



17239 - X-ray confirmation of optically selected IMBH-powered AGN and high-resolution imaging of their host

Cycle: 30, Proposal Category: GO

(Availability Mode: SUPPORTED)

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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) J104733.80+222400.6	WFC3/UVIS	1	29-Sep-2022 16:03:31.0	yes
02	(2) J112339.01+232259.1	WFC3/UVIS	1	29-Sep-2022 16:03:32.0	yes
03	(3) J132712.76+421754.4	WFC3/UVIS	1	29-Sep-2022 16:03:33.0	yes
04	(4) J144252.81+205451.5	WFC3/UVIS	1	29-Sep-2022 16:03:34.0	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>
05	(5) J170158.60+241411.1	WFC3/UVIS	1	29-Sep-2022 16:03:35.0	yes

5 Total Orbits Used

ABSTRACT

A population of intermediate black holes (IMBH) will allow us to solve one of the long-standing problems in modern astrophysics, the origin of supermassive black holes. We explore the published sample of 305 optically selected IMBH candidates ($3e4 < M_{BH} < 2e5 M_{Sun}$), which reside in galaxy centers and appear as weak type-I AGN. As of now, 24 of them were confirmed in X-ray using archival data. Here we propose to observe 23 objects from that list with Chandra and 5 most compact host galaxies with the HST to double the number of X-ray confirmed IMBHs and get the first insight on structural properties of compact IMBH host galaxies. This will enable detailed studies of the IMBH population and help to constrain the masses of seed black holes in the early Universe.

OBSERVING DESCRIPTION

This is a joint Chandra/HST program. We propose (i) to observe with Chandra ACIS-S 23 IMBH candidates from a sample of optically selected low-redshift ($0.021 < z < 0.1$) AGN from SDSS exhibiting optical variability and/or broad line component in H-alpha present in multiple epochs with the expected X-ray fluxes detectable in < 20 ksec; and (ii) obtain high-resolution NUV-to-optical images for the host galaxies of the five most compact objects using HST WFC3/UVIS. The candidates have virial BH masses between 30,000 and 200,000 M_{Sun} . Our observations will nearly double the currently available sample of X-ray confirmed IMBHs and triple the sample of IMBH host galaxies with high-resolution images, which is a crucially important aspect of our understanding of the physics behind the massive black hole growth. The X-ray luminosity combined with the MBH estimate from optical spectra will yield Eddington rates. The light profile decomposition done on high-resolution imaging will allow us to place IMBHs on the MBH-Mbulge diagram to test the BH/host co-evolution. The use of two optical colors will allow us to detect stellar population gradients in bulges, which can clarify the bulge growth scenario: for in situ "inside-out" pseudo-bulge growth there should be a negative metallicity gradient, while if a bulge is formed by mergers, the color and metallicity profiles should be flat because of the mixing of stars that occurs during mergers. Finally, the observations will place limits on the UV accretion SEDs.

We propose to use the F300X, F350LP and F600LP filters. (i) the near-UV F300X is the deepest UV option in WFC3/UVIS; it will to isolate a compact active nucleus from star formation in the bulge (ii) a difference of F350LP and F600LP is much deeper than any blue optical WFC3 filter; it will reveal dust morphology in the inner part and will be crucial for the stellar population analysis of host galaxies combined with pure F600LP; (ii)

