinox: J2000		V=(?) V=22.9, magnitude is that of a typical globular cluster in NGC 3379	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	NGC3379_F850LP_M1	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F850LP	CR-SPLIT=NO	POS TARG -96.497, -104.084	Pattern 2, Exps 1-1 (2)	425 Secs *[==>425.0 Secs (Pattern 1)]* *[==>425.0 Secs (Pattern 2)]* *[==>425.0 Secs (Pattern 3)]*	 ***[1]***
2	NGC3379_F475_M1	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F475W	CR-SPLIT=NO	POS TARG -96.497, -104.084	Pattern 1, Exps 2-2 (1)	377 Secs *[==>377.0 Secs (Pattern 1)]* *[==>377.0 Secs (Pattern 2)]*	 ***[1]***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Exp. 2
Exp. 2
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Visit

Proposal 11679, Visit 04, implementation Thu Dec 31 02:01:17 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 02

Patterns

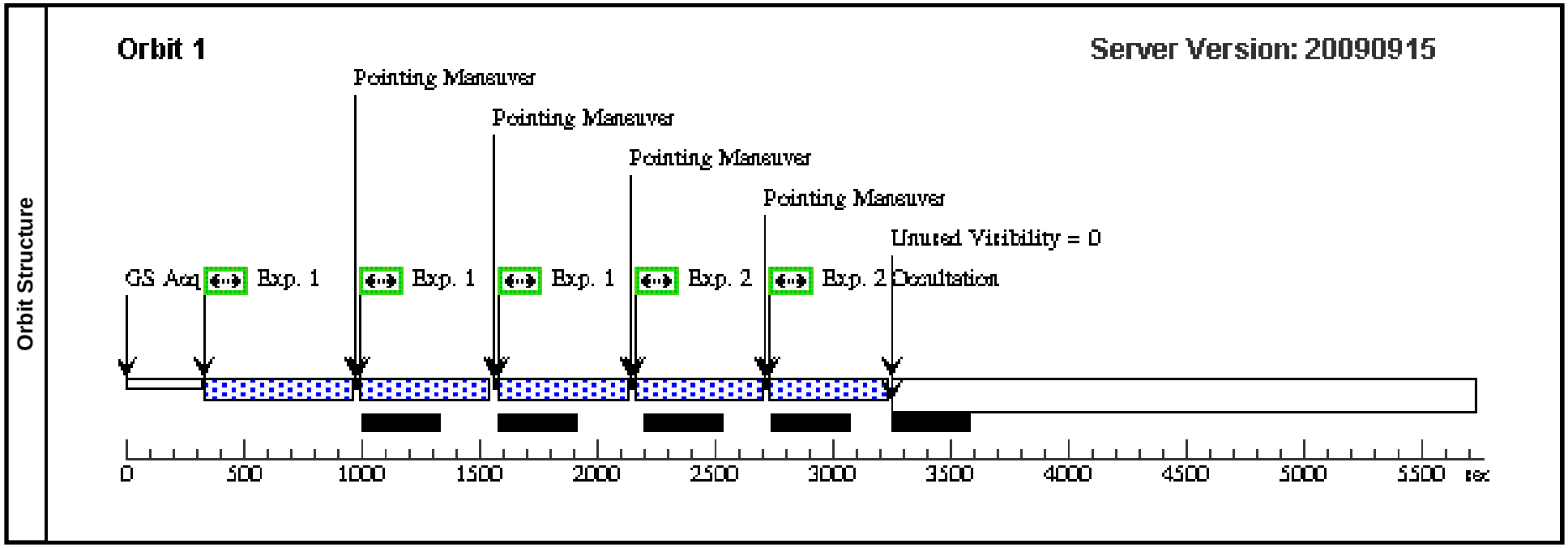
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(2)
(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-3379-CENTER-FIELD	RA: 10 47 49.6000 (161.9566667d) Dec: +12 34 53.90 (12.58164d) Equinox: J2000		V=(?) V=22.9, magnitude is that of a typical globular cluster in NGC 3379	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	NGC3379_F850LP_M2	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F850LP	CR-SPLIT=NO	POS TARG -96.497, 89.298	Pattern 2, Exps 1-1 (2)	425 Secs	
								[==>425 Secs (Pattern 1)]	***[1]***
								[==>425 Secs (Pattern 2)]	
								[==>425 Secs (Pattern 3)]	
2	NGC3379_F475W_M2	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F475W	CR-SPLIT=NO	POS TARG -96.497, 89.298	Pattern 1, Exps 2-2 (1)	377 Secs	
								[==>377 Secs (Pattern 1)]	***[1]***
								[==>377 Secs (Pattern 2)]	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Visit

