13300 - Mapping MgII Emission in the M82 Superwind: A Rosetta Stone for Understanding Feedback in the Distant Universe

Cycle: 21, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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Dr. Fabian Walter (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	walter@mpia.de

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) MESSIER-082 ANY	ACS/WFC WFC3/UVIS	4	07-Oct-2013 21:29:11.0	yes
02	(1) MESSIER-082 ANY	ACS/WFC WFC3/UVIS	4	07-Oct-2013 21:29:29.0	yes
03	(1) MESSIER-082 ANY	ACS/WFC WFC3/UVIS	4	07-Oct-2013 21:29:46.0	yes
04	(1) MESSIER-082 ANY	ACS/WFC WFC3/UVIS	2	07-Oct-2013 21:29:57.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
05	(1) MESSIER-082 ANY	ACS/WFC WFC3/UVIS	1	07-Oct-2013 21:30:04.0	yes

15 Total Orbits Used

ABSTRACT

Galactic-scale outflows driven by star formation are a pervasive feature of galaxy formation models, and are required to prevent the overproduction of low-mass galaxies by regulating their cool gas supply. Winds from star-forming galaxies are commonly observed in the local Universe and out to z~6; however, empirical constraints on the spatial extent and energetics of winds in distant systems have been very challenging to obtain. Our group has pioneered the study of outflows in emission using resonantly-scattered MgII 2796, 2803 photons, a method which has the potential to map the spatial extent and morphology of galactic winds out to z~2. To take full advantage of this technique, we request 15 orbits for WFC3/UVIS narrow-band imaging of the prototypical starburst M82 to map its superwind in MgII emission. This map will trace photons resonantly scattered from cool, photoionized gas flowing from this galaxy for the first time. Unlike optical nebular lines, scattered MgII emission is an unbiased probe of T<10^4 K material, and will thus reveal a heretofore hidden component of the M82 outflow. This pilot program will focus on a single WFC3/UVIS pointing, and will leverage an extensive suite of archival WFC3/UVIS and ACS observations including H-alpha, H-beta, [OII], [OIII] and [SII] narrow-band imaging. This HST coverage, along with existing soft X-ray and CO emission maps, will yield the most detailed constraints on the physical state of gas in a galactic superwind to date, providing a crucial link between local and high-redshift studies of this phenomenon. Such constraints are fundamental to understanding the impact of feedback processes on galaxy evolution.

OBSERVING DESCRIPTION

We will use WFC3/UVIS to obtain very deep Mg II narrow-band images of a single pointing centered at the base of M82's southern outflow cone. Coverage of this pointing is particularly valuable, as it has already been observed as part of the WFC3 Early Release Science Program (ID 11360) in several passbands, including the F225W, F336W, F373N, F487N, F502N, and F673N filter bands. These data provide narrow-band observations of [O II], H-alpha, [O III], and [S II] emission, as well as broad-band measurements of the UV continuum emission. The former, combined with the deep archival ACS/WFC H-alpha narrow-band coverage and our new F280N imaging (obtained over 14 orbits), will permit detailed modeling of the ionization state of the gas in this area of the outflow. The latter broad-band imaging, which we supplement with 1 orbit of observations in the F336W filter for increased depth and to ensure full overlap with the F280N pointing, will provide measurements of the UV continuum flux both from star-forming regions and from the outflow itself close to and on either side of the wavelength of the targeted emission. This will minimize the effects of

systematic continuum-subtraction errors on our line emission maps.

Visit

Proposal 13300, F280N-4pt (01), implementation Tue Oct 08 01:30:11 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 284D TO 294 D

Comments: The orientation of this visit should match those of archival observations of the same target (obtained using a different filter; Program 11360, IB6W83030). The PA_V3 value in the image header of this archival exposure is 109.00 degrees. We add 180 deg to this value to obtain our preferred ORIENT = 289 deg. We request that our observations be taken within +/- 5 deg of this angle using the orient range inputs below.

We also note that there was a failure during guide star acquisition for the archival observation of this target. We have not yet attempted any action to prevent this problem in this Phase II submission, but would like to do so if possible.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(5)	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		(1-4)

