



11170 - UV Imaging of the Martian Corona and the Escape of Hydrogen

Cycle: 16, Proposal Category: GO

(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) MARS-CORONA-1 (2) SKY-NEAR-MARS-1	ACS/SBC	3	23-Oct-2007 21:07:33.0	yes
02	(3) MARS-CORONA-2 (4) SKY-NEAR-MARS-2	ACS/SBC	3	23-Oct-2007 21:07:56.0	yes
11	(5) MARS-CORONA-11 (6) SKY-NEAR-MARS-11	ACS/SBC	3	23-Oct-2007 21:08:15.0	yes

9 Total Orbits Used

ABSTRACT

ACS SBC UV imaging observations of Mars are proposed to study the extended hydrogen corona, with application to the escape of hydrogen and the history of water on Mars. These observations will be scheduled when Mars is distant from the Earth, so that a field of view of ± 4 -5 Mars radii can be obtained to image the full range of the highly extended martian hydrogen corona through its H Ly α emission. The observations will also be obtained when the Sun-Earth-Mars angle is close to 90 degrees, so that any asymmetry along the Mars-Sun line can be observed. The observed 2-dimensional brightness distribution will be related to local density using two existing radiative transfer codes, and the upward flux and velocity distributions will be determined by comparison with runs from an exospheric distribution model. These observations, combined with simultaneous Ly α observations by the SPICAM instrument on Mars Express from within the atmosphere, will provide the first tight constraints on the total escape flux and importance of nonthermal processes on the rate of escape.

OBSERVING DESCRIPTION

This program is for

ACS SBC UV images of Mars to measure the distribution of the hydrogen corona via the extended H Ly γ emission out to $+4$ Mars radii. This will be performed by a series of clear and filtered images, with the F140LP filter used to record the disc emissions with Ly γ blocked. The scaled difference of the clear and F140LP frames will be the Ly γ emission. In practice, more than 300 km above the planet limb the only emission is from Ly γ , and the difference method is needed only for the disc. The science will be based largely on the extended emissions.

The observations will consist of clear ACS SBC images during the portion of the HST orbit when HST is in shadow, and filtered images when HST is in sunlight, to minimize the geocoronal background brightness at Ly γ . In two HST orbits, based on existing SBC images of Jupiter and Saturn, we can obtain the required sensitivity down to several tens of Rayleighs of diffuse Ly γ emission.

A visit will consist of 2 orbits observing Mars and 1 on the sky background. Two visits of three orbits each will sample variations in the solar wind with relevance to the nonthermal processes in the H corona. The two visits should be scheduled 2 weeks, or $1/2$ solar rotation, apart to maximize the chances of variations in the solar wind conditions. The program is for a total of 6 orbits.

We will schedule coordinated Mars Express SPICAM observations of the limb altitude profile of the Ly γ emissions from inside the atmosphere, for comparison and cross-calibration of the H distribution measurements. This will greatly aid the modeling effort to derive the distribution of H atoms with altitude and local time. This will require that we schedule in May 2007 the dates for the HST observations in August 2007, to permit the planning of the Mars Express observations.

The expected count rate for ACS SBC clear imaging of Mars, can be estimated by scaling from the measured count rates with STIS and earlier ACS images of Jupiter and Saturn. From the disc one gets 0.2 counts/sec-pixel for ACS. For a Mars diameter of 8 arc sec this would give a total of 12,000 counts/sec. For the extended emissions, the ACS value for the Mars + geocoronal Ly γ emissions is 0.015 cts/sec-pixel, for 1024x1024 pixels a total of 16,000 counts/sec. While the sky background may be higher by a factor of 2-3, it is clear that the total count rate will be well below the limit of 200,000 counts/sec, and the local count rate limits are also not exceeded.

At the time of the observations, Mars must of necessity be near 90 deg. from the Sun to observe the sunward/anti-sunward asymmetry. According to the two-gyro handbook, specifically Figure 6.1 showing the sky availability region in two-gyro mode, a point in the sky at 90 deg. from the Sun and close to the ecliptic can be observed on the trailing side of the Sun, but not on the leading side of the Sun. The proposed observation can in principle be performed with Mars on either side of the Sun. Assuming two-gyro pointing, the observation would be performed the next time that Mars appears on the trailing side of the Sun, in August 2007.

