13350 - How Low Can They Go? Detecting low luminosity supernova progenitors

Cycle: 21, 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) SN1999GI	WFC3/UVIS	1	16-Oct-2013 21:34:34.0	yes
02	(2) SN1999AN	WFC3/UVIS	1	16-Oct-2013 21:34:44.0	yes
03	(3) SN2000EW	WFC3/UVIS	1	16-Oct-2013 21:34:54.0	yes
04	(4) SN2004GN	WFC3/UVIS	1	16-Oct-2013 21:35:03.0	yes
05	(5) SN2006BC	WFC3/UVIS	1	16-Oct-2013 21:35:12.0	yes

5 Total Orbits Used

ABSTRACT

While we now discover thousands of supernovae (SNe) per year, in the history of astronomy a little more than a dozen SN progenitors have been identified, and all of these have been from Type II SNe. This dearth is largely due to the fact that the progenitors are destroyed in the SN, and so to study them one must have fortuitously taken data on them prior to their explosion. However, the fault may also partially lie with the methods

employed to search for progenitors.

In the past, searches have generally relied on looking at the location of a SNe in an archival image to see if a noticeable point source is at the right location. This method requires that the background field of the galaxy be relatively uniform, and if one wants an accurate estimate of the progenitor mangitude, that the star was not in an association or binary. Here we propose to take WFC3 images several years post explosion so that we can subtract them from archival WFPC2 images. We show that we can do this with extraordinary fidelity. We will apply this method to a well-chosen sample of three Type II SNe and two Type Ibc SNe, which lie on messy galaxy fields that may have camouflaged the presence of a progenitor. This method has the potential to detect or substantially deepen the limits on the progenitors of these objects, which already appear too faint for theoretical models.

OBSERVING DESCRIPTION

In this program, we ask for time to image a number of hosts of nearby SNe using WFC3, which were also observed by HST with WFPC2 prior to the explosion. In all cases we know the location of the SNe on the host to better than an arc second from ground-based imaging, and in a few cases we have post-explosion HST observations which show the light of the Sne on the host, giving us a sub-pixel position. In these cases, the light of the SNe prevents us from seeing the environment of the SN post explosion. However, we will be returning to SNe four or more years after explosion, when the light of the SN will have faded magnitudes below the expected luminosity of the original progenitor star. We will attempt to locate and determine the actual luminosity of the SN progenitors by subtracting the images we will acquire now from the images taken prior to the explosion. Although we will be using a different instrument from that used to take the initial image, we have found that we can nonetheless perform a very high fidelity image subtraction.

The excellent image subtraction is made possible by a number of propitious factors. First the WFC3 was placed in the same location on the focal plane of HST as WFPC2, so the two instruments share the same optics along most of their light path. In addition they share very similar filter sets, minimizing color terms. Thus the primary diferences in their point-spread functions (PSFs) arise through diferences in the detectors. A dithered WFC3 image however, has essentially all of the information contained in a WFPC2 image and more, and its PSF can in principle be convolved to closely match that of the WFPC2.

Visit

Proposal 13350, SN 1999GI (01), implementation Thu Oct 17 01:35:20 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 60%; ORIENT 295D TO 300 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	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		(1), (2)

