12223 - Exploring the Bright Side of Massive Stellar Death with NUV Spectroscopy

Cycle: 18, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Robert M. Quimby (PI)	**California Institute of Technology**	**quimby@astro.caltech.edu**
Prof. Shrinivas R. Kulkarni (CoI)	California Institute of Technology	srk@astro.caltech.edu
Dr. Eran O. Ofek (CoI)	California Institute of Technology	eran@astro.caltech.edu
Ms. Mansi Kasliwal (CoI)	Carnegie Institution of Washington	mansi@astro.caltech.edu
Dr. Avishay Gal-Yam (CoI)	Weizmann Institute of Science	avishay.gal-yam@weizmann.ac.il
Mr. Iair Arcavi (CoI)	Weizmann Institute of Science	arcavi@gmail.com
Dr. Stephen Bradley Cenko (CoI)	University of California - Berkeley	bcenko@astro.berkeley.edu
Dr. Daniel Kasen (CoI)	University of California - Santa Cruz	kasen@ucolick.org
Prof. Lars Bildsten (CoI)	University of California - Santa Barbara	bildsten@kitp.ucsb.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(7) PTF11DIJ	STIS/CCD STIS/NUV-MAMA	2	18-May-2011 21:02:40.0	yes
02	(2) LSN-TOO2	STIS/CCD STIS/NUV-MAMA	2	18-May-2011 21:02:45.0	yes
03	(3) LSN-TOO3	STIS/CCD STIS/NUV-MAMA	2	18-May-2011 21:02:49.0	yes
04	(4) LSN-MONITORING1	STIS/CCD STIS/NUV-MAMA	2	18-May-2011 21:02:52.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
05	(5) LSN-MONITORING2	STIS/CCD STIS/NUV-MAMA	2	18-May-2011 21:02:56.0	yes
06	(6) LSN-MONITORING3	STIS/CCD STIS/NUV-MAMA	2	18-May-2011 21:03:00.0	yes

12 Total Orbits Used

ABSTRACT

A new class of stellar outbursts dwarfing the most powerful supernovae observed in the past century has recently been uncovered by wide field optical imaging surveys. With peak luminosities in excess of 10^44 erg/s and total radiative outputs greater than 10^51 erg, these events push the limits of conventional supernova explosion theory. One possibility is that these luminous supernovae (LSNe) are triggered by the electron-positron pair instability, and they may thus represent local analogs of the first stellar explosions to shape the universe. Another is that an additional source of power, such as that provided by spin-down of a nacent magnetar, adds energy into the ejecta after the initial supernova explosion. Near UV spectroscopy from HST/STIS can help break the observational degereracy to reveal the true physical origin of these events. We propose a non-disruptive ToO program for STIS spectroscopy to follow-up new LSNe discoveries in Cycle 18 supplemented with Swift UV photometry and ground based optical imaging and spectroscopy from the Keck and Palomar observatories.

OBSERVING DESCRIPTION

Our goal is to acquire NUV spectra of three luminous supernovae (M < -21) to help uncover their physical origin. Our targets will be supplied by the Palomar Transient Factory (PTF) survey, although we could include discoveries from ROTSE-III or elsewhere in exceptional circumstances. We will choose three of these for NUV spectroscopy provided that they meet the following selection requirements: 1) rising r-band flux consistent with a LSNe, 2) spectroscopically confirmed LSNe classification and redshift, and 3) Swift UVW1 (2600 A) flux greater than F_lambda = 1e-16.

Existing data show that LSNe evolve slowly (weeks to month time scales), although some events evolve faster. PTF will first detect LSNe outbursts around 2 months prior to r-band maximum. Optical spectroscopic classification is typically performed with in 2 weeks of this, but often considerably sooner (1-2 days). Swift follow-up observations will occur no later than 5 days from this (allowing for analysis and additional photometric information). We will update our Phase II with the coordinates of select targets meeting the above criteria immediately following positive Swift results, allowing 10 to 15 days for the observations to be inserted into the HST queue. Of course sooner observations will improve the scientific

return and are welcome provided they do not disrupt the HST schedule.

