



15515 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN Mass Loss

Cycle: 26, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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	(1) CAS-A-NE (4) CAS-A-EAST (7) CAS-A-SE	WFC3/UVIS	3	26-Nov-2018 10:00:34.0	yes
02	(2) CAS-A-NORTH (5) CAS-A-CENTER (8) CAS-A-SOUTH	WFC3/UVIS	3	26-Nov-2018 10:00:37.0	yes
03	(3) CAS-A-NW (6) CAS-A-WEST (9) CAS-A-SW	WFC3/UVIS	3	26-Nov-2018 10:00:39.0	yes

9 Total Orbits Used

ABSTRACT

Proposal 15515 (STScI Edit Number: 0, Created: Monday, November 26, 2018 at 10:00:40 AM Eastern Standard Time) - Overview

The young Galactic supernova remnant Cassiopeia A (Cas A) provides us with the clearest look at the properties and explosion dynamics of a high mass, core-collapse supernova (CCSN). With an explosion date around 1670, Cas A is the youngest Galactic core-collapse SNR known and, at an estimated distance of 3.4 kpc, it is also among the closest. Cas A's main shell ejecta knots are typically 0.1 - 0.5 arcsec in size and can show emission and morphological changes on timescales of just a few months. No other remnant, with the exception of SN 1987A, shows such rapid optical changes across large portions of its structure.

Here we propose a new, complete optical survey of Cas A, the first since 2004, in order to measure the velocity and asymmetry of Cas A's reverse shock front across the whole remnant and map the distribution of its high-velocity outer ejecta, particularly in regions which align to the motion of the central compact source. H α images of the remnant's shocked CSM clumps will also provide strong tests of shock-cloud models across a broad range of cloud densities and sizes. These data will constitute a rich and unique archive both for Cas A and the general study of high mass CCSNe.

OBSERVING DESCRIPTION

This program is to image the young supernova remnant, Cassiopeia A (Cas A) in three filters: F475W, F625W, and F658N. Nine separate pointings are needed in order to cover the entire remnant images. Images in the three filters will be taken at each pointing during one CVZ orbit, totaling nine CVZ orbits.

A second set of identical images will be taken roughly one year apart in Cycle 26. The second epoch images are required to discern ejecta knots from stars or distant galaxies via their high proper motions.

Cas A lies at the very southern edge of the HST's Continuous Viewing Zone (CVZ) and the use of the full 96 minute HST orbit and hence observing time allows for a much more compact and efficient observing program. Similar CVZ imaging programs of Cas A have been done in the past, despite the few days that Cas A is observable in Hubble's CVZ.

Note: We have decided to omit the H-alpha imaging in this second set of images and concentrate on the F625W images. This allows two extra images for each target region plus longer exposure times (712 sec vs 510 sec) to obtain much deeper images.

NOTE:

Proposal 15515 (STScI Edit Number: 0, Created: Monday, November 26, 2018 at 10:00:40 AM Eastern Standard Time) - Overview
Revision 4: Nov 21, 2018: Have increased the exposure times from 712 to 730 sec for all targets, and have revised the nine target locations in order to increase visibility of the remnant's outer ejecta knots relative to previous HST images.

