12968 - Stellar Forensics IV: A post-explosion view of the progenitors of core-collapse supernovae

Cycle: 20, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) SN-2009HD	WFC3/UVIS	3	03-Oct-2012 21:15:59.0	yes

3 Total Orbits Used

ABSTRACT

Recent studies have used high spatial resolution HST observations of supernova (SN) sites to directly identify the progenitors of core-collapse SNe on pre-explosion images. These studies have set constraints about the nature of massive stars and their evolution just prior to their explosion as SNe. Now, at late-times when the SNe have faded sufficiently, it is possible to return to the sites of these core-collapse supernovae to search for clues about the nature of their progenitors.

We request time to conduct deep, late-time, high-resolution imaging with WFC3 UVIS of the site of the core-collapse SN 2009hd. We aim to: 1) Confirm our original identification, made in pre-explosion images, by confirming that the progenitor is now missing; 2) Apply image subtraction techniques for the pre-explosion images with this late-time imaging to determine accurate photometry of the progenitor to constrain its temperature and luminosity; and 3) use the stellar population in the immediate vicinity of the SN to determine the reddening and extinction that affected the progenitor. HST provides the unique combination of high-resolution optical/IR imaging at very faint magnitudes that will facilitate this study.

OBSERVING DESCRIPTION

We require deep 4 colour imaging of the site of the Type II SN 2009hd at late-times. A progenitor object was identified in deep pre-explosion WFPC2 and ACS imaging; we wish to see if the object that was identified in the pre-explosion F555W and F814W images has disappeared (and determine if the progenitor was also part of the background in pre-explosion F336W and F439W images, but not resolved as an individual source).

This late-time imaging consists of a series of deep observations at the site of SN 2009hd, using WFC3 UVIS and a 1kx1k subarray (to reduce readout times, since only a small area around the SN is actually required). The observations are to be conducted in the F336W, F438W, F555W and F814W filters, to match the corresponding pre-explosion HST observations. A standard 4-point box dither pattern is employed to aid the rejection of cosmic rays and hotpixels, as well as improve the sampling of the PSF. The observations are designed to go down to levels of m_F336W~26.5, m_F438W~27, m_F555W~27, m_F814W~26.5 (to a S/N of 3) to probe the nature of the faint background. Given the duration of the four individual exposures that make up the dither pattern, nearby bright sources should not saturate.

As we require as little as possible flux from the SN in these late-time images (to facilitate image subtraction analysis), we make a general requirement that the observation take place sometime towards the end of Cycle 20 (and have placed a requirement in this phase 2, such that the observations take place in the second half of cycle 20).

03-Oct-2012 - UPDATE

The F336W observation has been updated to use a larger box dither pattern to overcome the effects of local droplets in the UVIS field. The pattern A4 (from ISR WFC3-2010-09, Dahlen et al.) has been adopted, and I have calculated the values of the point spacing, line spacing, pattern orientation and angles between sides using their prescription - the resulting positions for the fovs for the individual pointings in this dither pattern (checked using Aladin) seem consistent with what I would expect for this pattern, but a check of my calculations would be useful.

The F336W and F438W observations have been updated to include a postflash - which has been set to 12e- per pixel in accordance with Anderson et al. 2012

CALIBRATION JUSTIFICATION

No special calibrations are required for these observations

Visit

Proposal 12968, Visit 01 Thu Oct 04 01:16:10 GMT 2012

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 100%; AFTER 01-APR-2013

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.119 Line Spacing=4.312	Coordinate Frame=POS-TARG Pattern Orientation=33.715 Angle Between Sides=80.735 Center Pattern=false		(1)
(3)	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		(2), (3), (4)

