



## 13079 - IR Linearity Monitor

Cycle: 20, Proposal Category: CAL/WFC3

(Availability Mode: RESTRICTED)

### INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
<b>Mr. Bryan Hilbert (PI) (Contact)</b>	<b>Space Telescope Science Institute</b>	<b>hilbert@stsci.edu</b>
Dr. Sylvia M. Baggett (CoI)	Space Telescope Science Institute	sbaggett@stsci.edu

### 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>
01	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:00:20.0	yes
02	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:00:26.0	yes
03	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:00:31.0	yes
04	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:00:36.0	yes
05	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:00:41.0	yes
06	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:00:45.0	yes
1E	(1) 47TUC DARK	WFC3/IR	1	08-Oct-2012 22:00:53.0	yes
07	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:00:59.0	yes

<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>
08	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:01:04.0	yes
09	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:01:09.0	yes
10	DARK TUNGSTEN	WFC3/IR	1	08-Oct-2012 22:01:13.0	yes
2E	(1) 47TUC DARK	WFC3/IR	1	08-Oct-2012 22:01:20.0	yes

12 Total Orbits Used

### **ABSTRACT**

These observations will be used to monitor the signal non-linearity of the IR channel, as well as to update the IR channel non-linearity calibration reference file. The non-linearity behavior of each pixel in the detector will be investigated through the use of full frame and subarray flat fields, while the photometric behavior of point sources will be studied using observations of 47 Tuc. This is a continuation of the Cycle 19 non-linearity monitor, program 12696.

### **OBSERVING DESCRIPTION**

Two types of data will be collected for this proposal. First we will collect flat field data through the F127M filter, using the internal tungsten calibration lamp. These observations will allow for a pixel-by-pixel examination of the non-linearity of the IR channel across the detector. These observations are designed to investigate the non-linearity behavior at all signal levels up the ramp. In order to effectively do this, we vary the sample sequence used to collect the flat field observations from visit to visit.

We will also make observations of 47 Tuc, for the purposes of studying the point source non-linearity behavior of the detector. For these observations, we collect ramps with two different exposure times. This leads to one low- and one high-signal ramp. Comparison of aperture photometry between the low and high signal ramps will provide a measure of the point source non-linearity behavior. Observation times for these ramps are optimized for stars in the magnitude range  $V = 17 - 22$ . In the low-signal ramps, stars with  $V = 17$  should just reach full well, while those at  $V = 22$  will have a SNR of  $\sim 30$ . In the high-signal ramps,  $V = 20$  stars should be saturated, and  $V = 22$  stars will have a SNR of approximately 130. At these signal levels 47 Tuc should provide many sources for the analysis of the non-linearity, from the low end at  $V = 22$ , to the bright end, where some sources will have signals well over full-well. This observing strategy is modeled after the non-linearity test performed on ACS, and

detailed in ACS ISR 2004-01 by R. Gilliland.

### **CALIBRATION JUSTIFICATION**

Accurate photometry of WFC3-IR images depends on a reliable non-linearity calibration. The data collected for this proposal will provide the information necessary to monitor the non-linearity behavior of the detector, as well as provide an update to the non-linearity calibration file produced from ground testing data.