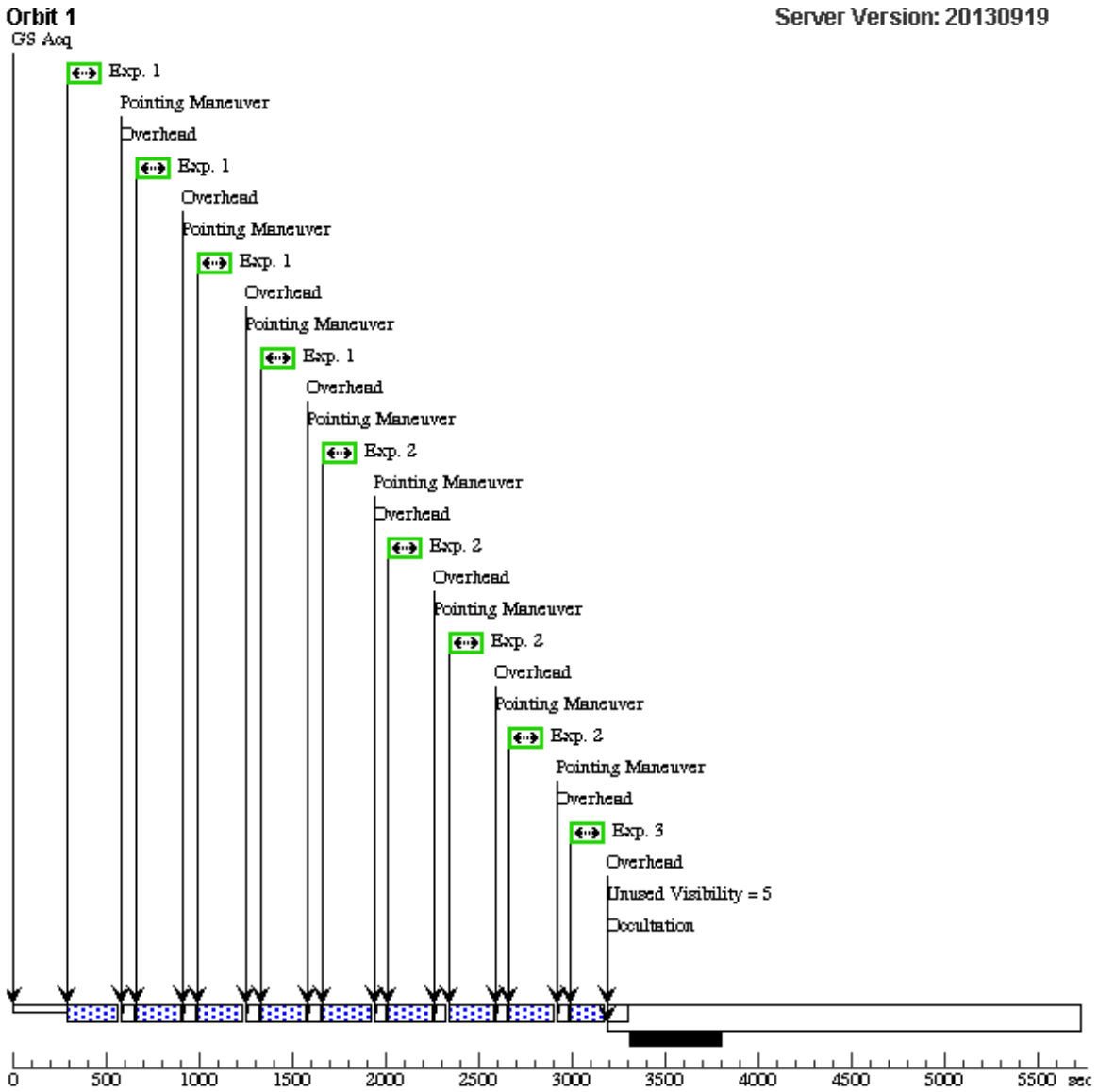
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN1999GI	RA: 10 18 16.2000 (154.5675000d) Dec: +41 26 28.60 (41.44128d) Equinox: J2000		V=25+/-1	Reference Frame: NED

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F300X	(1) SN1999GI	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F300X	FLASH=11	GS ACQ SCENARIO BASE1B3	Pattern 1, Exps 1-1 in SN 1999GI (01) (1)	235 Secs (964 Secs)	
								[==>241.0 Secs (Pattern 1)] *[==>241.0 Secs (Pattern 2)]* *[==>241.0 Secs (Pattern 3)]* *[==>241.0 Secs (Pattern 4)]*	***[1]***
2	F606W	(1) SN1999GI	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W			Pattern 1, Exps 2-2 in SN 1999GI (01) (1)	235 Secs (964 Secs)	
								[==>241.0 Secs (Pattern 1)] *[==>241.0 Secs (Pattern 2)]* *[==>241.0 Secs (Pattern 3)]* *[==>241.0 Secs (Pattern 4)]*	***[1]***
3	F606W-WIDE	(1) SN1999GI	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=3	POS TARG -60,-22		175 Secs (181 Secs)	
								[==>181.0 Secs]	***[1]***

Orbit Structure



Visit

Proposal 13350, SN 1999AN (02), implementation Thu Oct 17 01:35:22 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 60%; ORIENT 150D TO 160 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	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		(1), (2)

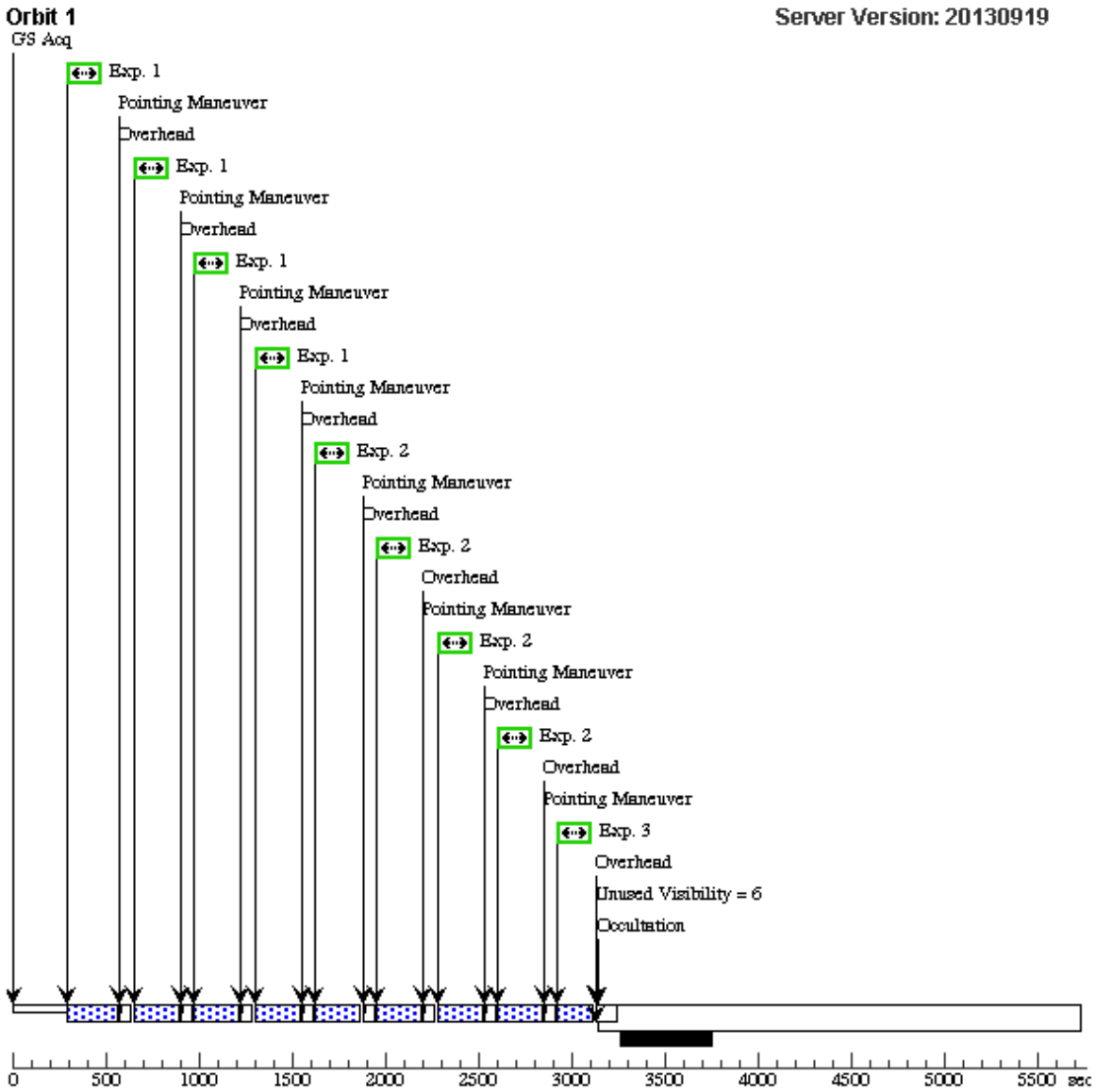
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	SN1999AN	RA: 12 01 10.5700 (180.2940417d) Dec: +14 06 12.30 (14.10342d) Equinox: J2000		V=25+/-1	Reference Frame: NED

