



15607 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

Cycle: 26, 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) SDSSJ032224.64+401119.8	WFC3/IR WFC3/UVIS	1	14-Dec-2018 11:02:16.0	yes
02	(2) SDSSJ114359.58+244251.7	WFC3/IR WFC3/UVIS	1	14-Dec-2018 11:02:18.0	yes
03	(3) SDSSJ133245.62+263449.3	WFC3/IR WFC3/UVIS	1	14-Dec-2018 11:02:19.0	yes
04	(4) SDSSJ005904.10+010004.2	WFC3/IR WFC3/UVIS	1	14-Dec-2018 11:02:20.0	yes
05	(5) SDSSJ154748.99+220303.2	WFC3/IR WFC3/UVIS	1	14-Dec-2018 11:02:22.0	yes

<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>
06	(6) SDSSJ160135.95+311353.7	WFC3/IR WFC3/UVIS	1	14-Dec-2018 11:02:23.0	yes
07	(7) SDSSJ233244.60-005847.9	WFC3/IR WFC3/UVIS	1	14-Dec-2018 11:02:24.0	yes

7 Total Orbits Used

ABSTRACT

Studies of massive black holes (BH) in nearby dwarf galaxies can provide important constraints on the birth and growth of the first seed BHs in the early Universe. We propose joint Chandra and HST observations of 7 dwarf galaxies from our recent sample of mid-IR selected candidate AGNs in galaxies with stellar masses comparable to the Magellanic Clouds (Hainline et al. 2016). The proposed observations will enable us to firmly establish the presence of massive BHs in these dwarf galaxies, characterize the compact X-ray emission from the AGNs, and determine the properties of the host galaxies. Our results will also be compared to existing Chandra and HST observations of optically-selected AGNs in dwarfs that lack mid-IR signatures of an AGN.

OBSERVING DESCRIPTION

We propose HST Wide Field Camera 3 (WFC3) observations in three filters spanning a wavelength range of $\sim 0.3 - 1.2\mu\text{m}$ (UVIS F336W & F606W and IR F140W, corresponding to U-band, Wide V-band and Wide JH-band, respectively). The short wavelength observations will enable us to pinpoint the location of star-forming regions in our target galaxies with respect to the X-ray emission from an AGN and help correct for any contribution from X-ray binaries. We will also use spatially-resolved color diagnostics to investigate the ages of stellar populations in these dwarfs hosting mid-IR selected AGNs. The near-IR observations will enable us to determine the detailed morphologies and structural components of the galaxies with sufficient resolution and sensitivity to detect small, faint bulges. As shown below, we can achieve our science goals with one HST orbit per galaxy for a total of 7 orbits.

We will use the IR/F140W filter to study the structures of our target galaxies. Based on surface brightness profiles of our faintest targets, we wish to reach a 10-sigma surface-brightness sensitivity of $u_r \sim 23 \text{ mag arcsec}^2$ in a given pixel. Prior experience suggests that we will be able to reach at least a magnitude deeper with radial averaging than our per-pixel depth. This will allow us to detect the outer parts of the disks in our target galaxies, which is necessary to adequately decouple bulge and disk components on small scales. According to the WFC3/IR exposure time calculator, we need $\sim 400 \text{ s}$ to reach our required sensitivity in F140W. We will break the total time into 4 dithered exposures to improve the PSF sampling and avoid bad

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pixels. We will use the timing sequence STEP25 with NSAMP=9 (~100 s per exposure) to increase our dynamic range, avoid potential saturation from AGN, and allow the use of the IRSUB512 subarray to avoid buffer dumps. Our galaxies are quite compact so using a subarray will not compromise our science or limit our sky subtraction.