### **ADDITIONAL COMMENTS**

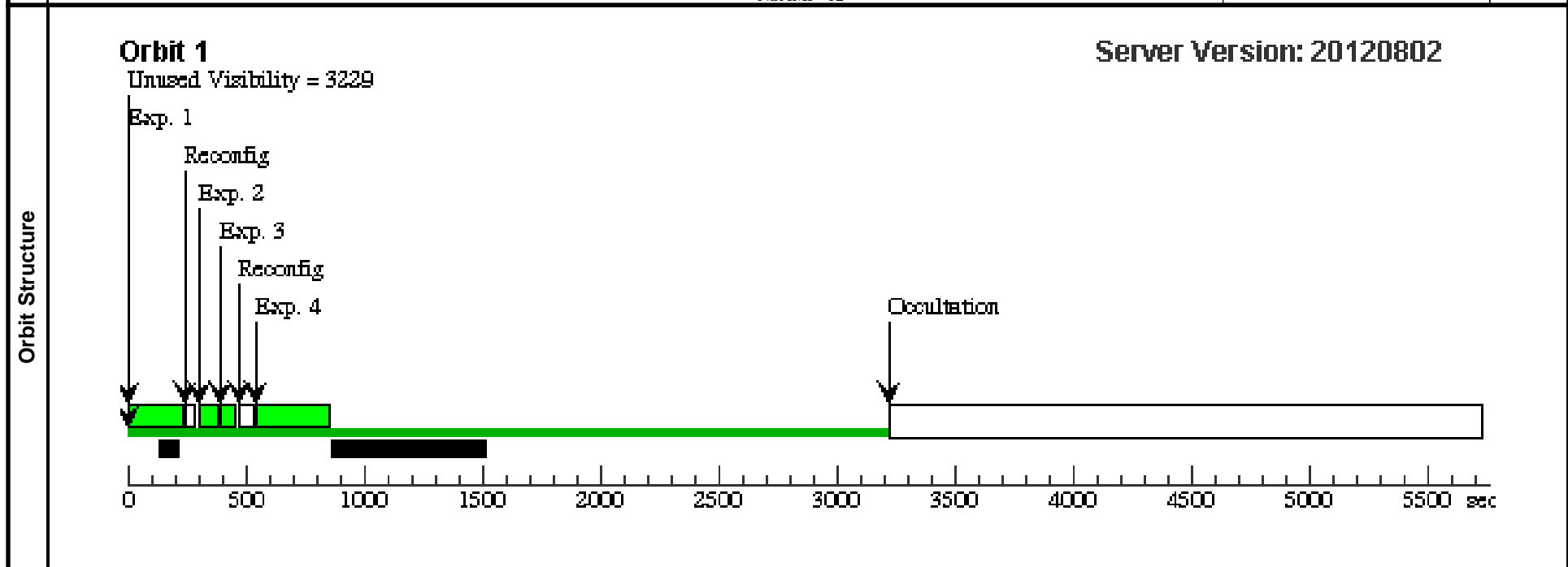
Previous versions of this test were contaminated by persistence from WFC3/IR observations made immediately prior to the calibration observations. For this iteration of the test, we have taken steps to minimize any persistence contamination while using dark current observations to monitor persistence. Each internal orbit is composed of a dark current ramp, to monitor persistence from prior observations. Also, by beginning the Visit with a dark current ramp, we will have the filter wheel at a known location when the Tungsten lamp is activated for the following flat fields. By choosing the F126N and F127M filters for the flat field collection, we guarantee that the wide band filters and the grisms will not pass through the beam while the tungsten lamp is on. If this were to happen, especially in the case of the grisms, we could very well trigger persistence.

After the dark current ramp, we collect a narrow band filter flat field, which is used to ensure that the Tungsten lamp is warm and stable in preparation for the next exposure. Cycle 17 data analysis have shown that the Tungsten lamp may need an additional 30 - 40 seconds of time beyond the nominal warm-up period before it reaches a stable flux. Since the non-linearity measurement depends critically on having a very stable flux for the duration of the ramp, we insert the short flat field to provide that extra time. By using the F126N filter, the amount of flux reaching the detector should be small enough that it will not trigger persistence.

After the narrow band "spacer" flat, we collect the flat field ramp which will be used to measure the non-linearity through the F127M filter. After this, we collect another dark current ramp, in order to monitor the persistence caused by the flat field observation.

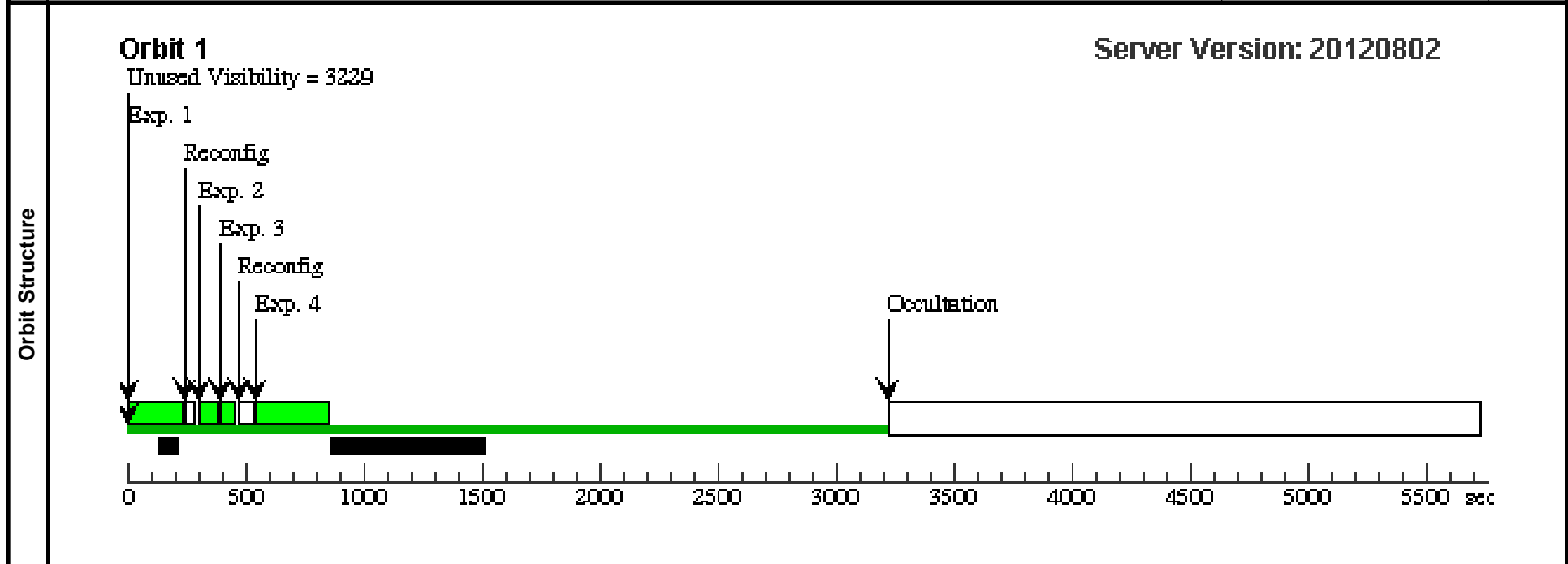
<b>Visit</b>	Proposal 13079, RAPIDa (01)								
	Diagnostic Status: No Diagnostics								
	Scientific Instruments: WFC3/IR								
	Special Requirements: (none)								