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F606W	(2) SN1999AN	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W			Pattern 1, Exps 1-1 in SN 1999AN (02) (1)	235 Secs (952 Secs) *[==>238.0 Secs (Pattern 1)]* *[==>238.0 Secs (Pattern 2)]* *[==>238.0 Secs (Pattern 3)]* *[==>238.0 Secs (Pattern 4)]*	 ***[1]***
2	F475W	(2) SN1999AN	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F475W			Pattern 1, Exps 2-2 in SN 1999AN (02) (1)	235 Secs (952 Secs) *[==>238.0 Secs (Pattern 1)]* *[==>238.0 Secs (Pattern 2)]* *[==>238.0 Secs (Pattern 3)]* *[==>238.0 Secs (Pattern 4)]*	 ***[1]***
3	F606W-WIDE	(2) SN1999AN	WFC3/UVIS, ACCUM, UVIS2	F606W	FLASH=5	POS TARG -60,-22		175 Secs (178 Secs) *[==>178.0 Secs]*	 ***[1]***

Orbit Structure



Visit

Proposal 13350, SN 2000EW (03), implementation Thu Oct 17 01:35:24 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 60%; ORIENT 260D TO 280 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	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		(1), (2)

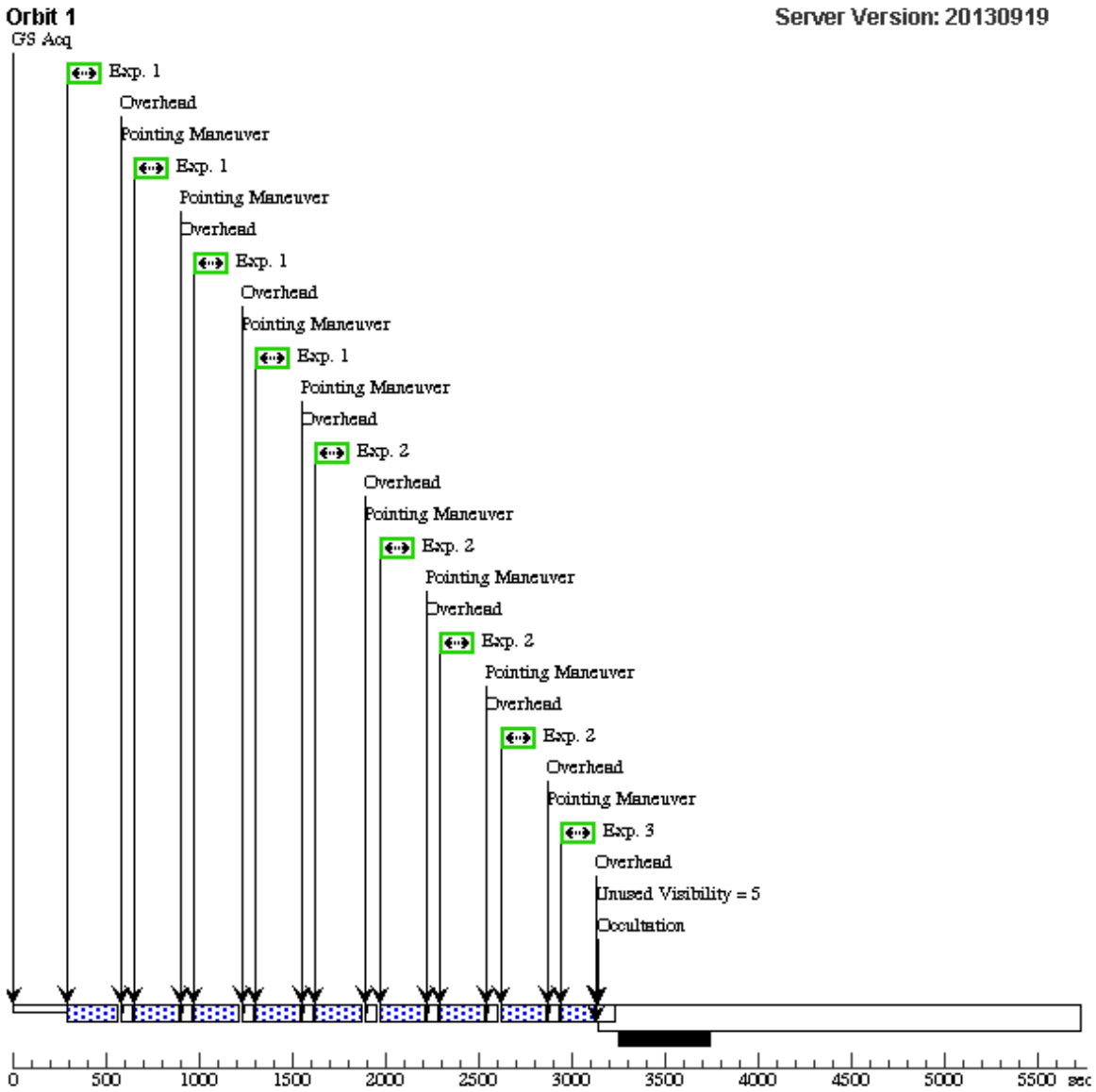
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	SN2000EW	RA: 11 40 58.5200 (175.2438333d) Dec: +11 27 55.90 (11.46553d) Equinox: J2000		V=25+/-1	Reference Frame: NED

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F475W	(3) SN2000EW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F475W			Pattern 1, Exps 1-1 in SN 2000EW (03) (1)	235 Secs (956 Secs) *[==>239.0 Secs (Pattern 1)]* *[==>239.0 Secs (Pattern 2)]* *[==>239.0 Secs (Pattern 3)]* *[==>239.0 Secs (Pattern 4)]*	***[1]***
2	F606W	(3) SN2000EW	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W			Pattern 1, Exps 2-2 in SN 2000EW (03) (1)	235 Secs (956 Secs) *[==>239.0 Secs (Pattern 1)]* *[==>239.0 Secs (Pattern 2)]* *[==>239.0 Secs (Pattern 3)]* *[==>239.0 Secs (Pattern 4)]*	***[1]***
3	F606W-WIDE	(3) SN2000EW	WFC3/UVIS, ACCUM, UVIS2	F606W		POS TARG -60,-22		175 Secs (179 Secs) *[==>179.0 Secs]*	***[1]***

Orbit Structure



Visit

Proposal 13350, SN 2004GN (04), implementation Thu Oct 17 01:35:25 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 60%; ORIENT 250D TO 295 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	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		(1), (2)

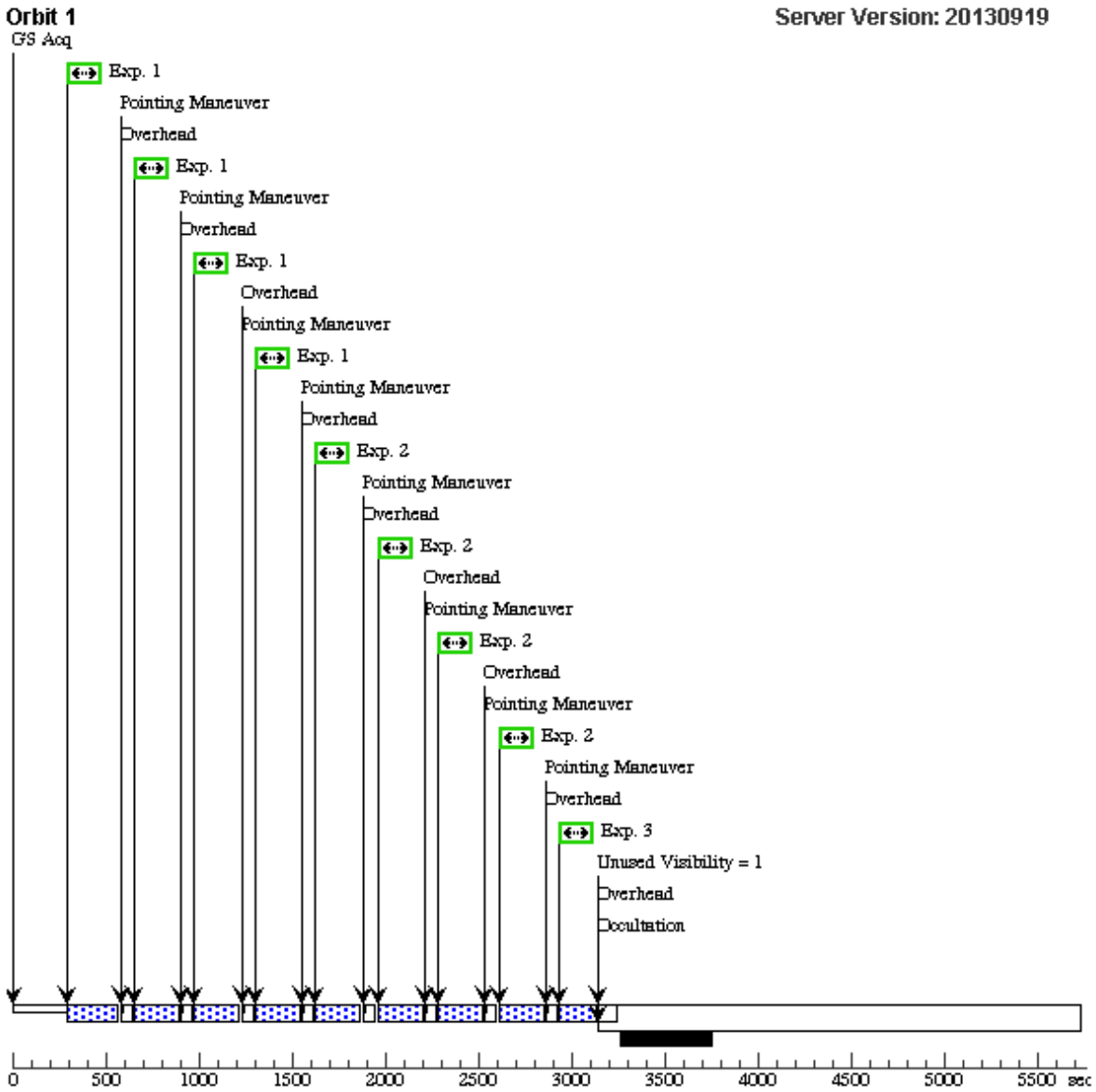
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(4)	SN2004GN	RA: 12 34 12.1000 (188.5504167d) Dec: +02 39 34.40 (2.65956d) Equinox: J2000		V=25+/-1	Reference Frame: NED

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F606W	(4) SN2004GN	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F606W			Pattern 1, Exps 1-1 in SN 2004GN (04) (1)	235 Secs (956 Secs)	
								[==>239.0 Secs (Pattern 1)] *[==>239.0 Secs (Pattern 2)]* *[==>239.0 Secs (Pattern 3)]* *[==>239.0 Secs (Pattern 4)]*	***[1]***
2	F475W	(4) SN2004GN	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F475W			Pattern 1, Exps 2-2 in SN 2004GN (04) (1)	235 Secs (956 Secs)	
								[==>239.0 Secs (Pattern 1)] *[==>239.0 Secs (Pattern 2)]* *[==>239.0 Secs (Pattern 3)]* *[==>239.0 Secs (Pattern 4)]*	***[1]***
3	F606W-WIDE	(4) SN2004GN	WFC3/UVIS, ACCUM, UVIS2	F606W		POS TARG -60,-22		175 Secs (179 Secs)	
								[==>179.0 Secs]	***[1]***

Orbit Structure



Visit

Proposal 13350, SN 2006BC (05), implementation Thu Oct 17 01:35:26 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: SCHED 90%; ORIENT 325D TO 355 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	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		(1), (2)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(5)	SN2006BC	RA: 07 21 16.5000 (110.3187500d) Dec: -68 59 57.30 (-68.99925d) Equinox: J2000		V=25+/-1	Reference Frame: NED

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	F475W	(5) SN2006BC	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F475W	FLASH=5		Pattern 1, Exps 1-1 in SN 2006BC (05) (1)	235 Secs (940 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
2	F814W	(5) SN2006BC	WFC3/UVIS, ACCUM, UVIS2-C1K1C-SUB	F814W			Pattern 1, Exps 2-2 in SN 2006BC (05) (1)	235 Secs (940 Secs)	
								[==>(Pattern 1)] *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
3	F814W-WIDE	(5) SN2006BC	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=8	POS TARG -60,-22		175 Secs (175 Secs)	
								[==>]	***[1]***

Orbit Structure