15123 - Probing the accretion flow and emission-line regions of M81, the nearest broad-lined low-luminosity AGN

Cycle: 25, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) M-81	STIS/CCD STIS/FUV-MAMA	3	24-Oct-2017 10:02:39.0	yes
02	(1) M-81	STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	2	24-Oct-2017 10:02:42.0	yes
03	(1) M-81 CCDFLAT	STIS/CCD	2	24-Oct-2017 10:02:44.0	yes
04	(1) M-81	WFC3/IR WFC3/UVIS	1	24-Oct-2017 10:02:47.0	yes

8 Total Orbits Used

ABSTRACT

The nucleus of M81 is an object of singular importance as a template for low-luminosity accretion flows onto supermassive black holes. We propose to obtain a complete, small-aperture, high S/N STIS UV/optical spectrum of the M81 nucleus and multi-filter WFC3 imaging covering the UV through near-IR. Such data have never previously been obtained with HST; the only prior archival UV/optical spectra of M81 have low S/N, incomplete wavelength coverage, and are strongly contaminated by starlight. Combined with new Chandra X-ray data, our proposed observations will comprise the definitive reference dataset on the spectral energy distribution of this benchmark low-luminosity AGN. These data will provide unique new constraints on the possible contribution of a truncated thin accretion disk to the AGN emission spectrum, clarifying a fundamental property of low-luminosity accretion flows. The data will additionally provide new insights into broad-line region structure and black hole mass scaling relationships at the lowest AGN luminosities, and spatially resolved diagnostics of narrow-line region excitation conditions at unprecedented spatial resolution to assess the impact of the AGN on the ionization state of the gas in the host galaxy bulge.

OBSERVING DESCRIPTION

This program is designed to obtain complete UV and optical spectroscopy plus multi-band near-UV through near-IR imaging of the nucleus of M81. We will obtain STIS spectroscopy in the 0.2 arcsec slit in the G140L, G230L, G430L, and G750L grating settings, plus the G750M grating with central wavelength 6581 A to obtain a medium-resolution spectrum of the H-alpha + [NII] blend. This program also includes a coordinated Chandra HETG observation of M81 in order to obtain the spectral energy distribution from X-rays through UVOIR wavelengths.

In order to minimize the impact of AGN variability on the spectral energy distribution measurement, we have grouped the HST visits to be observed within a 14 day window. If it is possible for all visits to be scheduled within an even shorter time window, that would be very beneficial for the science, so we request that the observations be scheduled within the shortest time span that is feasible to obtain. The HST visits can be carried out in any sequence, within the specified time window. We have also used the SAME-ORIENT-AS keyword to require that all of the STIS visits should be carried out at the same spacecraft orientation, in order to sample the same portion of the AGN narrow-line region within the STIS slit. We will also request that the Chandra observation be obtained during the same 14 day window if possible.

Each STIS visit will begin with a standard STIS target acquisition. The AGN nucleus is compact and bright, and we select ACQTYPE=POINT because this has been used successfully for past STIS acquisitions of the M81 nucleus in programs 7350 and 7351.

For the UV spectroscopy, we have 4 orbits for G140L and 1 orbit for G230L. These are broken up into two separate visits: one visit with 3 orbits of G140L, and one visit with 1 orbit of G140L and one orbit of G230L. The MAMA observations will be dithered using the STIS-ALONG-SLIT pattern following the recommendation of Section 12.5.1 of the STIS instrument handbook. For the MAMA observations, ACCUM mode will be used instead of TIME-TAG because the higher overheads required for memory buffer dumps for dithered TIME-TAG observations would lead to a reduction in the on-source integration time.

The STIS CCD observations will be carried out in a separate visit, with one orbit for G750M observations and one orbit for G430L and G750L. In each case, we will obtain 5 exposures dithered with STIS-ALONG-SLIT in order to optimize the cosmic-ray cleaning to produce a high S/N spectrum. For G750L we will obtain CCDFLAT exposures at the end of the orbit. CCDFLATs will be done using the 52X0.1 slit as recommended for point sources in Table 11.1 of the STIS Instrument Handbook. For the G750L observation of M81, we choose not to use the E2 aperture position since this would negatively impact the overall throughput and would negatively impact the spectral and spatial matching with the G430L grating observation.

