



# 17892 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Cycle: 32, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
<b>Dr. Doyee Byun (PI) (Contact)</b>	<b>University of Michigan</b>
Dr. Jon Matthew Miller (CoI)	University of Michigan

## 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) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:39.0	yes
02	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:40.0	yes
03	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:40.0	yes
04	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:41.0	yes
05	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:42.0	yes
06	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:42.0	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>
07	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:43.0	yes
08	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:44.0	yes
09	(1) NGC-4151 WAVE	STIS/CCD STIS/FUV-MAMA	1	06-Dec-2024 18:01:44.0	yes

9 Total Orbits Used

### **ABSTRACT**

The proximity of NGC 4151 leads to especially sensitive line diagnostics; for this reason, it has always been at the forefront of reverberation studies. Early observations of NGC 4151 in X-rays have revealed a complex Fe K-alpha line, and confirmed that the line flux likely responds to the continuum in the manner that optical and UV lines respond. As a result, XRISM will undertake a monitoring campaign in Cycle 1 to clearly measure the line response and map the accretion flow. A simultaneous UV campaign with Hubble will reveal the relative positions of the emission line geometries, and can also reveal the relationship between winds seen in absorption. We request a series of STIS observations between 12 and 31 December 2024 in order to create a uniquely powerful data set with legacy value to both missions.

### **OBSERVING DESCRIPTION**

We will obtain UV spectra of the Seyfert galaxy NGC 4151 through 9 orbits, monitoring time variability in parallel with the reverberation mapping campaign with XRISM Resolve.

This encompasses the major broad lines visible in a typical AGN spectrum: Ly alpha, N V 1240, Si IV 1400, C IV 1550, He II 1640, C III] 1909, and Mg II 2798.

We calculated the required exposure times with the HST ETC, with the  $3E-13$  erg/s/cm<sup>2</sup>/Å at  $\lambda \sim 2240$ Å, using the built in template of the Type-1 Seyfert Galaxy Mrk231.

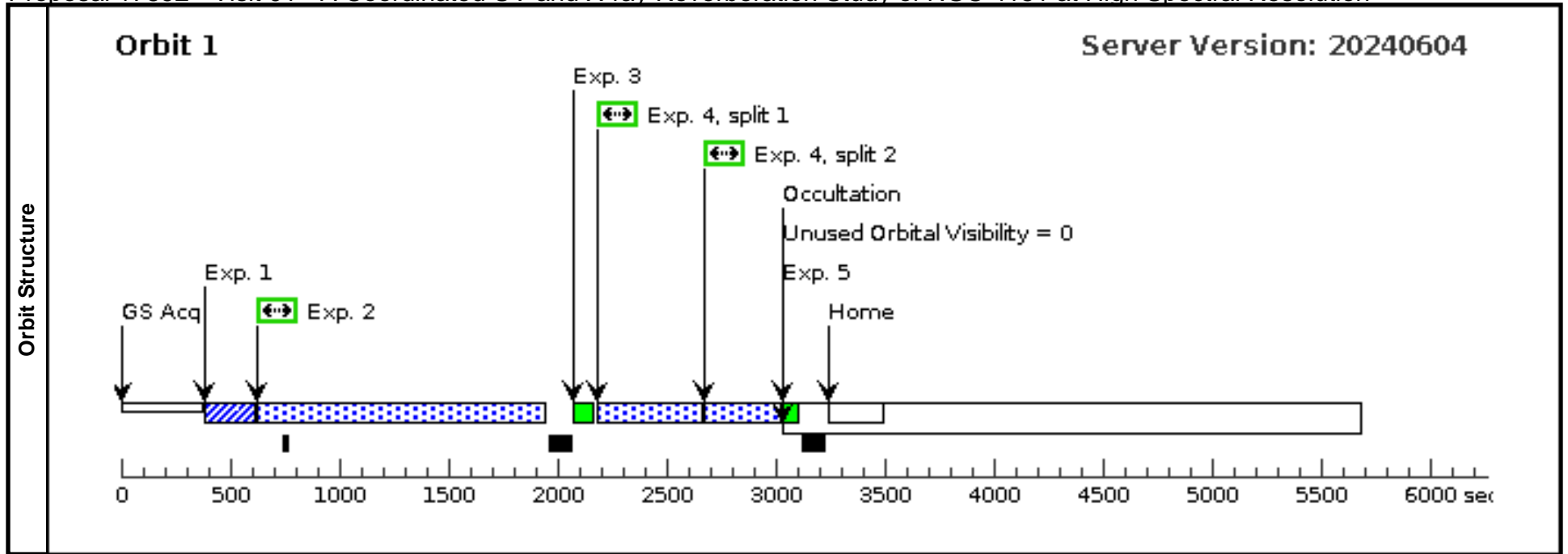
With a time of 200 seconds per orbit for G140L, and 100 seconds per orbit for G230LB, respectively, the S/N ratio (~50) will be sufficient.

