



## 14255 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

Cycle: 23, Proposal Category: GO

(UV Initiative)

(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) PTF-09GE	ACS/SBC	1	07-May-2016 21:01:58.0	yes
02	(2) D23H-1	ACS/SBC	1	07-May-2016 21:02:00.0	yes
03	(3) TDE1	ACS/SBC	1	07-May-2016 21:02:01.0	yes
04	(4) PTF-09DJL	ACS/SBC	1	07-May-2016 21:02:02.0	yes
05	(5) PS1-10JH	ACS/SBC	1	07-May-2016 21:02:02.0	yes
06	(6) D3-13	ACS/SBC	1	07-May-2016 21:02:03.0	yes
07	(7) D1-9	ACS/SBC	1	07-May-2016 21:02:03.0	yes
08	(8) TDE2	ACS/SBC	1	07-May-2016 21:02:04.0	yes

8 Total Orbits Used

## **ABSTRACT**

A star that passes too close to a supermassive black hole will be disrupted by the black hole's tidal gravity. The result is an electromagnetic flare that can outshine the optical luminosity of the host galaxy for a few months. The return rate of stellar debris decreases from highly super-Eddington to sub-Eddington in a few years, making stellar tidal disruptions flares (TDFs) a unique laboratory to study accretion physics. Synoptic surveys have so far yielded about 10 strong TDF candidates, and many more (10-100 per month) can be discovered by ongoing and near-future surveys. So far we have only observed the optical/UV emission in the first  $\sim 100$  days after the discovered event. The luminosity of this emission is too large to be produced in a compact accretion disk, and instead likely originates from  $\sim 100$ s- $1000$ s of gravitational radii from the black hole. After a few years, however, these outer regions will cool significantly, allowing us to directly observe the inner disk with short wavelength observations. Even in the most pessimistic scenario, the flux is readily detected at FUV wavelengths in  $\sim 1$  HST orbit. Here we propose HST ACS/SBC observations to measure the luminosity and temperature of newly formed accretion disks in a carefully selected sample of 8 known TDFs. These would be the first observations of late-time disk emission from tidal flares, greatly increasing our currently limited understanding of TDF emission mechanisms. In a broader sense, these observations might prove essential to fully realize the potential of TDFs as general tools in the era of time-domain astronomy.

## **OBSERVING DESCRIPTION**

ACS SBC observations of eight targets. One orbit per source. Our targets are faint point sources ( $FUV > 20$ ) at the center of resolved galaxies.

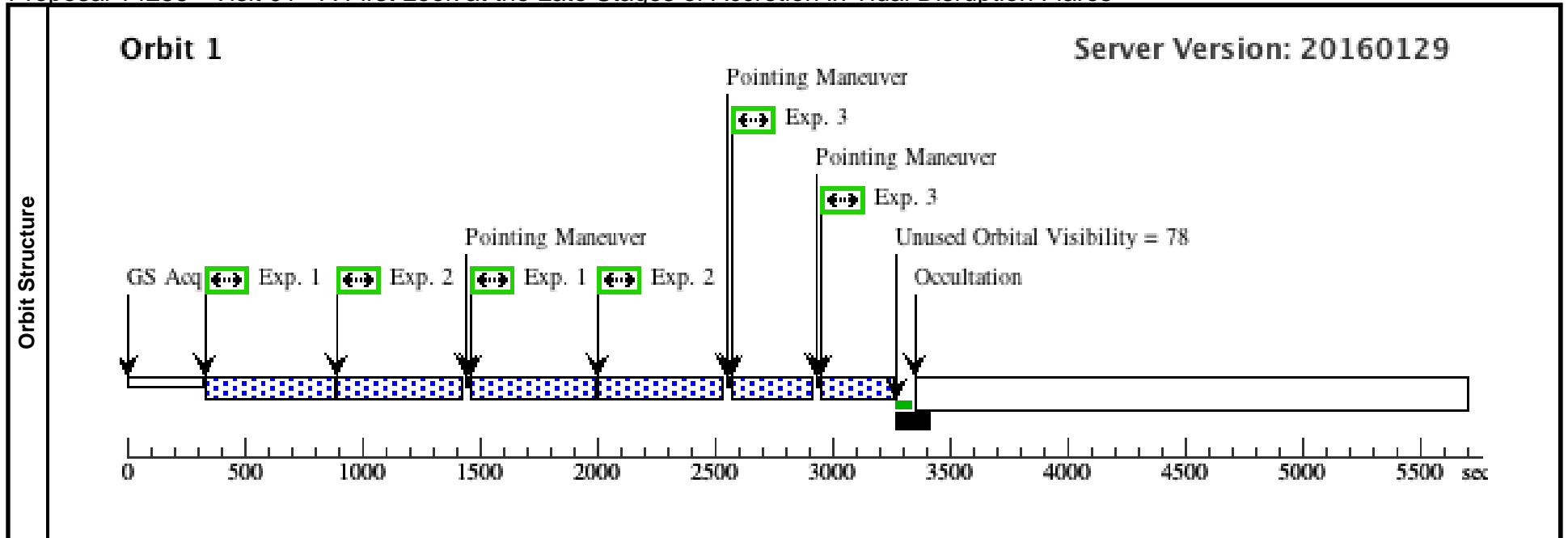
For the first 3 targets we plan both imaging in two filters (F125LP and F150LP) and slitless spectroscopic observations with PR130L. For these three targets, the spectroscopic observations should be about 25% of the full time for science observations of the orbit. For targets 4 to 8 we request only imaging (again, in F125LP and F150LP). We have decided to use 1x2 (LINE) dithering for the imaging observations and for the PR130L observations.

