17542 - Emission-Line Imaging of the M 82 Wind: Moving from Phenomenology to Physics

Cycle: 31, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Timothy M. Heckman (PI) (Contact)	**The Johns Hopkins University**
Dr. Lee Armus (CoI)	California Institute of Technology
Prof. Lisa Kewley (CoI)	Harvard University
Dr. Ralph S. Sutherland (CoI)	Australian National University
Dr. Jeffrey Austin Sterling Rich Jr. (CoI)	Carnegie Institution of Washington
Dr. Patrick L. Shopbell (CoI)	California Institute of Technology
Prof. Brant Robertson (CoI)	University of California - Santa Cruz
Dr. Evan Schneider (CoI)	University of Pittsburgh

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) M82	WFC3/UVIS	5	11-Jul-2024 13:00:18.0	yes
02	(1) M82	WFC3/UVIS	5	11-Jul-2024 13:00:19.0	yes
03	(1) M82	WFC3/UVIS	5	11-Jul-2024 13:00:19.0	yes
04	(1) M82	WFC3/UVIS	5	11-Jul-2024 13:00:20.0	yes
05	(1) M82	WFC3/UVIS	5	11-Jul-2024 13:00:21.0	yes
06	(1) M82	WFC3/UVIS	1	11-Jul-2024 13:00:21.0	yes

26 Total Orbits Used

ABSTRACT

Galactic winds play an essential role in the evolution of galaxies and the IGM. Despite an abundance of data and improving simulations, deep mysteries remain. The most widely-used probes of winds are UV and optical data that measure outflows of warm ionizied gas. However, we still do not understand how this gas is created, heated, and accelerated. Such understanding is required to use these probes to elucidate the underlying physics of galactic winds. More specifically, the emission from this gas may dominate the radiative cooling of the wind, draining away kinetic energy, and hence determining the wind's dynamical evolution and large-scale impact.

This is a proposal to obtain a set of narrow-band images tracing four different emission-lines in the warm-ionized gas in the proto-typical wind driven by M 82. With these data, we can map out key diagnostic line ratios on scales as small as a pc, where complex structures dominate the exisiting HST image of the emission. This will make it possible to fully disentangle the relative contibutions of collisional ionization (which drains energy from the wind) vs. photoionization by the light leaking out from the starburst. The data will also allow us to test competing models for the origin and acceleration of warm ionized gas in M82 and galactic winds in general.

We will compare these data to new JWST images of the M 82 wind, to state-off-the art high-resolution numerical simulations, and to exisiting IFU optical spectra. By addressing the key questions on the origin, heating, and acceleration of the warm ionized gas, we will move our understanding of galactic winds along the path from phenomenology to physics.

OBSERVING DESCRIPTION

Our science goal is to use narrow-band images of the southern portion of the M 82 outflow to daignose the physical processes responsible for creating and acceleraing the emission-line clouds. We will take narrow-band images of [OIII]5007, H-alpha, and [SII]6717,6731. The new H-alpha image will be used on its own, and will also be used in conjunction with the existing ACS H-alpha+[NII]6548,6584 image to create a pure [NII] image. We will also take a broad-band F606W image to subtract stellar continuum emission from the narrow-band images.

Based on ETC, we will need to post-flash by different amounts for each narrow band image to achieve a minimum of 20 counts per pixel (to insure good CTE). We choose not to dither so that the individual exposure times for the narrow-band images fill the orbit. This is to minimize the effects of the post-flash on the S/N ratio. Based on the relative fluxes of the emission-lines, we plan to spend 5 orbits imaging H-alpha, 10 on [SII], 10 on

[OIII], and one (CR-SPLIT) with F606W. There will then be enough images for each filer to do cosmic ray rejection.

Visit

Proposal 17542, H-alpha (01), implementation Thu Jul 11 17:00:22 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 11D TO 21 D; ORIENT 105D TO 115 D; ORIENT 285D TO 295 D

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82	RA: 09 55 59.7000 (148.9987500d) Dec: +69 39 3.00 (69.65083d) Equinox: J2000		V=8.4+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[EMISSION LINE NEBULA, STARBURST]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M82	WFC3/UVIS, ACCUM, UVIS	F656N	FLASH=12	POS TARG 0.089,1.203		2700 Secs (2763 Secs) *[==>2763.0 Secs]*	***[1]***
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2		(1) M82	WFC3/UVIS, ACCUM, UVIS	F656N	FLASH=12	POS TARG 0.089,1.203		2700 Secs (2763 Secs) *[==>2763.0 Secs]*	***[2]***
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Comments: postflash check run # WFC3UVIS.im.1926594									
4		(1) M82	WFC3/UVIS, ACCUM, UVIS	F656N	FLASH=12	POS TARG -0.089,-1.203		2700 Secs (2763 Secs) *[==>2763.0 Secs]*	***[4]***
Comments: postflash check run # WFC3UVIS.im.1926593									
5		(1) M82	WFC3/UVIS, ACCUM, UVIS	F656N	FLASH=12	POS TARG -0.089,-1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[5]***
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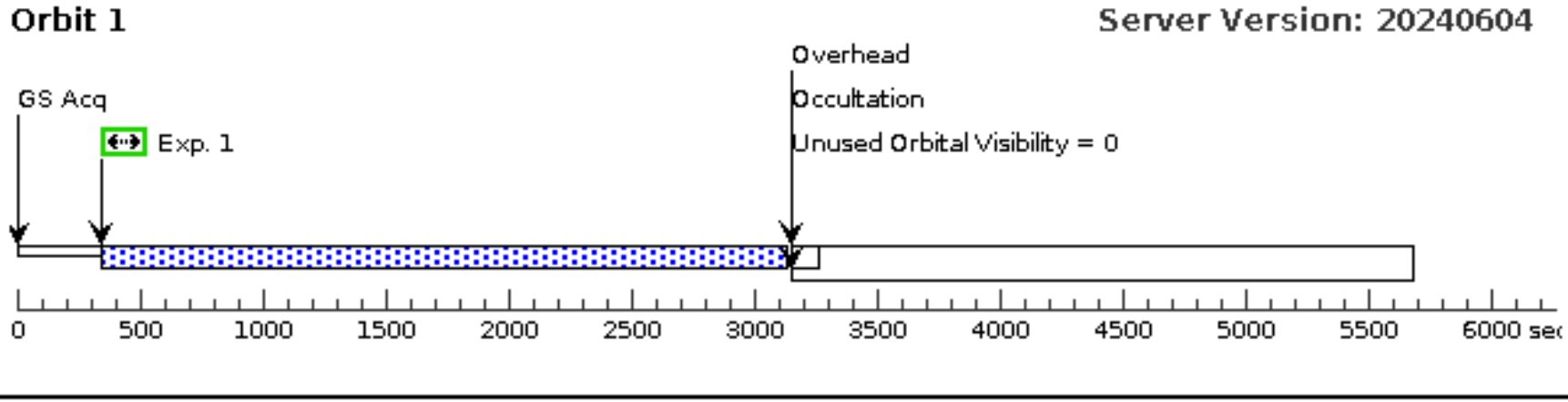
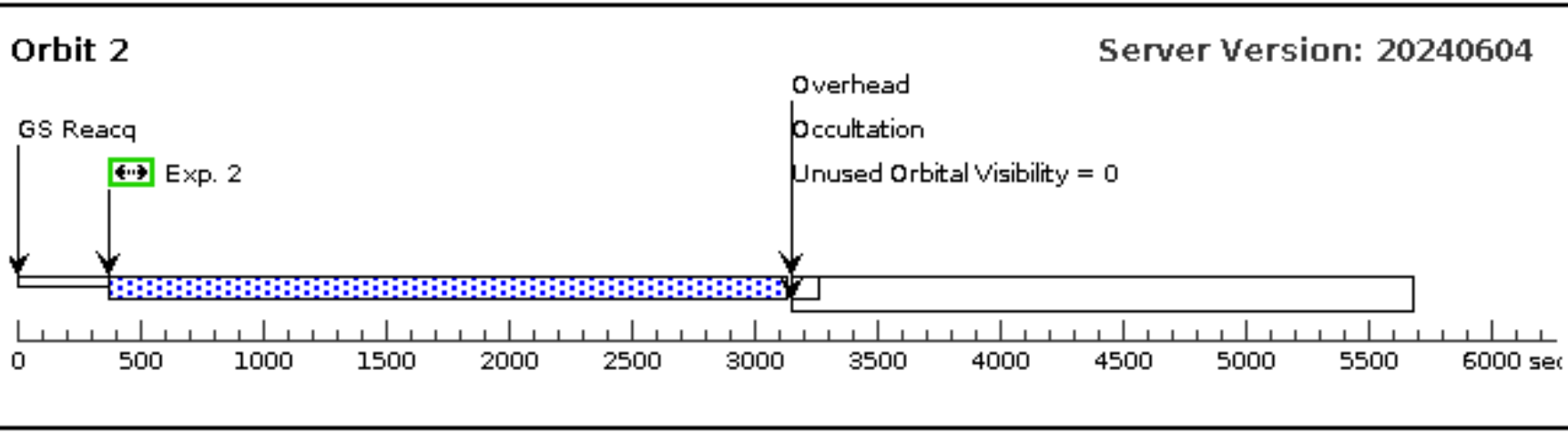
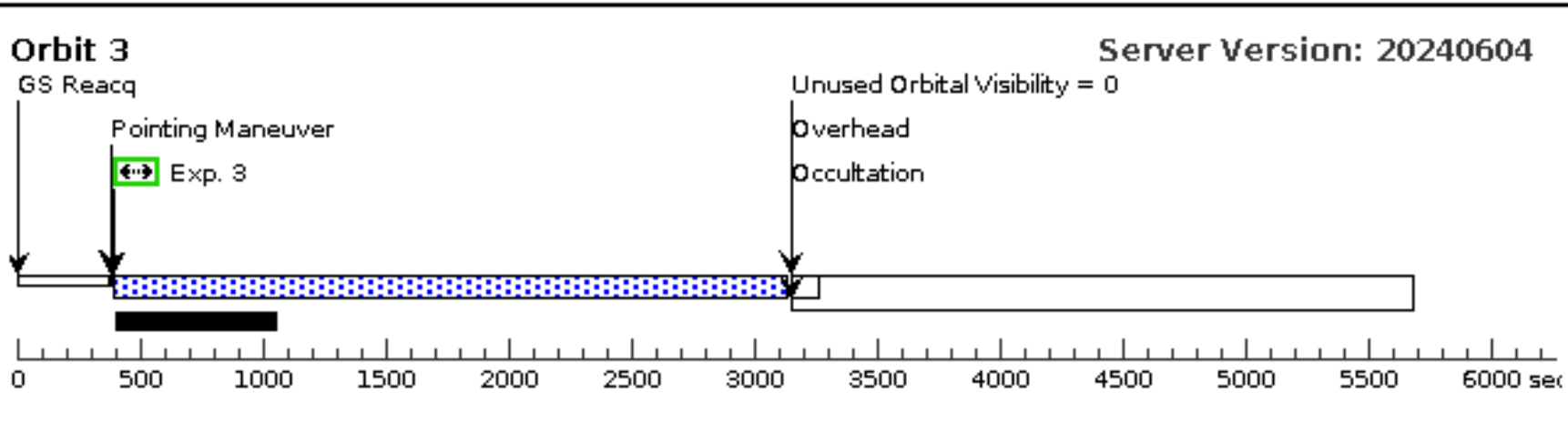
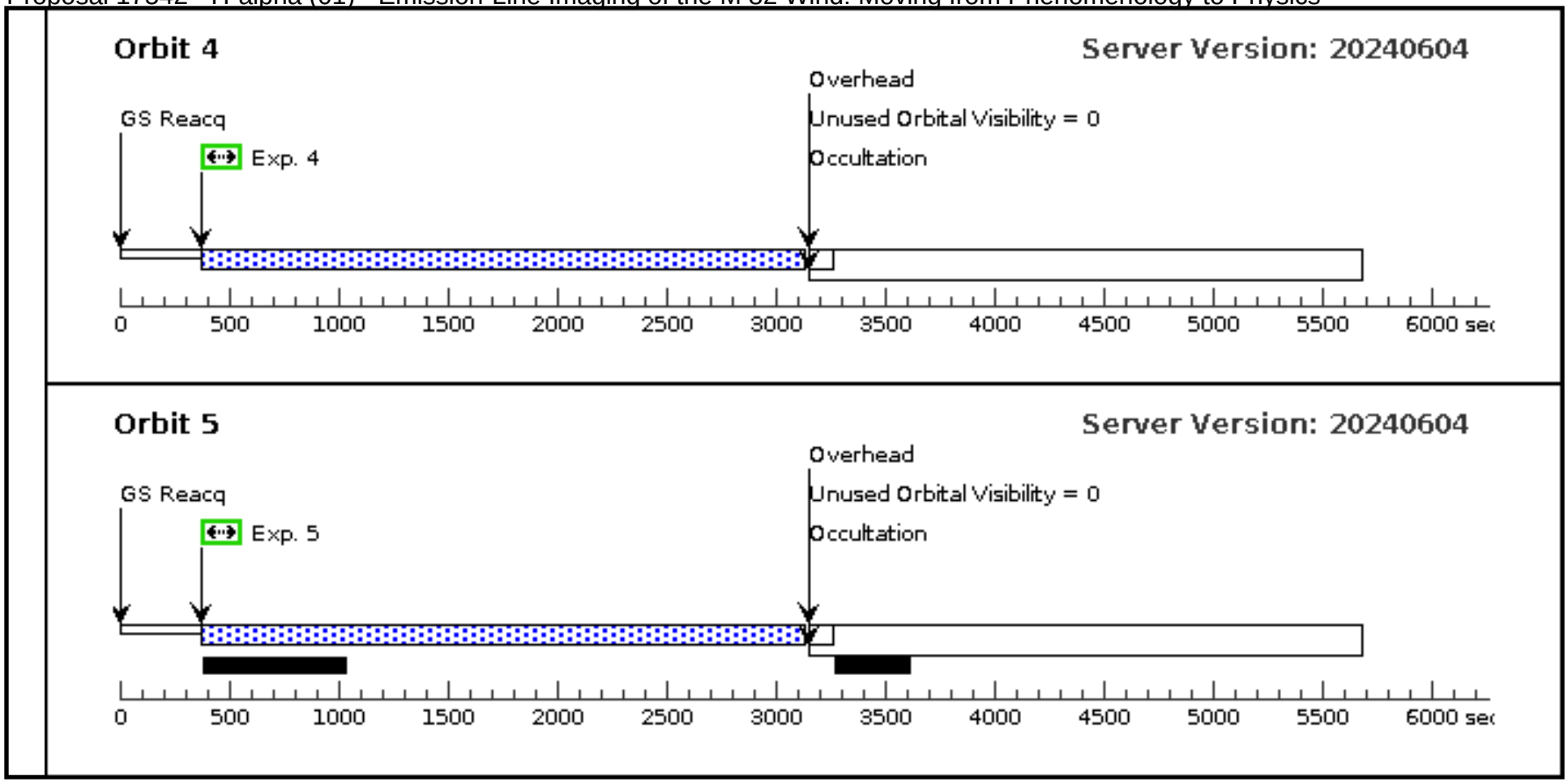
Orbit Structure





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Visit

Proposal 17542, [SII] (02), implementation Thu Jul 11 17:00:22 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 01

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82	RA: 09 55 59.7000 (148.9987500d) Dec: +69 39 3.00 (69.65083d) Equinox: J2000		V=8.4+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[EMISSION LINE NEBULA, STARBURST]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG 0.089,1.203		3200 Secs (2763 Secs) *[==>2763.0 Secs]*	***[1]***
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2		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG 0.089,1.203		3200 Secs (2763 Secs) *[==>2763.0 Secs]*	***[2]***
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3		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG -0.089,-1.203		3200 Secs (2740 Secs) *[==>2740.0 Secs]*	***[3]***
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4		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG -0.089,-1.203		3200 Secs (2763 Secs) *[==>2763.0 Secs]*	***[4]***
Comments: postflash check run # WFC3UVIS.im.1926596									
5		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG -0.089,-1.203		3200 Secs (2763 Secs) *[==>2763.0 Secs]*	***[5]***
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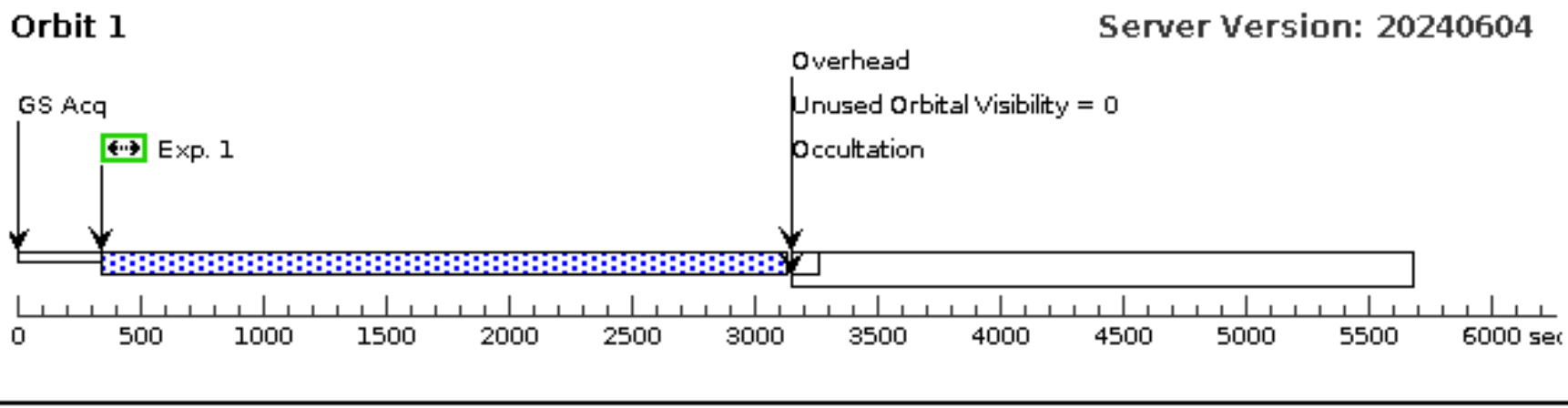
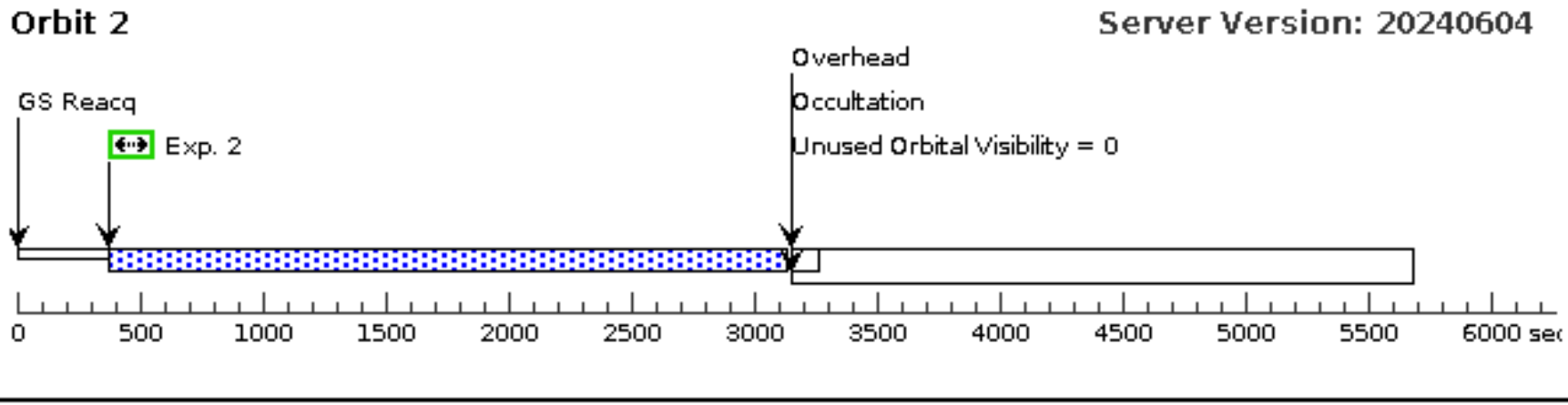
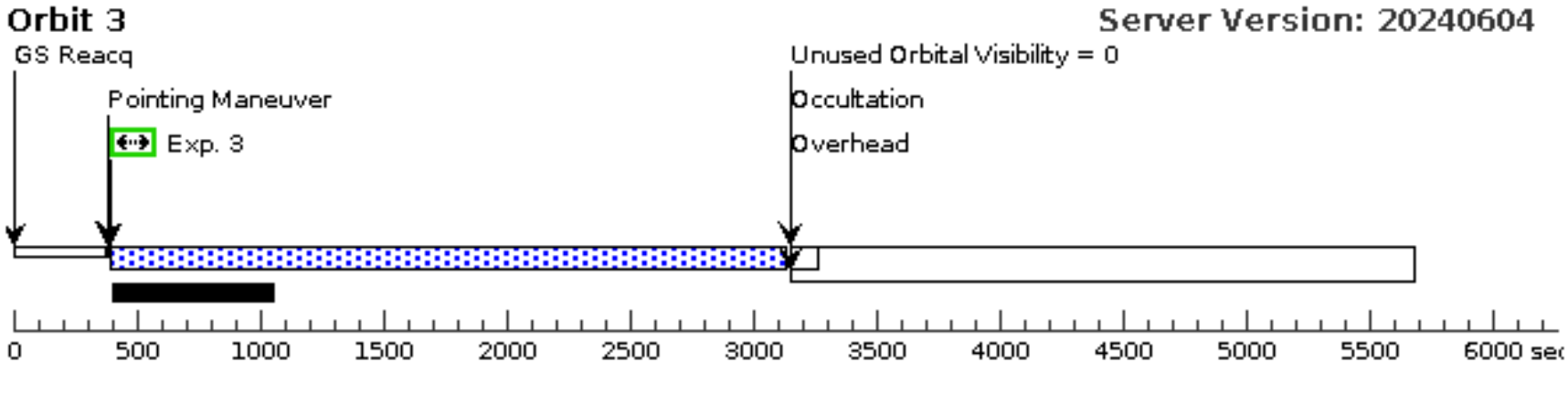
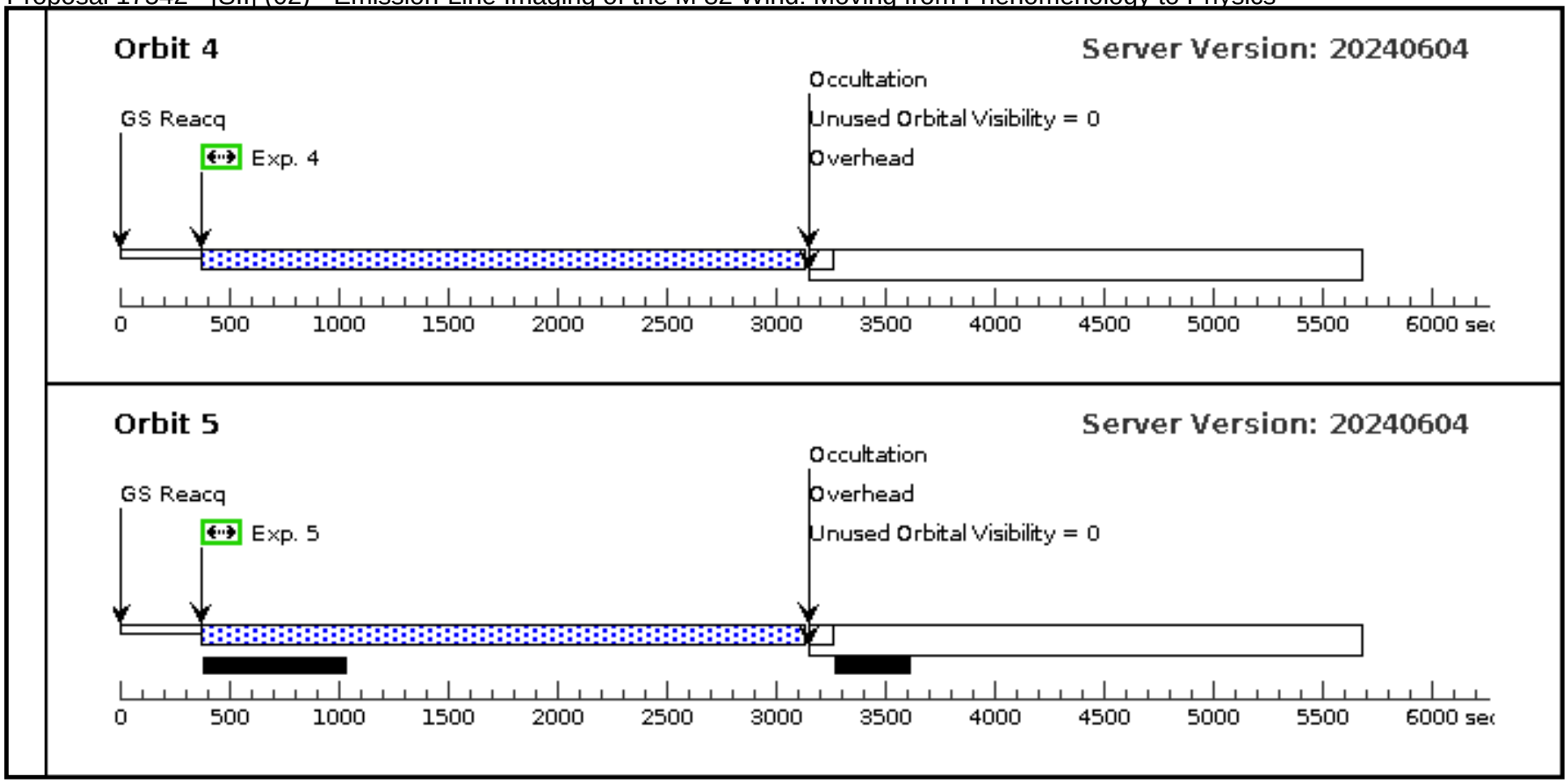
Orbit Structure





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Visit

Proposal 17542, [SII]-2 (03), implementation Thu Jul 11 17:00:22 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 01

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82	RA: 09 55 59.7000 (148.9987500d) Dec: +69 39 3.00 (69.65083d) Equinox: J2000		V=8.4+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[EMISSION LINE NEBULA, STARBURST]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG 0.089,1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[1]***
Comments: postflash check run # WFC3UVIS.im.1926596									
2		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG 0.089,1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[2]***
Comments: postflash check run # WFC3UVIS.im.1926596									
3		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG -0.089,-1.203		3100 Secs (2740 Secs) *[==>2740.0 Secs]*	***[3]***
Comments: postflash check run # WFC3UVIS.im.1926595									
4		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG -0.089,-1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[4]***
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5		(1) M82	WFC3/UVIS, ACCUM, UVIS	F673N	FLASH=7	POS TARG -0.089,-1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[5]***
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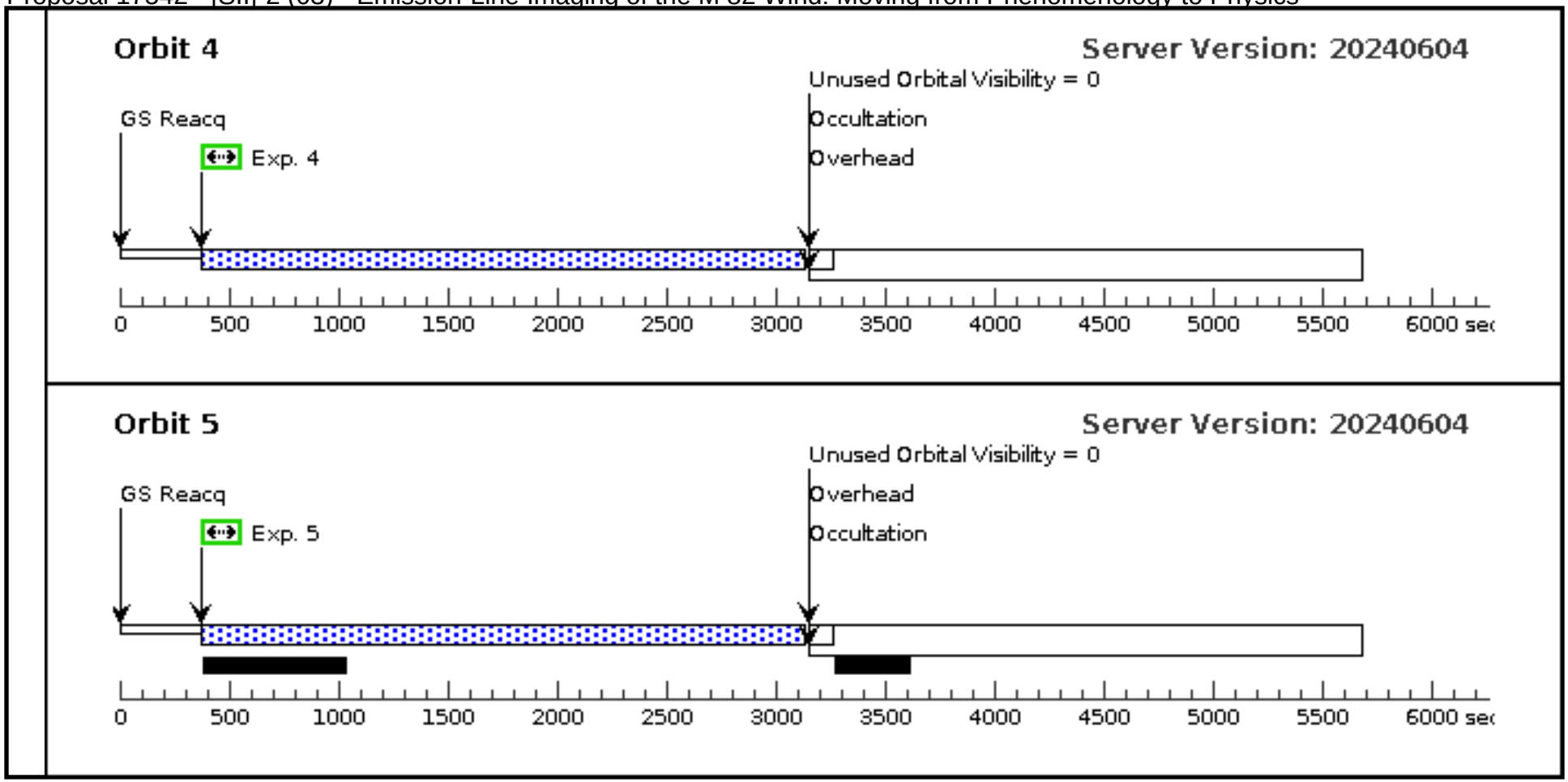
Orbit Structure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Visit

Proposal 17542, [OIII] (04), implementation Thu Jul 11 17:00:22 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 01

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82	RA: 09 55 59.7000 (148.9987500d) Dec: +69 39 3.00 (69.65083d) Equinox: J2000		V=8.4+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[EMISSION LINE NEBULA, STARBURST]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG 0.089,1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[1]***
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2		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG 0.089,1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[2]***
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3		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG -0.089,-1.203		3100 Secs (2740 Secs) *[==>2740.0 Secs]*	***[3]***
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4		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG -0.089,-1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[4]***
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5		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG -0.089,-1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	***[5]***
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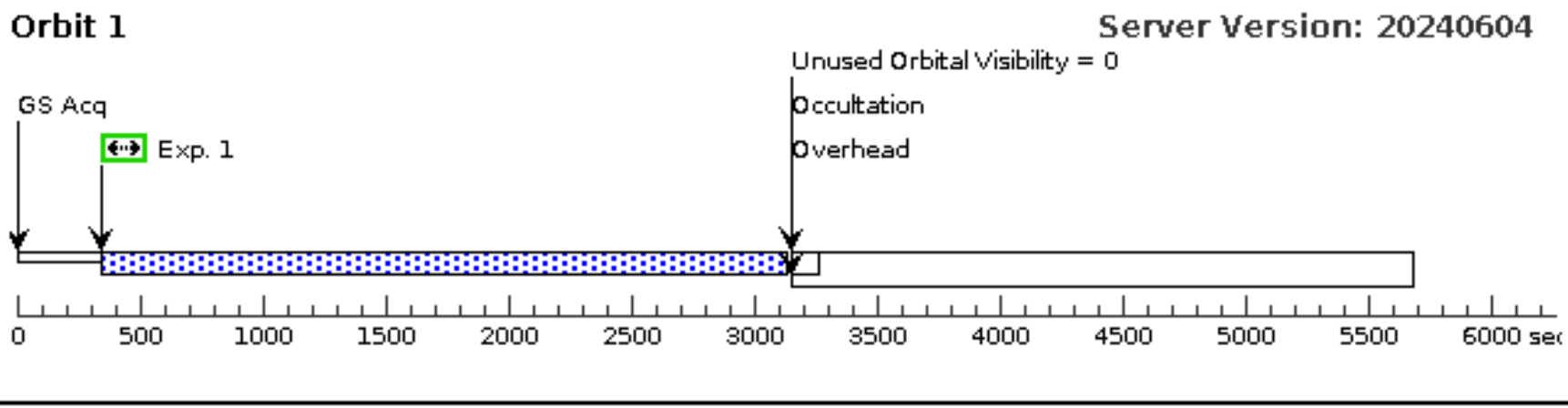
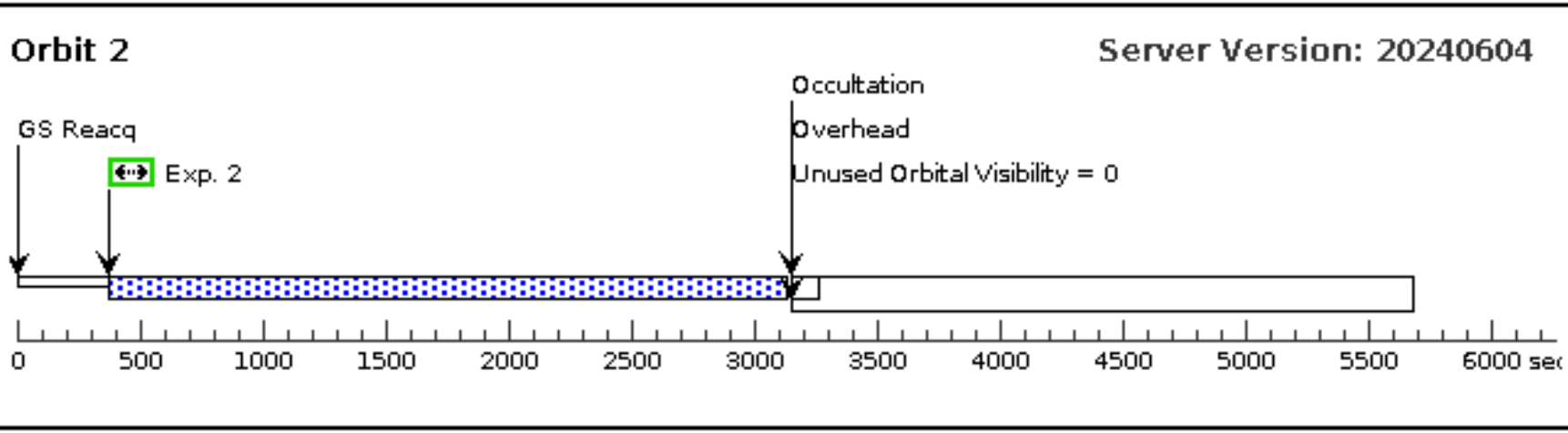
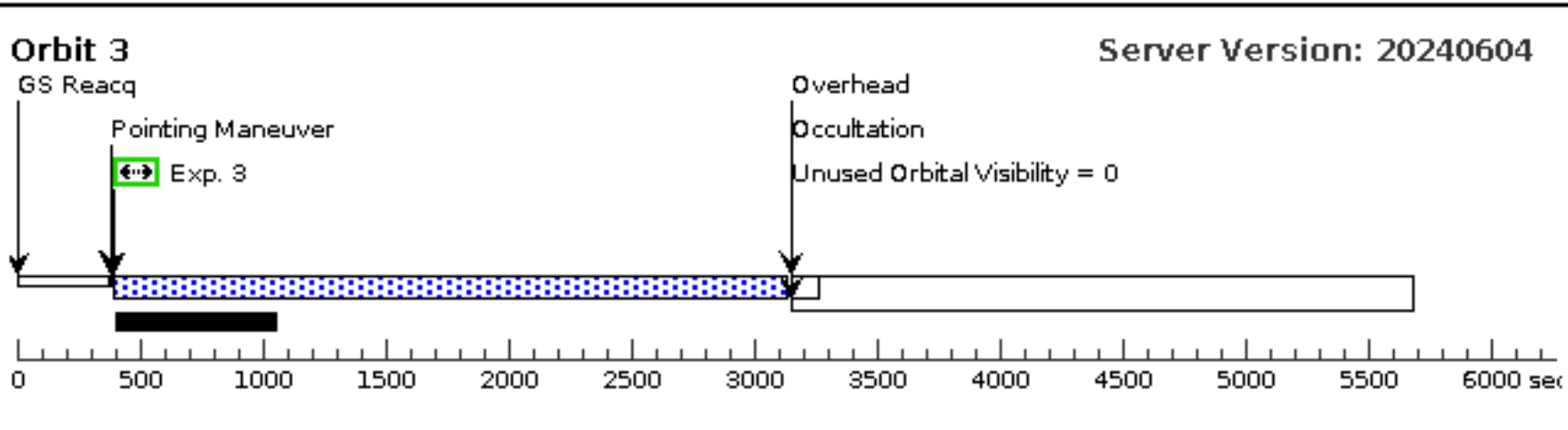
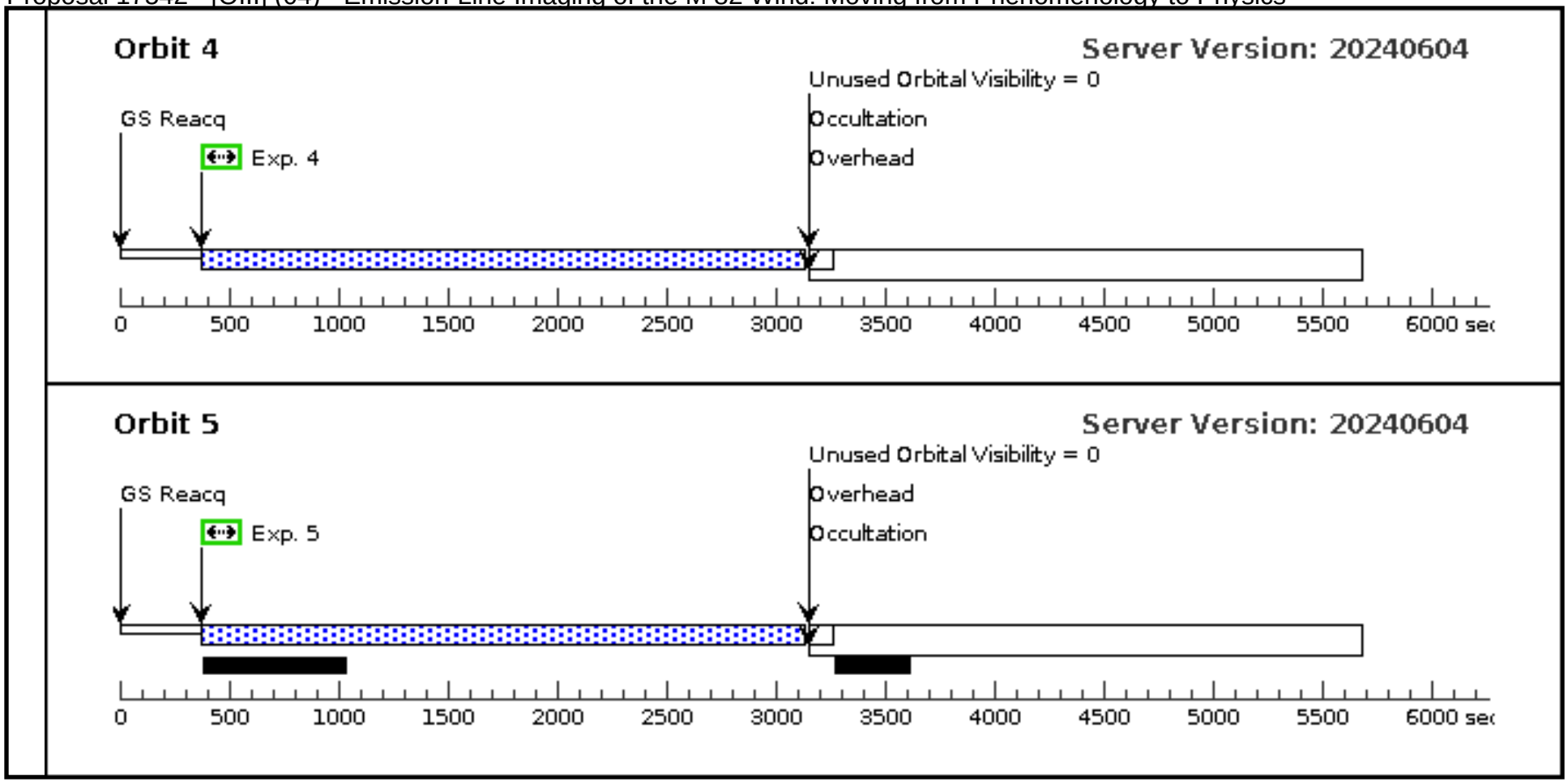
Orbit Structure





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Visit

Proposal 17542, [OIII]-2 (05), implementation Thu Jul 11 17:00:22 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 01

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82	RA: 09 55 59.7000 (148.9987500d) Dec: +69 39 3.00 (69.65083d) Equinox: J2000		V=8.4+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[EMISSION LINE NEBULA, STARBURST]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG 0.089,1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	 ***[1]***
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2		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG 0.089,1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	 ***[2]***
Comments: postflash check run # WFC3UVIS.im.1926597									
3		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG -0.089,-1.203		3100 Secs (2740 Secs) *[==>2740.0 Secs]*	 ***[3]***
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4		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG -0.089,-1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	 ***[4]***
Comments: postflash check run # WFC3UVIS.im.1926597									
5		(1) M82	WFC3/UVIS, ACCUM, UVIS	F502N	FLASH=10	POS TARG -0.089,-1.203		3100 Secs (2763 Secs) *[==>2763.0 Secs]*	 ***[5]***
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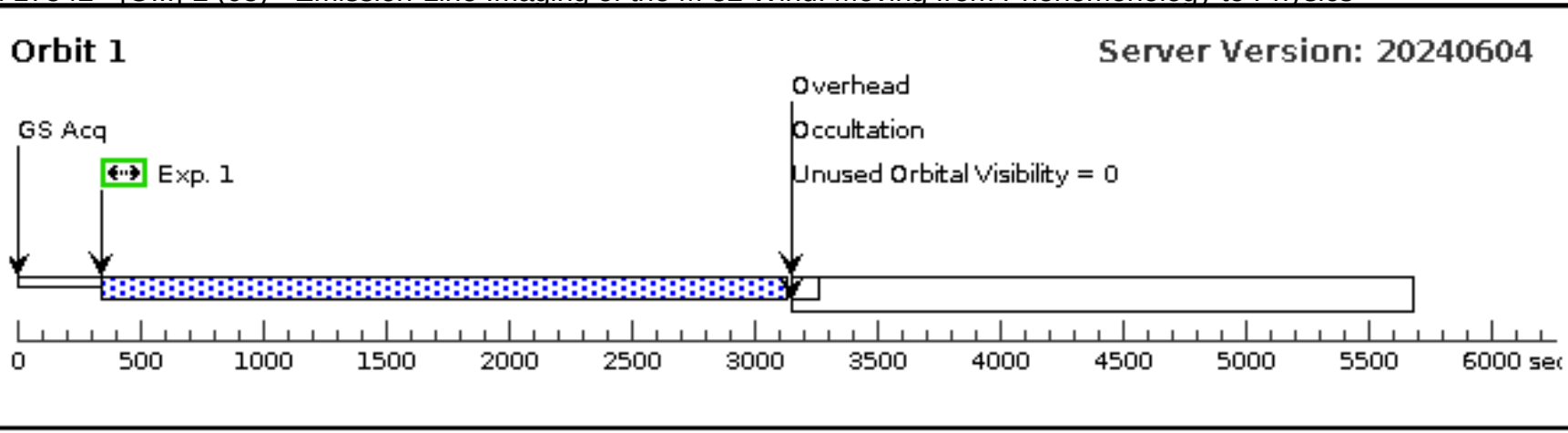
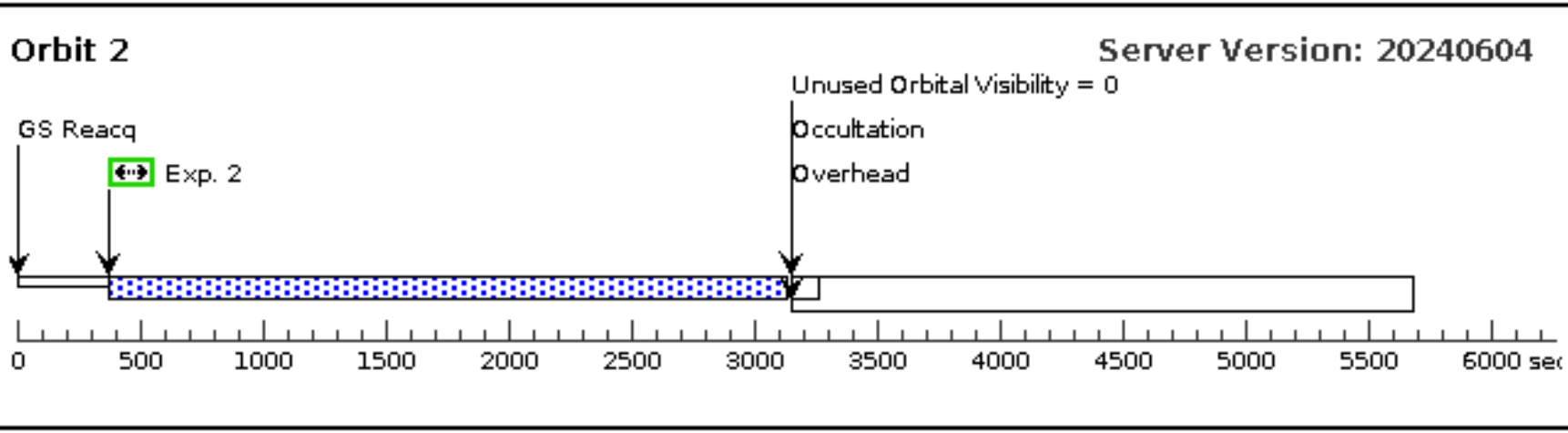
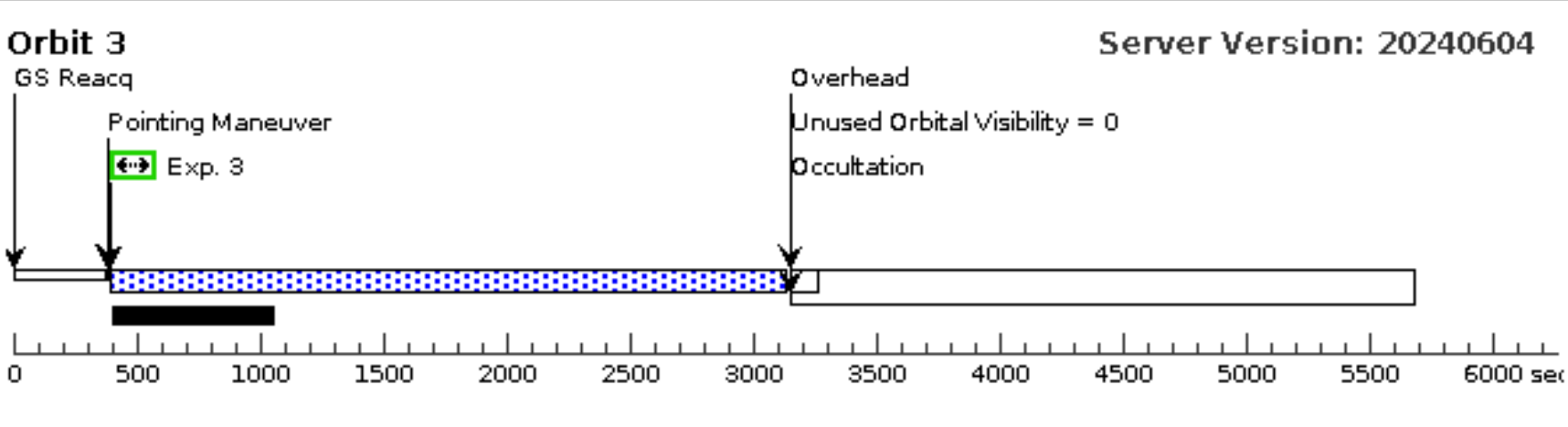
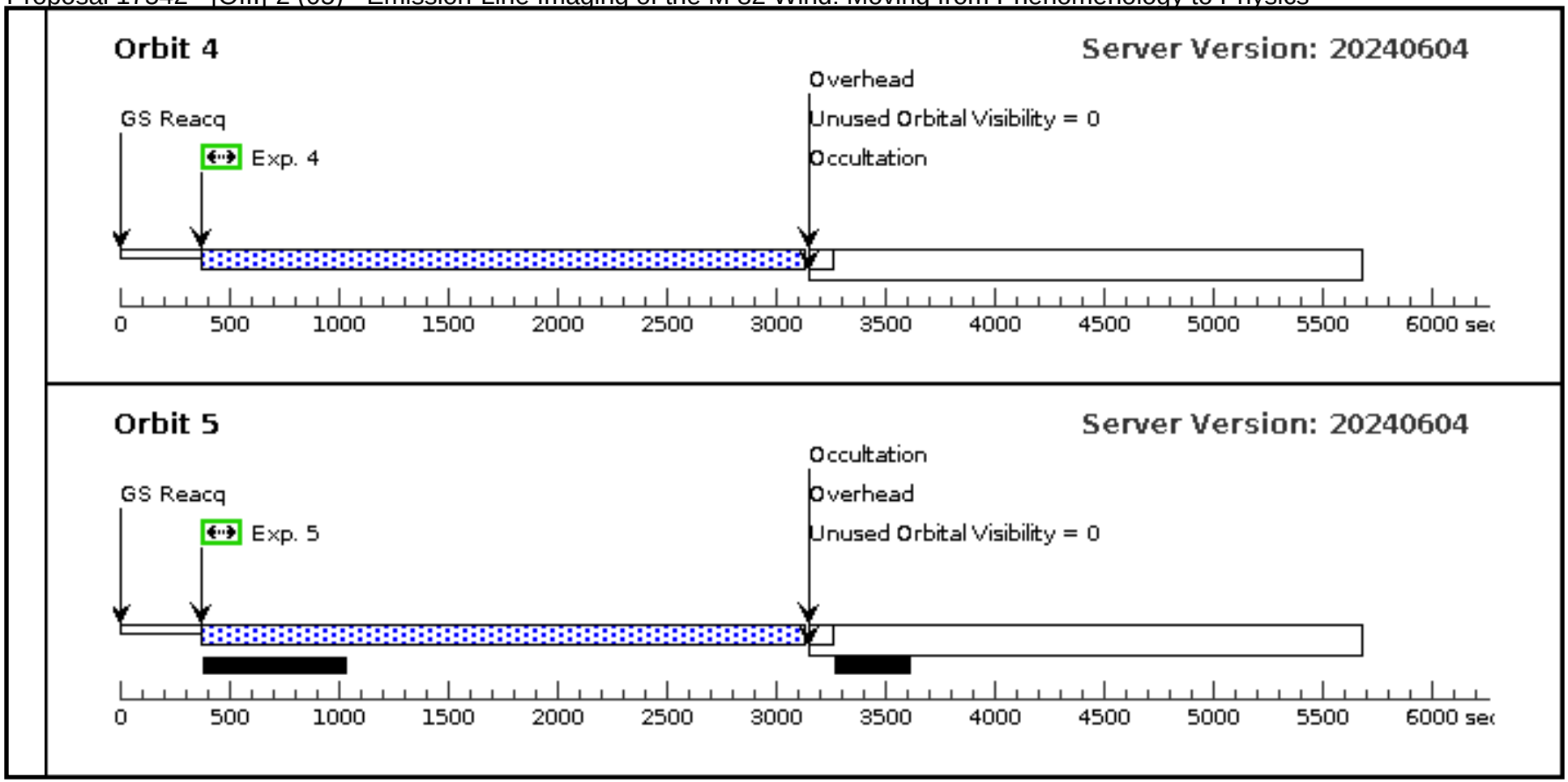
Orbit Structure





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Orbit 5
Server Version: 20240604
Occultation
Overhead
Unused Orbital Visibility = 0
GS Reacq
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Visit

Proposal 17542, W606W (06), implementation Thu Jul 11 17:00:22 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SAME ORIENT AS 01

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	M82	RA: 09 55 59.7000 (148.9987500d) Dec: +69 39 3.00 (69.65083d) Equinox: J2000		V=8.4+/-0.1	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[EMISSION LINE NEBULA, STARBURST]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) M82	WFC3/UVIS, ACCUM, UVIS	F606W		POS TARG -0.089,-1.203		594 Secs (594 Secs) *[==>]*	*[1]*
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Comments: postflash check run # WFC3UVIS.im.1926601									
3		(1) M82	WFC3/UVIS, ACCUM, UVIS	F606W		POS TARG 0.089,1.203		594 Secs (594 Secs) *[==>]*	*[1]*
Comments: postflash check run # WFC3UVIS.im.1926599									
4		(1) M82	WFC3/UVIS, ACCUM, UVIS	F606W		POS TARG 0.089,1.203		596 Secs (596 Secs) *[==>]*	*[1]*
Comments: postflash check run # WFC3UVIS.im.1926600									

Orbit Structure