The roll angle will be unconstrained for this program, posing no challenges for the two-gyro mode. The period of two weeks for the observing window should be more than sufficient to schedule these observations in either three-gyro or two-gyro mode, and the window may be expanded if needed. The fact that Mars moves across the sky generally makes it possible to locate good guide stars within any multi-week observing window. In two-gyro mode the pointing may vary from orbit to orbit more than before, but since we see the planet in each image, we can easily reconstruct the pointing from each observation. Finally, in terms of the potential added jitter in two-gyro mode, this will have little impact on the proposed observations, which do not require the highest possible angular resolution.

CALIBRATION JUSTIFICATION

To accurately subtract the background geocoronal and interplanetary emissions, it is imperative to measure its brightness versus HST orbital location. One HST orbit will be used in each visit for a series of clear images taken several arc min away from Mars, since the field of view near Mars will be filled with coronal emission. Although only the sky background will be observed, an accurate subtraction is key to determining the brightness of faint emission far from Mars. Experience with past programs has shown that the geocoronal conditions are too highly variable to be modeled with a high accuracy for this subtraction. A side benefit of this will be to build up a Ly γ flat field of the ACS MAMA, for comparison with the general UV flat field used for calibration. The low frequency response across the detector is important for the interpretation of extended emissions, and has not been established due to an apparent wavelength dependence of the SBC flat fields (based on discussions with R. Bohlin and C. Proffitt). The low order Ly γ flat field that we would obtain would be delivered to STScI for distribution to the public.

Proposal 11170 - Visit 01 - UV Imaging of the Martian Corona and the Escape of Hydrogen