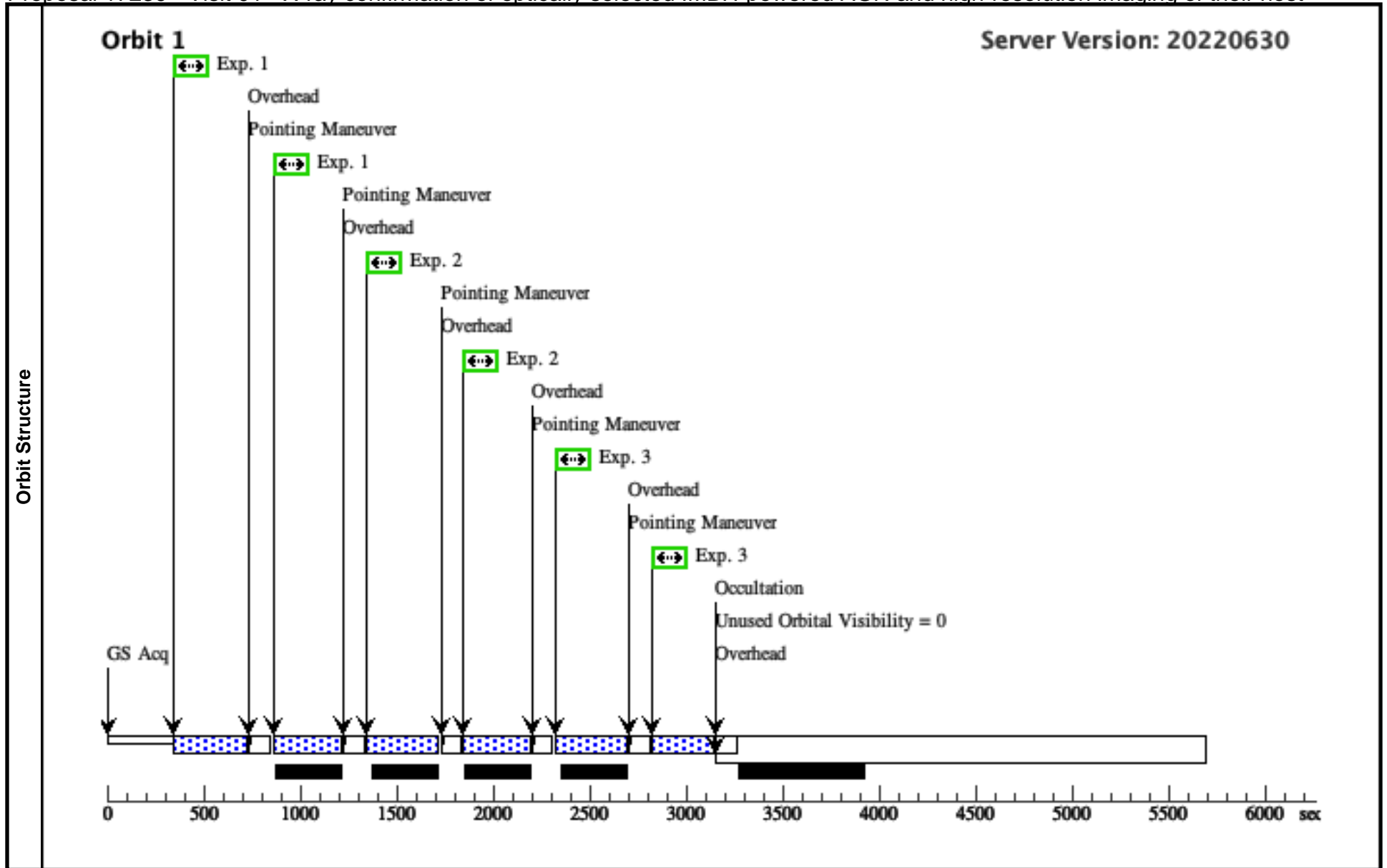
Proposal 17239 (STScI Edit Number: 0, Created: Thursday, September 29, 2022 at 3:03:35 PM Eastern Standard Time) - Overview
F600LP will be the primary filter for the 2D light profile decomposition; (iii) F350LP and F600LP will provide the best stellar mass estimates for structural components. We computed stellar population models using PEGASE.2 for the proposed filter setup and confirmed its suitability.

We use the WFC3 ETC to estimate the signal-to-noise ratio using best-fitting models of the light profiles of our targets from the Simard11 catalog. We estimate that in 700sec per filter in the optical F350LP and F600LP bands we will reach S/N ratios between 40 and 100 per pixel in the central regions of the IMBH host galaxies where we need to perform a two-dimensional light profile decomposition. It is difficult to make predictions for the UV AGN continuum in the proposed targets, as this regime has yet to be probed systematically. However, based on the results of past observational campaigns of small SMBHs such as proposal 13943 by Reines et al. available in the HST archive, which have significant nucleus detections, we request similar F300X integration times of 700sec per target. In total, we request 5 orbits to complete our project.