Analysis using BOT revealed no bright targets that yielded warning flags. All our targets are covered by GALEX imaging, no FUV-bright stars are in the field of view.

Proposal 14255 - Visit 01 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

Sun May 08 01:02:05 GMT 2016

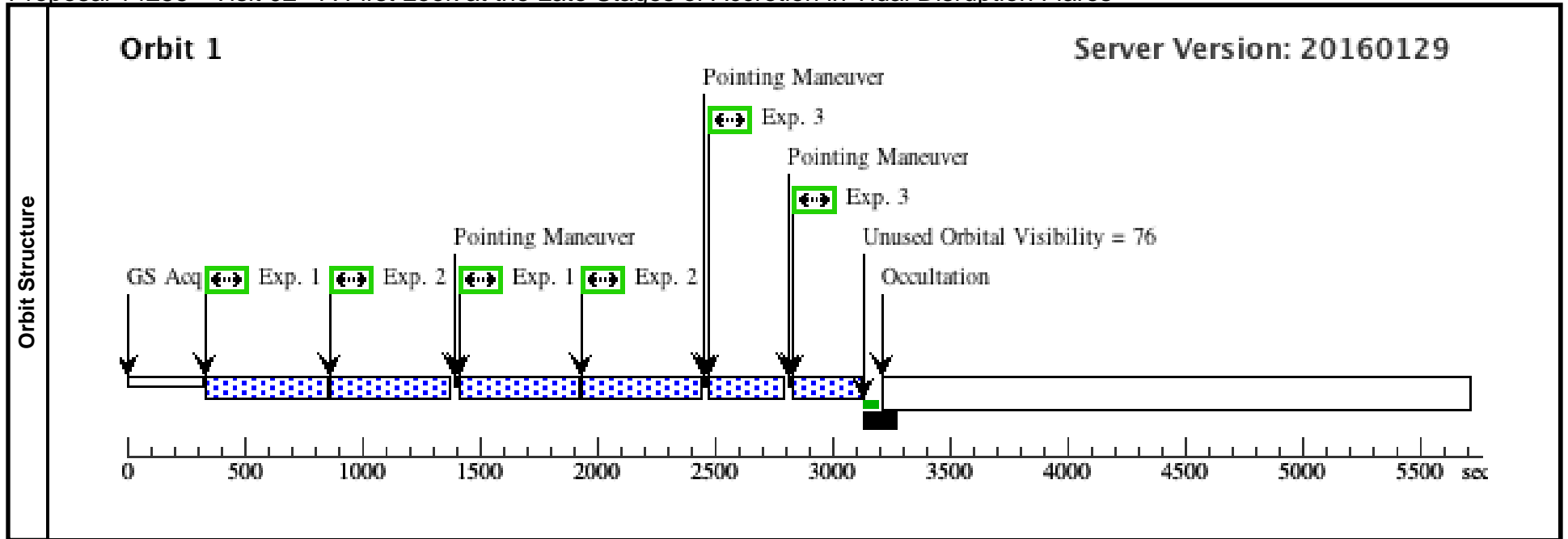
Visit	<b>Proposal 14255, Visit 01, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: (none)										
	Patterns	#	Primary Pattern			Secondary Pattern			Exposures		
		(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false					(1-2), (3)		
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes	Miscellaneous				
	(1)	PTF-09GE	RA: 14 57 3.1800 (224.2632500d) Dec: +49 36 40.97 (49.61138d) Equinox: J2000			V=17.5+/-0.1	Reference Frame: ICRS				
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1	(ACS.im.68 4441)	(1) PTF-09GE	ACS/SBC, ACCUM, SBC	F125LP			Pattern 2, Exps 1-2 in Visit 01 (2)	480 Secs (960 Secs)		
									[=>(Pattern 1)]		[1]
									[=>(Pattern 2)]		
	2	(ACS.im.68 4441)	(1) PTF-09GE	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2, Exps 1-2 in Visit 01 (2)	480 Secs (960 Secs)		
								[=>(Pattern 1)]		[1]	
								[=>(Pattern 2)]			
3	(ACS.sp.680 621)	(1) PTF-09GE	ACS/SBC, ACCUM, SBC	PR130L			Pattern 2, Exps 3-3 in Visit 01 (2)	280 Secs (560 Secs)			
								[=>(Pattern 1)]		[1]	
								[=>(Pattern 2)]			