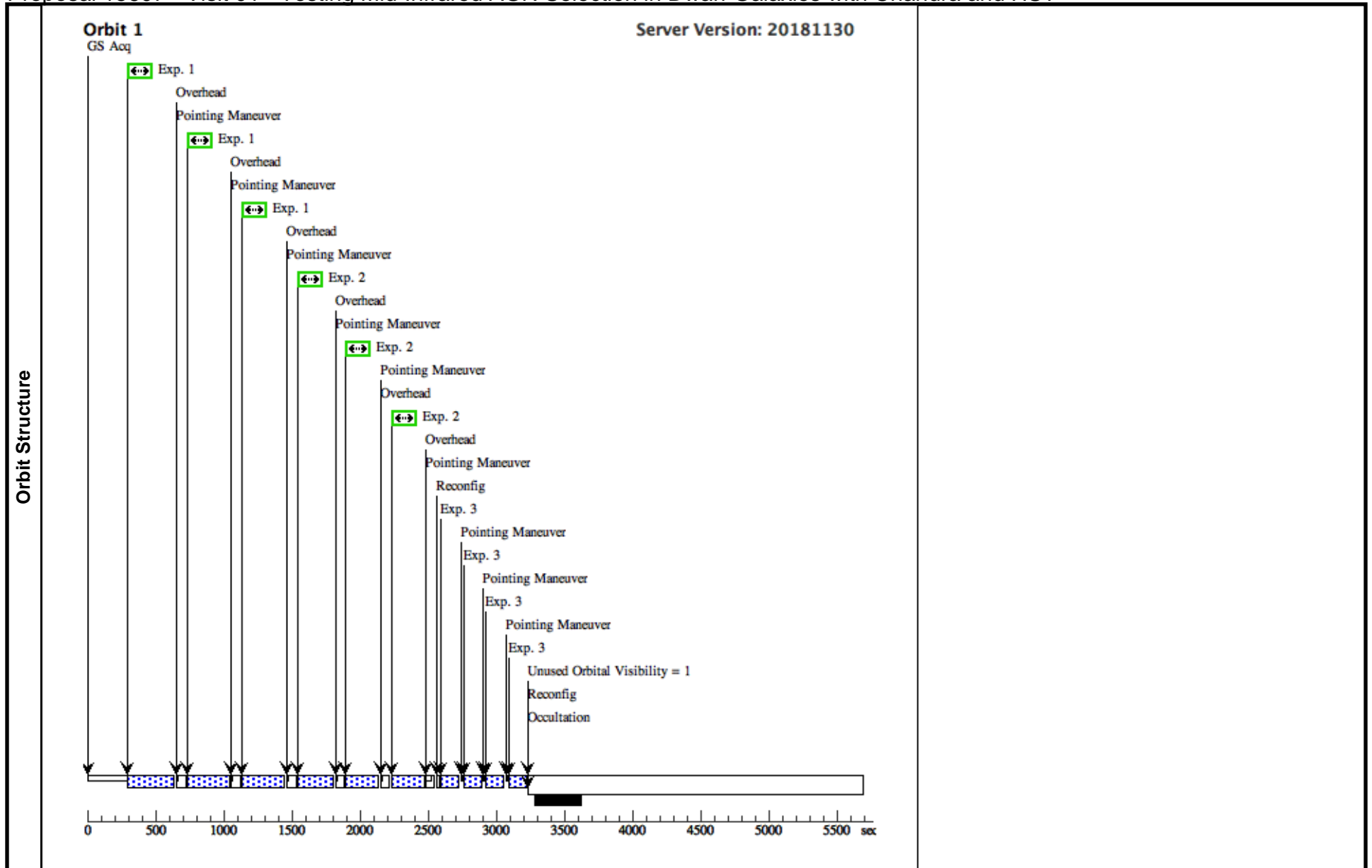
We will also use two optical filters, UVIS F336W and F606W, to obtain important color diagnostics of the stellar populations and evolutionary state of our target dwarf galaxies. To ensure we can accurately separate bulge and disk components, we aim to reach a 10-sigma surface- brightness sensitivity of $u_r \sim 23$ mag arcsec² in a 7 x 7 pixel box (roughly equivalent to 2 x 2 IR pixels). The WFC3/UVIS exposure time calculator suggests we need ~ 750 s in F336W and ~ 600 s in F606W, assuming a young B star spectrum. We will break the total time into 3 dithered exposures and use the 1k x 1k subarray with chip 2.

To summarize, we can achieve our science goals with 1 orbit per galaxy assuming a visibility of ~53 min. We will spend a minimum of ~400 s in F110W, ~600 s in F606W and ~750 s in F336W, leaving sufficient time for acquisition and instrument overheads (approximately 6 min for guide-star acquisition, 2 min for dithering, 14 min for readout, 1 min to switch from UVIS to IR).