If subsequent measurements by Swift indicate the UVW1 flux is rising and above F_lambda = 3e-16 and the observability window is larger than 40 days for HST and 60 days from the ground, we will trigger the multi-epoch NUV spectral follow-up sequence.

The spectral features of LSNe are broadened by about 10^4 km/s, and may therefore be studied with low spectral resolution. This combined with the need for significant wavelength coverage makes STIS preferable to COS. We will use the MAMA detector owing to its greater sensitivity over the CCD for wavelengths short of 2500 A. Using the SCP 06F6 spectra and our existing Swift photometry, we find that ~4500 s exposures are required to reach a S/N of 10 in the key line features (after binning to R~100) if the UVW1 flux is F_lambda = 1e-16.

Visit

Proposal 12223, Visit 01, implementation Thu May 19 01:03:04 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/NUV-MAMA

Special Requirements: PCS MODE FINE; BEFORE 04-JUN-2011:00:00:00

Comments: NUV spectrum of PTF11dij

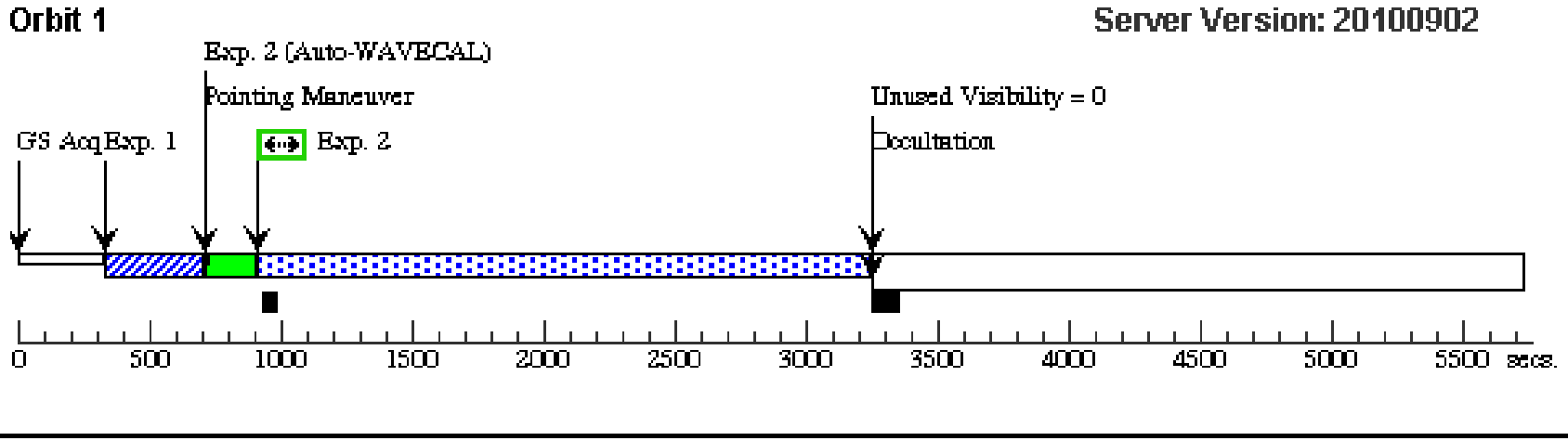
Fixed Targets

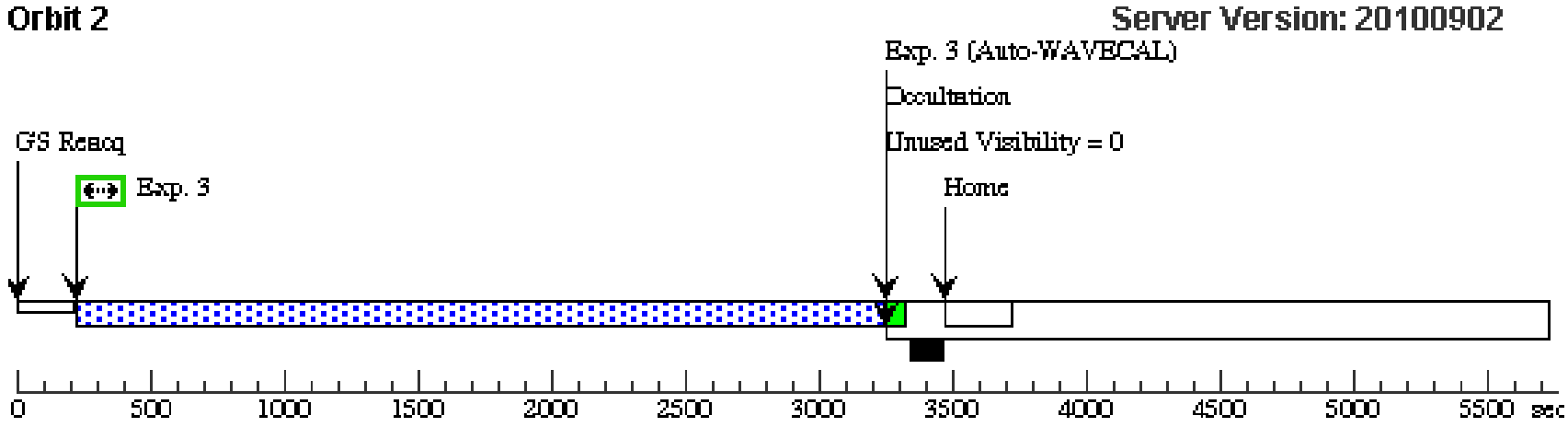
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(7)	PTF11DIJ	RA: 13 50 57.7970 (207.7408208d) Dec: +26 16 42.90 (26.27858d) Equinox: J2000		V=18+/-0.2	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	TargetAcquisition	(7) PTF11DIJ	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			35.0 Secs *[==>]*	 ***[1]***
2	NUVSpectrum	(7) PTF11DIJ	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				2315 Secs *[==>]*	 ***[1]***
3	NUVSpectrum	(7) PTF11DIJ	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				3007 Secs *[==>]*	 ***[2]***

Orbit Structure





Visit

Proposal 12223, Visit 02, implementation Thu May 19 01:03:05 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/NUV-MAMA

Special Requirements: PCS MODE FINE; BETWEEN 01-SEP-2010:00:00:00 AND 31-DEC-2011:00:00:00; ON HOLD

Comments: NUV spectrum of LSN-TOO2

On Hold Comments: Target of opportunity

Generic Targets

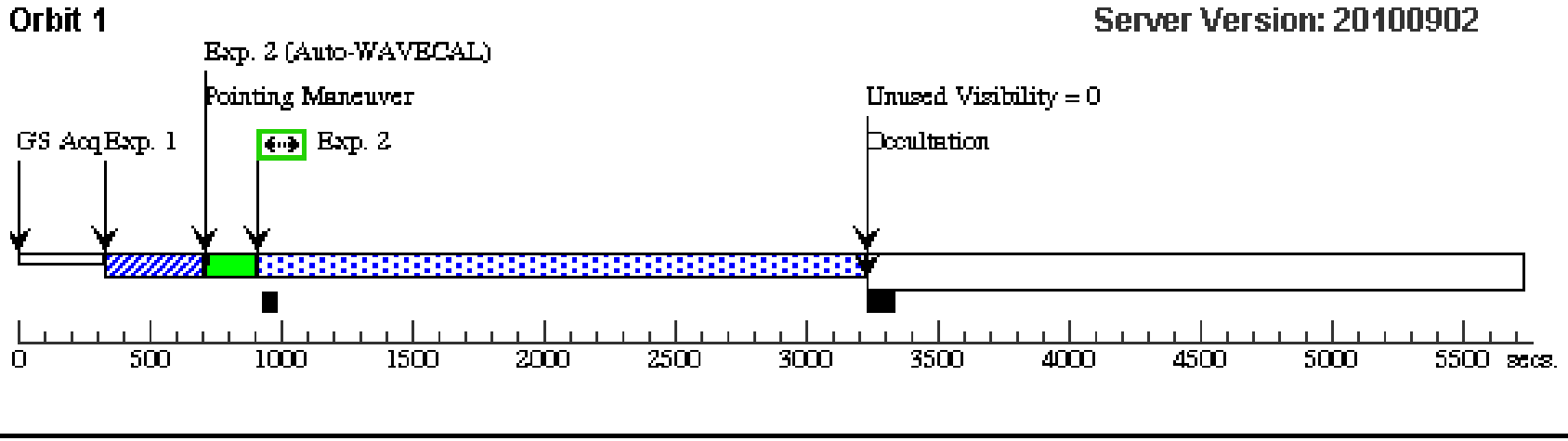
#	Name	Criteria	Description
(2)	LSN-TOO2	Target drawn from PTF search field	SUPERNOVA

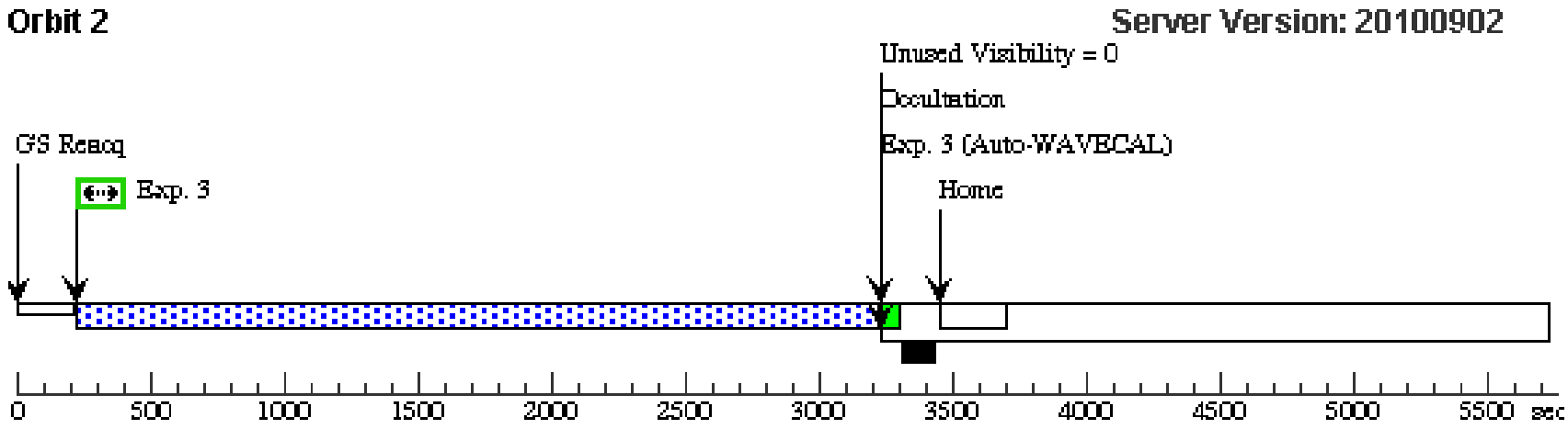
Comments: Luminous supernova not yet discovered

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	TargetAcquisition	(2) LSN-TOO2	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			35.0 Secs	
								[==>]	***[1]***
2	NUVSpectrum	(2) LSN-TOO2	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				2300 Secs	
								[==>2292.0 Secs]	***[1]***
3	NUVSpectrum	(2) LSN-TOO2	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				3000 Secs	
								[==>2984.0 Secs]	***[2]***

Orbit Structure





Visit

Proposal 12223, Visit 03, implementation Thu May 19 01:03:05 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/NUV-MAMA

Special Requirements: PCS MODE FINE; BETWEEN 01-SEP-2010:00:00:00 AND 31-DEC-2011:00:00:00; ON HOLD