Proposal 14255 - Visit 02 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

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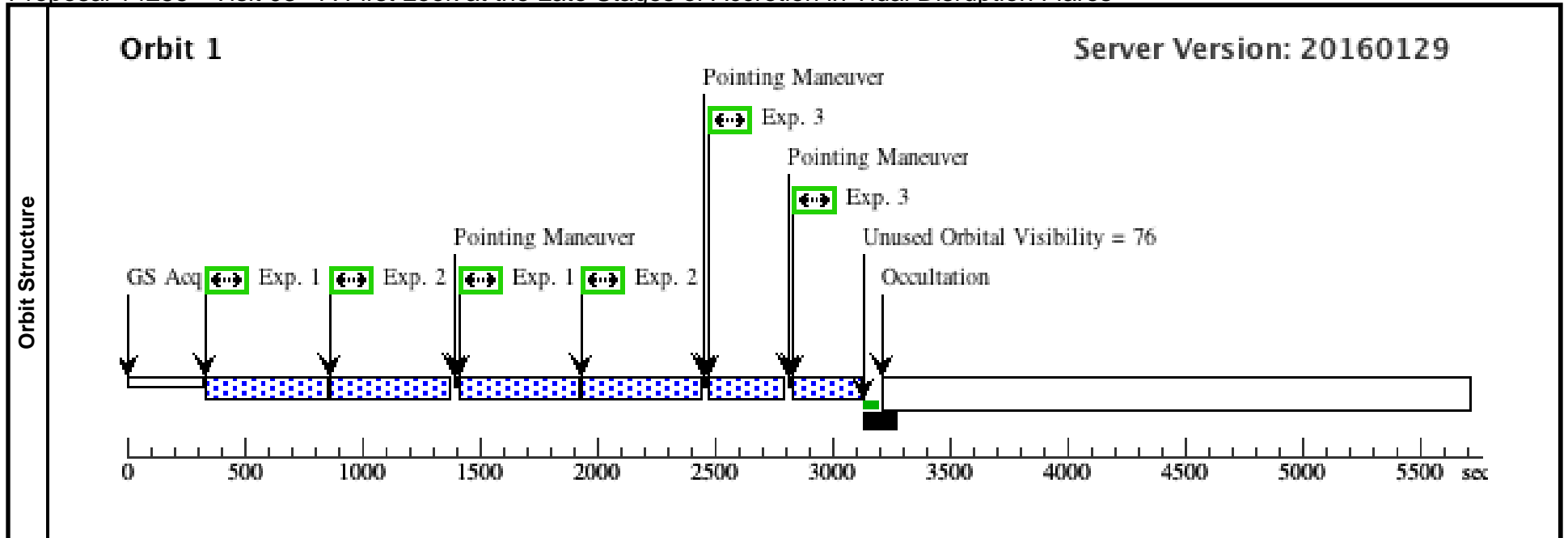
Visit	<b>Proposal 14255, Visit 02, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: (none)									
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures
		(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false				(1-2), (3)		
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(2)	D23H-1	RA: 23 31 59.5344 (352.9980600d) Dec: +00 17 14.57 (.28738d) Equinox: J2000				V=19.6+/-0.1		Reference Frame: ICRS	
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(ACS.im.68 4441)	(2) D23H-1	ACS/SBC, ACCUM, SBC	F125LP			Pattern 2, Exps 1-2 in Visit 02 (2)	455 Secs (910 Secs)	
									[=>(Pattern 1)]	[1]
									[=>(Pattern 2)]	
	2	(ACS.im.68 4441)	(2) D23H-1	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2, Exps 1-2 in Visit 02 (2)	455 Secs (910 Secs)	
								[=>(Pattern 1)]	[1]	
								[=>(Pattern 2)]		
3	(ACS.sp.680 621)	(2) D23H-1	ACS/SBC, ACCUM, SBC	PR130L				Pattern 2, Exps 3-3 in Visit 02 (2)	260 Secs (520 Secs)	
								[=>(Pattern 1)]	[1]	
								[=>(Pattern 2)]		