Proposal 15607 - Visit 01 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

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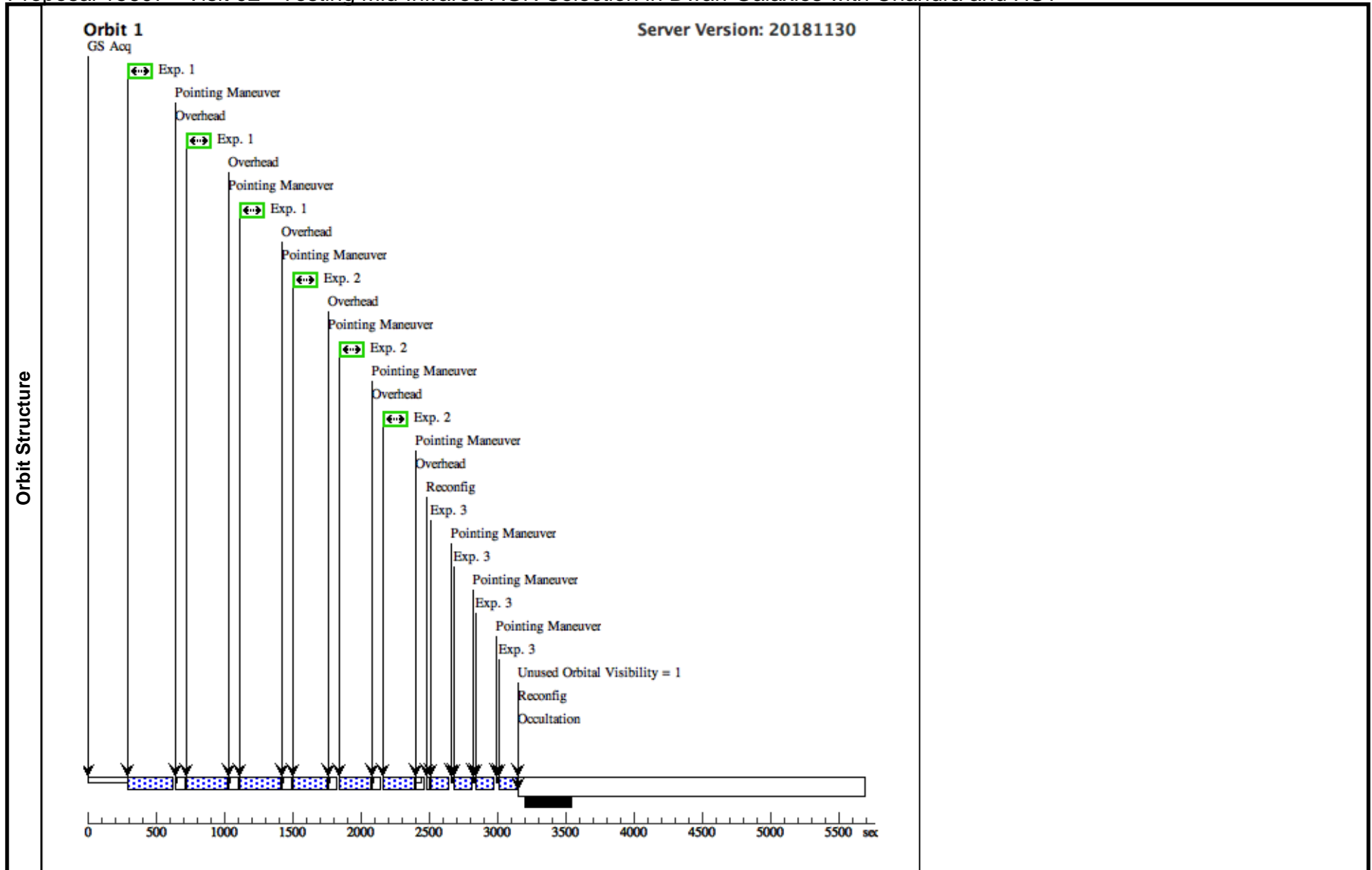
Visit	Proposal 15607, Visit 01, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(1)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)				
	(2)	Pattern Type=WFC3-IR-DITHER- BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(3)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	SDSSJ032224.64+401119.8	RA: 03 22 24.6432 (50.6026800d) Dec: +40 11 19.75 (40.18882d) Equinox: J2000		V=17.4	Reference Frame: ICRS				
	Comments: Category=GALAXY Description=[SEYFERT] Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) SDSSJ032224.64+401119.8	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11		Pattern 1, Exps 1-1 in Visit 01 (1)	312 Secs (936 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	2		(1) SDSSJ032224.64+401119.8	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=2		Pattern 1, Exps 2-2 in Visit 01 (1)	245 Secs (735 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)]	[1]
	3		(1) SDSSJ032224.64+401119.8	WFC3/IR, MULTIACCUM, IRSUB512	F140W	SAMP-SEQ=STEP25; NSAMP=9		Pattern 2, Exps 3-3 in Visit 01 (2)	105.518395 Secs (422.074 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)]	[1]