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 100; NSAMP=3			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 50; NSAMP=2			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=RAPID ; NSAMP=15			[==>]	[1]
	4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]



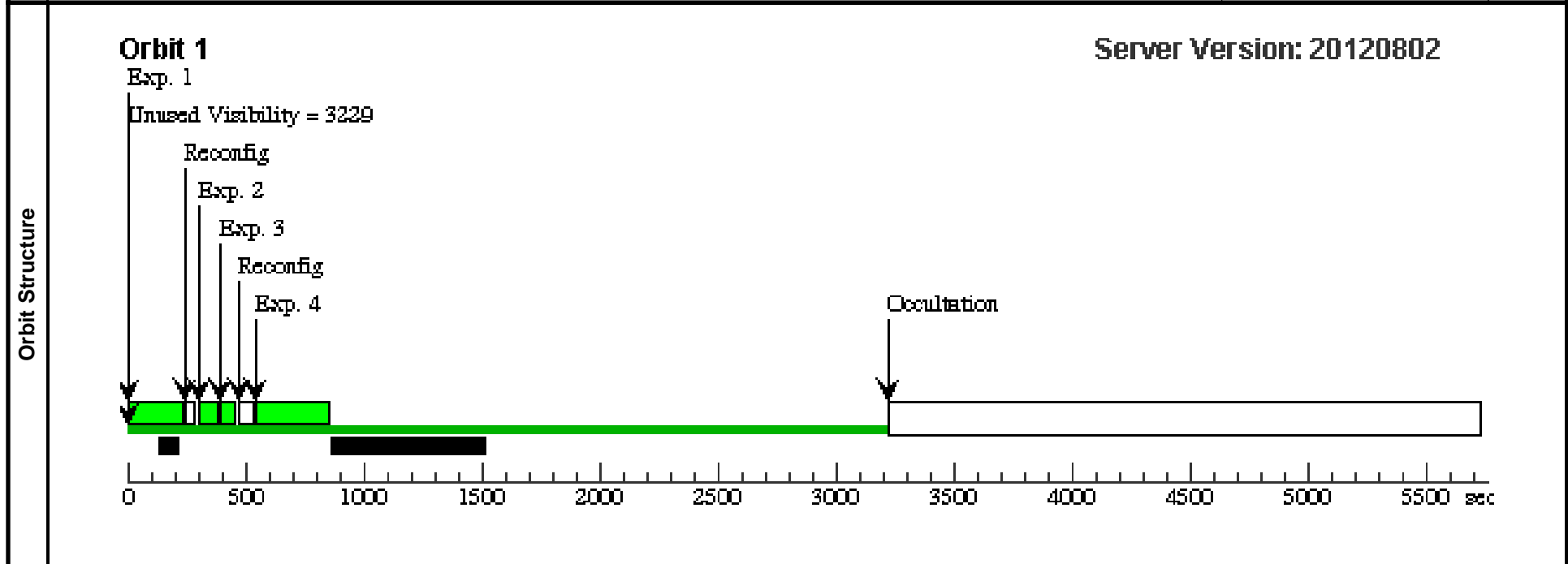
<b>Visit</b>	Proposal 13079, RAPIDb (02)								
	Diagnostic Status: No Diagnostics								
	Scientific Instruments: WFC3/IR								
	Special Requirements: (none)								

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 100; NSAMP=3			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 50; NSAMP=2			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=RAPID ; NSAMP=15			[==>]	[1]
	4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]



<b>Visit</b>	Proposal 13079, RAPIDc (03)								
	Diagnostic Status: No Diagnostics								
	Scientific Instruments: WFC3/IR								
	Special Requirements: (none)								

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 100; NSAMP=3			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 50; NSAMP=2			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=RAPID ; NSAMP=15			[==>]	[1]
4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]	