Fixed Targets

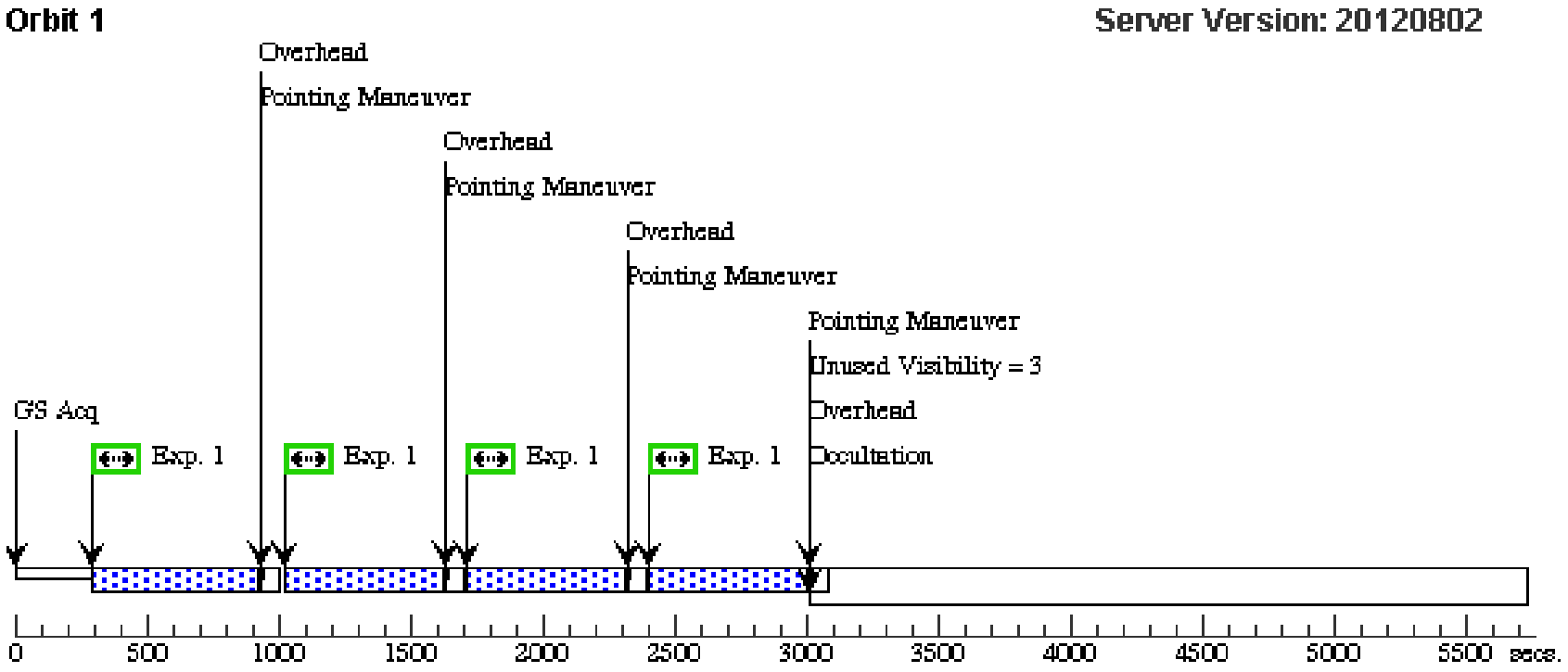
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2009HD	RA: 11 20 16.9900 (170.0707917d) Dec: +12 58 46.30 (12.97953d) Equinox: J2000		V=27+/-0.5	Reference Frame: ICRS