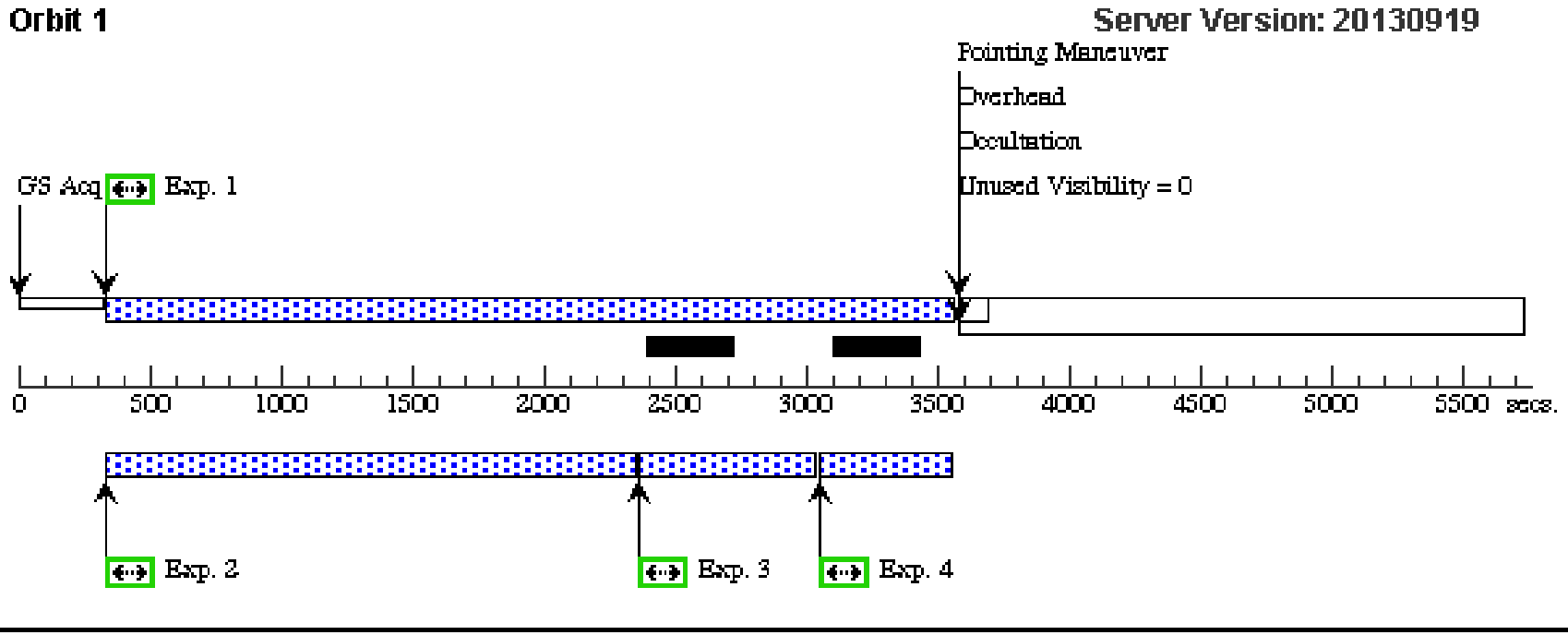
Fixed Targets

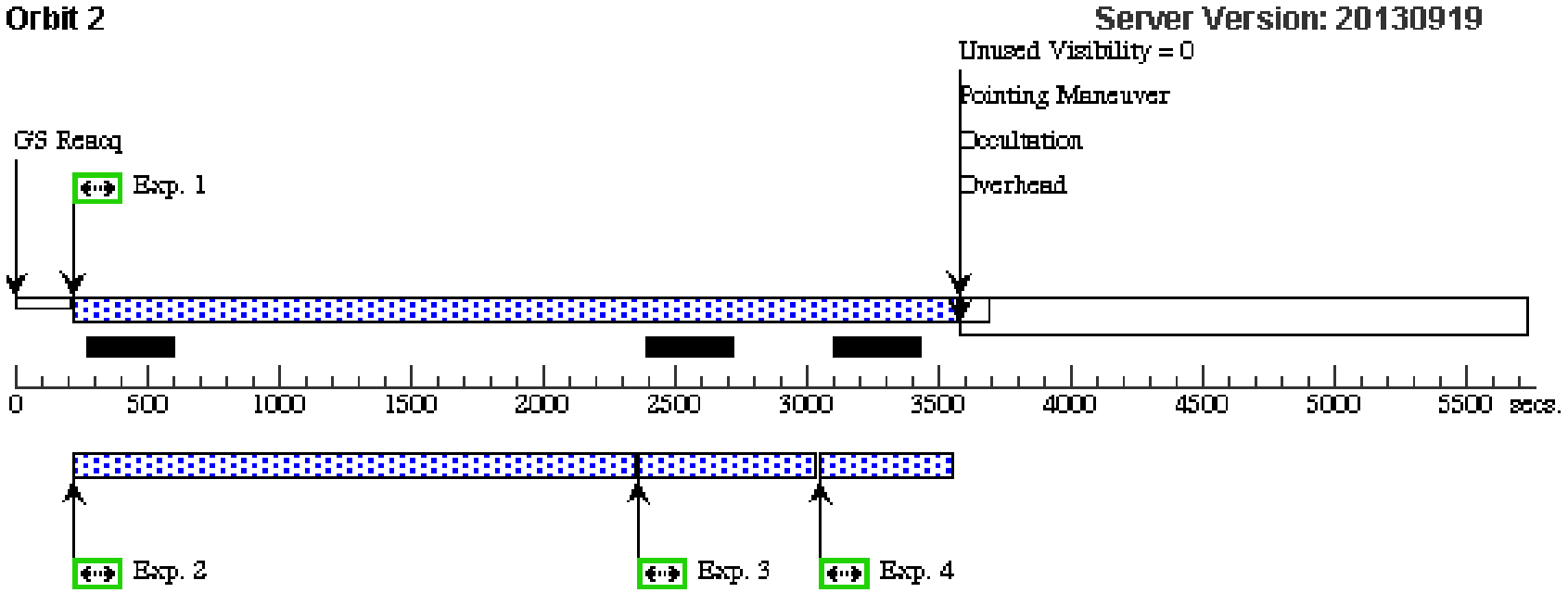
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	MESSIER-082	RA: 09 55 52.9030 (148.9704292d) Dec: +69 40 27.98 (69.67444d) Equinox: J2000		V=8.4+/-0.1 3.2e-18 erg/s/cm^2/Ang/arcsec^2 in WFC3/UVIS F336W; 6.3e-16 erg/s/cm^2/Ang/arcsec^2 in F280N	Reference Frame: ICRS

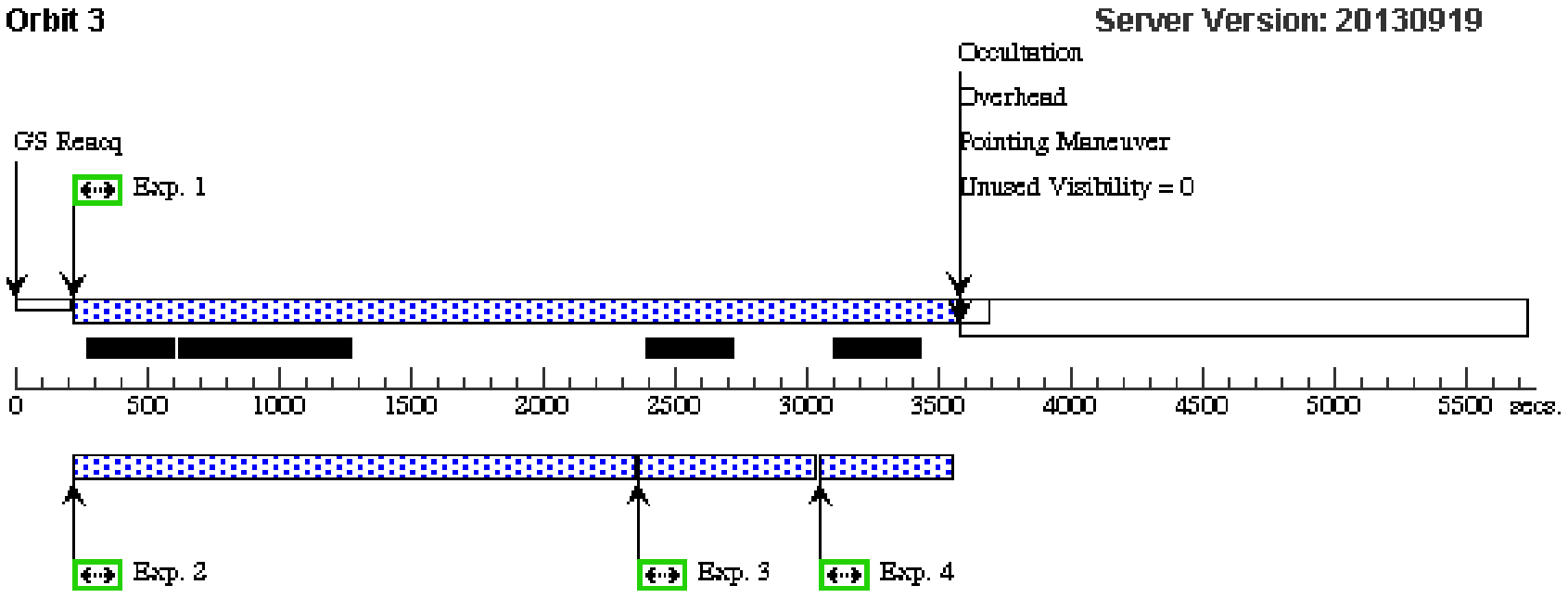
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F280N (517378)	(1) MESSIER-082	WFC3/UVIS, ACCUM, UVIS-FIX	F280N	FLASH=8.0	POS TARG 0.0,0.0	Pattern 5, Exps 1-4 in F280N-4pt (01) (5) Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (01)	3205 Secs (13249 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>3348.0 Secs (Pattern 2)]	***[2]***
								[==>3348.0 Secs (Pattern 3)]	***[3]***
								[==>3348.0 Secs (Pattern 4)]	***[4]***
	Comments: We prefer to take a single exposure during each orbit to minimize read noise. Although such a long exposure will be somewhat degraded by numerous cosmic rays, we will obtain 14 exposures of the same field and perform an 4-point dither pattern to mitigate this effect.								
2	F658N (517418)	ANY	ACS/WFC, ACCUM, WFC	F658N	FLASH=10.0		Pattern 5, Exps 1-4 in F280N-4pt (01) (5) Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (01)	1500 Secs (7678 Secs)	
								[==>1807.0 Secs (Pattern 1)]	***[1]***
								[==>1957.0 Secs (Pattern 2)]	***[2]***
								[==>1957.0 Secs (Pattern 3)]	***[3]***
								[==>1957.0 Secs (Pattern 4)]	***[4]***
3	F555W (537468)	ANY	ACS/WFC, ACCUM, WFC	F555W			Pattern 5, Exps 1-4 in F280N-4pt (01) (5) Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (01)	525 Secs (2100 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
4	F814W (537470)	ANY	ACS/WFC, ACCUM, WFC	F814W			Pattern 5, Exps 1-4 in F280N-4pt (01) (5) Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (01)	340 Secs (1360 Secs)	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