The time required for target acquisition with the F28X50LP aperture is less than 0.1 seconds, which is the minimum assignable time.

# Proposal 17892 - Visit 01 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

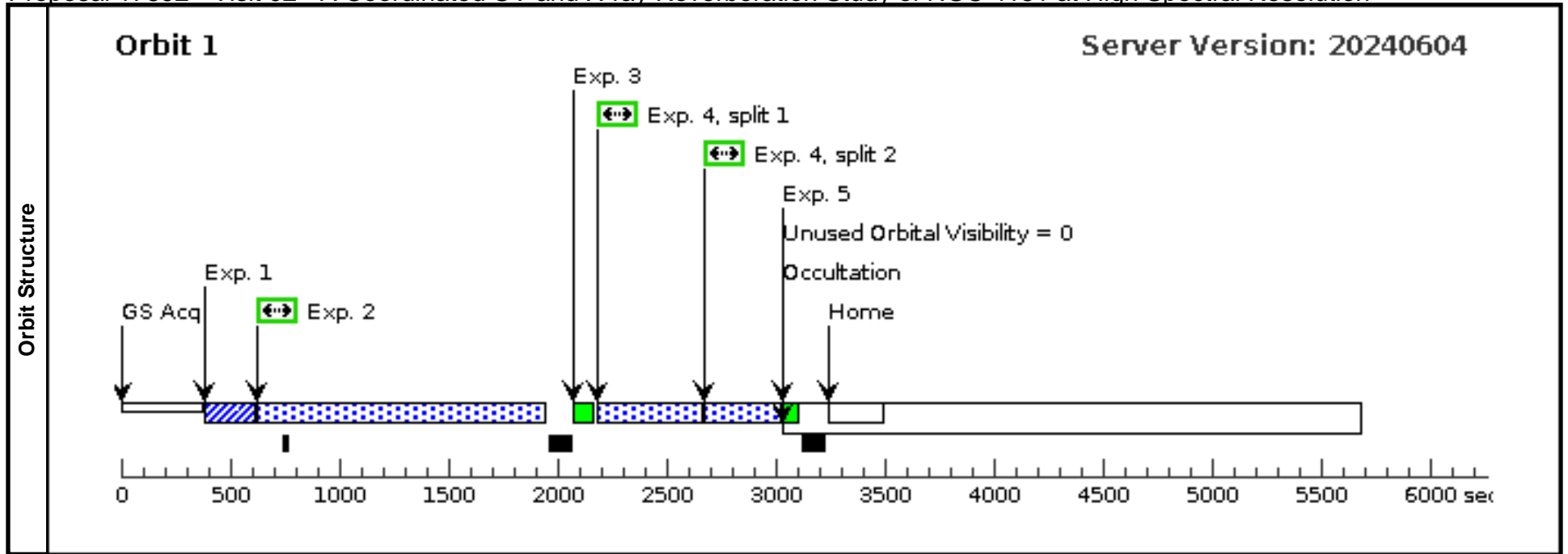
Visit	<b>Proposal 17892, Visit 01, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: BETWEEN 17-DEC-2024:03:00:00 AND 18-DEC-2024:00:00:00																																																																					
	Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>NGC-4151</td> <td>RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000</td> <td>Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000</td> <td>V=11.48</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table> <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.</i></p> <p>Category=GALAXY Description=[SEYFERT]</p>										#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	NGC-4151	RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000	Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000	V=11.48	Reference Frame: ICRS																																															
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# Proposal 17892 - Visit 02 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