Proposal 14255 - Visit 03 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

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Visit	<b>Proposal 14255, Visit 03, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: (none)									
	Patterns	#	Primary Pattern				Secondary Pattern			Exposures
		(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false						(1-2), (3)
Fixed Targets	#	Name	Target Coordinates		Targ. Coord. Corrections		Fluxes		Miscellaneous	
	(3)	TDE1	RA: 23 42 1.4064 (355.5058600d) Dec: +01 06 29.27 (1.10813d) Equinox: J2000				V=19.7+/-0.1		Reference Frame: ICRS	
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(ACS.im.68 4441)	(3) TDE1	ACS/SBC, ACCUM, SBC	F125LP			Pattern 2, Exps 1-2 in Visit 03 (2)	455 Secs (910 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2	(ACS.im.68 4441)	(3) TDE1	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2, Exps 1-2 in Visit 03 (2)	455 Secs (910 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	3	(ACS.sp.680 621)	(3) TDE1	ACS/SBC, ACCUM, SBC	PR130L			Pattern 2, Exps 3-3 in Visit 03 (2)	260 Secs (520 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]





Proposal 14255 - Visit 04 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

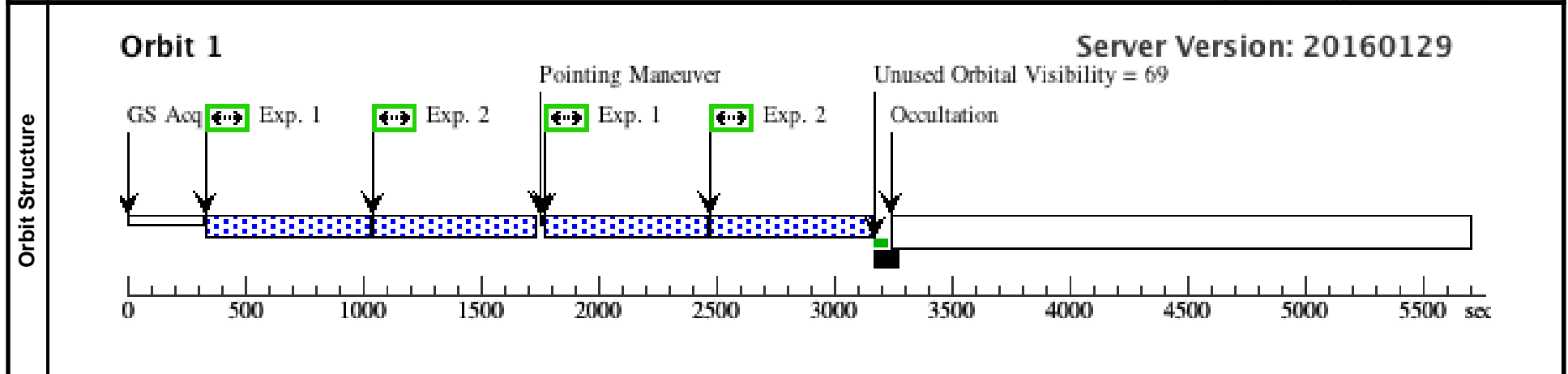
Sun May 08 01:02:05 GMT 2016