Comments: NUV spectrum of LSN-TOO3

On Hold Comments: Target of opportunity

Generic Targets

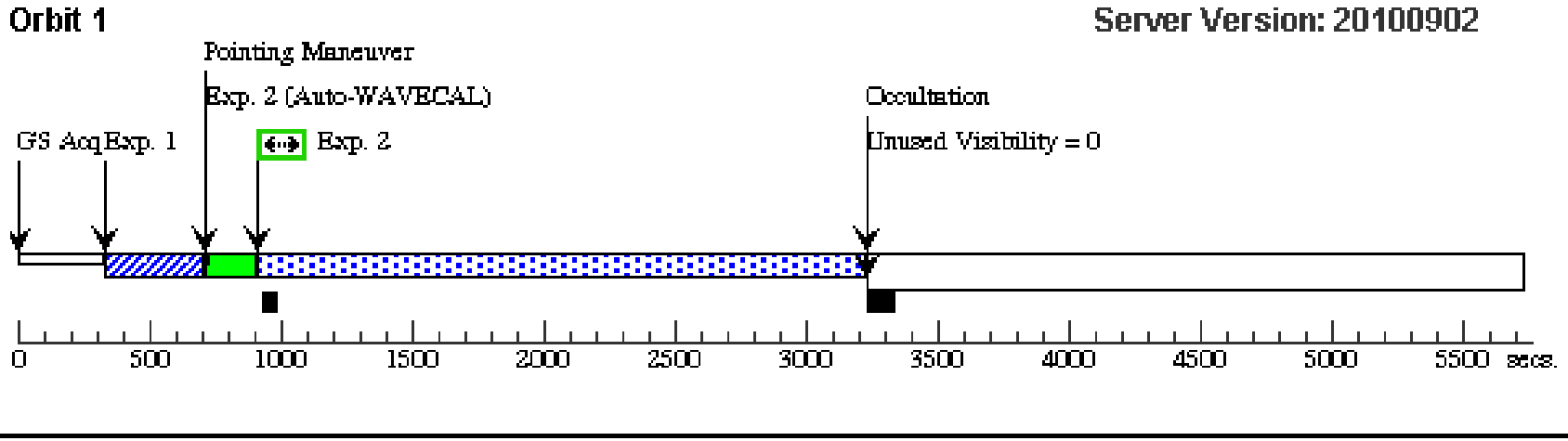
#	Name	Criteria	Description
(3)	LSN-TOO3	Target drawn from PTF search field	SUPERNOVA

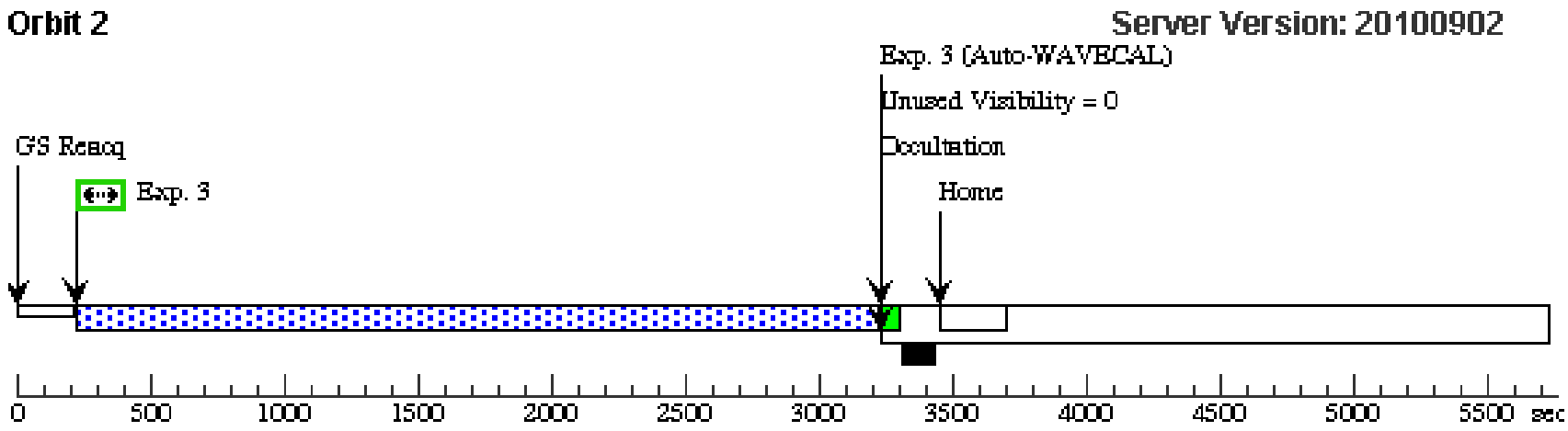
Comments: Luminous supernova not yet discovered

