



17398 - Narrowband Imaging of M76

Cycle: 30, Proposal Category: GO/DD

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>
Dr. Christopher Britt (PI) (Contact)	Space Telescope Science Institute
Max Mutchler (CoI) (Contact)	Space Telescope Science Institute
Varun Bajaj (CoI) (Contact)	Space Telescope Science Institute
John Maple (CoI)	Space Telescope Science Institute
Joseph DePasquale (CoI)	Space Telescope Science Institute
Alyssa Pagan (CoI)	Space Telescope Science Institute
Christine Pulliam (CoI)	Space Telescope Science Institute
Ray Villard (CoI)	Space Telescope Science Institute
Dr. Emma Marcucci (CoI)	Space Telescope Science Institute
Elizabeth Rafferty (CoI)	Space Telescope Science Institute

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>
07	(1) M-76	WFC3/UVIS	2	12-Dec-2023 11:00:34.0	yes
08	(1) M-76	WFC3/UVIS	2	12-Dec-2023 11:00:35.0	yes
09	(1) M-76	WFC3/UVIS	2	12-Dec-2023 11:00:36.0	yes
10	(1) M-76	WFC3/UVIS	2	12-Dec-2023 11:00:37.0	yes
11	(1) M-76	WFC3/UVIS	2	12-Dec-2023 11:00:38.0	yes
12	(1) M-76	WFC3/UVIS	2	12-Dec-2023 11:00:39.0	yes

12 Total Orbits Used

ABSTRACT

We propose to take deep narrowband imaging of the Little Dumbbell Nebula, M76. Deep H-alpha, [NII], and [OIII] images in F656N, F658N, and F502N will sample different density and temperature regions within the nebula.