Proposal 15607 - Visit 02 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

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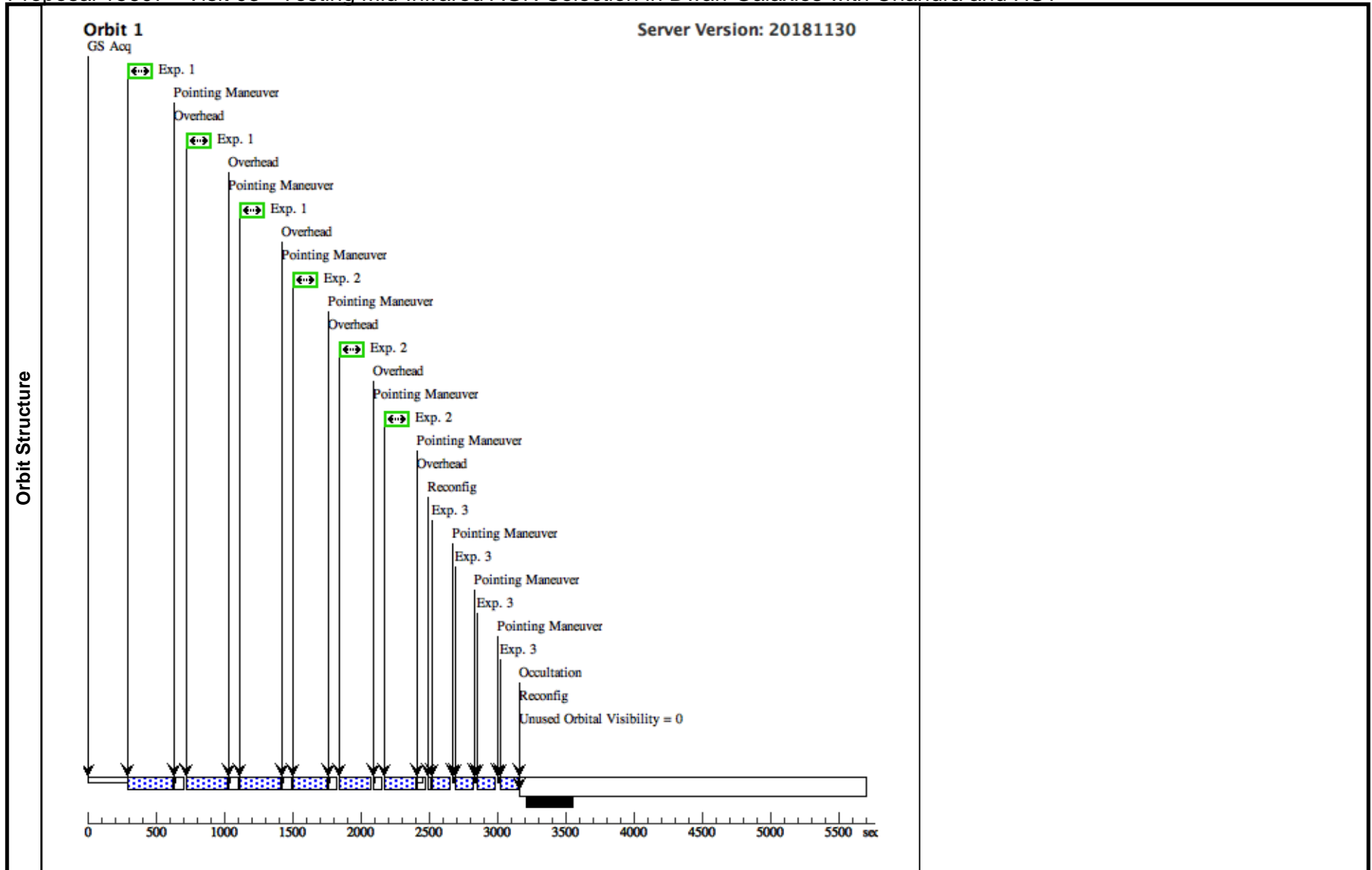
Visit	Proposal 15607, Visit 02, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: (none)									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(1)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)						
	(2)	Pattern Type=WFC3-IR-DITHER- BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365 Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	SDSSJ114359.58+244251.7	RA: 11 43 59.5944 (175.9983100d) Dec: +24 42 51.80 (24.71439d) Equinox: J2000		V=18.0	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[SEYFERT] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(2) SDSSJ114359.58+244251.7	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11		Pattern 1, Exps 1-1 in Visit 02 (1)	299 Secs (897 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2		(2) SDSSJ114359.58+244251.7	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=3		Pattern 1, Exps 2-2 in Visit 02 (1)	230 Secs (690 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3		(2) SDSSJ114359.58+244251.7	WFC3/IR, MULTIACCUM, IRSUB512	F140W	SAMP-SEQ=STEP25; NSAMP=9		Pattern 2, Exps 3-3 in Visit 02 (2)	105.518395 Secs (422.074 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]