<b>Visit</b>	<b>Proposal 14255, Visit 04, implementation</b>		
	<b>Diagnostic Status: No Diagnostics</b>		
	Scientific Instruments: ACS/SBC		
	Special Requirements: (none)		

<b>Patterns</b>	#	Primary Pattern	Secondary Pattern	Exposures
	(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false	

<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(4)	PTF-09DJL	RA: 16 33 55.9728 (248.4832200d) Dec: +30 14 16.66 (30.23796d) Equinox: J2000		V=20.1+/-0.1	Reference Frame: ICRS

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	(ACS.im.68 4441)	(4) PTF-09DJL	ACS/SBC, ACCUM, SBC	F125LP				Pattern 2, Exps 1-2 in Visit 04 (2)	635 Secs (1270 Secs)	
										[=>(Pattern 1)] [=>(Pattern 2)]	[1]
2	(ACS.im.68 4441)	(4) PTF-09DJL	ACS/SBC, ACCUM, SBC	F150LP				Pattern 2, Exps 1-2 in Visit 04 (2)	635 Secs (1270 Secs)		
									[=>(Pattern 1)] [=>(Pattern 2)]	[1]	



Proposal 14255 - Visit 05 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

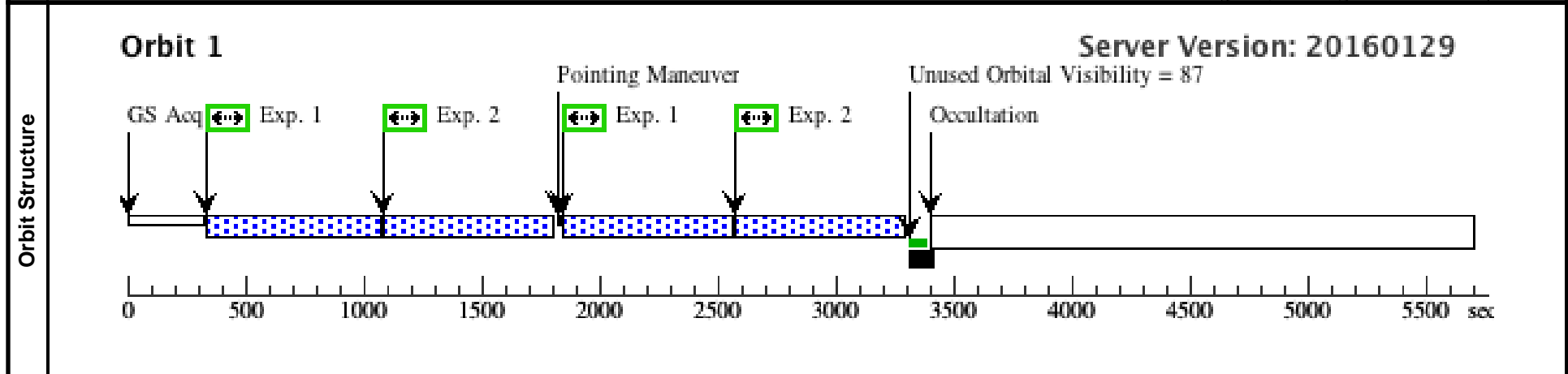
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<b>Visit</b>	<b>Proposal 14255, Visit 05, implementation</b>		
	<b>Diagnostic Status: No Diagnostics</b>		
	Scientific Instruments: ACS/SBC		
	Special Requirements: (none)		

<b>Patterns</b>	#	Primary Pattern	Secondary Pattern	Exposures
	(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false	