Orbit Structure



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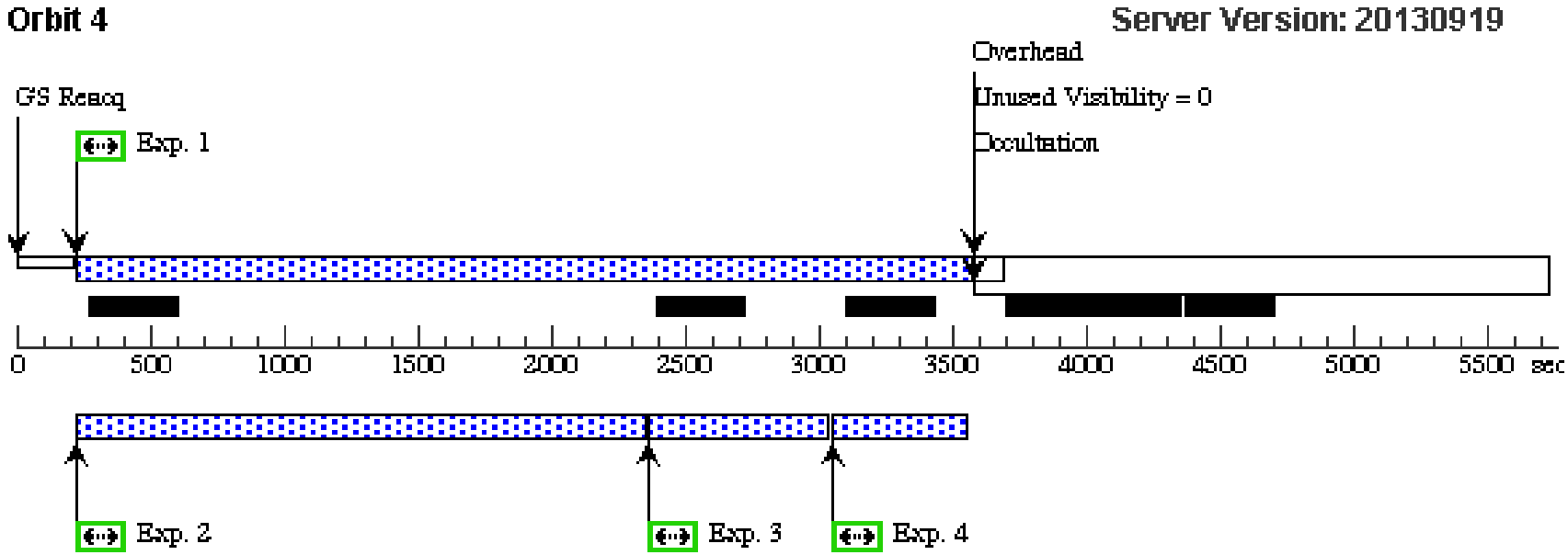
secs.
Exp. 2
Exp. 3
Exp. 4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Exp. 2
Exp. 3
Exp. 4

Visit

Proposal 13300, F280N-4pt (02), implementation Tue Oct 08 01:30:15 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 284D TO 294 D

Comments: The orientation of this visit should match those of archival observations of the same target (obtained using a different filter; Program 11360, IB6W83030). The PA_V3 value in the image header of this archival exposure is 109.00 degrees. We add 180 deg to this value to obtain our preferred ORIENT = 289 deg. We request that our observations be taken within +/- 5 deg of this angle using the orient range inputs below.

We also note that there was a failure during guide star acquisition for the archival observation of this target. We have not yet attempted any action to prevent this problem in this Phase II submission, but would like to do so if possible.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(5)	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		(1-4)