Proposal 17239 - Visit 01 - X-ray confirmation of optically selected IMBH-powered AGN and high-resolution imaging of their host

Thu Sep 29 20:03:35 GMT 2022

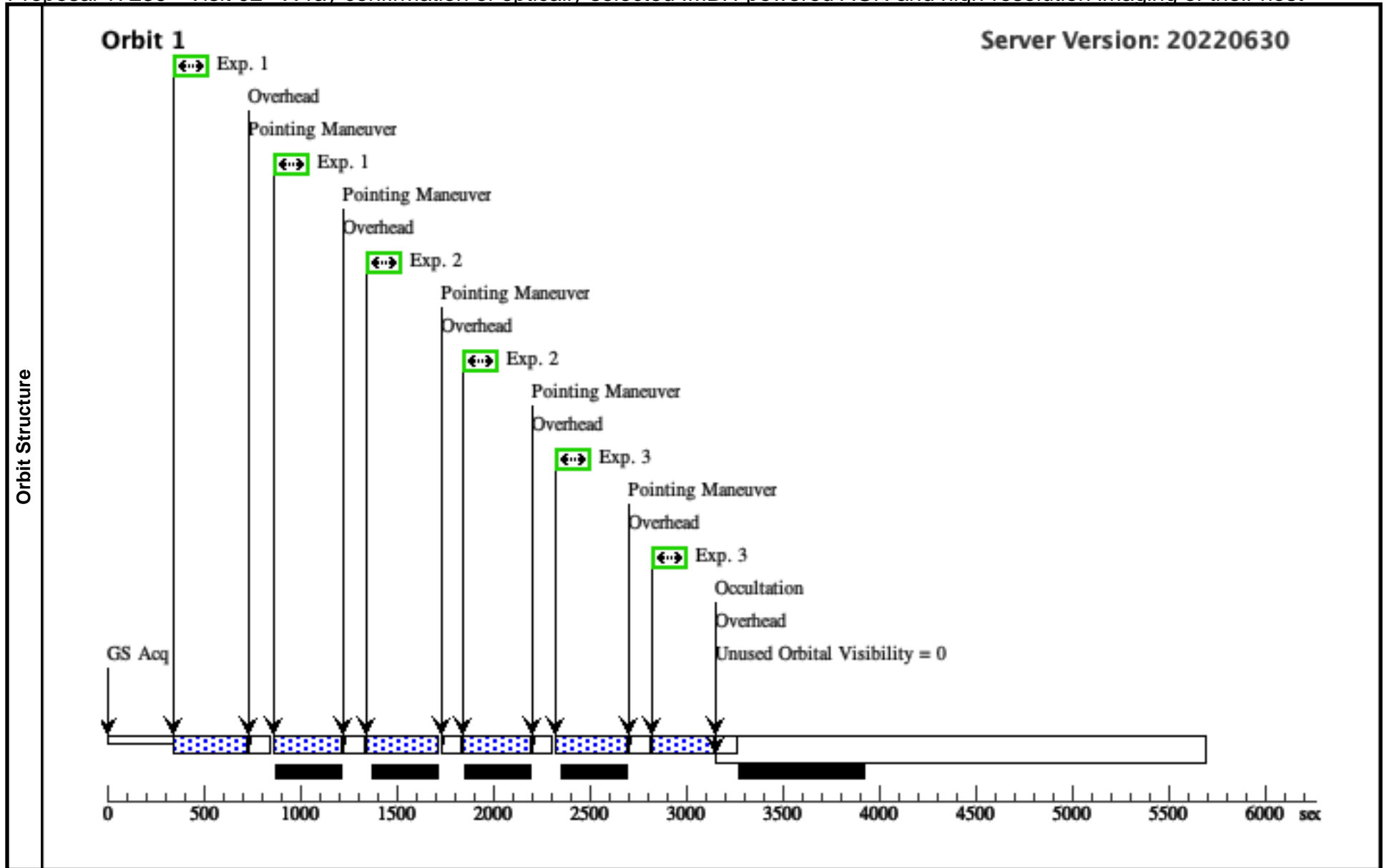
Visit	Proposal 17239, Visit 01 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-GAP-LINE Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=85.759 Number Of Points=2 Angle Between Sides= Point Spacing=2.414 Center Pattern=true Line Spacing=			(1), (2), (3)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	J104733.80+222400.6	RA: 10 47 33.8040 (161.8908500d) Dec: +22 24 0.59 (22.40016d) Equinox: J2000		V=17.933	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[SEYFERT]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) J104733.80+222400.6	WFC3/UVIS, ACCUM, UVIS2	F300X	FLASH=15		Pattern 1, Exps 1-1 in Visit 01 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2		(1) J104733.80+222400.6	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 01 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	3		(1) J104733.80+222400.6	WFC3/UVIS, ACCUM, UVIS2	F600LP	FLASH=3		Pattern 1, Exps 3-3 in Visit 01 (1)	348 Secs (669 Secs) [=>(Pattern 1)] [=>321 Secs (Pattern 2)]	[1]