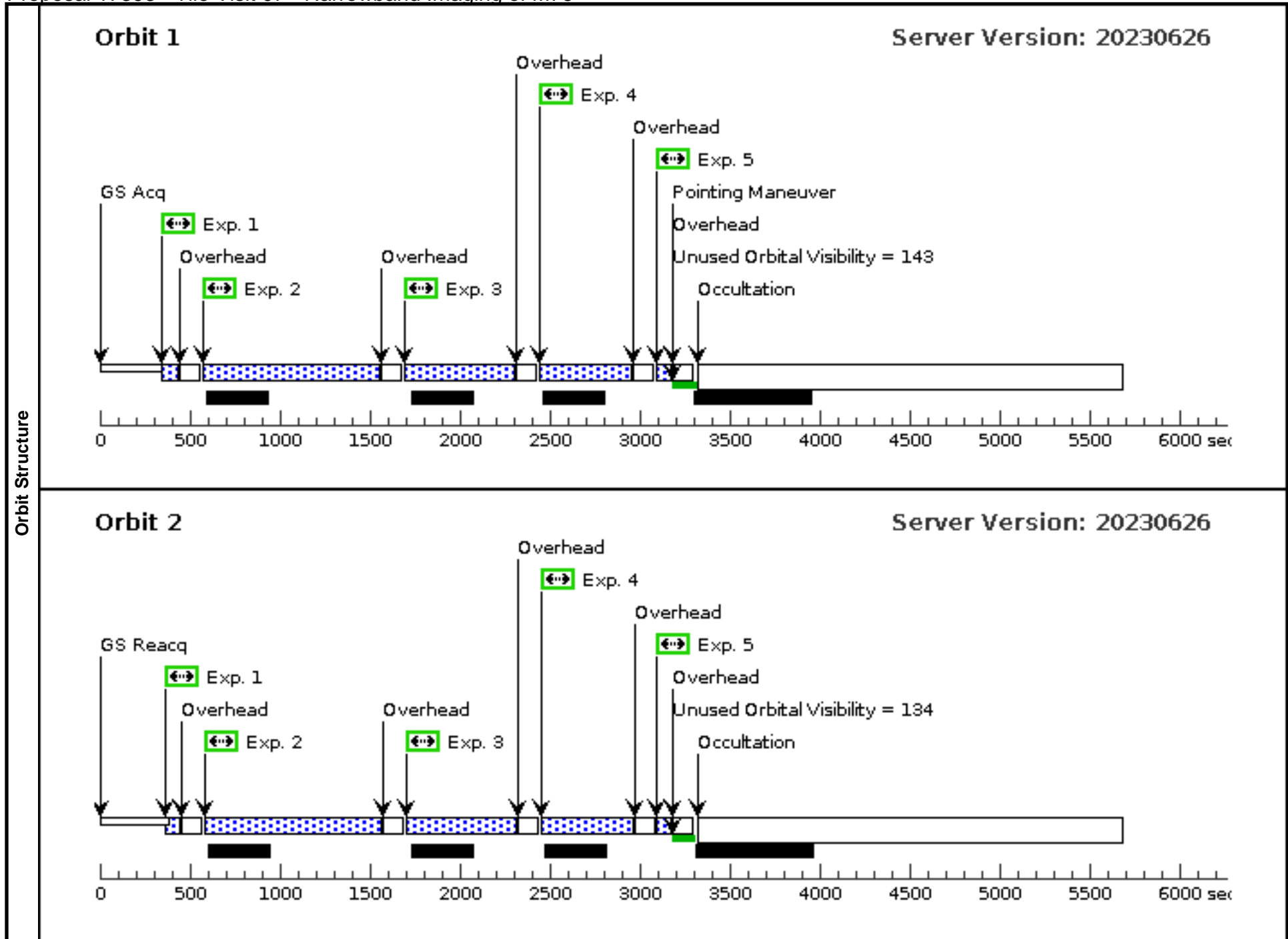
OBSERVING DESCRIPTION

We will obtain high signal-to-noise imaging of planetary nebula M76. We propose a 1x2 mosaic of WFC3 pointings at an orient of 145 degrees. We employ a 3-point stretched gap dither pattern which fills the chip gaps, expands the field a bit, and also mitigates scattered light concerns from the somewhat crowded star field. With 6 orbits per pointing and 2 mosaic tiles, we request 12 orbits. We include deep narrowband imaging with filters that isolate key emission bands for planetary nebulae: F502N for [O III], F656N for H/alpha, and F658N for [N II] which is quite strong in M76. We also include short exposures with broadband B and I filters (F475W, F814W) for star colors, continuum subtraction, and overall archival value. For each of the two tiles we employ a three point stretch dither, with each dither point also utilizing a two point chip gap dither, to ensure evenness of coverage over the imaged area. M76 extends over a 2.7 x 1.8 arcmin area, with the brightest region being a central stripe with two fainter lobes extending to the side. For our chosen dither pattern, and using the WFC3/UVIS Exposure Time Calculator with the planetary nebula spectrum from Kwitter & Henry, 1996, we can achieve a signal-to-noise ratio of > 50 for each resolution element in 2 orbits per tile for the filters F656N, F658N, and F502N for even the fainter lobes of the nebula. We can obtain 2-color short broadband imaging in F475W and F814W at the beginning and end of orbits. These short exposures can be added to the beginning and end of the visits for longer exposures. This target is schedulable in late November 2023 at the desired orient. In the event of any failed observation the target remains schedulable for repeat observations through late February 2024, although at somewhat less-desirable orientations. Scheduling as early as possible is ideal, so we have submitted the orient that is available earliest. We stress that 90 deg orientations are possible and more widely schedulable at later times.

Proposal 17398 - Tile Visit 07 - Narrowband Imaging of M76

Tue Dec 12 16:00:40 GMT 2023

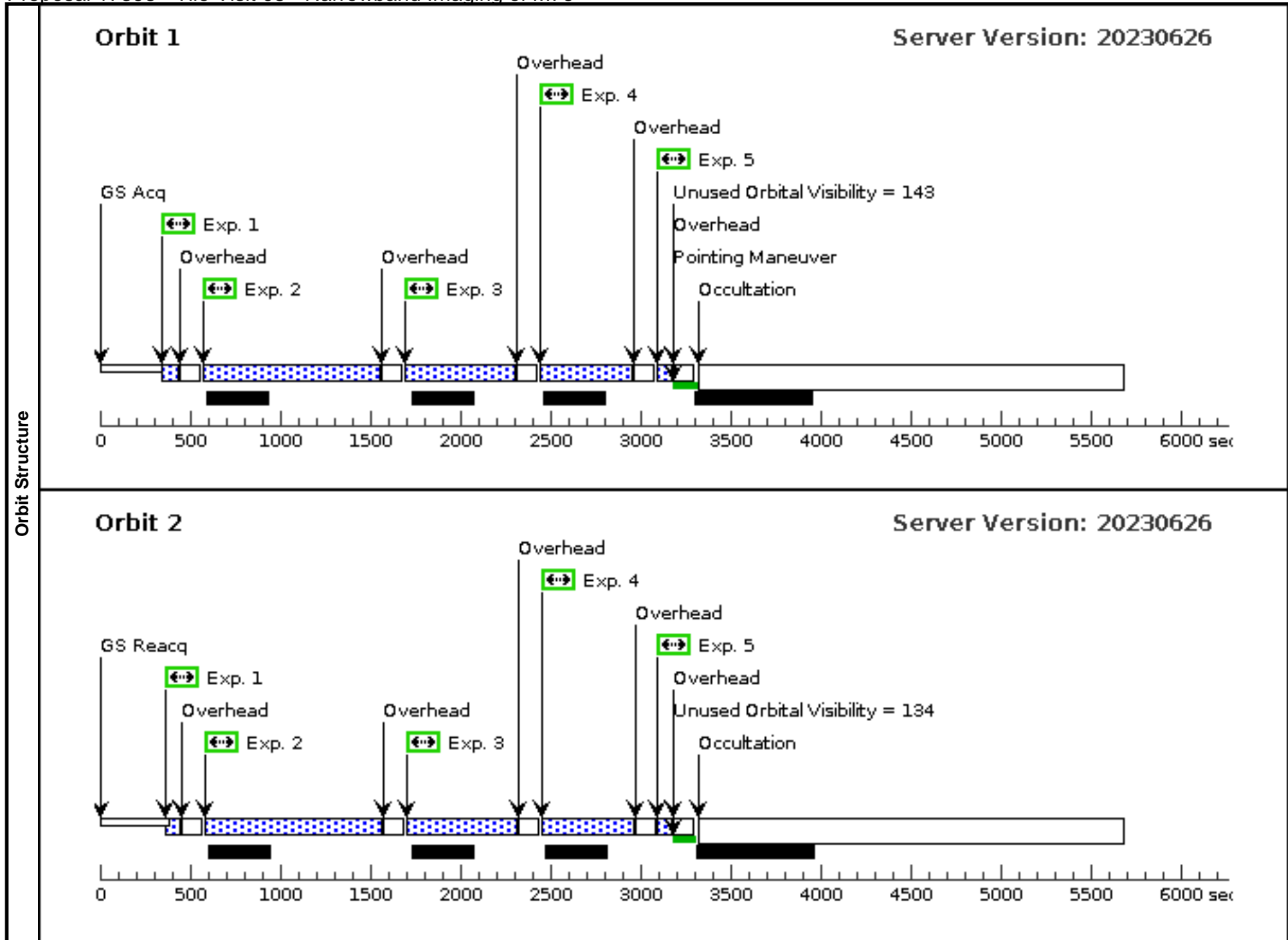
Visit	Proposal 17398, Tile Visit 07, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: SCHED 30%: ORIENT 65.0D TO 80.0 D; BEFORE 28-FEB-2024:00:00:00									
	Patterns	#	Primary Pattern			Secondary Pattern			Exposures	
		(5)	Pattern Type=WFC3-UVIS-GAP-LINE Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=85.759 Number Of Points=2 Angle Between Sides= Point Spacing=2.414 Center Pattern=false Line Spacing=						(1-5)	
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes	Miscellaneous		
	(1)	M-76	RA: 01 42 19.5714 (25.5815475d) Dec: +51 34 29.97 (51.57499d) Equinox: J2000		Proper Motion RA: 2.586 mas/yr Proper Motion Dec: -2.9590000849566422 mas/yr Epoch of Position: 2000		V=17.48	Reference Frame: SIMBAD		
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=EXT-STAR Description=[EMISSION LINE NEBULA, PLANETARY NEBULA CENTRAL STAR] Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	B 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=16	POS TARG -16.345 528328050165,-84.0	Pattern 5, Exps 1-5 in Tile Visit 07 (5)	55 Secs (110 Secs)	
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
2	Ha	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=18	POS TARG -16.345 528328050165,-84.0	Pattern 5, Exps 1-5 in Tile Visit 07 (5)	970 Secs (1940 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
3	OIII 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=18	POS TARG -16.345 528328050165,-84.0	Pattern 5, Exps 1-5 in Tile Visit 07 (5)	580 Secs (1160 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
4	NII	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F658N	FLASH=18	POS TARG -16.345 528328050165,-84.0	Pattern 5, Exps 1-5 in Tile Visit 07 (5)	490 Secs (980 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
5	I 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=16	POS TARG -16.345 528328050165,-84.0	Pattern 5, Exps 1-5 in Tile Visit 07 (5)	50 Secs (100 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	



Proposal 17398 - Tile Visit 08 - Narrowband Imaging of M76

Tue Dec 12 16:00:40 GMT 2023

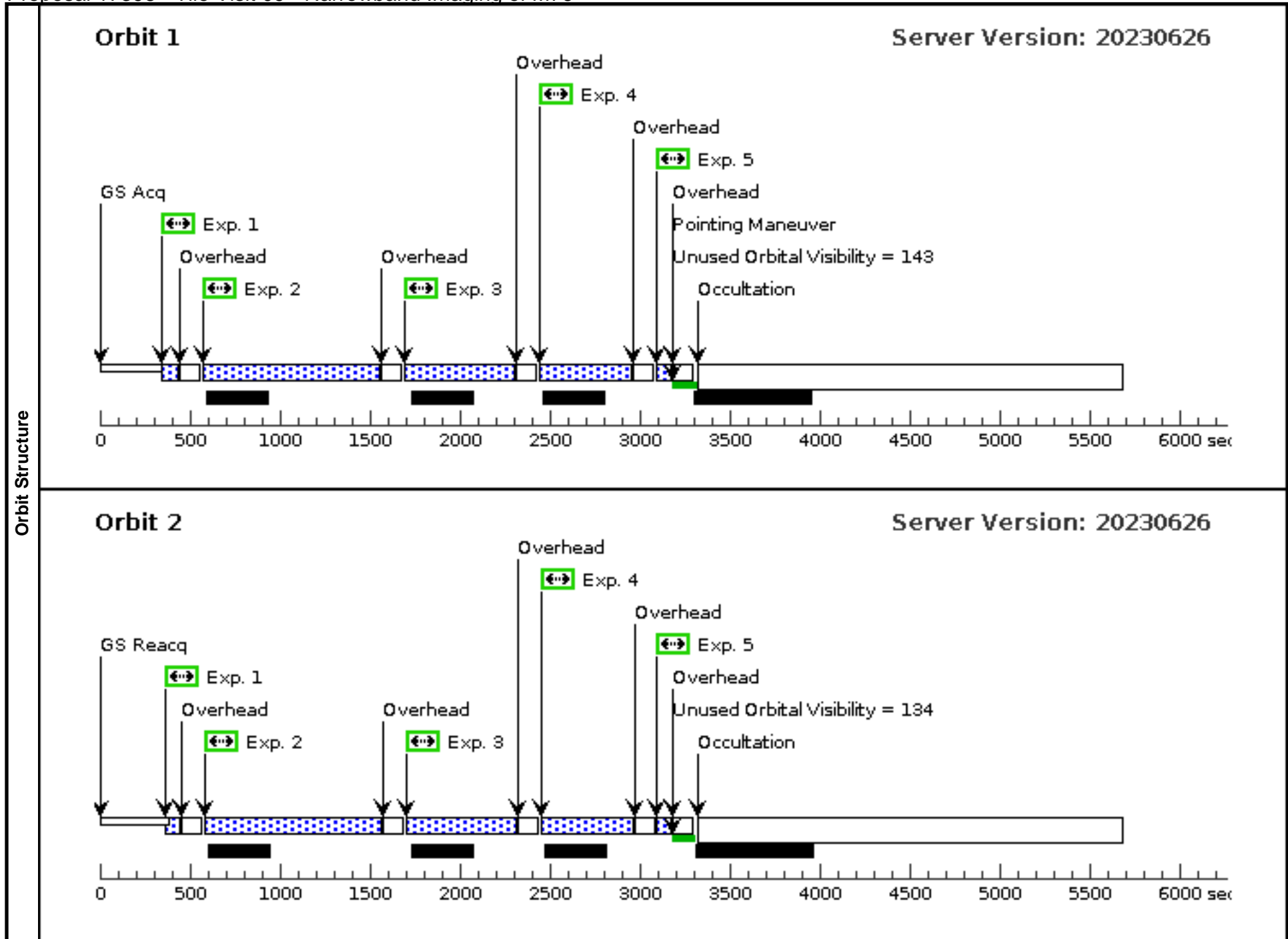
Visit	Proposal 17398, Tile Visit 08, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: SCHED 30%; SAME ORIENT AS 07; BEFORE 28-FEB-2024:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(5)	Pattern Type=WFC3-UVIS-GAP-LINE Coordinate Frame=POS-TARG Purpose=MOSAIC Pattern Orientation=85.759 Number Of Points=2 Angle Between Sides= Point Spacing=2.414 Center Pattern=false Line Spacing=		(1-5)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	M-76	RA: 01 42 19.5714 (25.5815475d) Dec: +51 34 29.97 (51.57499d) Equinox: J2000	Proper Motion RA: 2.586 mas/yr Proper Motion Dec: -2.9590000849566422 mas/yr Epoch of Position: 2000	V=17.48	Reference Frame: SIMBAD				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=EXT-STAR Description=[EMISSION LINE NEBULA, PLANETARY NEBULA CENTRAL STAR] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	B 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=16	POS TARG 0.0,-78.60321000000002	Pattern 5, Exps 1-5 in Tile Visit 08 (5)	55 Secs (110 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1] [2]
2	Ha	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=18	POS TARG 0.0,-78.60321000000002	Pattern 5, Exps 1-5 in Tile Visit 08 (5)	970 Secs (1940 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1] [2]	
3	OIII 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=18	POS TARG 0.0,-78.60321000000002	Pattern 5, Exps 1-5 in Tile Visit 08 (5)	580 Secs (1160 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1] [2]	
4	NII	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F658N	FLASH=18	POS TARG 0.0,-78.60321000000002	Pattern 5, Exps 1-5 in Tile Visit 08 (5)	490 Secs (980 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1] [2]	
5	I 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=16	POS TARG 0.0,-78.60321000000002	Pattern 5, Exps 1-5 in Tile Visit 08 (5)	50 Secs (100 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1] [2]	