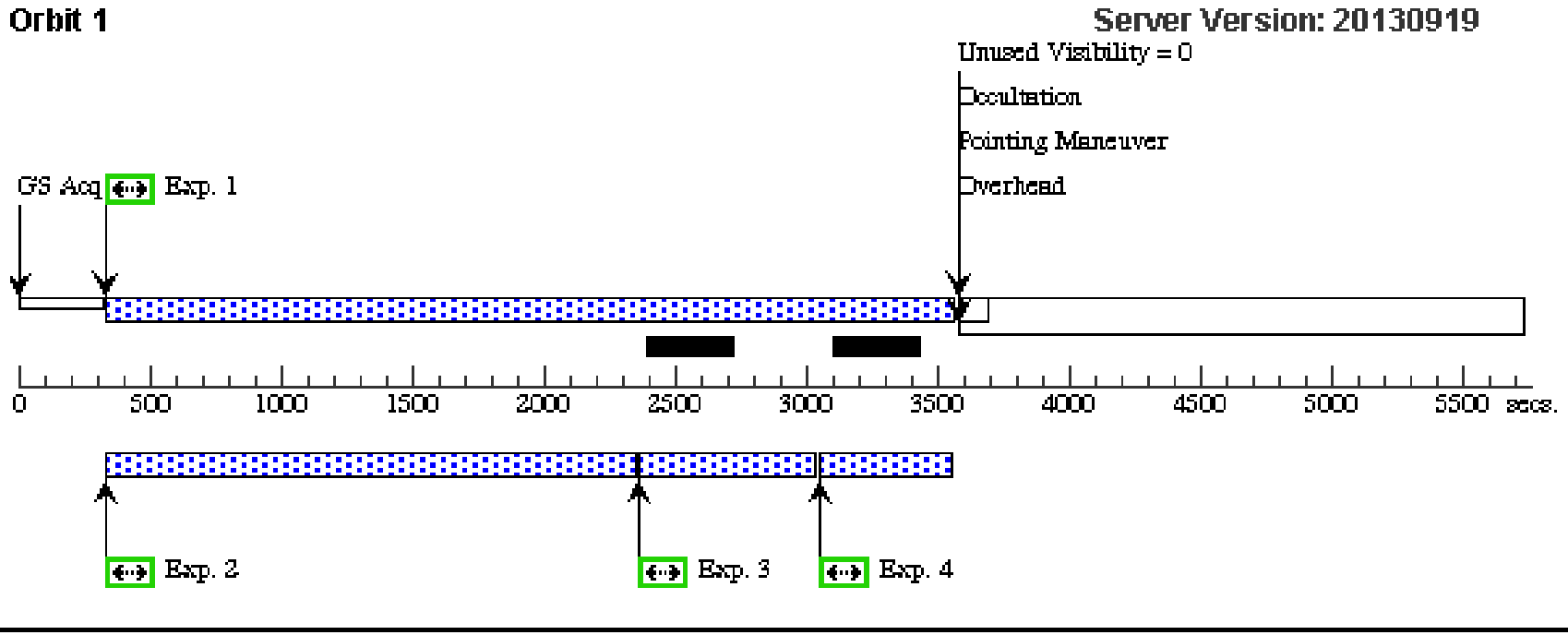
Fixed Targets

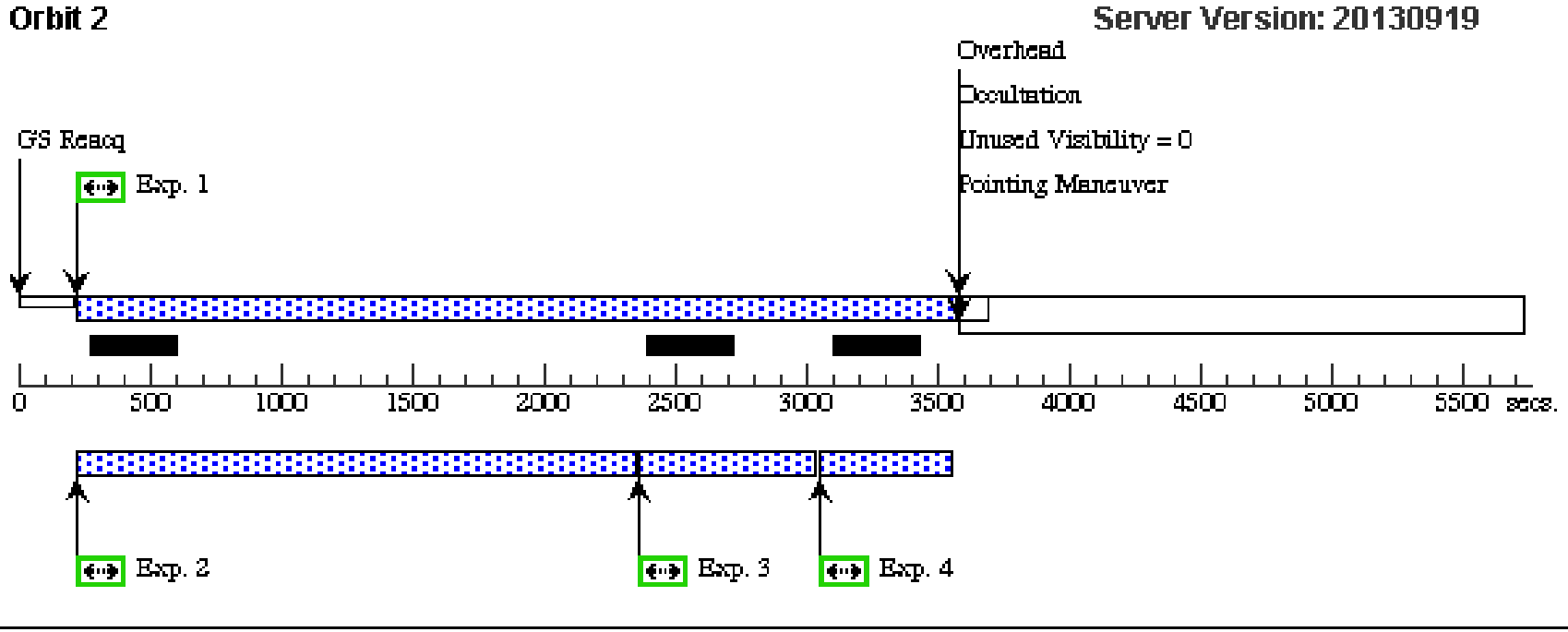
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	MESSIER-082	RA: 09 55 52.9030 (148.9704292d) Dec: +69 40 27.98 (69.67444d) Equinox: J2000		V=8.4+/-0.1 3.2e-18 erg/s/cm^2/Ang/arcsec^2 in WFC3/UVIS F336W; 6.3e-16 erg/s/cm^2/Ang/arcsec^2 in F280N	Reference Frame: ICRS

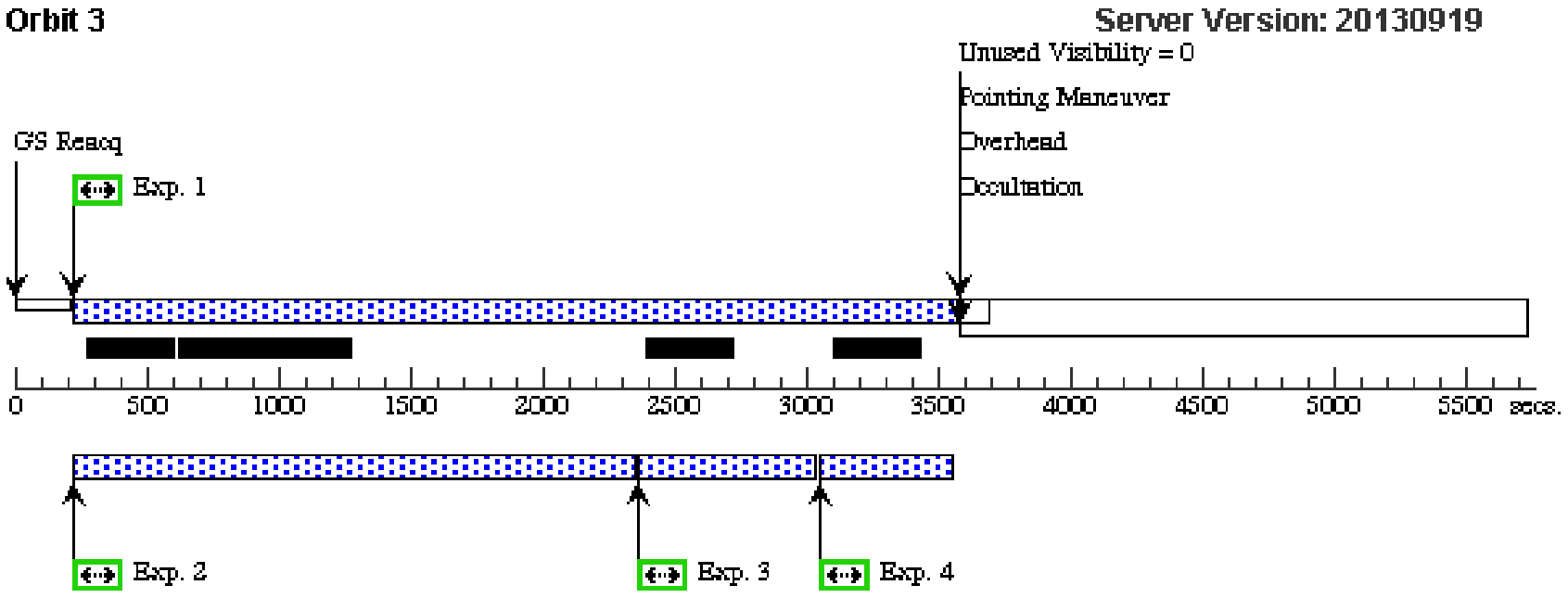
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F280N (517378)	(1) MESSIER-082	WFC3/UVIS, ACCUM, UVIS-FIX	F280N	FLASH=8.0	POS TARG 1.446,2.926	Pattern 5, Exps 1-4 in F280N-4pt (02) (5)	3205 Secs (13249 Secs)	
								[==>(Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (02)	*[==>3348.0 Secs (Pattern 2)]*	***[2]***
								[==>3348.0 Secs (Pattern 3)]	***[3]***
								[==>3348.0 Secs (Pattern 4)]	***[4]***
	Comments: We prefer to take a single exposure during each orbit to minimize read noise. Although such a long exposure will be somewhat degraded by numerous cosmic rays, we will obtain 14 exposures of the same field and perform an 4-point dither pattern to mitigate this effect.								
2	F658N (517418)	ANY	ACS/WFC, ACCUM, WFC	F658N	FLASH=10.0		Pattern 5, Exps 1-4 in F280N-4pt (02) (5)	1500 Secs (7678 Secs)	
								[==>1807.0 Secs (Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (02)	*[==>1957.0 Secs (Pattern 2)]*	***[2]***
								[==>1957.0 Secs (Pattern 3)]	***[3]***
								[==>1957.0 Secs (Pattern 4)]	***[4]***
3	F555W (537468)	ANY	ACS/WFC, ACCUM, WFC	F555W			Pattern 5, Exps 1-4 in F280N-4pt (02) (5)	525 Secs (2100 Secs)	
								[==>(Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (02)	*[==>(Pattern 2)]*	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
4	F814W (537470)	ANY	ACS/WFC, ACCUM, WFC	F814W			Pattern 5, Exps 1-4 in F280N-4pt (02) (5)	340 Secs (1360 Secs)	
								[==>(Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (02)	*[==>(Pattern 2)]*	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