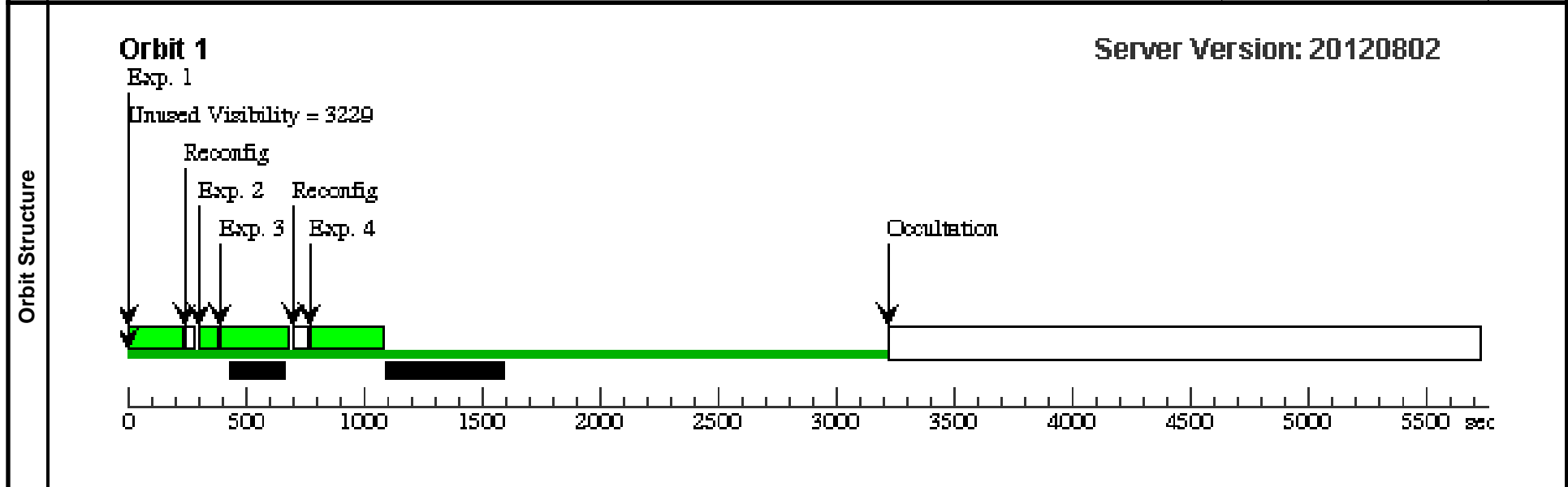


Proposal 13079 - STEP25a (04) - IR Linearity Monitor

Tue Oct 09 02:01:34 GMT 2012

<b>Visit</b>	Proposal 13079, STEP25a (04)								
	Diagnostic Status: No Diagnostics								
	Scientific Instruments: WFC3/IR								
	Special Requirements: (none)								

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 100; NSAMP=3			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 50; NSAMP=2			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=STEP2 5; NSAMP=15			[==>]	[1]
	4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]

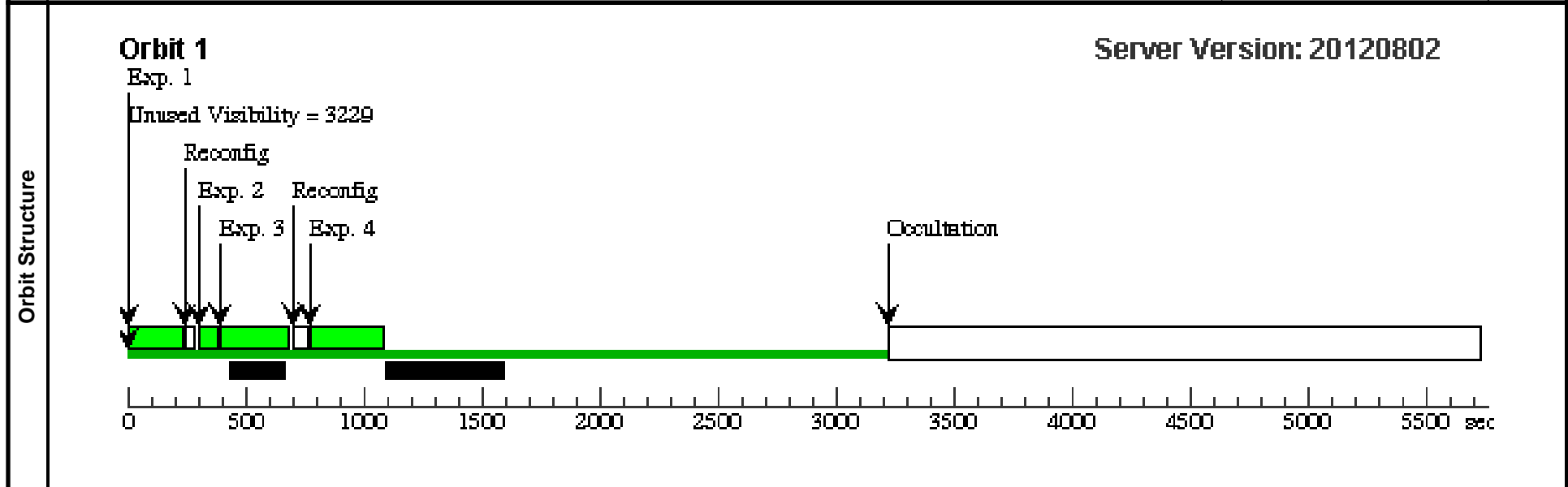


Proposal 13079 - STEP25b (05) - IR Linearity Monitor

Tue Oct 09 02:01:35 GMT 2012

<b>Visit</b>	Proposal 13079, STEP25b (05)								
	Diagnostic Status: No Diagnostics								
	Scientific Instruments: WFC3/IR								
	Special Requirements: (none)								

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 100; NSAMP=3			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 50; NSAMP=2			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=STEP2 5; NSAMP=15			[==>]	[1]
	4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]



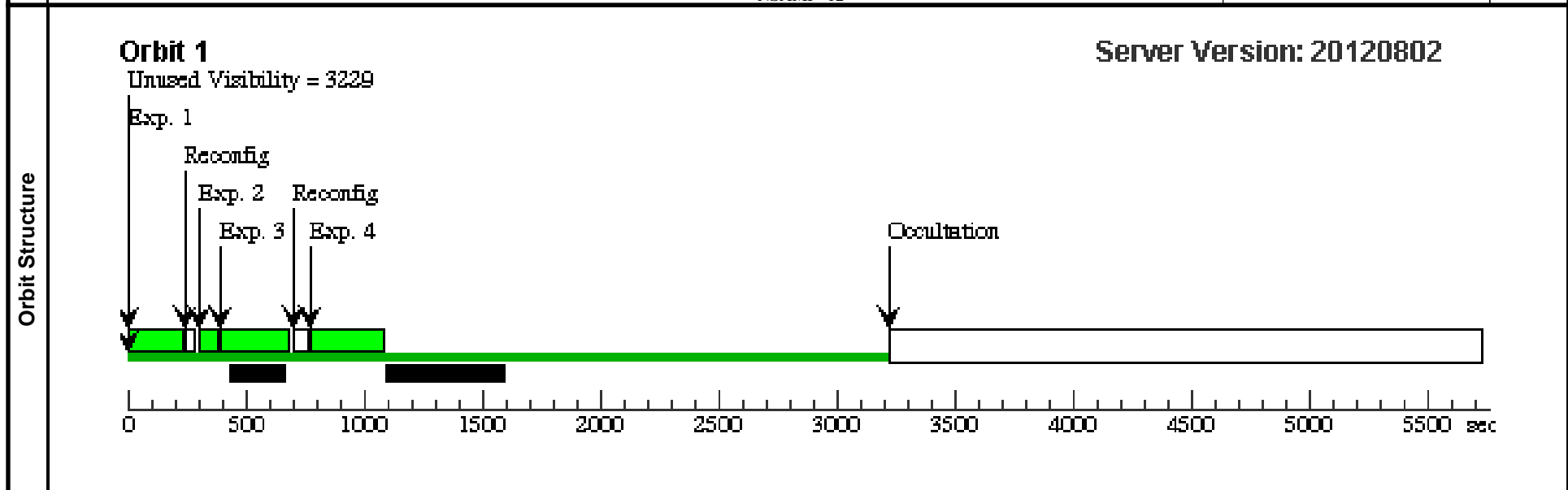


Proposal 13079 - STEP25c (06) - IR Linearity Monitor

Tue Oct 09 02:01:36 GMT 2012

<b>Visit</b>	Proposal 13079, STEP25c (06)								
	Diagnostic Status: No Diagnostics								
	Scientific Instruments: WFC3/IR								
	Special Requirements: (none)								