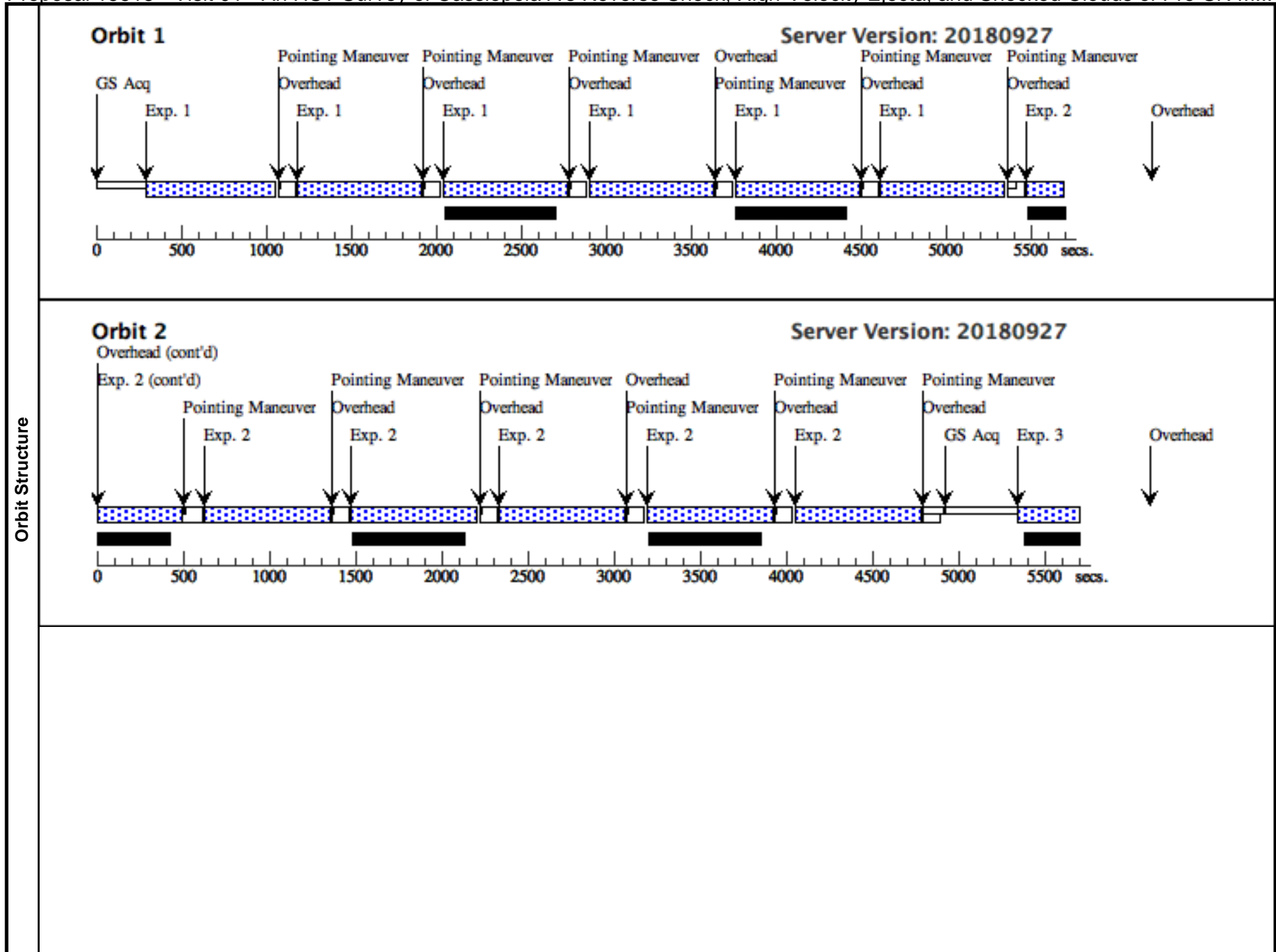
Proposal 15515 - Visit 01 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