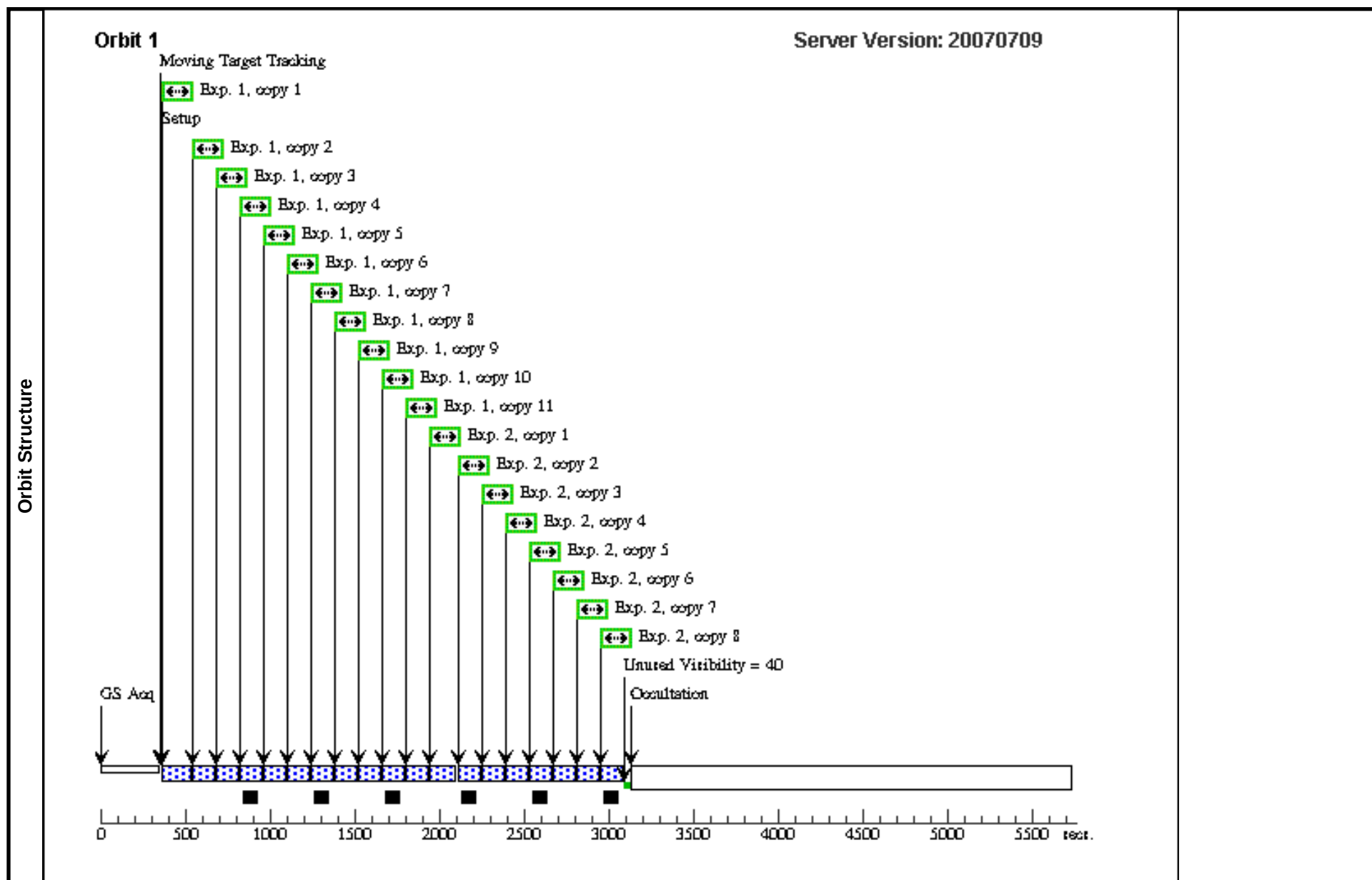
Visit	Proposal 11170, Visit 01, failed										Wed Oct 24 01:08:22 GMT 2007
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: ACS/SBC										
	Special Requirements: ORIENT 293.0D TO 295.0 D; BETWEEN 15-OCT-2007:09:00:00 AND 15-OCT-2007:10:00:00										
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window					
	(1)	MARS-CORONA-1	STD=MARS	TYPE=POS_ANGLE,RAD=12.0,ANG=65.0,REF=NORTH							
	(2)	SKY-NEAR-MARS-1	STD=MARS	TYPE=POS_ANGLE,RAD=295.0,ANG=0.0,REF=NORTH							
