



13798 - A chemical inventory of Gas and Star-Grazing Exocomets in HD 172555

Cycle: 22, 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) HD-172555	COS/FUV STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	5	09-Sep-2014 21:26:29.0	yes
02	(1) HD-172555	COS/FUV STIS/CCD STIS/FUV-MAMA STIS/NUV-MAMA	5	09-Sep-2014 21:26:33.0	yes

10 Total Orbits Used

ABSTRACT

Planetary systems similar to our own harbor not only planets, but a range of minor bodies and their associated collisional debris. In the solar system, small bodies can be perturbed into sun-grazing orbits, where they sublimate, and their bulk composition can be inferred spectroscopically. Similar activity has been detected in UV spectra of rapidly rotating A stars, where circumstellar gas can be separated at high contrast from the stellar spectrum. Two components are seen in the edge-on disk of beta Pic, a stable gas component, potentially associated with the Kuiper Belt analog at 85 au, and transient features which may represent star-grazing bodies possibly originating from an asteroid belt at 4 au. The stable gas in the beta Pic system is unusually carbon-rich, but until recently, we have lacked data on other young systems to establish whether this is typical, or reflects the presence of parent bodies with no solar system analogs. In the past year, we have obtained STIS spectra of 49 Cet, demonstrating that both gas components are detectable even when the system is not inclined exactly edge-on to our line of sight, and similar gas features at optical wavelengths have been reported for another beta Pictoris Moving Group member: HD 172555. This system has conspicuous far-IR [O I] emission, and mid-IR spectra which have been interpreted as showing debris from a recent massive collision in the terrestrial planet zone. We propose obtaining COS and STIS UV spectra of HD 172555 to obtain an inventory of the stable gas in this system which can be compared with beta Pic and search for UV signatures of star-grazing transiting exocomets.

OBSERVING DESCRIPTION

The Target: HD 172555 (HR 7012, HIP 92024) is an A7V ($T_{\text{eff}}=7800$ K) member of the beta Pictoris moving group. It has a co-moving K7-M0 companion, CD-64D1208 ($V=10.4$, $K=6.1$) at 68.5 arcseconds from HD172555 (Feigelson et al. 2006) which will fall outside the STIS or COS apertures. Feigelson et al. (2006) report a Chandra ACIS non-detection for HD 172555 with an upper limit to $L_x < 26.9$ erg/s, but a firm detection of the distant co-moving M0 star. This excludes the presence of any stellar (later than mid-F) or massive brown dwarf companion within a few arcseconds of the A7V primary (Stelzer et al. 2006) at distances which could affect exposure time estimates for the UV spectroscopy we propose. In common with other young, main sequence A stars with debris disks like beta Pictoris or 49 Cet, we expect that the UV spectrum should be dominated by the stellar photosphere, and this is observed in the lone IUE spectrum, SWP 45799 at wavelengths where the IUE data are usefully exposed ($\lambda > 1500$ Å). The FUSE spectra are consistent with detection of the A7V star only within the 30" LWRS. The nearest source other than CD minus 64D1208 at 5', consistent with galactic latitude of minus 23D and may be a halo object.

$E(B-V)=0$ for this object, as expected for $d=29$ pc, and the interstellar gas absorption is at minus 19 km s⁻¹ relative to the star, so there is no contamination of circumstellar absorption by line-of-sight interstellar features (Kiefer et al. 2014).

Stellar Activity: FUSE observed HD 172555 twice in 2005-2006, with observations separated by 1.3 years (F3200203000, F3200201000) and detected O VI and C II emission in HD 172555, but only an upper limit of $5E-15$ erg/cm/cm/s/A for C III] 1176. Si III 1206 A is expected to have similar peak emission to C III]. If the emission line flux ratios are similar to that observed in the rapidly rotating A7V star Altair (GHRS G140L observation Z3GB0104T), a conservative assumption since HD 172555 rotates less rapidly than Altair, we expect Lyman alpha peak emission to be $\sim 4x$ stronger or $< 2E-14$ erg/cm/cm/s/A, while N V is typically weaker than C III]. The photospheric continuum at these wavelengths is expected to be near $5E-15$ erg/cm/cm/s/A, based on the FUSE data.

In this program we plan to obtain spectral data covering 1140-2070 A, providing data on circumstellar gas absorption which will cover transitions of super-refractory elements (Al II, Al III), siderophiles (Fe II), lithophiles (Si II, III, IV), and volatiles (C I, C II, C IV, O I). The longer wavelength data will be provided by STIS, with shorter wavelength coverage provided by COS G130M spectra.