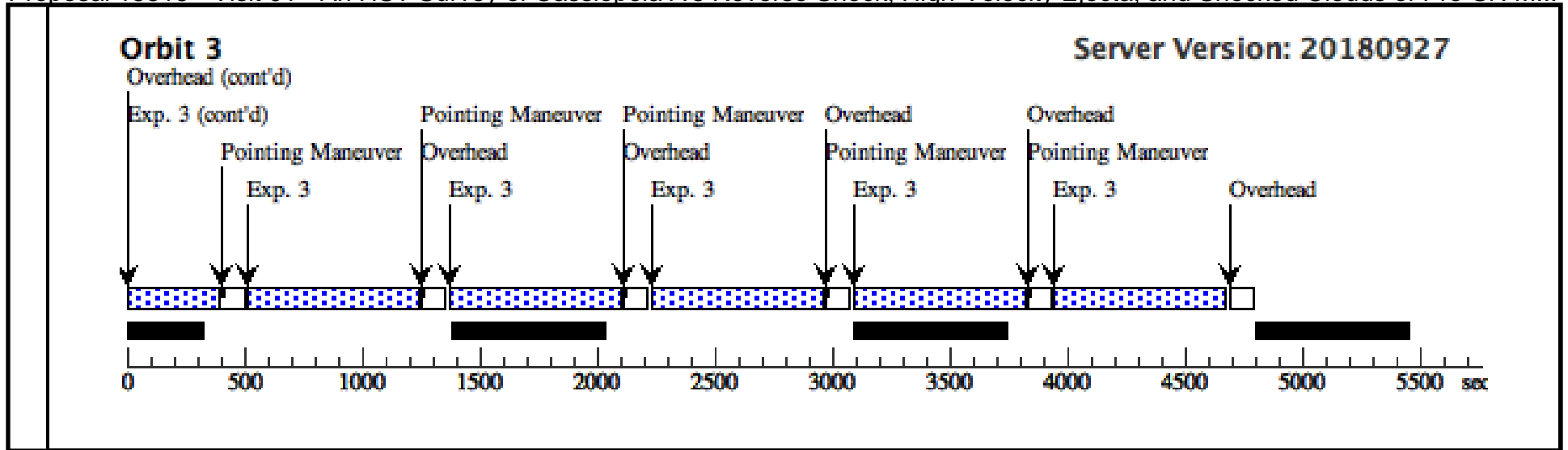
Mon Nov 26 15:00:40 GMT 2018

Visit	Proposal 15515, Visit 01, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: CVZ; ORIENT 41.0D TO 42.0 D; ORIENT 131.0D TO 132.0 D; ORIENT 221.0D TO 222.0 D; ORIENT 311.0D TO 312.0 D					
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures	
		(1)	Pattern Type=WFC3-UVIS-MOS-DITH-LINE Purpose=MOSAIC Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.754 Angle Between Sides= Center Pattern=true	Pattern Type=WFC3-UVIS-MOS-DITH-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.119 Line Spacing=	(1), (2), (3)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	CAS-A-NE	RA: 23 23 52.2000 (350.9675000d) Dec: +58 50 55.00 (58.84861d) Equinox: J2000		V=17	Reference Frame: ICRS
	<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES					
	(4)	CAS-A-EAST	RA: 23 23 48.5000 (350.9520833d) Dec: +58 49 20.00 (58.82222d) Equinox: J2000		V=17	Reference Frame: ICRS
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						
(7)	CAS-A-SE	RA: 23 23 44.0000 (350.9333333d) Dec: +58 47 3.00 (58.78417d) Equinox: J2000		V=17	Reference Frame: ICRS	
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR]						

Proposal 15515 - Visit 01 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(1) CAS-A-NE	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 1-1 i n Visit 01 (1)	730 Secs (4380 Secs)			
								[==>(Pattern 1,1)]	[1]	
								[==>(Pattern 1,2)]		
								[==>(Pattern 1,3)]		
								[==>(Pattern 2,1)]		
								[==>(Pattern 2,2)]		
								[==>(Pattern 2,3)]		
	2	(4) CAS-A-EAST	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 2-2 i n Visit 01 (1)	730 Secs (4380 Secs)			
								[==>(Pattern 1,1)]	[1]	
							[==>(Pattern 1,2)]			
							[==>(Pattern 1,3)]			
							[==>(Pattern 2,1)]	[2]		
							[==>(Pattern 2,2)]			
							[==>(Pattern 2,3)]			
3	(7) CAS-A-SE	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 3-3 i n Visit 01 (1)	730 Secs (4380 Secs)				
							[==>(Pattern 1,1)]	[2]		
							[==>(Pattern 1,2)]			
							[==>(Pattern 1,3)]			
							[==>(Pattern 2,1)]	[3]		
							[==>(Pattern 2,2)]			
							[==>(Pattern 2,3)]			