Proposal 15607 - Visit 03 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

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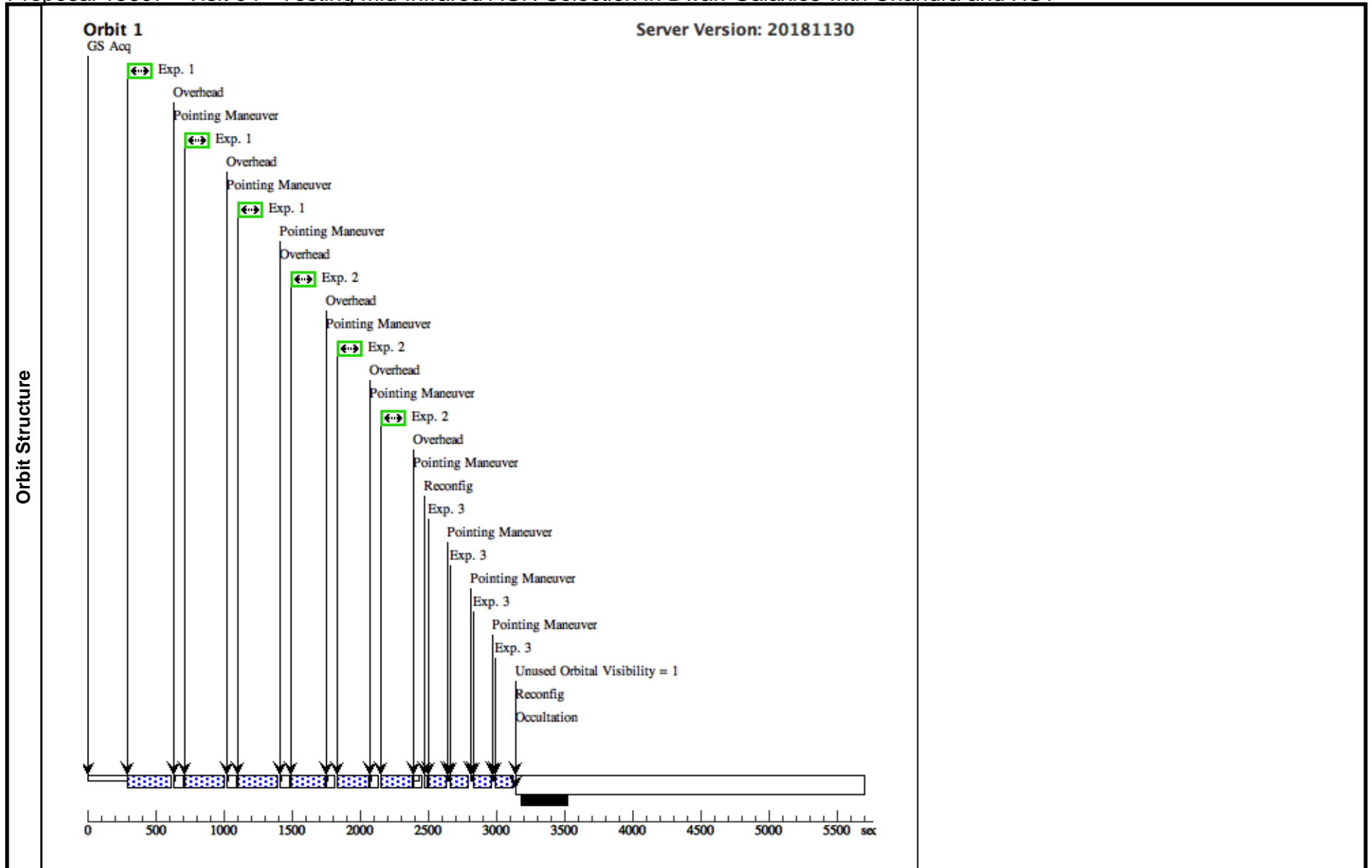
Visit	Proposal 15607, Visit 03, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: (none)									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(1)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)						
	(2)	Pattern Type=WFC3-IR-DITHER- BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365 Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(3)	SDSSJ133245.62+263449.3	RA: 13 32 45.6216 (203.1900900d) Dec: +26 34 49.37 (26.58038d) Equinox: J2000		V=17.3	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[SEYFERT] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(3) SDSSJ133245.62+263449.3	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11		Pattern 1, Exps 1-1 in Visit 03 (1)	298 Secs (894 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2		(3) SDSSJ133245.62+263449.3	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=2		Pattern 1, Exps 2-2 in Visit 03 (1)	235 Secs (705 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3		(3) SDSSJ133245.62+263449.3	WFC3/IR, MULTIACCUM, IRSUB512	F140W	SAMP-SEQ=STEP25; NSAMP=9		Pattern 2, Exps 3-3 in Visit 03 (2)	105.518395 Secs (422.074 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]



Proposal 15607 - Visit 04 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

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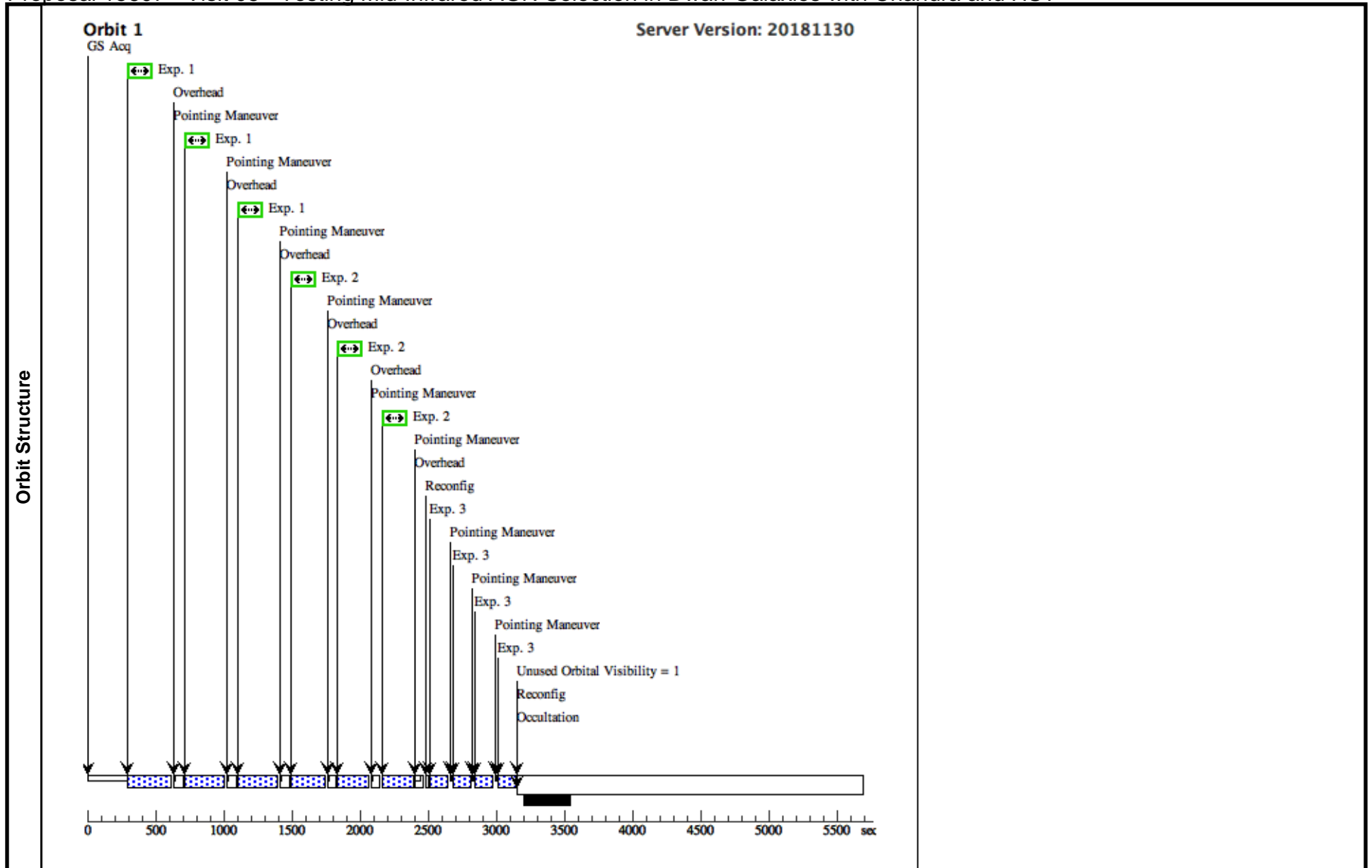
Visit	Proposal 15607, Visit 04, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(1)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)				
	(2)	Pattern Type=WFC3-IR-DITHER- BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(3)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(4)	SDSSJ005904.10+010004.2	RA: 00 59 4.1112 (14.7671300d) Dec: +01 00 4.36 (1.00121d) Equinox: J2000		V=16.1	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[STARBURST] Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(4) SDSSJ005904.10+010004.2	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11		Pattern 1, Exps 1-1 in Visit 04 (1)	295 Secs (885 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2		(4) SDSSJ005904.10+010004.2	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=2		Pattern 1, Exps 2-2 in Visit 04 (1)	230 Secs (690 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3		(4) SDSSJ005904.10+010004.2	WFC3/IR, MULTIACCUM, IRSUB512	F140W	SAMP-SEQ=STEP2 5; NSAMP=9		Pattern 2, Exps 3-3 in Visit 04 (2)	105.518395 Secs (422.074 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]