Proposal 17239 - Visit 02 - X-ray confirmation of optically selected IMBH-powered AGN and high-resolution imaging of their host

Thu Sep 29 20:03:35 GMT 2022

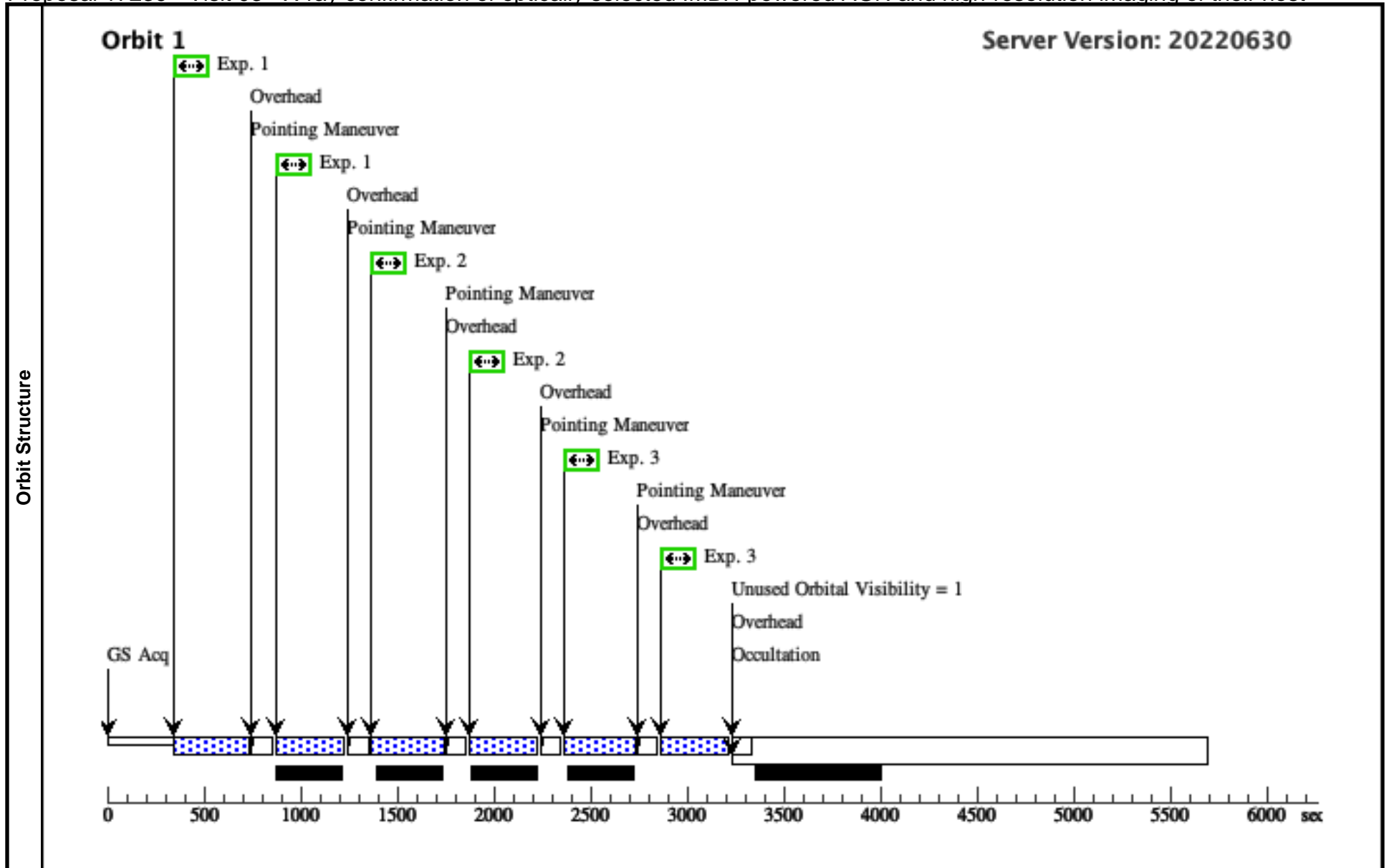
Visit	Proposal 17239, Visit 02 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-GAP-LINE Purpose=MOSAIC Number Of Points=2 Point Spacing=2.414 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.759 Angle Between Sides= Center Pattern=true		(1), (2), (3)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	J112339.01+232259.1	RA: 11 23 39.0127 (170.9125529d) Dec: +23 22 59.10 (23.38308d) Equinox: J2000		V=17.423	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[SEYFERT]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(2) J112339.01+232 259.1	WFC3/UVIS, ACCUM, UVIS2	F300X	FLASH=15		Pattern 1, Exps 1-1 i n Visit 02 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2		(2) J112339.01+232 259.1	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 i n Visit 02 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	3		(2) J112339.01+232 259.1	WFC3/UVIS, ACCUM, UVIS2	F600LP	FLASH=3		Pattern 1, Exps 3-3 i n Visit 02 (1)	348 Secs (669 Secs) [=>(Pattern 1)] [=>321.0 Secs (Pattern 2)]	[1]