With WFC3, we will obtain observations in F218W, F438W, F547M, and F814W (UVIS), and F153M (IR). Short exposure times will be used in order to avoid saturation of the bright nuclear point source in the optical filters. In order to fit all WFC3 observations into one orbit and avoid buffer dump overheads, we will use subarray readouts for the UVIS and IR detectors. Subarray readouts are acceptable in this case because our primary goal is to measure the AGN point source flux, and the HST archive already contains extensive full-frame observations of M81 in multiple filters. There are no orientation constraints for the WFC3 visit, but it should be done as close in time to the STIS observations as is feasible, within the specified 14-day window.

Visit

Proposal 15123, Visit 01, implementation Tue Oct 24 14:02:49 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: GROUP 01,02,03,04 WITHIN 14D

Comments: All 4 visits should be done within a total span of 14 days, and a shorter total span is strongly preferred in order to minimize the impact of source variability. Please schedule all visits as close in time to one another as is feasible. Visits 1, 2, and 3 should be done at the same spacecraft orientation to obtain the same STIS slit positioning on the target.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(5)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3), (4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.4	Center Pattern=false		
	Line Spacing=			

Fixed Targets

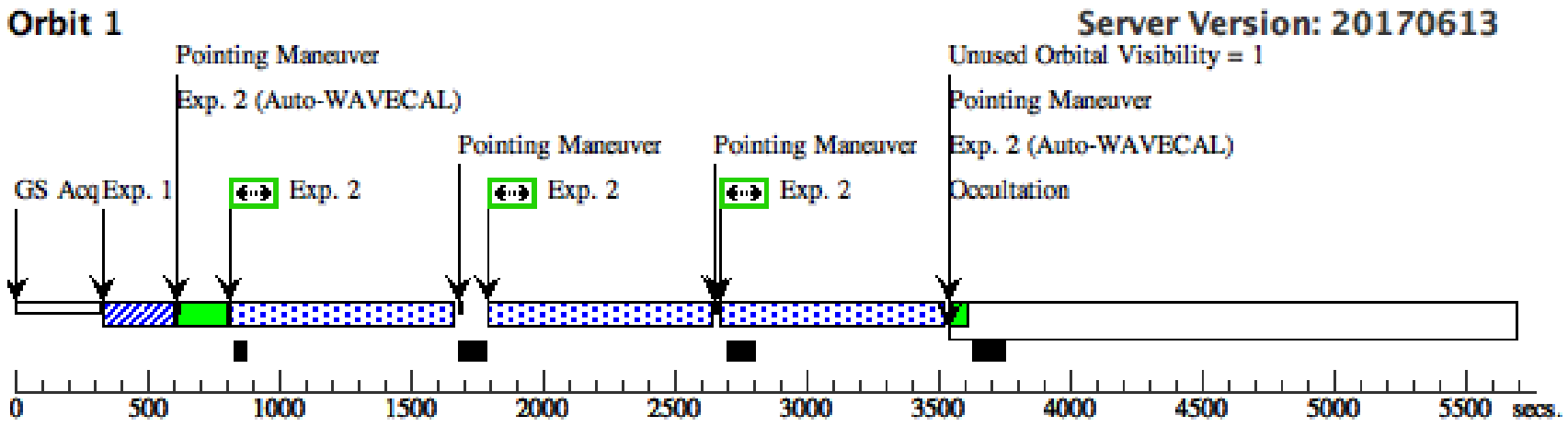
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M-81	RA: 09 55 33.1731 (148.8882212d)		V=6.94	Reference Frame: ICRS
		Dec: +69 03 55.06 (69.06529d)			
		Equinox: J2000			