Orbit Structure



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Overhead
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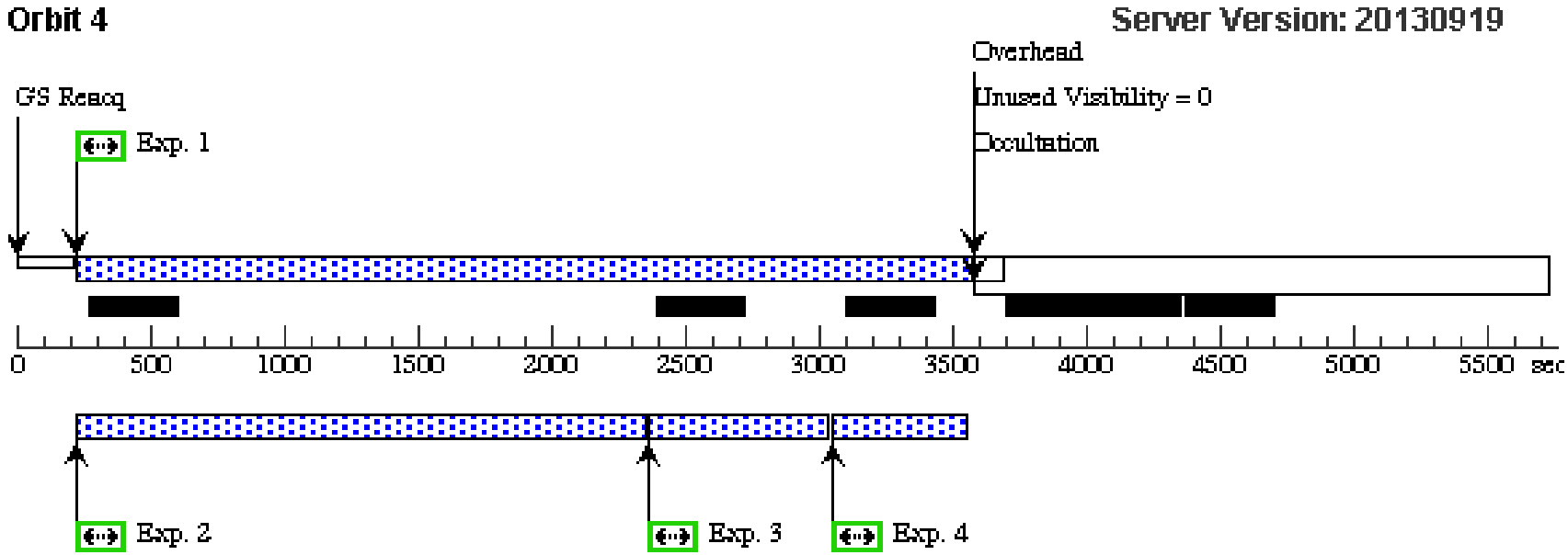
secs.
Exp. 2
Exp. 3
Exp. 4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sec
Exp. 2
Exp. 3
Exp. 4

Visit

Proposal 13300, F280N-4pt (03), implementation Tue Oct 08 01:30:17 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 284D TO 294 D

Comments: The orientation of this visit should match those of archival observations of the same target (obtained using a different filter; Program 11360, IB6W83030). The PA_V3 value in the image header of this archival exposure is 109.00 degrees. We add 180 deg to this value to obtain our preferred ORIENT = 289 deg. We request that our observations be taken within +/- 5 deg of this angle using the orient range inputs below.

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Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(5)	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		(1-4)

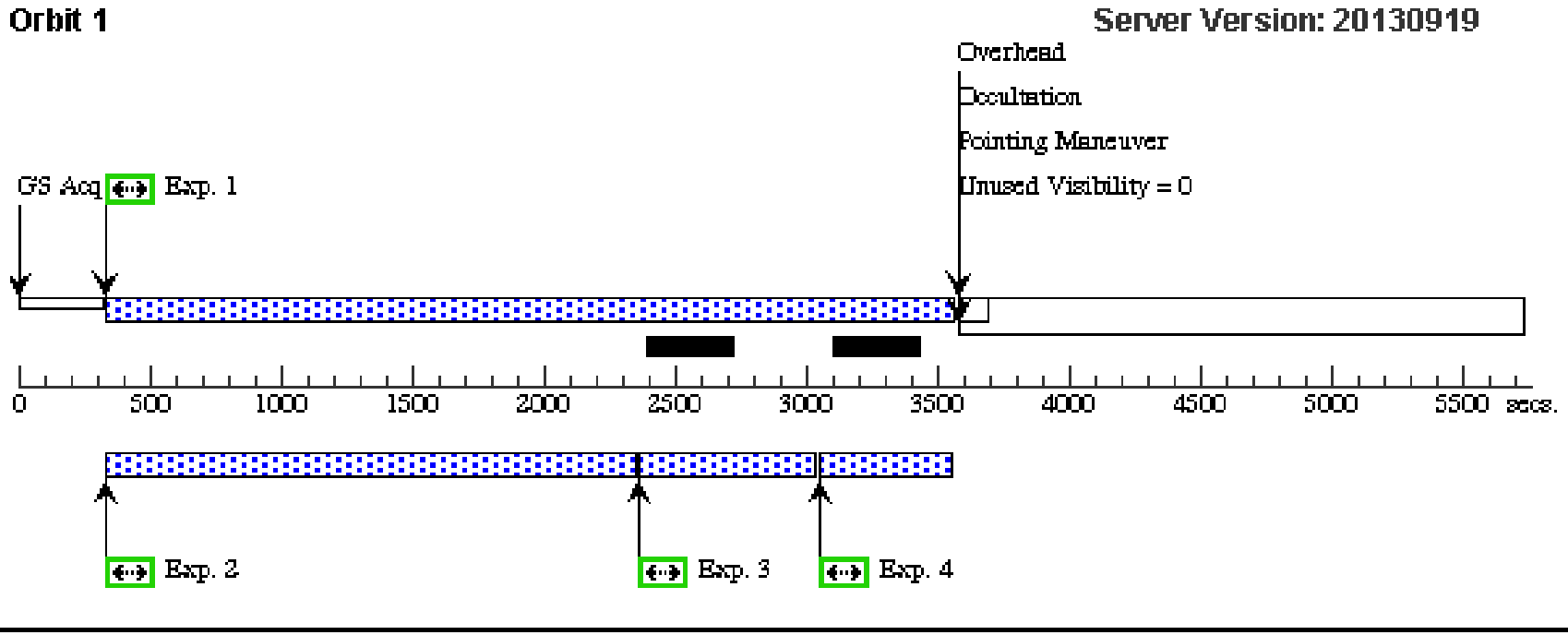
Fixed Targets

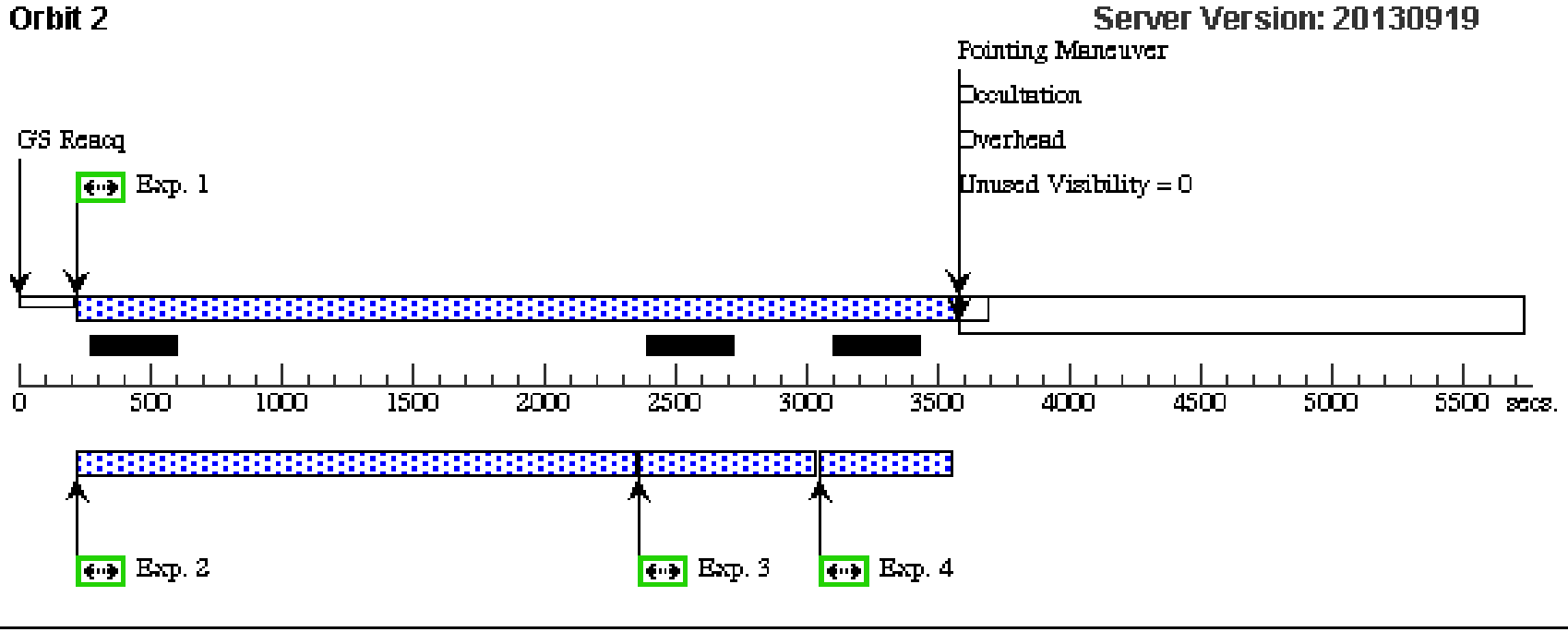
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	MESSIER-082	RA: 09 55 52.9030 (148.9704292d) Dec: +69 40 27.98 (69.67444d) Equinox: J2000		V=8.4+/-0.1 3.2e-18 erg/s/cm^2/Ang/arcsec^2 in WFC3/UVIS F336W; 6.3e-16 erg/s/cm^2/Ang/arcsec^2 in F280N	Reference Frame: ICRS