STIS Target Acquisition: We are using a Kurucz A7V, $T_{\text{eff}}=7800\text{K}$ model for HD 172555 which provides an excellent fit to the photosphere (Riviere-Marichalar et al. 2012) for all of our exposure time estimates, since the IUE data provide only partial wavelength coverage of the regions of interest to this study, and low S/N. We propose STIS F25ND3 filtered target acquisition imagery. This will achieve $\text{SNR}=49.5$ in 2 seconds, with the brightest pixel providing 595 e/s at $\text{GAIN}=4$ with no warnings (STIS.ta.617257).

For the ACQ/PEAK we will use the 0.3x0.05ND aperture, with $\text{GAIN}=4$ and expect to achieve $\text{SNR}=50$ in 0.1s, the minimum CCD integration time, with the time to saturation=3.41s, and no warnings (STIS.ta.617259).

STIS Spectroscopic Exposures: Our STIS exposure sequence will consist of 2 E230H spectra with wavelength centers of 2070 and 1763 A. At these wavelengths we expect the spectrum to be dominated by the stellar photosphere with superposed circumstellar absorption. For the 2070 A segment, the brightest pixel is at 2126 A and has a count rate of 1.875 c/s. The global count rate of 160.6K exceeds the bright object limit for irregularly varying objects (which HD 172555 as a main sequence A star is NOT)(STIS.sp.616965), but this should not preclude observations of the photosphere with variable absorption.

The E230H observation centered at 1763 A provides $\text{SNR}=25$ for Al III in 188s, and has a peak count rate at 1882.9 A of 0.83 c/s/p with a global count rate of 45,773 counts/s assuming average backgrounds. Orbital visibilities permit us to extend these observations to 250s. There are no warnings for this observation. (STIS.sp.616964).

The E140M spectrum produces the brightest pixel at 1682.99 Å with a count rate of 0.105 c/s, and a global rate of 2,093.084 c/s, assuming low airglow and average earthshine. In 6 ks, we expect to achieve a SNR of 38 longward of 1680 Å, near 20 for C I 1657 and Al II, and near 15 at C IV. The SNR ratio is below 10 for wavelengths shortward of 1500 Å. Our anticipated C III], Si III, and Lyman alpha emission line fluxes will at most increase the SNR from a few to ~4. Orbital visibilities permit us to extend the E140M exposures to 7385s, divided into 3 exposures.

There are no warnings for the E140M observations.

COS Target Acquisition: HD 172555 is sufficiently bright that we plan a dispersed light acquisition using G130M and the PSA aperture. We plan to do this using the wavelength center 1309 Å and using the A segment only for centering. SNR=40 is achieved in 3.8s (COS.sa.617269) but the COS Instrument handbook indicates that SNR=25 is acceptable. That is achieved in 1.5s for the ACQ/PEAKXD. The brightest pixel in segment A is at 1448.99 Å, and reaches a count rate of 0.007 c/s. The count rate for segment A is 559.031 c/s. We will follow this with an ACQ/PEAKD using NUM-POS=5.

COS G130M observation: We propose G130M exposures in the 1309 Å and 1327 Å wavelength centers using the PSA. We expect SNR~18 at 1450 Å, and >10 for wavelengths >1300 Å in 980 s. SNR will drop to 2 by Lyman alpha for photospheric light. A factor of 4 increase in flux due to emission will still be well below bright object limits. There are no warnings in COS.sp.617019, assuming minimal airglow contamination. The count rate in segment A is 610.7 c/s and segment B is 195.38. The buffer time is 2,926 s. Conditions are similar for the 1327 Å setting.

Timing: Each visit to HD 17255 will consist of the same exposures, spread over 5 orbits. We further request that observations in each visit occur in sequential, non-interruptible orbits, with a visit spacing of ~5-7 days.

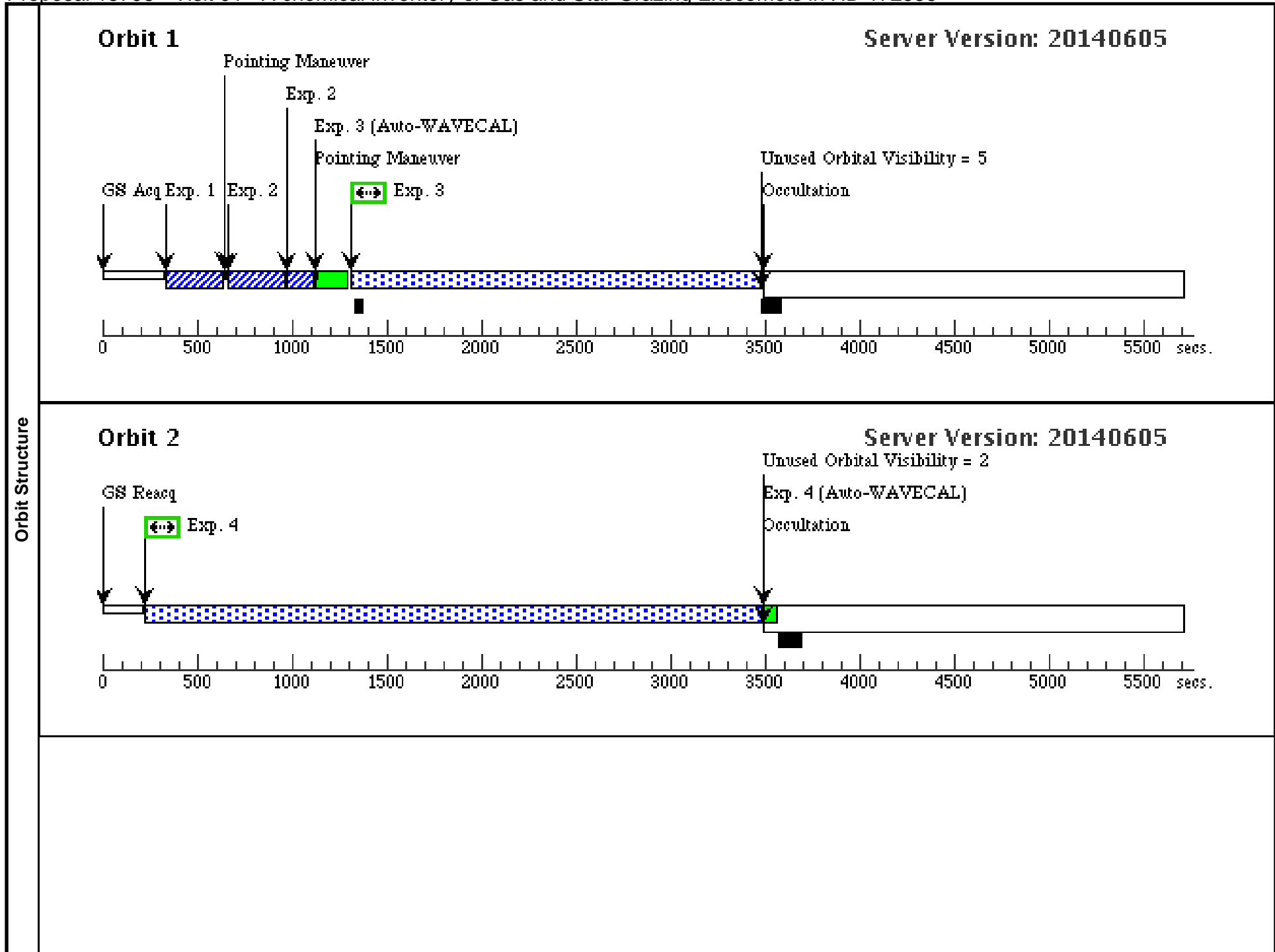
Coordinated Ground-Based Observations: We plan to augment the value of the HST observations by proposing for spectroscopic monitoring at the time of the HST observations, likely using the SAA0

1.5m telescope. We therefore ask that we be given as much advance notice of the timing of the HST observations, so that we can coordinate with the ground observations.

Proposal 13798 - Visit 01 - A chemical inventory of Gas and Star-Grazing Exocomets in HD 172555

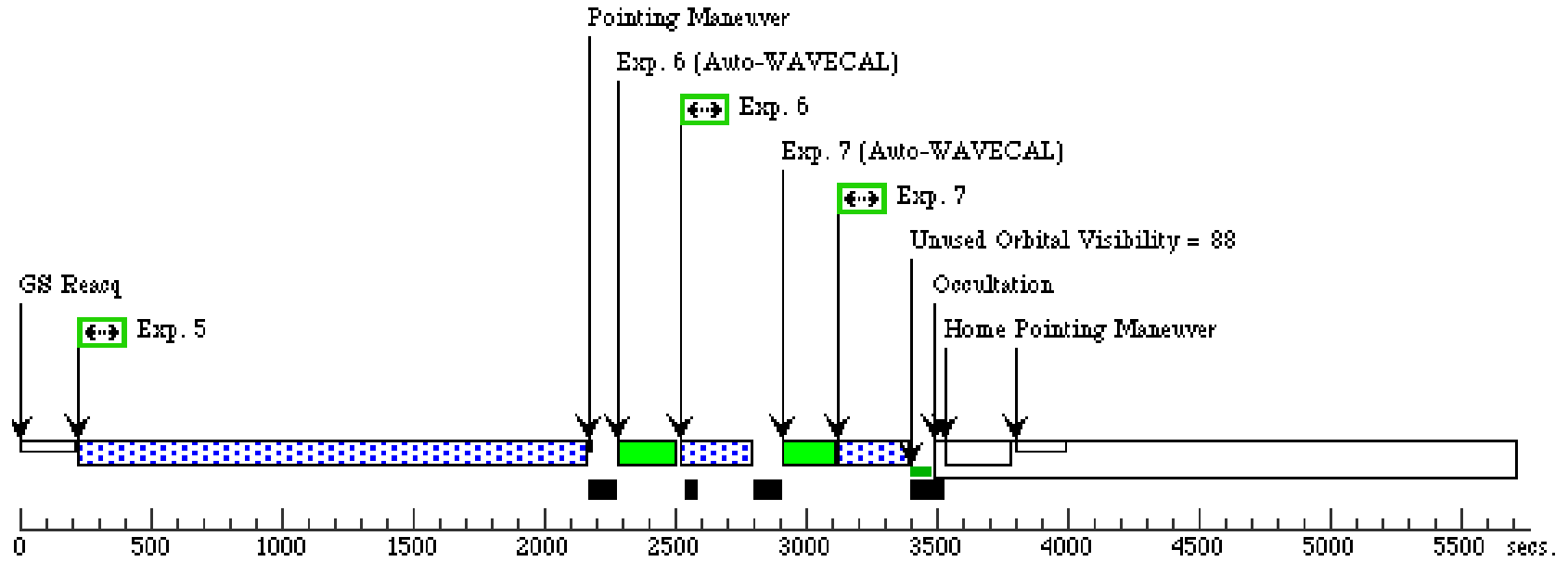
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Visit	Proposal 13798, Visit 01, implementation Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, COS/FUV, STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: SEQ 01.02 WITHIN 7 D									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(1)	HD-172555 Alt Name1: HR-7012 Alt Name2: HIP-92024	RA: 18 45 26.9005 (281.3620854d) Dec: -64 52 16.54 (-64.87126d) Equinox: J2000	Proper Motion RA: 32.40 mas/yr Proper Motion Dec: -149.48 mas/yr Parallax: 0.03503" Epoch of Position: 2000 Radial Velocity: 2.0 km/sec	V=4.779+/-0.01 B=4.970+/-0.01, B-V=0.201	Reference Frame: ICRS				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.617 257)	(1) HD-172555	STIS/CCD, ACQ, F25ND5	MIRROR				2 Secs (2 Secs) [==>]	[1]
	2	(STIS.ta.617 259)	(1) HD-172555	STIS/CCD, ACQ/PEAK, 0.3X0.05ND	MIRROR				0.1 Secs (0.1 Secs) [==>]	[1]
	3	(STIS.sp.61 7015)	(1) HD-172555	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A				2145 Secs (2145 Secs) [==>]	[1]
	4	(STIS.sp.61 7015)	(1) HD-172555	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A				3240 Secs (3240 Secs) [==>]	[2]
	5	(STIS.sp.61 7015)	(1) HD-172555	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A				1920 Secs (1920 Secs) [==>]	[3]
	6	(STIS.sp.61 6965)	(1) HD-172555	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2063 A				250 Secs (250 Secs) [==>]	[3]
	7	(STIS.sp.61 6964)	(1) HD-172555	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1763 A				250 Secs (250 Secs) [==>]	[3]
	8	(COS.sa.617 269)	(1) HD-172555	COS/FUV, ACQ/PEAKXD, PSA	G130M 1309 A				2.5 Secs (2.5 Secs) [==>]	[4]
	9	(COS.sa.617 269)	(1) HD-172555	COS/FUV, ACQ/PEAKD, PSA	G130M 1309 A	NUM-POS=5; STEP-SIZE=0.3; CENTER=DEF			8 Secs (8 Secs) [==>]	[4]
	10	(COS.sp.617 020)	(1) HD-172555	COS/FUV, TIME-TAG, PSA	G130M 1309 A	FP-POS=ALL; BUFFER-TIME=25 46.			465 Secs (1860 Secs) [==>(Split 1)] [==>(Split 2)] [==>(Split 3)] [==>(Split 4)]	[4]
11	(COS.sp.617 020)	(1) HD-172555	COS/FUV, TIME-TAG, PSA	G130M 1327 A	FP-POS=ALL; BUFFER-TIME=25 46.			570 Secs (2280 Secs) [==>(Split 1)] [==>(Split 2)] [==>(Split 3)] [==>(Split 4)]	[5]	

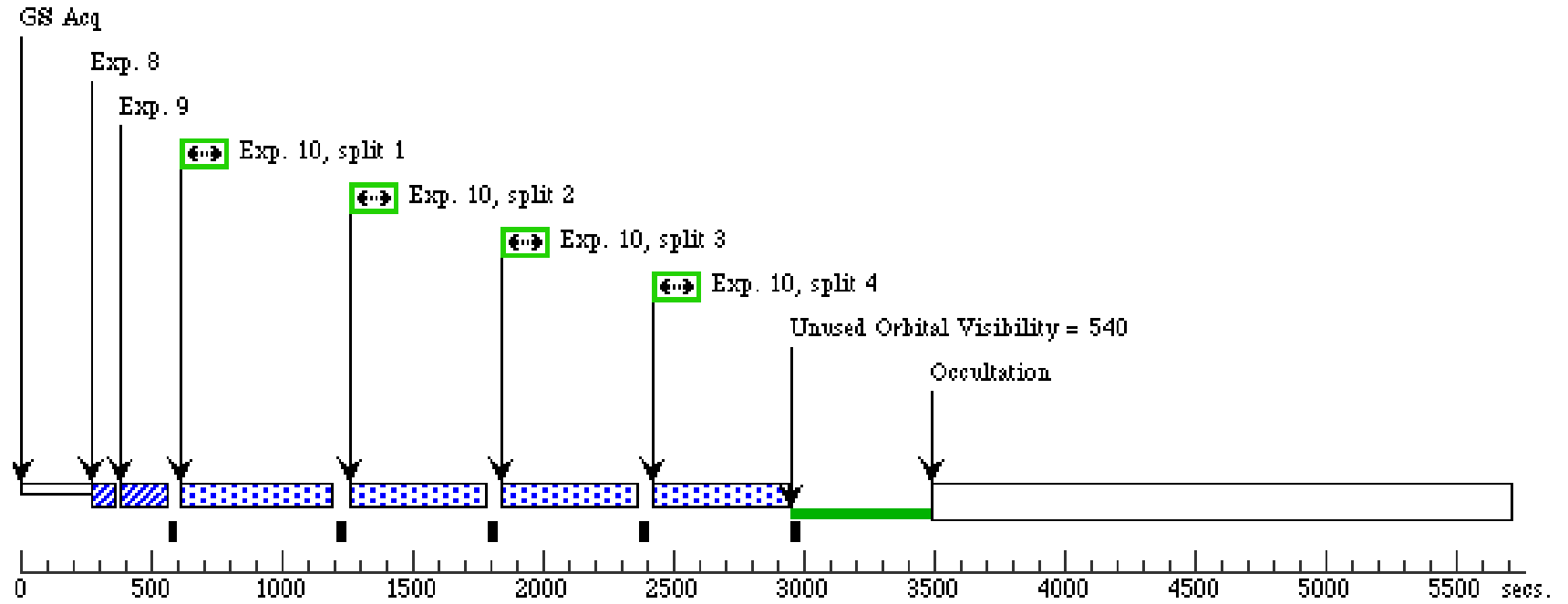


Orbit 3

Server Version: 20140605

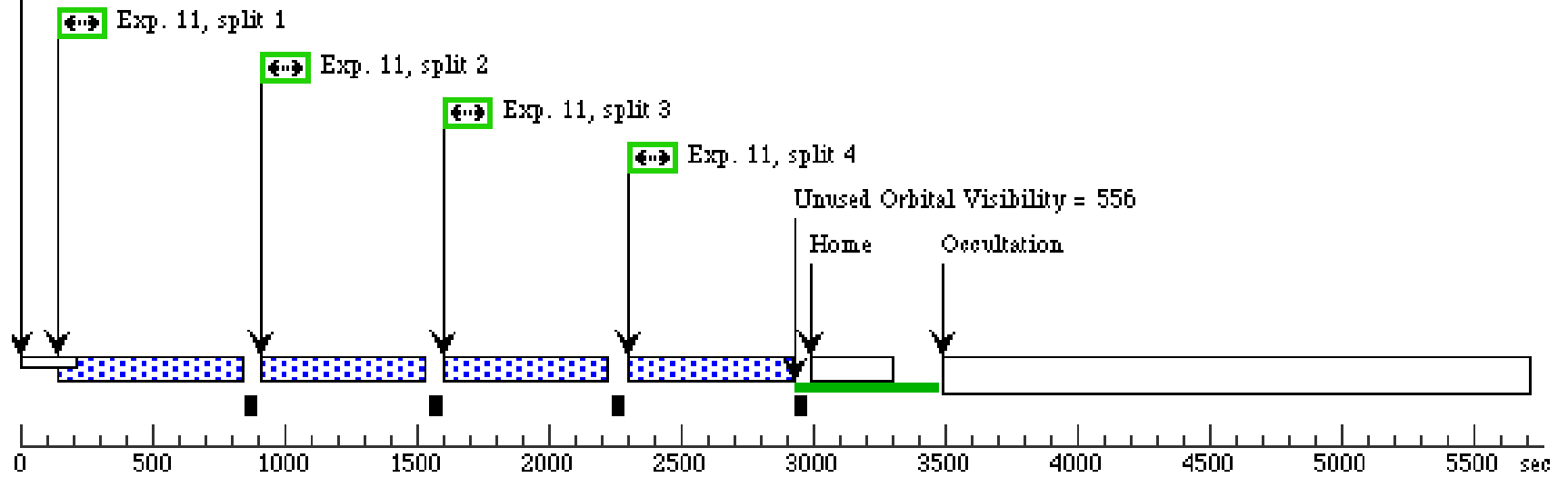


Orbit 4



Orbit 5

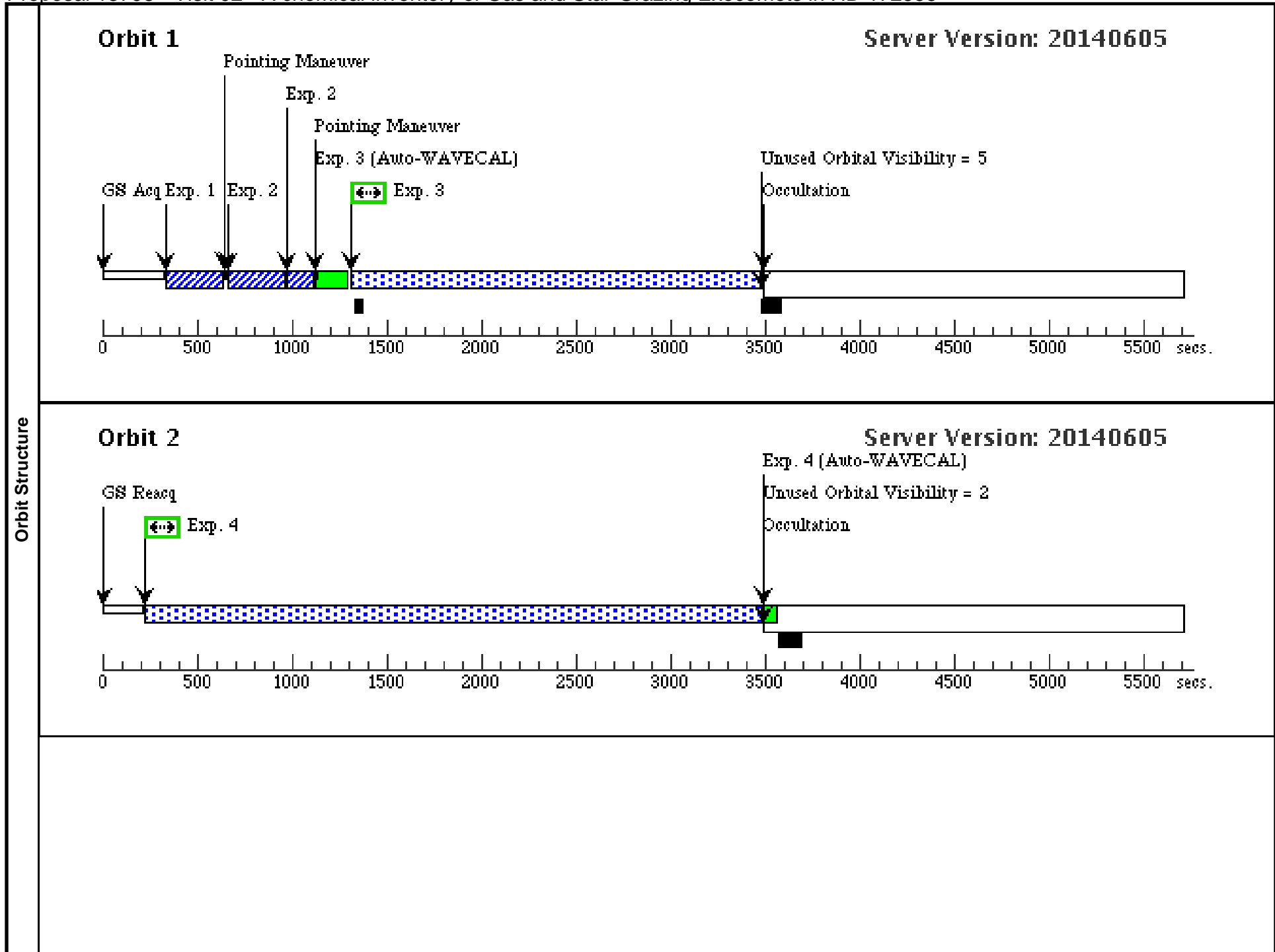
GS Reacq



Proposal 13798 - Visit 02 - A chemical inventory of Gas and Star-Grazing Exocomets in HD 172555

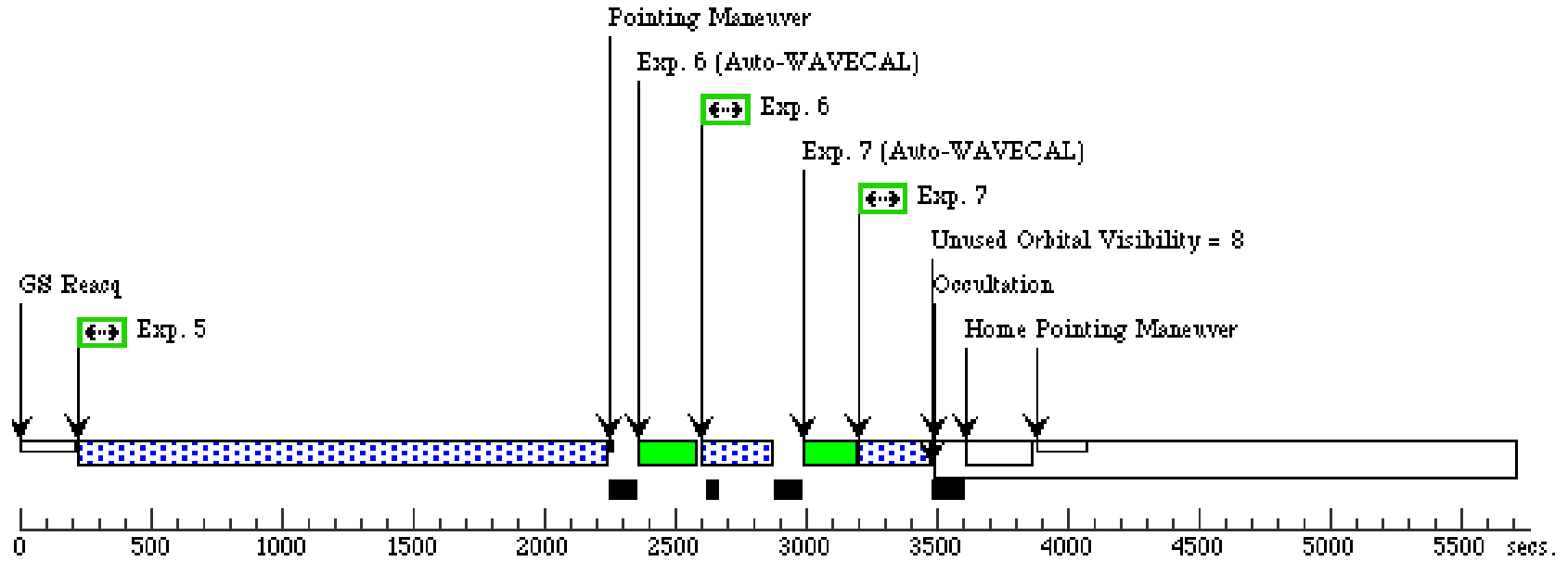
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Visit	Proposal 13798, Visit 02, implementation Diagnostic Status: No Diagnostics Scientific Instruments: STIS/CCD, COS/FUV, STIS/FUV-MAMA, STIS/NUV-MAMA Special Requirements: AFTER 01 BY 5.0 D TO 7.0 D; SEQ 01,02 WITHIN 7 D									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
		(1)	HD-172555 Alt Name1: HR-7012 Alt Name2: HIP-92024	RA: 18 45 26.9005 (281.3620854d) Dec: -64 52 16.54 (-64.87126d) Equinox: J2000	Proper Motion RA: 32.40 mas/yr Proper Motion Dec: -149.48 mas/yr Parallax: 0.03503" Epoch of Position: 2000 Radial Velocity: 2.0 km/sec	V=4.779+/-0.01 B=4.970+/-0.01, B-V=0.201	Reference Frame: ICRS			
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	(STIS.ta.617 257)	(1) HD-172555	STIS/CCD, ACQ, F25ND5	MIRROR				2 Secs (2 Secs) [==>]	[1]
	2	(STIS.ta.617 259)	(1) HD-172555	STIS/CCD, ACQ/PEAK, 0.3X0.05ND	MIRROR				0.1 Secs (0.1 Secs) [==>]	[1]
	3	(STIS.sp.61 7015)	(1) HD-172555	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A				2145 Secs (2145 Secs) [==>]	[1]
	4	(STIS.sp.61 7015)	(1) HD-172555	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A				3240 Secs (3240 Secs) [==>]	[2]
	5	(STIS.sp.61 7015)	(1) HD-172555	STIS/FUV-MAMA, ACCUM, 0.2X0.06	E140M 1425 A				2000 Secs (2000 Secs) [==>]	[3]
	6	(STIS.sp.61 6965)	(1) HD-172555	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 2063 A				250 Secs (250 Secs) [==>]	[3]
	7	(STIS.sp.61 6964)	(1) HD-172555	STIS/NUV-MAMA, ACCUM, 0.2X0.09	E230H 1763 A				250 Secs (250 Secs) [==>]	[3]
	8	(COS.sa.617 269)	(1) HD-172555	COS/FUV, ACQ/PEAKXD, PSA	G130M 1309 A				2.5 Secs (2.5 Secs) [==>]	[4]
	9	(COS.sa.617 269)	(1) HD-172555	COS/FUV, ACQ/PEAKD, PSA	G130M 1309 A	NUM-POS=5; STEP-SIZE=0.3; CENTER=DEF			8 Secs (8 Secs) [==>]	[4]
	10	(COS.sp.617 020)	(1) HD-172555	COS/FUV, TIME-TAG, PSA	G130M 1309 A	FP-POS=ALL; BUFFER-TIME=25 46.			465 Secs (1860 Secs) [==>(Split 1)] [==>(Split 2)] [==>(Split 3)] [==>(Split 4)]	[4]
	11	(COS.sp.617 020)	(1) HD-172555	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=ALL; BUFFER-TIME=25 46.			570 Secs (2280 Secs) [==>(Split 1)] [==>(Split 2)] [==>(Split 3)] [==>(Split 4)]	[5]

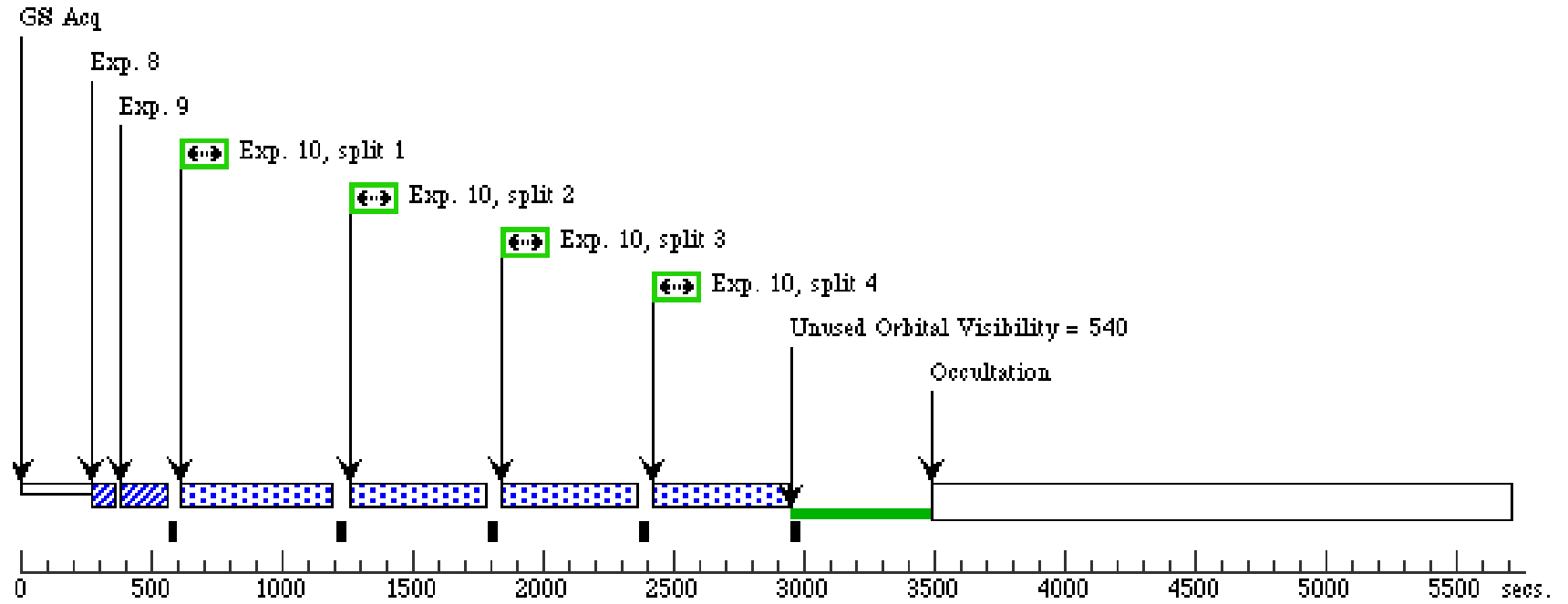


Orbit 3

Server Version: 20140605



Orbit 4



Orbit 5

GS Reacq

