



15337 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN Mass Loss

Cycle: 25, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
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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	30-Jan-2018 17:14:51.0	yes
02	(2) CAS-A-NORTH (5) CAS-A-CENTER (8) CAS-A-SOUTH	WFC3/UVIS	3	30-Jan-2018 17:14:55.0	yes
04	(5) CAS-A-CENTER (10) CAS-A-NORTH-CENTER (11) CAS-A-SOUTH-CENTER	WFC3/UVIS	3	30-Jan-2018 17:14:58.0	yes
03	(3) CAS-A-NW (6) CAS-A-WEST (9) CAS-A-SW	WFC3/UVIS	3	30-Jan-2018 17:15:02.0	yes

12 Total Orbits Used

ABSTRACT

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 is 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.

Proposal 15337 - Visit 01 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

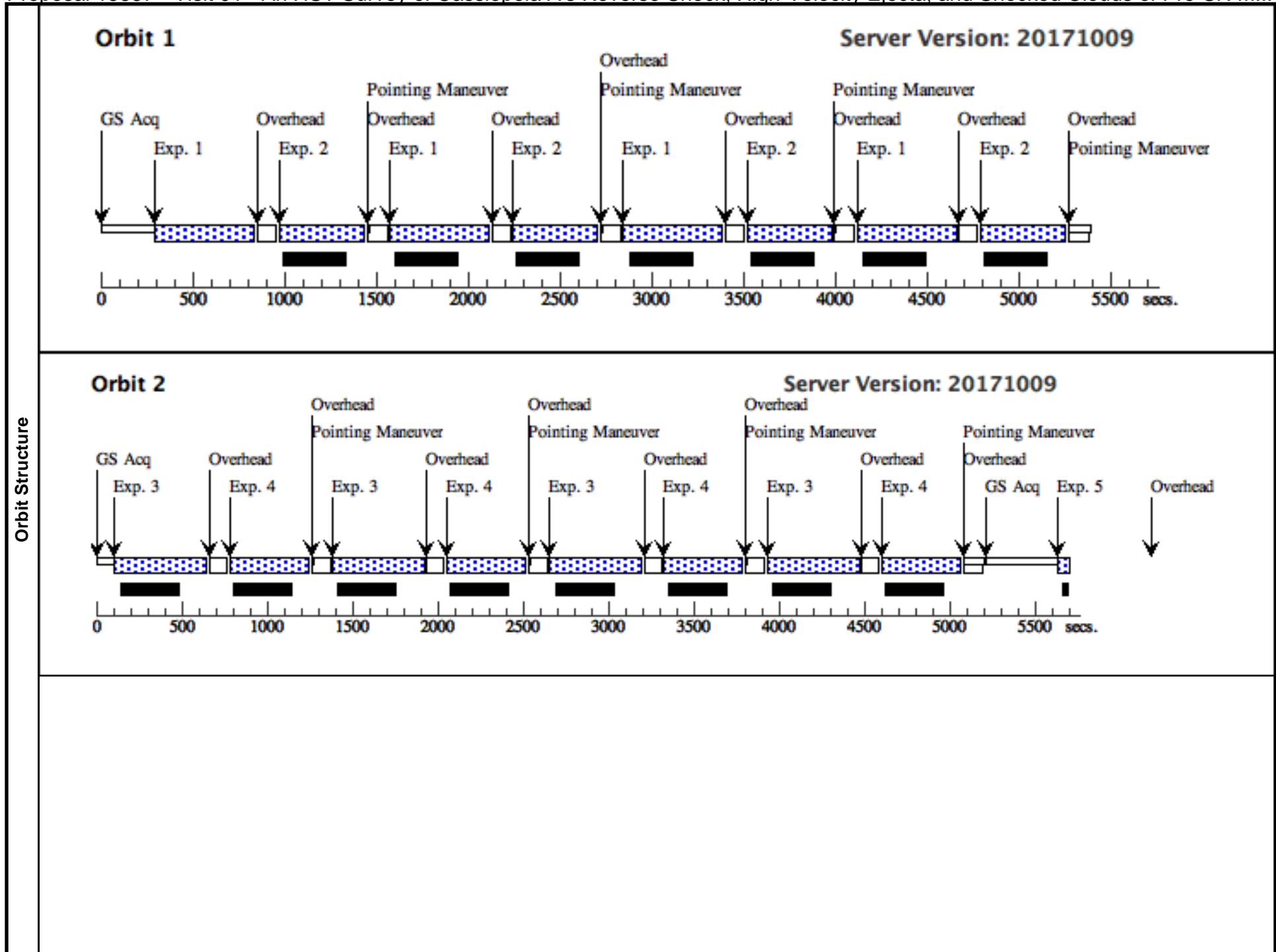
Tue Jan 30 22:15:04 GMT 2018