Proposal 15607 - Visit 05 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

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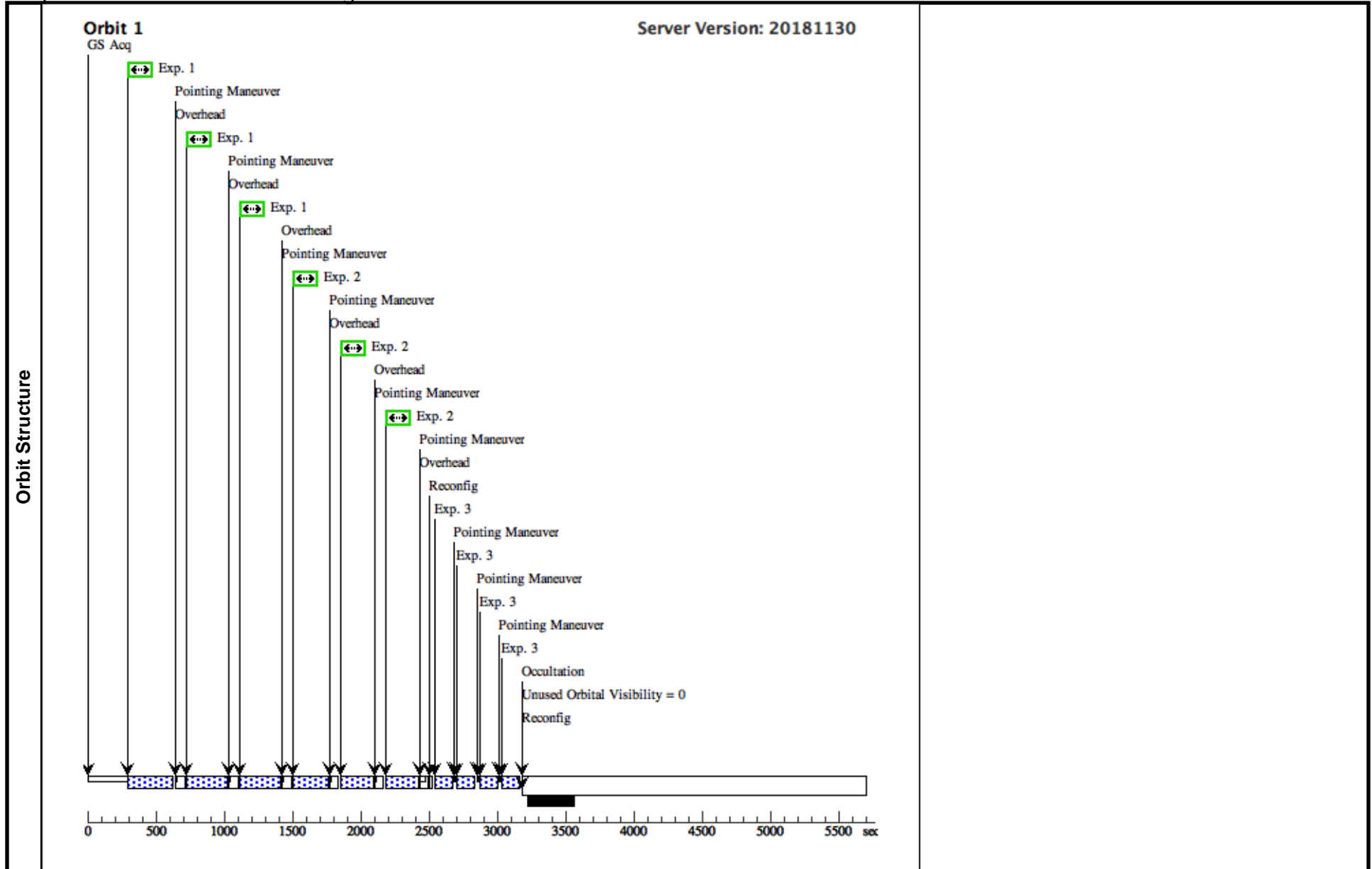
Visit	Proposal 15607, Visit 05, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: (none)									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(1)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)						
	(2)	Pattern Type=WFC3-IR-DITHER- BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365 Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(5)	SDSSJ154748.99+220303.2	RA: 15 47 48.9960 (236.9541500d) Dec: +22 03 3.31 (22.05092d) Equinox: J2000		V=18.2	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[STARBURST] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(5) SDSSJ154748.99+220303.2	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11		Pattern 1, Exps 1-1 in Visit 05 (1)	295 Secs (885 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2		(5) SDSSJ154748.99+220303.2	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=2		Pattern 1, Exps 2-2 in Visit 05 (1)	235 Secs (705 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3		(5) SDSSJ154748.99+220303.2	WFC3/IR, MULTIACCUM, IRSUB512	F140W	SAMP-SEQ=STEP2 5; NSAMP=9		Pattern 2, Exps 3-3 in Visit 05 (2)	105.518395 Secs (422.074 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]