Proposal 17239 - Visit 03 - X-ray confirmation of optically selected IMBH-powered AGN and high-resolution imaging of their host

Thu Sep 29 20:03:35 GMT 2022

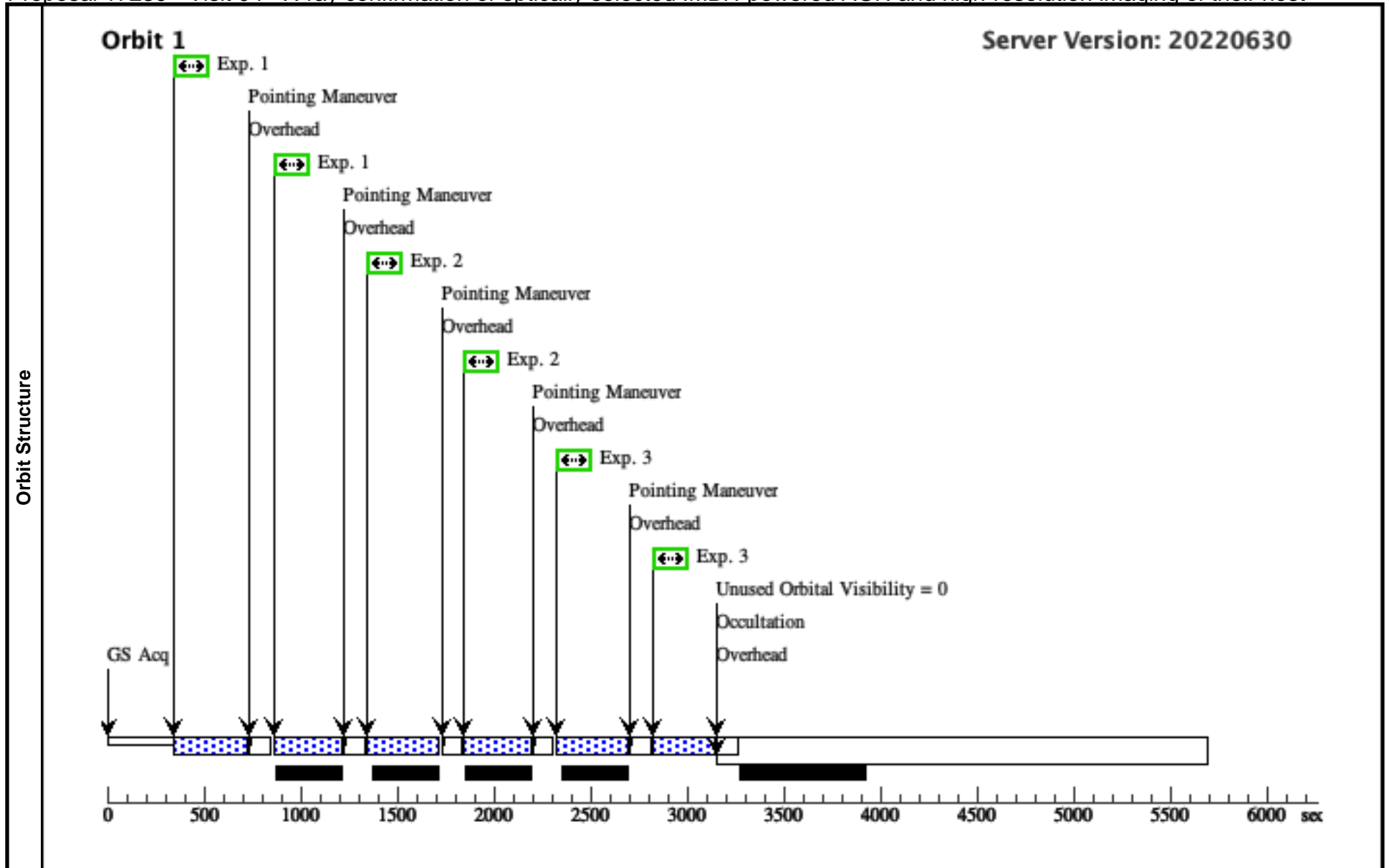
Visit	Proposal 17239, Visit 03 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-GAP-LINE Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=85.759 Number Of Points=2 Angle Between Sides= Point Spacing=2.414 Center Pattern=true Line Spacing=		(1), (2), (3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(3)	J132712.76+421754.4	RA: 13 27 12.7555 (201.8031479d) Dec: +42 17 54.40 (42.29844d) Equinox: J2000		V=16.177	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[SEYFERT]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(3) J132712.76+421754.4	WFC3/UVIS, ACCUM, UVIS2	F300X	FLASH=15		Pattern 1, Exps 1-1 in Visit 03 (1)	357 Secs (714 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2		(3) J132712.76+421754.4	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 03 (1)	357 Secs (714 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	3		(3) J132712.76+421754.4	WFC3/UVIS, ACCUM, UVIS2	F600LP	FLASH=2		Pattern 1, Exps 3-3 in Visit 03 (1)	357 Secs (714 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]



