11133 - Late-Time Photometry of SN 2005hk: A New Kind of Type Ia Supernova

Cycle: 16, Proposal Category: GO

(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) SN-2005HK	WFPC2	1	14-Jun-2007 21:16:21.0	yes

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
02	(1) SN-2005HK	WFPC2	3	14-Jun-2007 21:16:27.0	yes
03	(1) SN-2005HK	NIC2	2	14-Jun-2007 21:16:32.0	yes
04	(1) SN-2005HK	NIC2	3	14-Jun-2007 21:16:41.0	yes

9 Total Orbits Used

ABSTRACT

Our lack of understanding of Type Ia supernova (SN Ia) explosions limits our confidence in their use for cosmology. While there is broad agreement that these objects represent the explosions of white dwarfs, the details of the explosion mechanism are not well-understood. Recent observations have detected a previously unacknowledged variant class of SNe Ia whose photometric and spectroscopic peculiarities make them quite distinct from normal SNe Ia. These objects represent a challenge for thermonuclear supernova models, as a complete theory of exploding white dwarfs must allow for their existence. A particularly well-studied example of this class of objects is the recent SN 2005hk, whose properties in some respects resemble those of models which invoke a subsonic burning front, called a deflagration. We propose to test SN Ia models by obtaining late-time photometry for this extreme SN Ia using WFPC2 and NICMOS on HST. We will accurately measure the late-time photometric decline rate and spectral energy distribution (SED). These observations will allow us to test whether the ejecta contain the large amount of oxygen predicted by certain models, the efficiency of energy deposition by gamma rays and positrons, and possibly detect major evolution of the SED expected due to a change in the dominant cooling mechanism of the ejecta.

OBSERVING DESCRIPTION

We will observe SN 2005hk with WFPC2 in F555W, F675W, and F814W. To image SN 2005hk, we will use the PC with a standard dither pattern, providing a well-sampled point-spread function and the best photometry. In addition we will follow the recommendation to mitigate CTE losses by placing the SN at position (150,150), nearer to the readout electronics than the default aperture. Other point sources throughout the field will be used to firmly establish the astrometry and precise location of SN 2005hk. Based on extrapolations of the current data and inferences from other SNe Ia, we anticipate SN 2005hk to have V ~ 25, R ~ 24.5, and I ~ 23.5, at the epoch of observation, with an uncertainty of about 1 mag. To meaningfully

constrain models, we must achieve S/N >= 10 in all bands, even in the pessimistic case (1 mag below the prediction). Based on the WFPC2 exposure time calculator and including overheads, this requires a total of 4 orbits.

We will also observe SN 2005hk with NICMOS in F110W and F160W. During the observation window, we predict J ~ 23.5, and H ~ 23, for the supernova. We have chosen the NIC2 detector to get the best balance of high sensitivity and angular resolution to resolve the PSF, and will use a standard dither pattern. With 2 orbits in F110W and 3 orbits in F160W, we will again ensure S/N >= 10 even if the SN flux is low by as much as 1 mag.

UPDATE: Recent data show that SN 2005hk has faded faster in the optical than its previous decline rate would have predicted. We thus intend to go deeper in our observations by replacing the V (F555W) and R (F675W) exposures with images in the more efficient F606W passband (effectively V+R). This change will still allow us to constrain the SN SED in the optical region.

Visit

Proposal 11133, Visit 01, implementation Fri Jun 15 01:16:43 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: ORIENT 250.0D TO 320.0 D; BEFORE 01-OCT-2007:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFPC2-BOX	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=26.57		
	Number Of Points=4	Angle Between Sides=143.13		
	Point Spacing=0.559	Center Pattern=false		
	Line Spacing=0.559			

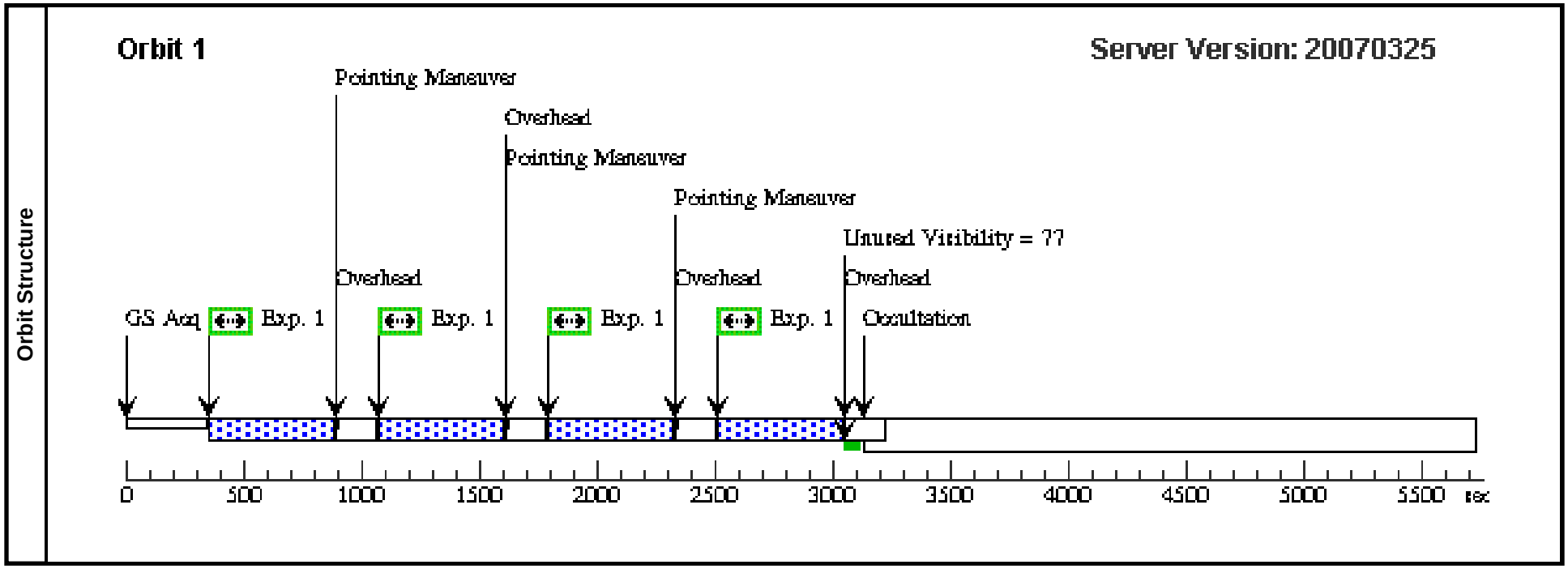
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2005HK	RA: 00 27 50.8805 (6.9620021d)		V=25.0+/-1.0	Reference Frame: ICRS
		Dec: -01 11 53.33 (-1.19815d)		R = 24.5 +/-1,	
		Equinox: J2000		I = 23.5 +/- 1,	
				J = 23.5 +/- 1,	
				H = 23 +/- 1; fading	

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

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	I-band box	(1) SN-2005HK	WFPC2, IMAGE, PC1	F814W		POS TARG -7,-8	Pattern 1-1 (1)	400.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	


Orbit Structure
Orbit 1
Server Version: 20070325
Pointing Maneuver
Overhead
Pointing Maneuver
Pointing Maneuver
Unused Vitibility = 77
Overhead
Overhead
Overhead
GS Acq
Exp. 1
Exp. 1
Exp. 1
Exp. 1
Occultation
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11133, Visit 02, implementation Fri Jun 15 01:16:44 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: ORIENT 250.0D TO 320.0 D; BEFORE 01-OCT-2007:00:00:00

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFPC2-BOX	Coordinate Frame=POS-TARG		(1), (2), (3)
	Purpose=DITHER	Pattern Orientation=26.57		
	Number Of Points=4	Angle Between Sides=143.13		
	Point Spacing=0.559	Center Pattern=false		
	Line Spacing=0.559			