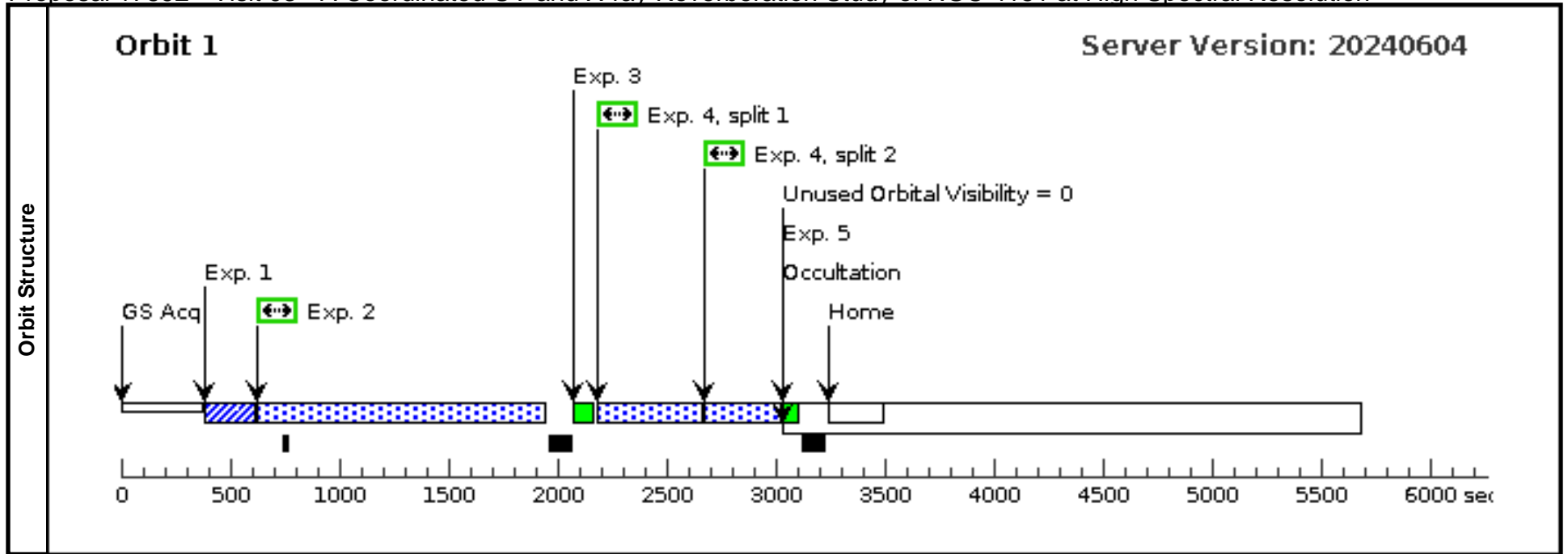
Visit	<b>Proposal 17892, Visit 02, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: BETWEEN 19-DEC-2024:11:00:00 AND 20-DEC-2024:00:00:00									
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	NGC-4151	RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000	Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000	V=11.48	Reference Frame: ICRS				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=GALAXY Description=[SEYFERT]									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	acq (STIS.ta.194 4736)	(1) NGC-4151	STIS/CCD, ACQ, F28X50LP	MIRROR				0.5 Secs (0.5 Secs) [==>]	[1]
	2	g140l (STIS.sp.19 44882)	(1) NGC-4151	STIS/FUV-MAMA, ACCUM, 0.2X0.2	G140L 1425 A	WAVECAL=NO			200 Secs (1213 Secs) [==>1213.0 Secs ]	[1]
	3	fuvwave	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140L 1425 A				[==>]	[1]
	4	g230lb (STIS.sp.19 44883)	(1) NGC-4151	STIS/CCD, ACCUM, 0.2X0.2	G230LB 2375 A	WAVECAL=NO; GAIN=4			100 Secs (626 Secs) [==>313.0 Secs (Split 1)] [==>313.0 Secs (Split 2)]	[1]
	5		WAVE	STIS/CCD, ACCUM, 52X0.1	G230LB 2375 A				[==>]	[1]