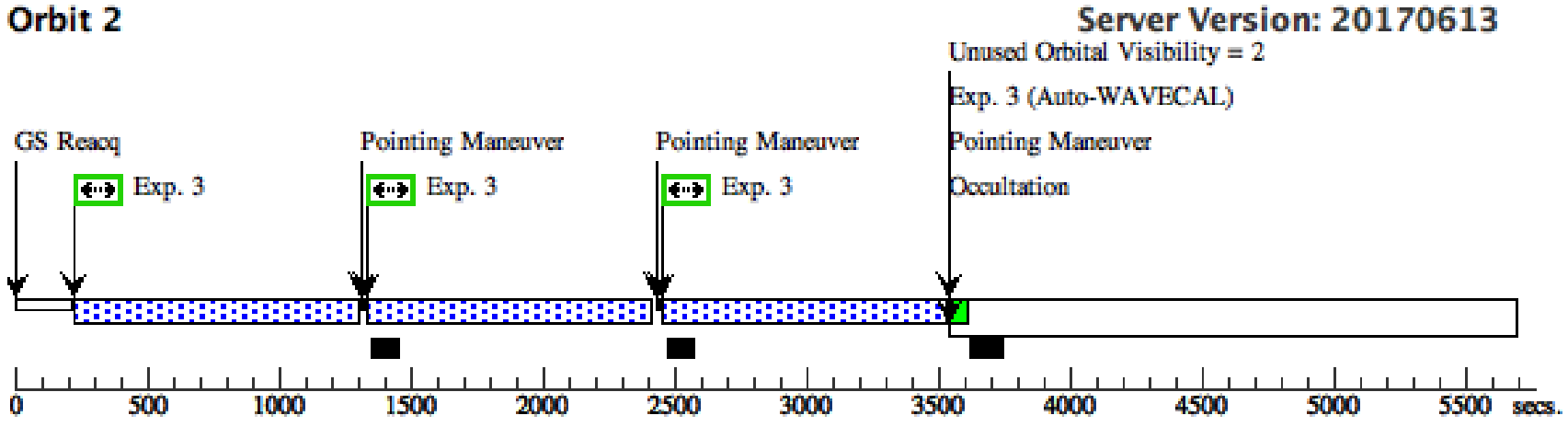
Comments: Coordinates are from ICRF2 catalog (Fey et al 2015, AJ, 150, 58) and were checked against SDSS and 2MASS images for consistency.

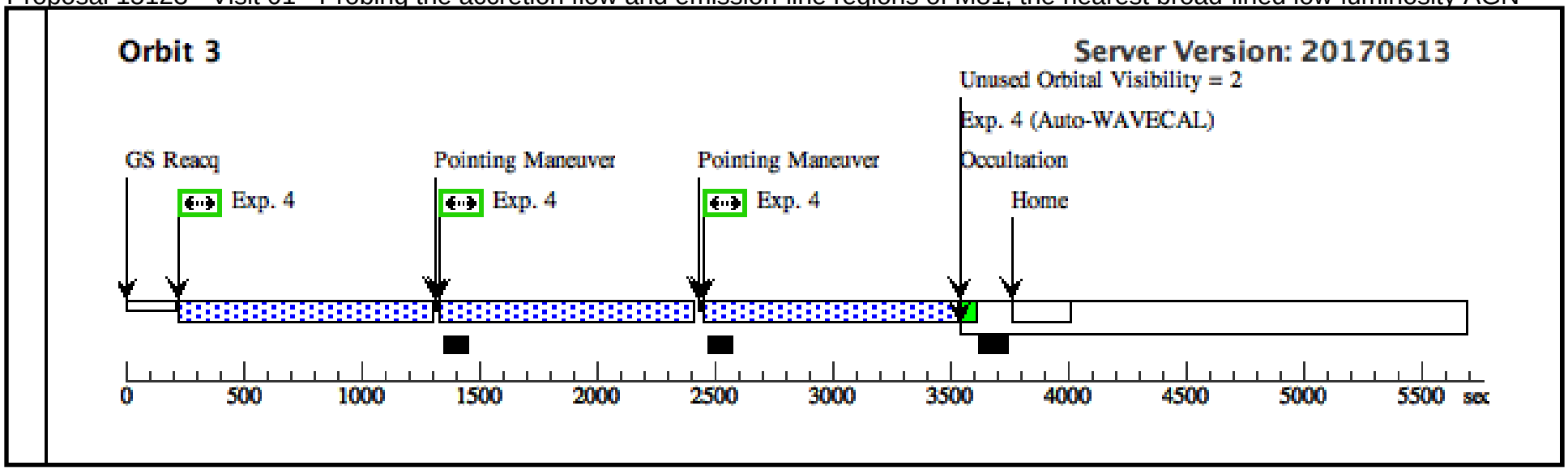
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M-81	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs)	
								[==>]	***[1]***
Comments: ACQ exposure time of 10 s was used previously in GO-7350, producing ~17000 counts within a 3x3 checkbox at the galaxy nucleus.									
2	(STIS.sp.1008237)	(1) M-81	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 5, Exps 2-2 in Visit 01 (5)	838 Secs (2514 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	
3	(STIS.sp.1008229)	(1) M-81	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 5, Exps 3-3 in Visit 01 (5)	1066 Secs (3198 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	
4	(STIS.sp.1008229)	(1) M-81	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 5, Exps 4-4 in Visit 01 (5)	1066 Secs (3198 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[3]***
								[==>(Pattern 3)]	