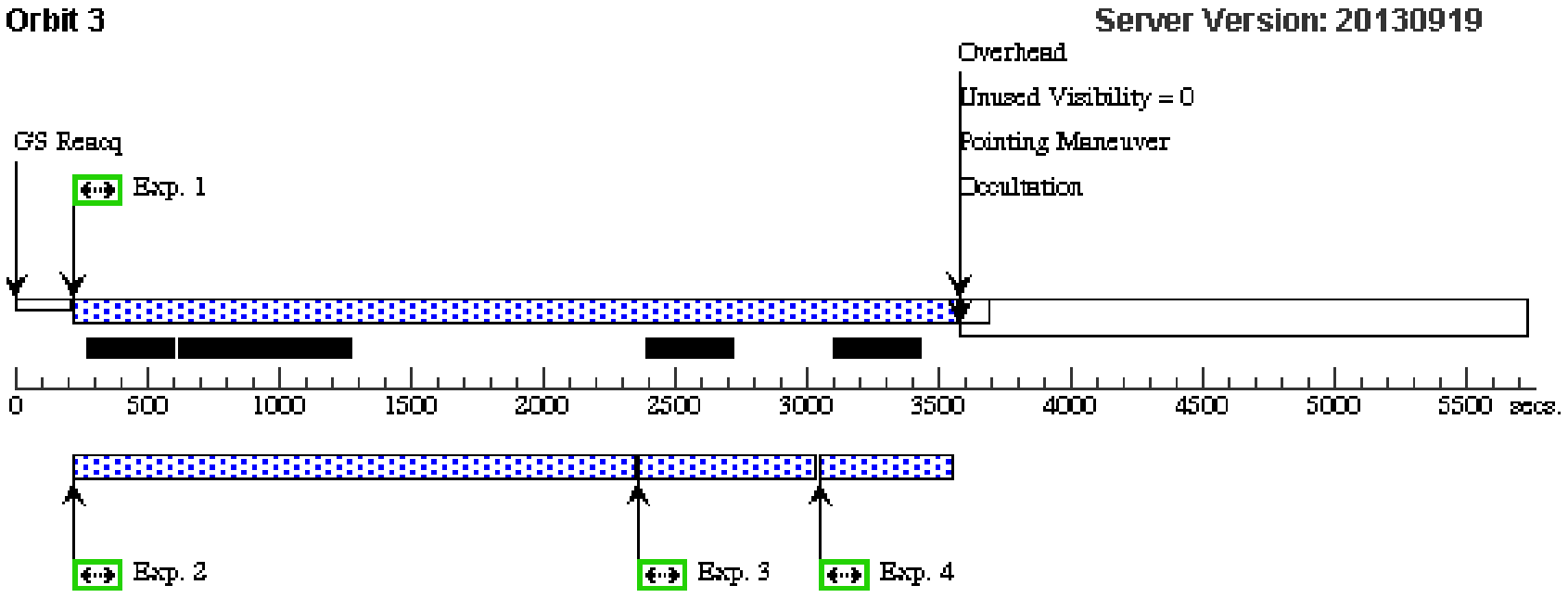
Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F280N (517378)	(1) MESSIER-082	WFC3/UVIS, ACCUM, UVIS-FIX	F280N	FLASH=8.0	POS TARG -1.446,-2.926	Pattern 5, Exps 1-4 in F280N-4pt (03) (5)	3205 Secs (13249 Secs)	
								[==>(Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (03)	*[==>3348.0 Secs (Pattern 2)]*	***[2]***
								[==>3348.0 Secs (Pattern 3)]	***[3]***
								[==>3348.0 Secs (Pattern 4)]	***[4]***
	Comments: We prefer to take a single exposure during each orbit to minimize read noise. Although such a long exposure will be somewhat degraded by numerous cosmic rays, we will obtain 14 exposures of the same field and perform an 4-point dither pattern to mitigate this effect.								
2	F658N (517418)	ANY	ACS/WFC, ACCUM, WFC	F658N	FLASH=10.0		Pattern 5, Exps 1-4 in F280N-4pt (03) (5)	1500 Secs (7678 Secs)	
								[==>1807.0 Secs (Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (03)	*[==>1957.0 Secs (Pattern 2)]*	***[2]***
								[==>1957.0 Secs (Pattern 3)]	***[3]***
								[==>1957.0 Secs (Pattern 4)]	***[4]***
3	F555W (537468)	ANY	ACS/WFC, ACCUM, WFC	F555W			Pattern 5, Exps 1-4 in F280N-4pt (03) (5)	525 Secs (2100 Secs)	
								[==>(Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (03)	*[==>(Pattern 2)]*	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***
4	F814W (537470)	ANY	ACS/WFC, ACCUM, WFC	F814W			Pattern 5, Exps 1-4 in F280N-4pt (03) (5)	340 Secs (1360 Secs)	
								[==>(Pattern 1)]	***[1]***
							Prime + Parallel Group 1-4 in Pattern 5, Exps 1-4 in F280N-4pt (03)	*[==>(Pattern 2)]*	***[2]***
								[==>(Pattern 3)]	***[3]***
								[==>(Pattern 4)]	***[4]***

