13858 - The environment of the rarest and most energetic supernovae: do pair-instability explosions exist in the nearby Universe?

Cycle: 22, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) PTF11HRQ	WFC3/UVIS	1	16-Sep-2014 21:10:21.0	yes
02	(2) PTF12DAM	WFC3/UVIS	1	16-Sep-2014 21:10:23.0	yes
03	(3) IPTF13DCC	ACS/WFC	1	16-Sep-2014 21:10:24.0	yes
04	(4) IPTF13EHE	ACS/WFC	1	16-Sep-2014 21:10:24.0	yes

4 Total Orbits Used

ABSTRACT

We propose imaging of the host galaxies of super-luminous supernovae (SLSNe) of the rarest class, SLSN-R. These SNe are several magnitudes brighter than typical core-collapse SNe and their late-time light curves follow the 56Co radioactive decay. The physical process that leads to their explosion is under debate. Observationally, the more likely possibility is that SLSN-R are the product of stars with cores more massive than several tens of solar masses, that explode due to pair-production instability. However, such pair instability supernovae (PISNe) are theoretically easier to form from zero-metallicity population III stars at high redshifts, that could develop the massive cores required. Local pockets of low-metallicity gas or highly dense stellar clusters may allow PISNe to form at low redshift, but this has not been observationally confirmed. Our pilot HST program targeting a single SLSN-R (PTF10nmn) surprisingly showed it occurred well away from the host's most intense star formation, in a lower-metallicity region, up to 10 times lower than would have been measured using ground-based data alone. Here, we propose to target 4 additional SLSNe-R (out of a total of 6 events), all nearby candidate PISNe homogeneously selected from the Palomar Transient Factory wide-field survey, among thousands of classified SNe. The accurate location of these SNe with respect to their host galaxies and star-forming regions can provide invaluable information on the (typical?) environment of these events. This is crucial to both address the question of the existence of PISNe in the nearby Universe and to investigate the physical nature of these rare, extreme and debated explosions.

OBSERVING DESCRIPTION

The targets are 4 host galaxies of superluminous supernovae, each one to be observed for 1 orbit. PTF11hrq and PTF12dam are brighter (V~19.2-19.4) and we will observe them with WCF3/UVIS, with three filters (F625W, F336W and F225W). The two fainter galaxies (iPTF13dcc with V~23.6 and iPTF13ehe with 21) still host the ongoing supernova (equal in brightness or fainter than the galaxy) and we will observe them with ACS with one filter (F625W). We intend to divide each orbit in a few sub-exposures and dither them to correct for cosmic rays and bad pixels.

Visit

Proposal 13858, 11hrq (01), implementation Wed Sep 17 01:10:25 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2), (3)

