10634 - White Dwarf Cooling Physics: Calibrating the Clock

Cycle: 14, Proposal Category: SNAP

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets*	*Configurations*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) NGC1245	ACS/WFC	1	29-Jun-2005 21:56:37.0	yes
02	(2) NGC2360	ACS/WFC	1	29-Jun-2005 21:56:42.0	yes
03	(3) NGC2660	ACS/WFC	1	29-Jun-2005 21:56:46.0	yes
04	(4) NGC3960	ACS/WFC	1	29-Jun-2005 21:56:49.0	yes
05	(5) NGC7789	ACS/WFC	1	29-Jun-2005 21:56:52.0	yes

5 Total Orbits Used

ABSTRACT

We know approximate ages for the Galactic disk from white dwarf cooling theory applied to local white dwarfs and for the Galactic halo from main sequence stellar evolutionary theory applied to star clusters. However, the two chronometers are not cross-calibrated to the same absolute scale; our observations will perform this cross-calibration and improve the precision of both chronometers. We propose to use HST/ACS photometry of white dwarfs in five moderately old open cluster (0.6-2.2 Gyr), along with all available up-to-date white dwarf interior and atmosphere models and a powerful new statistical approach, to compare main sequence evolutionary theory and white dwarf cooling theory. This comparison will be done in such a manner as to test white dwarf crystallization and carbon/oxygen phase separation, as well as main sequence models in the range where they are sensitive to the degree of core overshooting and where PP burning transitions to CNO burning. This confrontation is essential before we can accurately and precisely apply white dwarf cosmochronometry to the disk and halo field populations and to globular clusters. Past support by HST for white dwarf ages in globular clusters (123 orbits for M4 and a similarly large scheduled campaign for NGC 6397) will only be fully levereged by ensuring that both stellar chronometers are calibrated to the same age scale. Only then can white dwarf chronometers live up to their potential as fundamental, independent, and new age estimators for the Galaxy.

OBSERVING DESCRIPTION

All five clusters will be observed to the bottom of their WD cooling sequences, which are expected to terminate at V = 24.2-26.0 and I = 23.7-25.2, depending on the cluster. Past experience with HST/WFPC2 has taught us to obtain S/N ~ 15 at the WD terminus, which meets both our photometric and galaxy-resolving requirements. In addition, obtaining reliable photometry ~0.5 mag fainter than the expected WD terminus is essential to demonstrate that the observations have not missed fainter WDs. Depending on the cluster and the zodaical light contribution to the sky during observing, we expect S/N(V) = 11.3-49 and and S/N(I) = 9.5-36 for the faintest cluster WDs.

Since these are SNAP observations rather than GO observations, our observing program is guided by the available exposure time in typical single-orbit SNAP windows. Following the STScI recommendations, we set this (flexible) value at 45 minutes and subtract off the expected overheads for our observations. These overheads (guide star acquisition, overheads for 4 exposures, and small dithers between observations in the same filter) total 18.5 minutes. This allows us to obtain a total of 800 sec in each filter, which we split between two exposures (400 sec each) minimally offset. This

approach helps remove both cosmic rays and hot pixels.

We have attempted to make these observations as simple as possible so that they will be easy to schedule. There are no special constraints, such as timing or roll angle constraints, for instance, and the exposures are simple sequences of 2 x 400s in F555W and 2 x 400s in F814W with the ACS/WFC.

ADDITIONAL COMMENTS

Our goal is to obtain deep color-magnitude diagrams for these clusters. The exact pointing is unimportant and if there is a problem with guide stars the target location can be altered somewhat. We have set the pointing near the center of the cluster to maximize the number of white dwarfs observed, and then in some cases adjusted the pointing somewhat to minimize the impact of bright stars, which will saturate and leave less of the area of the ACS/WFC available for deep photometry.

We have used a pattern to offset the second F555W and the second F814W exposures for each target in order to create a dither that will remove cosmic rays and hot pixels. The goal of the POS-TARG between the F555W pair and the F814 pair is to avoid the overhead and extra complexity of a spacecraft dither offset, since this isn't necessary when the filters change.