<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(5)	PS1-10JH	RA: 16 09 28.2761 (242.3678171d) Dec: +53 40 23.99 (53.67333d) Equinox: J2000		V=21.4+/-0.1	Reference Frame: ICRS

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	(ACS.im.68 4441)	(5) PS1-10JH	ACS/SBC, ACCUM, SBC	F125LP				Pattern 2, Exps 1-2 in Visit 05 (2)	670 Secs (1340 Secs)	
										[=>(Pattern 1)] [=>(Pattern 2)]	[1]
2	(ACS.im.68 4441)	(5) PS1-10JH	ACS/SBC, ACCUM, SBC	F150LP				Pattern 2, Exps 1-2 in Visit 05 (2)	670 Secs (1340 Secs)		
									[=>(Pattern 1)] [=>(Pattern 2)]	[1]	



Proposal 14255 - Visit 06 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

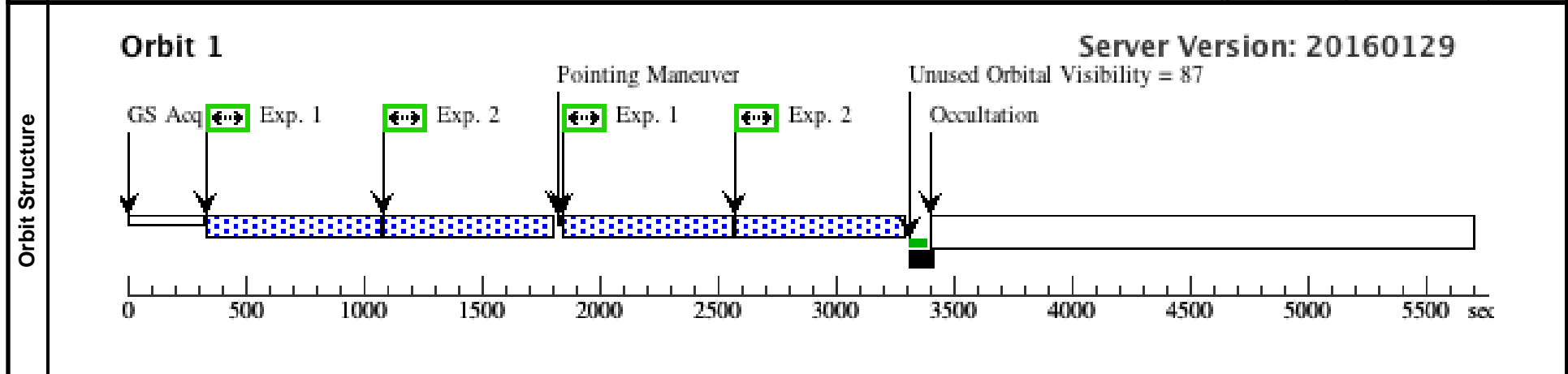
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<b>Visit</b>	<b>Proposal 14255, Visit 06, implementation</b>		
	<b>Diagnostic Status: No Diagnostics</b>		
	Scientific Instruments: ACS/SBC		
	Special Requirements: (none)		

<b>Patterns</b>	#	Primary Pattern	Secondary Pattern	Exposures
	(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false	

<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(6)	D3-13	RA: 14 19 29.8086 (214.8742025d) Dec: +52 52 6.36 (52.86843d) Equinox: J2000		V=21.1+/-0.1	Reference Frame: ICRS

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit	
	1	(ACS.im.68 4441)	(6) D3-13	ACS/SBC, ACCUM, SBC	F125LP				Pattern 2, Exps 1-2 in Visit 06 (2)	670 Secs (1340 Secs)	
										[=>(Pattern 1)] [=>(Pattern 2)]	[1]
2	(ACS.im.68 4441)	(6) D3-13	ACS/SBC, ACCUM, SBC	F150LP				Pattern 2, Exps 1-2 in Visit 06 (2)	670 Secs (1340 Secs)		
									[=>(Pattern 1)] [=>(Pattern 2)]	[1]	



Proposal 14255 - Visit 07 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

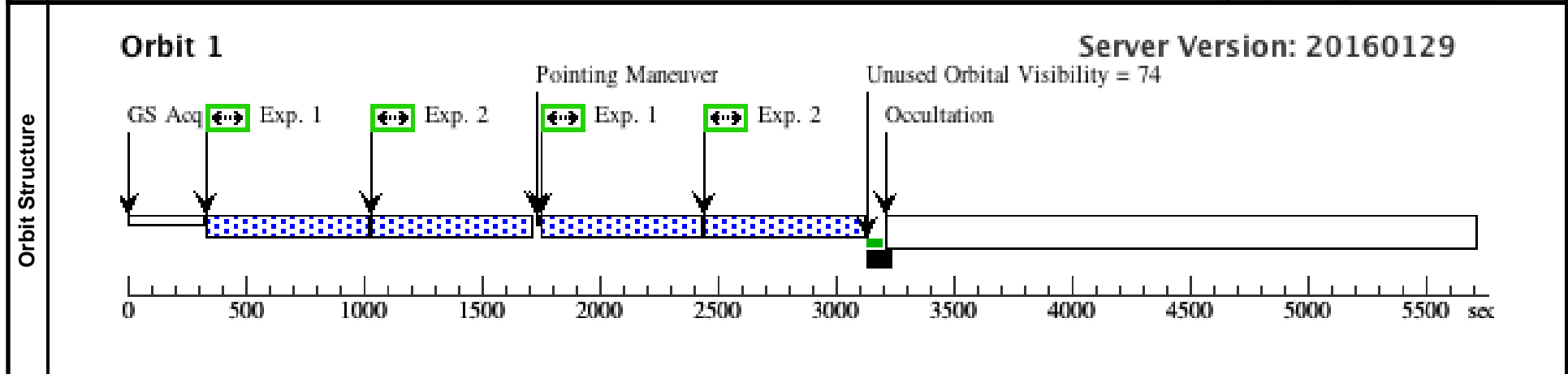
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<b>Visit</b>	<b>Proposal 14255, Visit 07, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: (none)		
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<b>Patterns</b>	#	Primary Pattern	Secondary Pattern	Exposures
	(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1-2)

<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(7)	D1-9	RA: 02 25 16.9699 (36.3207079d) Dec: -04 32 59.13 (-4.54976d) Equinox: J2000		V=21.4+/-0.1	Reference Frame: ICRS

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(ACS.im.68 4441)	(7) D1-9	ACS/SBC, ACCUM, SBC	F125LP			Pattern 2, Exps 1-2 in Visit 07 (2)	625 Secs (1250 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]
	2	(ACS.im.68 4441)	(7) D1-9	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2, Exps 1-2 in Visit 07 (2)	625 Secs (1250 Secs) [=>(Pattern 1)] [=>(Pattern 2)]	[1]



Proposal 14255 - Visit 08 - A First Look at the Late Stages of Accretion in Tidal Disruption Flares

Sun May 08 01:02:06 GMT 2016

<b>Visit</b>	<b>Proposal 14255, Visit 08, implementation</b> <b>Diagnostic Status: No Diagnostics</b> Scientific Instruments: ACS/SBC Special Requirements: (none)		
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<b>Patterns</b>	#	Primary Pattern	Secondary Pattern	Exposures
	(2)	Pattern Type=ACS-SBC-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.472 Line Spacing= Coordinate Frame=POS-TARG Pattern Orientation=44.4 Angle Between Sides= Center Pattern=false		(1-2)

<b>Fixed Targets</b>	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
	(8)	TDE2	RA: 23 23 48.6144 (350.9525600d) Dec: -01 08 10.25 (-1.13618d) Equinox: J2000		V=20.1+/-0.1	Reference Frame: ICRS

<b>Exposures</b>	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(ACS.im.68 4441)	(8) TDE2	ACS/SBC, ACCUM, SBC	F125LP			Pattern 2, Exps 1-2 in Visit 08 (2)	625 Secs (1250 Secs)	
									[=>(Pattern 1)] [=>(Pattern 2)]	[1]
2	(ACS.im.68 4441)	(8) TDE2	ACS/SBC, ACCUM, SBC	F150LP			Pattern 2, Exps 1-2 in Visit 08 (2)	625 Secs (1250 Secs)		
								[=>(Pattern 1)] [=>(Pattern 2)]	[1]	