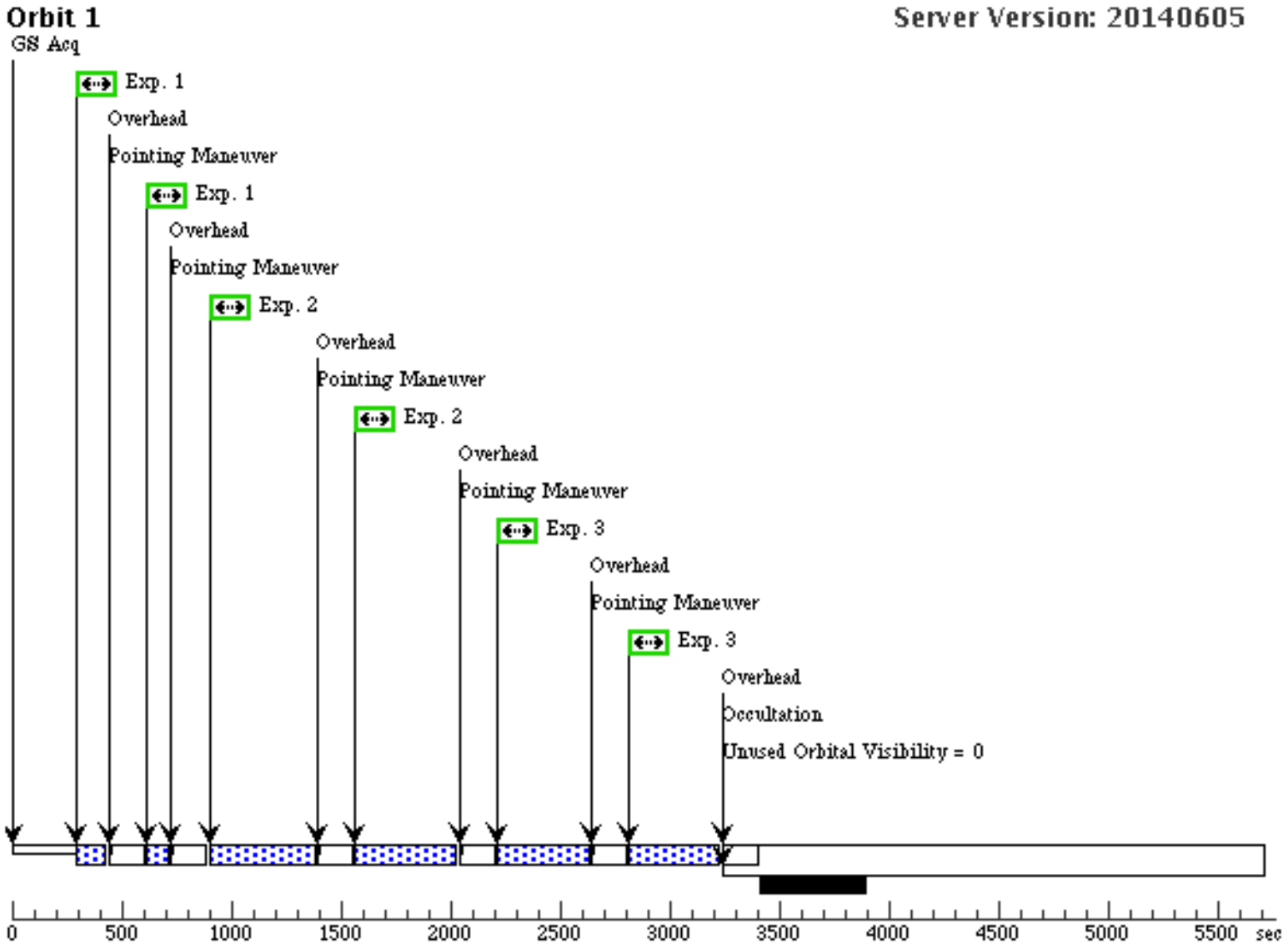
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PTF11HRQ	RA: 00 51 47.2200 (12.9467500d) Dec: -26 25 10.00 (-26.41944d) Equinox: J2000		V=19.4+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	11hrq_r	(1) PTF11HRQ	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F625W	FLASH=9		Pattern 1, Exps 1-1 in 11hrq (01) (1)	400 Secs (200 Secs) *[==>100.0 Secs (Pattern 1)]* *[==>100.0 Secs (Pattern 2)]*	***[1]***
2	11hrq_U	(1) PTF11HRQ	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F336W	FLASH=11		Pattern 1, Exps 2-2 in 11hrq (01) (1)	450 Secs (920 Secs) *[==>460.0 Secs (Pattern 1)]* *[==>460.0 Secs (Pattern 2)]*	***[1]***
3	11hrq_UV	(1) PTF11HRQ	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F225W	FLASH=11		Pattern 1, Exps 3-3 in 11hrq (01) (1)	700 Secs (813 Secs) *[==>400.0 Secs (Pattern 1)]* *[==>413.0 Secs (Pattern 2)]*	***[1]***

Orbit Structure



Visit

Proposal 13858, 12dam (02), implementation Wed Sep 17 01:10:26 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

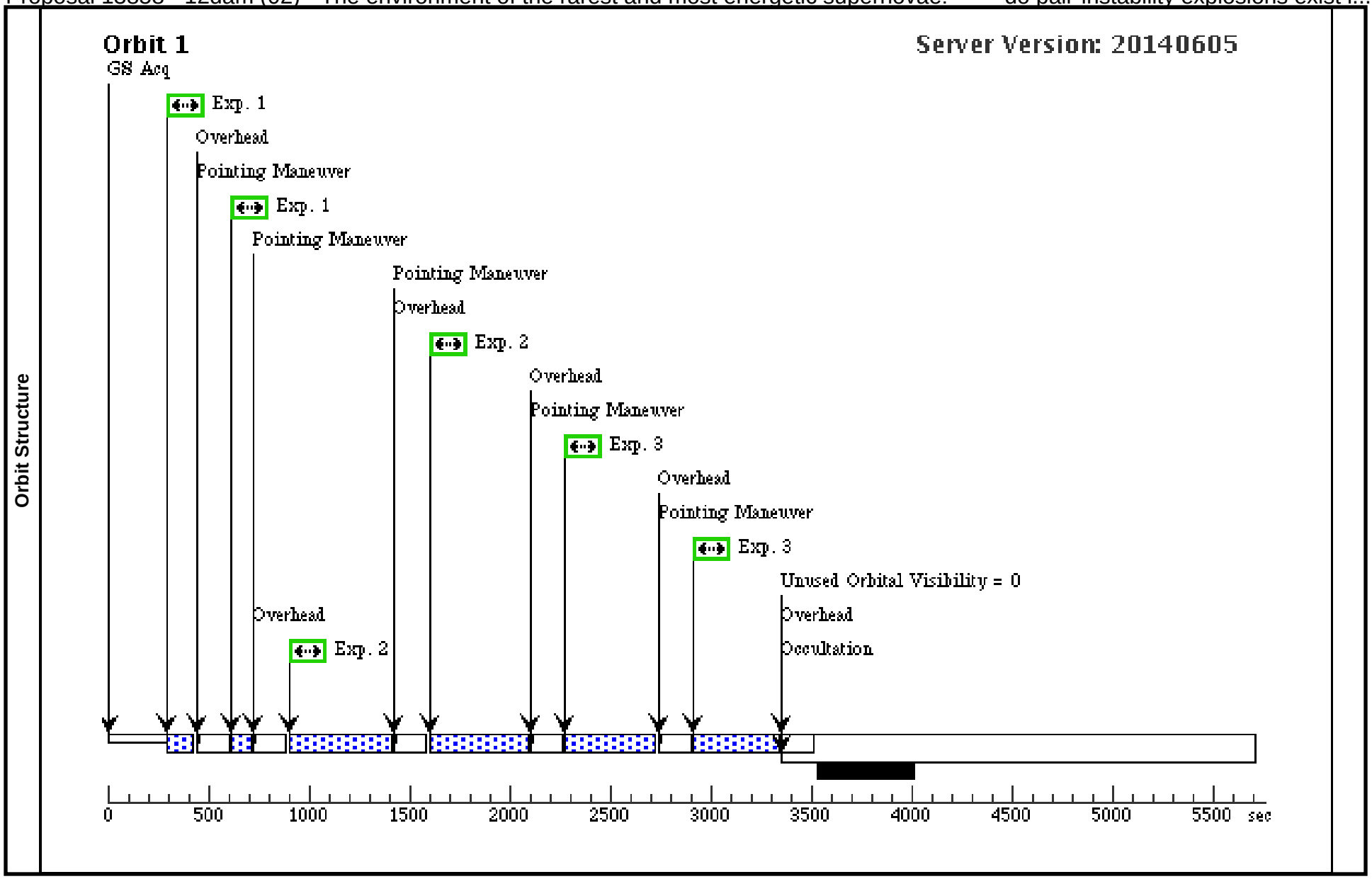
#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(1), (2), (3)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	PTF12DAM	RA: 14 24 46.2000 (216.1925000d) Dec: +46 13 48.30 (46.23008d) Equinox: J2000		V=19.2+/-0.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	12dam_r	(2) PTF12DAM	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F625W	FLASH=9		Pattern 1, Exps 1-1 in 12dam (02) (1)	300 Secs (200 Secs) *[==>100.0 Secs (Pattern 1)]* *[==>100.0 Secs (Pattern 2)]*	***[1]***
2	12dam_U	(2) PTF12DAM	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F336W	FLASH=11		Pattern 1, Exps 2-2 in 12dam (02) (1)	300 Secs (984 Secs) *[==>492.0 Secs (Pattern 1)]* *[==>492.0 Secs (Pattern 2)]*	***[1]***
3	12dam_UV	(2) PTF12DAM	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F225W	FLASH=11		Pattern 1, Exps 3-3 in 12dam (02) (1)	400 Secs (866 Secs) *[==>433.0 Secs (Pattern 1)]* *[==>433.0 Secs (Pattern 2)]*	***[1]***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Orbit Structure
GS Acq
Exp. 1
Overhead
Pointing Maneuver
Exp. 1
Pointing Maneuver
Pointing Maneuver
Overhead
Exp. 2
Overhead
Pointing Maneuver
Exp. 3
Overhead
Pointing Maneuver
Exp. 3
Unused Orbital Visibility = 0
Overhead
Occultation
Overhead
Exp. 2
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 13858, 13dcc (03), implementation Wed Sep 17 01:10:26 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 22D TO 39 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(1)

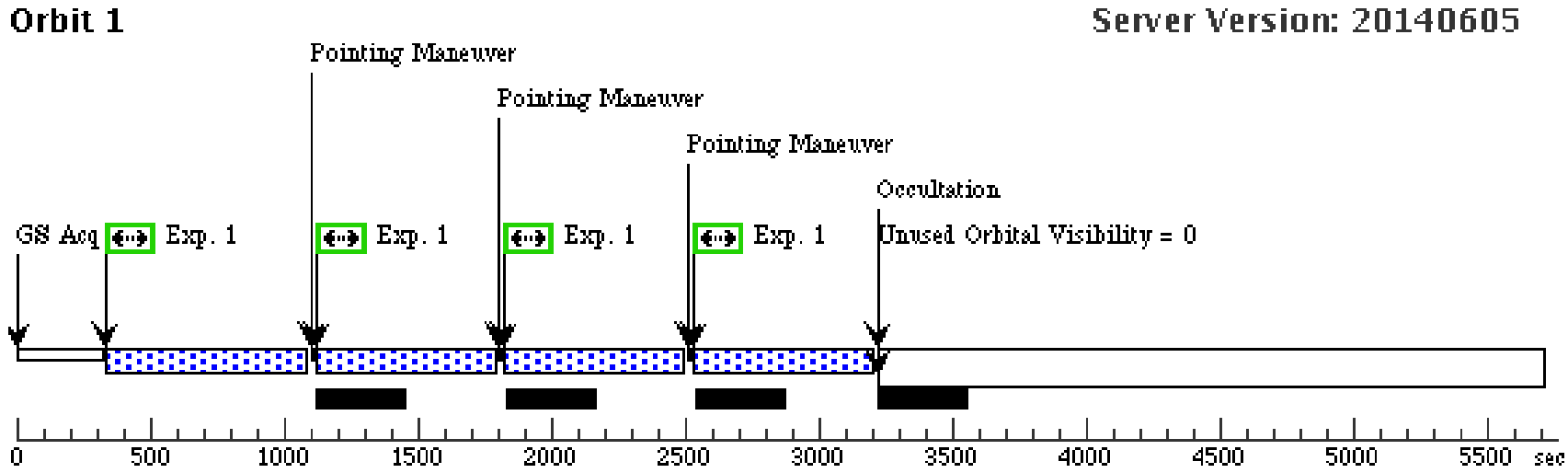
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	IPTF13DCC	RA: 02 57 2.5000 (44.2604167d) Dec: -00 18 44.00 (-.31222d) Equinox: J2000		V=23.6+/-0.4 SN still present with V~23.5	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	13dcc_r	(3) IPTF13DCC	ACS/WFC, ACCUM, WFC1	F625W			Pattern 2, Exps 1-1 in 13dcc (03) (2)	600 Secs (2195 Secs) *[==>548.0 Secs (Pattern 1)]* *[==>548.0 Secs (Pattern 2)]* *[==>548.0 Secs (Pattern 3)]* *[==>551.0 Secs (Pattern 4)]*	*[1]*

Orbit Structure



Visit

Proposal 13858, 13ehe (04), implementation Wed Sep 17 01:10:26 GMT 2014

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: ORIENT 84D TO 104 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	IPTF13EHE	RA: 06 53 21.5000 (103.3395833d) Dec: +67 07 56.00 (67.13222d) Equinox: J2000		V=21 V > 21, SN still present with V~21	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	13ehe	(4) IPTF13EHE	ACS/WFC, ACCUM, WFC1	F625W			Pattern 2, Exps 1-1 in 13ehe (04) (2)	600 Secs (2545 Secs) *[==>636.0 Secs (Pattern 1)]* *[==>636.0 Secs (Pattern 2)]* *[==>636.0 Secs (Pattern 3)]* *[==>637.0 Secs (Pattern 4)]*	*[1]*

Orbit Structure