Orbit Structure






Orbit 3
Server Version: 20170613
Unused Orbital Visibility = 2
Exp. 4 (Auto-WAVECAL)
GS Reacq
Pointing Maneuver
Pointing Maneuver
Occultation
Exp. 4
Exp. 4
Exp. 4
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15123, Visit 02, implementation Tue Oct 24 14:02:49 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD, STIS/FUV-MAMA

Special Requirements: SAME ORIENT AS 01

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(5)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=3	Angle Between Sides=		
	Point Spacing=0.4	Center Pattern=false		
	Line Spacing=			

Fixed Targets

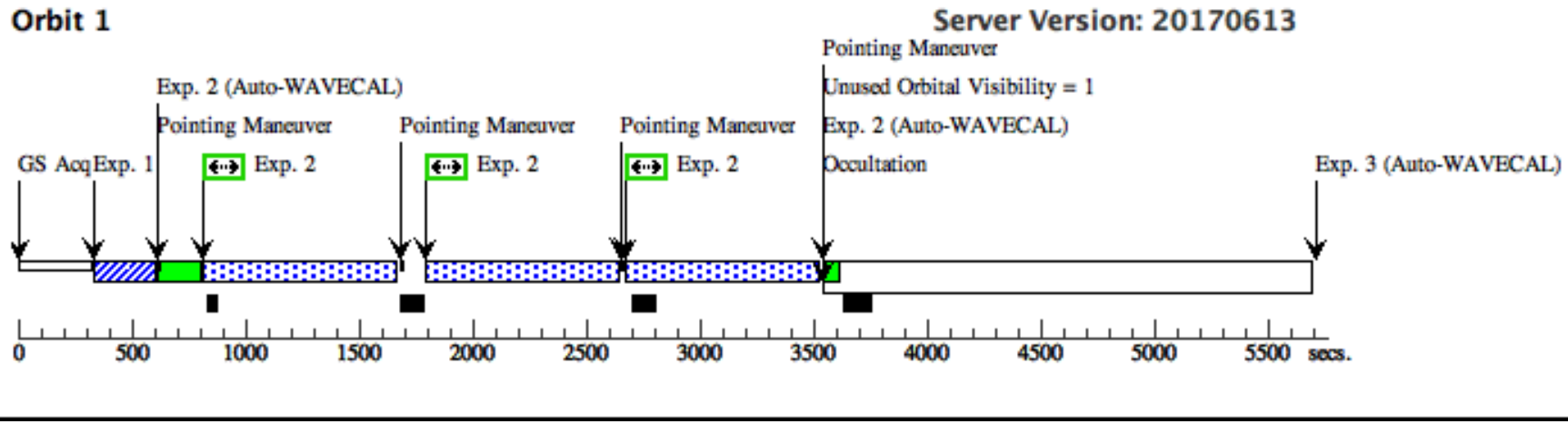
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M-81	RA: 09 55 33.1731 (148.8882212d) Dec: +69 03 55.06 (69.06529d) Equinox: J2000		V=6.94	Reference Frame: ICRS