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	TargetAcquisition	(3) LSN-TOO3	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			35.0 Secs	
								[==>]	***[1]***
2	NUVSpectrum	(3) LSN-TOO3	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				2300 Secs	
								[==>2292.0 Secs]	***[1]***
3	NUVSpectrum	(3) LSN-TOO3	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				3000 Secs	
								[==>2984.0 Secs]	***[2]***

Orbit Structure





Visit

Proposal 12223, Visit 04, implementation Thu May 19 01:03:06 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/NUV-MAMA

Special Requirements: PCS MODE FINE; BETWEEN 01-SEP-2010:00:00:00 AND 31-DEC-2011:00:00:00; ON HOLD

Comments: NUV spectrum of LSN-MONITORING1

On Hold Comments: Target of opportunity

Generic Targets

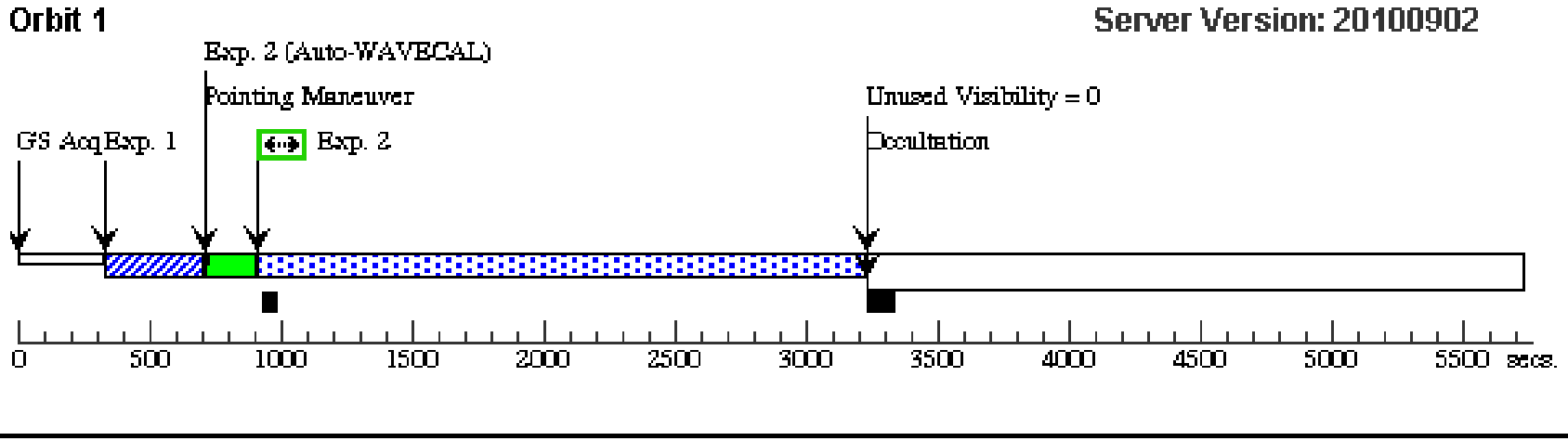
#	Name	Criteria	Description
(4)	LSN-MONITORING1	Target drawn from PTF search field	SUPERNOVA