Orbit Structure



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Pointing Maneuver
Occultation
GS Reacq
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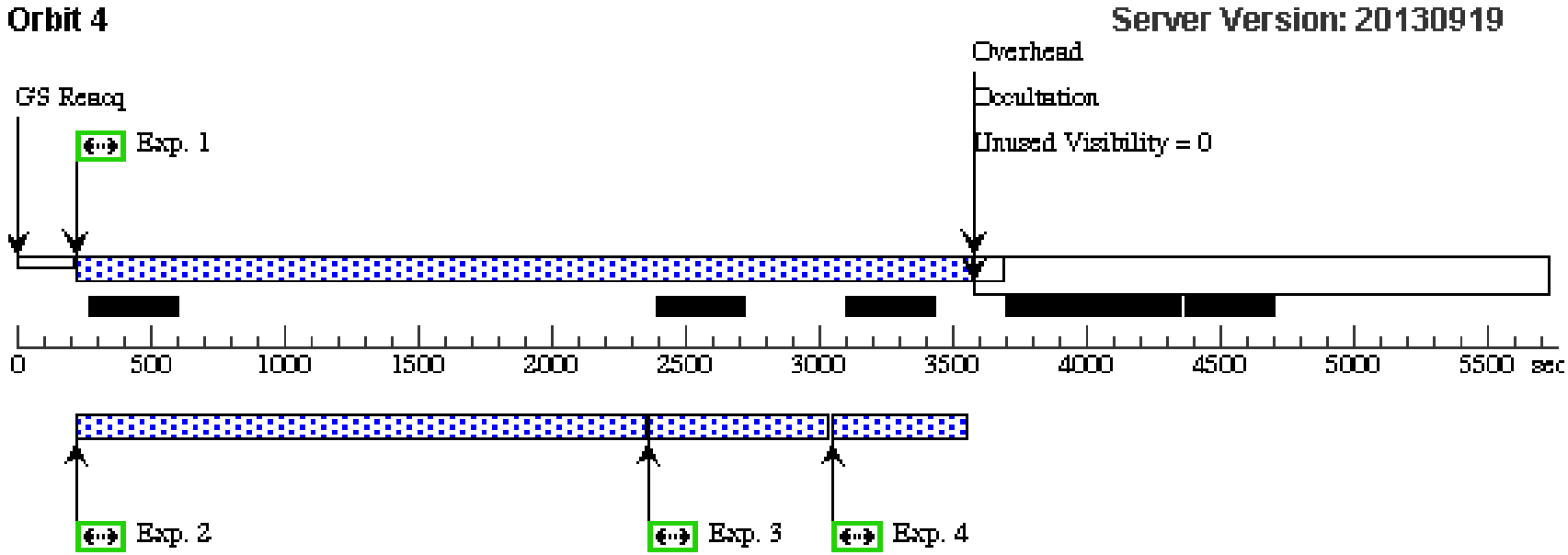
secs.
Exp. 2
Exp. 3
Exp. 4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sec
Exp. 2
Exp. 3
Exp. 4

Visit

Proposal 13300, F280N-2pt (04), implementation Tue Oct 08 01:30:19 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 284D TO 294 D

Comments: The orientation of this visit should match those of archival observations of the same target (obtained using a different filter; Program 11360, IB6W83030). The PA_V3 value in the image header of this archival exposure is 109.00 degrees. We add 180 deg to this value to obtain our preferred ORIENT = 289 deg. We request that our observations be taken within +/- 5 deg of this angle using the orient range inputs below.

We also note that there was a failure during guide star acquisition for the archival observation of this target. We have not yet attempted any action to prevent this problem in this Phase II submission, but would like to do so if possible.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=2.414 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.759 Angle Between Sides= Center Pattern=false		(1-4)

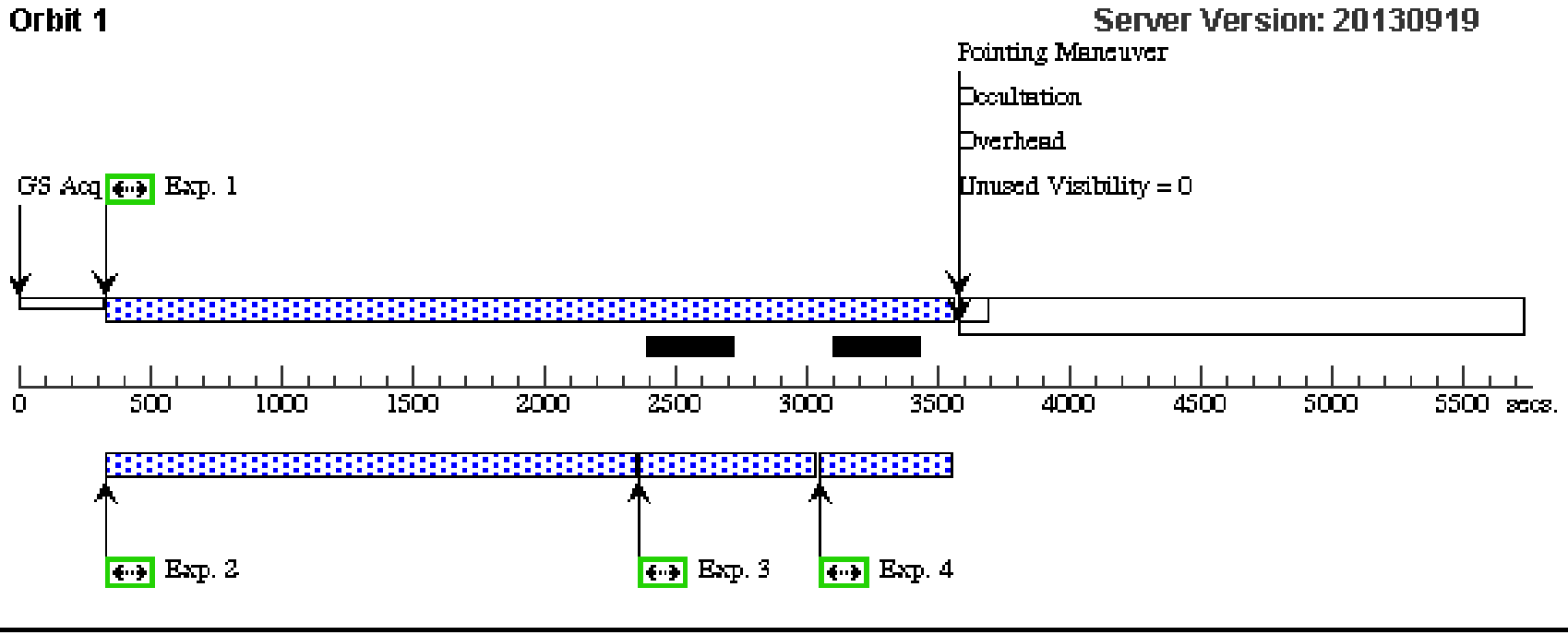
Fixed Targets

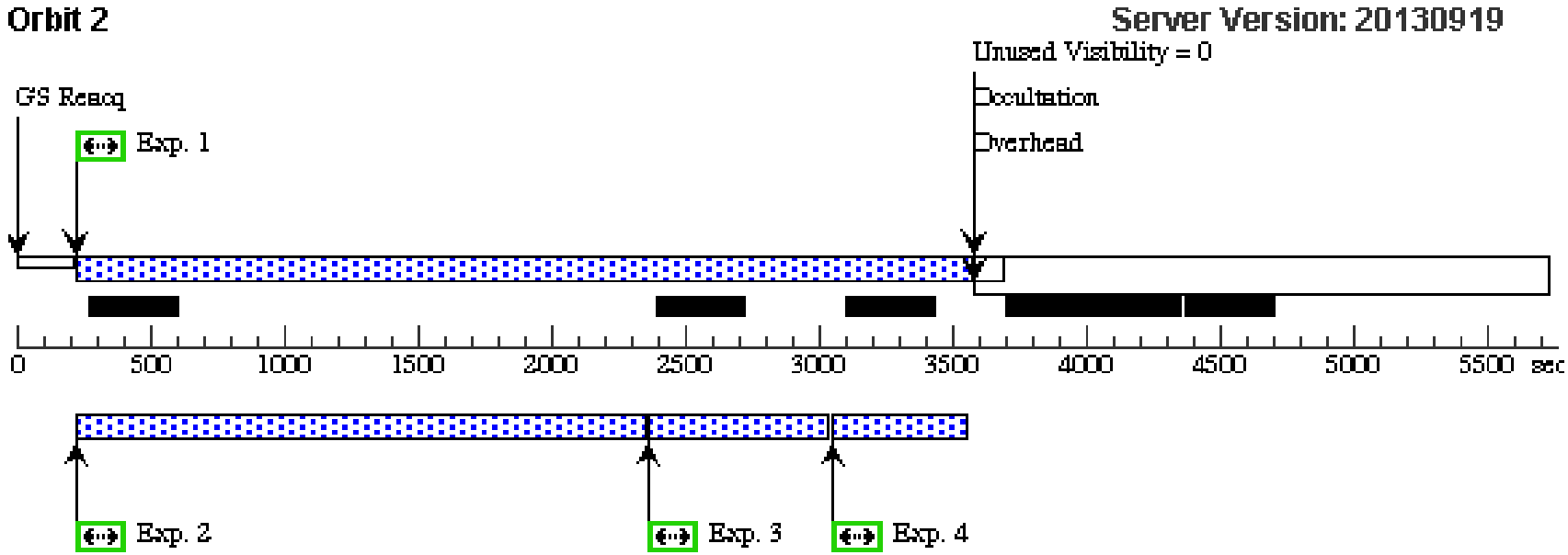
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	MESSIER-082	RA: 09 55 52.9030 (148.9704292d) Dec: +69 40 27.98 (69.67444d) Equinox: J2000		V=8.4+/-0.1 3.2e-18 erg/s/cm^2/Ang/arcsec^2 in WFC3/UVIS F336W; 6.3e-16 erg/s/cm^2/Ang/arcsec^2 in F280N	Reference Frame: ICRS

