



13340 - Detecting a Hot Companion to the Progenitor of the Type Ic Supernova 1994I in M51

Cycle: 21, 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) SN-1994I-COMPANION	WFC3/UVIS	4	01-Apr-2014 21:09:00.0	yes

4 Total Orbits Used

ABSTRACT

Core-collapse supernovae (SNe) are the endpoints of the lives of massive stars (with initial mass > 8 solar masses). We are reasonably confident that the progenitor stars for most hydrogen-rich Type II SNe are red supergiants, based in part on direct identifications with HST. However, the progenitors of the stripped-envelope He-rich Type Ib and He-poor Type Ic SNe have yet to be directly identified. These SNe are thought to arise from either single, high-mass stars in the Wolf-Rayet phase or, alternatively, from lower-mass stars in interacting binary systems. Both models can account for the required extensive envelope stripping. Until a progenitor is identified for these SN types, our best hope of testing these progenitor models is to detect the companion star to the progenitor, if the binary model holds. This star is predicted to be a hot supergiant. Therefore, it is best detected in the ultraviolet. The only SN which is sufficiently nearby and experienced low enough reddening to be a viable target for this detection is the SN Ic 1994I in M51. Furthermore, the SN was imaged by HST when it was still bright, so we can pinpoint its location. We therefore propose, as

part of the UV Initiative in Cycle 21, to image the site in F275W and F336W to levels deep enough to significantly detect a putative progenitor companion, if it exists. The proposed observations will provide an important test of the binary progenitor hypothesis.

