13299 - Silver Linings: Using Cloud Maps to Understand the L/T Spectral Transtion

Cycle: 21, 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) 2MASS-J16291840+0335371	WFC3/IR	4	11-Jul-2013 13:34:20.0	yes
02	(2) SDSS-J075840.33+324723.4	WFC3/IR	5	11-Jul-2013 13:37:52.0	yes
03	(3) 2MASS-J11263991-5003550	WFC3/IR	3	11-Jul-2013 13:43:41.0	yes

12 Total Orbits Used

ABSTRACT

Recent observations in the time domain have revealed large amplitude variability for a subset of objects at the transition between cloudy L and clear T spectral types, indicative of patchy cloud coverage. We propose to obtain time-resolved near-infrared spectra of two highly variable L/T transition

brown dwarfs and an unusually blue L dwarf in order to make spectrally and spatially resolved maps of their surfaces. By decomposing the spectral time series into principal components we can determine the number of different surface spectra that contribute to the variability and test whether the current paradigm---namely that variability for these objects results due to holes in the cloud layer---is accurate.

Our previous Cycle 18 observations (GO12314, PI:Apai) of two early T-dwarfs suggest a simple two-surface scenario where variability across a wide range of atmospheric pressures is correlated, and presumably governed by the horizontal distribution of condensates (Apai, Radigan & Buenzli et al., submitted), while the behavior of a T6.5 dwarf was observed to be significantly more complex (Buenzli et al. 2012). While these data are suggestive, a pattern cannot be inferred from observations of only two objects. The proposed observations will double the sample of variable L/T transition objects mapped with WFC3 grism spectroscopy from 2 to 4, and allow us to establish a pattern; namely, do all L/T transition objects share similar spectral variations, indicative of a common mechanism and number of surface components? We will then investigate whether this pattern extends to unusually blue L-dwarfs, also hypothesized to have patchy clouds.

OBSERVING DESCRIPTION

We are monitoring 3 brown dwarfs for variability using WFC3 IR with the G141 grism. The goal is to obtain a precise spectral time series for each target. We stare at each target for N consecutive orbits (where N=3,4 or 5 depending on the rotation period of the target) without dithering. At the beginning of each orbit, a direct image is taken for wavelength calibration.

PROGRAM STRUCTURE:

Each target is observed in a single visit. Each visit consists of several orbits. One "exposure sequence" has been defined for each orbit.

EXPOSURE SEQUENCES:

At the beginning of each orbit we take one or more** direct images of the target in the G141 grism FOV for the purpose of wavelength calibration. We then take a series of spectra without dithering, for the remainder of the orbit. We do not offset between the direct image and spectral sequence, nor between individual spectra. The source is placed near the center of the _full array_, which is near the edge of the 256 x 256 sub array. In this position, the 1st order of the spectrum is dispersed along the x-axis of the array, away from the position of the direct image (can the CS please check that this understanding is correct?).

**When there was room in the orbit without sacrificing spectral exposures, multiple direct images are taken to protect against cosmic rays.

ORIENTATION REQUIREMENTS:

We require that the spectral traces of our targets do not overlap with those of other stars in the field. Orientation constraints were calculated as follows:

PA=absolute position angle between target and backgound star
d= distance between target and background star
ORIENT = position angle of HST
A_WFC3 = angle of WFC3 wrt HST = 45 deg
PA_WFC3 = PA - (A_WFC3 + ORIENT) = position angle between target and background star in WFC3 detector FOV
dY = absolute distance between spectral traces, perpedicular to the direction of dispersion

We have required that dy > 2 arcseconds, where dY=d * cos(PA_WFC3). In some cases an extra buffer of up to +/- 5 deg was added due to uncertainties in source and background star proper motions.

TARGETS

Our targets are brown dwarfs (bright in the IR), and do not appear in optical images using the target confirmation tool. They also have significant proper motions, which have been provided. Their positions wrt to the WFC3 FOV have been checked using the Aladin tool.

Visit

Proposal 13299, visit_1629 (01), implementation Thu Jul 11 17:44:02 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 0D TO 49 D; ORIENT 63D TO 105 D; ORIENT 152D TO 229 D; ORIENT 243D TO 285 D; ORIENT 332D TO 359 D

Comments: Continuous observation of 2MASS-J16291840+0335371

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	2MASS-J16291840+0335371	RA: 16 29 18.4090 (247.3267042d) Dec: +03 35 37.10 (3.59364d) Equinox: J2000	Proper Motion RA: 0.243 arcsec/yr Proper Motion Dec: -0.158 arcsec/yr Epoch of Position: 2000.44	V=(?) J=15.3	Reference Frame: ICRS

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

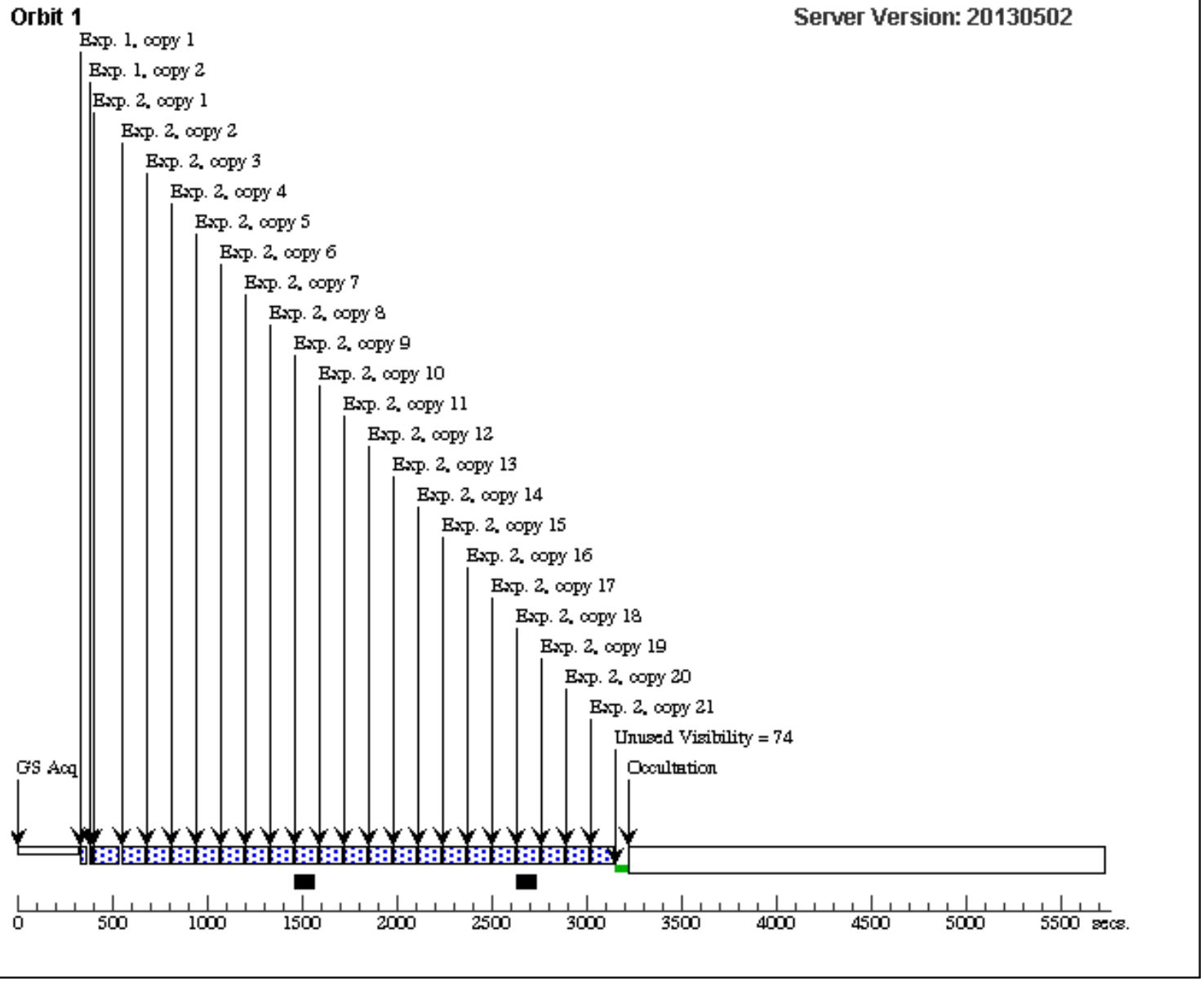
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	PreImage	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10			7.624302 Secs X 2 (15.249 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	***[1]***
2	SpectralSeries	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25			112.00801 Secs X 21 (2352.168 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]*	***[1]***
3	PreImage	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10			7.624302 Secs X 2 (15.249 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	***[2]***

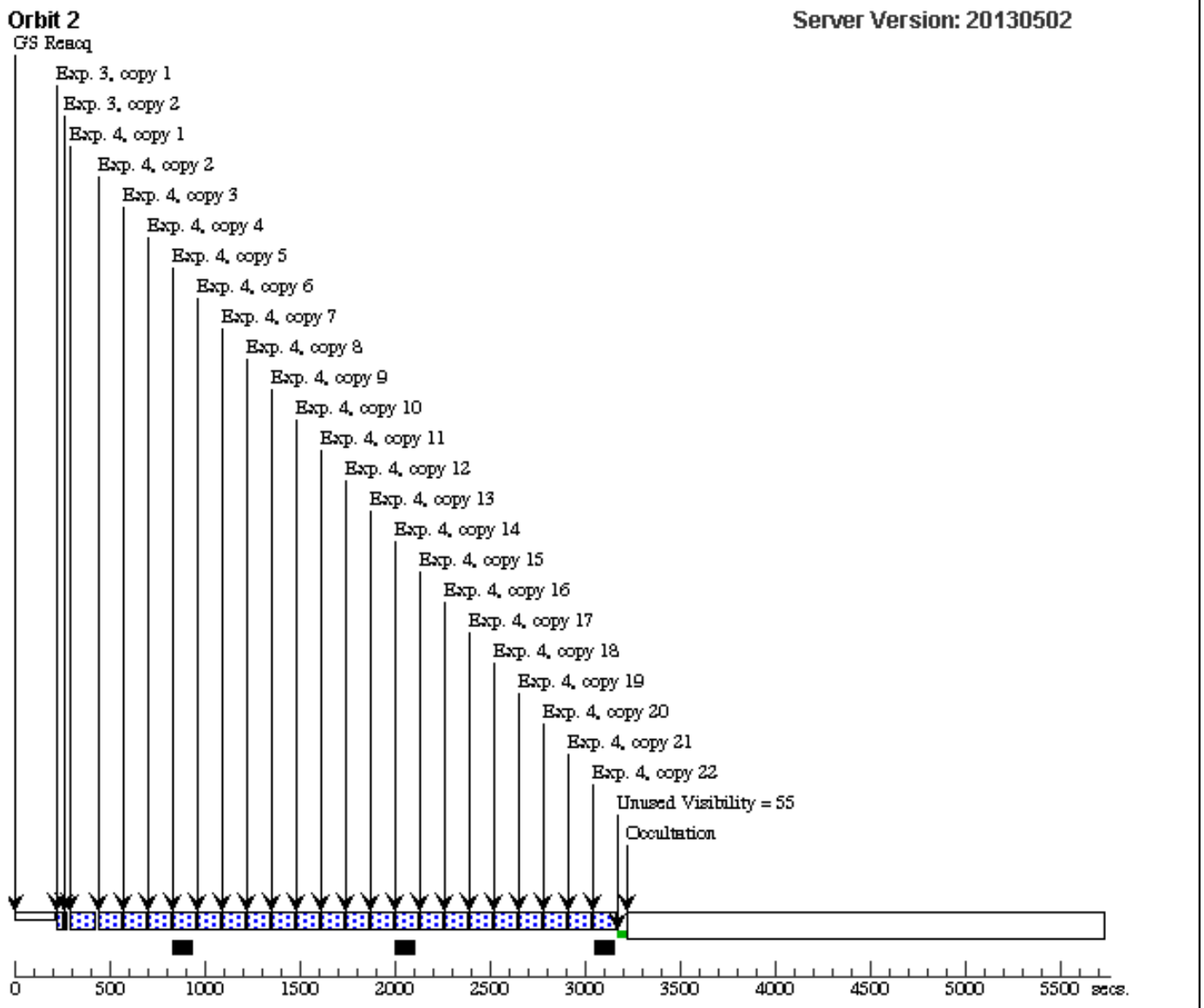
	4	SpectralSeries	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25	112.00801 Secs X 22 (2464.176 Secs)	
							[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]*	***[2]***
	5	PreImage	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10	7.624302 Secs (7.624 Secs)	
							[==>]	***[3]***

	6	SpectralSeries	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25	112.00801 Secs X 22 (2464.176 Secs)	
							[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]*	***[3]***
	7	PreImage	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10	7.624302 Secs X 2 (15.249 Secs)	
							[==>(Copy 1)]	***[3]***
							[==>(Copy 2)]	***[4]***

	8	SpectralSeries	(1) 2MASS-J16291840+0335371	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25	112.00801 Secs X 22 (2464.176 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]*	***[4]***

Orbit Structure

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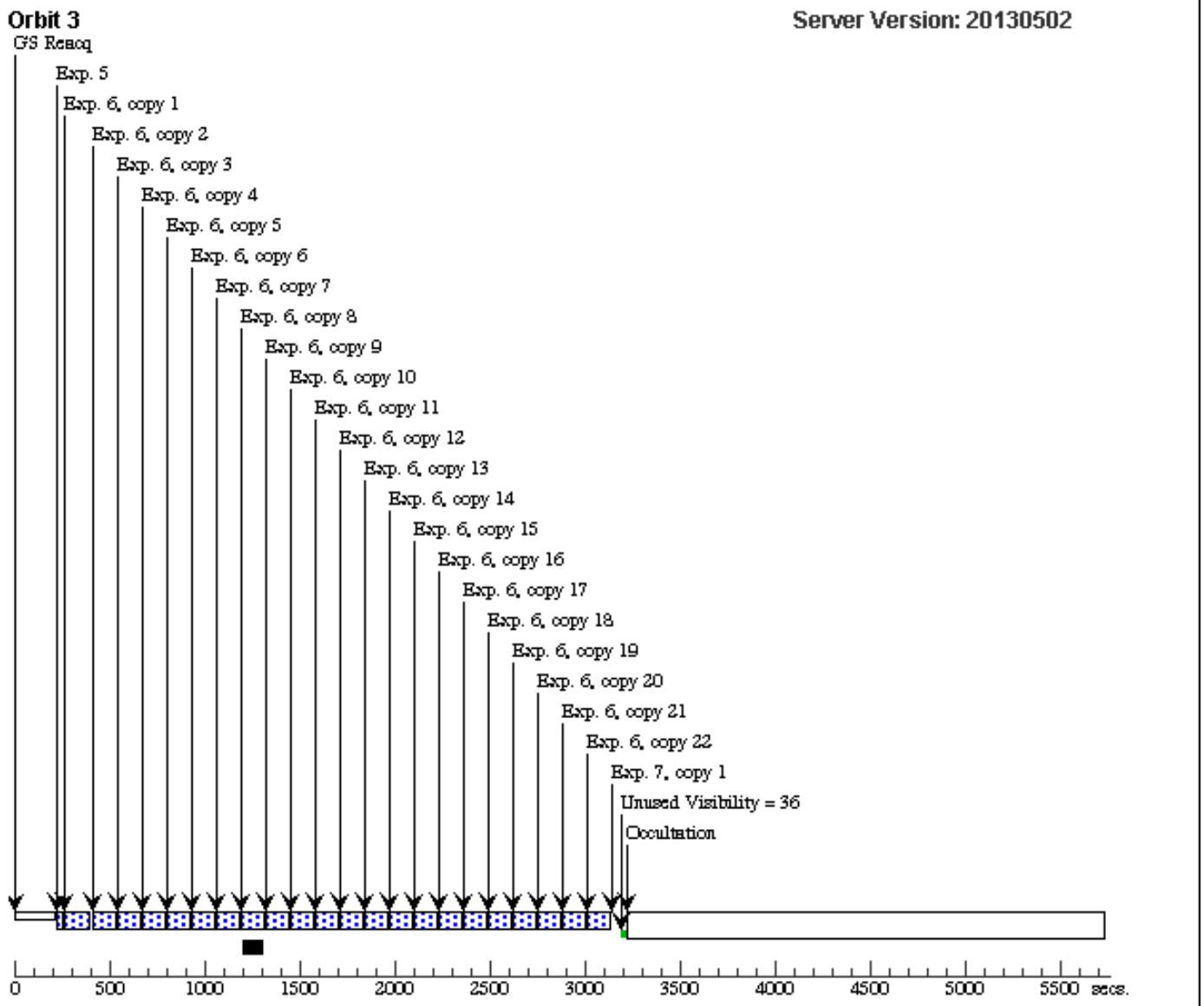
secs.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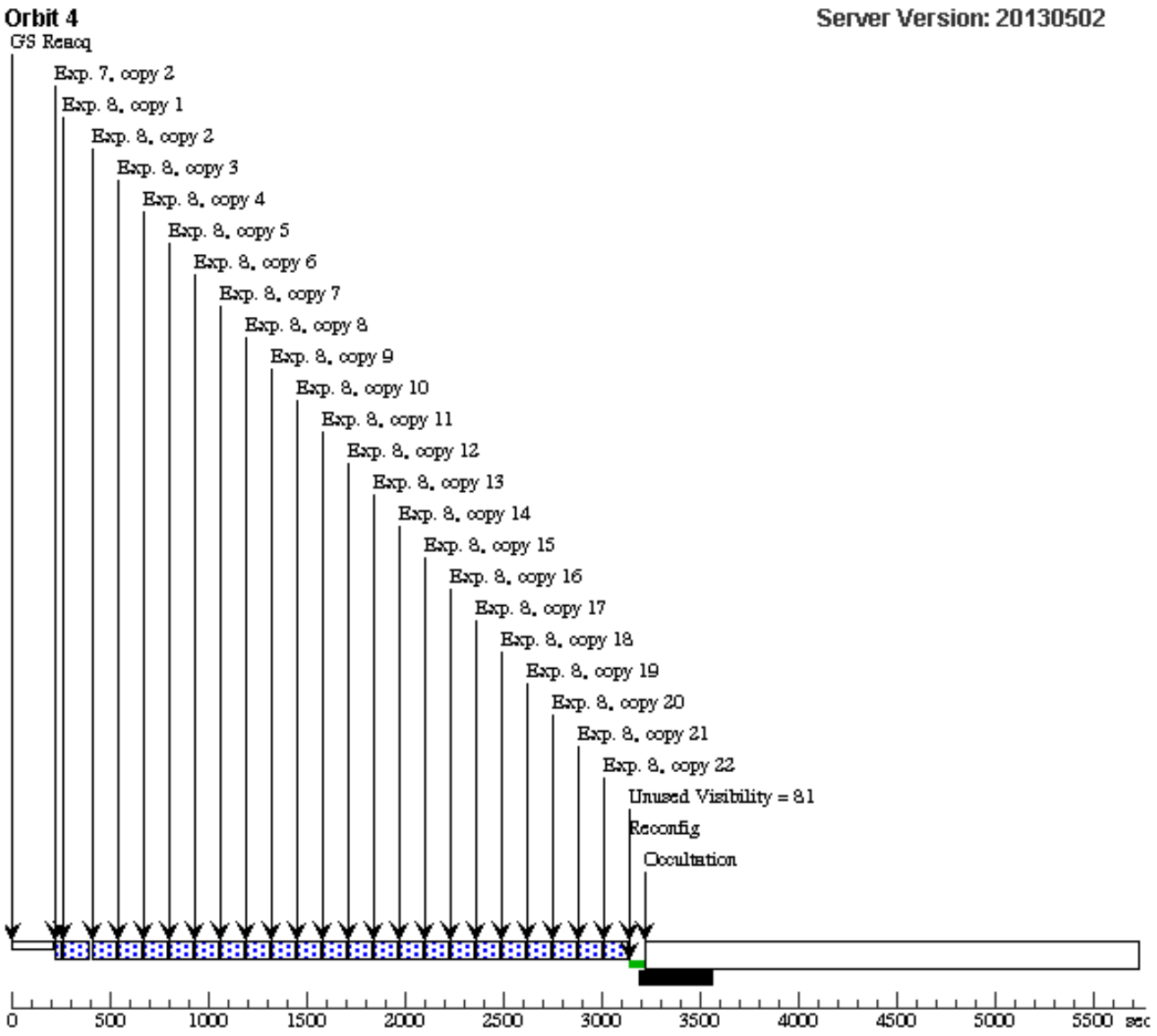
secs.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Exp. 8, copy 22
Unused Visibility = 81
Reconfig
Occultation
0
500
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sec

Visit

Proposal 13299, visit_0758 (02), implementation Thu Jul 11 17:44:07 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 18D TO 83 D; ORIENT 97D TO 165 D; ORIENT 198D TO 257 D; ORIENT 280D TO 352 D

Comments: Continuous observation of SDSS-J075840.33+324723.4

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SDSS-J075840.33+324723.4	RA: 07 58 40.3300 (119.6680417d) Dec: +32 47 23.40 (32.78983d) Equinox: J2000	Proper Motion RA: -0.240 arcsec/yr Proper Motion Dec: -0.316 arcsec/yr Epoch of Position: 1998.43	V=(?) J=15	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	PreImage	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10			7.624302 Secs (7.624 Secs)	
								[==>]	***[1]***
2	SpectralSeries	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25			112.00801 Secs X 22 (2464.176 Secs)	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]*	***[1]***
3	PreImage	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10			7.624302 Secs X 2 (15.249 Secs)	
								[==>(Copy 1)] *[==>(Copy 2)]*	***[2]***

	4	SpectralSeries	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25	112.00801 Secs X 22 (2464.176 Secs)	
							[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]*	***[2]***
	5	PreImage	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10	7.624302 Secs X 2 (15.249 Secs)	
							[==>(Copy 1)] *[==>(Copy 2)]*	***[3]***

	6	SpectralSeries	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25	112.00801 Secs X 22 (2464.176 Secs)	
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	7	PreImage	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10	7.624302 Secs X 2 (15.249 Secs)	
							[==>(Copy 1)] *[==>(Copy 2)]*	***[4]***

	8	SpectralSeries	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25	112.00801 Secs X 22 (2464.176 Secs)	
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	9	PreImage	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	F127M	NSAMP=2; SAMP-SEQ=SPARS10	7.624302 Secs (7.624 Secs)	
							[==>]	***[4]***

	10	SpectralSeries	(2) SDSS-J075840.33+324723.4	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=6; SAMP-SEQ=SPARS25	112.00801 Secs X 23 (2576.184 Secs)	
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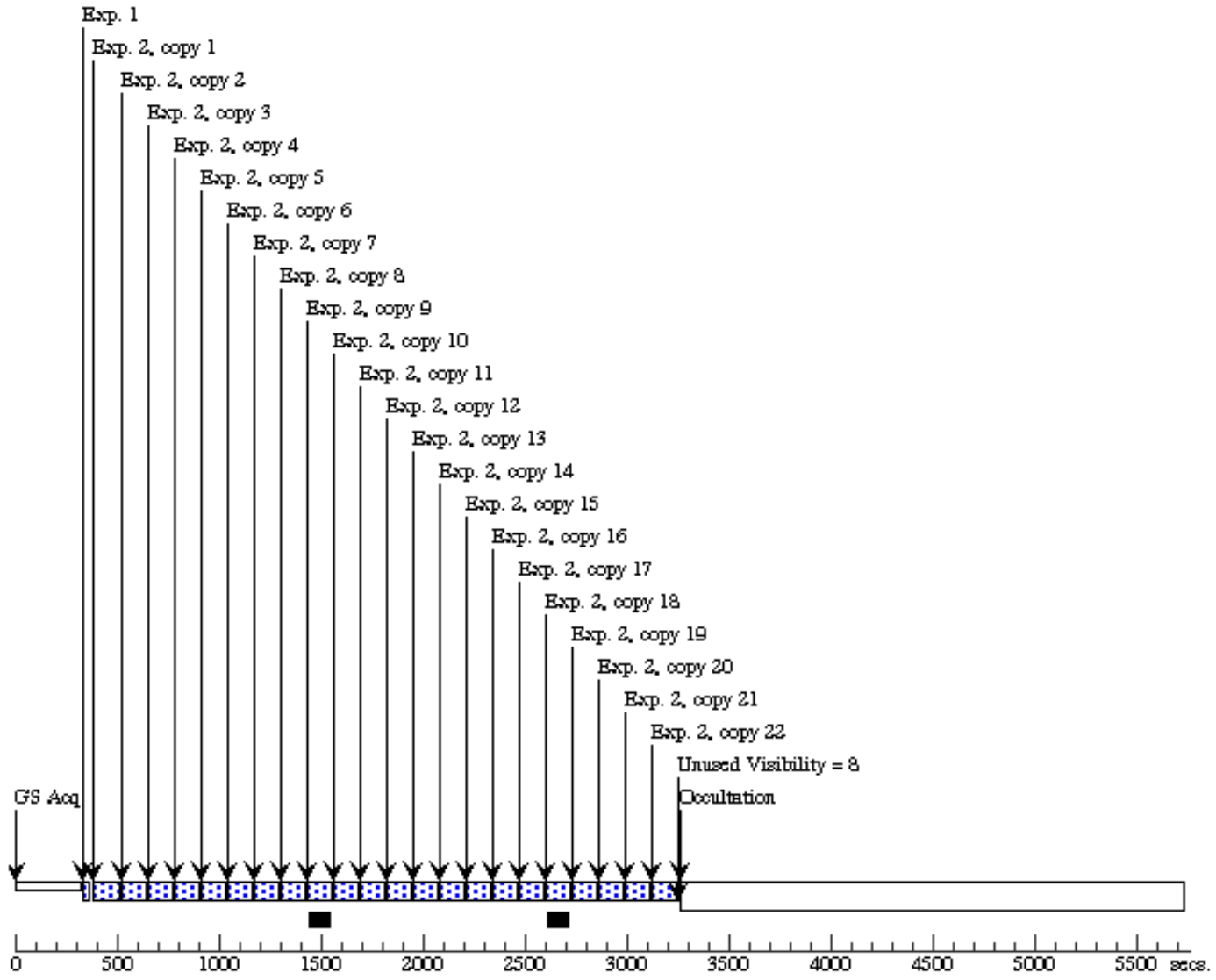
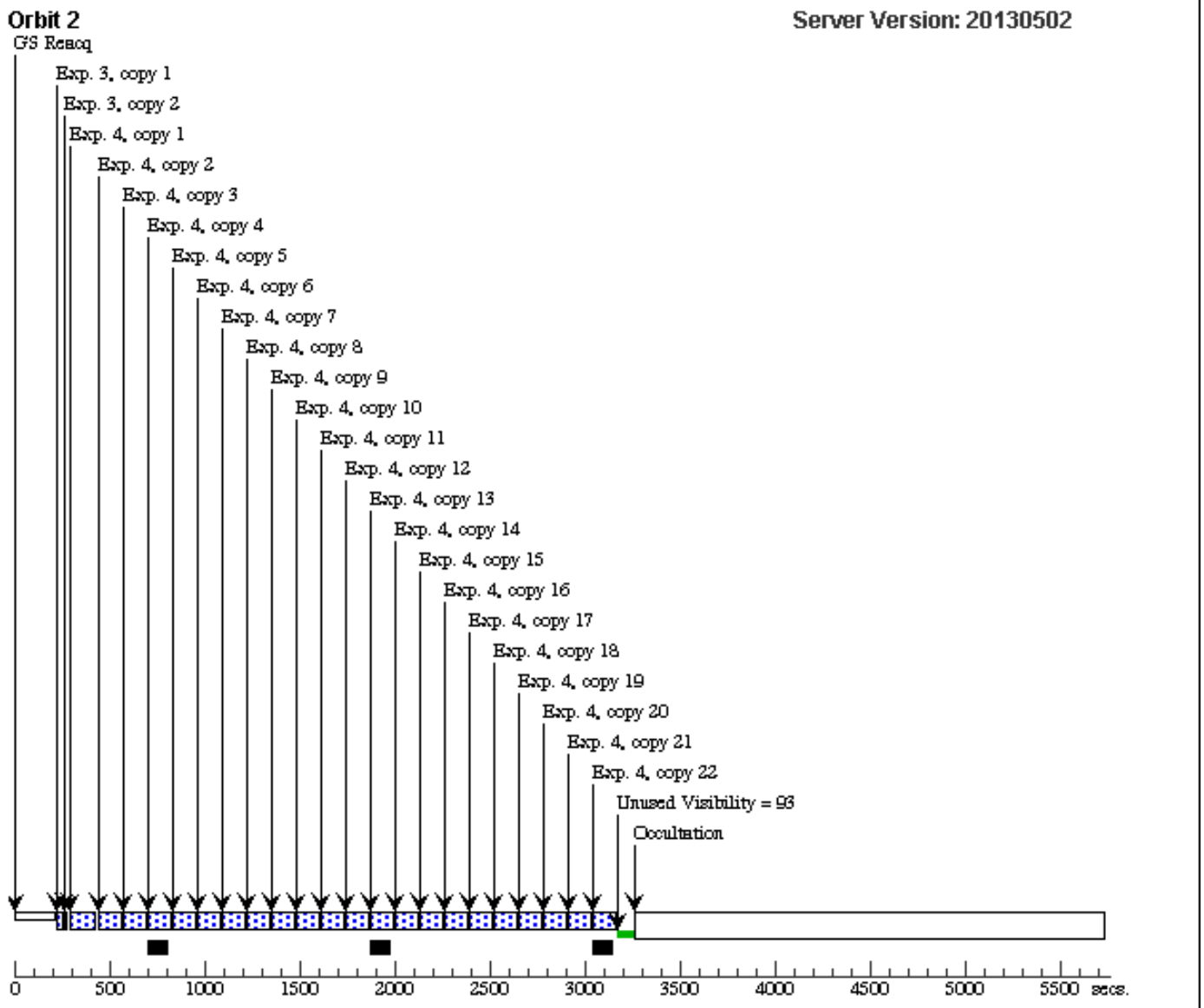
Orbit Structure

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Exp. 4, copy 21
Exp. 4, copy 22
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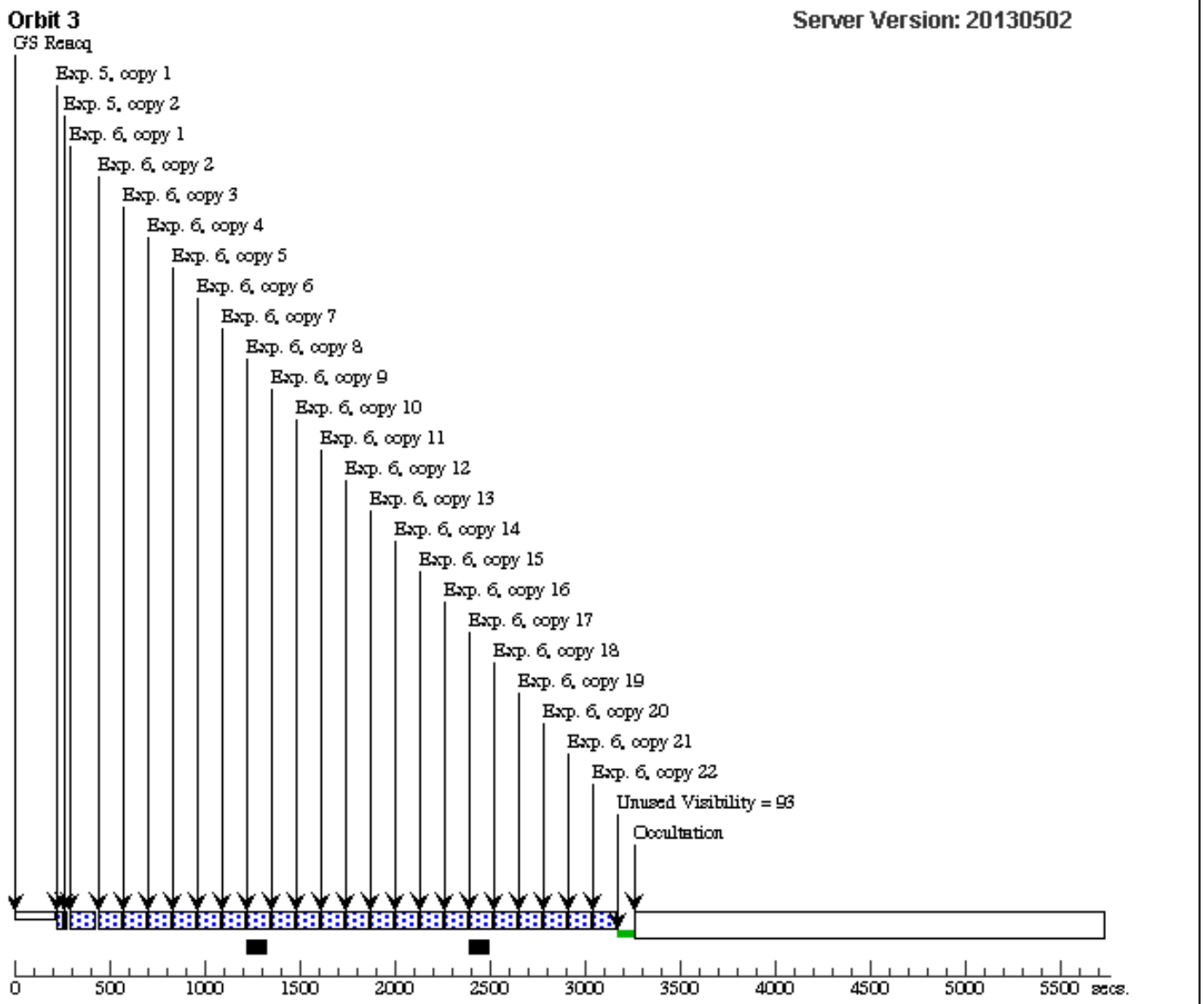
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Exp. 6, copy 22
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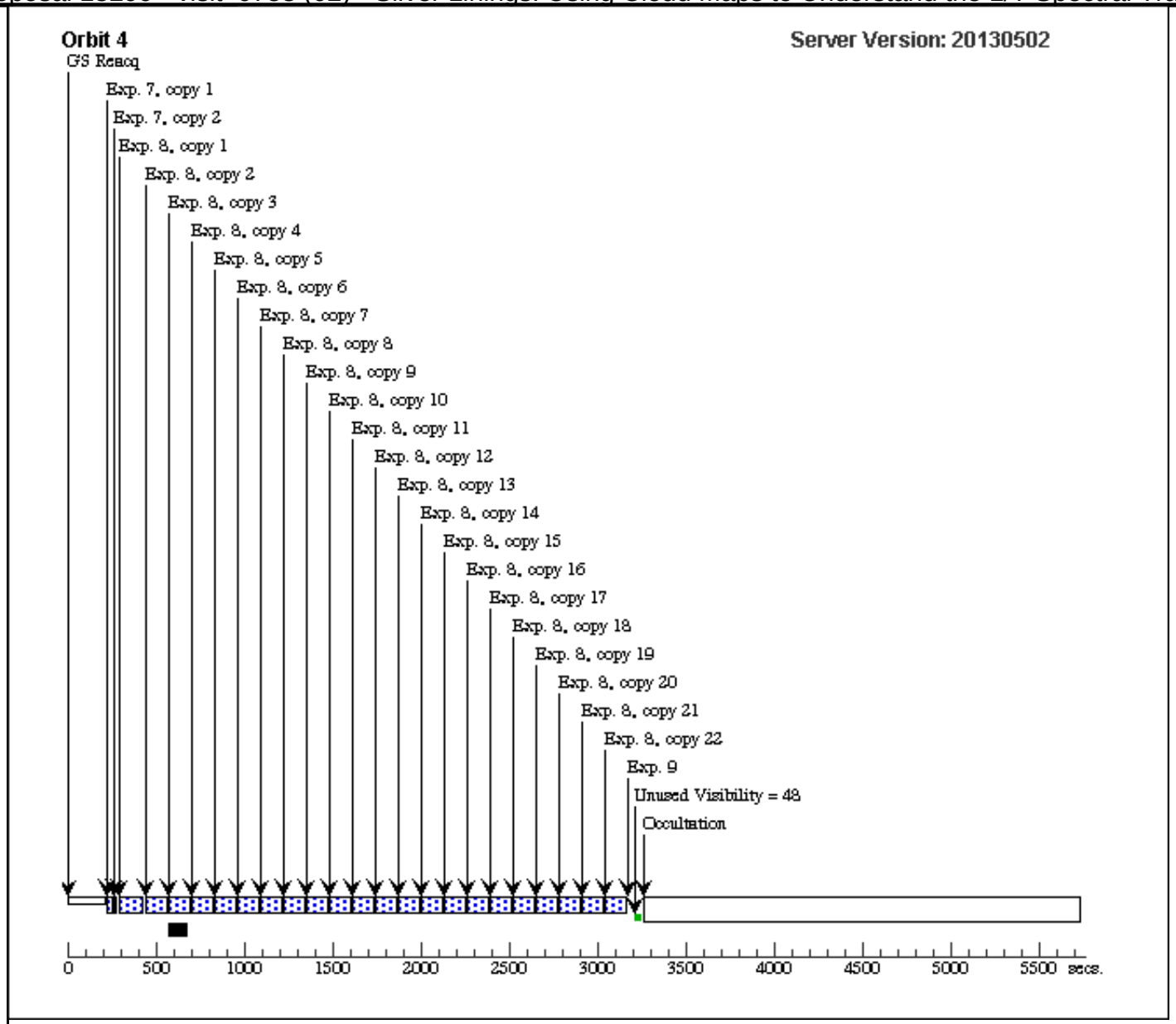
secs.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Exp. 9
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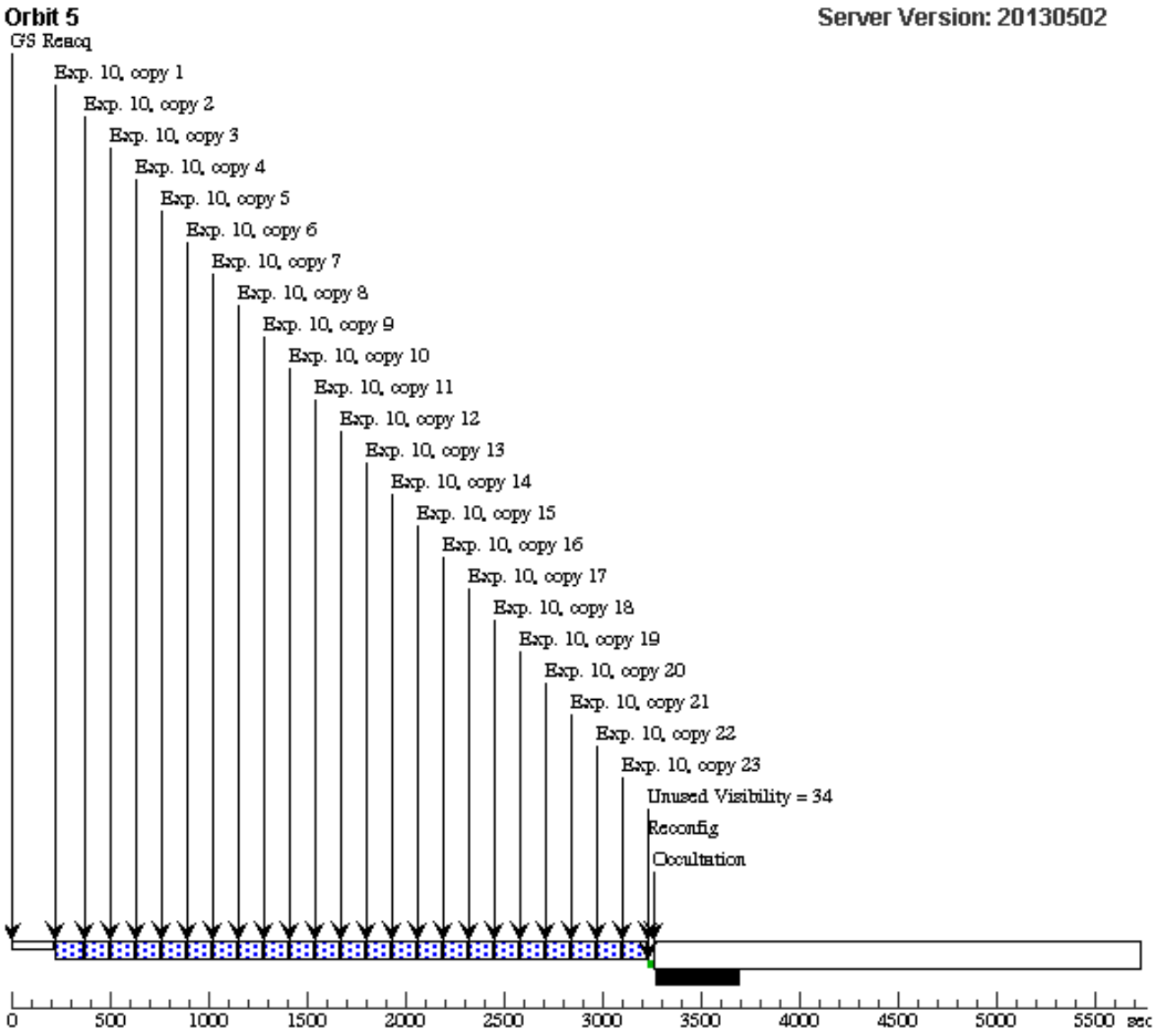
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Exp. 10, copy 23
Unused Visibility = 34
Reconfig
Occultation
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4000
4500
5000
5500
sec

Visit

Proposal 13299, visit_1126 (03), implementation Thu Jul 11 17:44:14 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 10D TO 108 D; ORIENT 190D TO 284 D

Comments: Continuous observation of 2MASS-J11263991-5003550

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	2MASS-J11263991-5003550	RA: 11 26 39.9110 (171.6662958d)	Proper Motion RA: -1.57 arcsec/yr	V=(?)	Reference Frame: SIMBAD
		Dec: -50 03 55.01 (-50.06528d)	Proper Motion Dec: 0.452 arcsec/yr	J=14.0	
		Equinox: J2000	Epoch of Position: 1999.44		

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	PreImage	(3) 2MASS-J11263991-5003550	WFC3/IR, MULTIACCUM, GRISM256	F132N	NSAMP=3; SAMP-SEQ=SPARS10			14.970789 Secs (14.971 Secs)	
								[==>]	***[1]***
2	SpectralSeries	(3) 2MASS-J11263991-5003550	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=4; SAMP-SEQ=SPARS25			67.315932 Secs X 35 (2356.058 Secs)	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]* *[==>(Copy 23)]* *[==>(Copy 24)]* *[==>(Copy 25)]* *[==>(Copy 26)]* *[==>(Copy 27)]* *[==>(Copy 28)]* *[==>(Copy 29)]* *[==>(Copy 30)]* *[==>(Copy 31)]* *[==>(Copy 32)]* *[==>(Copy 33)]* *[==>(Copy 34)]* *[==>(Copy 35)]*	***[1]***
3	Preimage	(3) 2MASS-J11263991-5003550	WFC3/IR, MULTIACCUM, GRISM256	F132N	NSAMP=3; SAMP-SEQ=SPARS10			14.970789 Secs X 2 (29.942 Secs)	
								[==>(Copy 1)] *[==>(Copy 2)]*	***[2]***

	4	SpectralSeries	(3) 2MASS-J11263991-5003550	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=4; SAMP-SEQ=SPARS25	67.315932 Secs X 36 (2423.374 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]* *[==>(Copy 23)]* *[==>(Copy 24)]* *[==>(Copy 25)]* *[==>(Copy 26)]* *[==>(Copy 27)]* *[==>(Copy 28)]* *[==>(Copy 29)]* *[==>(Copy 30)]* *[==>(Copy 31)]* *[==>(Copy 32)]* *[==>(Copy 33)]* *[==>(Copy 34)]* *[==>(Copy 35)]* *[==>(Copy 36)]*	***[2]***
	5	PreImage	(3) 2MASS-J11263991-5003550	WFC3/IR, MULTIACCUM, GRISM256	F132N	NSAMP=3; SAMP-SEQ=SPARS10	14.970789 Secs X 2 (29.942 Secs) *[==>(Copy 1)]* *[==>(Copy 2)]*	***[3]***

	6	SpectralSeries	(3) 2MASS-J11263991-5003550	WFC3/IR, MULTIACCUM, GRISM256	G141	NSAMP=4; SAMP-SEQ=SPARS25	67.315932 Secs X 36 (2423.374 Secs)	
							[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]* *[==>(Copy 9)]* *[==>(Copy 10)]* *[==>(Copy 11)]* *[==>(Copy 12)]* *[==>(Copy 13)]* *[==>(Copy 14)]* *[==>(Copy 15)]* *[==>(Copy 16)]* *[==>(Copy 17)]* *[==>(Copy 18)]* *[==>(Copy 19)]* *[==>(Copy 20)]* *[==>(Copy 21)]* *[==>(Copy 22)]* *[==>(Copy 23)]* *[==>(Copy 24)]* *[==>(Copy 25)]* *[==>(Copy 26)]* *[==>(Copy 27)]* *[==>(Copy 28)]* *[==>(Copy 29)]* *[==>(Copy 30)]* *[==>(Copy 31)]* *[==>(Copy 32)]* *[==>(Copy 33)]* *[==>(Copy 34)]* *[==>(Copy 35)]* *[==>(Copy 36)]*	***[3]***

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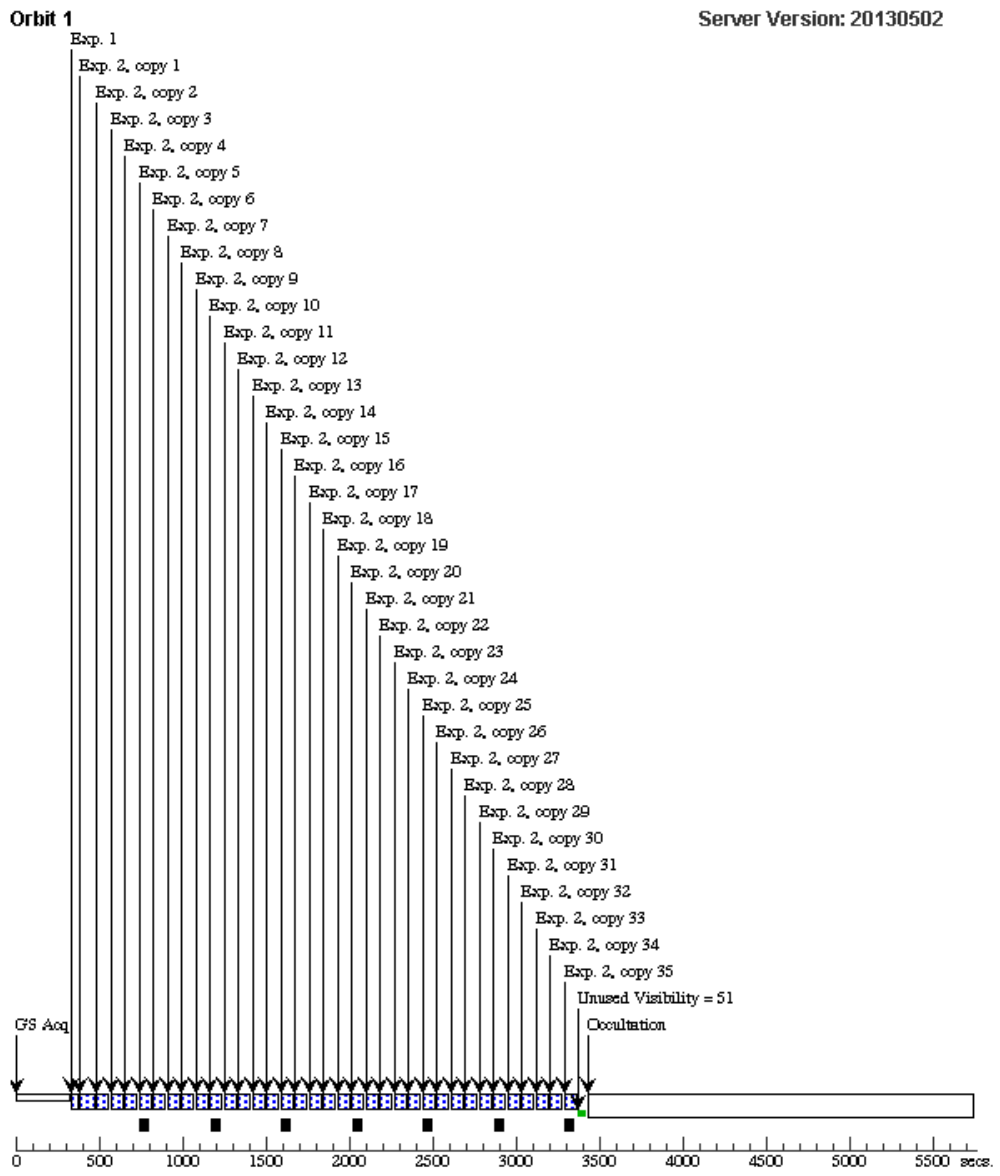

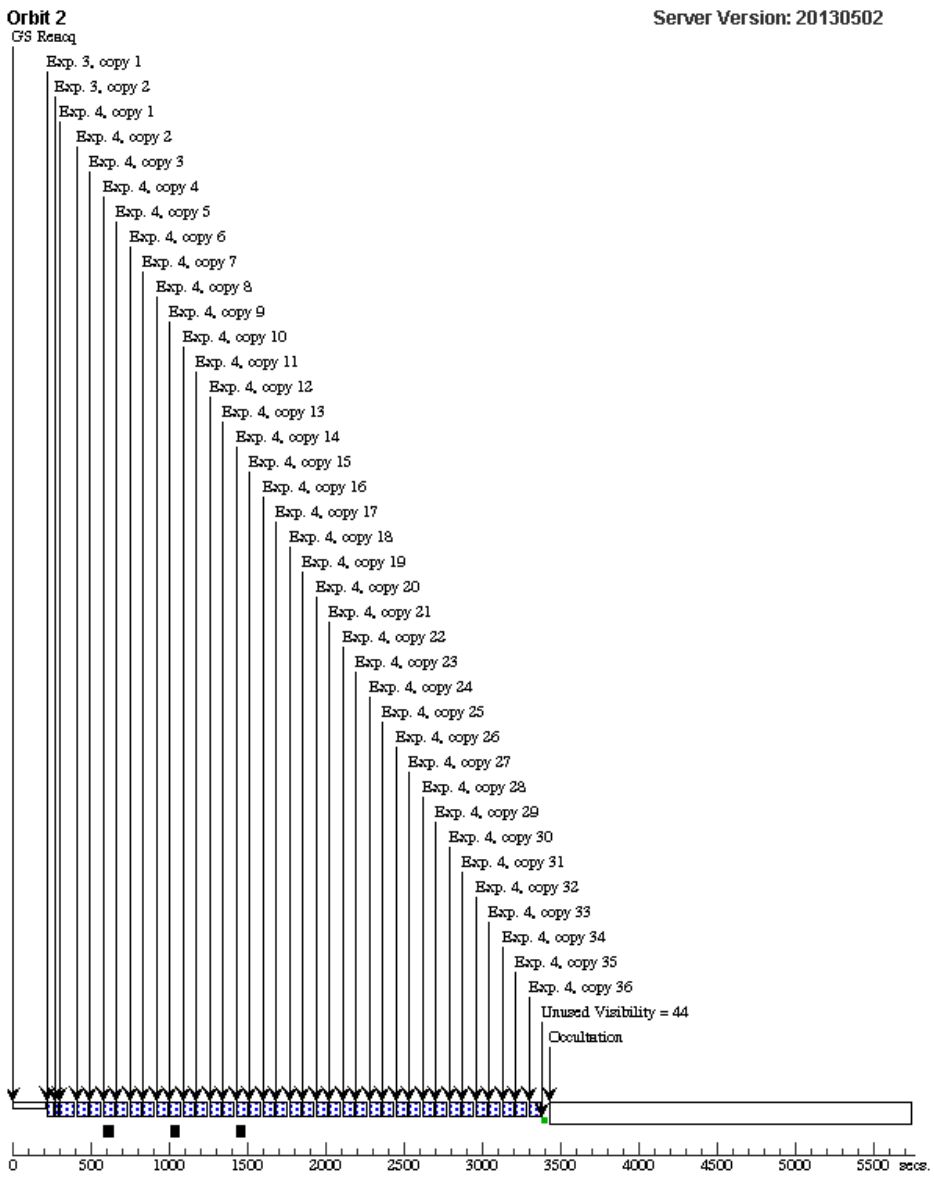
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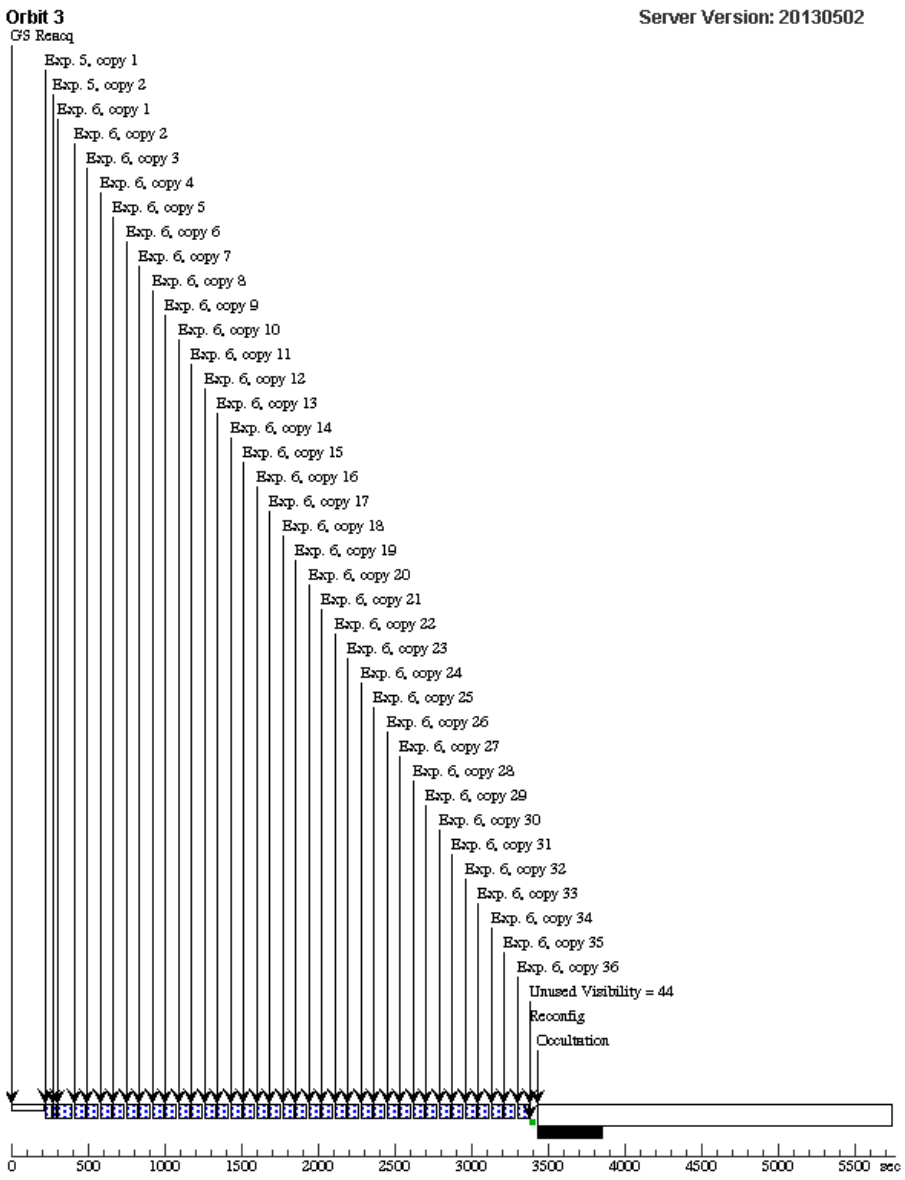
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