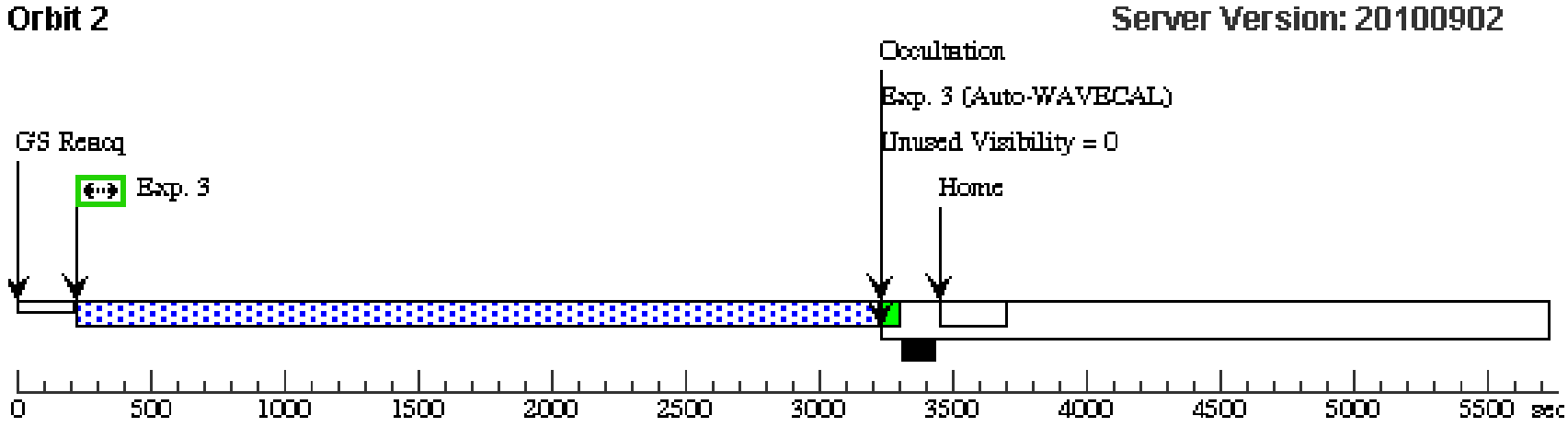
Comments: Luminous supernova not yet discovered

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	TargetAcquisition	(4) LSN-MONITORING1	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			35.0 Secs	
								[==>]	***[1]***
2	NUVSpectrum	(4) LSN-MONITORING1	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				2300 Secs	
								[==>2292.0 Secs]	***[1]***
3	NUVSpectrum	(4) LSN-MONITORING1	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				3000 Secs	
								[==>2984.0 Secs]	***[2]***

Orbit Structure





Proposal 12223 - Visit 05 - Exploring the Bright Side of Massive Stellar Death with NUV Spectroscopy

Visit

Proposal 12223, Visit 05, implementation Thu May 19 01:03:06 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/NUV-MAMA

Special Requirements: PCS MODE FINE; BETWEEN 01-SEP-2010:00:00:00 AND 31-DEC-2011:00:00:00; ON HOLD

Comments: NUV spectrum of LSN-MONITORING2

On Hold Comments: Target of opportunity

Generic Targets

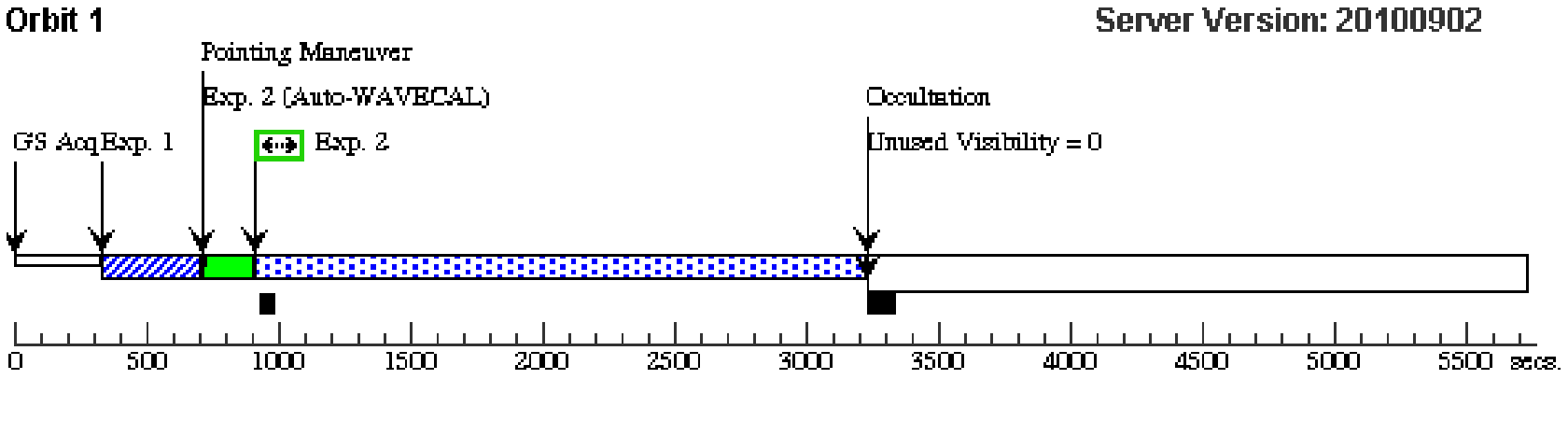
#	Name	Criteria	Description
(5)	LSN-MONITORING2	Target drawn from PTF search field	SUPERNOVA