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F280N (517378)	(1) MESSIER-082	WFC3/UVIS, ACCUM, UVIS-FIX	F280N	FLASH=8.0		Pattern 2, Exps 1-4 in F280N-2pt (04) (2) Prime + Parallel Group 1-4 in Pattern 2, Exps 1-4 in F280N-2pt (04)	3205 Secs (6553 Secs) *[==>(Pattern 1)]* *[==>3348.0 Secs (Pattern 2)]*	 ***[1]*** ***[2]***
	Comments: We prefer to take a single exposure during each orbit to minimize read noise. Although such a long exposure will be somewhat degraded by numerous cosmic rays, we will obtain 14 exposures of the same field and perform an 4-point dither pattern to mitigate this effect.								
2	F658N (517418)	ANY	ACS/WFC, ACCUM, WFC	F658N	FLASH=10.0		Pattern 2, Exps 1-4 in F280N-2pt (04) (2) Prime + Parallel Group 1-4 in Pattern 2, Exps 1-4 in F280N-2pt (04)	1500 Secs (3764 Secs) *[==>1807.0 Secs (Pattern 1)]* *[==>1957.0 Secs (Pattern 2)]*	 ***[1]*** ***[2]***
3	F555W (537468)	ANY	ACS/WFC, ACCUM, WFC	F555W			Pattern 2, Exps 1-4 in F280N-2pt (04) (2) Prime + Parallel Group 1-4 in Pattern 2, Exps 1-4 in F280N-2pt (04)	525 Secs (1050 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	 ***[1]*** ***[2]***
4	F814W (537470)	ANY	ACS/WFC, ACCUM, WFC	F814W			Pattern 2, Exps 1-4 in F280N-2pt (04) (2) Prime + Parallel Group 1-4 in Pattern 2, Exps 1-4 in F280N-2pt (04)	340 Secs (680 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	 ***[1]*** ***[2]***

Orbit Structure





Visit

Proposal 13300, F336W-3pt (05), implementation Tue Oct 08 01:30:20 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 284D TO 294 D

Comments: The orientation of this visit should match those of archival observations of the same target (obtained using a different filter; Program 11360, IB6W83030). The PA_V3 value in the image header of this archival exposure is 109.00 degrees. We add 180 deg to this value to obtain our preferred ORIENT = 289 deg. We request that our observations be taken within +/- 5 deg of this angle using the orient range inputs below.

Patterns

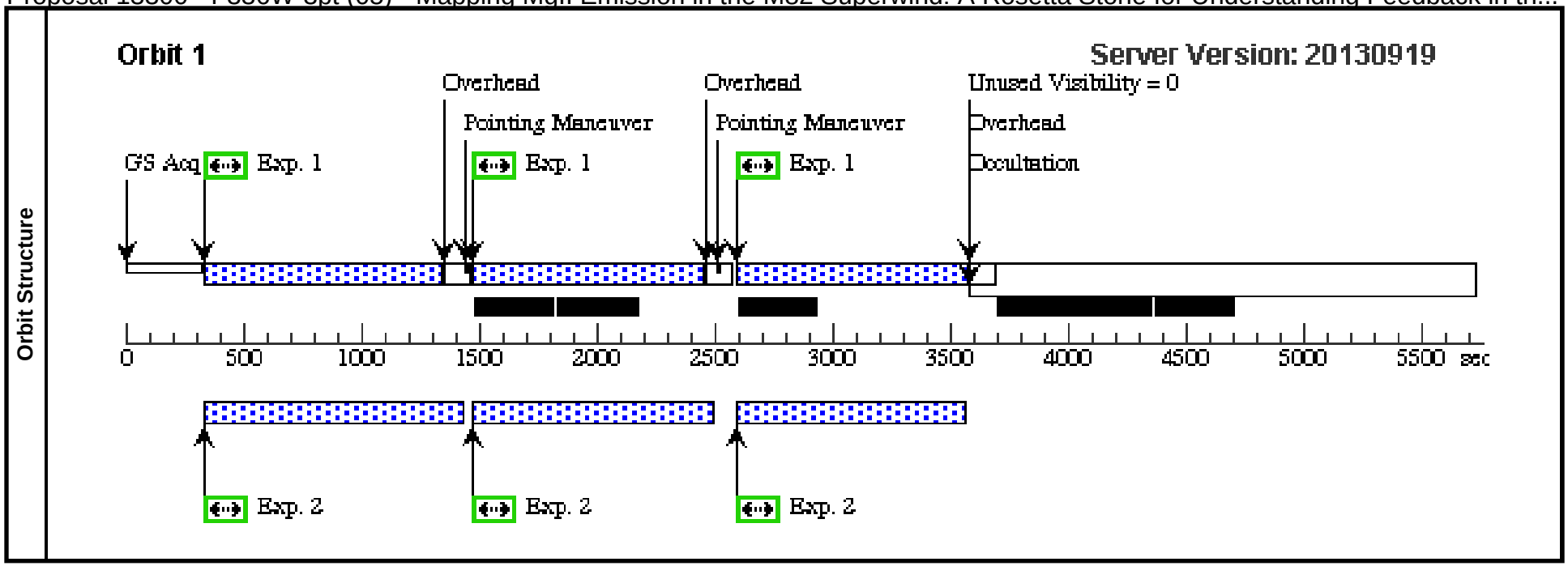
#	Primary Pattern		Secondary Pattern	Exposures
(4)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=2.400 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.754 Angle Between Sides= Center Pattern=true		(1-2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	MESSIER-082	RA: 09 55 52.9030 (148.9704292d) Dec: +69 40 27.98 (69.67444d) Equinox: J2000		V=8.4+/-0.1 3.2e-18 erg/s/cm^2/Ang/arcsec^2 in WFC3/UVIS F336W; 6.3e-16 erg/s/cm^2/Ang/arcsec^2 in F280N	Reference Frame: ICRS

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F336W (517533)	(1) MESSIER-082	WFC3/UVIS, ACCUM, UVIS-FIX	F336W	FLASH=10.0		Pattern 4, Exps 1-2 in F336W-3pt (05) (4) Prime + Parallel Group 1-2 in Pattern 4, Exps 1-2 in F336W-3pt (05)	600 Secs (2937 Secs) *[==>979.0 Secs (Pattern 1)]* *[==>979.0 Secs (Pattern 2)]* *[==>979.0 Secs (Pattern 3)]*	***[1]***
2	F658N (517539)	ANY	ACS/WFC, ACCUM, WFC	F658N	FLASH=12.0		Pattern 4, Exps 1-2 in F336W-3pt (05) (4) Prime + Parallel Group 1-2 in Pattern 4, Exps 1-2 in F336W-3pt (05)	200 Secs (2620 Secs) *[==>890.0 Secs (Pattern 1)]* *[==>890.0 Secs (Pattern 2)]* *[==>840.0 Secs (Pattern 3)]*	***[1]***


Orbit Structure
Orbit 1
Server Version: 20130919
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Unused Visibility = 0
Overhead
Occultation
GS Acq
Exp. 1
Exp. 1
Exp. 1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec
Exp. 2
Exp. 2
Exp. 2