15701 - The most massive protoclusters at z=4.3-5.8 selected by the South Pole Telescope

Cycle: 26, Proposal Category: GO

(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) SPT2349-56	WFC3/IR	2	08-Jul-2019 14:00:20.0	yes
02	(2) SPT0348-62	WFC3/IR	2	08-Jul-2019 14:00:22.0	yes
Z2	(2) SPT0348-62	WFC3/IR	2	08-Jul-2019 14:00:24.0	yes
Z4	(2) SPT0348-62	WFC3/IR	3	08-Jul-2019 14:00:26.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
03	(1) SPT2349-56	WFC3/IR	3	08-Jul-2019 14:00:29.0	yes
04	(2) SPT0348-62	WFC3/IR	3	08-Jul-2019 14:00:32.0	yes

15 Total Orbits Used

ABSTRACT

We request deep near-infrared imaging of two SPT-selected protoclusters, SPT2349-56 (z=4.3) and SPT0348-62 (z=5.8). They possess some of the largest halo masses ever observed directly at z>4. Selected via millimeter-wavelength dust emission in the 2500 square degree South Pole Telescope (SPT) survey, they have as many as 31 gas-rich galaxies resolved by ALMA, all lying in a compact protocluster. We have obtained sensitive observations of carbon monoxide and ionized carbon with ALMA, thereby allowing us to assess the obscured star formation and gas masses of cluster members. The goal of this proposal is to obtain F160W and F110W HST imaging with a total of 3 (2) orbits per cluster to measure the stellar content, galaxy morphology, and assess the spatial extent of these structures. The proposed HST observations will provide the imaging and photometric information required for a complete picture of the obscured and unobscured stellar components of these galaxies, revealing the complicated structure in the gas-rich galaxies that host rapid star formation. The combination of our unique high resolution ALMA datasets with the proposed HST observations will allow a full characterization of the stars, gas, and dust in these cosmologically important protoclusters of primordial starburst galaxies, which mark the epoch of stellar mass assembly in the Universe. From an outreach perspective, the high spatial resolution of the HST identifications of protocluster galaxies will complement the ALMA data in publicizing these high impact results.

OBSERVING DESCRIPTION

We will image each of our targets (SPT2349-56 and SPT0348-62) with the F160W and F110W filters. The HST field of view is well suited to completely sample the 1.5 arcmin diameter regions of the proto-cluster cores, so mosaicing will not be required. Our target depths are informed by our Gemini K-band and Spitzer-IRAC imaging, as well as a handful similar sources analogues with HST imaging. The typical half-light radii for SMGs from previous studies is about 2.8kpc, corresponding to 0.4 arcsec at z = 5. This suggests typical expected average surface brightnesses of H = 23 mag/arcsec^2 and J = 23.3 mag/arcsec^2 within the within the half-light radius, ranging to H < 24.4 mag/arcsec^2 and J < 24.7 mag/arcsec^2 for the faintest sources. To reach these surface brightness limits with a S/N=5 per 0.15 arcsec resolution element requires an exposure time of 7800 seconds in the F160W band and 5200 sec in te F110W band, which is obtainable in three and two orbits, respectively. This will be sucient to morphologically resolve all sources under a range of assumptions.

Visit

Proposal 15701, SPT2349-F110W (01), completed Mon Jul 08 18:00:33 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Comments: 5200s in F110W filter targeting SPT2349.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SPT2349-56	RA: 23 49 42.2700 (357.4261250d) Dec: -56 38 1.37 (-56.63371d) Equinox: J2000	Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Redshift: 4.3	V=30+/-1 ~23 mag/arcsec^2 in H and J bands	Reference Frame: ICRS

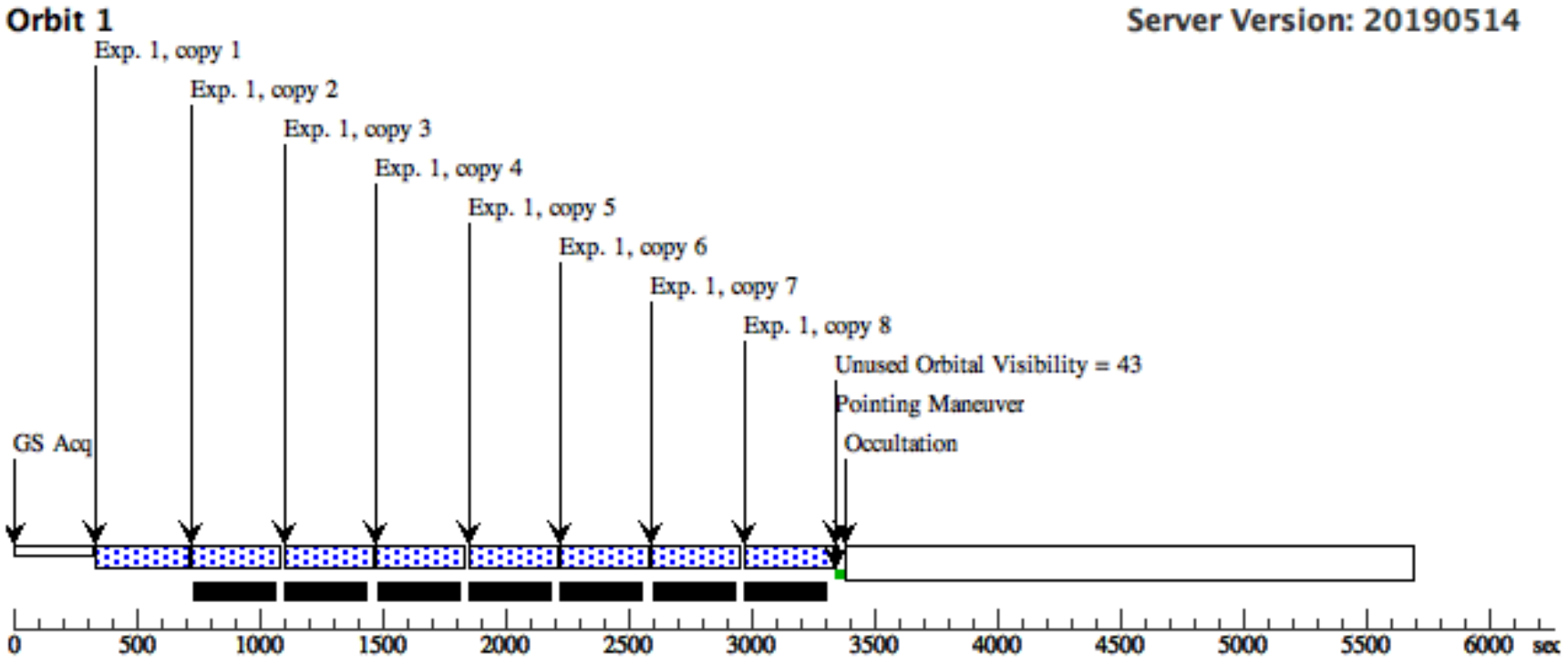
Comments: Observations will use F110W and F160W band filters, the V-magnitude quoted is an unreliable estimate.
Category=CLUSTER OF GALAXIES
Description=[NUCLEUS]
Extended=YES

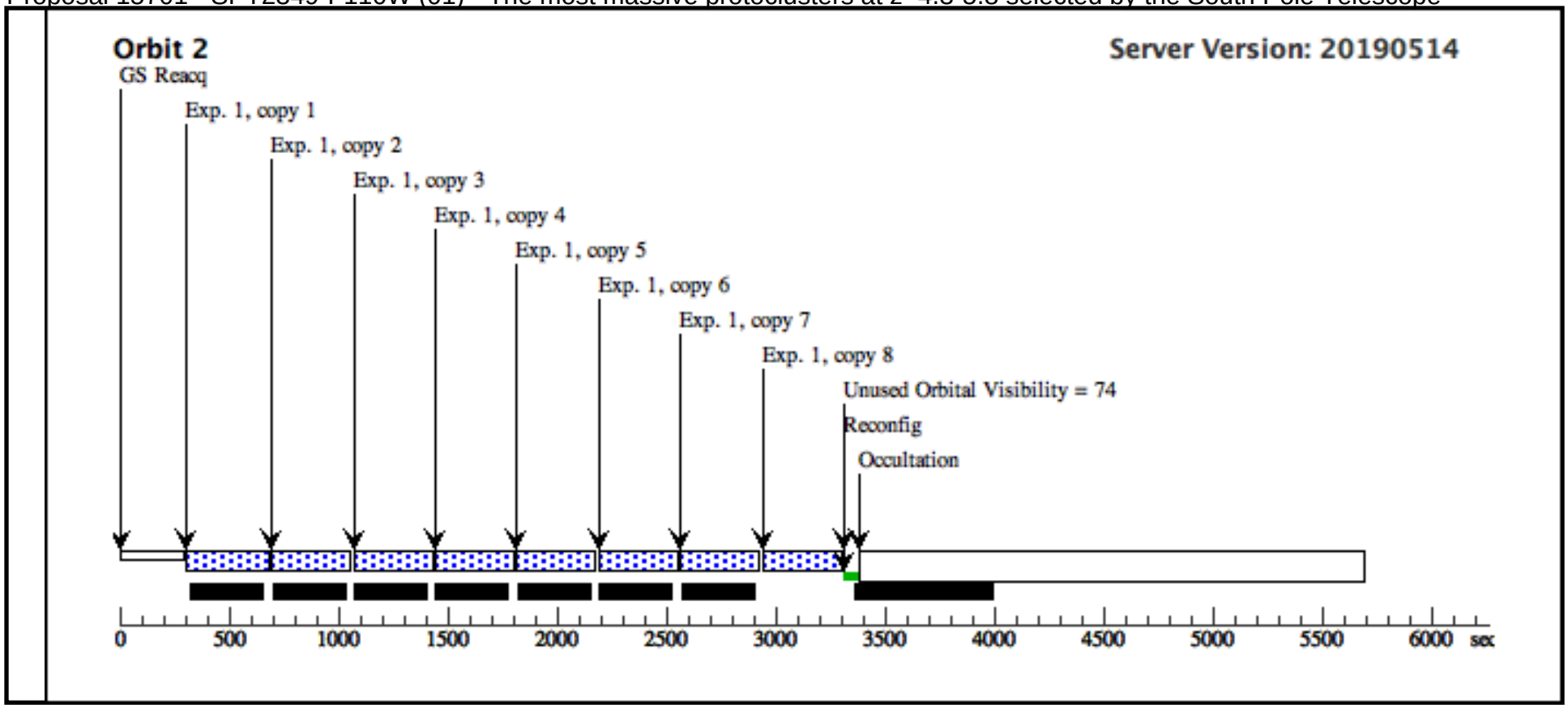
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	SPT2349-F110W	(1) SPT2349-56	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=15; SAMP-SEQ=SPARS25		Pattern 1, Exps 1-1 in SPT2349-F110W (01) (1)	352.939501 Secs X 8 (5647.032 Secs)	
								[==>(Pattern 1, Copy 1)] *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 1, Copy 5)]* *[==>(Pattern 1, Copy 6)]* *[==>(Pattern 1, Copy 7)]* *[==>(Pattern 1, Copy 8)]*	***[1]***
								[==>(Pattern 2, Copy 1)] *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 2, Copy 5)]* *[==>(Pattern 2, Copy 6)]* *[==>(Pattern 2, Copy 7)]* *[==>(Pattern 2, Copy 8)]*	***[2]***

Comments: 5200s on-source in F110W filter targeting SPT2349.

Orbit Structure

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GS Reacq
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Exp. 1, copy 5
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Exp. 1, copy 8
Unused Orbital Visibility = 74
Reconfig
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15701, SPT0348-F110W (02), failed Mon Jul 08 18:00:33 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Comments: 5200s in F110W filter targeting SPT0348.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SPT0348-62	RA: 03 48 42.6800 (57.1778333d) Dec: -62 20 39.50 (-62.34431d) Equinox: J2000	Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Redshift: 5.6	V=30+/-1 ~23 mag/arcsec^2 in H and J bands	Reference Frame: ICRS

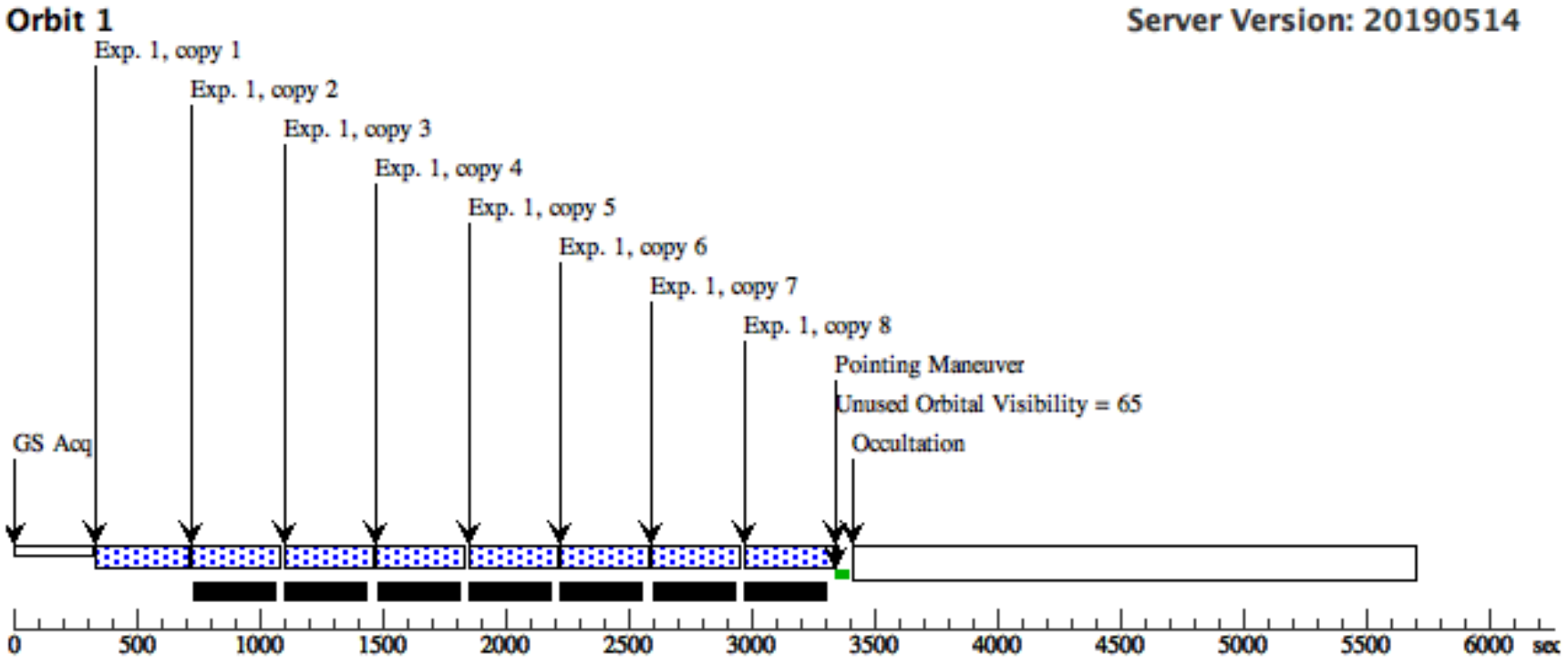
Comments: Observations will use F110W and F160W band filters, the V-magnitude quoted is an unreliable estimate.
Category=CLUSTER OF GALAXIES
Description=[NUCLEUS]
Extended=YES

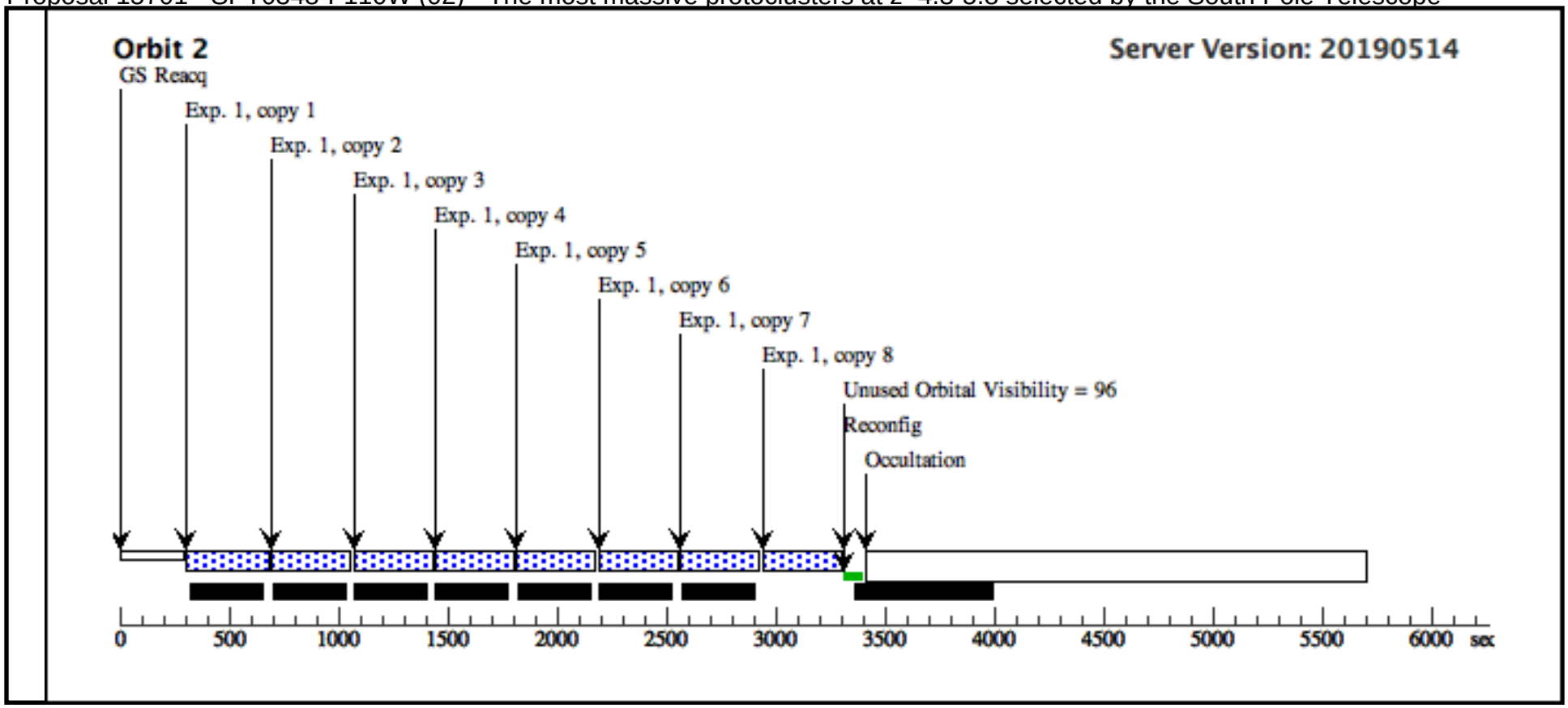
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	SPT0348-F110W	(2) SPT0348-62	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=15; SAMP-SEQ=SPARS25		Pattern 1, Exps 1-1 in SPT0348-F110W (02) (1)	352.939501 Secs X 8 (5647.032 Secs)	
								[==>(Pattern 1, Copy 1)] *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 1, Copy 5)]* *[==>(Pattern 1, Copy 6)]* *[==>(Pattern 1, Copy 7)]* *[==>(Pattern 1, Copy 8)]*	***[1]***
								[==>(Pattern 2, Copy 1)] *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 2, Copy 5)]* *[==>(Pattern 2, Copy 6)]* *[==>(Pattern 2, Copy 7)]* *[==>(Pattern 2, Copy 8)]*	***[2]***

Comments: 5200s on-source in F110W filter targeting SPT0348.

Orbit Structure

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Server Version: 20190514
GS Reacq
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Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Exp. 1, copy 5
Exp. 1, copy 6
Exp. 1, copy 7
Exp. 1, copy 8
Unused Orbital Visibility = 96
Reconfig
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15701, SPT0348-F110W HOPR (Z2) Mon Jul 08 18:00:33 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Comments: 5200s in F110W filter targeting SPT0348.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SPT0348-62	RA: 03 48 42.6800 (57.1778333d) Dec: -62 20 39.50 (-62.34431d) Equinox: J2000	Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Redshift: 5.6	V=30+/-1 ~23 mag/arcsec^2 in H and J bands	Reference Frame: ICRS

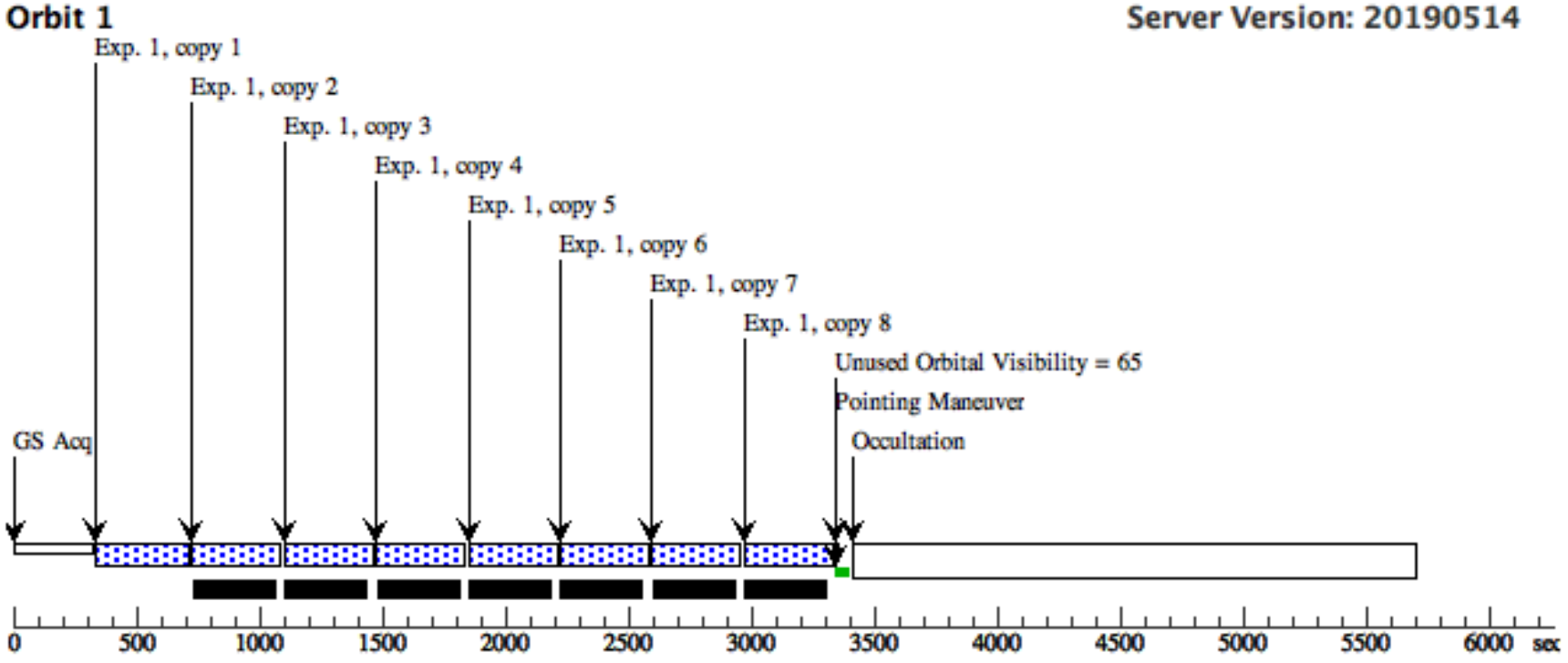
Comments: Observations will use F110W and F160W band filters, the V-magnitude quoted is an unreliable estimate.
Category=CLUSTER OF GALAXIES
Description=[NUCLEUS]
Extended=YES

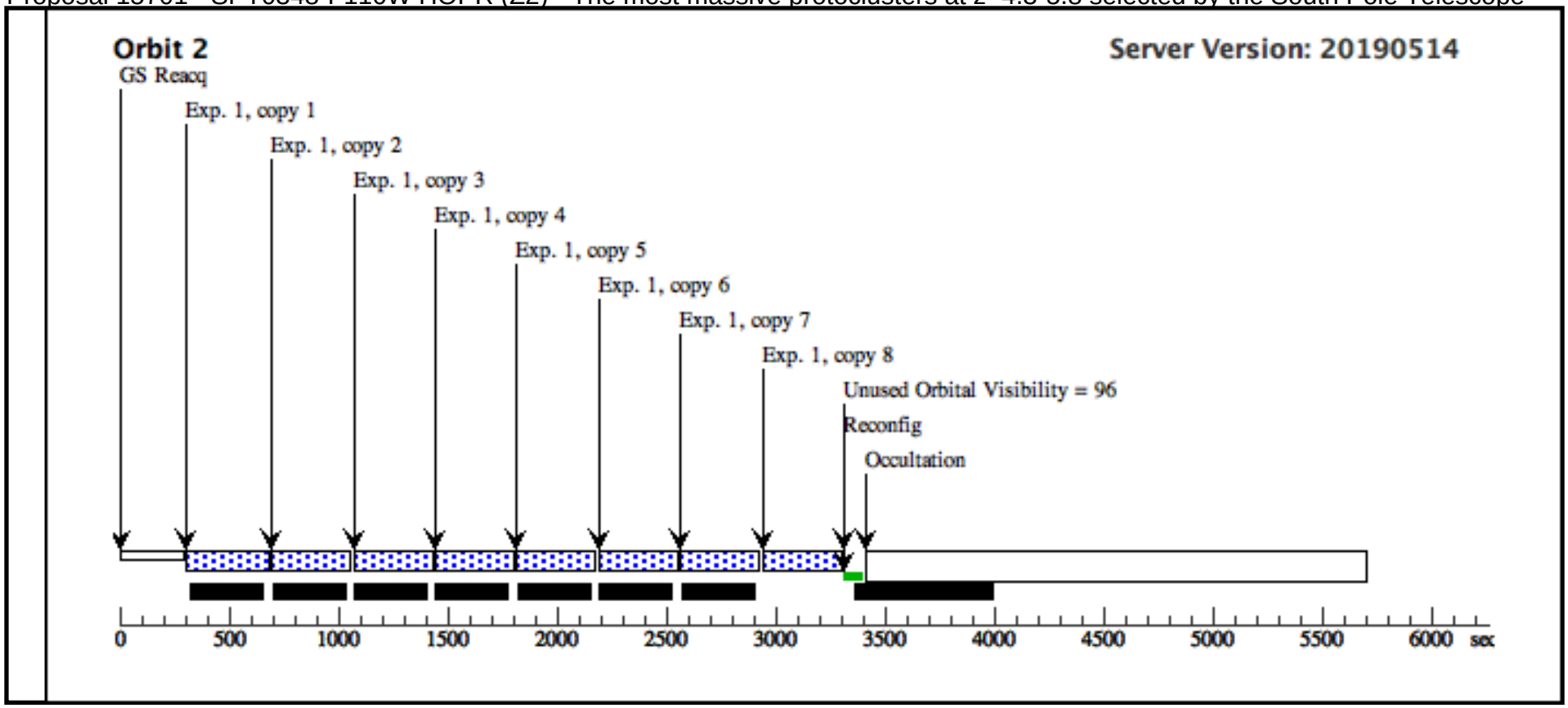
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	SPT0348-F110W	(2) SPT0348-62	WFC3/IR, MULTIACCUM, IR	F110W	NSAMP=15; SAMP-SEQ=SPARS25		Pattern 1, Exps 1-1 in SPT0348-F110W HOPR (Z2) (1)	352.939501 Secs X 8 (5647.032 Secs)	
								[==>(Pattern 1, Copy 1)] *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 1, Copy 5)]* *[==>(Pattern 1, Copy 6)]* *[==>(Pattern 1, Copy 7)]* *[==>(Pattern 1, Copy 8)]*	***[1]***
								[==>(Pattern 2, Copy 1)] *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 2, Copy 5)]* *[==>(Pattern 2, Copy 6)]* *[==>(Pattern 2, Copy 7)]* *[==>(Pattern 2, Copy 8)]*	***[2]***

Comments: 5200s on-source in F110W filter targeting SPT0348.

Orbit Structure

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Server Version: 20190514
GS Reacq
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Exp. 1, copy 4
Exp. 1, copy 5
Exp. 1, copy 6
Exp. 1, copy 7
Exp. 1, copy 8
Unused Orbital Visibility = 96
Reconfig
Occultation
0
500
1000
1500
2000
2500
3000
3500
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sec

Visit

Proposal 15701, SPT0348-F160W HOPR (Z4) Mon Jul 08 18:00:33 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Comments: 7800s in F110W filter targeting SPT0348.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SPT0348-62	RA: 03 48 42.6800 (57.1778333d) Dec: -62 20 39.50 (-62.34431d) Equinox: J2000	Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Redshift: 5.6	V=30+/-1 ~23 mag/arcsec^2 in H and J bands	Reference Frame: ICRS

Comments: Observations will use F110W and F160W band filters, the V-magnitude quoted is an unreliable estimate.
Category=CLUSTER OF GALAXIES
Description=[NUCLEUS]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	SPT0348-F160W	(2) SPT0348-62	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25		Pattern 1, Exps 1-1 in SPT0348-F160W HOPR (Z4) (1)	352.939501 Secs X 12 (8470.548 Secs)	
								[==>(Pattern 1, Copy 1)]	***[1]***
								[==>(Pattern 1, Copy 2)]	
								[==>(Pattern 1, Copy 3)]	
								[==>(Pattern 1, Copy 4)]	
								[==>(Pattern 1, Copy 5)]	
								[==>(Pattern 1, Copy 6)]	
								[==>(Pattern 1, Copy 7)]	
								[==>(Pattern 1, Copy 8)]	
								[==>(Pattern 1, Copy 9)]	***[2]***
								[==>(Pattern 1, Copy 10)]	
								[==>(Pattern 1, Copy 11)]	
								[==>(Pattern 1, Copy 12)]	
								[==>(Pattern 2, Copy 1)]	
								[==>(Pattern 2, Copy 2)]	
								[==>(Pattern 2, Copy 3)]	
								[==>(Pattern 2, Copy 4)]	
								[==>(Pattern 2, Copy 5)]	***[3]***
								[==>(Pattern 2, Copy 6)]	
								[==>(Pattern 2, Copy 7)]	
								[==>(Pattern 2, Copy 8)]	
								[==>(Pattern 2, Copy 9)]	
								[==>(Pattern 2, Copy 10)]	
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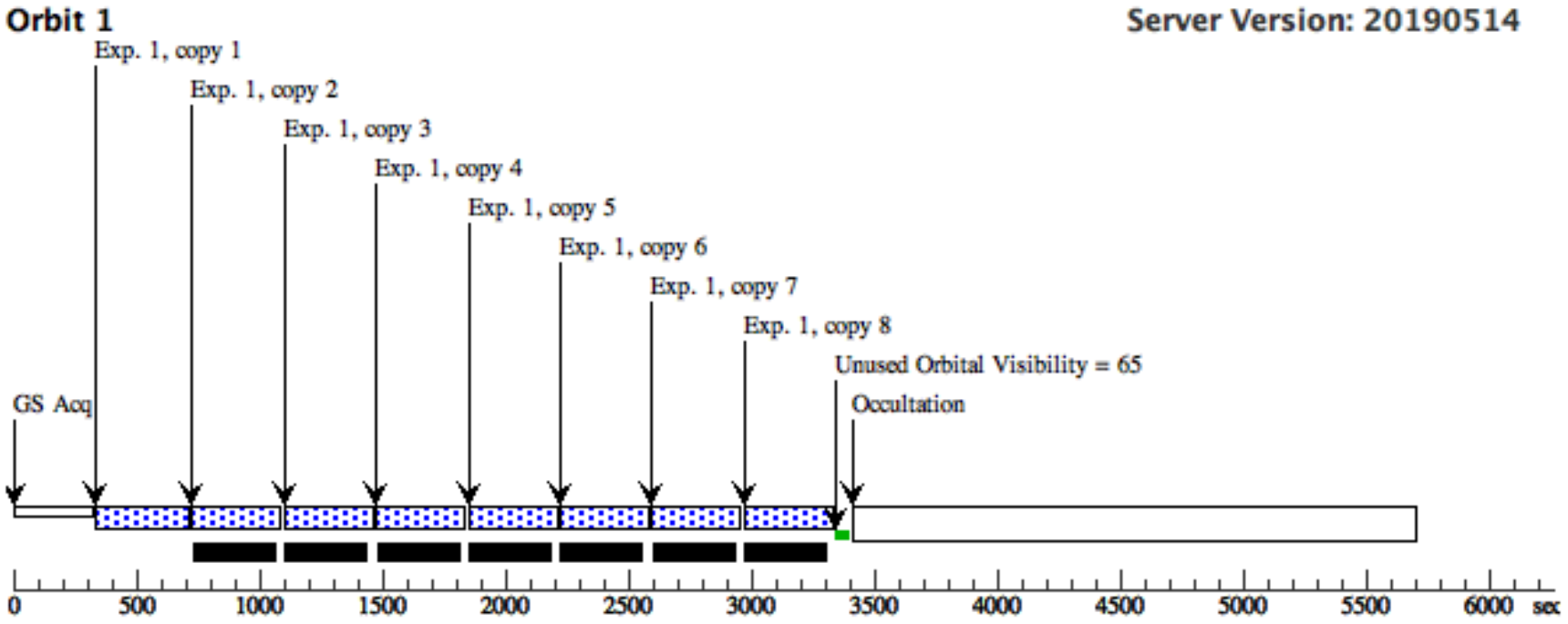
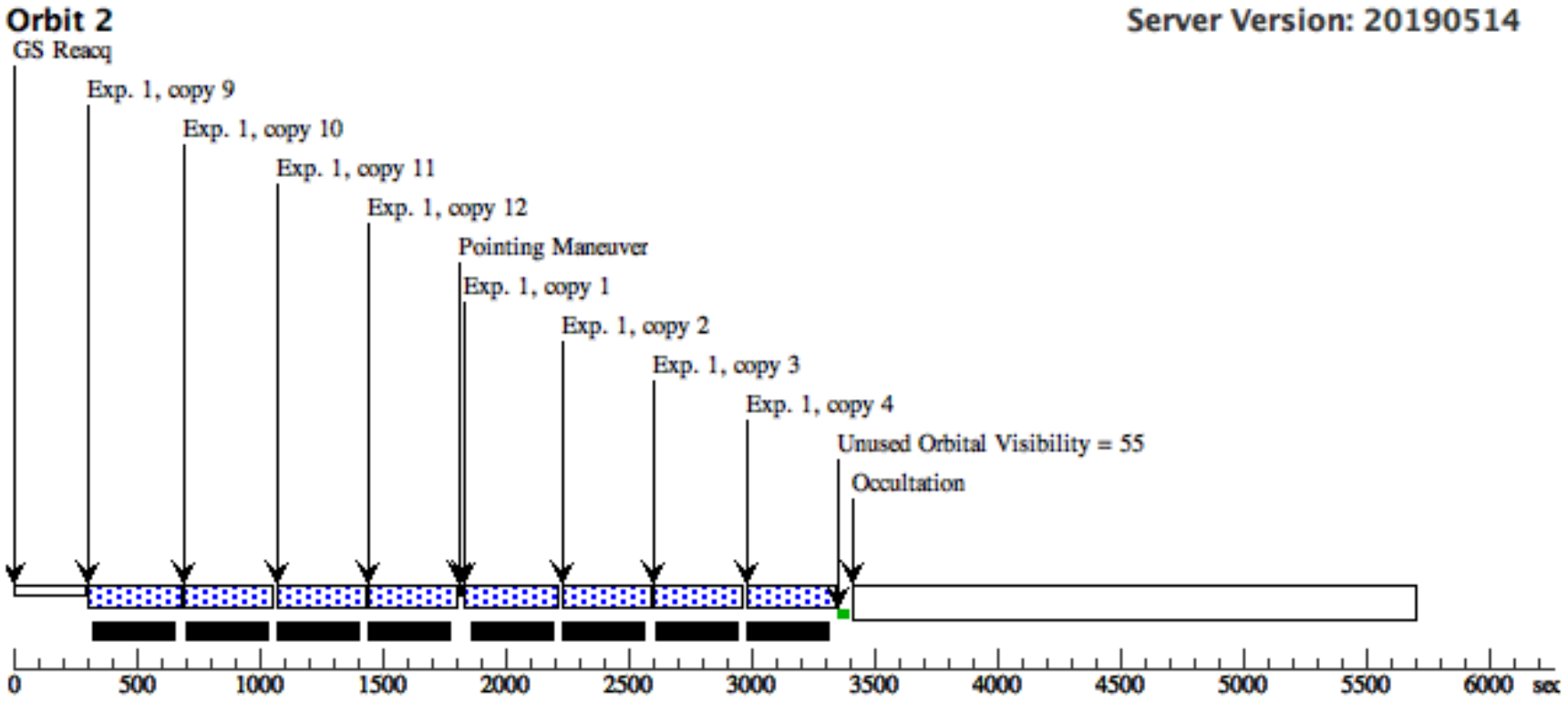
Comments: 7800s on-source in F110W filter targeting SPT0348.

Orbit Structure

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Pointing Maneuver
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Unused Orbital Visibility = 55
Occultation
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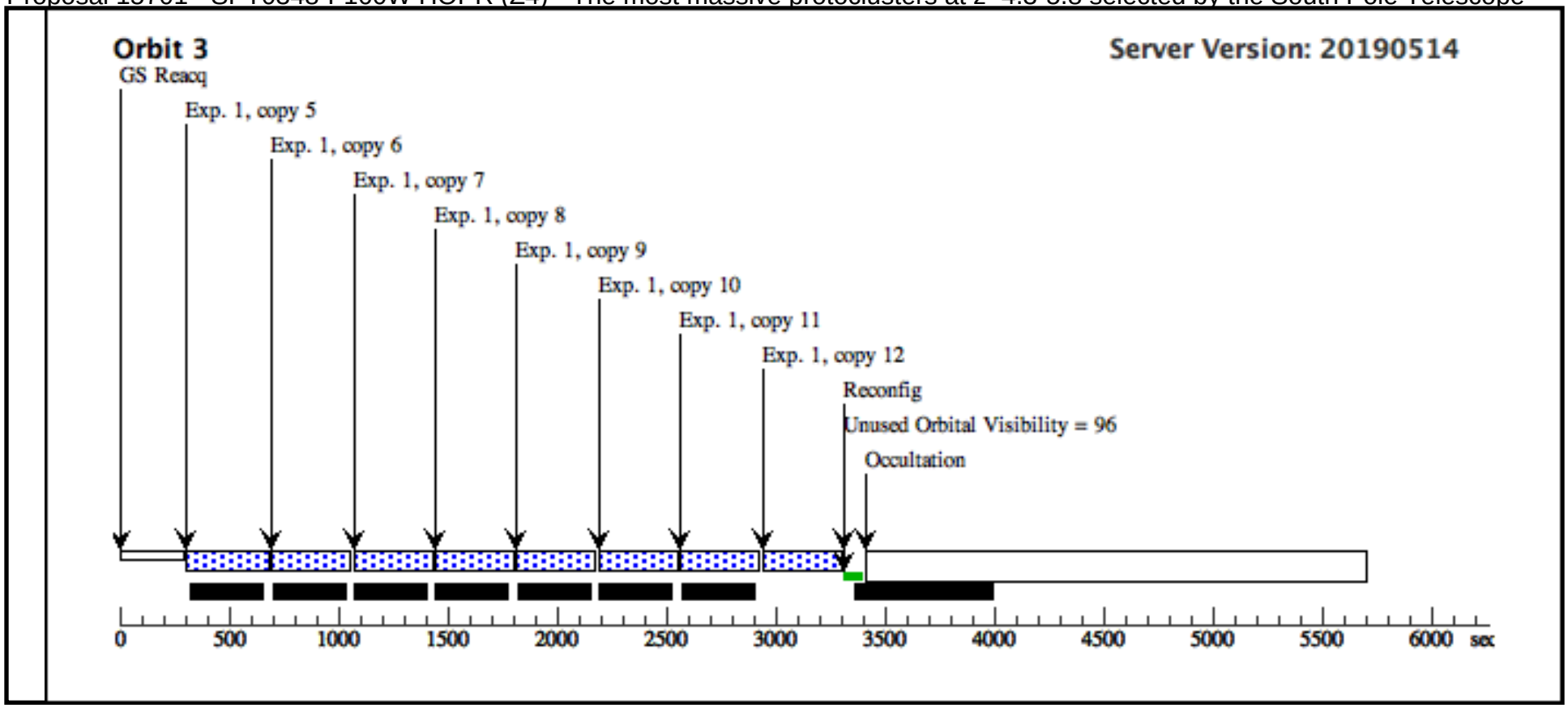
sec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Exp. 1, copy 12
Reconfig
Unused Orbital Visibility = 96
Occultation
0
500
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1500
2000
2500
3000
3500
4000
4500
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5500
6000
sec

Visit

Proposal 15701, SPT2349-F160W (03), completed Mon Jul 08 18:00:34 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Comments: 7800s in F110W filter targeting SPT2349.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SPT2349-56	RA: 23 49 42.2700 (357.4261250d) Dec: -56 38 1.37 (-56.63371d) Equinox: J2000	Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Redshift: 4.3	V=30+/-1 ~23 mag/arcsec^2 in H and J bands	Reference Frame: ICRS

Comments: Observations will use F110W and F160W band filters, the V-magnitude quoted is an unreliable estimate.
Category=CLUSTER OF GALAXIES
Description=[NUCLEUS]
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	SPT2349-F160W	(1) SPT2349-56	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25		Pattern 1, Exps 1-1 in SPT2349-F160W (03) (1)	352.939501 Secs X 12 (8470.548 Secs)	
								[==>(Pattern 1, Copy 1)]	***[1]***
								[==>(Pattern 1, Copy 2)]	
								[==>(Pattern 1, Copy 3)]	
								[==>(Pattern 1, Copy 4)]	
								[==>(Pattern 1, Copy 5)]	
								[==>(Pattern 1, Copy 6)]	
								[==>(Pattern 1, Copy 7)]	
								[==>(Pattern 1, Copy 8)]	
								[==>(Pattern 1, Copy 9)]	***[2]***
								[==>(Pattern 1, Copy 10)]	
								[==>(Pattern 1, Copy 11)]	
								[==>(Pattern 1, Copy 12)]	
								[==>(Pattern 2, Copy 1)]	
								[==>(Pattern 2, Copy 2)]	
								[==>(Pattern 2, Copy 3)]	
								[==>(Pattern 2, Copy 4)]	
								[==>(Pattern 2, Copy 5)]	***[3]***
								[==>(Pattern 2, Copy 6)]	
								[==>(Pattern 2, Copy 7)]	
								[==>(Pattern 2, Copy 8)]	
								[==>(Pattern 2, Copy 9)]	
								[==>(Pattern 2, Copy 10)]	
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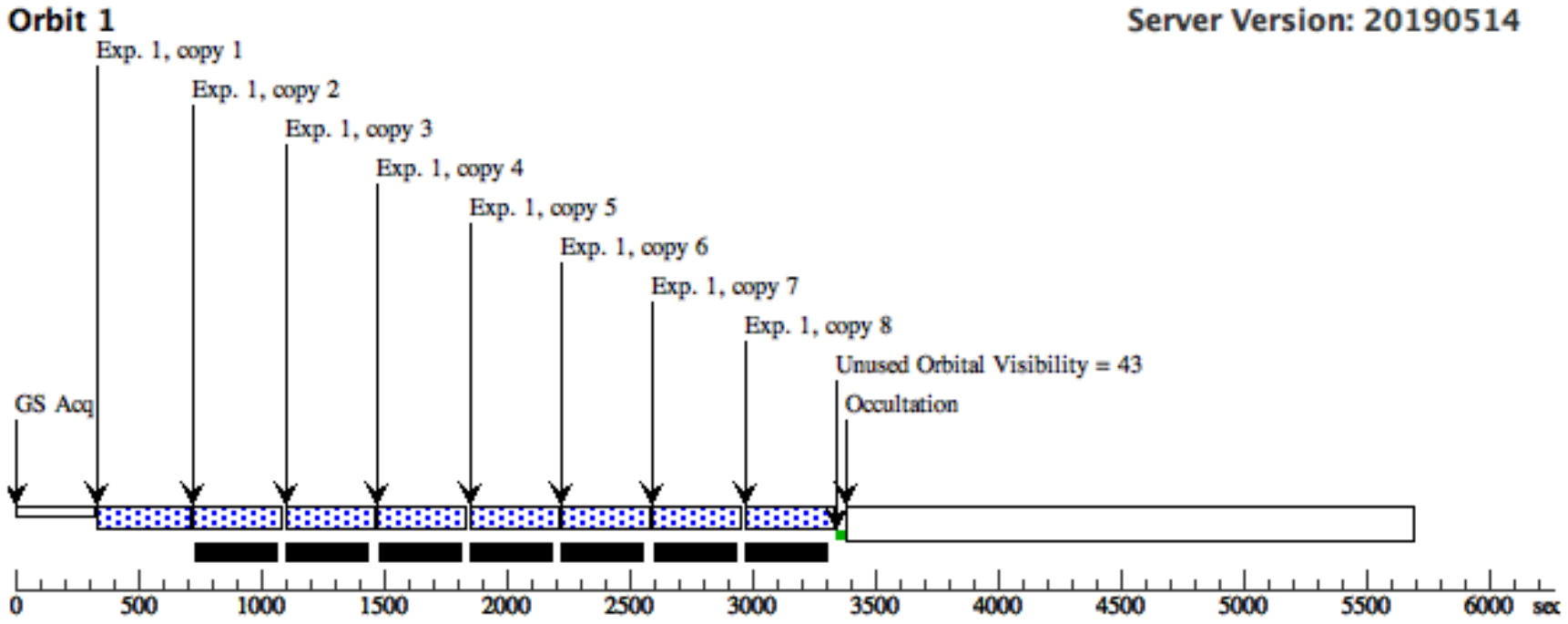
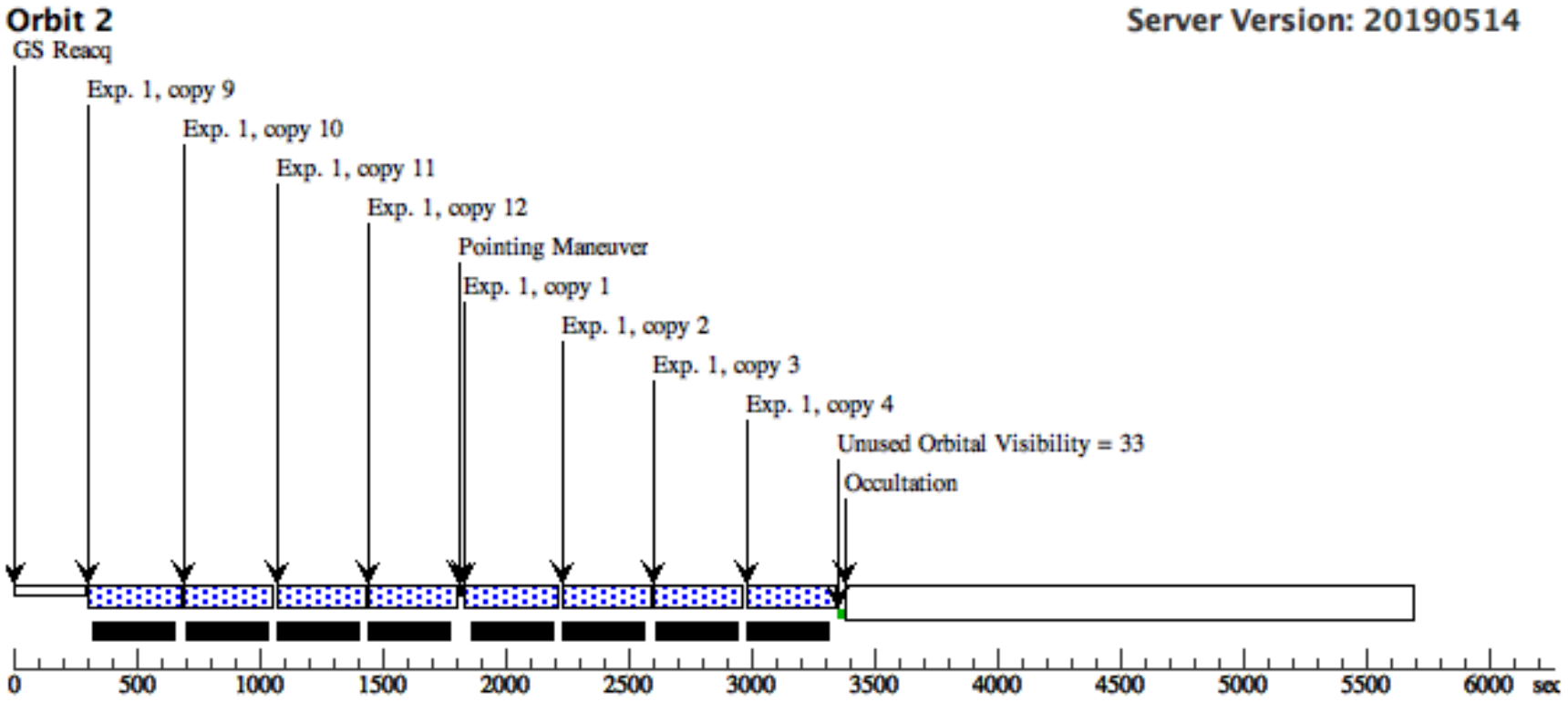
Comments: 7800s on-source in F110W filter targeting SPT2349.

Orbit Structure

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Exp. 1, copy 12
Pointing Maneuver
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Unused Orbital Visibility = 33
Occultation
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1500
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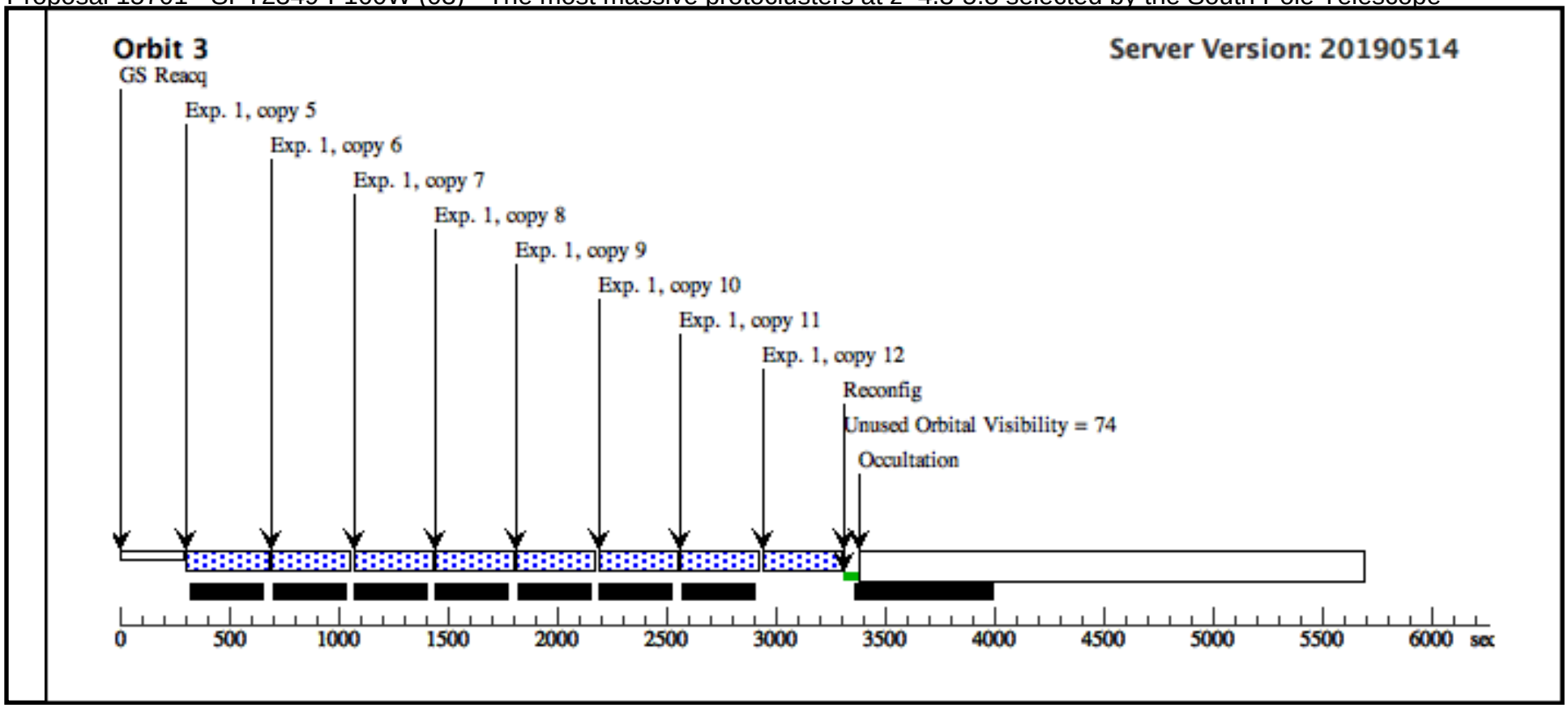
5500
6000
sec


Orbit 3
Server Version: 20190514
GS Reacq
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Exp. 1, copy 9
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Exp. 1, copy 11
Exp. 1, copy 12
Reconfig
Unused Orbital Visibility = 74
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec

Visit

Proposal 15701, SPT0348-F160W (04), failed Mon Jul 08 18:00:34 GMT 2019

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: (none)

Comments: 7800s in F110W filter targeting SPT0348.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.636 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=41.788 Angle Between Sides= Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SPT0348-62	RA: 03 48 42.6800 (57.1778333d) Dec: -62 20 39.50 (-62.34431d) Equinox: J2000	Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Redshift: 5.6	V=30+/-1 ~23 mag/arcsec^2 in H and J bands	Reference Frame: ICRS

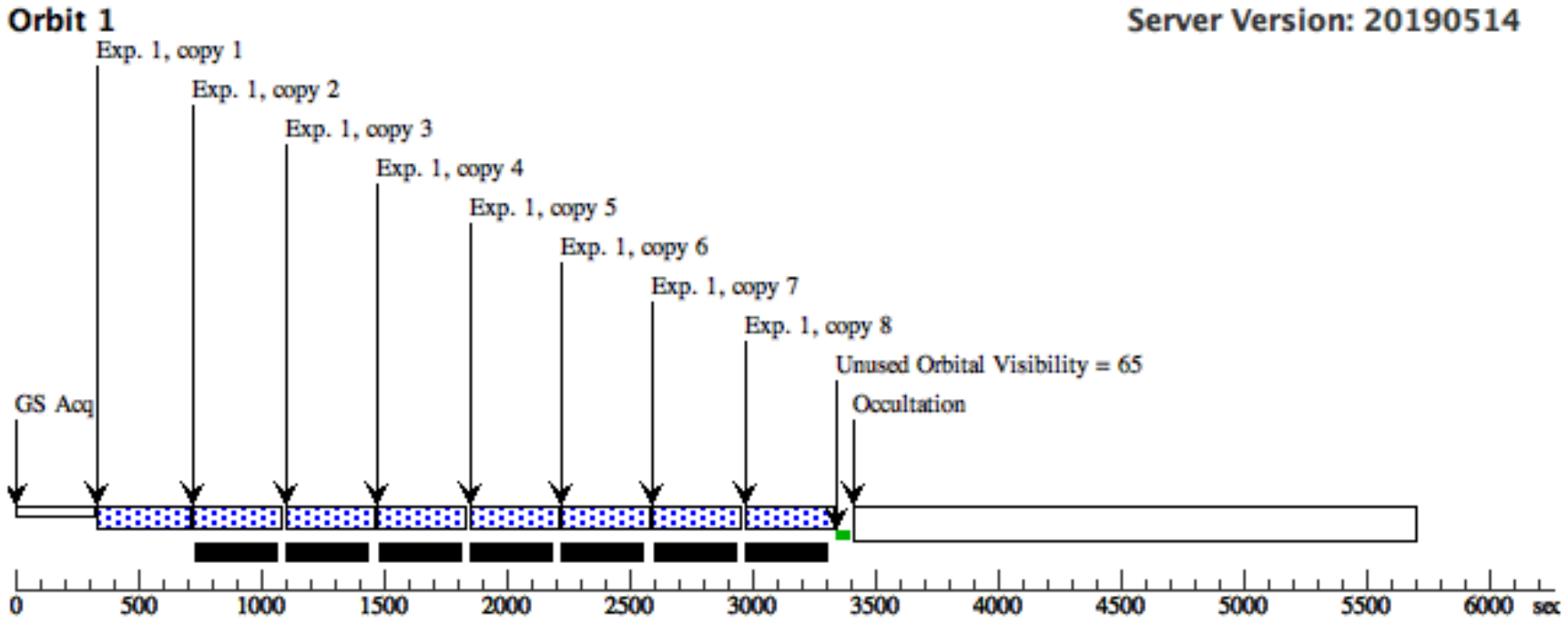
Comments: Observations will use F110W and F160W band filters, the V-magnitude quoted is an unreliable estimate.
Category=CLUSTER OF GALAXIES
Description=[NUCLEUS]
Extended=YES

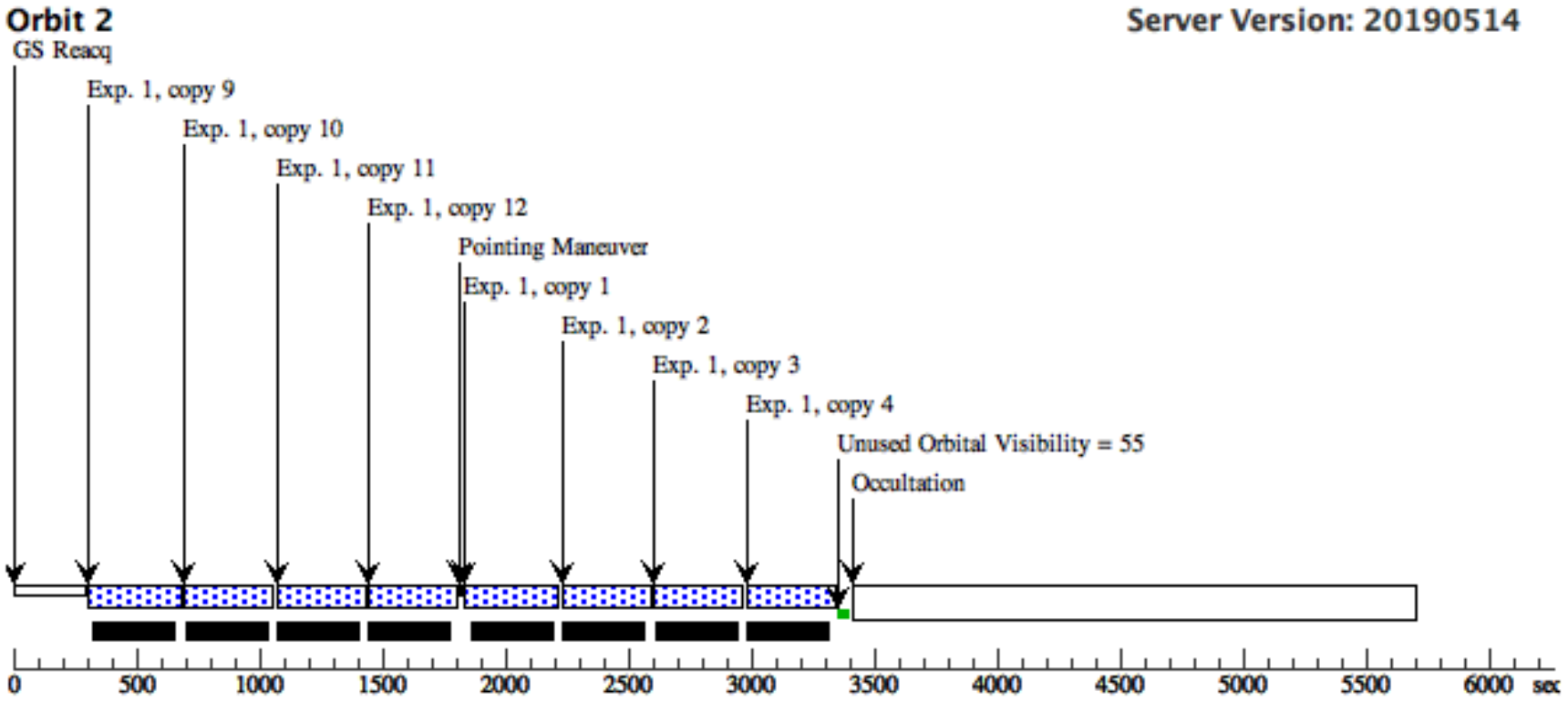
Exposures

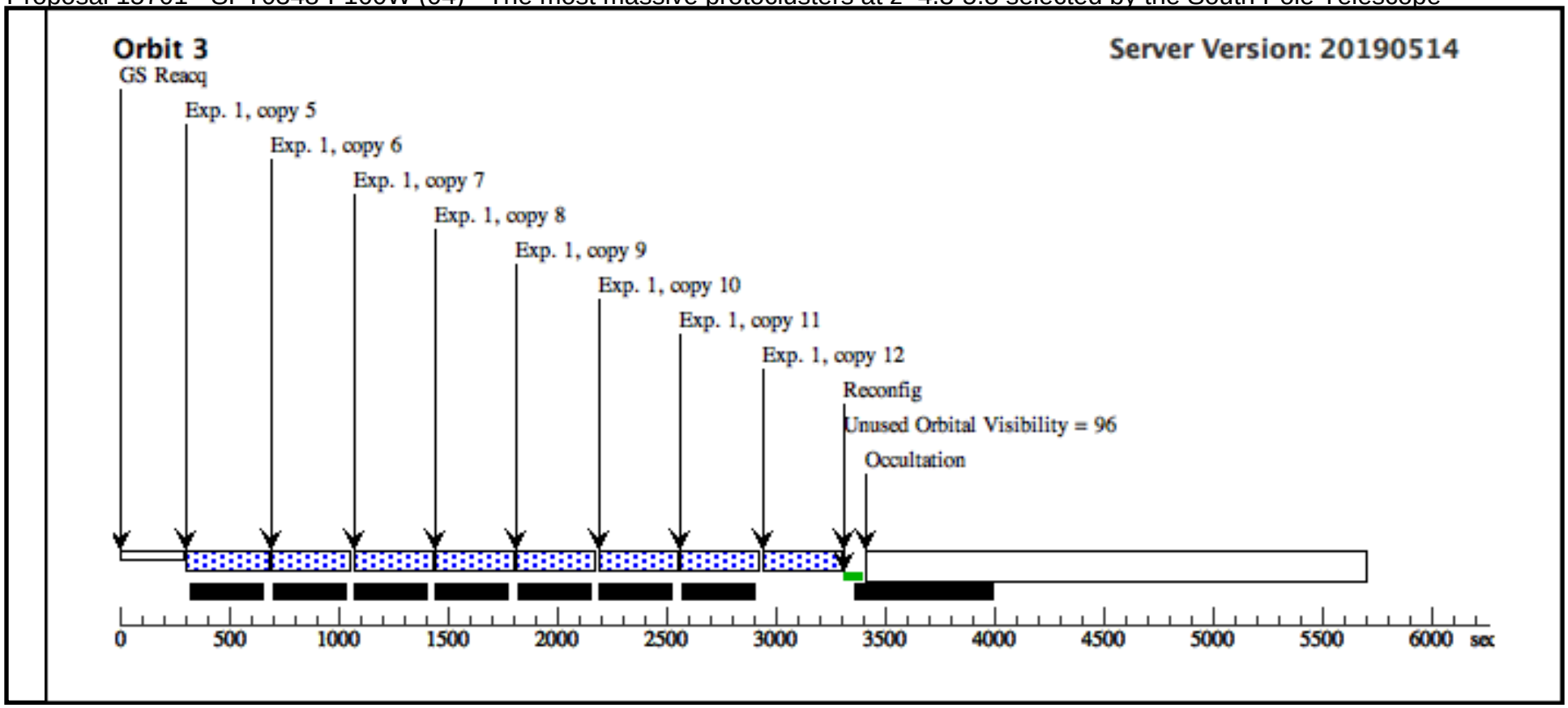
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	SPT0348-F160W	(2) SPT0348-62	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=15; SAMP-SEQ=SPARS25		Pattern 1, Exps 1-1 in SPT0348-F160W (04) (1)	352.939501 Secs X 12 (8470.548 Secs)	
								[==>(Pattern 1, Copy 1)] *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 1, Copy 5)]* *[==>(Pattern 1, Copy 6)]* *[==>(Pattern 1, Copy 7)]* *[==>(Pattern 1, Copy 8)]*	***[1]***
								[==>(Pattern 1, Copy 9)] *[==>(Pattern 1, Copy 10)]* *[==>(Pattern 1, Copy 11)]* *[==>(Pattern 1, Copy 12)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]*	***[2]***
								[==>(Pattern 2, Copy 5)] *[==>(Pattern 2, Copy 6)]* *[==>(Pattern 2, Copy 7)]* *[==>(Pattern 2, Copy 8)]* *[==>(Pattern 2, Copy 9)]* *[==>(Pattern 2, Copy 10)]* *[==>(Pattern 2, Copy 11)]* *[==>(Pattern 2, Copy 12)]*	***[3]***

Comments: 7800s on-source in F110W filter targeting SPT0348.

Orbit Structure




Orbit 2
Server Version: 20190514
GS Reacq
Exp. 1, copy 9
Exp. 1, copy 10
Exp. 1, copy 11
Exp. 1, copy 12
Pointing Maneuver
Exp. 1, copy 1
Exp. 1, copy 2
Exp. 1, copy 3
Exp. 1, copy 4
Unused Orbital Visibility = 55
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec


Orbit 3
Server Version: 20190514
GS Reacq
Exp. 1, copy 5
Exp. 1, copy 6
Exp. 1, copy 7
Exp. 1, copy 8
Exp. 1, copy 9
Exp. 1, copy 10
Exp. 1, copy 11
Exp. 1, copy 12
Reconfig
Unused Orbital Visibility = 96
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
sec