Fixed Targets

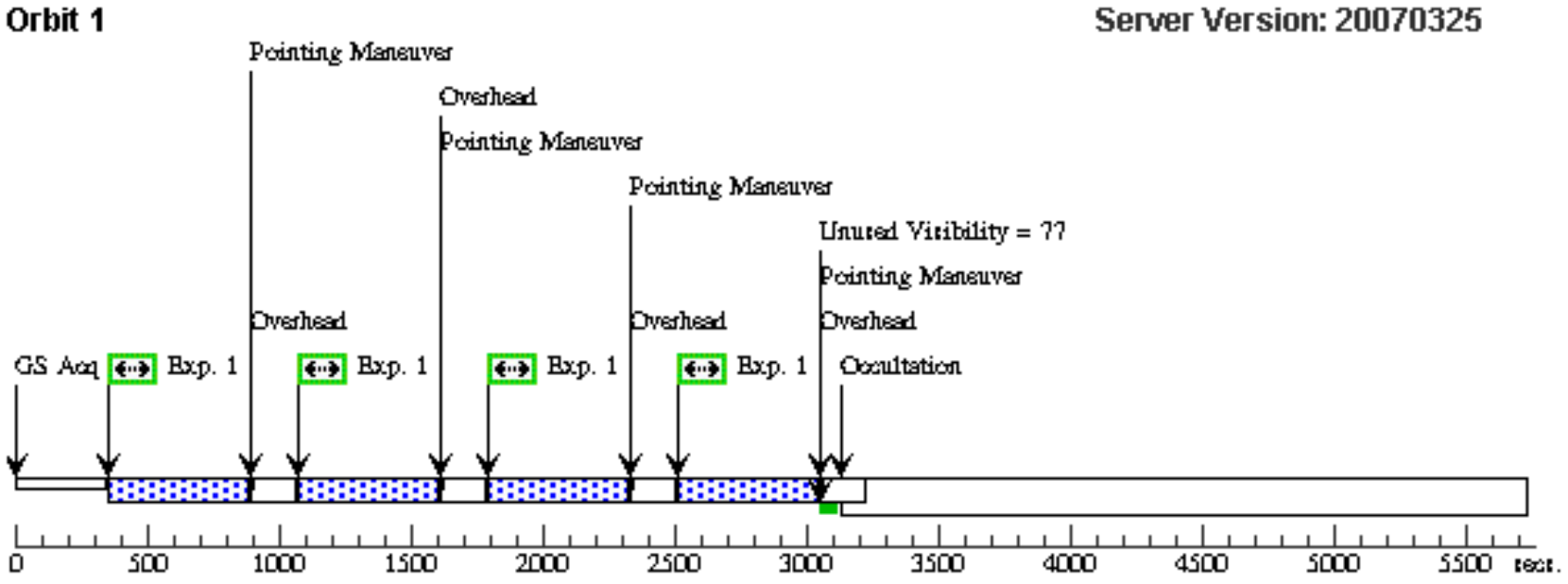
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2005HK	RA: 00 27 50.8805 (6.9620021d)		V=25.0+/-1.0	Reference Frame: ICRS
		Dec: -01 11 53.33 (-1.19815d)		R = 24.5 +/-1,	
		Equinox: J2000		I = 23.5 +/- 1,	
				J = 23.5 +/- 1,	
				H = 23 +/- 1; fading	