# Proposal 17892 - Visit 03 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

Visit	<b>Proposal 17892, Visit 03, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: BETWEEN 21-DEC-2024:19:12:00 AND 23-DEC-2024:00:00:00																																																												
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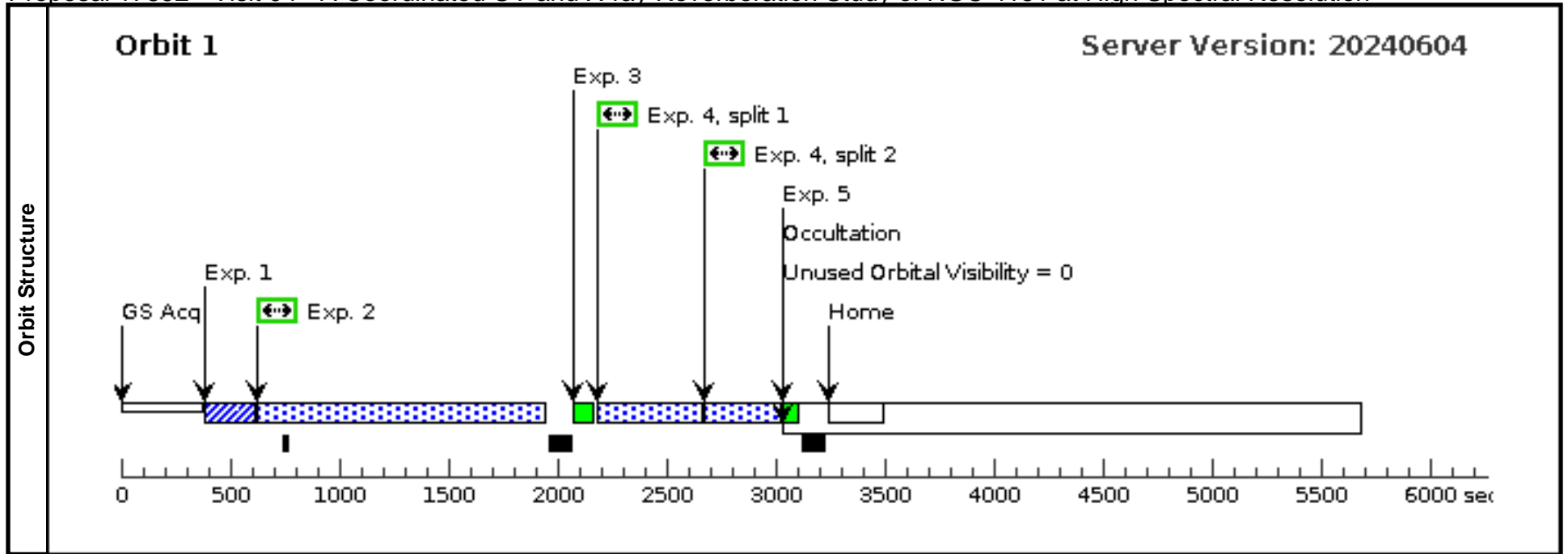
# Proposal 17892 - Visit 04 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

<b>Visit</b>	<b>Proposal 17892, Visit 04, implementation</b>				
	<b>Diagnostic Status: No Diagnostics</b>				
	Scientific Instruments: STIS/CCD, STIS/FUV-MAMA				
	Special Requirements: BETWEEN 23-DEC-2024:00:00:00 AND 24-DEC-2024:00:00:00				

<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>
	(1)	NGC-4151	RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000	Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000	V=11.48	Reference Frame: ICRS
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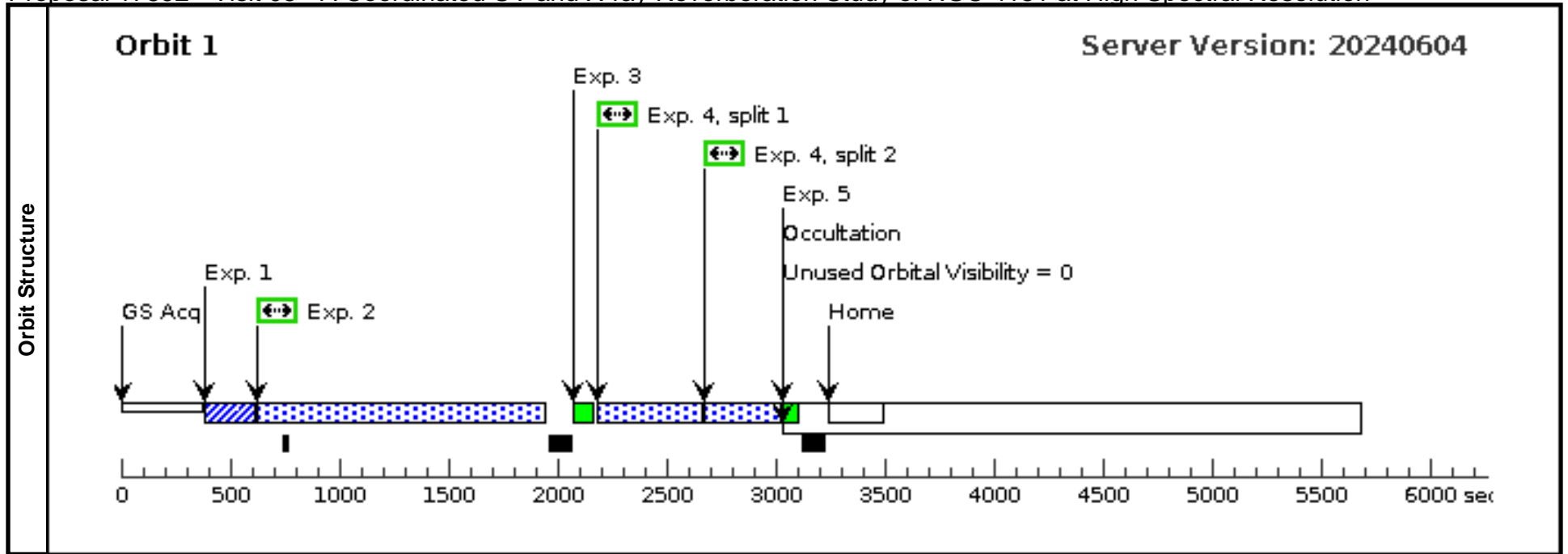
<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	acq (STIS.ta.194 4736)	(1) NGC-4151	STIS/CCD, ACQ, F28X50LP	MIRROR				0.5 Secs (0.5 Secs) [==>]	[1]
	2	g140l (STIS.sp.19 44882)	(1) NGC-4151	STIS/FUV-MAMA, ACCUM, 0.2X0.2	G140L 1425 A		WAVECAL=NO		200 Secs (1213 Secs) [==>1213.0 Secs ]	[1]
	3	fuvwave	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140L 1425 A				[==>]	[1]
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	5		WAVE	STIS/CCD, ACCUM, 52X0.1	G230LB 2375 A				[==>]	[1]