Proposal 11679, Visit 05, implementation Thu Dec 31 02:01:17 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 02

Patterns

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Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-3379-CENTER-FIELD	RA: 10 47 49.6000 (161.9566667d) Dec: +12 34 53.90 (12.58164d) Equinox: J2000		V=(?) V=22.9, magnitude is that of a typical globular cluster in NGC 3379	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	NGC3379_F850LP_M3	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F850LP	CR-SPLIT=NO	POS TARG 96.497,104.084	Pattern 2, Exps 1-1 (2)	425 Secs	
								[==>425 Secs (Pattern 1)]	***[1]***
								[==>425 Secs (Pattern 2)]	
								[==>425 Secs (Pattern 3)]	
2	NGC3379_F475W_M3	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F475W	CR-SPLIT=NO	POS TARG 96.497,104.084	Pattern 1, Exps 2-2 (1)	377 Secs	
								[==>377 Secs (Pattern 1)]	***[1]***
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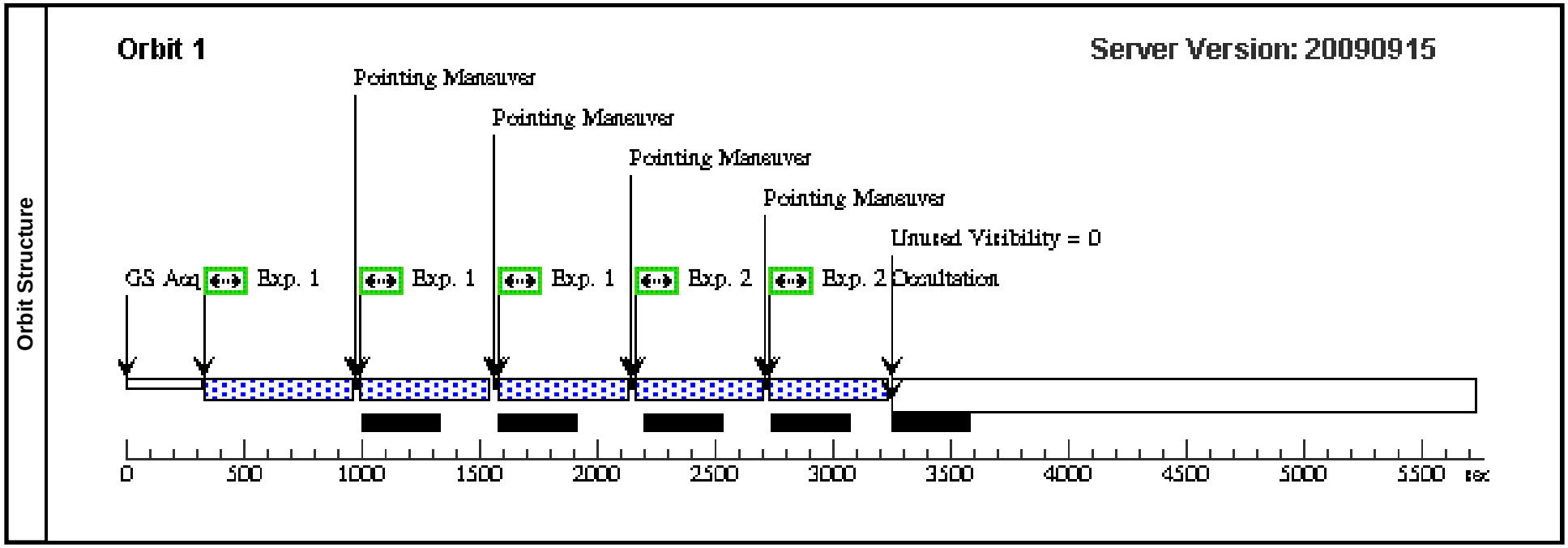
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Exp. 1
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Exp. 2
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Visit