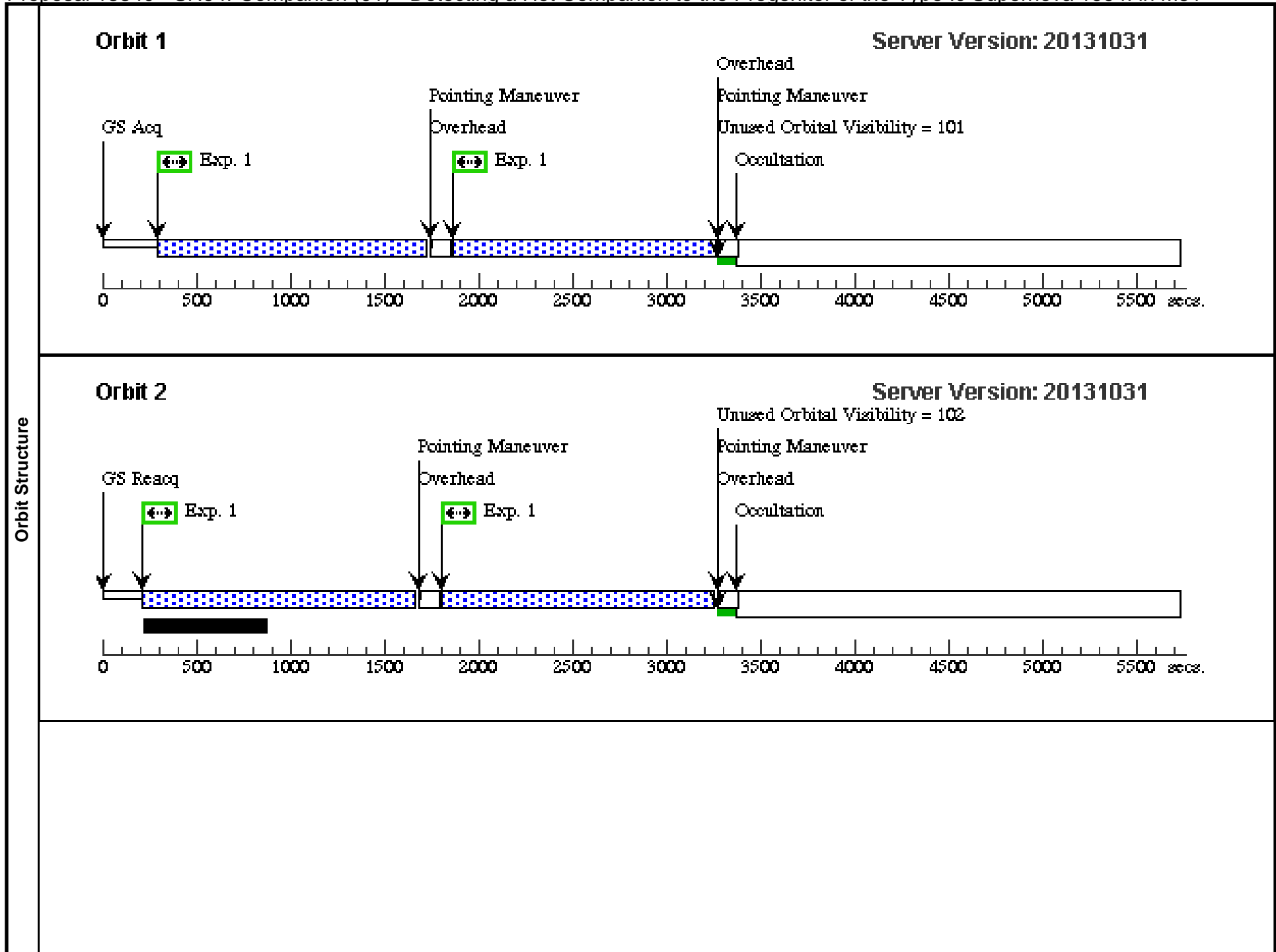
OBSERVING DESCRIPTION

I will be using WFC3/UVIS at F275W and F336W to observe the site of the Type Ic supernova 1994I in M51, to attempt detection of a possible hot binary companion star to the supernova progenitor. This will provide a useful test of the massive interacting binary hypothesis for the origin of these types of supernovae. I have used the UVIS2 aperture, which will optimally place the site on chip 2 of the detector, this chip being the more UV-sensitive of the two chips. I have used the default line dithers between exposures to mitigate against cosmic ray hits and bad pixels, and to optimize subpixel sampling of the star's PSF. More importantly, I used post-flash, with 12 e-, for all exposures, in order to mitigate against CTE losses. The exposure times in each band were established based on assumptions of the largest distance to M51 and the highest likely extinction to the supernova. The observations consist of five frames at F275W, totalling 7360 sec of exposure time, and three frames at F336W, totalling 4548 sec. I will isolate the position of the supernova site through careful comparison with existing WFPC2 imaging of the supernova itself at these wavelengths. The star should be the only UV-bright object at the exact position of the supernova (which itself should have faded well below detectability), should have F275W=25.4 and F336W=25.6 mag based on model predictions, and should be detectable at >5 sigma. Even a non-detection will provide a vital and important constraint on the existing progenitor models. Although I am only interested in the detection of one point source in the images, rather than use the subarray of UVIS, I have used the full two-chip array to provide future archival value of these observations of this famous and important spiral galaxy to other researchers for other studies.

Proposal 13340 - SN94I-Companion (01) - Detecting a Hot Companion to the Progenitor of the Type Ic Supernova 1994I in M51

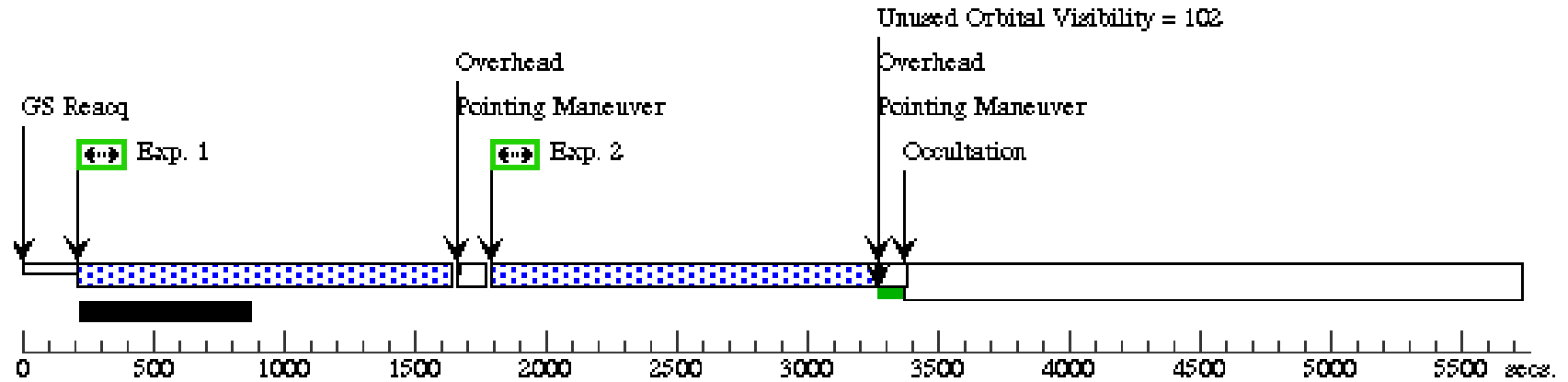
Wed Apr 02 01:09:11 GMT 2014

Visit	Proposal 13340, SN94I-Companion (01), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: ORIENT 298D TO 318 D; ORIENT 200D TO 220 D; ORIENT 20D TO 40 D									
	#	Primary Pattern	Secondary Pattern	Exposures						
Patterns	(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Coordinate Frame=POS-TARG Pattern Orientation=46.84 Purpose=DITHER Angle Between Sides= Number Of Points=5 Center Pattern=false Point Spacing=0.145 Line Spacing=		(1)						
	(2)	Pattern Type=WFC3-UVIS-DITHER-LINE-3PT Coordinate Frame=POS-TARG Pattern Orientation=46.84 Purpose=DITHER Angle Between Sides= Number Of Points=3 Center Pattern=false Point Spacing=0.135 Line Spacing=		(2)						
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	SN-1994I-COMPANION	RA: 13 29 54.1037 (202.4754321d) Dec: +47 11 30.23 (47.19173d) Equinox: J2000		V=26.9+/-0.1	Reference Frame: ICRS				
<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) SN-1994I-COMPANION	WFC3/UVIS, ACCUM, UVIS2	F275W	FLASH=12		Pattern 1, Exps 1-1 in SN94I-Companion (01) (1)	1450 Secs (7147 Secs)	
									[==>1400 Secs (Pattern 1)]	[1]
									[==>1400 Secs (Pattern 2)]	
									[==>1455 Secs (Pattern 3)]	[2]
			[==>1455 Secs (Pattern 4)]							
		[==>1437 Secs (Pattern 5)]	[3]							
2		(1) SN-1994I-COMPANION	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=12		Pattern 2, Exps 2-2 in SN94I-Companion (01) (2)	1450 Secs (4360 Secs)		
								[==>1450 Secs (Pattern 1)]	[3]	
								[==>1455 Secs (Pattern 2)]		
		[==>1455 Secs (Pattern 3)]	[4]							



Orbit 3

Server Version: 20131031



Orbit 4

Server Version: 20131031