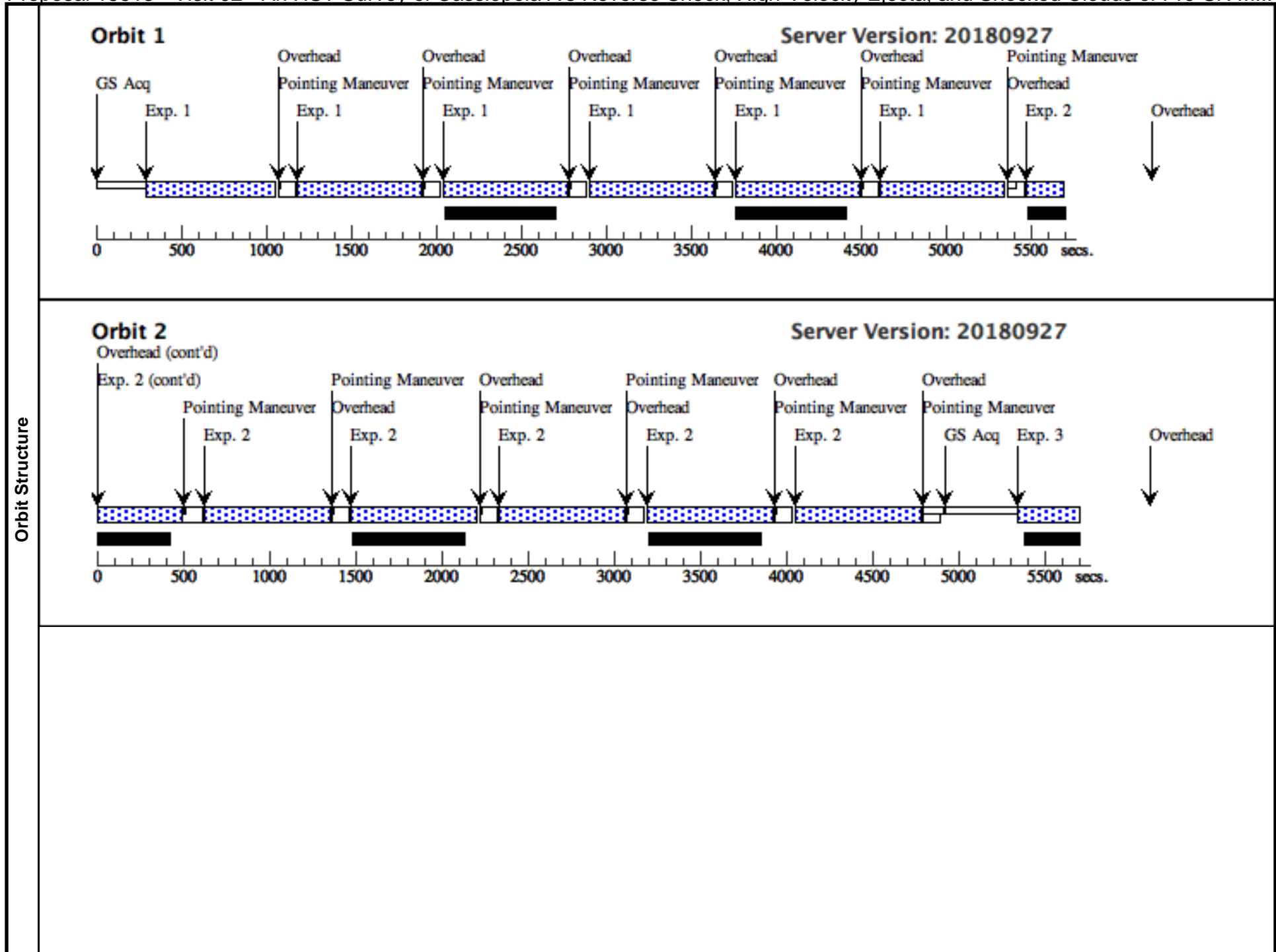
Proposal 15515 - Visit 02 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