Visit

Proposal 10634, Visit 01 Thu Jun 30 01:56:54 GMT 2005

Priority: L

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

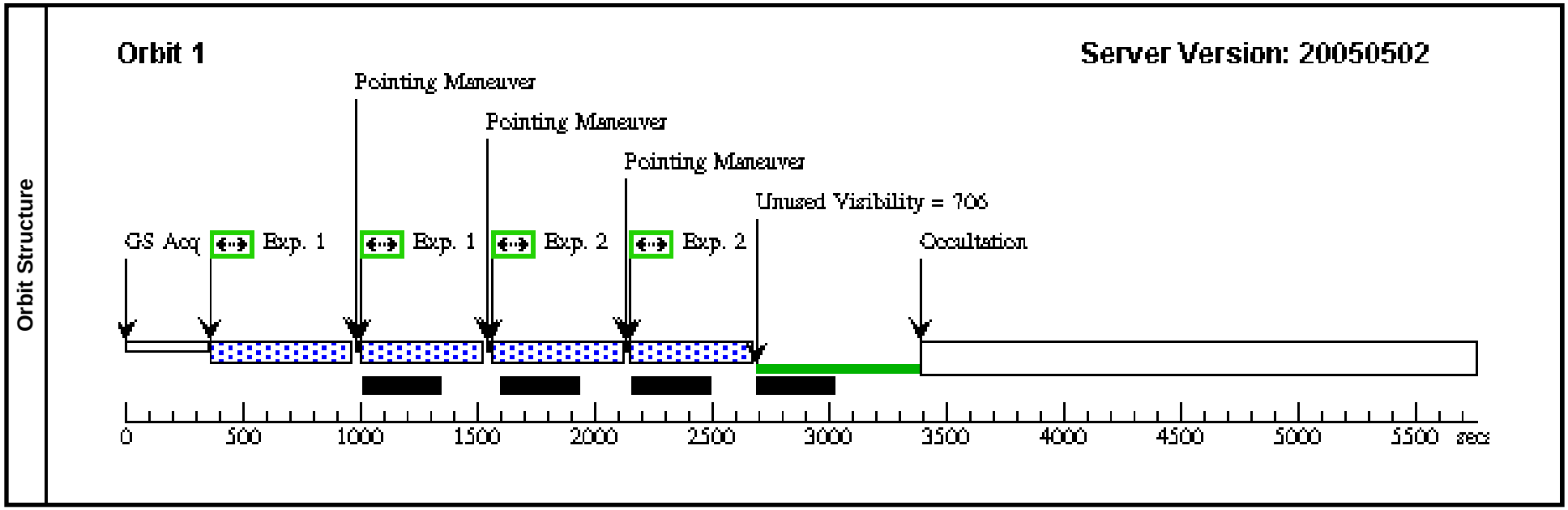
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.2 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC1245	RA: 03 14 44.0000 (48.6833333d) Dec: +47 13 42.00 (47.22833d) Equinox: J2000 Plate Id: (?)		V=26.0+/-0.2 V=13-26, I=12-25.2	Coordinate Source: IMAGE_TIED_TO_GSC_FRAME

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	f555w	(1) NGC1245	ACS/WFC, ACCUM, WFCENTER	F555W	CR-SPLIT=NO		Pattern 1-1 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
2	f814w	(1) NGC1245	ACS/WFC, ACCUM, WFCENTER	F814W	CR-SPLIT=NO	POS TARG 0.099,0.107	Pattern 2-2 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***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Server Version: 20050502
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 706
GS Acq
Exp. 1
Exp. 1
Exp. 2
Exp. 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 10634, Visit 02 Thu Jun 30 01:56:55 GMT 2005