Proposal 11679, Visit 06, implementation Thu Dec 31 02:01:17 GMT 2009

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: SAME ORIENT AS 02

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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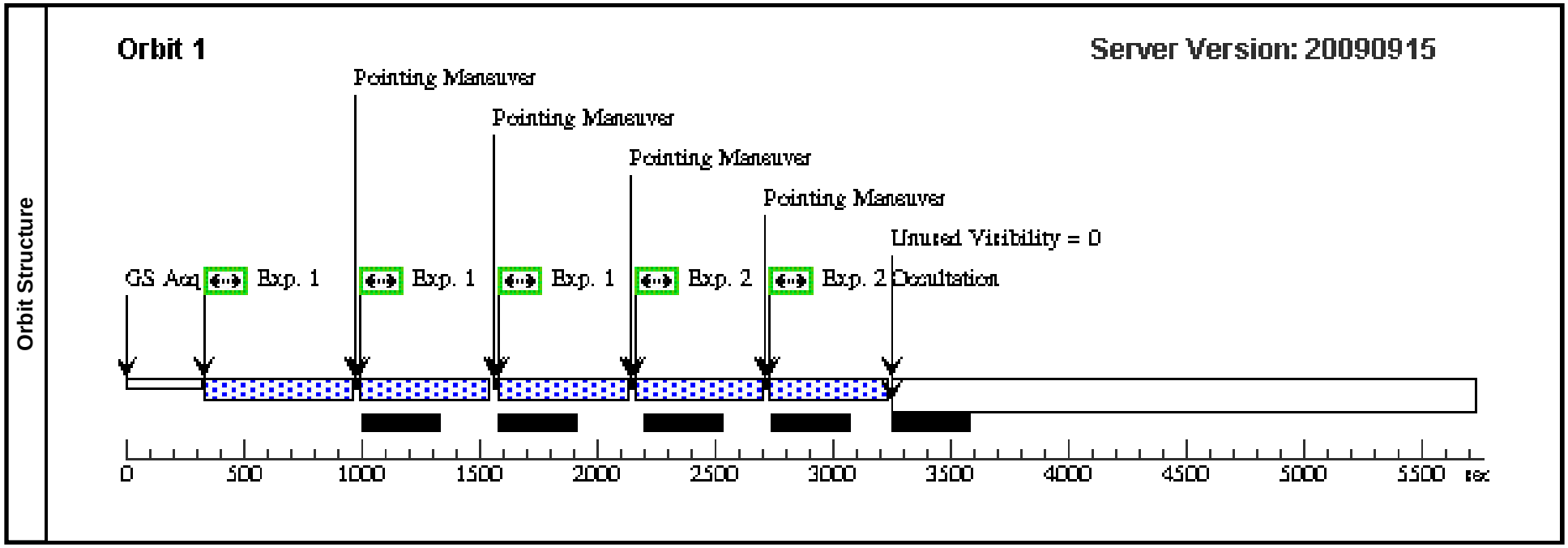
(2)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.23 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC-3379-CENTER-FIELD	RA: 10 47 49.6000 (161.9566667d) Dec: +12 34 53.90 (12.58164d) Equinox: J2000		V=(?) V=22.9, magnitude is that of a typical globular cluster in NGC 3379	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	NGC3379_F850LP_M4	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F850LP	CR-SPLIT=NO	POS TARG 96.497,-89.298	Pattern 2, Exps 1-1 (2)	425 Secs	
								[==>425 Secs (Pattern 1)]	***[1]***
								[==>425 Secs (Pattern 2)]	
								[==>425 Secs (Pattern 3)]	
2	NGC3379_F475W_M4	(2) NGC-3379-CENTER-FIELD	ACS/WFC, ACCUM, WFCENTER	F475W	CR-SPLIT=NO	POS TARG 96.497,-89.298	Pattern 1, Exps 2-2 (1)	377 Secs	
								[==>377 Secs (Pattern 1)]	***[1]***
								[==>377 Secs (Pattern 2)]	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GS Acq
Exp. 1
Exp. 1
Exp. 1
Exp. 2
Exp. 2
Occultation
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