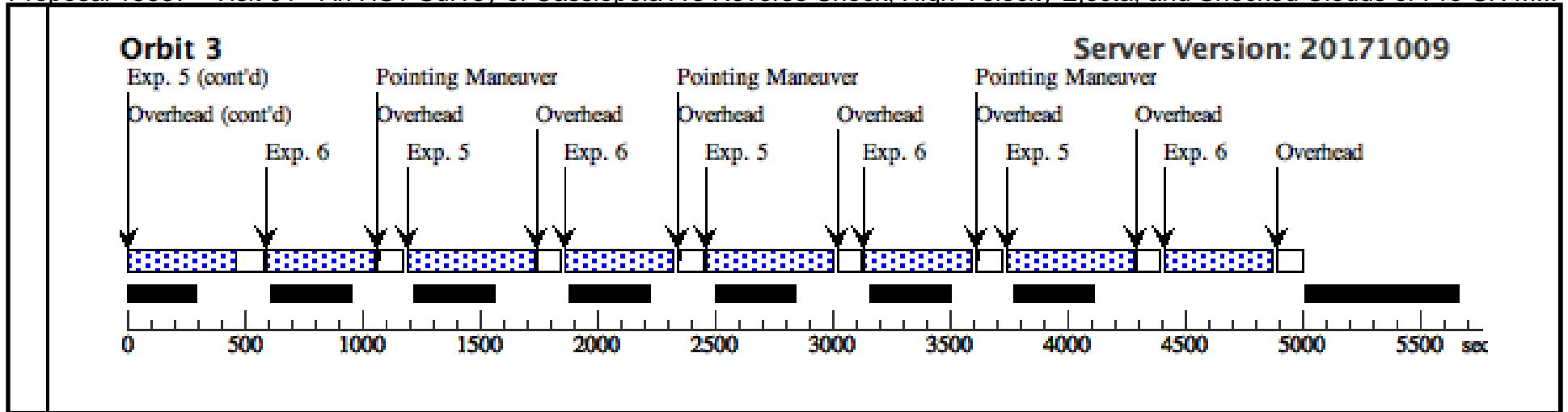
Patterns	#	Primary Pattern	Secondary Pattern	Exposures
	(1)	Pattern Type=WFC3-UVIS-MOS- DITH-LINE Purpose=MOSAIC Number Of Points=2 Point Spacing=2.4 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=85.754 Angle Between Sides= Center Pattern=true	Pattern Type=WFC3-UVIS-MOS- DITH-LINE Purpose=DITHER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

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(1)	CAS-A-NE	RA: 23 23 43.3000 (350.9304167d) Dec: +58 51 25.00 (58.85694d) 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 43.3000 (350.9304167d) Dec: +58 49 4.77 (58.81799d) 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 43.3000 (350.9304167d) Dec: +58 46 45.00 (58.77917d) Equinox: J2000			V=17	Reference Frame: ICRS
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR]						

