



14159 - Monitoring an Internal Shock Collision in Action in 3C 264

Cycle: 23, 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) 3C264	WFC3/UVIS	2	07-Nov-2015 21:14:57.0	yes
02	(1) 3C264	ACS/WFC	1	07-Nov-2015 21:14:59.0	yes
A1	BIAS	ACS/WFC	1	07-Nov-2015 21:15:00.0	yes
A2	BIAS	ACS/WFC	1	07-Nov-2015 21:15:01.0	yes
A3	BIAS	ACS/WFC	1	07-Nov-2015 21:15:01.0	yes
A4	BIAS	ACS/WFC	1	07-Nov-2015 21:15:02.0	yes

ABSTRACT

3C264 is a nearby radio galaxy with a prominent optical jet. Recent HST observations (May 2014) have revealed not only the fastest-ever superluminal speed (on kpc scales) of $7c$ for knot B, but also that knot B is in the very early stages of a collision with slow-moving downstream knot C (Meyer et al. 2015, *Nature*). This remarkable discovery represents the first strong evidence for the "internal shock" model for particle acceleration, a mechanism proposed to explain sources as diverse as gamma-ray bursts, microquasars, and jetted AGN. While a popular theoretical framework, such a collision has never actually been observed directly in any astrophysical object. Our recent HST imaging has captured the collision in its incipient stages, thus we have a unique opportunity to monitor a major shock collision as it unfolds. We propose 2 epochs of WFC3/UVIS (near-UV, B, and I band) imaging to monitor the optical-UV spectral energy distribution for the colliding knots and continue spatial proper motion measurements of the jet over the next 2-3 years. We also request 1 orbit of polarimetry in F606W with ACS/WFC in each epoch to monitor the polarization structure in the jet for changes as a result of the collision. The collision is expected to manifest in brightening and hardening of the optical spectrum and increasing polarization over the next several years, and our observations will allow us to evaluate the applicability, efficiency and physical characterization of the internal shock mechanism.

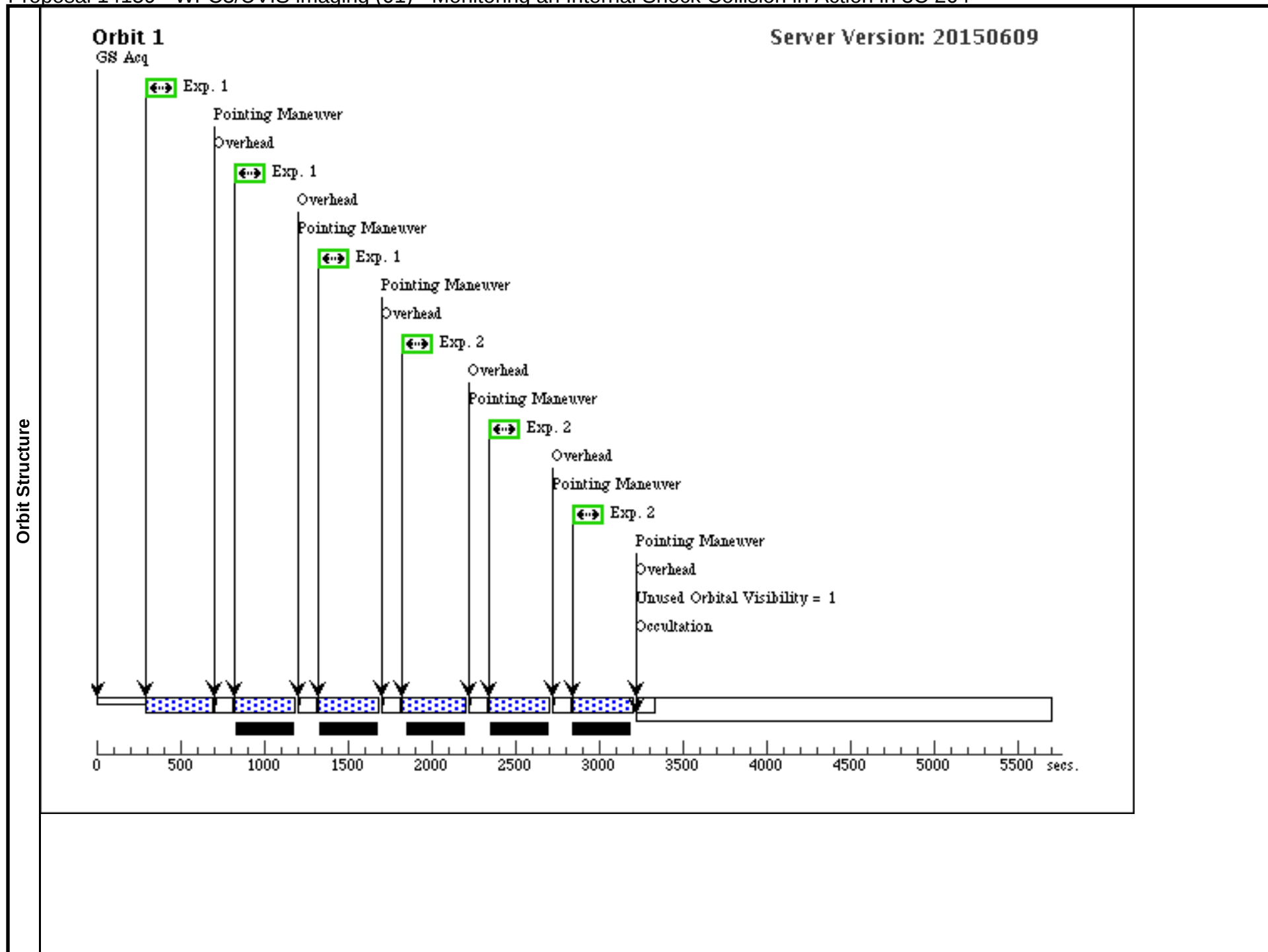
OBSERVING DESCRIPTION

Observations are of an optical jet approximately 2" long in the northeast direction, as part of a monitoring proposal for flaring behavior (follow-up time awarded in cycle 25). The field of view is dominated by the host galaxy, a nearby elliptical. The observations consist of two visits: the first is WFC3/UVIS imaging in three filters (F475W, F814W splitting the first orbit, F225W in the second orbit). The second visit is ACS/WFC polarimetry in F606W filter. Orient constraints are specified to avoid any risk of the central nucleus from producing diffraction spikes that run over the jet. Secondly, we request that the observations occur before March 2016 in order to evaluate the flux level of the jet, in case a rapid increase is detected which would warrant additional observations before the next scheduled observation in cycle 25.

CALIBRATION ORBITS: As per STScI policy, 4 internal orbits have been added to this proposal for the purpose of obtaining subarray bias frames that are contemporaneous with the science observations. These internal orbits will be charged to STScI's Cycle 23 ACS Calibration Program, not to GO 14159. The ACS Instrument Team at STScI is responsible for producing superbias reference files from the bias frames obtained in this GO proposal.

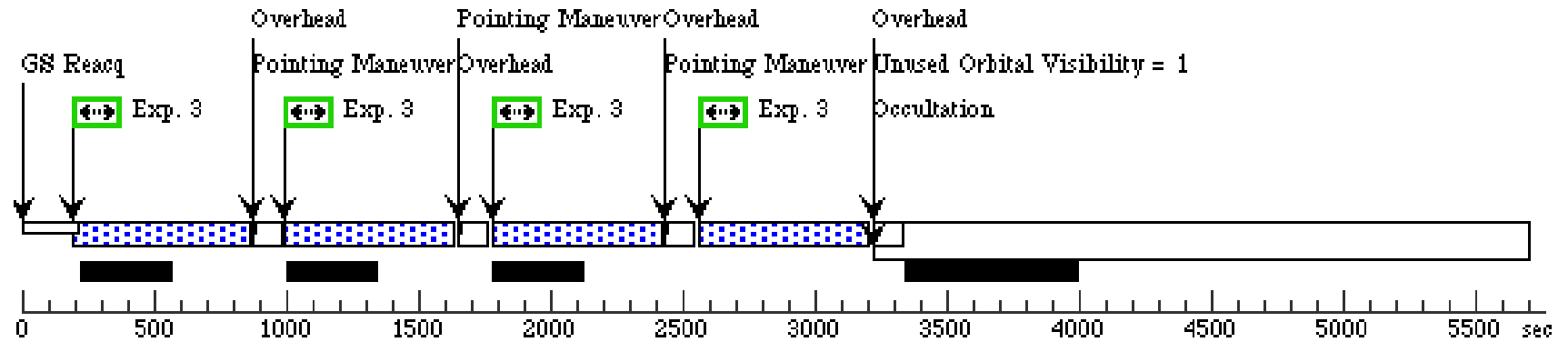
Proposal 14159 - WFC3/UVIS imaging (01) - Monitoring an Internal Shock Collision in Action in 3C 264