# Proposal 17892 - Visit 05 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

Visit	<b>Proposal 17892, Visit 05, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: BETWEEN 24-DEC-2024:00:00:00 AND 25-DEC-2024:00:00:00																																																												
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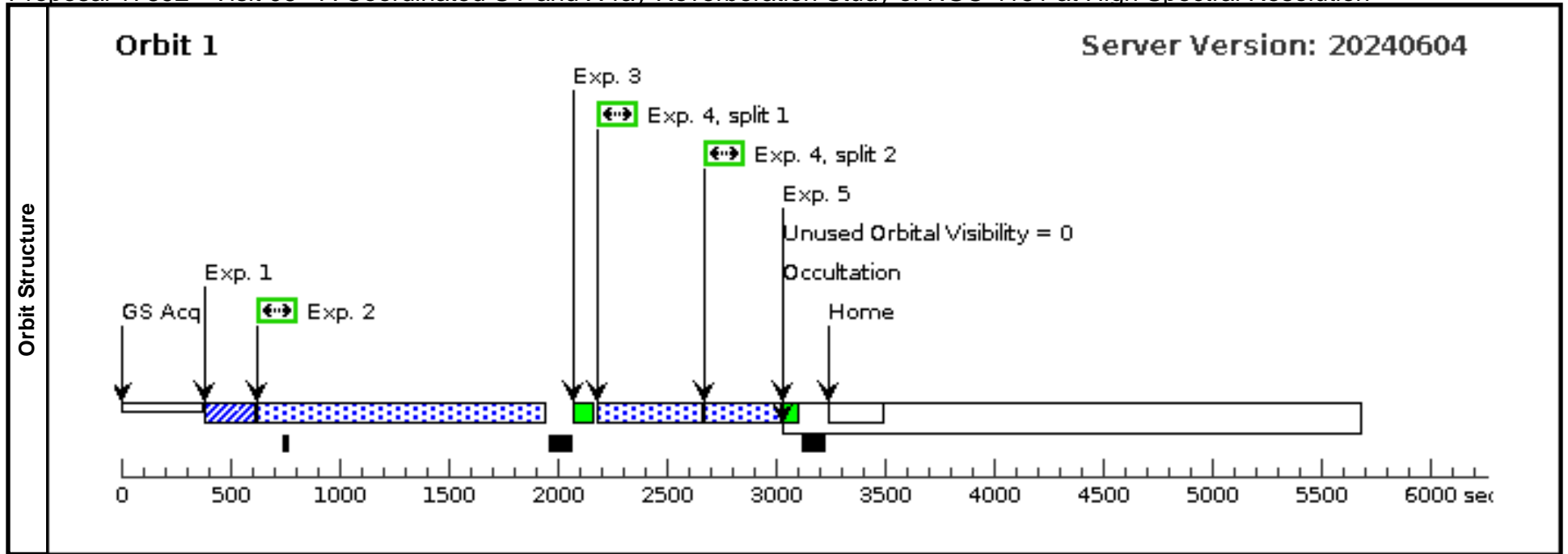
# Proposal 17892 - Visit 06 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