Proposal 17398 - Tile Visit 09 - Narrowband Imaging of M76

Tue Dec 12 16:00:40 GMT 2023

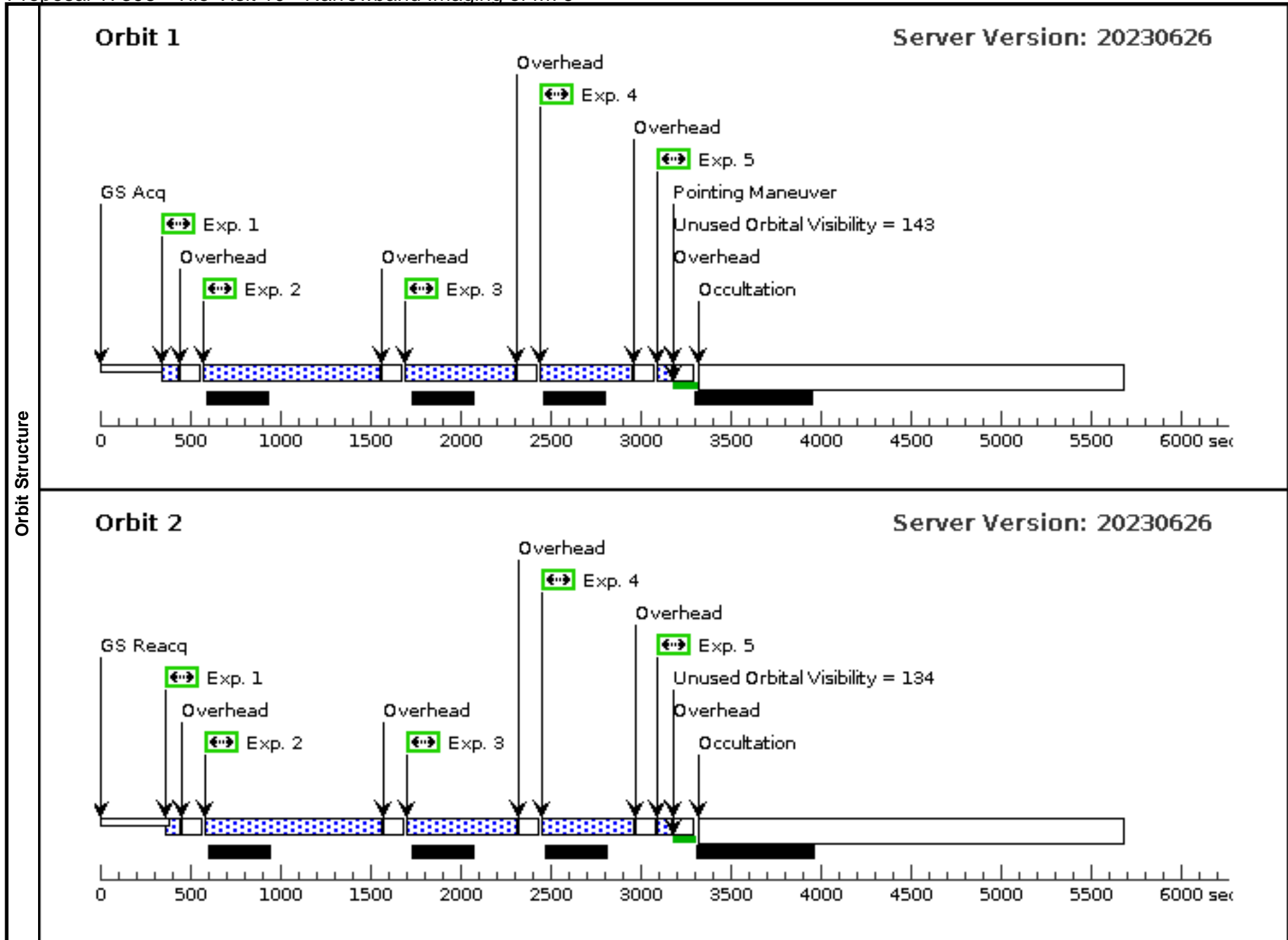
Visit	Proposal 17398, Tile Visit 09, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: SCHED 30%; SAME ORIENT AS 07; BEFORE 28-FEB-2024:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(5)	Pattern Type=WFC3-UVIS-GAP-LINE 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=false		(1-5)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	M-76	RA: 01 42 19.5714 (25.5815475d) Dec: +51 34 29.97 (51.57499d) Equinox: J2000	Proper Motion RA: 2.586 mas/yr Proper Motion Dec: -2.9590000849566422 mas/yr Epoch of Position: 2000	V=17.48	Reference Frame: SIMBAD				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=EXT-STAR Description=[EMISSION LINE NEBULA, PLANETARY NEBULA CENTRAL STAR] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	B 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=16	POS TARG 16.3455 28328050165,-73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 09 (5)	55 Secs (110 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]
2	Ha	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=18	POS TARG 16.3455 28328050165,-73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 09 (5)	970 Secs (1940 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
3	OIII 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=18	POS TARG 16.3455 28328050165,-73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 09 (5)	580 Secs (1160 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
4	NII	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F658N	FLASH=18	POS TARG 16.3455 28328050165,-73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 09 (5)	490 Secs (980 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
5	I 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=16	POS TARG 16.3455 28328050165,-73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 09 (5)	50 Secs (100 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	