Priority: H

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

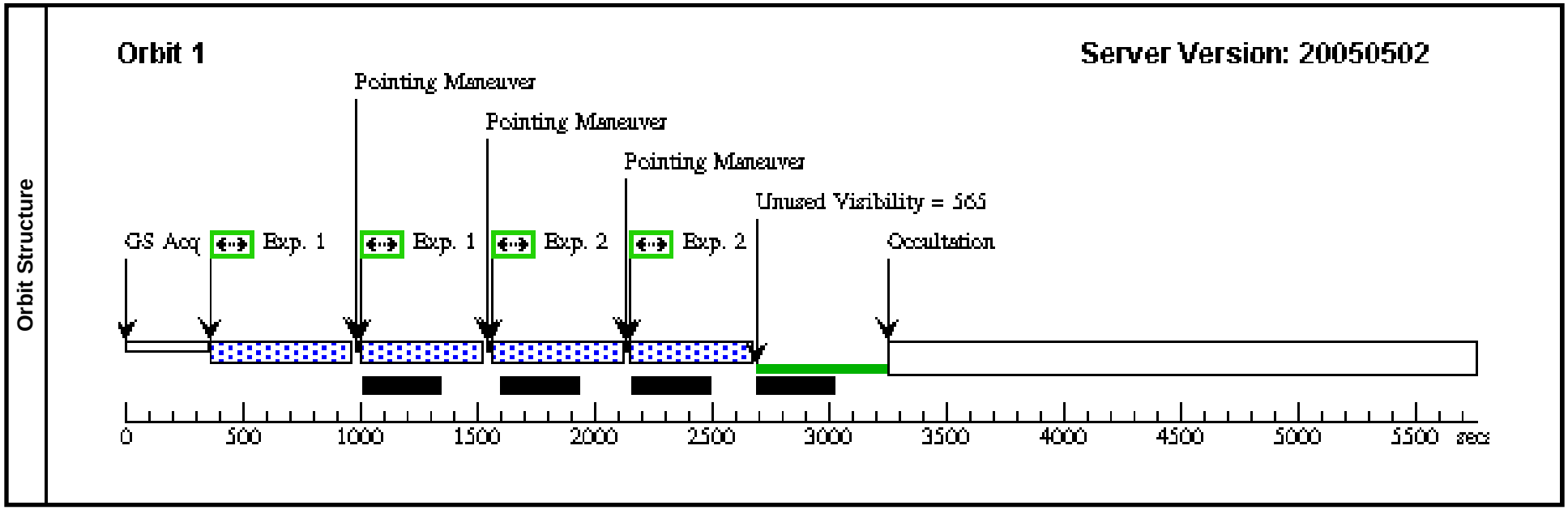
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.2 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	NGC2360	RA: 07 17 54.0000 (109.4750000d) Dec: -15 38 1.00 (-15.63361d) Equinox: J2000 Plate Id: (?)		V=24.5+/-0.2 V=13-24.5, I=12-23.7	Coordinate Source: IMAGE_TIED_TO_GSC_FRAME

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	f555w	(2) NGC2360	ACS/WFC, ACCUM, WFCENTER	F555W	CR-SPLIT=NO		Pattern 1-1 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
2	f814w	(2) NGC2360	ACS/WFC, ACCUM, WFCENTER	F814W	CR-SPLIT=NO	POS TARG 0.099,0.107	Pattern 2-2 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***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Pointing Maneuver
Pointing Maneuver
Unused Visibility = 565
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Exp. 1
Exp. 2
Exp. 2
Occultation
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1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 10634, Visit 03 Thu Jun 30 01:56:55 GMT 2005

Priority: M

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

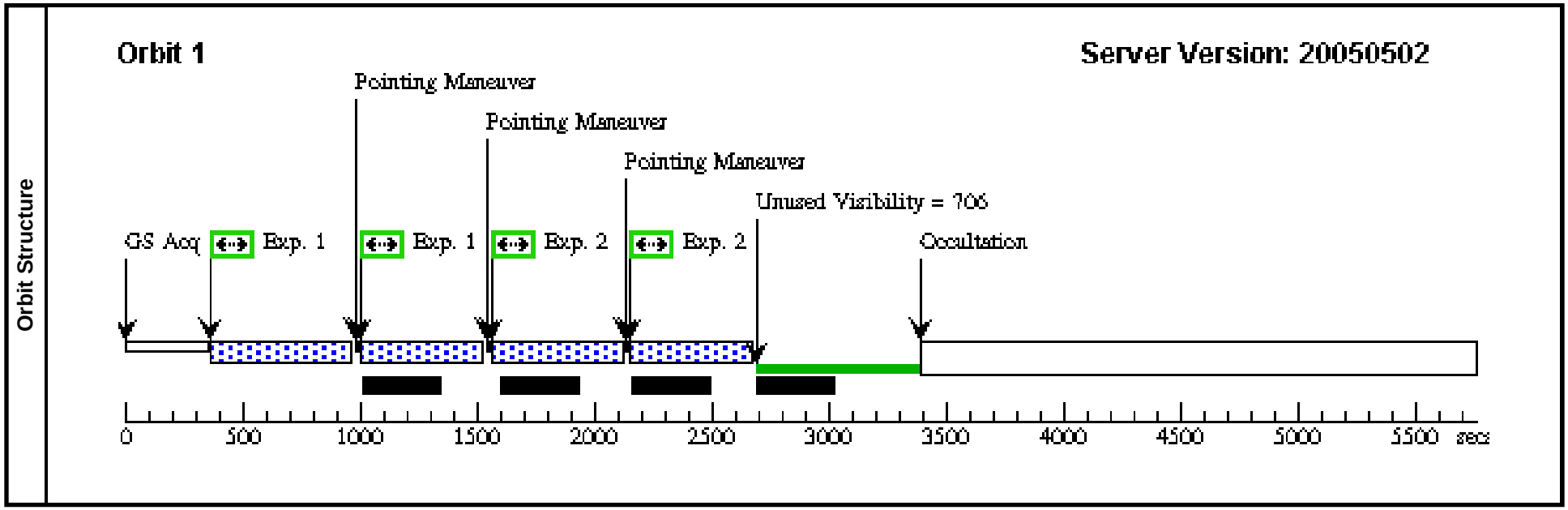
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.2 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	NGC2660	RA: 08 42 36.5000 (130.6520833d) Dec: -47 11 50.00 (-47.19722d) Equinox: J2000 Plate Id: (?)		V=25.8+/-0.2 V=13-25.8, I=12-24.8	Coordinate Source: IMAGE_TIED_TO_GSC_FRAME