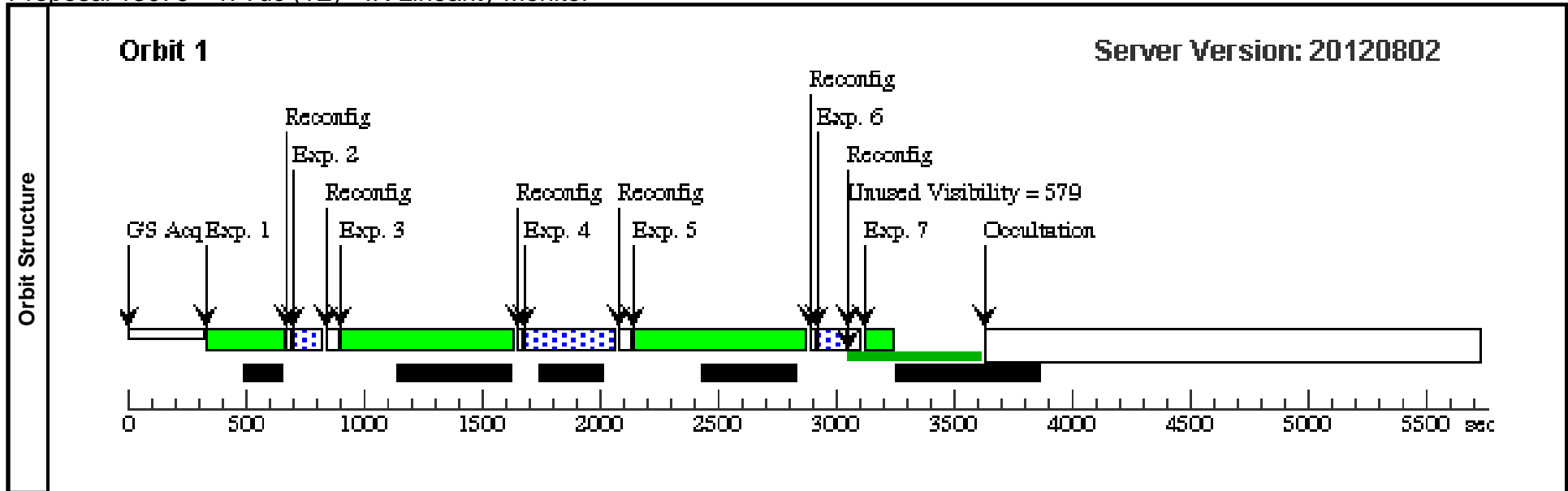
<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 100; NSAMP=3			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 50; NSAMP=2			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=STEP2 5; NSAMP=15			[==>]	[1]
	4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]



Proposal 13079 - 47Tuc (1E) - IR Linearity Monitor

Tue Oct 09 02:01:37 GMT 2012

Visit	<b>Proposal 13079, 47Tuc (1E)</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: WFC3/IR Special Requirements: (none)										
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	47TUC Alt Name1: NGC104	RA: 00 22 27.8446 (5.6160192d) Dec: -72 04 4.75 (-72.06799d) Equinox: J2000		V=22.0	Reference Frame: ICRS					
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=13			[==>]	[1]	
	2	Short	(1) 47TUC	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS 10; NSAMP=10			[==>]	[1]	
	3	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 50; NSAMP=15			[==>]	[1]	
	4	Long	(1) 47TUC	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS 25; NSAMP=15			[==>]	[1]	
	<i>Comments: Designed to just saturate V=20 stars.</i>										
	5	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 50; NSAMP=15			[==>]	[1]	
	6	Short	(1) 47TUC	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS 10; NSAMP=10			[==>]	[1]	
7	Dark	DARK	WFC3/IR, MULTIACCUM, IR-FIX	BLANK	SAMP-SEQ=SPARS 10; NSAMP=10			[==>]	[1]		



Proposal 13079 - SPARS25a (07) - IR Linearity Monitor

Tue Oct 09 02:01:38 GMT 2012

Visit	Proposal 13079, SPARS25a (07) Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: (none)									
	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=11			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 10; NSAMP=6			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=SPARS 25; NSAMP=15			[==>]	[1]
	4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]