<b>Visit</b>	<b>Proposal 17892, Visit 06, implementation</b>				
	<b>Diagnostic Status: No Diagnostics</b>				
	Scientific Instruments: STIS/CCD, STIS/FUV-MAMA				
	Special Requirements: BETWEEN 25-DEC-2024:00:00:00 AND 26-DEC-2024:00:00:00				

<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>
	(1)	NGC-4151	RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000	Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000	V=11.48	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	<i>SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=GALAXY Description=[SEYFERT]</i>					

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	acq (STIS.ta.194 4736)	(1) NGC-4151	STIS/CCD, ACQ, F28X50LP	MIRROR				0.5 Secs (0.5 Secs)	
									[==>]	[1]
	2	g140l (STIS.sp.19 44882)	(1) NGC-4151	STIS/FUV-MAMA, ACCUM, 0.2X0.2	G140L 1425 A		WAVECAL=NO		200 Secs (1213 Secs)	
									[==>1213.0 Secs ]	[1]
	3	fuvwave	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140L 1425 A				[==>]	[1]
4	g230lb (STIS.sp.19 44883)	(1) NGC-4151	STIS/CCD, ACCUM, 0.2X0.2	G230LB 2375 A		WAVECAL=NO; GAIN=4		100 Secs (626 Secs)		
								[==>313.0 Secs (Split 1)]	[1]	
								[==>313.0 Secs (Split 2)]	[1]	
5		WAVE	STIS/CCD, ACCUM, 52X0.1	G230LB 2375 A				[==>]	[1]	



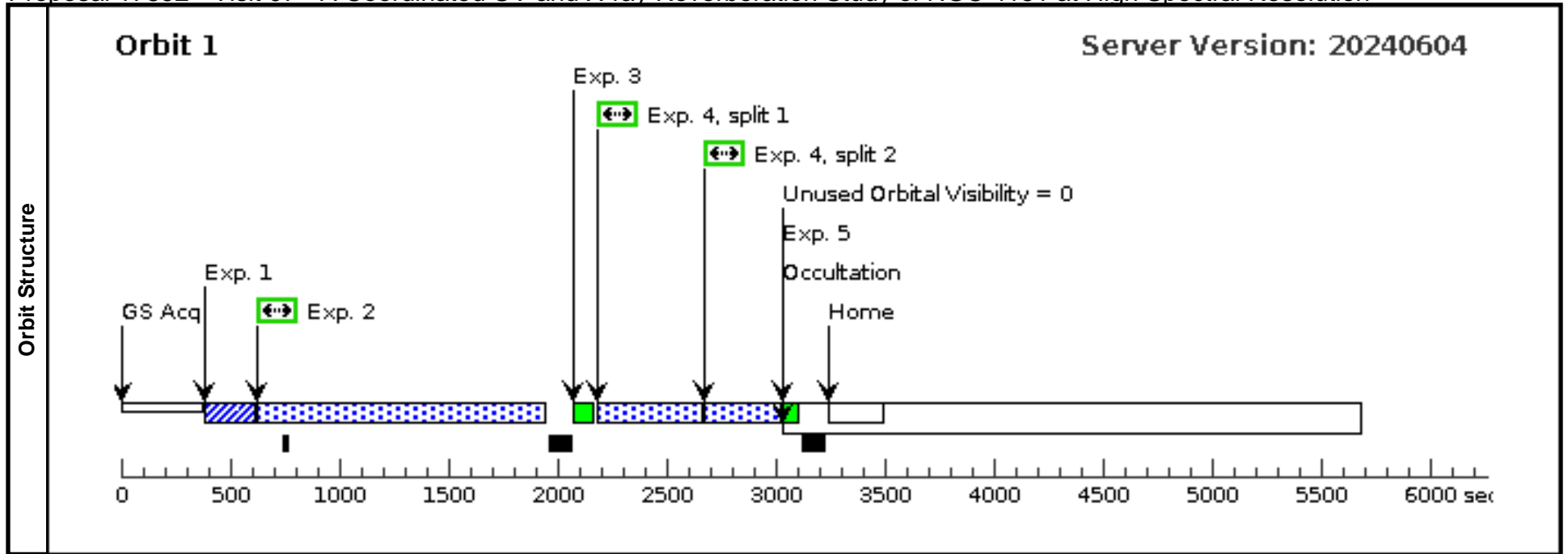
# Proposal 17892 - Visit 07 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

<b>Visit</b>	<b>Proposal 17892, Visit 07, implementation</b>				
	<b>Diagnostic Status: No Diagnostics</b>				
	Scientific Instruments: STIS/CCD, STIS/FUV-MAMA				
	Special Requirements: BETWEEN 26-DEC-2024:11:00:00 AND 27-DEC-2024:00:00:00				

<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>
	(1)	NGC-4151	RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000	Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000	V=11.48	Reference Frame: ICRS
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>					
	<i>SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM. Category=GALAXY Description=[SEYFERT]</i>					

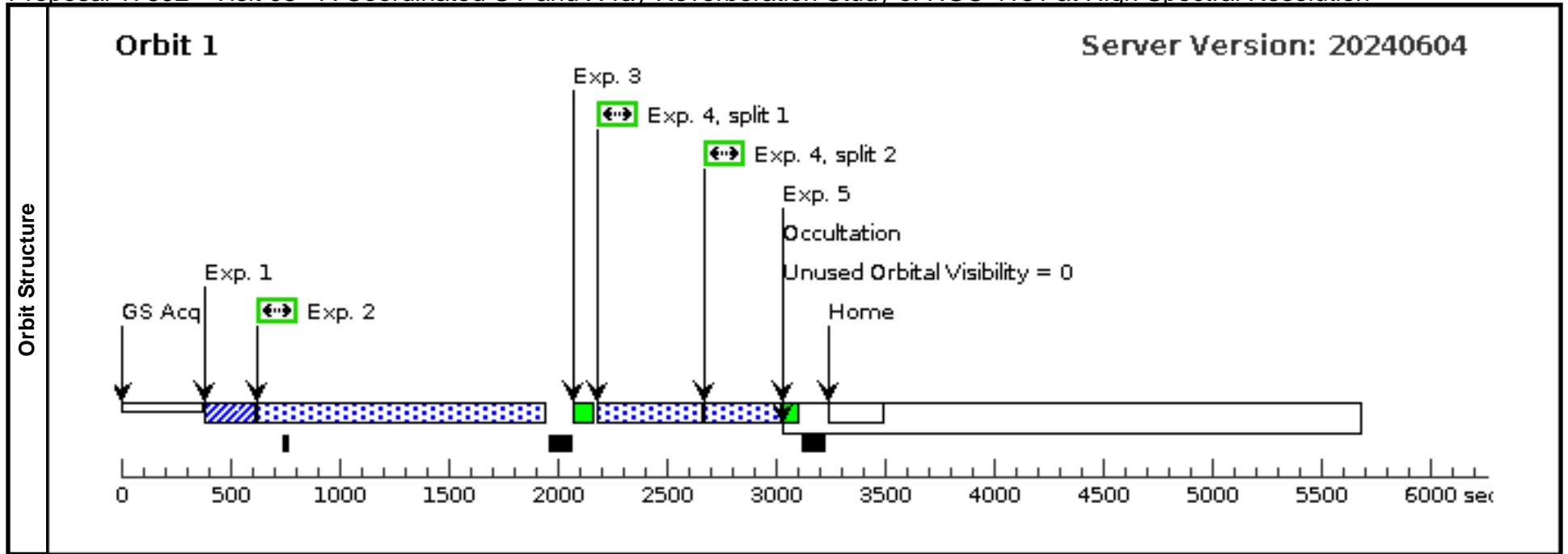
<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	acq (STIS.ta.194 4736)	(1) NGC-4151	STIS/CCD, ACQ, F28X50LP	MIRROR				0.5 Secs (0.5 Secs)	
									[==>]	[1]
	2	g140l (STIS.sp.19 44882)	(1) NGC-4151	STIS/FUV-MAMA, ACCUM, 0.2X0.2	G140L 1425 A		WAVECAL=NO		200 Secs (1213 Secs)	
									[==>1213.0 Secs ]	[1]
	3	fuvwave	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140L 1425 A				[==>]	[1]
4	g230lb (STIS.sp.19 44883)	(1) NGC-4151	STIS/CCD, ACCUM, 0.2X0.2	G230LB 2375 A		WAVECAL=NO; GAIN=4		100 Secs (626 Secs)		
								[==>313.0 Secs (Split 1)]	[1]	
								[==>313.0 Secs (Split 2)]	[1]	
5		WAVE	STIS/CCD, ACCUM, 52X0.1	G230LB 2375 A				[==>]	[1]	



# Proposal 17892 - Visit 08 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

Visit	<b>Proposal 17892, Visit 08, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: BETWEEN 28-DEC-2024:08:00:00 AND 29-DEC-2024:00:00:00																																																																					
	Fixed Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>NGC-4151</td> <td>RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000</td> <td>Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000</td> <td>V=11.48</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table> <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>SIMBAD listed proper motion for this target. When retrieving targets with PM from SIMBAD, APT requests the coordinates be calculated with an epoch of the year 2000. Do not modify this epoch. Always review coordinates using the Target Confirmation tool, which graphically displays the PM.</i></p> <p>Category=GALAXY Description=[SEYFERT]</p>										#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	NGC-4151	RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000	Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000	V=11.48	Reference Frame: ICRS																																															
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# Proposal 17892 - Visit 09 - A Coordinated UV and X-ray Reverberation Study of NGC 4151 at High Spectral Resolution

Fri Dec 06 23:01:45 GMT 2024

Visit	<b>Proposal 17892, Visit 09, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: STIS/CCD, STIS/FUV-MAMA Special Requirements: BETWEEN 29-DEC-2024:23:00:00 AND 31-DEC-2024:00:00:00																																																																					
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#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous																																																																	
(1)	NGC-4151	RA: 12 10 32.5760 (182.6357333d) Dec: +39 24 21.06 (39.40585d) Equinox: J2000	Proper Motion RA: -0.206 mas/yr Proper Motion Dec: -0.16299998151225736 mas/yr Parallax: 2.161E-4" Epoch of Position: 2000	V=11.48	Reference Frame: ICRS																																																																	
Exposures	<table border="1"> <thead> <tr> <th>#</th> <th>Label (ETC Run)</th> <th>Target</th> <th>Config,Mode,Aperture</th> <th>Spectral Els.</th> <th>Opt. Params.</th> <th>Special Reqs.</th> <th>Groups</th> <th>Exp. Time (Total)/[Actual Dur.]</th> <th>Orbit</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>acq (STIS.ta.194 4736)</td> <td>(1) NGC-4151</td> <td>STIS/CCD, ACQ, F28X50LP</td> <td>MIRROR</td> <td></td> <td></td> <td></td> <td>0.5 Secs (0.5 Secs) [==&gt;]</td> <td>[1]</td> </tr> <tr> <td>2</td> <td>g140l (STIS.sp.19 44882)</td> <td>(1) NGC-4151</td> <td>STIS/FUV-MAMA, ACCUM, 0.2X0.2</td> <td>G140L 1425 A</td> <td>WAVECAL=NO</td> <td></td> <td></td> <td>200 Secs (1213 Secs) [==&gt;1213.0 Secs ]</td> <td>[1]</td> </tr> <tr> <td>3</td> <td>fuvwave</td> <td>WAVE</td> <td>STIS/FUV-MAMA, ACCUM, 52X0.05</td> <td>G140L 1425 A</td> <td></td> <td></td> <td></td> <td>[==&gt;]</td> <td>[1]</td> </tr> <tr> <td>4</td> <td>g230lb (STIS.sp.19 44883)</td> <td>(1) NGC-4151</td> <td>STIS/CCD, ACCUM, 0.2X0.2</td> <td>G230LB 2375 A</td> <td>WAVECAL=NO; GAIN=4</td> <td></td> <td></td> <td>100 Secs (626 Secs) [==&gt;313.0 Secs (Split 1)] [==&gt;313.0 Secs (Split 2)]</td> <td>[1]</td> </tr> <tr> <td>5</td> <td></td> <td>WAVE</td> <td>STIS/CCD, ACCUM, 52X0.1</td> <td>G230LB 2375 A</td> <td></td> <td></td> <td></td> <td>[==&gt;]</td> <td>[1]</td> </tr> </tbody> </table>										#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	1	acq (STIS.ta.194 4736)	(1) NGC-4151	STIS/CCD, ACQ, F28X50LP	MIRROR				0.5 Secs (0.5 Secs) [==>]	[1]	2	g140l (STIS.sp.19 44882)	(1) NGC-4151	STIS/FUV-MAMA, ACCUM, 0.2X0.2	G140L 1425 A	WAVECAL=NO			200 Secs (1213 Secs) [==>1213.0 Secs ]	[1]	3	fuvwave	WAVE	STIS/FUV-MAMA, ACCUM, 52X0.05	G140L 1425 A				[==>]	[1]	4	g230lb (STIS.sp.19 44883)	(1) NGC-4151	STIS/CCD, ACCUM, 0.2X0.2	G230LB 2375 A	WAVECAL=NO; GAIN=4			100 Secs (626 Secs) [==>313.0 Secs (Split 1)] [==>313.0 Secs (Split 2)]	[1]	5		WAVE	STIS/CCD, ACCUM, 52X0.1	G230LB 2375 A				[==>]	[1]
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