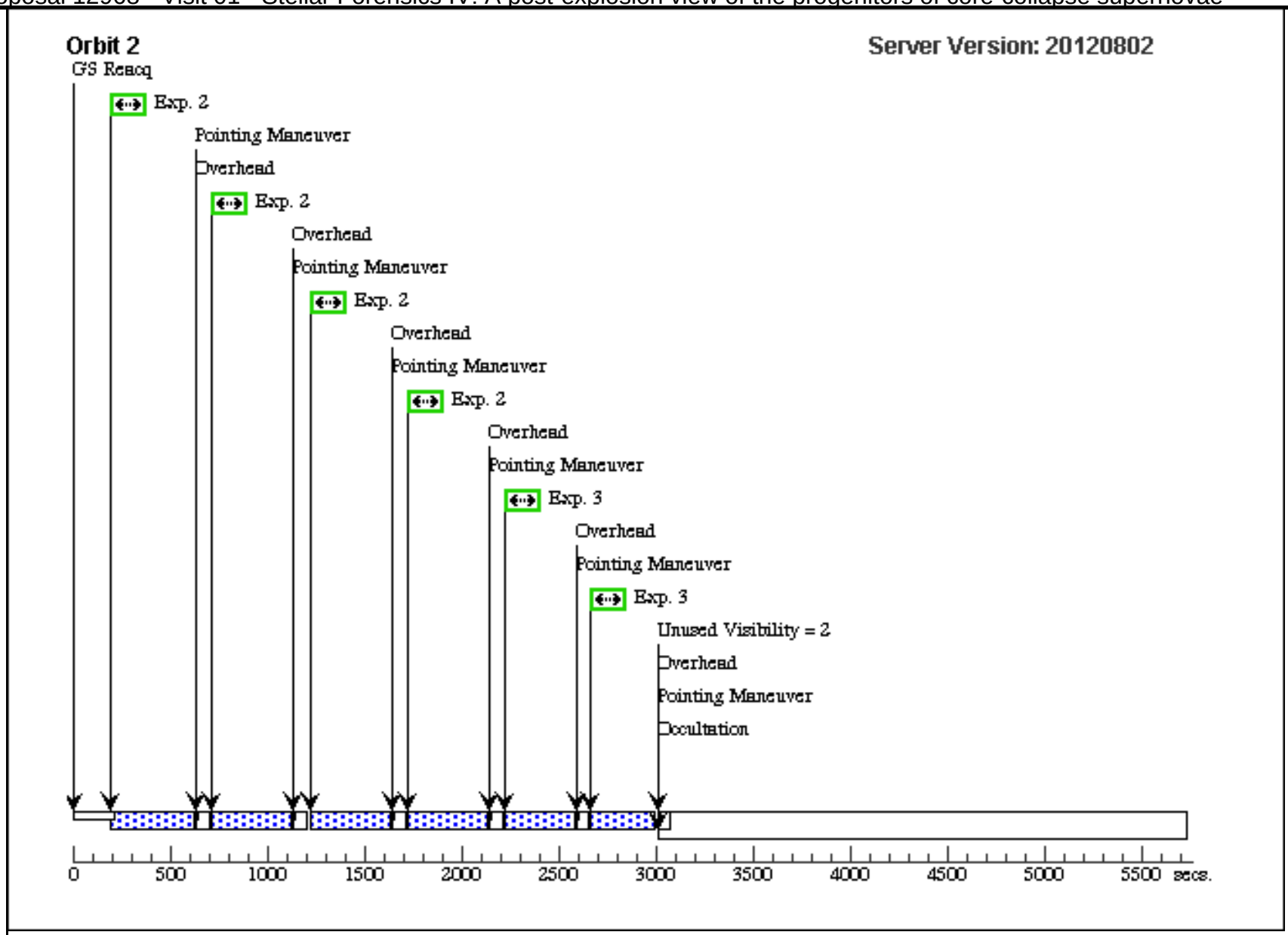
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