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

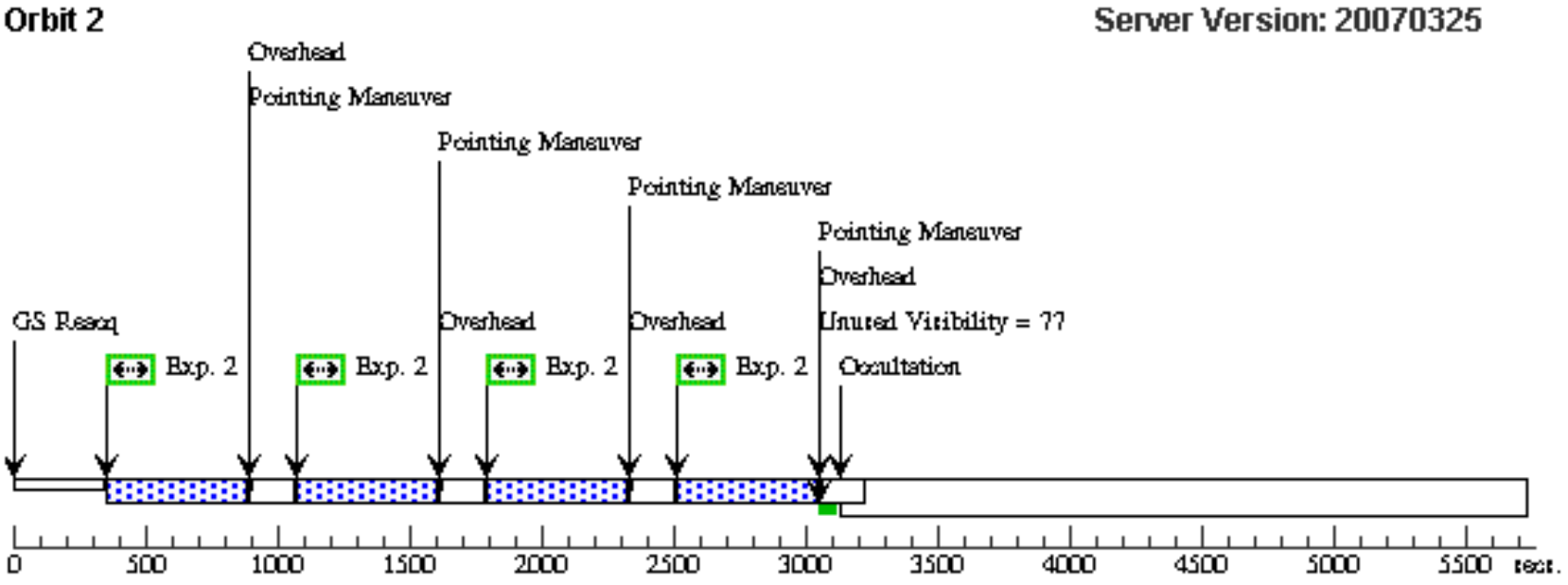
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	VR-band box 1	(1) SN-2005HK	WFPC2, IMAGE, PC1	F606W		POS TARG -7,-8	Pattern 1-1 (1)	400.0 Secs	
								[==>(Pattern 1)]	***[1]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
2	VR-band box 2	(1) SN-2005HK	WFPC2, IMAGE, PC1	F606W		POS TARG -7,-8	Pattern 2-2 (1)	400.0 Secs	
								[==>(Pattern 1)]	***[2]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	
3	VR-band box 3	(1) SN-2005HK	WFPC2, IMAGE, PC1	F606W		POS TARG -7,-8	Pattern 3-3 (1)	400.0 Secs	
								[==>(Pattern 1)]	***[3]***
								[==>(Pattern 2)]	
								[==>(Pattern 3)]	
								[==>(Pattern 4)]	

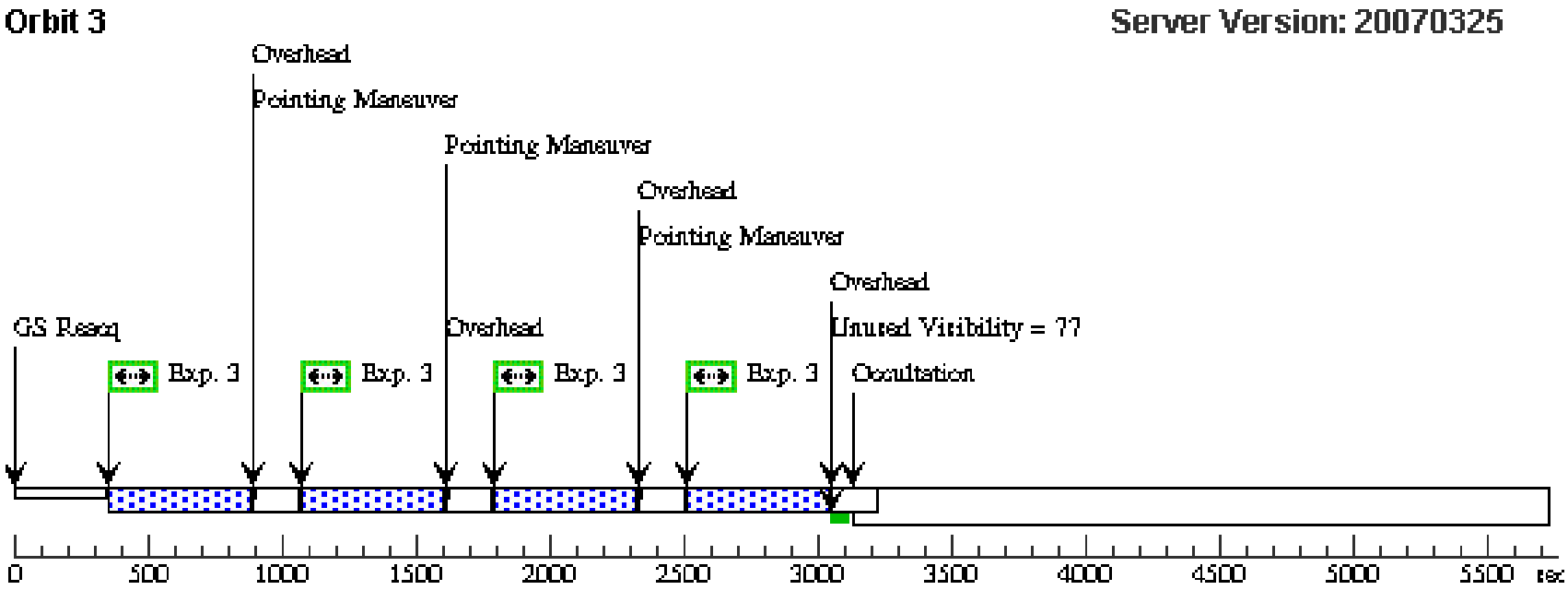
Orbit Structure



Orbit Structure (continued)



Orbit Structure (continued)



Visit

Proposal 11133, Visit 03, scheduling Fri Jun 15 01:16:46 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: NIC2

Special Requirements: BEFORE 01-OCT-2007:00:00:00

Comments: Please schedule in SAA-free orbits.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=NIC-SPIRAL-DITH	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=0		
	Number Of Points=8	Angle Between Sides=		
	Point Spacing=0.34	Center Pattern=false		
	Line Spacing=			

Fixed Targets

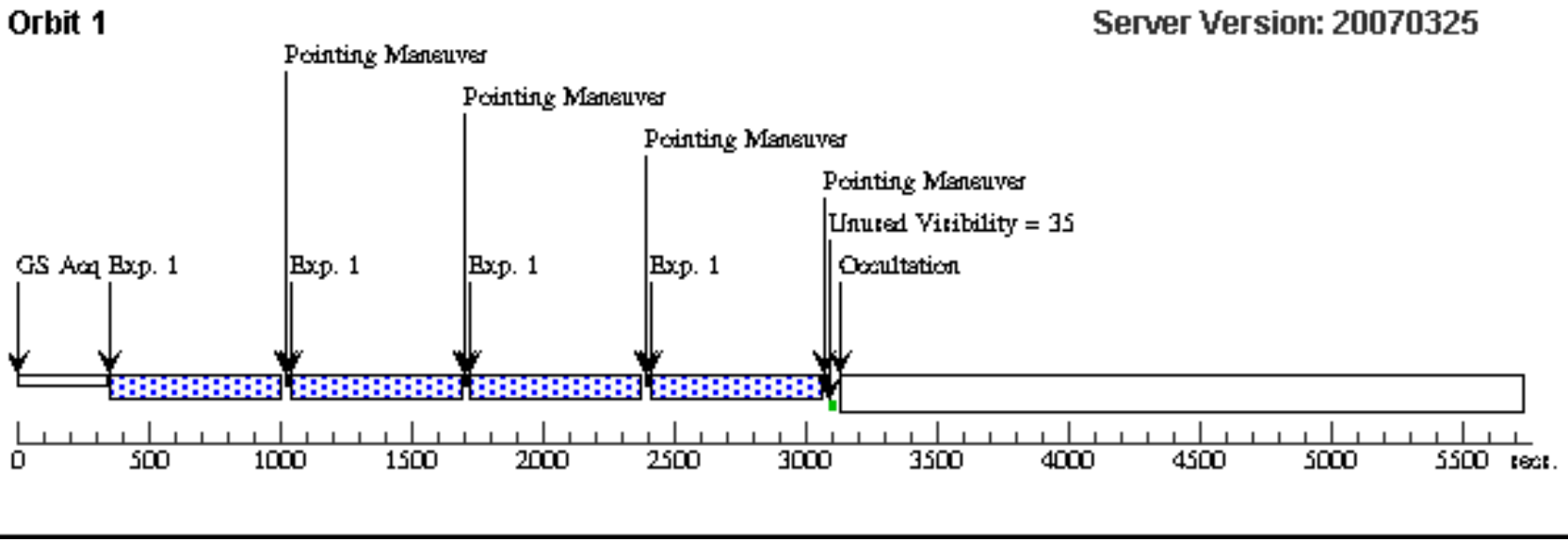
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2005HK	RA: 00 27 50.8805 (6.9620021d)		V=25.0+/-1.0	Reference Frame: ICRS
		Dec: -01 11 53.33 (-1.19815d)		R = 24.5 +/-1,	
		Equinox: J2000		I = 23.5 +/- 1,	
				J = 23.5 +/- 1,	
				H = 23 +/- 1; fading	

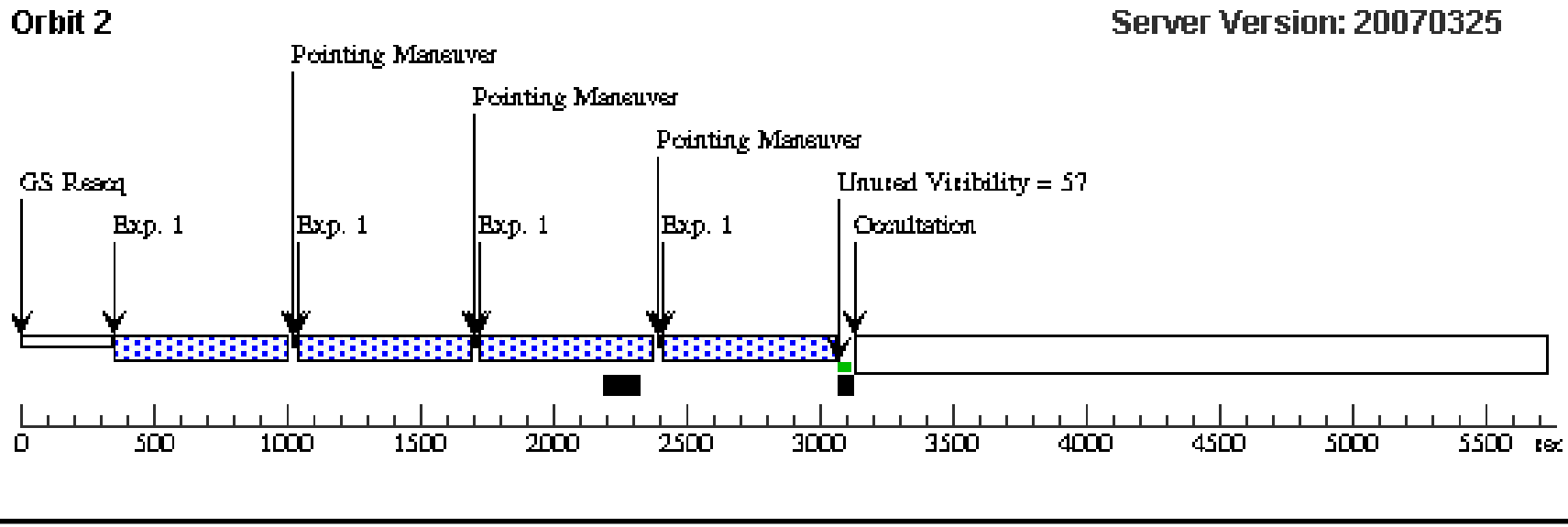
Comments: This object was generated by the targetselector and retrieved from the NED database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	J-band	(1) SN-2005HK	NIC2, MULTIACCUM, NIC2-FIX	F110W	NSAMP=12; SAMP-SEQ=SPARS 64		Pattern 1-1 (2)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
								[==>(Pattern 5)] *[==>(Pattern 6)]* *[==>(Pattern 7)]* *[==>(Pattern 8)]*	***[2]***

Orbit Structure





Visit

Proposal 11133, Visit 04, scheduling Fri Jun 15 01:16:46 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: NIC2

Special Requirements: BEFORE 01-OCT-2007:00:00:00

Comments: Please schedule in SAA-free orbits.

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(3)	Pattern Type=NIC-SPIRAL-DITH	Coordinate Frame=POS-TARG		(1)
	Purpose=DITHER	Pattern Orientation=0		
	Number Of Points=12	Angle Between Sides=		
	Point Spacing=0.34	Center Pattern=false		
	Line Spacing=			

Fixed Targets

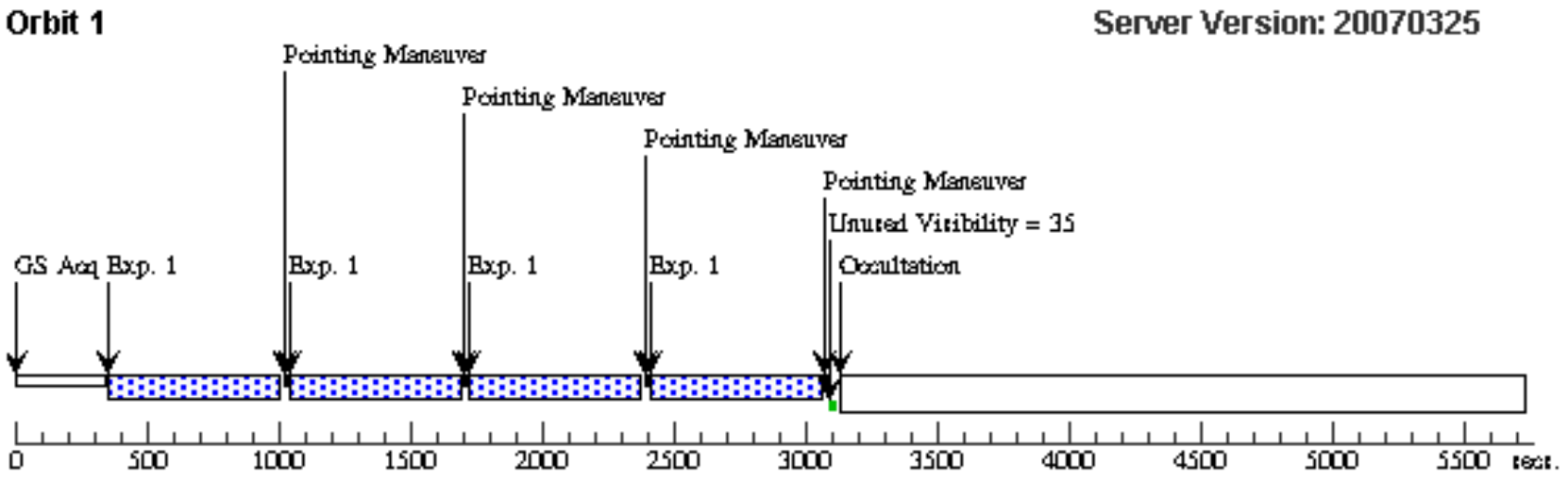
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SN-2005HK	RA: 00 27 50.8805 (6.9620021d)		V=25.0+/-1.0	Reference Frame: ICRS
		Dec: -01 11 53.33 (-1.19815d)		R = 24.5 +/-1,	
		Equinox: J2000		I = 23.5 +/- 1,	
				J = 23.5 +/- 1,	
				H = 23 +/- 1; fading	