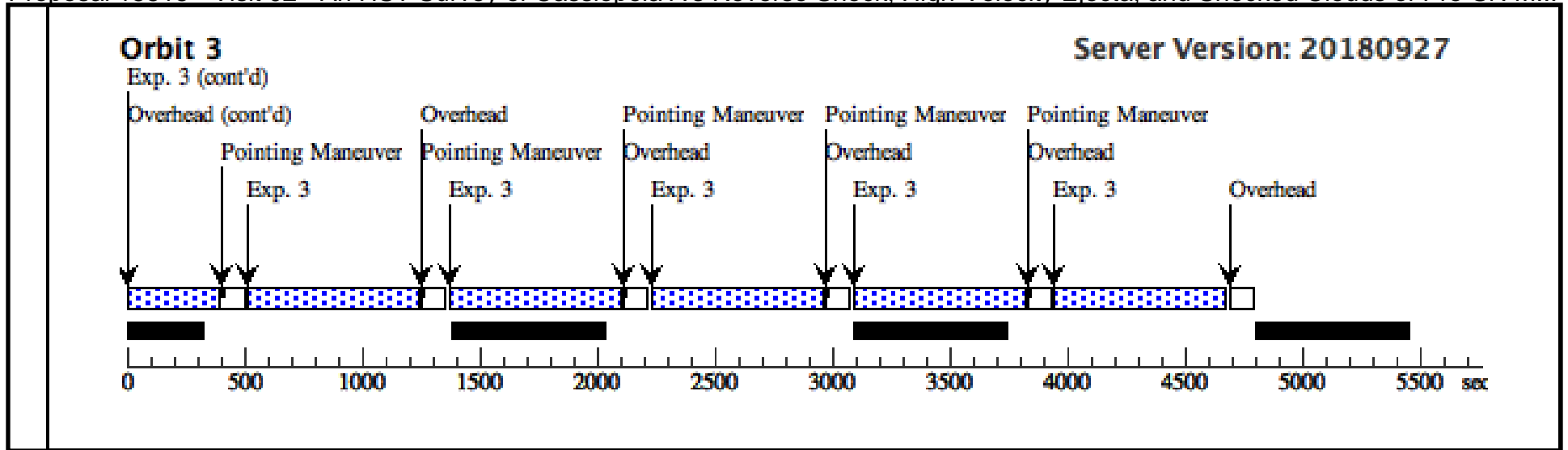
Mon Nov 26 15:00:40 GMT 2018

Visit	Proposal 15515, Visit 02, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: CVZ; SAME ORIENT AS 01					
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures	
		(1)	Pattern Type=WFC3-UVIS-MOS-DITH-LINE Purpose=MOSAIC Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.754 Angle Between Sides= Center Pattern=true	Pattern Type=WFC3-UVIS-MOS-DITH-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.119 Line Spacing=	(1), (2), (3)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(2)	CAS-A-NORTH	RA: 23 23 33.6500 (350.8902083d) Dec: +58 50 45.00 (58.84583d) Equinox: J2000		V=17	Reference Frame: ICRS
	<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES					
	(5)	CAS-A-CENTER	RA: 23 23 29.4700 (350.8727917d) Dec: +58 49 10.00 (58.81944d) Equinox: J2000		V=17	Reference Frame: ICRS
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						
(8)	CAS-A-SOUTH	RA: 23 23 25.7000 (350.8570833d) Dec: +58 46 55.00 (58.78194d) Equinox: J2000			V=17	Reference Frame: ICRS
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						

Proposal 15515 - Visit 02 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(2) CAS-A-NORTH	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 1-1 i n Visit 02 (1)	730 Secs (4380 Secs)			
								[=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 1,3)] [=>(Pattern 2,1)] [=>(Pattern 2,2)] [=>(Pattern 2,3)]	[1]	
	2	(5) CAS-A-CENTE R	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 2-2 i n Visit 02 (1)	730 Secs (4380 Secs)			
							[=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 1,3)] [=>(Pattern 2,1)] [=>(Pattern 2,2)] [=>(Pattern 2,3)]	[2]		
3	(8) CAS-A-SOUTH	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 3-3 i n Visit 02 (1)	730 Secs (4380 Secs)				
							[=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 1,3)] [=>(Pattern 2,1)] [=>(Pattern 2,2)] [=>(Pattern 2,3)]	[3]		





Proposal 15515 - Visit 03 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

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Patterns	#	Primary Pattern	Secondary Pattern	Exposures
	(1)	Pattern Type=WFC3-UVIS-MOS- DITH-LINE Purpose=MOSAIC Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.754 Angle Between Sides= Center Pattern=true	Pattern Type=WFC3-UVIS-MOS- DITH-LINE Purpose=DITHER Number Of Points=3 Point Spacing=0.119 Line Spacing=

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(3)	CAS-A-NW	RA: 23 23 15.0000 (350.8125000d) Dec: +58 50 40.00 (58.84444d) Equinox: J2000		V=17	Reference Frame: ICRS
	<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES					
	(6)	CAS-A-WEST	RA: 23 23 10.3500 (350.7931250d) Dec: +58 49 10.00 (58.81944d) Equinox: J2000		V=17	Reference Frame: ICRS
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						
(9)	CAS-A-SW	RA: 23 23 7.5000 (350.7812500d) Dec: +58 46 50.00 (58.78056d) Equinox: J2000		V=17	Reference Frame: ICRS	
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						

Proposal 15515 - Visit 03 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(3) CAS-A-NW	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 1-1 i n Visit 03 (1)	730 Secs (4380 Secs)			
								[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 1,3)] [==>(Pattern 2,1)] [==>(Pattern 2,2)] [==>(Pattern 2,3)]	[1]	
	2	(6) CAS-A-WEST	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 2-2 i n Visit 03 (1)	730 Secs (4380 Secs)			
							[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 1,3)] [==>(Pattern 2,1)] [==>(Pattern 2,2)] [==>(Pattern 2,3)]	[2]		
3	(9) CAS-A-SW	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO	Pattern 1, Exps 3-3 i n Visit 03 (1)	730 Secs (4380 Secs)				
							[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 1,3)] [==>(Pattern 2,1)] [==>(Pattern 2,2)] [==>(Pattern 2,3)]	[3]		