Proposal 15337 - Visit 01 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(1) CAS-A-NE	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 1-2 in Visit 01 (1)	515 Secs (2060 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[1]
	2	(1) CAS-A-NE	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	CR-SPLIT=NO; FLASH=12		Pattern 1, Exps 1-2 in Visit 01 (1)	450 Secs (1800 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[1]
	3	(4) CAS-A-EAST	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 3-4 in Visit 01 (1)	515 Secs (2060 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2]
	4	(4) CAS-A-EAST	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12		Pattern 1, Exps 3-4 in Visit 01 (1)	450 Secs (1800 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2]
	5	(7) CAS-A-SE	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 5-6 in Visit 01 (1)	515 Secs (2060 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2] [3]
	6	(7) CAS-A-SE	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12		Pattern 1, Exps 5-6 in Visit 01 (1)	450 Secs (1800 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[3]





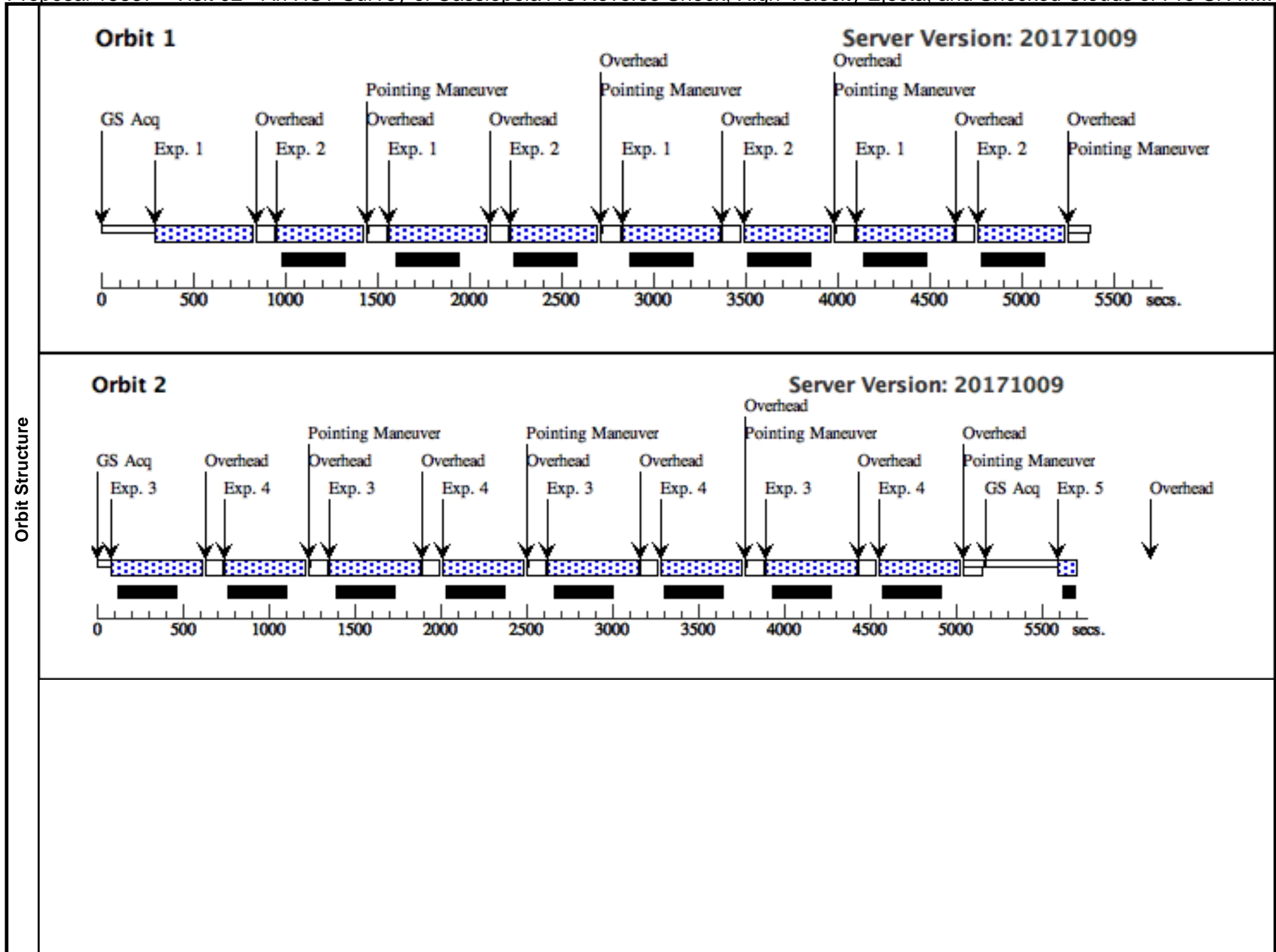
Proposal 15337 - Visit 02 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

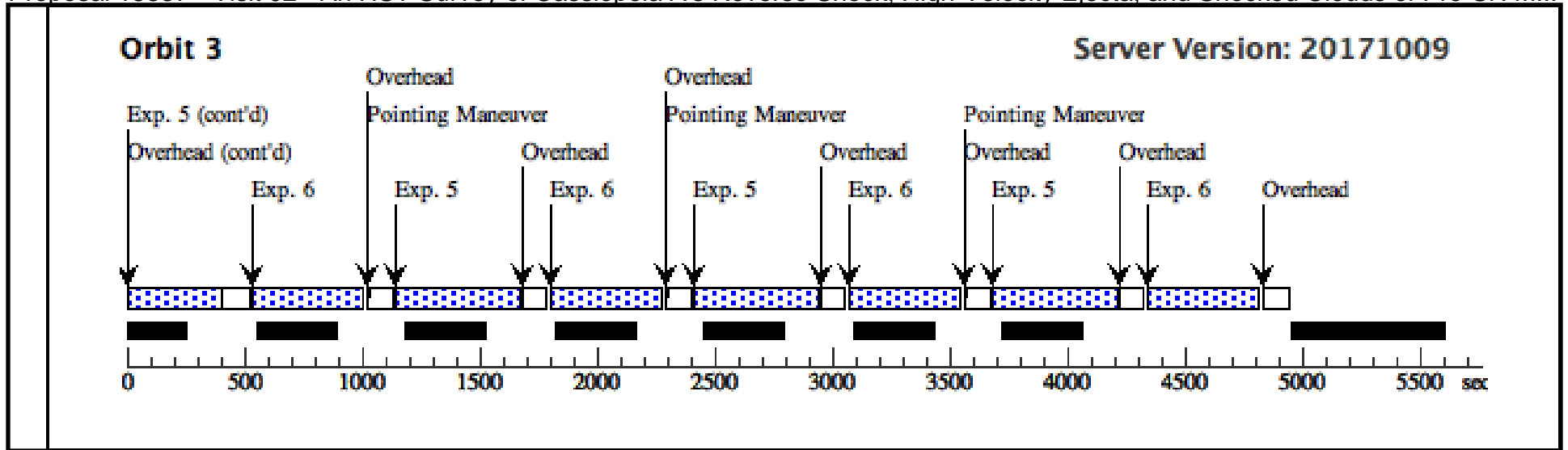
Tue Jan 30 22:15:04 GMT 2018

Visit	Proposal 15337, Visit 02, completed 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=2 Point Spacing=0.119 Line Spacing=	(1-2), (3-4), (5-6)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(2)	CAS-A-NORTH	RA: 23 23 24.2600 (350.8510833d) Dec: +58 51 21.00 (58.85583d) 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 24.2500 (350.8510417d) Dec: +58 49 0.00 (58.81667d) 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 24.2300 (350.8509583d) Dec: +58 46 40.00 (58.77778d) Equinox: J2000			V=17	Reference Frame: ICRS
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						