**Orbit 1**  
Exp. 1

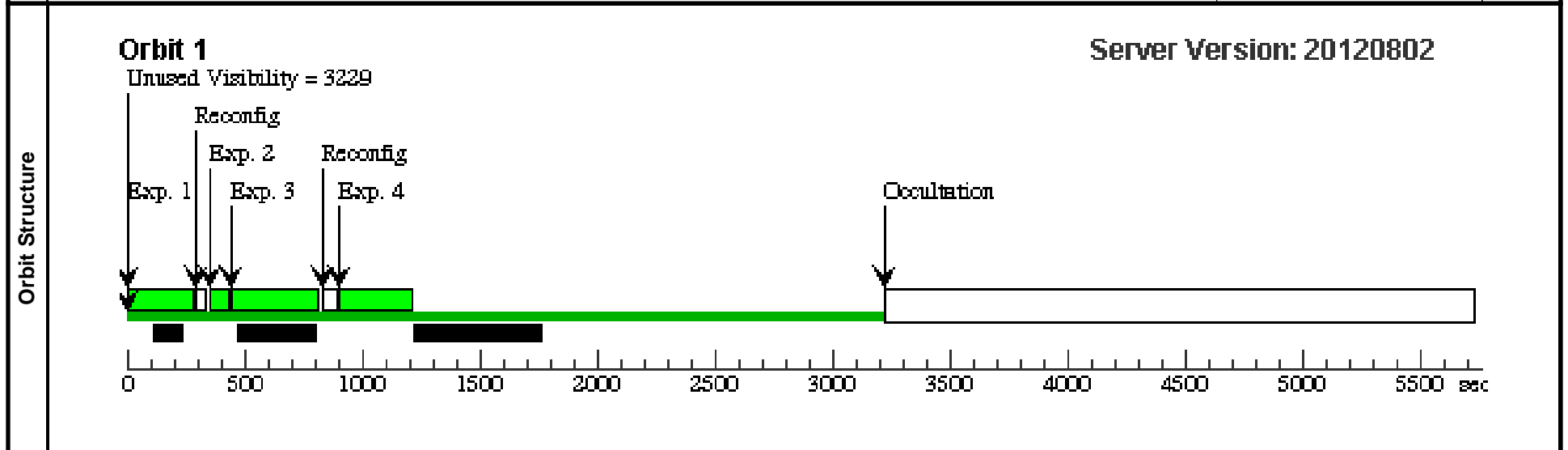
Unused Visibility = 3229

Reconfig  
Exp. 2  
Exp. 3  
Reconfig  
Exp. 4  
Occultation

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 sec

**Server Version: 20120802**

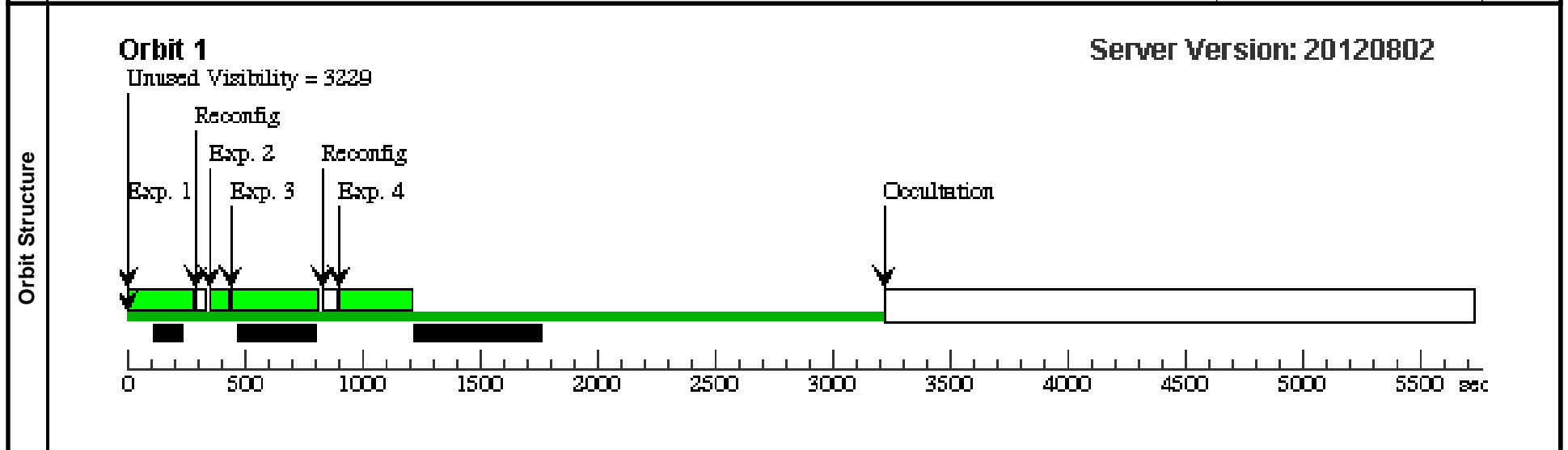
<b>Visit</b>	Proposal 13079, SPARS25b (08) <span style="float: right;">Tue Oct 09 02:01:38 GMT 2012</span> Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: (none)										
	<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time/[Actual Dur.]</b>	<b>Orbit</b>
		1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=11			[==>]	[1]
		2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 10; NSAMP=6			[==>]	[1]
		3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=SPARS 25; NSAMP=15			[==>]	[1]
4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]		



Proposal 13079 - SPARS25c (09) - IR Linearity Monitor

Tue Oct 09 02:01:39 GMT 2012

Visit	Proposal 13079, SPARS25c (09)									
	Diagnostic Status: No Diagnostics									
Scientific Instruments: WFC3/IR										
Special Requirements: (none)										
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=11			[==>]	[1]	
2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 10; NSAMP=6			[==>]	[1]	
3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=SPARS 25; NSAMP=15			[==>]	[1]	
4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]	

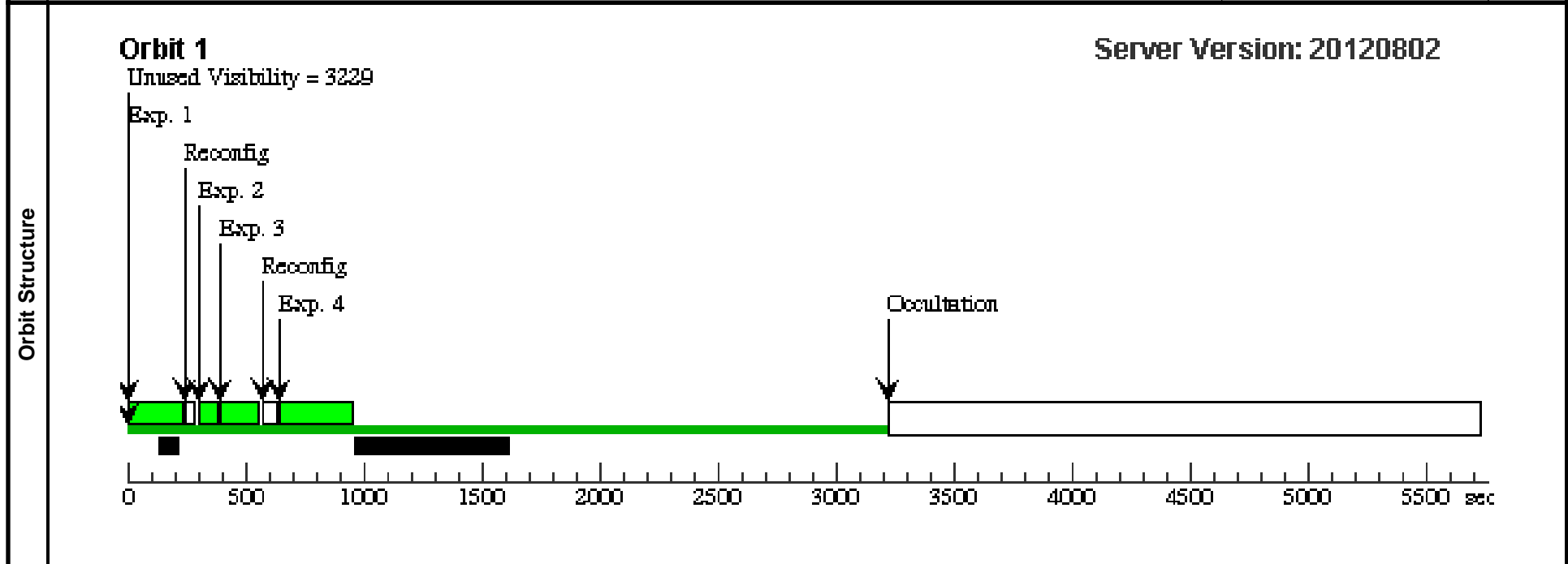


Proposal 13079 - SPARS10 (10) - IR Linearity Monitor

Tue Oct 09 02:01:40 GMT 2012

<b>Visit</b>	Proposal 13079, SPARS10 (10)								
	Diagnostic Status: No Diagnostics								
	Scientific Instruments: WFC3/IR								
	Special Requirements: (none)								

<b>Exposures</b>	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 100; NSAMP=3			[==>]	[1]
	2	warm up flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F126N	SAMP-SEQ=SPARS 50; NSAMP=2			[==>]	[1]
	3	full flat	TUNGSTEN	WFC3/IR, MULTIACCUM, IR	F127M	SAMP-SEQ=SPARS 10; NSAMP=15			[==>]	[1]
	4	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=12			[==>]	[1]



Proposal 13079 - 47Tuc (2E) - IR Linearity Monitor

Tue Oct 09 02:01:41 GMT 2012

Visit	Proposal 13079, 47Tuc (2E) Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/IR Special Requirements: (none)										
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	47TUC Alt Name1: NGC104	RA: 00 22 27.8446 (5.6160192d) Dec: -72 04 4.75 (-72.06799d) Equinox: J2000			V=22.0	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
	1	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 25; NSAMP=13			[==>]	[1]	
	2	Short	(1) 47TUC	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS 10; NSAMP=10			[==>]	[1]	
	3	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 50; NSAMP=15			[==>]	[1]	
	4	Long	(1) 47TUC	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS 25; NSAMP=15			[==>]	[1]	
	<i>Comments: Designed to just saturate V=20 stars.</i>										
	5	Dark	DARK	WFC3/IR, MULTIACCUM, IR	BLANK	SAMP-SEQ=SPARS 50; NSAMP=15			[==>]	[1]	
	6	Short	(1) 47TUC	WFC3/IR, MULTIACCUM, IR-FIX	F160W	SAMP-SEQ=SPARS 10; NSAMP=10			[==>]	[1]	
7	Dark	DARK	WFC3/IR, MULTIACCUM, IR-FIX	BLANK	SAMP-SEQ=SPARS 10; NSAMP=10			[==>]	[1]		