	Comments: Offset ~5 arc min north of Mars, observations to measure variation in brightness of Ly alpha geocoronal background emission over course of orbit.										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]		Orbit
	1		(1) MARS-CORON A-1	ACS/SBC, ACCUM, SBC-FIX	F115LP				100.0 Secs X 11		[1]
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								[==>(Copy 11)]			
2		(1) MARS-CORON A-1	ACS/SBC, ACCUM, SBC-FIX	F140LP					100.0 Secs X 8		[1]
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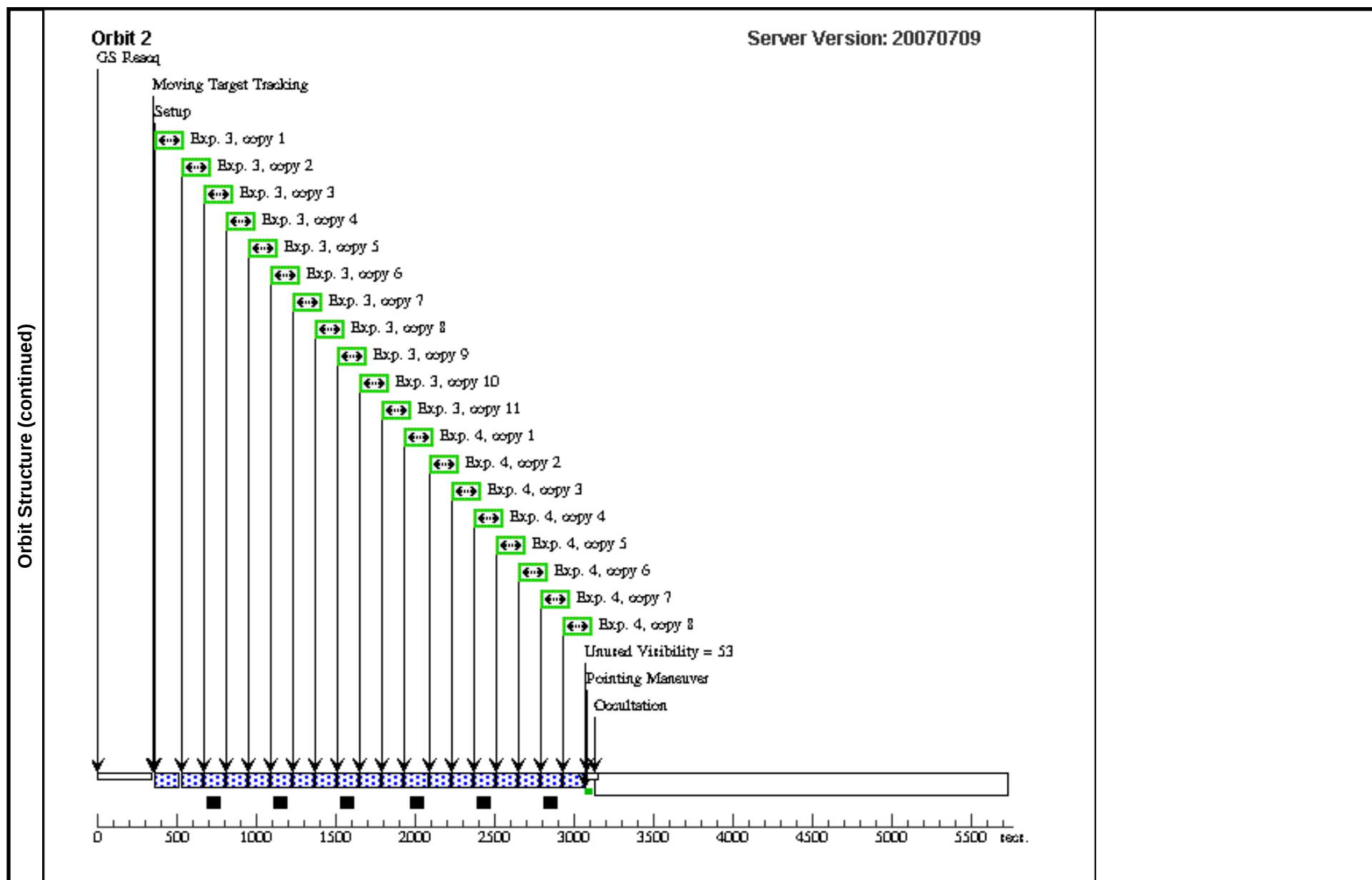
Proposal 11170 - Visit 01 - UV Imaging of the Martian Corona and the Escape of Hydrogen