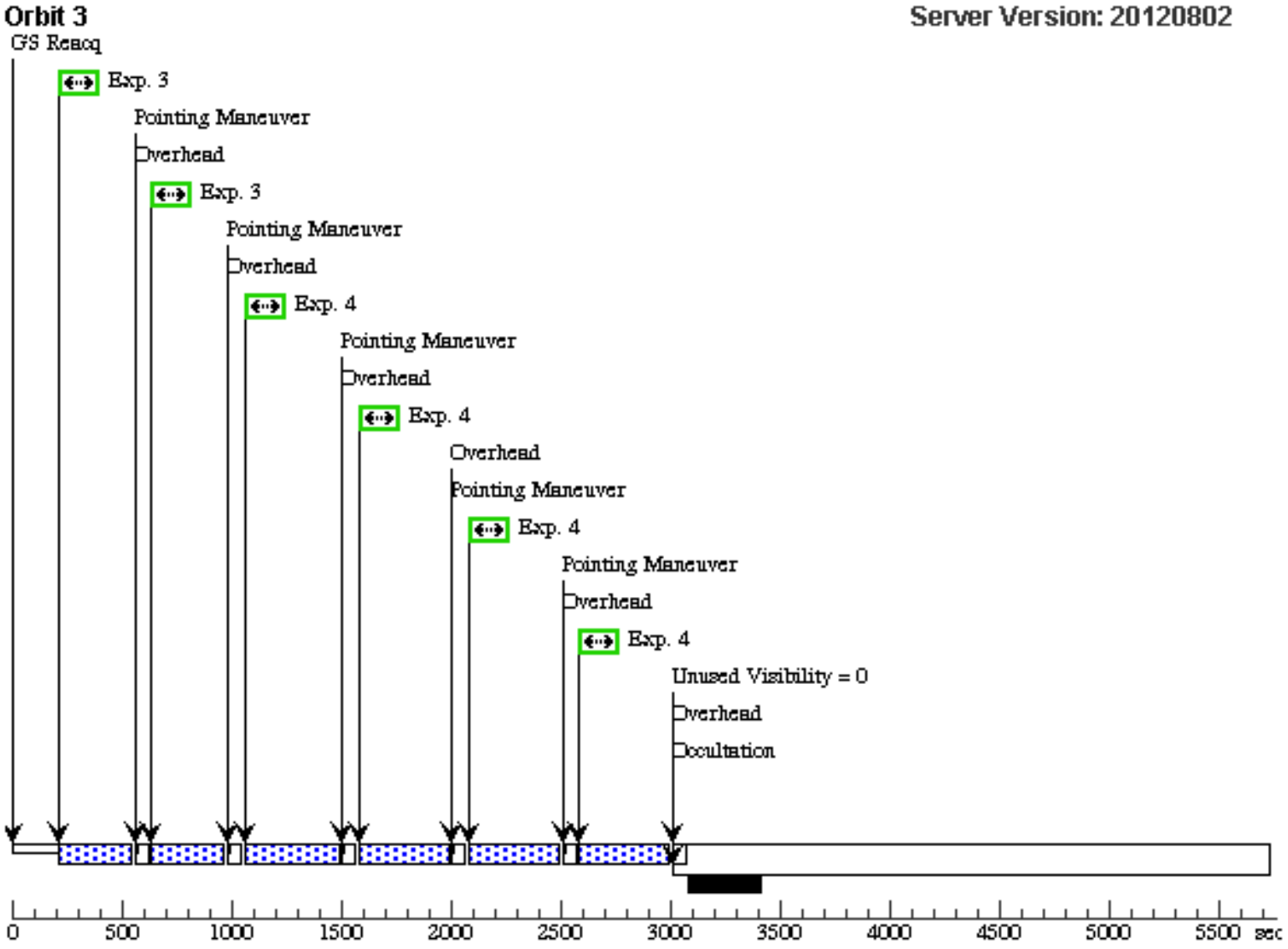
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	2009HD_F336W	(1) SN-2009HD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F336W	FLASH=12		Pattern 2, Exps 1-1 in Visit 01 (2)	598 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	2009HD_F438W	(1) SN-2009HD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F438W	FLASH=12		Pattern 3, Exps 2-2 in Visit 01 (3)	408 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[2]***
3	2009HD_F555W	(1) SN-2009HD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F555W			Pattern 3, Exps 3-3 in Visit 01 (3)	335 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]*	***[2]***
								[==>(Pattern 3)] *[==>(Pattern 4)]*	***[3]***
4	2009HD_F814W	(1) SN-2009HD	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W			Pattern 3, Exps 4-4 in Visit 01 (3)	417 Secs	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[3]***

Orbit Structure




Orbit 2
Server Version: 20120802
GS Reacq
Exp. 2
Pointing Maneuver
Overhead
Exp. 2
Overhead
Pointing Maneuver
Exp. 2
Overhead
Pointing Maneuver
Exp. 2
Overhead
Pointing Maneuver
Exp. 3
Overhead
Pointing Maneuver
Exp. 3
Unused Visibility = 2
Overhead
Pointing Maneuver
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
secs.


Orbit 3
Server Version: 20120802
GS Reacq
Exp. 3
Pointing Maneuver
Overhead
Exp. 3
Pointing Maneuver
Overhead
Exp. 4
Pointing Maneuver
Overhead
Exp. 4
Overhead
Pointing Maneuver
Exp. 4
Pointing Maneuver
Overhead
Exp. 4
Unused Visibility = 0
Overhead
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec