



10864 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

Cycle: 15, Proposal Category: GO

(Availability Mode: AVAILABLE)

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) V-AA-TAU	ACS/SBC	3	01-Sep-2006 21:01:02.0	yes
02	(2) V-DL-TAU	ACS/SBC	3	01-Sep-2006 21:01:13.0	yes
03	(4) V-CY-TAU	ACS/SBC	3	01-Sep-2006 21:01:25.0	yes
04	(5) V-CQ-TAU	ACS/SBC	3	01-Sep-2006 21:01:34.0	yes

<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>
05	(6) V-GM-AUR	ACS/SBC	3	01-Sep-2006 21:01:42.0	yes
06	(7) HD-135344-OFFSET	ACS/SBC	2	01-Sep-2006 21:01:52.0	yes
07	(8) HS-2027-+0651	ACS/SBC	2	01-Sep-2006 21:02:00.0	yes

19 Total Orbits Used

ABSTRACT

One of the key problems in planetary system formation is understanding how rapidly, and over what time interval Jovian planets can form. Dust in the protoplanetary disk is critical in planetesimal formation, but it is the gas which produces giant planets, and which is essential for their migration. However, compared to data on the circumstellar dust, information on the gas component is sparse, especially in the planet-formation zone. This severely limits our ability to put observational constraints on giant planet formation, except to note that the process must be largely complete by 12 Myr, given the paucity of Herbig Ae or classical T Tauri stars older than 10-12 Myr. In the FUV, photo-excited molecular hydrogen transitions have the requisite contrast to the stellar photosphere, accretion shock, and reflection nebulosity, and can be traced 50-100 AU from the exciting stars in both envelopes and outflow cavities and protoplanetary disks. Central disk cavities, an expected consequence of planet formation, larger than 0.1" are directly detectable in HST FUV spectra, while smaller cavities may be detected by comparison with protoplanetary disks which are still accreting onto their stars. We propose augmenting existing HST coronagraphic imagery of 6 Herbig Fe and T Tauri disks with ACS Solar-Blind Channel Lyman alpha imagery and slitless spectroscopy simultaneously sampling the disk in molecular hydrogen and small-grain reflection nebulosity. These data will be used to quantify the amount of vertical stratification in these disks, to map the mass-loss geometry from the star, and to determine whether removal of molecular material precedes, lags, or is contemporary with clearing of the dust.

OBSERVING DESCRIPTION

Program Stars: We will obtain ACS SBC F122M (Lyman alpha) images and SBC PR130L spatially-resolved spectra of each of our program science targets and one white dwarf. The white dwarf will be used as a deep PSF comparison object. Our program stars have well-studied disks, archival optical and NIR coronagraphic imagery. The stars have known inclinations, optical outflow data, and are minimally affected by remnant

envelope material. We are also requesting a deep PSF observation of an ACS SBC spectrophotometric standard, currently HS 2027 +0651. For each target, we are requesting the equivalent of a full orbital visibility for F122M imagery, to permit easy comparison with the Herbig Ae stars HD 100453 and HD 169142 which are to be observed under HST-GO-10764. The remaining time will be spent upon the PR130L spectroscopy, with the equivalent of 2 orbits for all targets except HD 135344 and the white dwarf. All of the observations will be obtained with the ACS small-box dither pattern to permit us to monitor the sources and any low-mass companions for flaring.

HD 135344: This F4Ve star has an archival FUSE spectrum (Q306020100) showing the faint ($5E-15$ erg/cm/cm/s/A) continuum and emission-line spectrum expected for a mid-F star with very little accretion. Based on the FUSE data the dominant emission-line source should be chromospheric and transition region features in the ACS spectral range. The stellar photosphere at the long wavelength end of the PR130L response will be the dominant signal source, but even when conservatively modelled as F2V ($V=8.61$), there are no warnings for the star. In 2ks, the integrated counts are above 120,000 c/pixel from 1750-1950 Å, so dithering will be essential to avoid loss of data. For the F122M imagery, we have a) scaled from HD 169142, an A8Ve Herbig Ae star with low current accretion rate, and b) scaled from the FUSE C III 1176 profile. Both approaches result in a peak count rate of 20-25 c/s, with no MAMA bright object warnings. HD 135344 has a foreground F2V star (CD -36 10010, $V=7.9$, F2V at 15H15M48.95S -37D08'56.11") about 22" to the NNE of our science target. In the event of a bad maneuver to HD 135344, this object may end up in the SBC FOV, but does not exceed either the global or local bright object limits. In the event that it is in the SBC, we will use it as a comparison object.

CQ Tau: CQ Tau is a UXOR, a large amplitude light and color variable PMS star in the optical ($V=9.7$ to 11.2). However, in the FUV, the continuum is near $1E-14$ erg/cm/cm/s/A in repeated IUE observations, ranging from optical maximum to optical minimum light. These data suggest the star may be obscured by the inner disk and visible only via scattered light in the FUV. There are no MAMA bright limit issues for this star.

CY Tau: This is the UV-brightest of our program T tauri stars, and has an archival STIS E140M (0.2x0.2" aperture). The strongest line in the UV spectrum is Lyman alpha, with a peak flux of $6E-14$ erg/cm/cm/s/A. C IV, He II, and C III 1176 are the next strongest features with peak fluxes near 3-4 $E-14$ erg/cm/cm/s/A. The continuum is near $1E-15$ erg/cm/cm/s/A. The ACS SBC F122M image will be dominated by Lyman alpha and will have a peak count rate of 0.82 c/p/s, yielding $S/N=106$ in 2ks. The PR130L spectrum will have the highest count rate at C IV, 2.9 c/p/s, for a total signal near 30kcounts in 2 ks. The spectrum in the H₂ bands will have

approximately 6Kcounts/pixel in 2ks. The STIS data indicate that CY Tau is isolated. STIS coronagraphic imagery have revealed an HH knot at PA=65.2D which was 2" from the star in 2001. This knot and any more extended jet material should be visible in the F122M imagery, but should not appreciably contaminate the spectral image.

GM Aur: This star has a STIS G140L spectrum. From 1420-1510 Å, the spectrum has a faint continuum, with fluxes near $3E-15$ erg/cm/cm/s/Å, with lines a factor of 2 brighter. At the resolution of the PR130L, the signal is $5E-15$ erg/cm/cm/s/Å, with the signal in the reflection nebulosity band near $2E-15$ erg/cm/cm/s/Å. The strongest emission lines in the FUV are C IV (peak $5E-14$ erg/cm/cm/s/Å) and He II ($3E-14$ erg/cm/cm/s/Å).

For ACS, the ETC indicates a peak count rate at C IV of 4.37 c/s. In the H₂ band, the on-source S/N is ~73: binning over the band means that, absent airglow, we will expose the wings of the PSF to 30 counts/band 1" from the star. GM Aur has fluorescent H₂ emission a factor of 2 above this level in the STIS spectrum (at 0.5"). In a high airglow environment, we will be able to detect the circumstellar emission only to 0.5" (which is still 70 AU from the star). The F122M image will yield an on-source S/N of 51 under low background conditions, and 34 under high airglow conditions in 300s.

NICMOS saw a ribbon of nebulosity to the NE of the star which may be a molecular cloud rim. This structure will fall within the ACS field of view.

AA Tau and DL Tau: GM Aur is brighter than our other program stars, DL Tau, and AA Tau, both in the on-star spectrum (judging by the IUE data), and in terms of its reflection nebulosity in the NIR. We therefore anticipate no MAMA bright object issues with any of these stars.

Serendipitous Science: AA Tau, DL Tau, and CY Tau are all known to drive microjets with HH knots (Grady et al. 2006) which will be within the ACS SBC field of view. The DL Tau field also contains 3 other bright, red sources within 12" of DL Tau. These are expected to be additional, lower mass T Tauri stars.

REAL TIME JUSTIFICATION

N/A

CALIBRATION JUSTIFICATION

Identification of low-surface brightness extended emission in either Lyman alpha or the fluorescent molecular hydrogen transitions requires knowledge of the instrumental point spread function. Current calibration of the ACS SBC is optimized for routine point source spectral extraction and lacks the contrast we require. As a result, we have requested 2 orbits for observation of a PSF template object, baselined as HS 2027 +0651, with the observations carried out with the same aperture, dither pattern and relative distribution of exposure time as for our science targets.

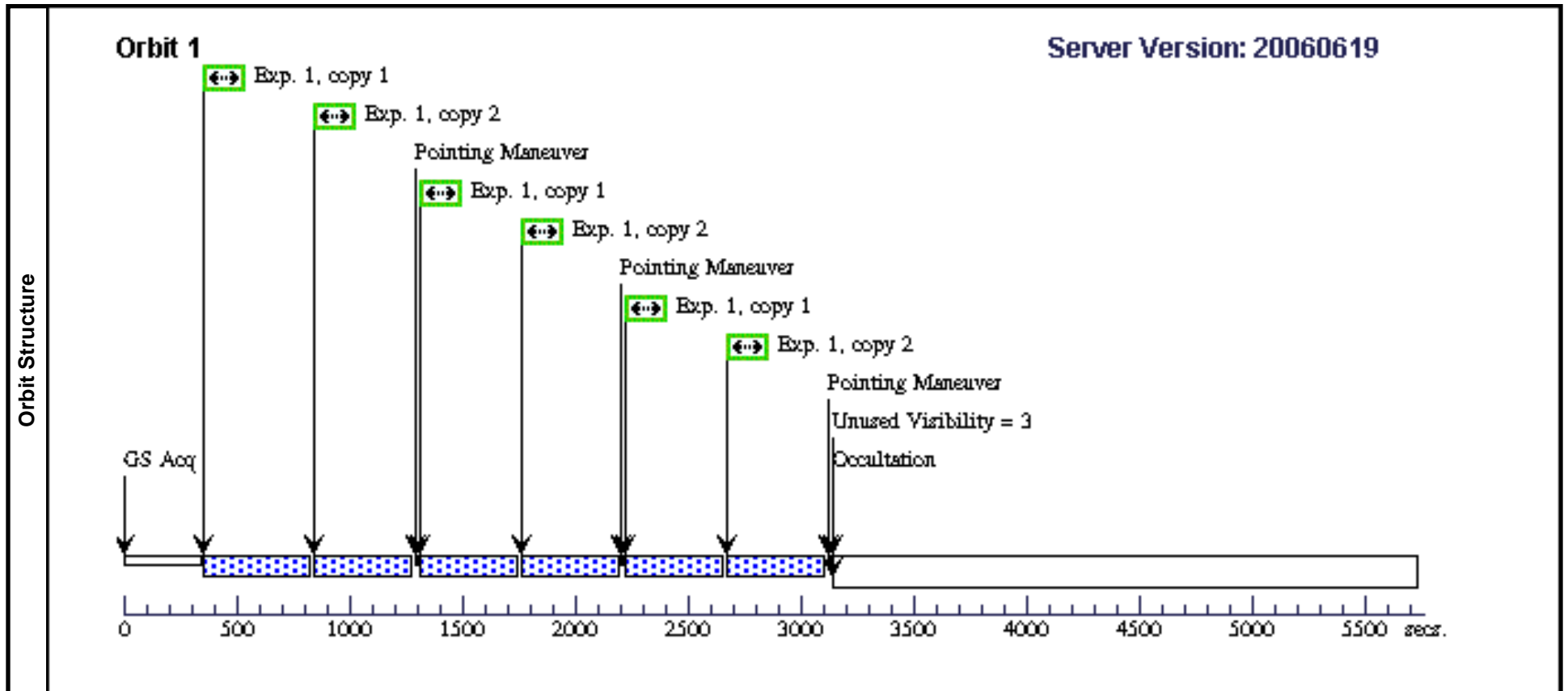
Proposal 10864 - Visit 01 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

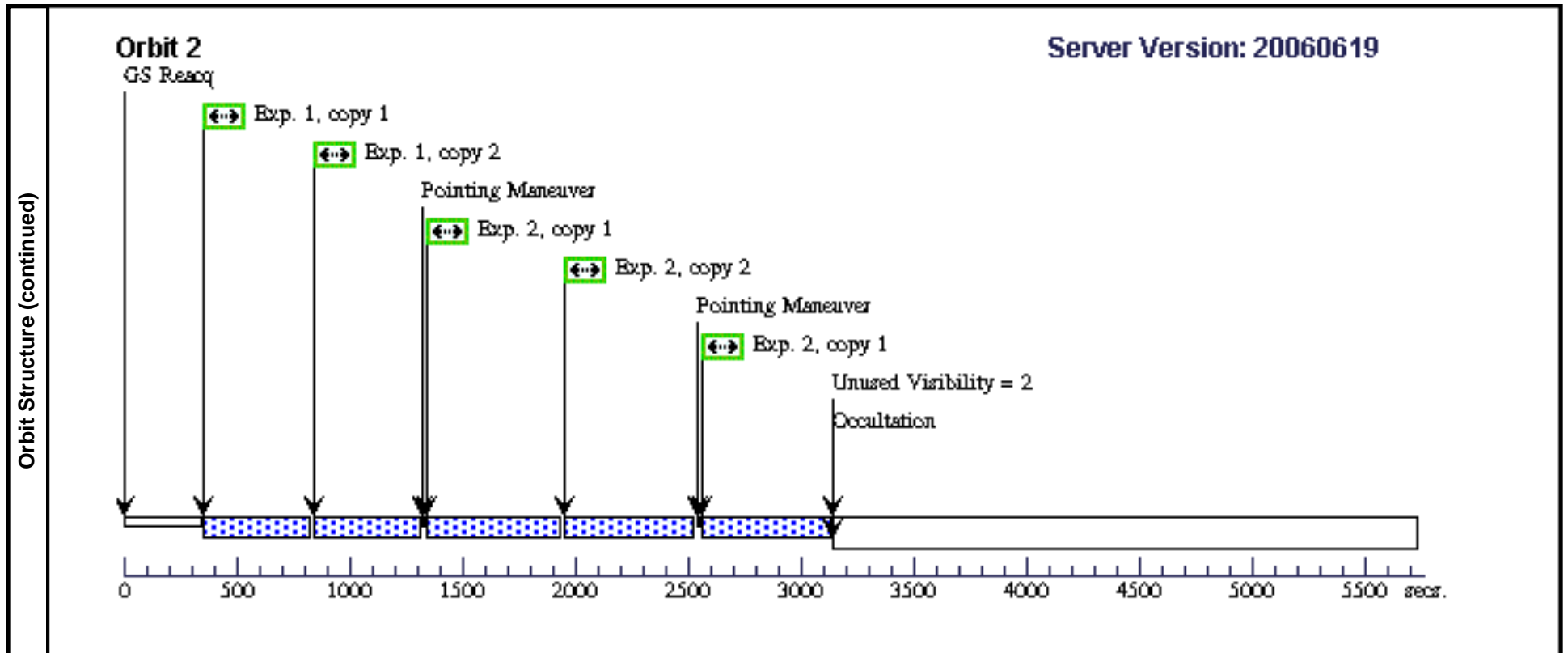
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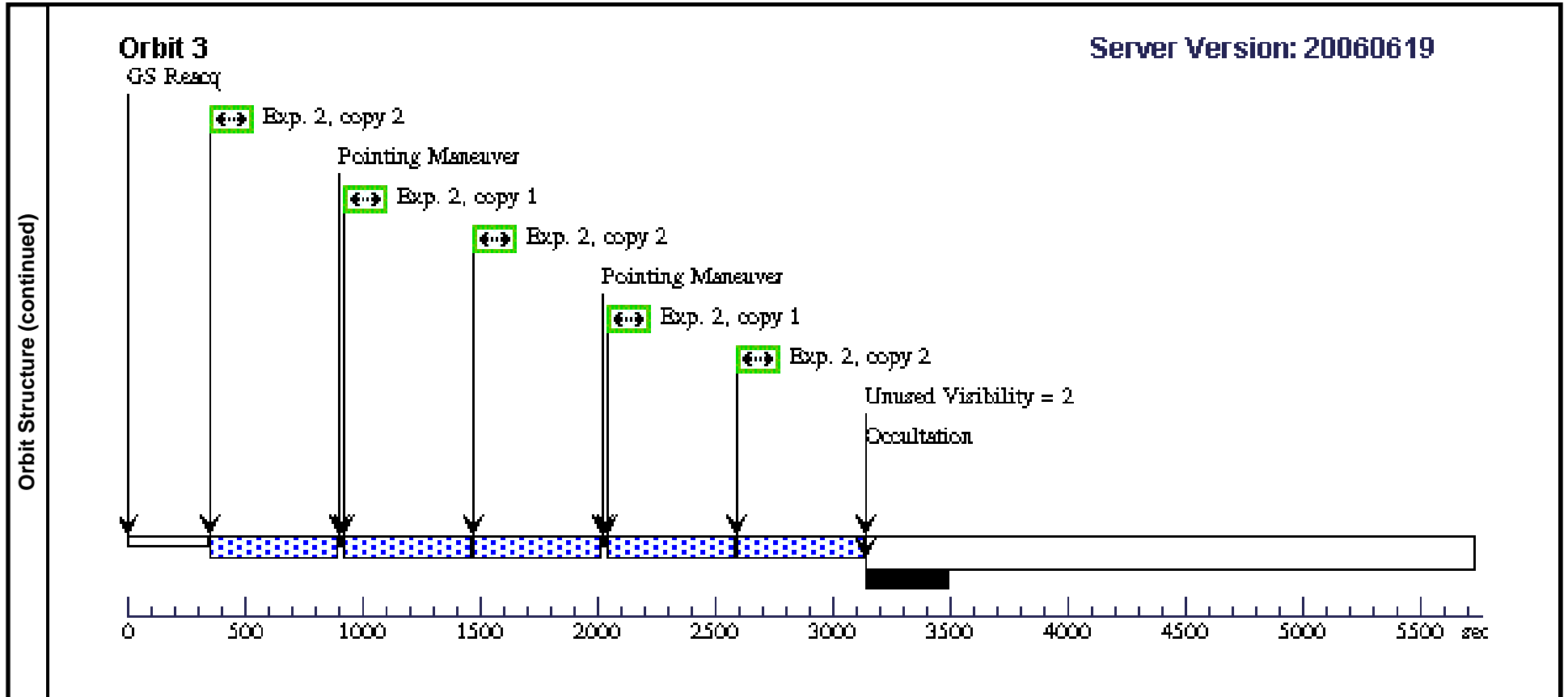
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		Alt Name2: GSC-01833-00851	Equinox: J2000			FUV continuum 3-5E-15 erg/cm/cm/s/A				
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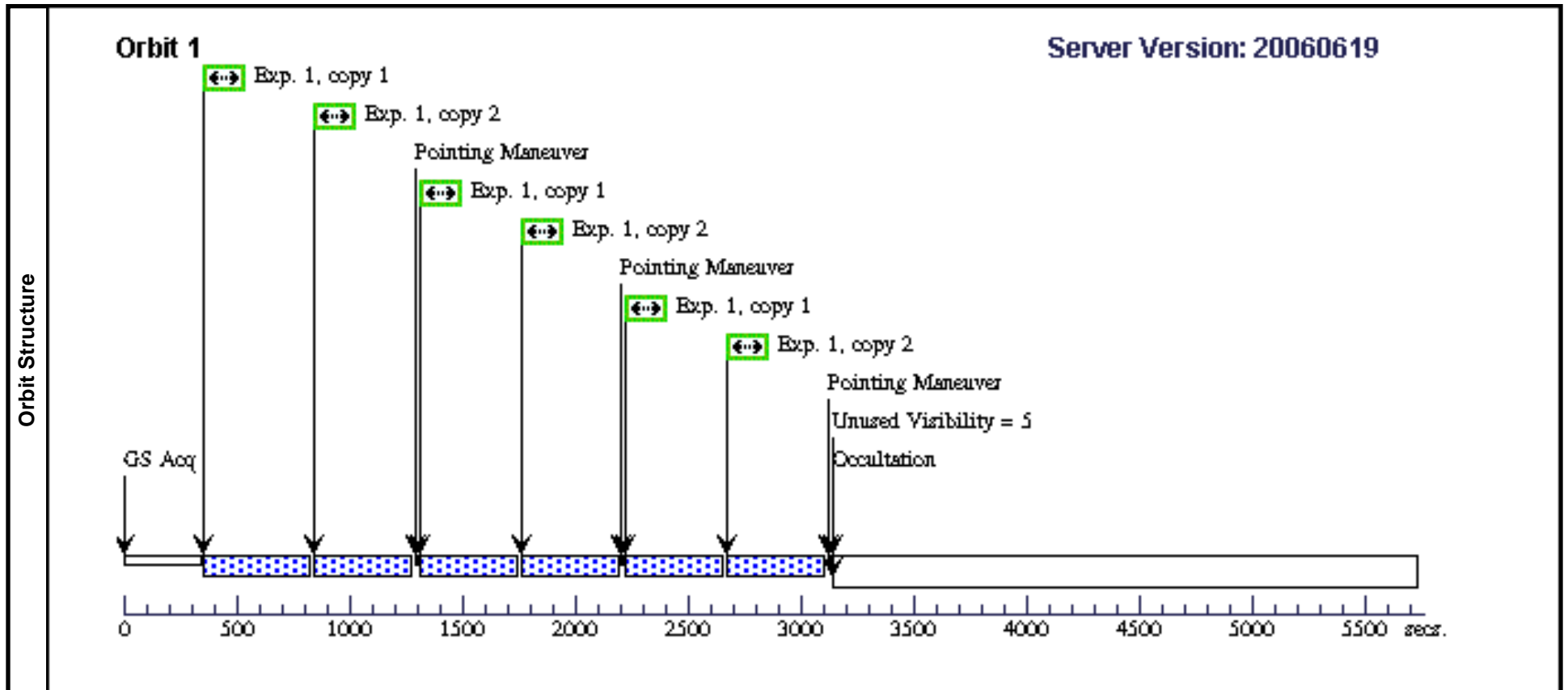
Proposal 10864 - Visit 02 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

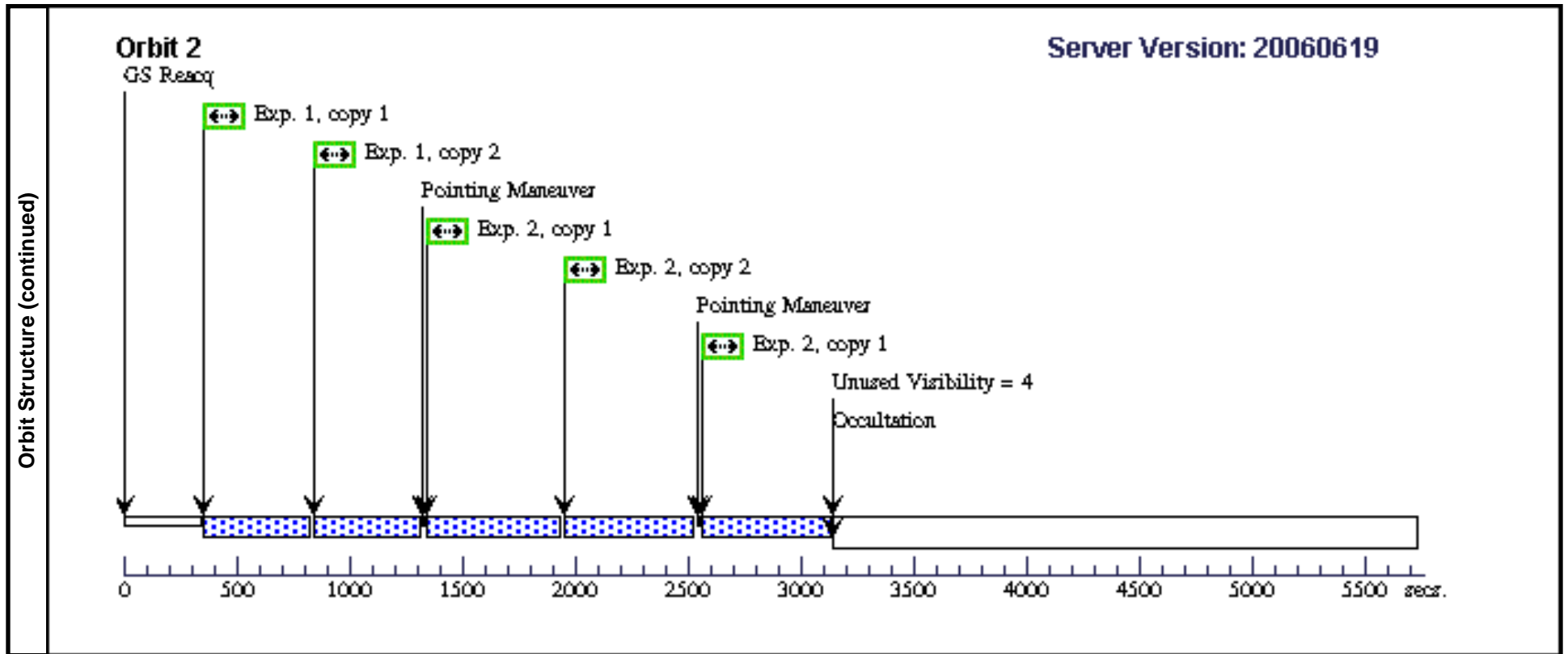
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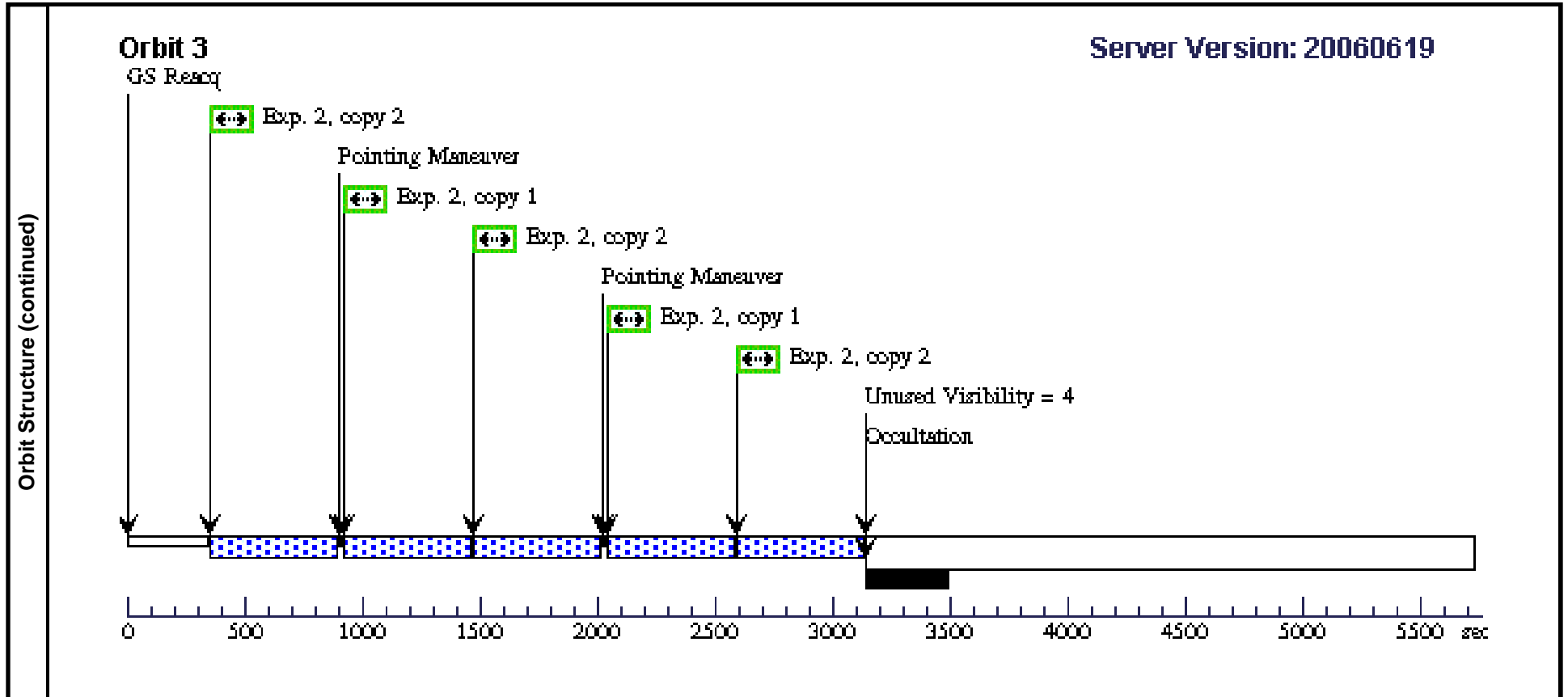
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Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
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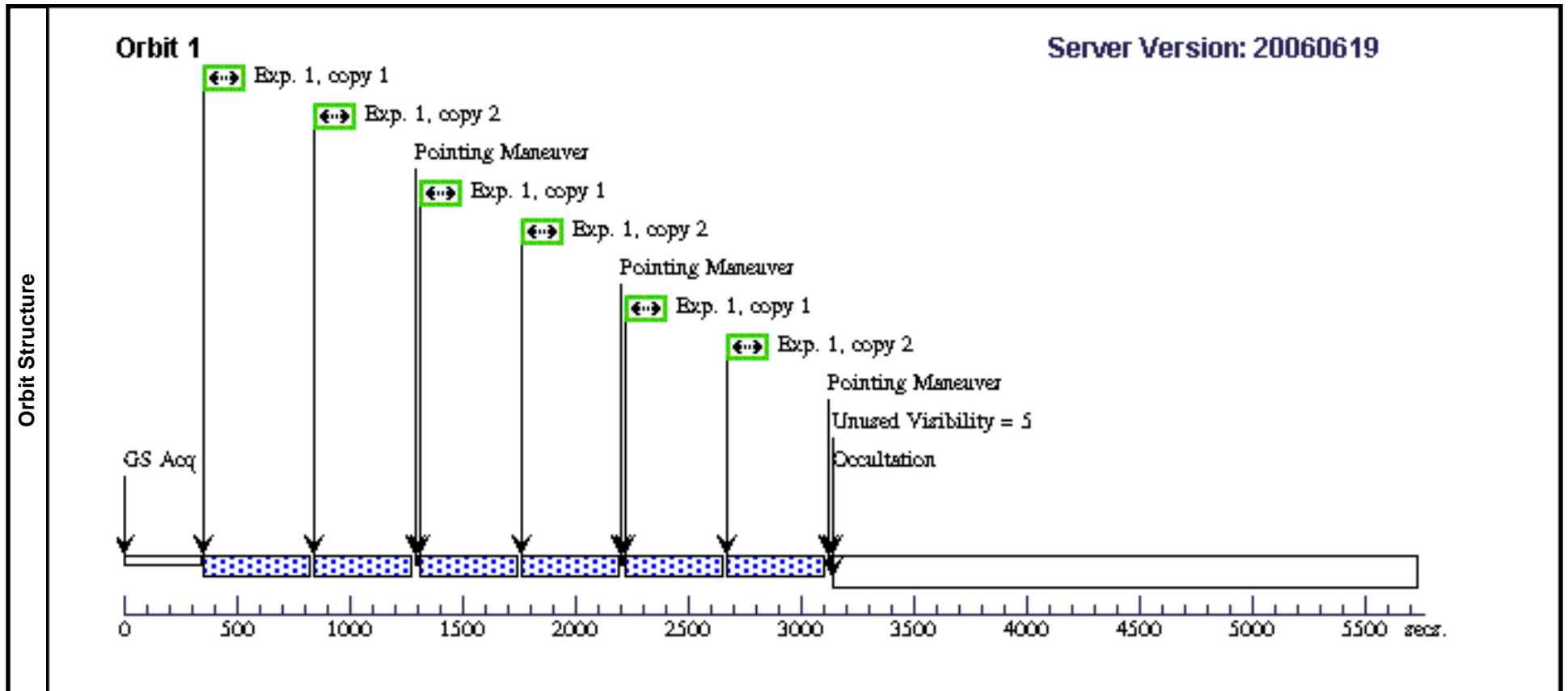
Proposal 10864 - Visit 03 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

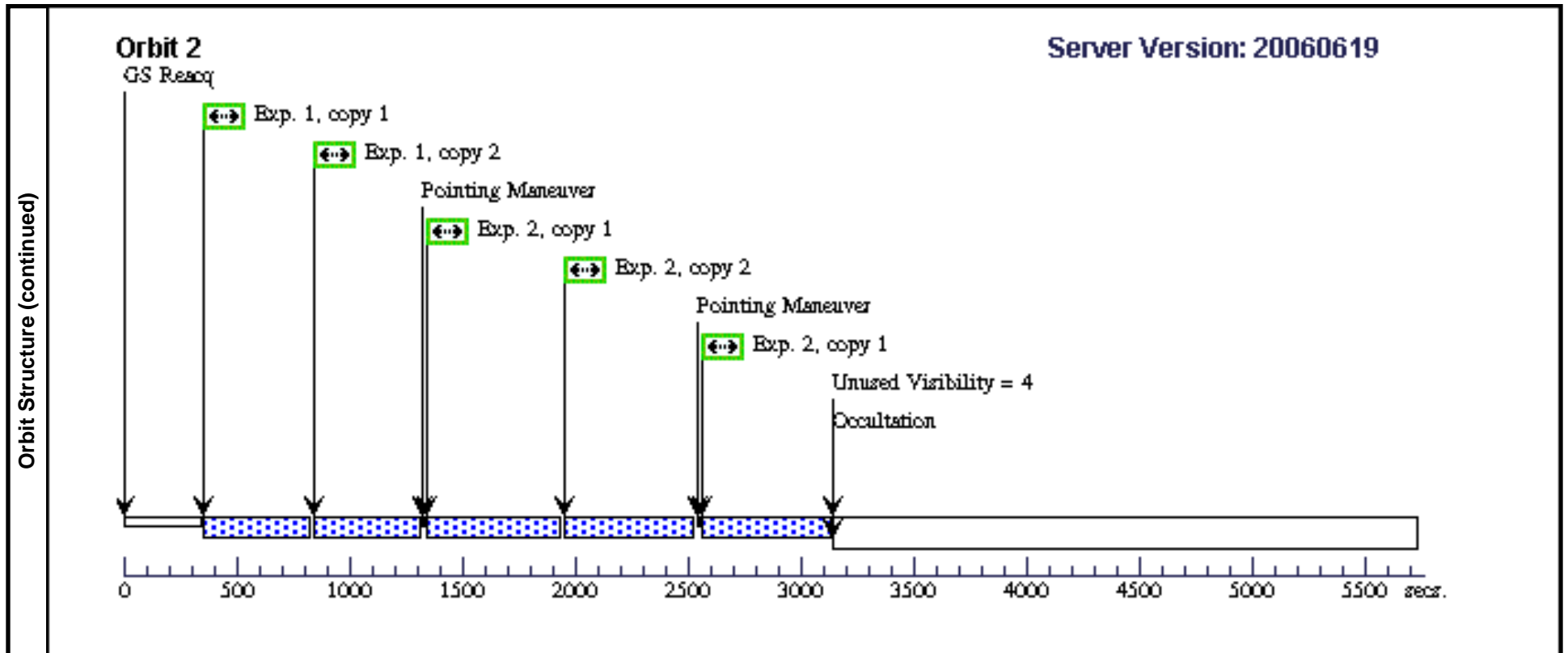
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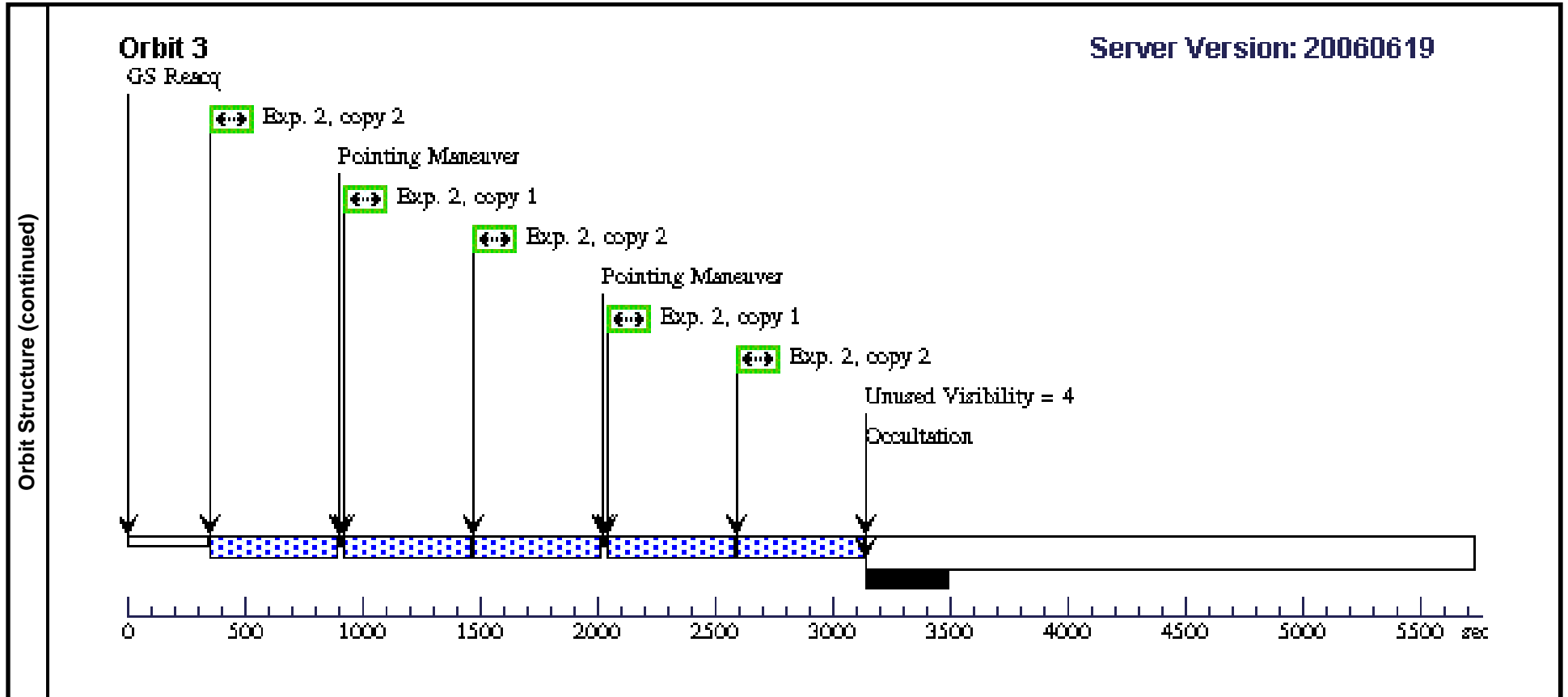
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Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(4)	V-CY-TAU	RA: 04 17 33.7200 (64.3905000d) Dec: +28 20 46.80 (28.34633d) Equinox: J2000		V=13.5	Reference Frame: SIMBAD				
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Proposal 10864 - Visit 03 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

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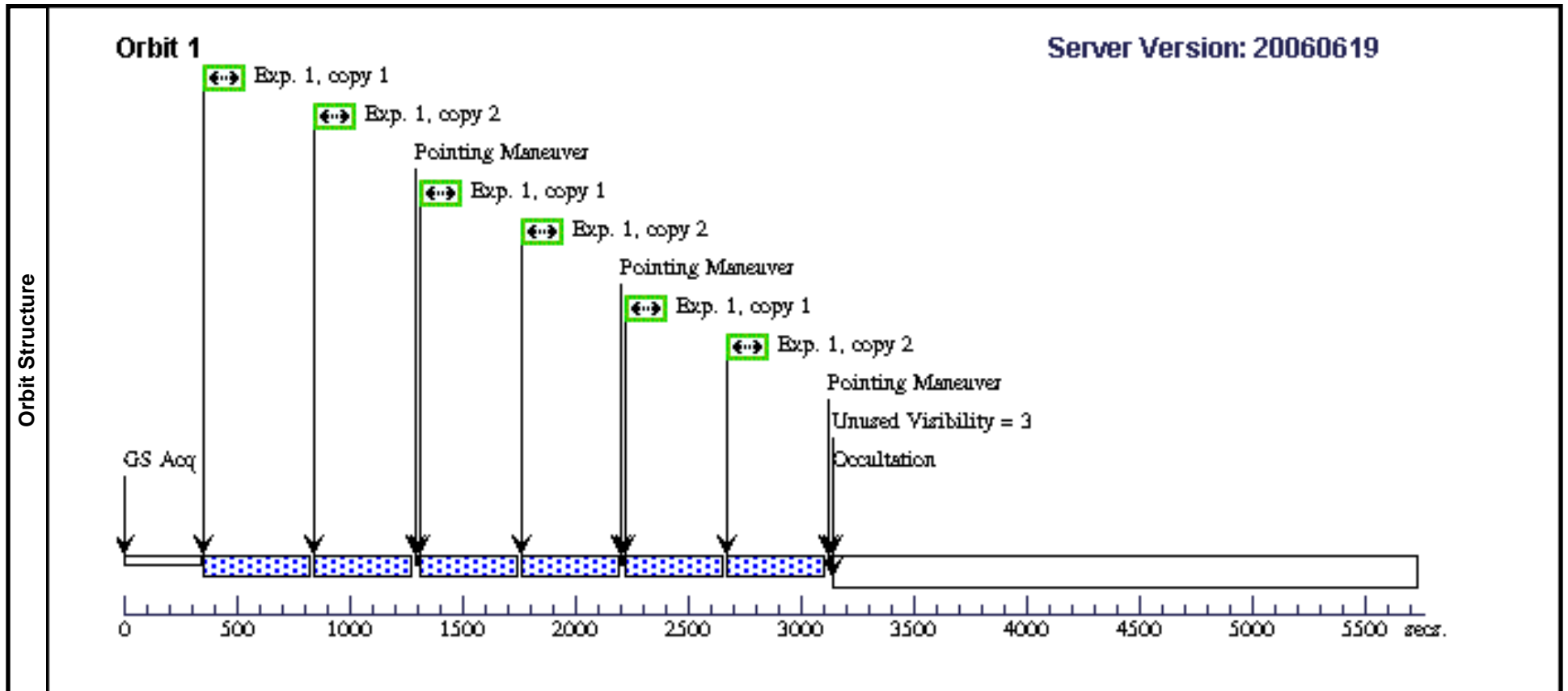
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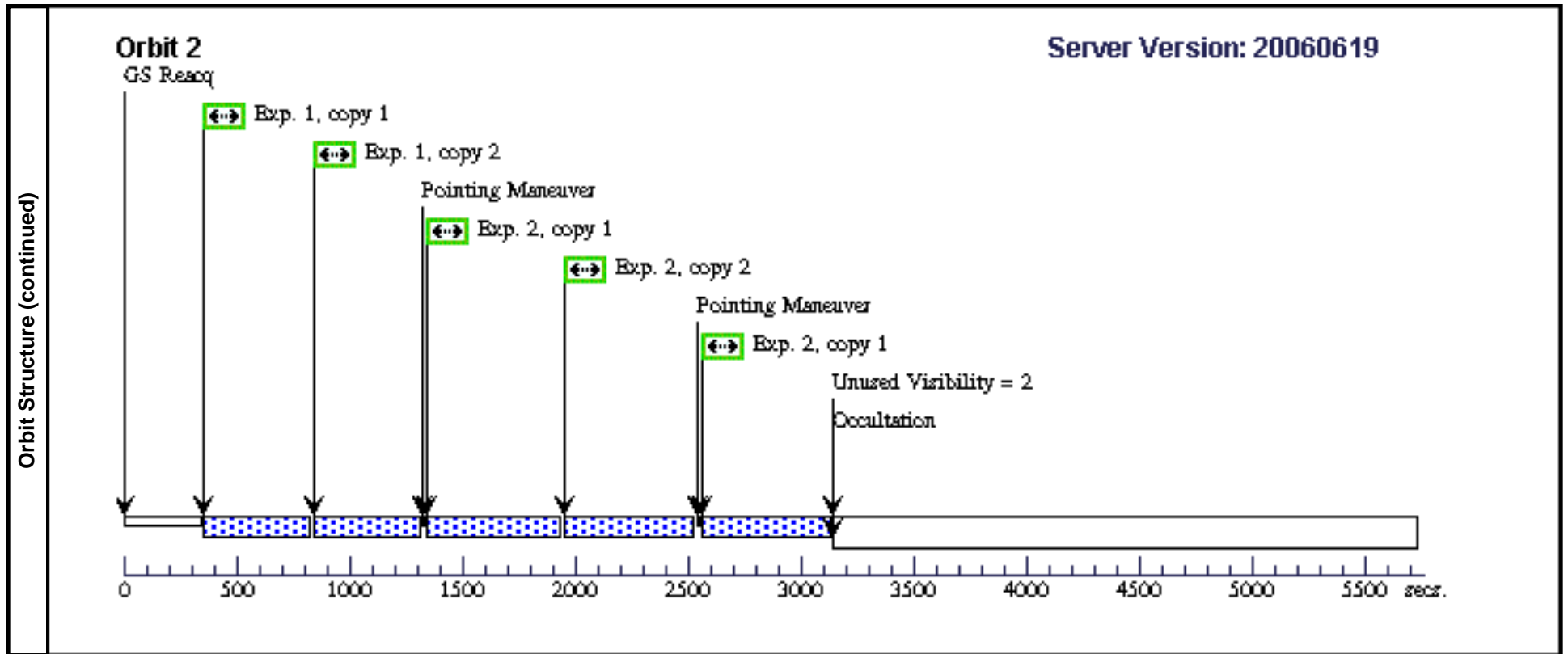
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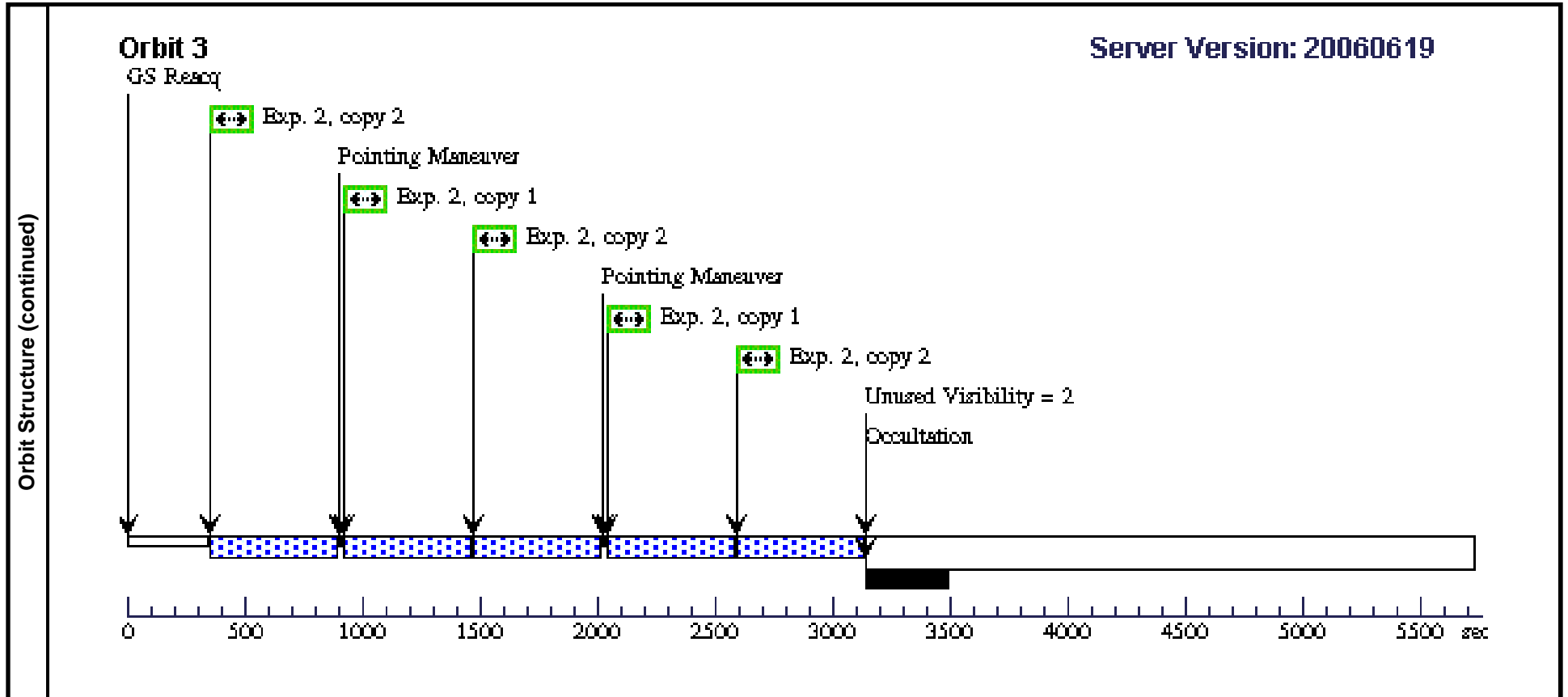
Visit	Proposal 10864, Visit 04, implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/SBC Special Requirements: ORIENT 265.0D TO 275.0 D									
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Proposal 10864 - Visit 04 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

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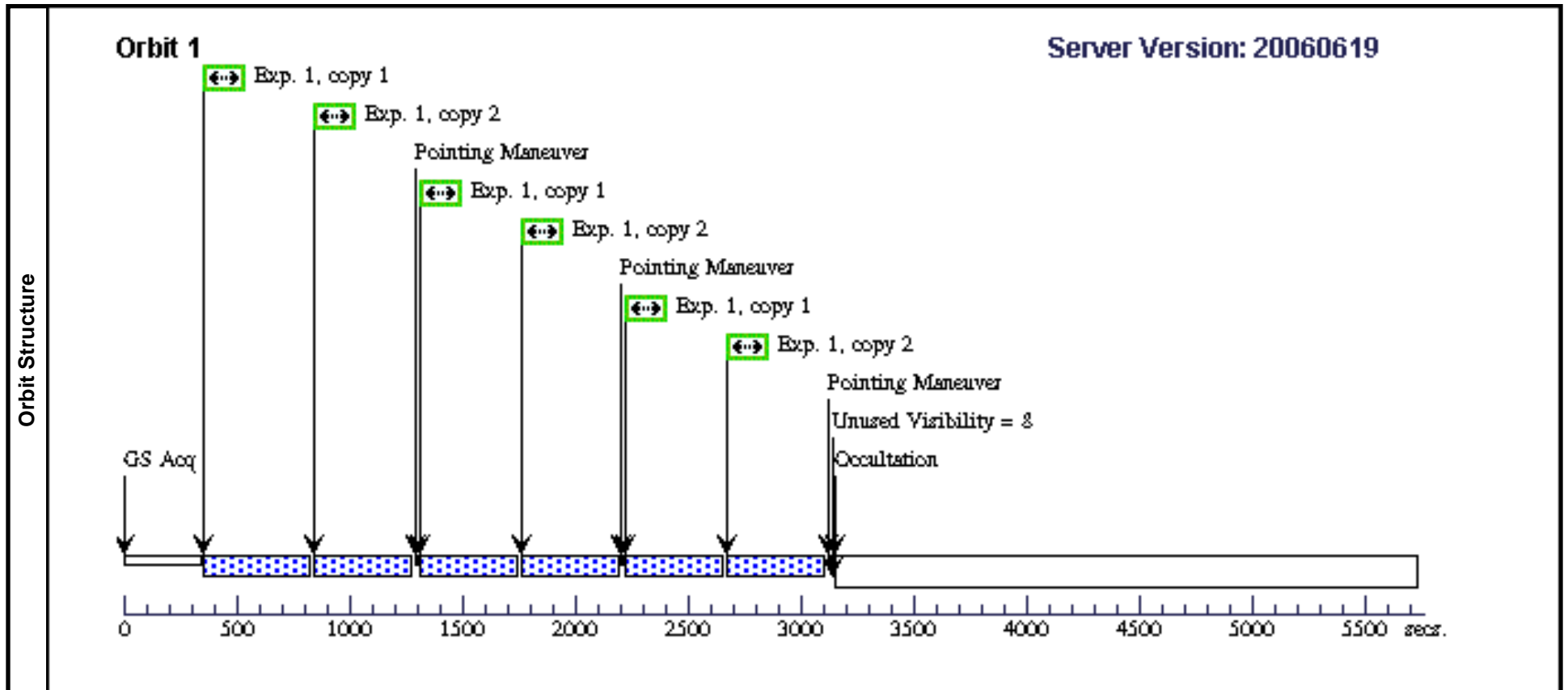
Proposal 10864 - Visit 05 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

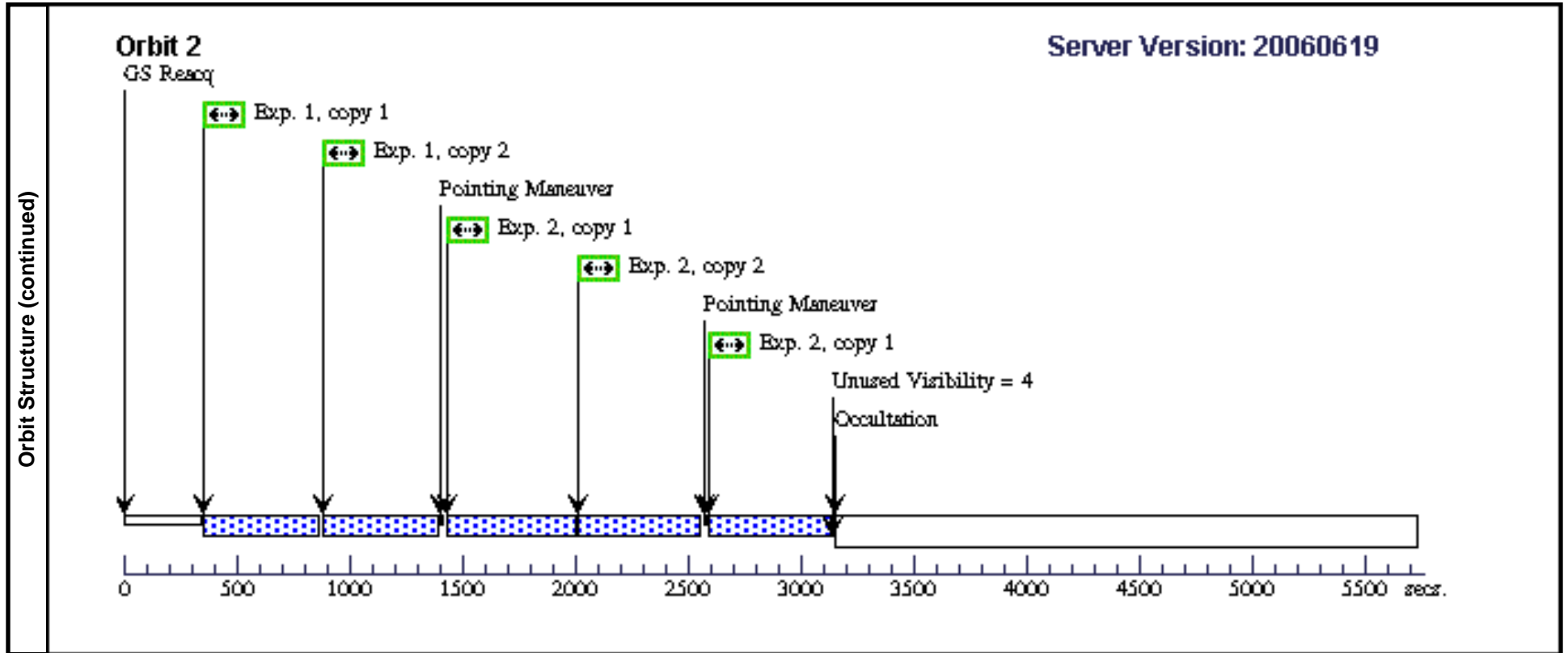
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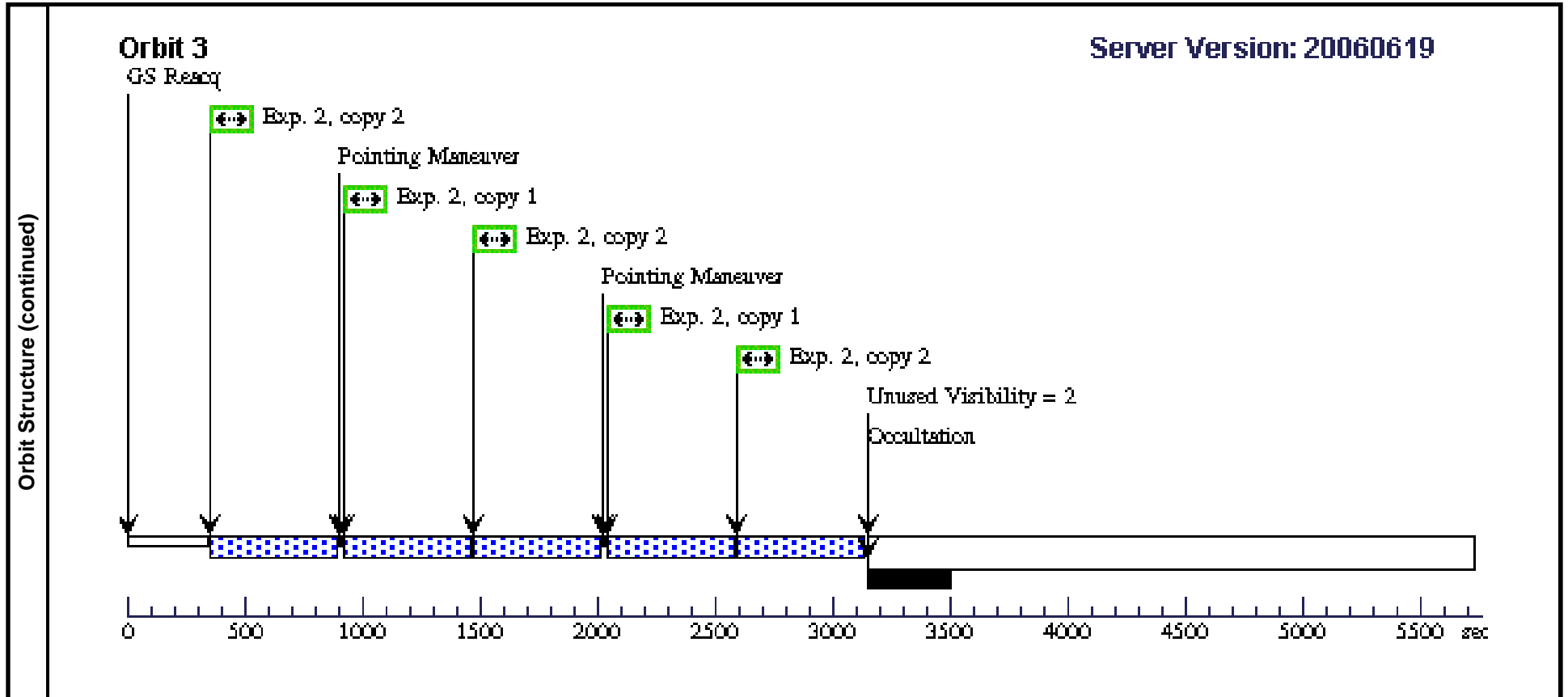
Visit	Proposal 10864, Visit 05, implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/SBC Special Requirements: ORIENT 230.0D TO 250.0 D									
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Proposal 10864 - Visit 05 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

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Exposures (continued)	2	(6) V-GM-AUR	ACS/SBC, ACCUM, SBC	PR130L			Pattern 2-2 (1)	450.0 Secs X 2	
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	[=>511.0 Secs (Pattern 3, Copy 1)]								
	[=>511.0 Secs (Pattern 3, Copy 2)]								
	[=>511.0 Secs (Pattern 4, Copy 1)]								
	[=>511.0 Secs (Pattern 4, Copy 2)]								







Proposal 10864 - Visit 06 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

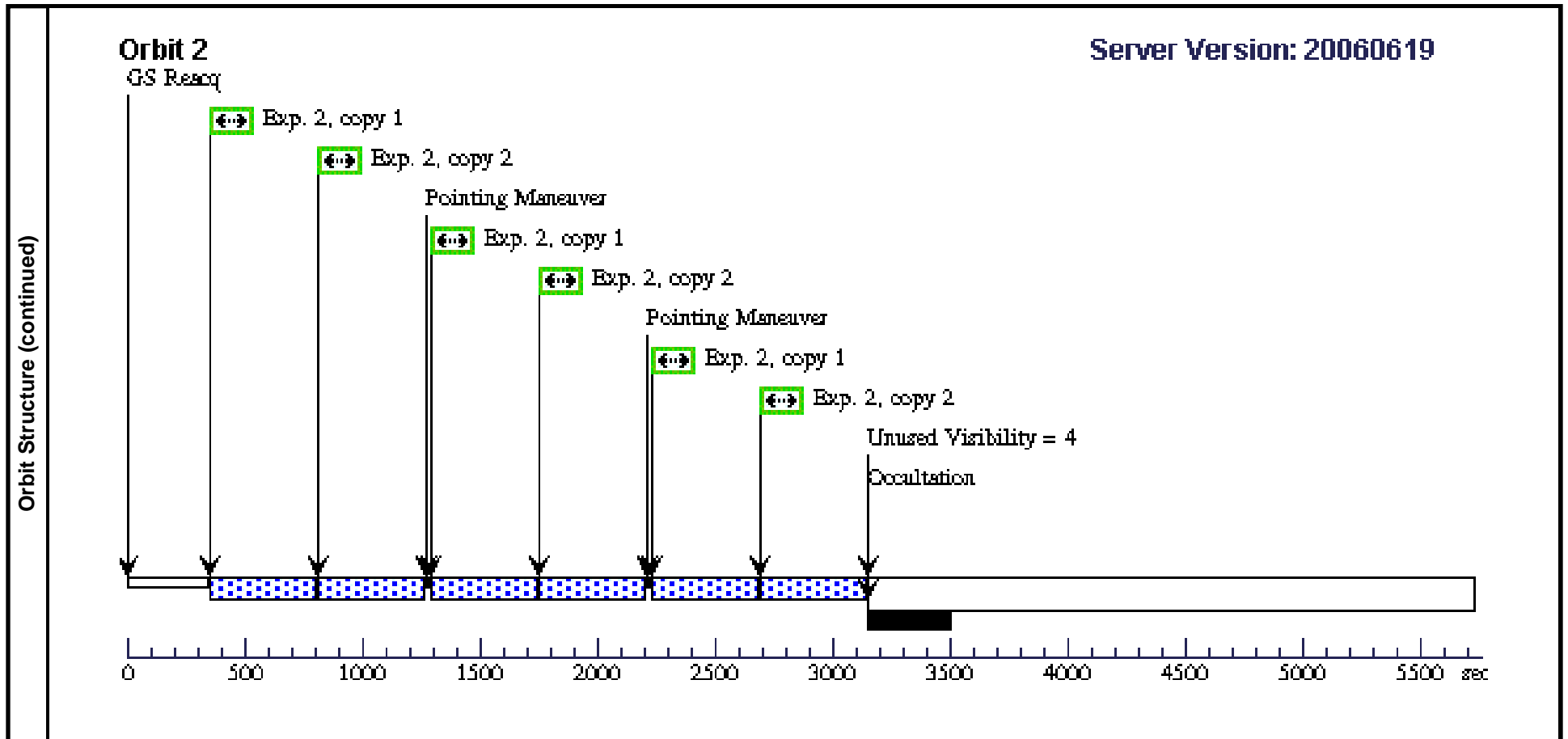
Sat Sep 02 01:02:10 GMT 2006

Visit	Proposal 10864, Visit 06, implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/SBC Special Requirements: ORIENT 0.0D TO 220.0 D									
	Patterns	#	Primary Pattern			Secondary Pattern			Exposures	
		(1)	Pattern Type=ACS-SBC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.179 Line Spacing=0.116	Coordinate Frame=POS-TARG Pattern Orientation=20 Angle Between Sides=63.7 Center Pattern=false					(1), (2)	
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(7)	HD-135344-OFFSET	RA: 15 15 48.4390 (228.9518292d) Dec: -37 09 22.03 (-37.15612d) Equinox: J2000		V=8.61	Reference Frame: SIMBAD				
	<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/[Actual Dur.]	Orbit
	1		(7) HD-135344-OFFSET	ACS/SBC, ACCUM, SBC	F122M			Pattern 1-1 (1)	200.0 Secs X 2 [==>203.0 Secs (Pattern 1, Copy 1)] [==>203.0 Secs (Pattern 1, Copy 2)] [==>203.0 Secs (Pattern 2, Copy 1)] [==>203.0 Secs (Pattern 2, Copy 2)] [==>203.0 Secs (Pattern 3, Copy 1)] [==>203.0 Secs (Pattern 3, Copy 2)] [==>203.0 Secs (Pattern 4, Copy 1)] [==>203.0 Secs (Pattern 4, Copy 2)]	[1]

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#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures (continued)	2	(7) HD-135344-OFF SET	ACS/SBC, ACCUM, SBC	PR130L			Pattern 2-2 (1)	300.0 Secs X 2	
	[=>303.0 Secs (Pattern 1, Copy 1)]	[1]	[=>303.0 Secs (Pattern 1, Copy 2)]	[=>420.0 Secs (Pattern 2, Copy 1)]	[2]				
						[=>420.0 Secs (Pattern 2, Copy 2)]			
	[=>420.0 Secs (Pattern 3, Copy 1)]	[=>420.0 Secs (Pattern 3, Copy 2)]							
	[=>420.0 Secs (Pattern 4, Copy 1)]	[=>420.0 Secs (Pattern 4, Copy 2)]							





Proposal 10864 - Visit 07 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

Sat Sep 02 01:02:12 GMT 2006

Visit	Proposal 10864, Visit 07, implementation Diagnostic Status: No Diagnostics Scientific Instruments: ACS/SBC Special Requirements: (none)									
	Patterns	#	Primary Pattern			Secondary Pattern			Exposures	
		(1)	Pattern Type=ACS-SBC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.179 Line Spacing=0.116	Coordinate Frame=POS-TARG Pattern Orientation=20 Angle Between Sides=63.7 Center Pattern=false					(1), (2)	
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(8)	HS-2027-+0651	RA: 20 29 32.5000 (307.3854167d) Dec: +07 01 8.00 (7.01889d) Equinox: J2000		V=16.9	Reference Frame: SIMBAD				
	<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/[Actual Dur.]	Orbit
	1		(8) HS-2027-+0651	ACS/SBC, ACCUM, SBC	F122M			Pattern 1-1 (1)	200.0 Secs X 2 [==>201.0 Secs (Pattern 1, Copy 1)] [==>201.0 Secs (Pattern 1, Copy 2)] [==>201.0 Secs (Pattern 2, Copy 1)] [==>201.0 Secs (Pattern 2, Copy 2)] [==>201.0 Secs (Pattern 3, Copy 1)] [==>201.0 Secs (Pattern 3, Copy 2)] [==>201.0 Secs (Pattern 4, Copy 1)] [==>201.0 Secs (Pattern 4, Copy 2)]	[1]

Proposal 10864 - Visit 07 - Mapping the Gaseous Content of Protoplanetary and Young Planetary Systems with ACS

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
Exposures (continued)	2	(8) HS-2027-+0651	ACS/SBC, ACCUM, SBC	PR130L			Pattern 2-2 (1)	300.0 Secs X 2	
	[=>301.0 Secs (Pattern 1, Copy 1)]								
	[=>301.0 Secs (Pattern 1, Copy 2)]								
	[=>416.0 Secs (Pattern 2, Copy 1)]								
	[=>416.0 Secs (Pattern 2, Copy 2)]								
	[=>416.0 Secs (Pattern 3, Copy 1)]								
	[=>416.0 Secs (Pattern 3, Copy 2)]								
	[=>416.0 Secs (Pattern 4, Copy 1)]								
[=>416.0 Secs (Pattern 4, Copy 2)]									
[1]									
[2]									