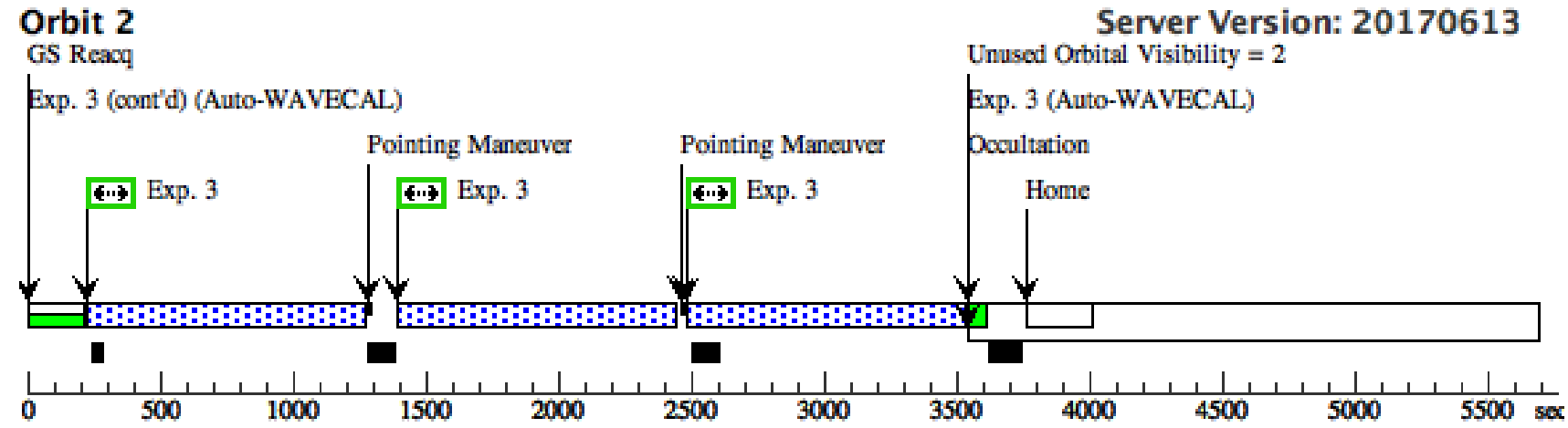
Comments: Coordinates are from ICRF2 catalog (Fey et al 2015, AJ, 150, 58) and were checked against SDSS and 2MASS images for consistency.

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M-81	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs)	
								[==>]	***[1]***
2	(STIS.sp.10 08237)	(1) M-81	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A			Pattern 5, Exps 2-2 in Visit 02 (5)	838 Secs (2514 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[1]***
								[==>(Pattern 3)]	
3	(STIS.sp.10 12360)	(1) M-81	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A			Pattern 5, Exps 3-3 in Visit 02 (5)	1035 Secs (3105 Secs)	
								[==>(Pattern 1)]	
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	

Orbit Structure





Visit

Proposal 15123, Visit 03, implementation Tue Oct 24 14:02:49 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD

Special Requirements: SAME ORIENT AS 01

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(6)	Pattern Type=STIS-ALONG-SLIT	Coordinate Frame=POS-TARG		(2), (3), (4)
	Purpose=DITHER	Pattern Orientation=90.0		
	Number Of Points=5	Angle Between Sides=		
	Point Spacing=0.1	Center Pattern=false		
	Line Spacing=			

Fixed Targets

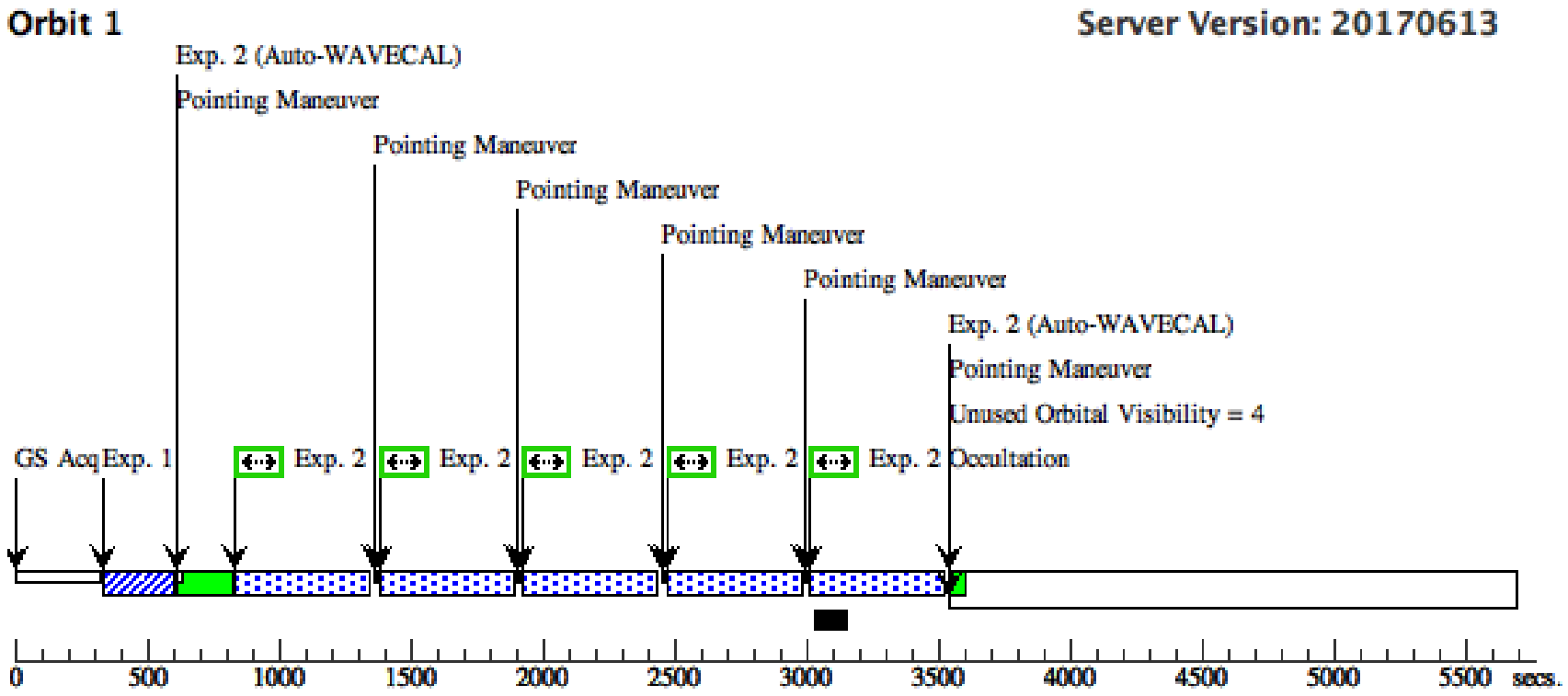
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M-81	RA: 09 55 33.1731 (148.8882212d) Dec: +69 03 55.06 (69.06529d) Equinox: J2000		V=6.94	Reference Frame: ICRS