Proposal 17398 - Tile Visit 10 - Narrowband Imaging of M76

Tue Dec 12 16:00:40 GMT 2023

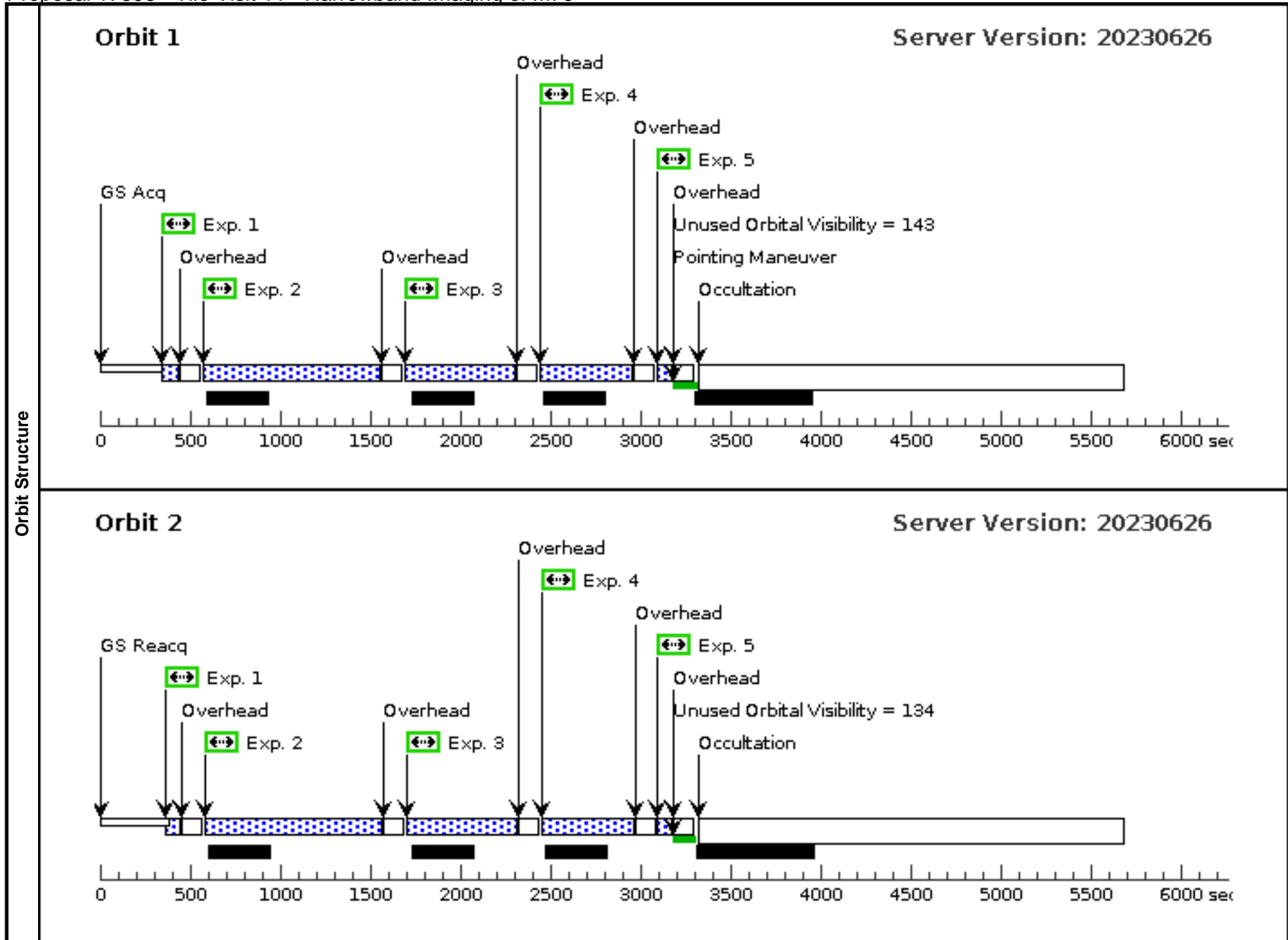
Visit	Proposal 17398, Tile Visit 10, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: SCHED 30%; SAME ORIENT AS 07; BEFORE 28-FEB-2024:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
	(5)	Pattern Type=WFC3-UVIS-GAP-LINE 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=false		(1-5)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	M-76	RA: 01 42 19.5714 (25.5815475d) Dec: +51 34 29.97 (51.57499d) Equinox: J2000	Proper Motion RA: 2.586 mas/yr Proper Motion Dec: -2.9590000849566422 mas/yr Epoch of Position: 2000	V=17.48	Reference Frame: SIMBAD				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=EXT-STAR Description=[EMISSION LINE NEBULA, PLANETARY NEBULA CENTRAL STAR] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	B 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=16	POS TARG -16.345 528328050165,73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 10 (5)	55 Secs (110 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]
2	Ha	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=18	POS TARG -16.345 528328050165,73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 10 (5)	970 Secs (1940 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
3	OIII 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=18	POS TARG -16.345 528328050165,73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 10 (5)	580 Secs (1160 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
4	NII	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F658N	FLASH=18	POS TARG -16.345 528328050165,73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 10 (5)	490 Secs (980 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
5	I 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=16	POS TARG -16.345 528328050165,73.20 21931448713	Pattern 5, Exps 1-5 in Tile Visit 10 (5)	50 Secs (100 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	