Visit	Proposal 14159, WFC3/UVIS imaging (01), implementation										Sun Nov 08 02:15:03 GMT 2015
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: WFC3/UVIS										
	Special Requirements: ORIENT 25D TO 55 D; ORIENT 110D TO 145 D; ORIENT 290D TO 325 D; BEFORE 15-MAR-2016:00:00:00										
Comments: We used a 3-point dithering pattern for the sets of F475W (3 exp) and F814W (3 exp) observations in the first epoch. We used a 4-point dithering pattern for the 4 F225W exposures in the second orbit. Orient constraints are specified to avoid any risk of the central nucleus from producing diffraction spikes that run over the jet. We request observations in late 2015 in order to evaluate if the flux from the jet is rapidly increasing (i.e. flaring). POS TARGETS are also used to put the target somewhat closer to the readout corner to minimize CTE.											
Patterns	#	Primary Pattern					Secondary Pattern				Exposures
	(1)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Purpose=DITHER Number Of Points=3 Point Spacing=0.135 Line Spacing=			Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false						(1), (2)
	(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112			Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false						(3)
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous		
	(1)	3C264	RA: 11 45 5.0090 (176.2708708d) Dec: +19 36 22.74 (19.60632d) Equinox: J2000				V=13.97		Reference Frame: SIMBAD		
	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	F475W	(1) 3C264	WFC3/UVIS, ACCUM, UVIS1	F475W	FLASH=6	POS TARG 30,10; GS ACQ SCENARI O BASE1B3	Pattern 1, Exps 1-1 i n WFC3/UVIS imagi ng (01) (1)	366 Secs (1098 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]		[1]
	2	F814W	(1) 3C264	WFC3/UVIS, ACCUM, UVIS1	F814W	FLASH=5	POS TARG 30,10	Pattern 1, Exps 2-2 i n WFC3/UVIS imagi ng (01) (1)	366 Secs (1098 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)]		[1]
	3	F225W	(1) 3C264	WFC3/UVIS, ACCUM, UVIS1	F225W	FLASH=10	POS TARG 30,10	Pattern 2, Exps 3-3 i n WFC3/UVIS imagi ng (01) (2)	647 Secs (2588 Secs) [==>(Pattern 1)] [==>(Pattern 2)] [==>(Pattern 3)] [==>(Pattern 4)]		[2]



Orbit 2

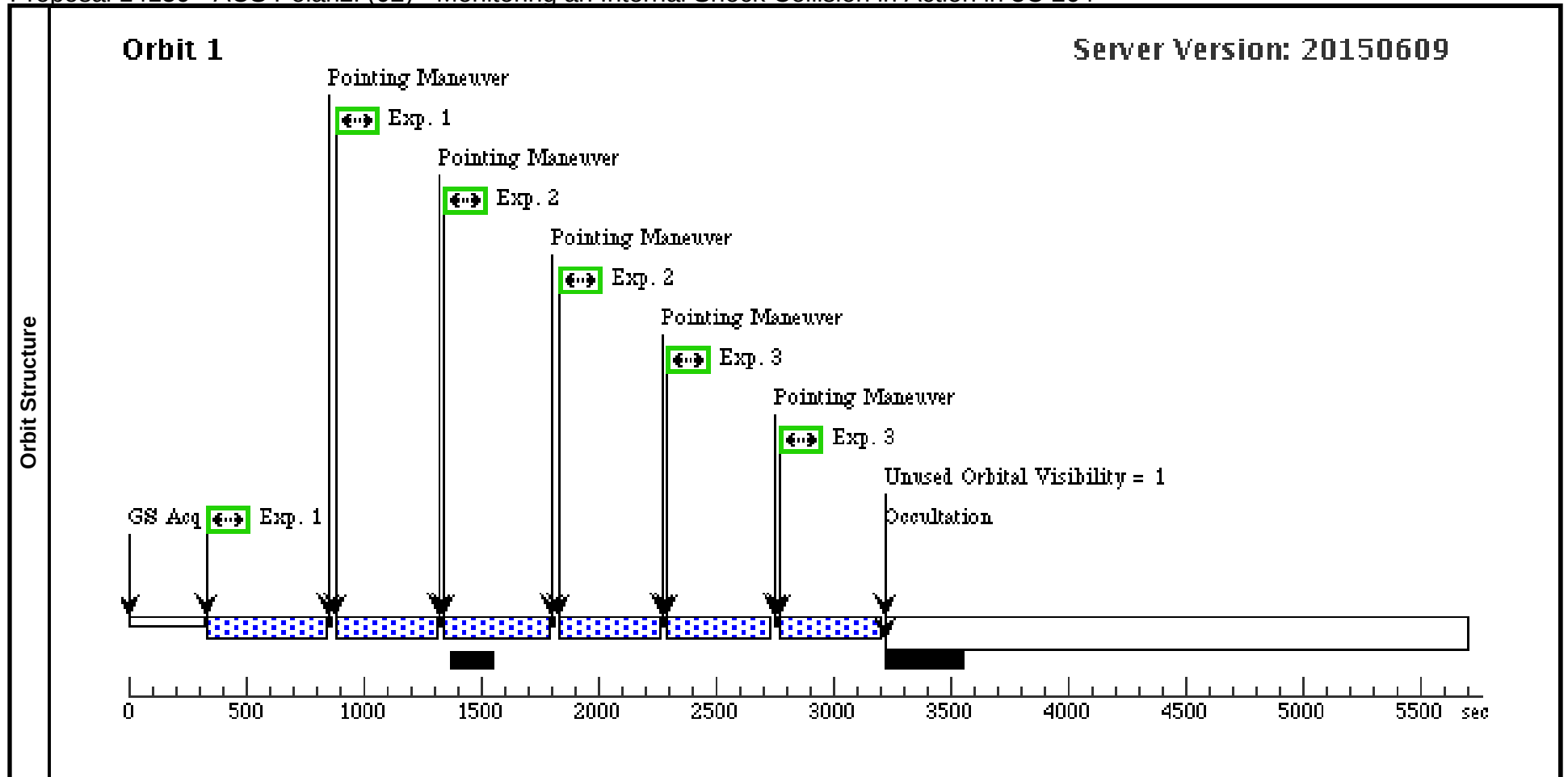
Server Version: 20150609



Proposal 14159 - ACS Polariz. (02) - Monitoring an Internal Shock Collision in Action in 3C 264

Sun Nov 08 02:15:04 GMT 2015

Visit	Proposal 14159, ACS Polariz. (02), implementation							Sun Nov 08 02:15:04 GMT 2015		
	Diagnostic Status: No Diagnostics									
	Scientific Instruments: ACS/WFC									
	Special Requirements: ORIENT 40D TO 85 D; ORIENT 128D TO 170 D; ORIENT 215D TO 270 D; ORIENT 305D TO 345 D; BEFORE 10-APR-2016:00:00:00									
Comments: 1 orbit of ACS polarization in F606W filter. The observations cover the three polarization angle filters, with two exposures each, using a 2-point dither pattern to improve image quality and mitigate cosmic ray artifacts. Orient constraints are specified to avoid any risk of the central nucleus from producing diffraction spikes that run over the jet. We request observations in late 2015 in order to evaluate if the flux from the jet is rapidly increasing (i.e. flaring).										
Patterns	#	Primary Pattern			Secondary Pattern			Exposures		
	(3)	Pattern Type=ACS-WFC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=3.011 Line Spacing=		Coordinate Frame=POS-TARG Pattern Orientation=85.28 Angle Between Sides= Center Pattern=false				(1), (2), (3)		
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(1)	3C264	RA: 11 45 5.0090 (176.2708708d) Dec: +19 36 22.74 (19.60632d) Equinox: J2000				V=13.97		Reference Frame: SIMBAD	
	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		(1) 3C264	ACS/WFC, ACCUM, WFC1	F606W		POS TARG 0,0	Pattern 3, Exps 1-1 in ACS Polariz. (02) (3)	253 Secs (506 Secs)	
					POL0V				[==>(Pattern 1)] [==>(Pattern 2)]	[1]
	2		(1) 3C264	ACS/WFC, ACCUM, WFC1	F606W		POS TARG 0,0	Pattern 3, Exps 2-2 in ACS Polariz. (02) (3)	253 Secs (506 Secs)	
					POL120V				[==>(Pattern 1)] [==>(Pattern 2)]	[1]
	3		(1) 3C264	ACS/WFC, ACCUM, WFC1	F606W		POS TARG 0,0	Pattern 3, Exps 3-3 in ACS Polariz. (02) (3)	253 Secs (506 Secs)	
					POL60V				[==>(Pattern 1)] [==>(Pattern 2)]	[1]



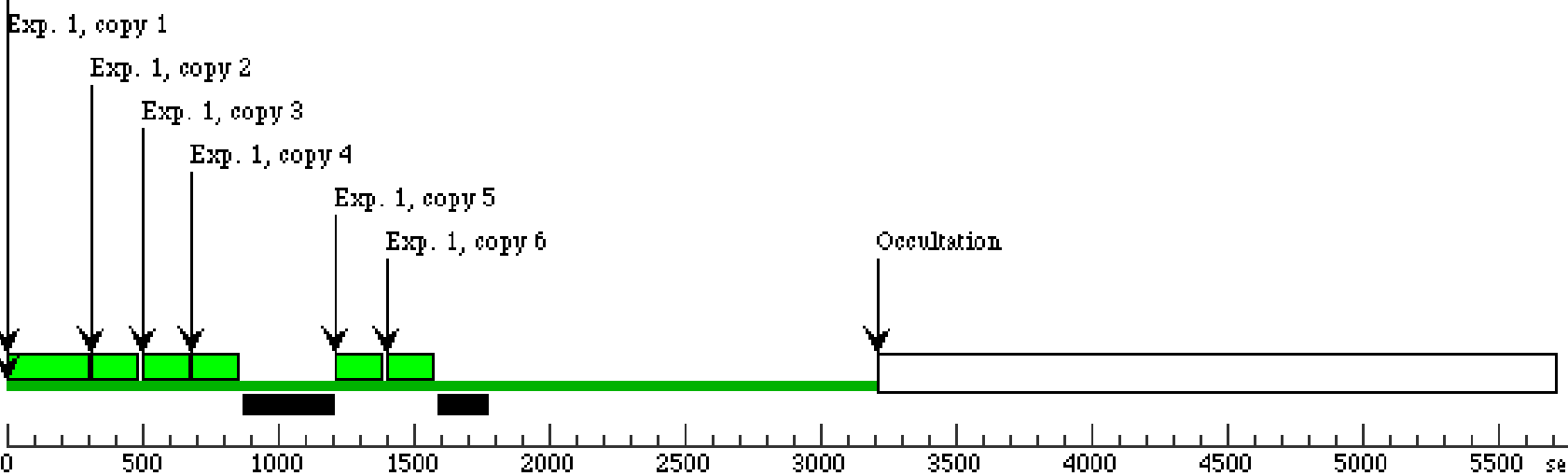
Proposal 14159 - WFC1-2K_BIAS (A1) - Monitoring an Internal Shock Collision in Action in 3C 264

Visit	Proposal 14159, WFC1-2K_BIAS (A1), implementation									Sun Nov 08 02:15:04 GMT 2015
	Diagnostic Status: Error Scientific Instruments: ACS/WFC Special Requirements: SEQ A1,A2,A3,A4 WITHIN 1 D									
Diagnostics	(Exposure 1 (WFC1-2K_BIAS (A1))) Error (Form): Illegal selection: DEF.									
	(Exposure 1 (WFC1-2K_BIAS (A1))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION The combination of attributes chosen is illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A1))) Error (Form): This attribute cannot have this value due to other choices: Spectral_Element=DEF This value is by default illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A1))) Error (Form): COMPRESSION is not a valid selection									
	(Exposure 1 (WFC1-2K_BIAS (A1))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION=NONE The combination of attributes chosen is illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A1))) Error (Form): Target BIAS is no longer a valid selection									
Exposures	(Exposure 1 (WFC1-2K_BIAS (A1))) Error (Form): This attribute is not allowed to have this value: Calibration_Target = BIAS It is an Available option and cannot normally be used in a GO proposal.									
	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		BIAS	ACS/WFC, ACCUM, WFC1-2K	DEF	GAIN=2.0; COMPRESSION=N ONE			0 Secs X 6 (0 Secs)	
									[==>(Copy 1)]	[1]
									[==>(Copy 2)]	
									[==>(Copy 3)]	
									[==>(Copy 4)]	
									[==>(Copy 5)]	
									[==>(Copy 6)]	
	Comments: All visits should be done within one anneal cycle in order to not have to repeat the subarray bias observations.									
Orbit Structure	Orbit 1 Exp. 1, copy 1 Unused Orbital Visibility = 3210 Exp. 1, copy 2 Exp. 1, copy 3 Exp. 1, copy 4 Exp. 1, copy 5 Exp. 1, copy 6 Occultation 0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 sec									
	Server Version: 20150609									

Proposal 14159 - WFC1-2K_BIAS (A2) - Monitoring an Internal Shock Collision in Action in 3C 264

Visit	Proposal 14159, WFC1-2K_BIAS (A2), implementation									Sun Nov 08 02:15:04 GMT 2015
	Diagnostic Status: Error Scientific Instruments: ACS/WFC Special Requirements: (none)									
Diagnostics	(Exposure 1 (WFC1-2K_BIAS (A2))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION The combination of attributes chosen is illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A2))) Error (Form): Target BIAS is no longer a valid selection									
	(Exposure 1 (WFC1-2K_BIAS (A2))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION=NONE The combination of attributes chosen is illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A2))) Error (Form): This attribute is not allowed to have this value: Calibration_Target = BIAS It is an Available option and cannot normally be used in a GO proposal.									
	(Exposure 1 (WFC1-2K_BIAS (A2))) Error (Form): Illegal selection: DEF.									
	(Exposure 1 (WFC1-2K_BIAS (A2))) Error (Form): This attribute cannot have this value due to other choices: Spectral_Element=DEF This value is by default illegal.									
Exposures	(Exposure 1 (WFC1-2K_BIAS (A2))) Error (Form): COMPRESSION is not a valid selection									
	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		BIAS	ACS/WFC, ACCUM, WFC1-2K	DEF	GAIN=2.0; COMPRESSION=N ONE			0 Secs X 6 (0 Secs)	
									[==>(Copy 1)]	[1]
									[==>(Copy 2)]	
									[==>(Copy 3)]	
								[==>(Copy 4)]		
								[==>(Copy 5)]		
								[==>(Copy 6)]		
Comments: All visits should be done within one anneal cycle in order to not have to repeat the subarray bias observations.										
Orbit Structure	Orbit 1 Exp. 1, copy 1 Unused Orbital Visibility = 3210 Exp. 1, copy 2 Exp. 1, copy 3 Exp. 1, copy 4 Exp. 1, copy 5 Exp. 1, copy 6 Occultation 05001000150020002500300035004000450050005500sec									
	Server Version: 20150609									

Proposal 14159 - WFC1-2K_BIAS (A3) - Monitoring an Internal Shock Collision in Action in 3C 264

Visit	Proposal 14159, WFC1-2K_BIAS (A3), implementation									Sun Nov 08 02:15:04 GMT 2015
	Diagnostic Status: Error Scientific Instruments: ACS/WFC Special Requirements: (none)									
Diagnostics	(Exposure 1 (WFC1-2K_BIAS (A3))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION The combination of attributes chosen is illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A3))) Error (Form): This attribute cannot have this value due to other choices: Spectral_Element=DEF This value is by default illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A3))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION=NONE The combination of attributes chosen is illegal.									
	(Exposure 1 (WFC1-2K_BIAS (A3))) Error (Form): COMPRESSION is not a valid selection									
	(Exposure 1 (WFC1-2K_BIAS (A3))) Error (Form): This attribute is not allowed to have this value: Calibration_Target = BIAS It is an Available option and cannot normally be used in a GO proposal.									
	(Exposure 1 (WFC1-2K_BIAS (A3))) Error (Form): Target BIAS is no longer a valid selection									
Exposures	(Exposure 1 (WFC1-2K_BIAS (A3))) Error (Form): Illegal selection: DEF.									
	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		BIAS	ACS/WFC, ACCUM, WFC1-2K	DEF	GAIN=2.0; COMPRESSION=N ONE			0 Secs X 6 (0 Secs)	
									[==>(Copy 1)]	[1]
									[==>(Copy 2)]	
									[==>(Copy 3)]	
								[==>(Copy 4)]		
								[==>(Copy 5)]		
								[==>(Copy 6)]		
Comments: All visits should be done within one anneal cycle in order to not have to repeat the subarray bias observations.										
Orbit Structure	Orbit 1 Unused Orbital Visibility = 3210 Exp. 1, copy 1 Exp. 1, copy 2 Exp. 1, copy 3 Exp. 1, copy 4 Exp. 1, copy 5 Exp. 1, copy 6 Occultation  05001000150020002500300035004000450050005500sec									
	Server Version: 20150609									

Proposal 14159 - WFC1-2K_BIAS (A4) - Monitoring an Internal Shock Collision in Action in 3C 264

Visit	Proposal 14159, WFC1-2K_BIAS (A4), implementation									Sun Nov 08 02:15:04 GMT 2015
Diagnostic Status: Error										
Scientific Instruments: ACS/WFC										
Special Requirements: GROUP A4,02 WITHIN 14D										
Diagnostics	(Exposure 1 (WFC1-2K_BIAS (A4))) Error (Form): Target BIAS is no longer a valid selection (Exposure 1 (WFC1-2K_BIAS (A4))) Error (Form): COMPRESSION is not a valid selection (Exposure 1 (WFC1-2K_BIAS (A4))) Error (Form): This attribute is not allowed to have this value: Calibration_Target = BIAS It is an Available option and cannot normally be used in a GO proposal. (Exposure 1 (WFC1-2K_BIAS (A4))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION The combination of attributes chosen is illegal. (Exposure 1 (WFC1-2K_BIAS (A4))) Error (Form): This attribute cannot have this value due to other choices: Spectral_Element=DEF This value is by default illegal. (Exposure 1 (WFC1-2K_BIAS (A4))) Error (Form): This attribute cannot have this value due to other choices: Optional_Parameter=COMPRESSION=NONE The combination of attributes chosen is illegal. (Exposure 1 (WFC1-2K_BIAS (A4))) Error (Form): Illegal selection: DEF.									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		BIAS	ACS/WFC, ACCUM, WFC1-2K	DEF	GAIN=2.0; COMPRESSION=N ONE			0 Secs X 6 (0 Secs)	
									[==>(Copy 1)] [==>(Copy 2)] [==>(Copy 3)] [==>(Copy 4)] [==>(Copy 5)] [==>(Copy 6)]	[1]
Comments: All visits should be done within one anneal cycle in order to not have to repeat the subarray bias observations.										
Orbit Structure	Orbit 1 Unused Orbital Visibility = 3210 Server Version: 20150609 Exp. 1, copy 1 Exp. 1, copy 2 Exp. 1, copy 3 Exp. 1, copy 4 Exp. 1, copy 5 Exp. 1, copy 6 Occultation									