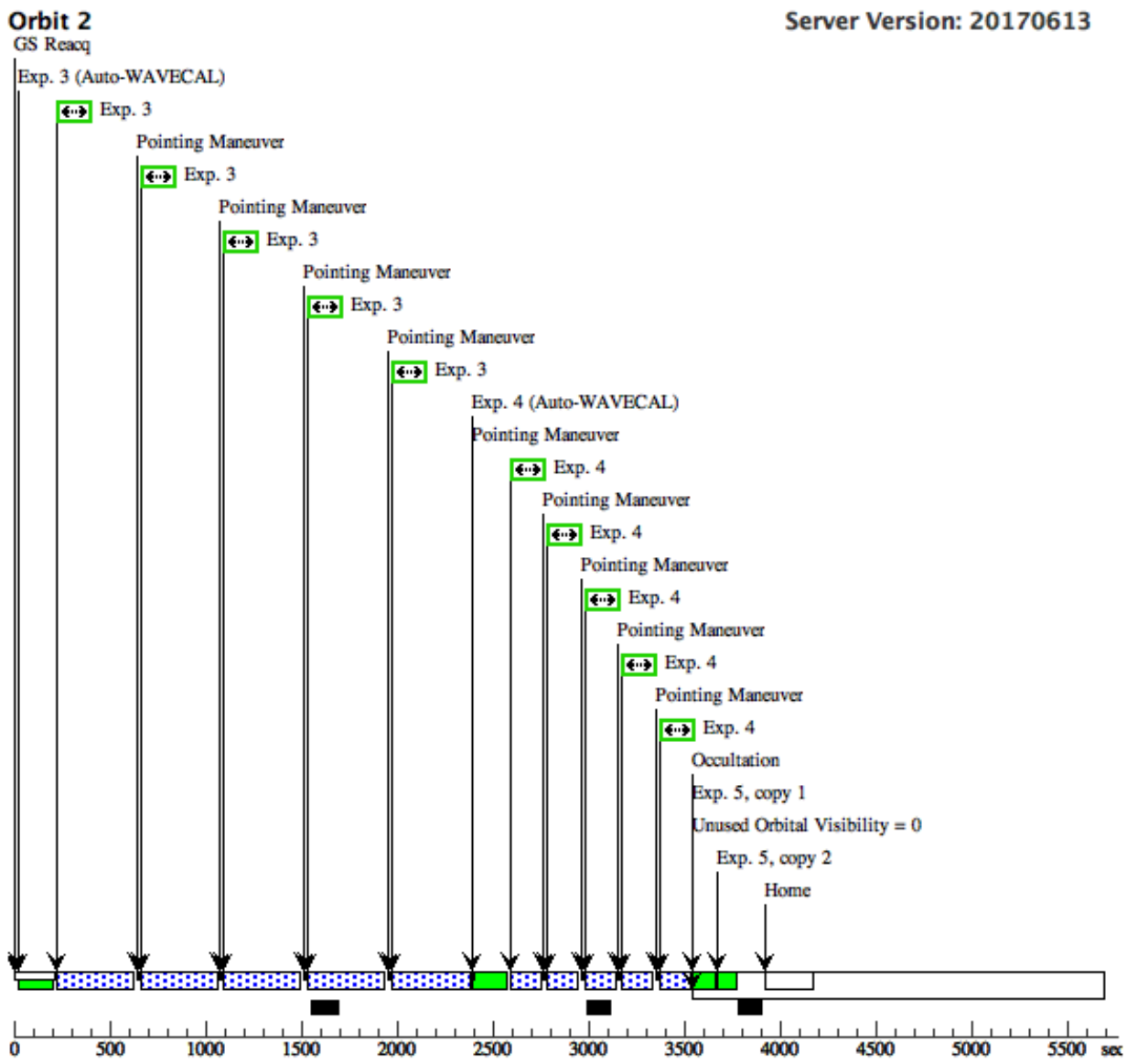
Comments: Coordinates are from ICRF2 catalog (Fey et al 2015, AJ, 150, 58) and were checked against SDSS and 2MASS images for consistency.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M-81	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			10 Secs (10 Secs)	
								[==>]	***[1]***
2		(1) M-81	STIS/CCD, ACCUM, 52X0.2E1	G750M 6581 A	CR-SPLIT=NO		Pattern 6, Exps 2-2 in Visit 03 (6)	475 Secs (2375 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]* *[==>(Pattern 5)]*	***[1]***
3		(1) M-81	STIS/CCD, ACCUM, 52X0.2E1	G430L 4300 A	CR-SPLIT=NO		Pattern 6, Exps 3-3 in Visit 03 (6)	368 Secs (1840 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]* *[==>(Pattern 5)]*	***[2]***
4		(1) M-81	STIS/CCD, ACCUM, 52X0.2E1	G750L 7751 A	CR-SPLIT=NO		Pattern 6, Exps 4-4 in Visit 03 (6)	125 Secs (625 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]* *[==>(Pattern 5)]*	***[2]***
5		CCDFLAT	STIS/CCD, ACCUM, 52X0.1	G750L 7751 A				*[==>(Copy 1)]* *[==>(Copy 2)]*	***[2]***