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	f555w	(3) NGC2660	ACS/WFC, ACCUM, WFCENTER	F555W	CR-SPLIT=NO		Pattern 1-1 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
2	f814w	(3) NGC2660	ACS/WFC, ACCUM, WFCENTER	F814W	CR-SPLIT=NO	POS TARG 0.099,0.107	Pattern 2-2 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Unused Visibility = 706
GS Acq
Exp. 1
Exp. 1
Exp. 2
Exp. 2
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 10634, Visit 04 Thu Jun 30 01:56:56 GMT 2005

Priority: M

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

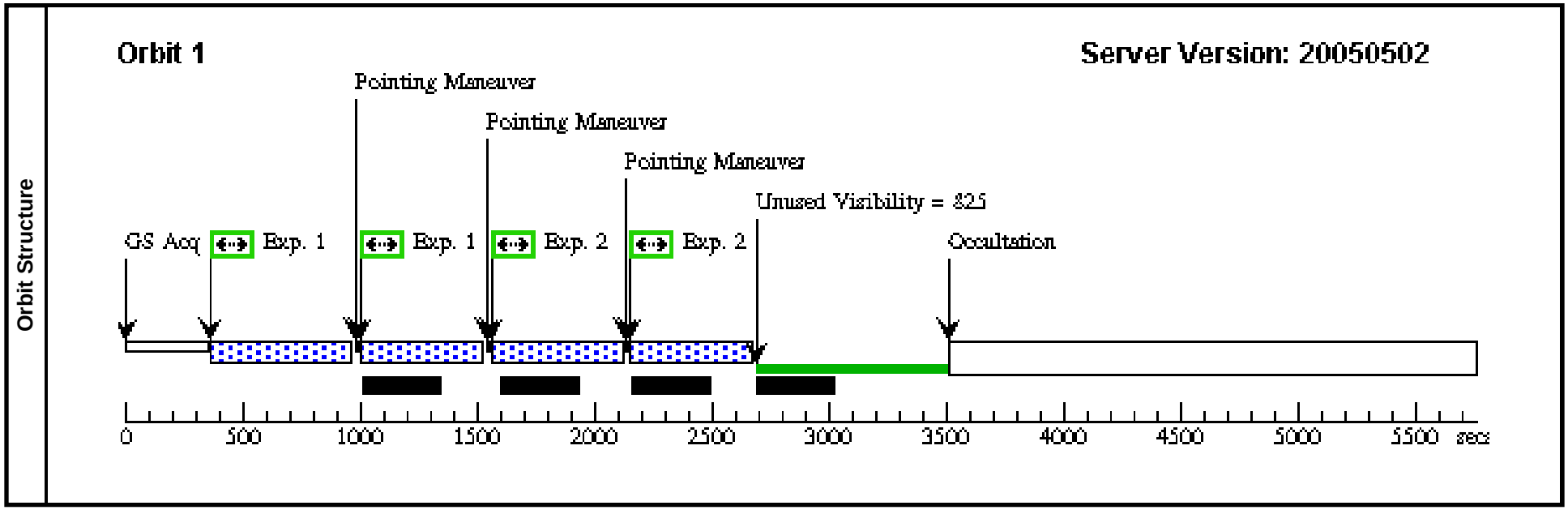
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.2 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	NGC3960	RA: 11 50 39.0000 (177.6625000d) Dec: -55 40 31.00 (-55.67528d) Equinox: J2000 Plate Id: (?)		V=24.2+/-0.2 V=13-24.2, I=12-24.0	Coordinate Source: IMAGE_TIED_TO_GSC_FRAME

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	f555w	(4) NGC3960	ACS/WFC, ACCUM, WFCENTER	F555W	CR-SPLIT=NO		Pattern 1-1 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
2	f814w	(4) NGC3960	ACS/WFC, ACCUM, WFCENTER	F814W	CR-SPLIT=NO	POS TARG 0.099,0.107	Pattern 2-2 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***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Pointing Maneuver
Pointing Maneuver
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Exp. 1
Exp. 2
Exp. 2
Occultation
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1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 10634, Visit 05 Thu Jun 30 01:56:56 GMT 2005

Priority: M

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

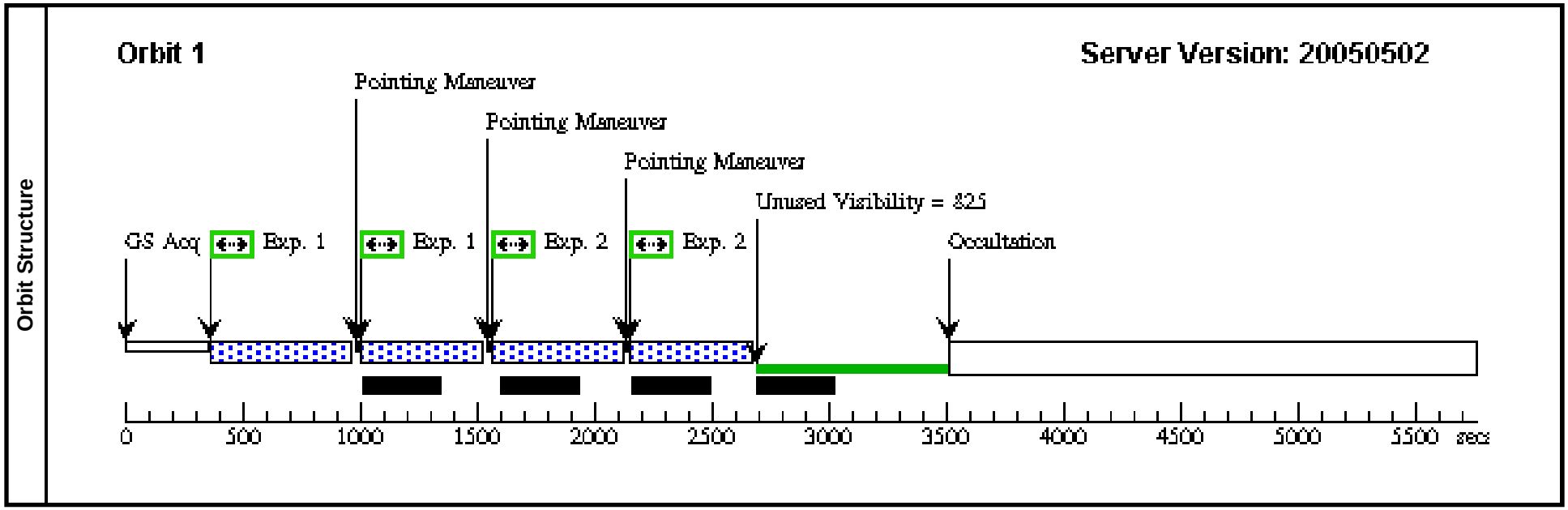
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=47.2 Angle Between Sides= Center Pattern=false		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	NGC7789	RA: 23 57 28.0000 (359.3666667d) Dec: +56 42 58.00 (56.71611d) Equinox: J2000 Plate Id: (?)		V=25.2+/-0.2 V=13-25.2, I=12-24.5	Coordinate Source: IMAGE_TIED_TO_GSC_FRAME

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	f555w	(5) NGC7789	ACS/WFC, ACCUM, WFCENTER	F555W	CR-SPLIT=NO		Pattern 1-1 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***
2	f814w	(5) NGC7789	ACS/WFC, ACCUM, WFCENTER	F814W	CR-SPLIT=NO	POS TARG 0.099,0.107	Pattern 2-2 (1)	400.0 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[1]***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Unused Visibility = 825
GS Acq
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Exp. 1
Exp. 2
Exp. 2
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