Proposal 17239 - Visit 04 - X-ray confirmation of optically selected IMBH-powered AGN and high-resolution imaging of their host

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Visit	Proposal 17239, Visit 04 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-GAP-LINE Purpose=MOSAIC Number Of Points=2 Point Spacing=2.414 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.759 Angle Between Sides= Center Pattern=true		(1), (2), (3)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(4)	J144252.81+205451.5	RA: 14 42 52.8077 (220.7200321d) Dec: +20 54 51.55 (20.91432d) Equinox: J2000		V=17.704	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[SEYFERT]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(4) J144252.81+205451.5	WFC3/UVIS, ACCUM, UVIS2	F300X	FLASH=15		Pattern 1, Exps 1-1 in Visit 04 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2		(4) J144252.81+205451.5	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 04 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	3		(4) J144252.81+205451.5	WFC3/UVIS, ACCUM, UVIS2	F600LP	FLASH=3		Pattern 1, Exps 3-3 in Visit 04 (1)	348 Secs (669 Secs) [=>(Pattern 1)] [=>321.0 Secs (Pattern 2)]	[1]



Proposal 17239 - Visit 05 - X-ray confirmation of optically selected IMBH-powered AGN and high-resolution imaging of their host

Thu Sep 29 20:03:36 GMT 2022

Visit	Proposal 17239, Visit 05 Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(1)	Pattern Type=WFC3-UVIS-GAP-LINE Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=85.759 Number Of Points=2 Angle Between Sides= Point Spacing=2.414 Center Pattern=true Line Spacing=		(1), (2), (3)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(5)	J170158.60+241411.1	RA: 17 01 58.6022 (255.4941758d) Dec: +24 14 11.14 (24.23643d) Equinox: J2000		V=17.317	Reference Frame: ICRS				
	<i>Comments:</i> Category=GALAXY Description=[SEYFERT]									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(5) J170158.60+241411.1	WFC3/UVIS, ACCUM, UVIS2	F300X	FLASH=15		Pattern 1, Exps 1-1 in Visit 05 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2		(5) J170158.60+241411.1	WFC3/UVIS, ACCUM, UVIS2	F350LP			Pattern 1, Exps 2-2 in Visit 05 (1)	348 Secs (696 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	3		(5) J170158.60+241411.1	WFC3/UVIS, ACCUM, UVIS2	F600LP	FLASH=3		Pattern 1, Exps 3-3 in Visit 05 (1)	348 Secs (669 Secs) [=>(Pattern 1)] [=>321.0 Secs (Pattern 2)]	[1]