Orbit Structure




Orbit 2
Server Version: 20170613
GS Reacq
Exp. 3 (Auto-WAVECAL)
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Pointing Maneuver
Exp. 3
Exp. 4 (Auto-WAVECAL)
Pointing Maneuver
Exp. 4
Pointing Maneuver
Exp. 4
Pointing Maneuver
Exp. 4
Pointing Maneuver
Exp. 4
Pointing Maneuver
Exp. 4
Occultation
Exp. 5, copy 1
Unused Orbital Visibility = 0
Exp. 5, copy 2
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 15123, Visit 04, implementation Tue Oct 24 14:02:49 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1), (2), (3), (4)
(3)	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		(5)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M-81	RA: 09 55 33.1731 (148.8882212d) Dec: +69 03 55.06 (69.06529d) Equinox: J2000		V=6.94	Reference Frame: ICRS

Comments: Coordinates are from ICRF2 catalog (Fey et al 2015, AJ, 150, 58) and were checked against SDSS and 2MASS images for consistency.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M-81	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F547M	CR-SPLIT=NO; FLASH=11		Pattern 2, Exps 1-1 in Visit 04 (2)	10 Secs (40 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2		(1) M-81	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F814W	CR-SPLIT=NO; FLASH=11		Pattern 2, Exps 2-2 in Visit 04 (2)	5 Secs (20 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3		(1) M-81	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F438W	CR-SPLIT=NO; FLASH=11		Pattern 2, Exps 3-3 in Visit 04 (2)	20 Secs (80 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
4		(1) M-81	WFC3/UVIS, ACCUM, UVIS2-C512C-SUB	F218W	CR-SPLIT=NO; FLASH=11		Pattern 2, Exps 4-4 in Visit 04 (2)	410 Secs (1640 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
5		(1) M-81	WFC3/IR, MULTIACCUM, IRSUB512	F153M	NSAMP=14; SAMP-SEQ=SPARS5		Pattern 3, Exps 5-5 in Visit 04 (3)	38.832618 Secs (155.33 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure