12284 - Light Echoes from a Periodic Protostellar Outburst

Cycle: 18, 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) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:21:03.0	yes
02	(1) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:21:13.0	yes
03	(1) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:21:25.0	yes
04	(1) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:21:32.0	yes
05	(1) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:21:40.0	yes
06	(1) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:21:47.0	yes
07	(1) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:21:55.0	yes
08	(1) LRLL-54361	WFC3/IR	1	17-Sep-2010 21:22:02.0	yes

8 Total Orbits Used

ABSTRACT

We propose to obtain multi-epoch WFC3IR imaging of a remarkable variable protostar in the IC 348 star forming region. This object, LRLL 54361, exhibits unique outbursts in the infrared that repeat on a roughly 25 day timescale and produce luminosity variations of over an order of magnitude. Images taken with the Spitzer Space Telescope show a resolved scattered light outflow cavity whose morphology changes in concert with the central source, indicating a light echo effect. We need HST observations to characterize the outflow cavity geometry and constrain models of the infalling envelope structure, verify the presence of a binary outflow, and measure shocked emission in the outflow itself. In combination with other proposed and existing observations, these data will help unravel the mystery of this variable source and provide important new insight into the dynamic evolution of young suns.

OBSERVING DESCRIPTION

We propose to image the infrared-variable protostar LRLL 54361 with WFC3. We need detailed information on the spatial structure of the circumstellar material in order to better constrain the shape of the outflow cavity and measure mass loss diagnostics in the outflow. Broad band observations with the F160W filter will be sufficient to characterize the scattered light morphology, while the narrow band F164N is needed to detect resolved [Fe II] emission from the outflow. In order to best trace the propagation of the light echo, we are requesting 7 repeat F160W observations evenly spread (using follow-on timing constraints of 3.5-4.5 days) over the 25-day duty cycle of the variable central source. The scheduling constraints will ensure that we obtain at least one observation near the outburst peak in case of slight errors in our estimate of the period. Since the outflow itself is not likely to register observable changes on this timescale (at typical outflow speeds of ~ 200 km/s, parcels of gas would move ~ 3 AU, or 0.01", in 25 days), we require only one epoch with the F164N filter.

We estimate a peak central source brightness of H ~ 17.5 from ground-based observations obtained within a few days of an outburst peak. Given the full range of the MIR variations and the lack of wavelength dependence, we estimate a quiescent-level brightness of H ~ 20. The surface brightness of the scattered light is fainter by about a factor of 10. We can achieve S/N > 15 of the outflow cavity at F160W with dithered exposures in one full orbit. Each visit will be split into 150 second exposures (SPARS50 with NSAMP=4) to limit saturation of the brightest source in the field (H ~ 13), with 4 dither positions (using pattern WFC3-IR-DITHER-BOX-MIN) to improve sampling of the PSF. For the F164N observation, we estimate a total exposure time of about 2600 seconds, fit into a single orbit, for S/N > 30 of the brighter emission knots. We note that Walawender et al. (2006) detect shock emission at Halpha+[S II] in the NW part of the outflow, indicating that the line-of-sight extinction there is less and so corresponding [Fe II] emission should be more easily detected. Combining the F164N observation with the multiple F160W observations, we request a total of 8 orbits.

Visit

Proposal 12284, Visit 01, implementation Sat Sep 18 01:22:07 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)

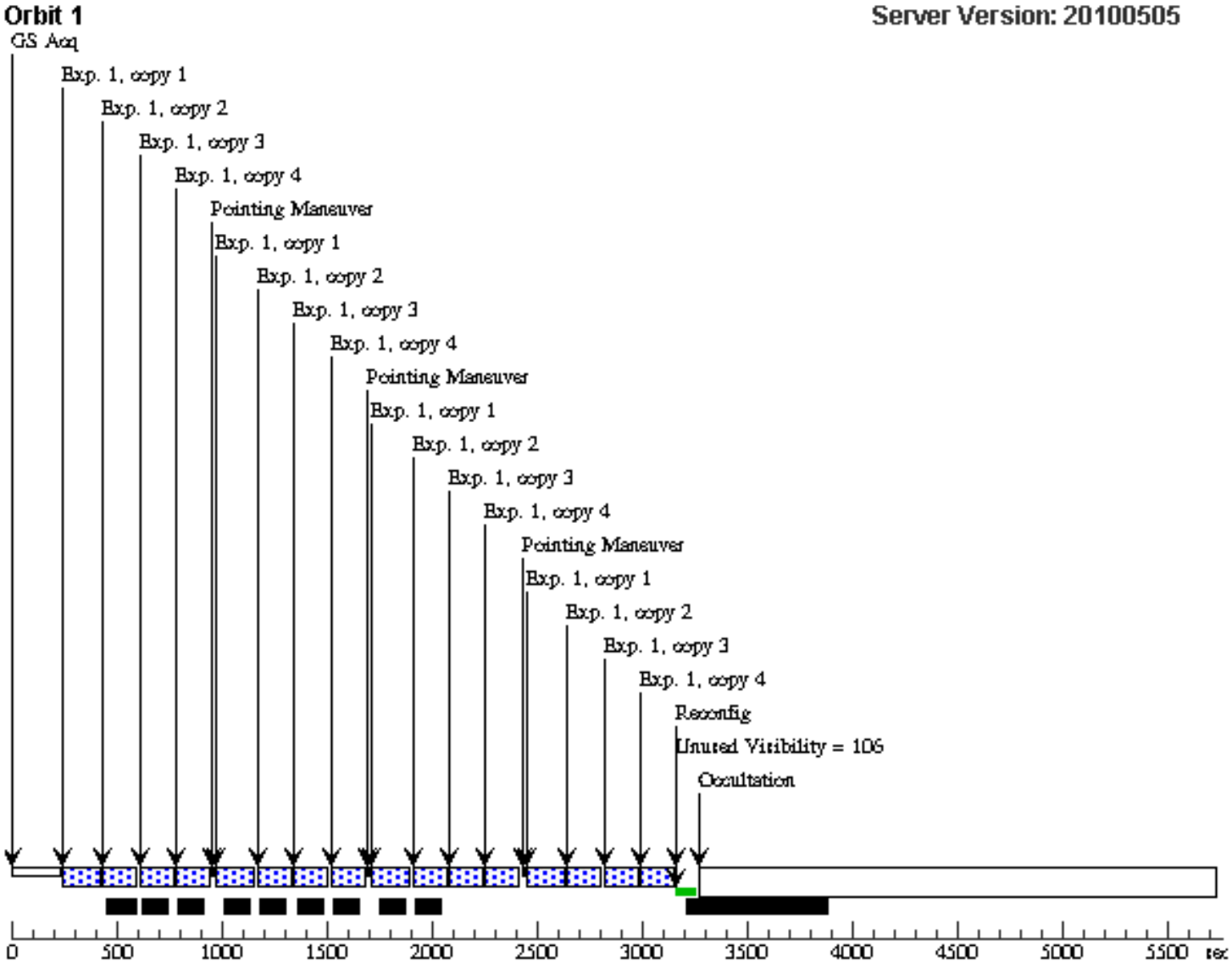
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=4; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 3, Copy 3)]* *[==>(Pattern 3, Copy 4)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]* *[==>(Pattern 4, Copy 3)]* *[==>(Pattern 4, Copy 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12284, Visit 02, implementation Sat Sep 18 01:22:08 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D; AFTER 01 BY 3.5 D TO 4.5 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)

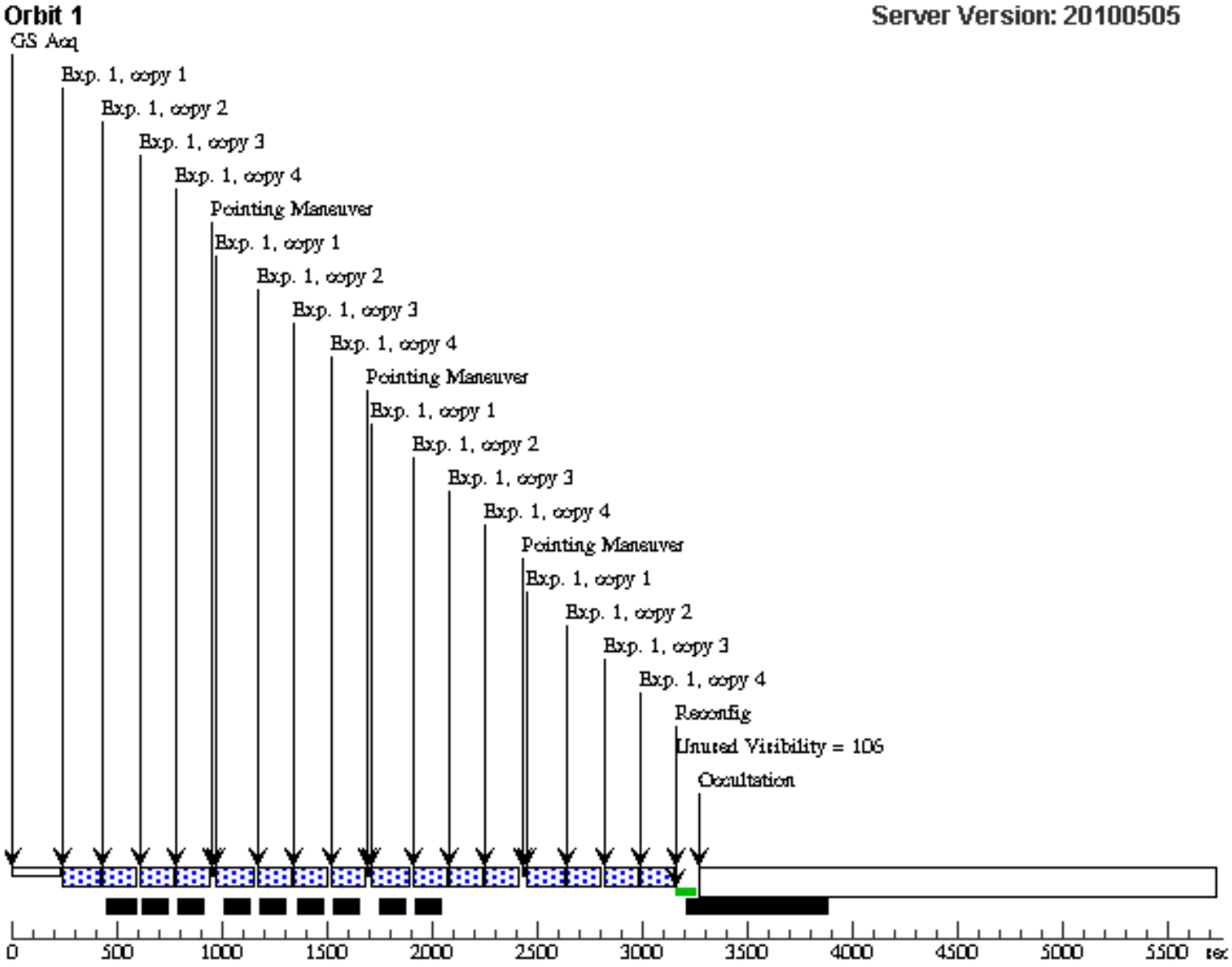
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=4; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 3, Copy 3)]* *[==>(Pattern 3, Copy 4)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]* *[==>(Pattern 4, Copy 3)]* *[==>(Pattern 4, Copy 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12284, Visit 03, implementation Sat Sep 18 01:22:08 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D; AFTER 02 BY 3.5 D TO 4.5 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)

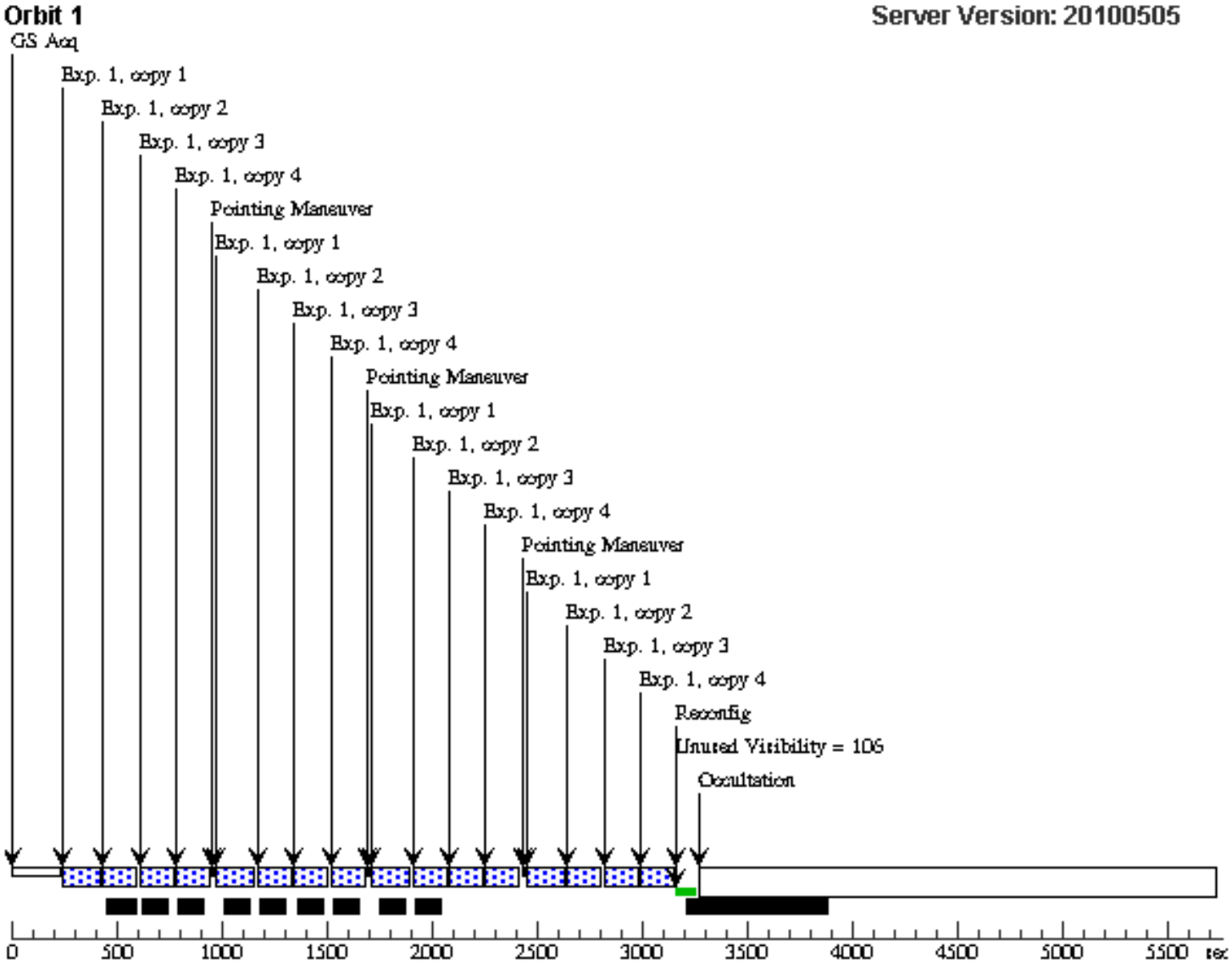
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=4; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 3, Copy 3)]* *[==>(Pattern 3, Copy 4)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]* *[==>(Pattern 4, Copy 3)]* *[==>(Pattern 4, Copy 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12284, Visit 04, implementation Sat Sep 18 01:22:09 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D; AFTER 03 BY 3.5 D TO 4.5 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)

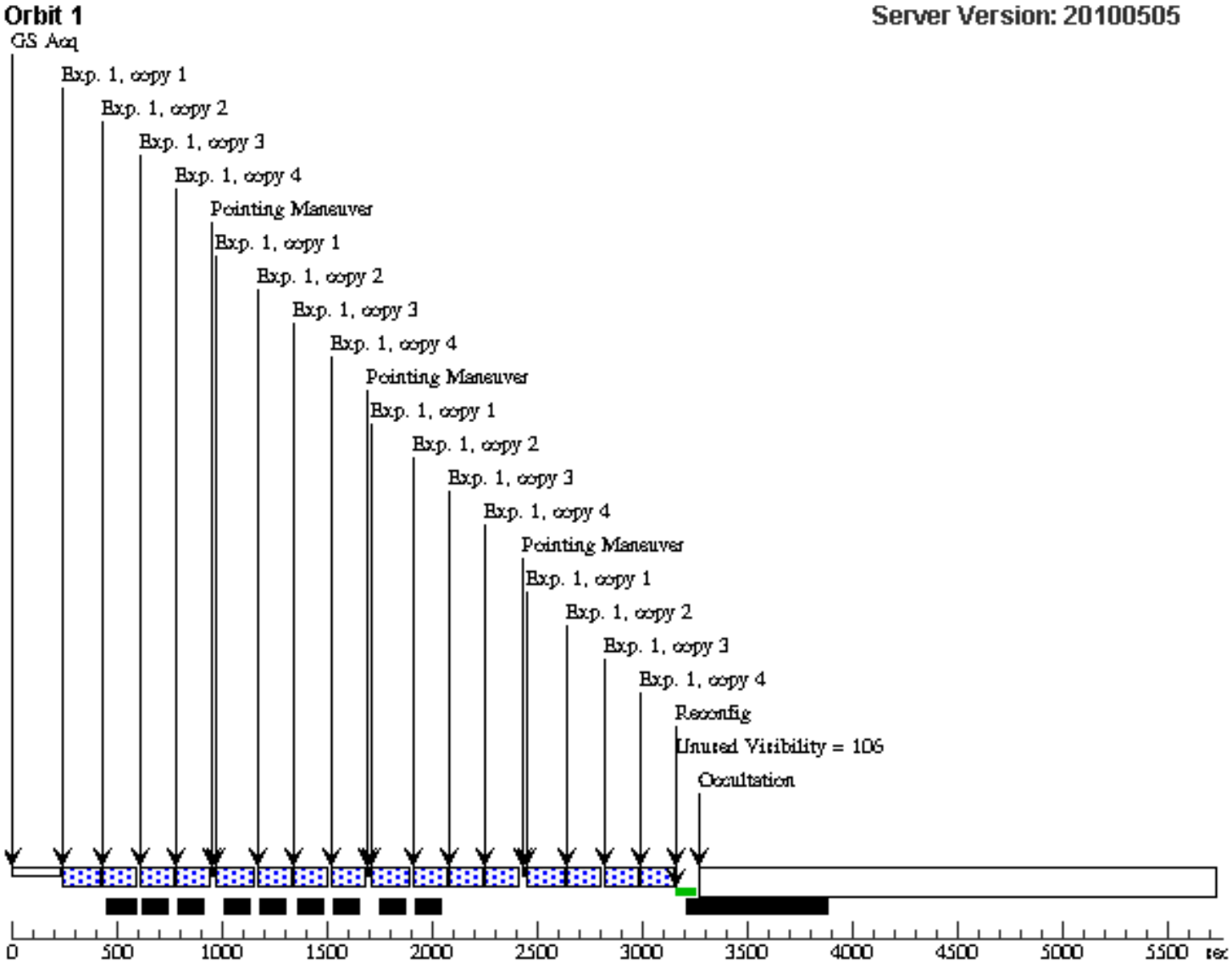
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=4; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 3, Copy 3)]* *[==>(Pattern 3, Copy 4)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]* *[==>(Pattern 4, Copy 3)]* *[==>(Pattern 4, Copy 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12284, Visit 05, implementation Sat Sep 18 01:22:09 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D; AFTER 04 BY 3.5 D TO 4.5 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)

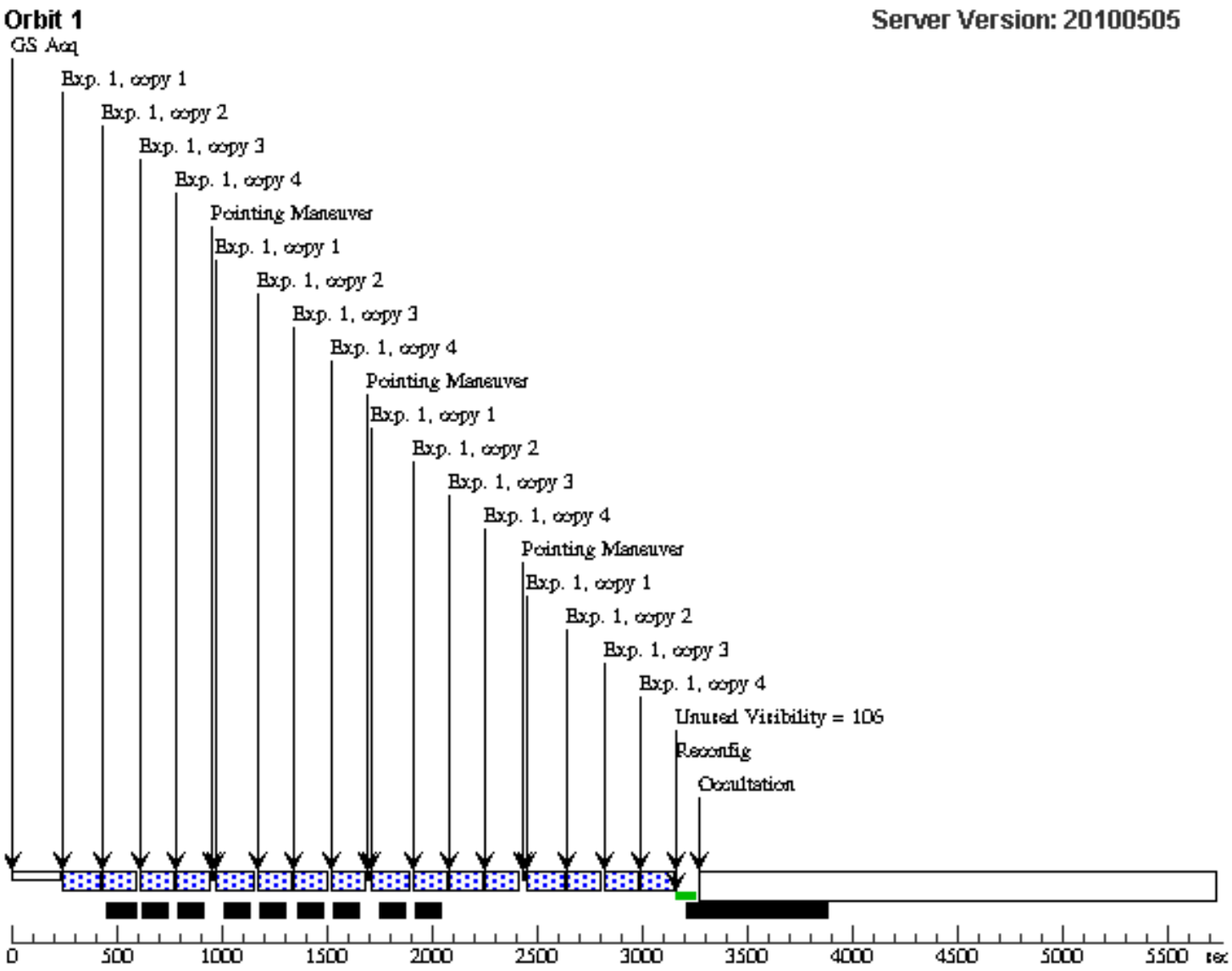
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=4; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 3, Copy 3)]* *[==>(Pattern 3, Copy 4)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]* *[==>(Pattern 4, Copy 3)]* *[==>(Pattern 4, Copy 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12284, Visit 06, implementation Sat Sep 18 01:22:11 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D; AFTER 05 BY 3.5 D TO 4.5 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)

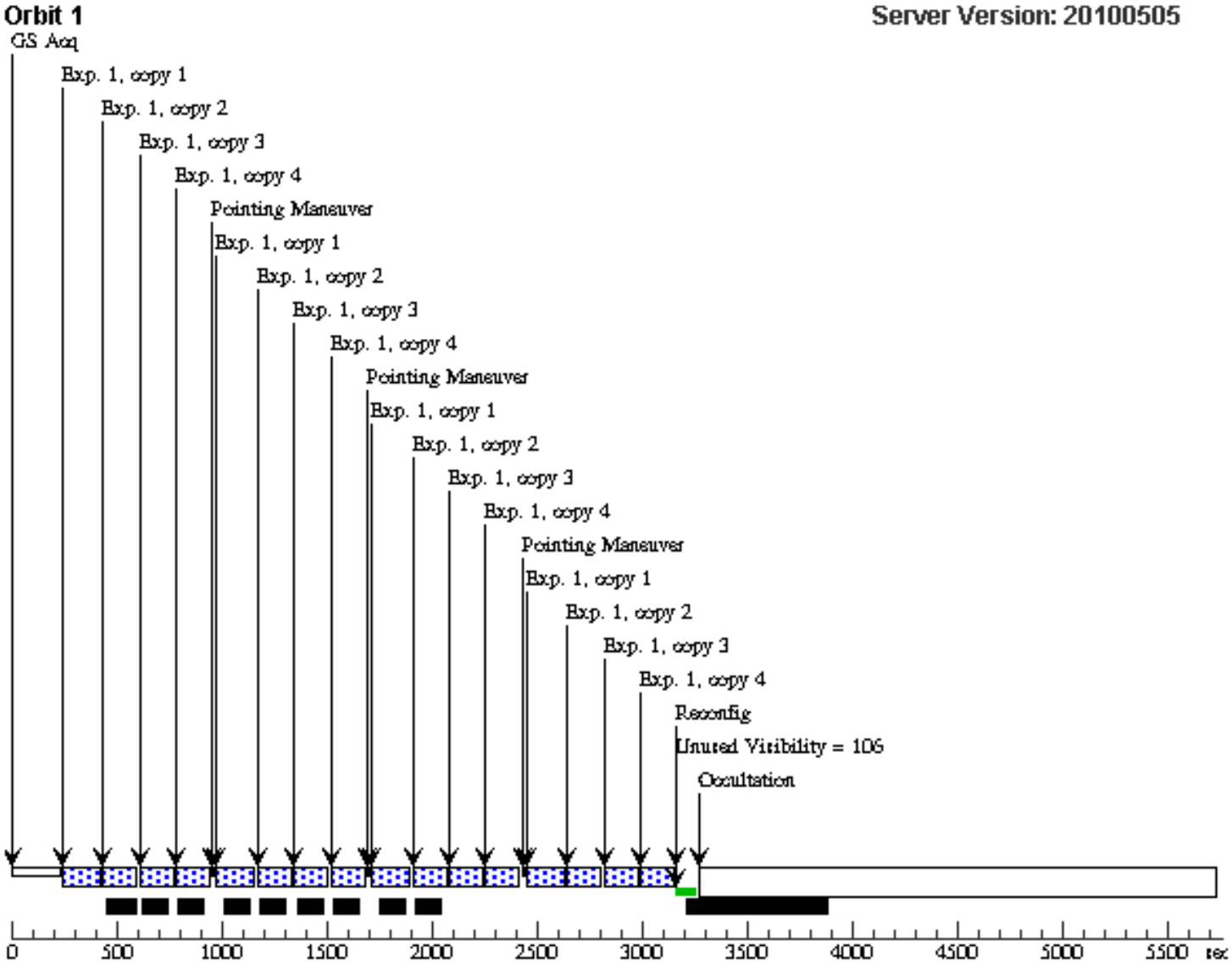
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=4; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 3, Copy 3)]* *[==>(Pattern 3, Copy 4)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]* *[==>(Pattern 4, Copy 3)]* *[==>(Pattern 4, Copy 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12284, Visit 07, implementation Sat Sep 18 01:22:11 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D; AFTER 06 BY 3.5 D TO 4.5 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=false		(1)

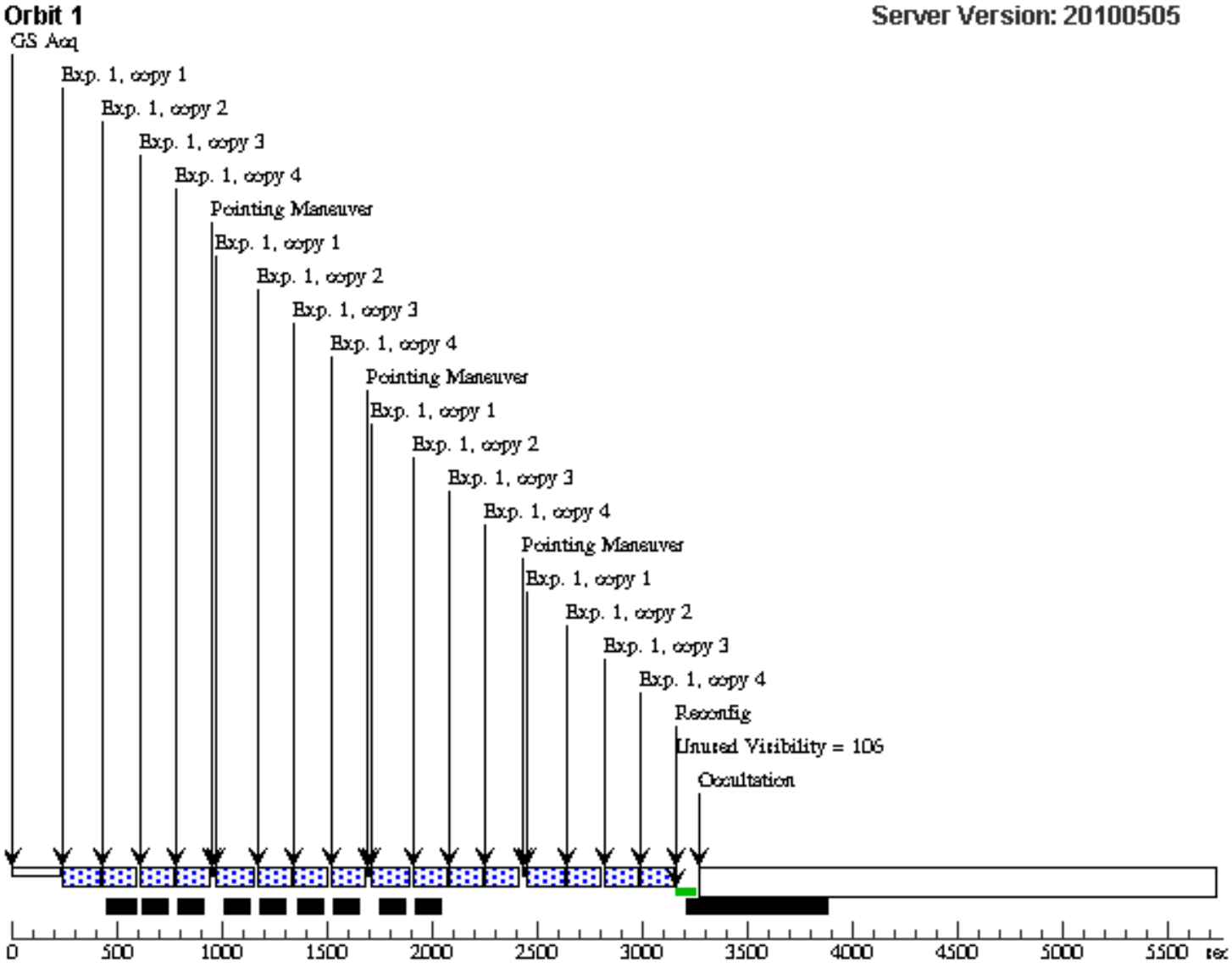
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F160W	NSAMP=4; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1, Copy 1)]* *[==>(Pattern 1, Copy 2)]* *[==>(Pattern 1, Copy 3)]* *[==>(Pattern 1, Copy 4)]* *[==>(Pattern 2, Copy 1)]* *[==>(Pattern 2, Copy 2)]* *[==>(Pattern 2, Copy 3)]* *[==>(Pattern 2, Copy 4)]* *[==>(Pattern 3, Copy 1)]* *[==>(Pattern 3, Copy 2)]* *[==>(Pattern 3, Copy 3)]* *[==>(Pattern 3, Copy 4)]* *[==>(Pattern 4, Copy 1)]* *[==>(Pattern 4, Copy 2)]* *[==>(Pattern 4, Copy 3)]* *[==>(Pattern 4, Copy 4)]*	***[1]***

Orbit Structure



Visit

Proposal 12284, Visit 08, implementation Sat Sep 18 01:22:12 GMT 2010

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR

Special Requirements: ORIENT 115.95D TO 121.3 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
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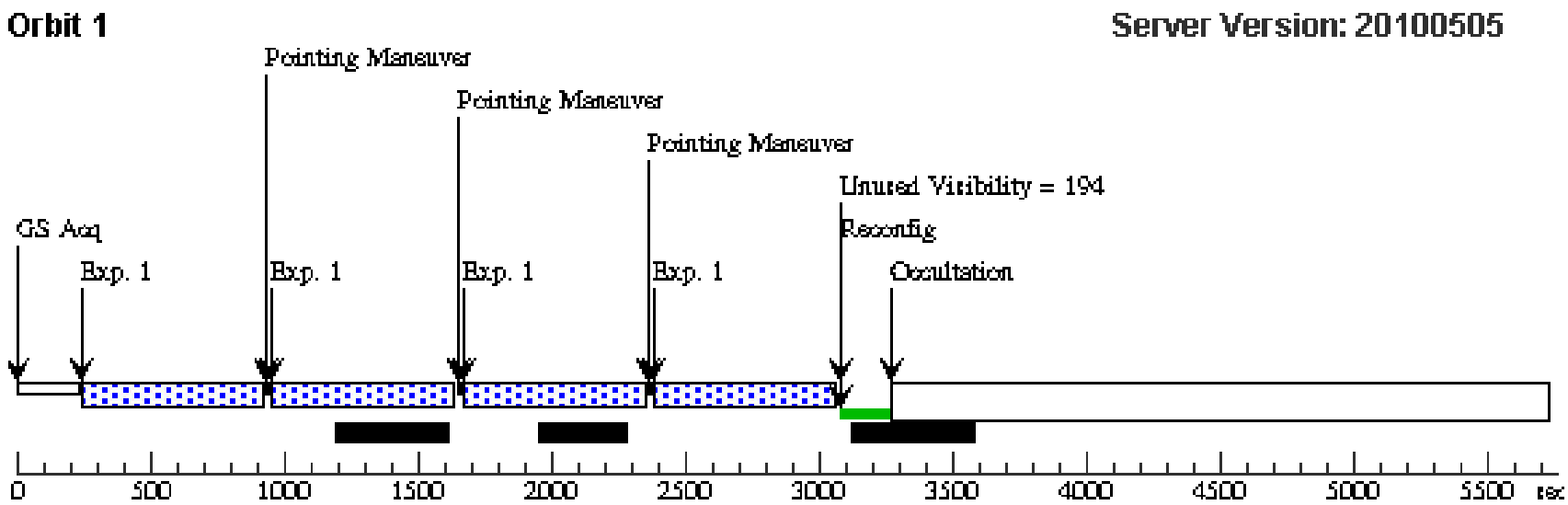
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LRLL-54361	RA: 03 43 51.0300 (55.9626250d) Dec: +32 02 48.00 (32.04667d) Equinox: J2000		V=(?) H ~ 17.5-20	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) LRLL-54361	WFC3/IR, MULTIACCUM, IR	F164N	NSAMP=14; SAMP-SEQ=SPARS50	GS ACQ SCENARIO SINGLE	Pattern 1, Exps 1-1 (1)	*[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	***[1]***

Orbit Structure