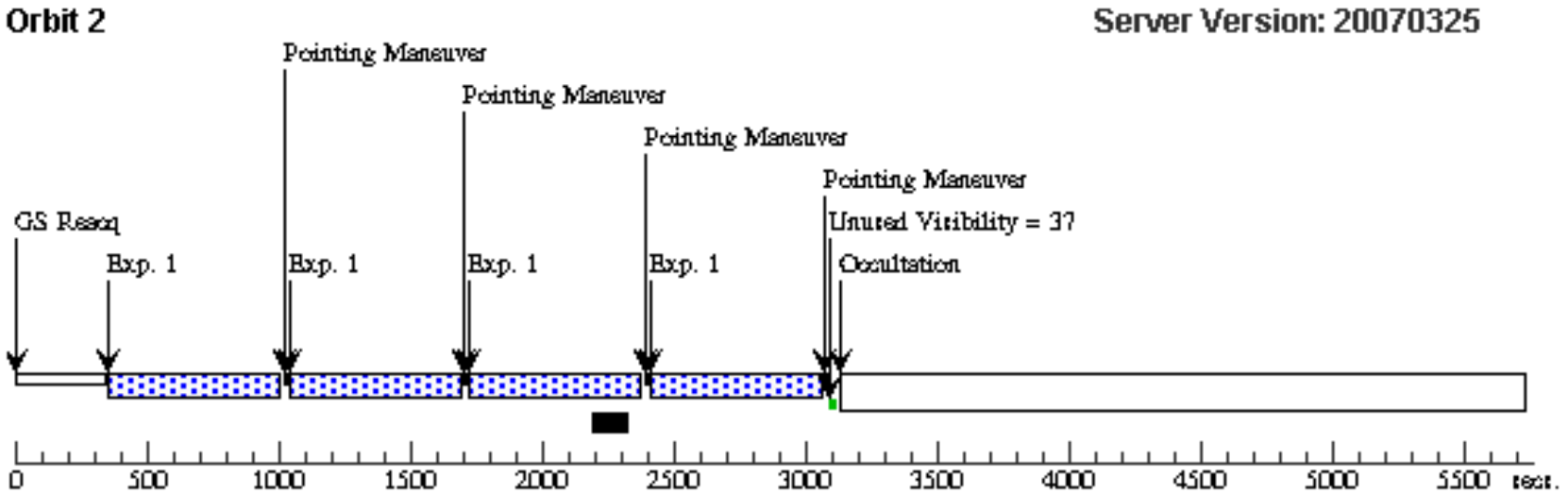
Comments: This object was generated by the targetselector and retrieved from the NED database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	H-band	(1) SN-2005HK	NIC2, MULTIACCUM, NIC2-FIX	F160W	NSAMP=12; SAMP-SEQ=SPARS 64		Pattern 1-1 (3)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***
								[==>(Pattern 5)] *[==>(Pattern 6)]* *[==>(Pattern 7)]* *[==>(Pattern 8)]*	***[2]***
								[==>(Pattern 9)] *[==>(Pattern 10)]* *[==>(Pattern 11)]* *[==>(Pattern 12)]*	***[3]***

Orbit Structure





Orbit Structure (continued)