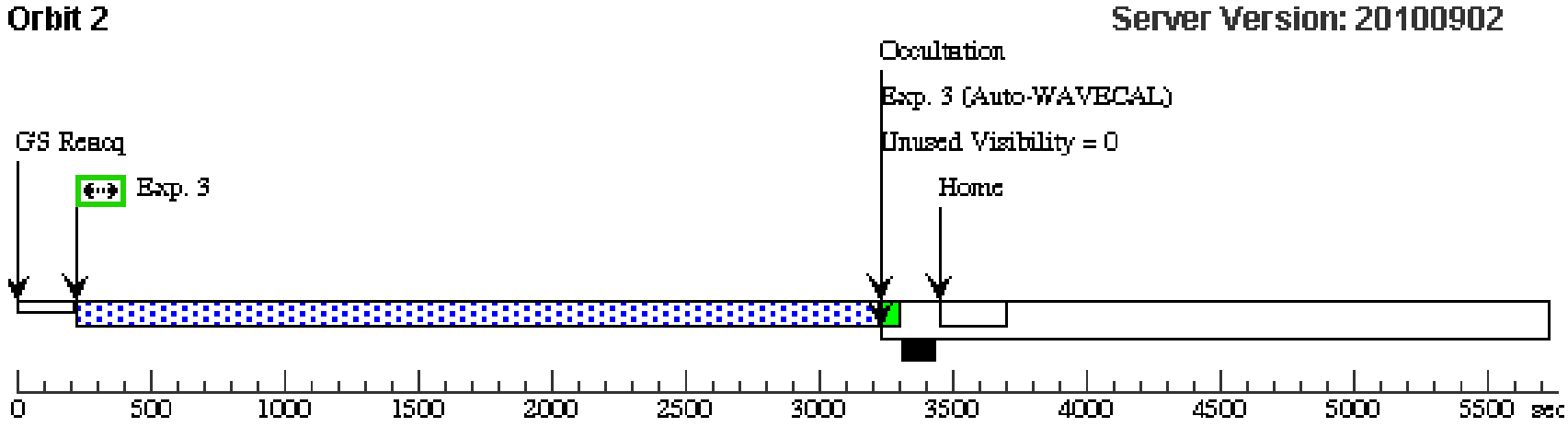
Comments: Luminous supernova not yet discovered

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	TargetAcquisition	(5) LSN-MONITORING2	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			35.0 Secs	
								[==>]	***[1]***
2	NUVSpectrum	(5) LSN-MONITORING2	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				2300 Secs	
								[==>2292.0 Secs]	***[1]***
3	NUVSpectrum	(5) LSN-MONITORING2	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				3000 Secs	
								[==>2984.0 Secs]	***[2]***

Orbit Structure





Proposal 12223 - Visit 06 - Exploring the Bright Side of Massive Stellar Death with NUV Spectroscopy

Visit

Proposal 12223, Visit 06, implementation Thu May 19 01:03:07 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/NUV-MAMA

Special Requirements: PCS MODE FINE; BETWEEN 01-SEP-2010:00:00:00 AND 31-DEC-2011:00:00:00; ON HOLD

Comments: NUV spectrum of LSN-MONITORING3

On Hold Comments: Target of opportunity

Generic Targets

#	Name	Criteria	Description
(6)	LSN-MONITORING3	Target drawn from PTF search field	SUPERNOVA

Comments: Luminous supernova not yet discovered

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	TargetAcquisition	(6) LSN-MONITORING3	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=POINT			35.0 Secs	
								[==>]	***[1]***
2	NUVSpectrum	(6) LSN-MONITORING3	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				2300 Secs	
								[==>2292.0 Secs]	***[1]***
3	NUVSpectrum	(6) LSN-MONITORING3	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				3000 Secs	
								[==>2984.0 Secs]	***[2]***

Orbit Structure