Proposal 15337 - 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 1-2 in Visit 02 (1)	500 Secs (2000 Secs)	
									[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)]	[1]
	2	(2) CAS-A-NORTH	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	CR-SPLIT=NO; FLASH=12			Pattern 1, Exps 1-2 in Visit 02 (1)	460 Secs (1840 Secs)	
									[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)]	[1]
	3	(5) CAS-A-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO			Pattern 1, Exps 3-4 in Visit 02 (1)	500 Secs (2000 Secs)	
									[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)]	[2]
4	(5) CAS-A-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12			Pattern 1, Exps 3-4 in Visit 02 (1)	460 Secs (1840 Secs)		
								[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)]	[2]	
5	(8) CAS-A-SOUTH	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO			Pattern 1, Exps 5-6 in Visit 02 (1)	500 Secs (2000 Secs)		
								[==>(Pattern 1,1)]	[2]	
								[==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)]	[3]	
6	(8) CAS-A-SOUTH	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12			Pattern 1, Exps 5-6 in Visit 02 (1)	460 Secs (1840 Secs)		
								[==>(Pattern 1,1)] [==>(Pattern 1,2)] [==>(Pattern 2,1)] [==>(Pattern 2,2)]	[3]	





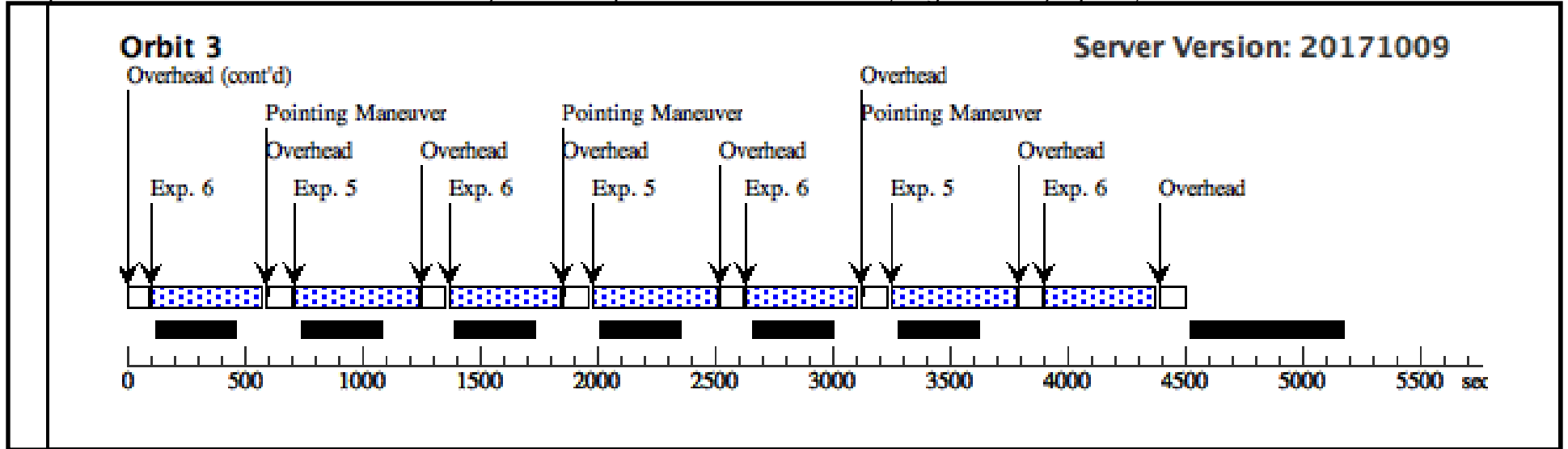
Proposal 15337 - Visit 04 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