Proposal 17398 - Tile Visit 11 - Narrowband Imaging of M76

Tue Dec 12 16:00:40 GMT 2023

Visit	Proposal 17398, Tile Visit 11, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: SCHED 30%; SAME ORIENT AS 07; BEFORE 28-FEB-2024:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(5)	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=false Line Spacing=		(1-5)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	M-76	RA: 01 42 19.5714 (25.5815475d) Dec: +51 34 29.97 (51.57499d) Equinox: J2000	Proper Motion RA: 2.586 mas/yr Proper Motion Dec: -2.9590000849566422 mas/yr Epoch of Position: 2000	V=17.48	Reference Frame: SIMBAD				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=EXT-STAR Description=[EMISSION LINE NEBULA, PLANETARY NEBULA CENTRAL STAR] Extended=YES										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	B 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=16	POS TARG 0.0,78.6 0321000000002	Pattern 5, Exps 1-5 in Tile Visit 11 (5)	55 Secs (110 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]
2	Ha	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=18	POS TARG 0.0,78.6 0321000000002	Pattern 5, Exps 1-5 in Tile Visit 11 (5)	970 Secs (1940 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
3	OIII 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=18	POS TARG 0.0,78.6 0321000000002	Pattern 5, Exps 1-5 in Tile Visit 11 (5)	580 Secs (1160 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
4	NII	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F658N	FLASH=18	POS TARG 0.0,78.6 0321000000002	Pattern 5, Exps 1-5 in Tile Visit 11 (5)	490 Secs (980 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	
5	I 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=16	POS TARG 0.0,78.6 0321000000002	Pattern 5, Exps 1-5 in Tile Visit 11 (5)	50 Secs (100 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1] [2]	



Proposal 17398 - Tile Visit 12 - Narrowband Imaging of M76

Tue Dec 12 16:00:40 GMT 2023

Visit	Proposal 17398, Tile Visit 12, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: SCHED 30%; SAME ORIENT AS 07; BEFORE 28-FEB-2024:00:00:00									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(5)	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=false Line Spacing=		(1-5)					
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	M-76	RA: 01 42 19.5714 (25.5815475d) Dec: +51 34 29.97 (51.57499d) Equinox: J2000	Proper Motion RA: 2.586 mas/yr Proper Motion Dec: -2.9590000849566422 mas/yr Epoch of Position: 2000	V=17.48	Reference Frame: SIMBAD				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=EXT-STAR Description=[EMISSION LINE NEBULA, PLANETARY NEBULA CENTRAL STAR] Extended=YES									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	B 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F475W	FLASH=16	POS TARG 16.3455 28328050165,84.0	Pattern 5, Exps 1-5 in Tile Visit 12 (5)	55 Secs (110 Secs)	
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
2	Ha	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F656N	FLASH=18	POS TARG 16.3455 28328050165,84.0	Pattern 5, Exps 1-5 in Tile Visit 12 (5)	970 Secs (1940 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
3	OIII 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F502N	FLASH=18	POS TARG 16.3455 28328050165,84.0	Pattern 5, Exps 1-5 in Tile Visit 12 (5)	580 Secs (1160 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
4	NII	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F658N	FLASH=18	POS TARG 16.3455 28328050165,84.0	Pattern 5, Exps 1-5 in Tile Visit 12 (5)	490 Secs (980 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
5	I 1	(1) M-76	WFC3/UVIS, ACCUM, UVIS-CENTER	F814W	FLASH=16	POS TARG 16.3455 28328050165,84.0	Pattern 5, Exps 1-5 in Tile Visit 12 (5)	50 Secs (100 Secs)		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	