Proposal 15607 - Visit 06 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

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Visit	Proposal 15607, Visit 06, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: (none)									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(1)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)						
	(2)	Pattern Type=WFC3-IR-DITHER- BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365 Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(6)	SDSSJ160135.95+311353.7	RA: 16 01 35.9616 (240.3998400d) Dec: +31 13 53.83 (31.23162d) Equinox: J2000		V=17.7	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[STARBURST]										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(6) SDSSJ160135.95+311353.7	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11		Pattern 1, Exps 1-1 in Visit 06 (1)	300 Secs (900 Secs)	
									[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2		(6) SDSSJ160135.95+311353.7	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=2		Pattern 1, Exps 2-2 in Visit 06 (1)	238 Secs (714 Secs)	
								[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]	
3		(6) SDSSJ160135.95+311353.7	WFC3/IR, MULTIACCUM, IRSUB512	F140W	SAMP-SEQ=STEP2 5; NSAMP=9			Pattern 2, Exps 3-3 in Visit 06 (2)	105.518395 Secs (422.074 Secs)	
								[==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]	



Proposal 15607 - Visit 07 - Testing Mid-Infrared AGN Selection in Dwarf Galaxies with Chandra and HST

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Visit	Proposal 15607, Visit 07, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR, WFC3/UVIS Special Requirements: (none)									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(1)	Pattern Type=WFC3-UVIS-DITHER- LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2)						
	(2)	Pattern Type=WFC3-IR-DITHER- BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365 Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(7)	SDSSJ233244.60-005847.9	RA: 23 32 45.0384 (353.1876600d) Dec: -00 58 45.88 (-.97941d) Equinox: J2000		V=16.1	Reference Frame: ICRS				
<i>Comments:</i> Category=GALAXY Description=[STARBURST] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(7) SDSSJ233244.60-005847.9	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=11		Pattern 1, Exps 1-1 in Visit 07 (1)	295 Secs (885 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	2		(7) SDSSJ233244.60-005847.9	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W	FLASH=2		Pattern 1, Exps 2-2 in Visit 07 (1)	230 Secs (690 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]	[1]
	3		(7) SDSSJ233244.60-005847.9	WFC3/IR, MULTIACCUM, IRSUB512	F140W	SAMP-SEQ=STEP25; NSAMP=9		Pattern 2, Exps 3-3 in Visit 07 (2)	105.518395 Secs (422.074 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]	[1]