Tue Jan 30 22:15:04 GMT 2018

Visit	Proposal 15337, Visit 04, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: CVZ; ORIENT 0D TO 6 D Comments: copy of visit 2 - HOPR repeat					
	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=2 Point Spacing=0.119 Line Spacing=	(1-2), (3-4), (5-6)
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(5)	CAS-A-CENTER	RA: 23 23 24.2500 (350.8510417d) Dec: +58 49 0.00 (58.81667d) Equinox: J2000		V=17	Reference Frame: ICRS
	Comments: Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES					
	(10)	CAS-A-NORTH-CENTER	RA: 23 23 24.2600 (350.8510833d) Dec: +58 50 40.00 (58.84444d) Equinox: J2000		V=17	Reference Frame: ICRS
Comments: Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						
(11)	CAS-A-SOUTH-CENTER	RA: 23 23 24.2300 (350.8509583d) Dec: +58 47 20.00 (58.78889d) Equinox: J2000		V=17	Reference Frame: ICRS	
Comments: Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						

Proposal 15337 - Visit 04 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(10) CAS-A-NORTH-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 1-2 in Visit 04 (1)	500 Secs (2000 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[1]
	2	(10) CAS-A-NORTH-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	CR-SPLIT=NO; FLASH=12		Pattern 1, Exps 1-2 in Visit 04 (1)	460 Secs (1840 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[1]
	3	(5) CAS-A-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 3-4 in Visit 04 (1)	500 Secs (2000 Secs) [=>(Pattern 1,1)]	[1]
								[=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2]
	4	(5) CAS-A-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12		Pattern 1, Exps 3-4 in Visit 04 (1)	460 Secs (1840 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2]
	5	(11) CAS-A-SOUTH-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 5-6 in Visit 04 (1)	500 Secs (2000 Secs) [=>(Pattern 1,1)]	[2]
							[=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[3]	
6	(11) CAS-A-SOUTH-CENTER	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12		Pattern 1, Exps 5-6 in Visit 04 (1)	460 Secs (1840 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[3]	



Proposal 15337 - Visit 03 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

Tue Jan 30 22:15:05 GMT 2018

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=2 Point Spacing=0.119 Line Spacing=

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(3)	CAS-A-NW	RA: 23 23 5.1000 (350.7712500d) Dec: +58 51 15.00 (58.85417d) 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 5.1000 (350.7712500d) Dec: +58 48 55.00 (58.81528d) 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 5.1000 (350.7712500d) Dec: +58 46 35.00 (58.77639d) Equinox: J2000		V=17	Reference Frame: ICRS	
<i>Comments:</i> Category=ISM Description=[EJECTA, EMISSION LINE NEBULA, SHOCK FRONT, SNR] Extended=YES						

Proposal 15337 - Visit 03 - An HST Survey of Cassiopeia A's Reverse Shock, High-Velocity Ejecta, and Shocked Clouds of Pre-SN M...

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(3) CAS-A-NW	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 1-2 in Visit 03 (1)	500 Secs (2000 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[1]
	2	(3) CAS-A-NW	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	CR-SPLIT=NO; FLASH=12		Pattern 1, Exps 1-2 in Visit 03 (1)	460 Secs (1840 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[1]
	3	(6) CAS-A-WEST	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 3-4 in Visit 03 (1)	500 Secs (2000 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2]
	4	(6) CAS-A-WEST	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12		Pattern 1, Exps 3-4 in Visit 03 (1)	460 Secs (1840 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2]
	5	(9) CAS-A-SW	WFC3/UVIS, ACCUM, UVIS-CENTER	F625W	CR-SPLIT=NO		Pattern 1, Exps 5-6 in Visit 03 (1)	500 Secs (2000 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[2] [3]
	6	(9) CAS-A-SW	WFC3/UVIS, ACCUM, UVIS-CENTER	F657N	FLASH=12		Pattern 1, Exps 5-6 in Visit 03 (1)	460 Secs (1840 Secs) [=>(Pattern 1,1)] [=>(Pattern 1,2)] [=>(Pattern 2,1)] [=>(Pattern 2,2)]	[3]