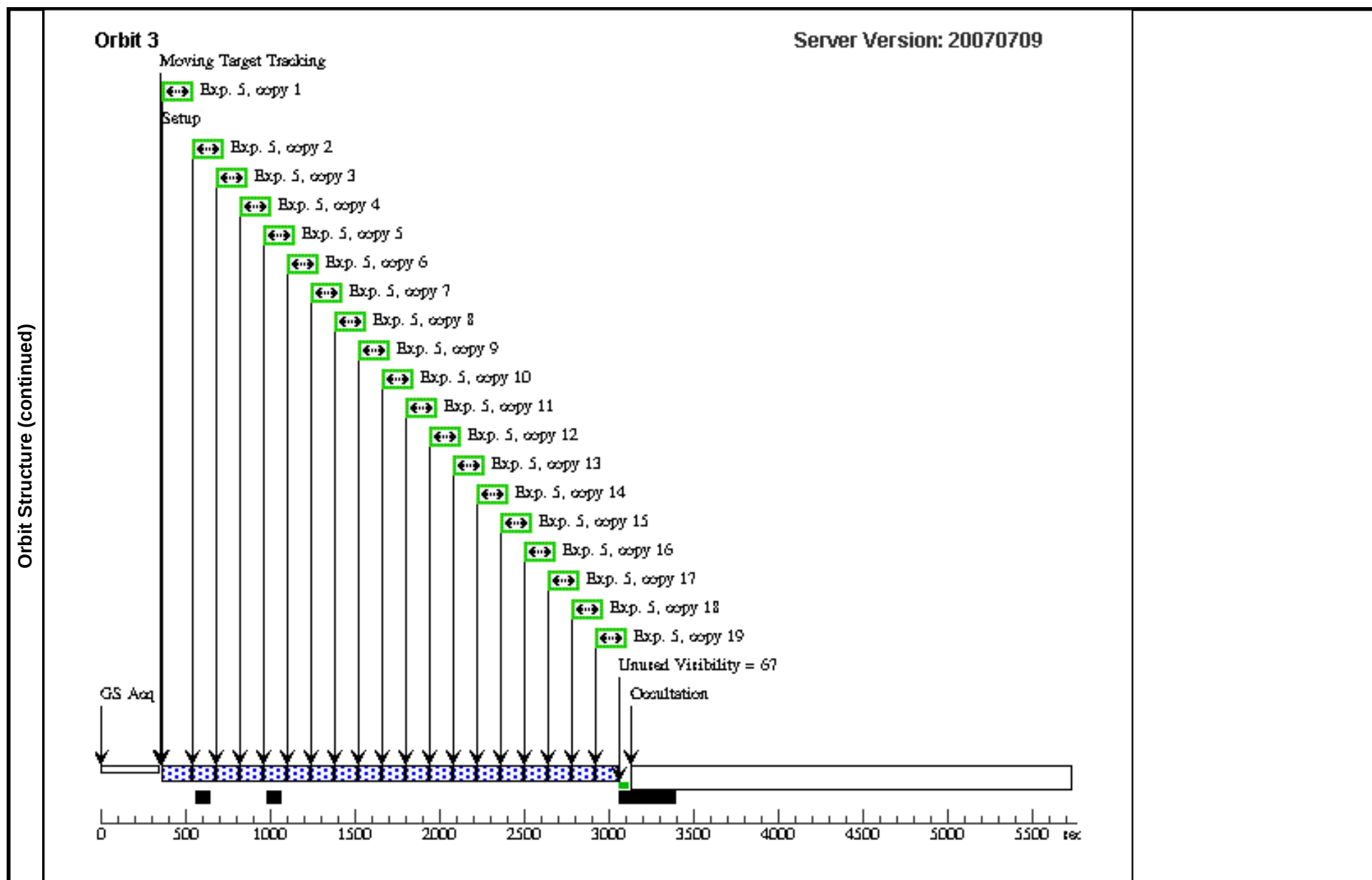
Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	3		(1) MARS-CORON A-1	ACS/SBC, ACCUM, SBC-FIX	F115LP				100.0 Secs X 11	
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									[==>(Copy 11)]	
Exposures (continued)	4		(1) MARS-CORON A-1	ACS/SBC, ACCUM, SBC-FIX	F140LP				100.0 Secs X 8	
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Proposal 11170 - Visit 01 - UV Imaging of the Martian Corona and the Escape of Hydrogen

Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	5		(2) SKY-NEAR-MA RS-1	ACS/SBC, ACCUM, SBC-FIX	F115LP		NEW OBSET FULL ACQ		100.0 Secs X 19	
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Proposal 11170 - Visit 02 - UV Imaging of the Martian Corona and the Escape of Hydrogen

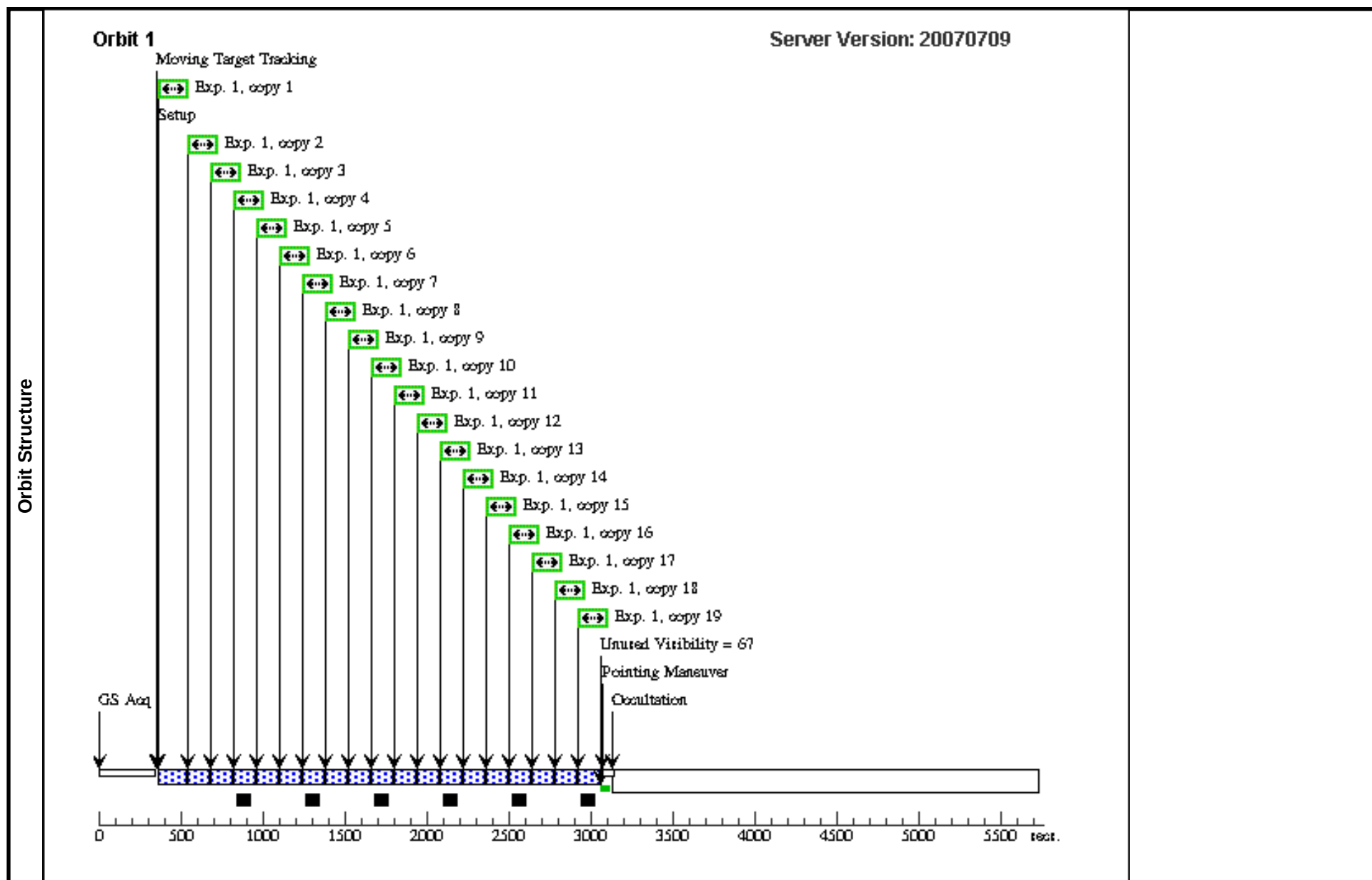
Visit	Proposal 11170, Visit 02, scheduling										Wed Oct 24 01:08:24 GMT 2007
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: ACS/SBC										
	Special Requirements: ORIENT 293.0D TO 295.0 D; BETWEEN 27-OCT-2007:08:45:00 AND 27-OCT-2007:09:45:00										
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window					
	(3)	MARS-CORONA-2	STD=MARS	TYPE=POS_ANGLE,RAD=9.0,ANG=90.0 ,REF=NORTH							
	(4)	SKY-NEAR-MARS-2	STD=MARS	TYPE=POS_ANGLE,RAD=357.0,ANG=0.0,REF=NORTH							
	Comments: Offset ~5 arc min north of Mars, observations to measure variation in brightness of Ly alpha geocoronal background emission over course of orbit.										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]		Orbit
	1		(4) SKY-NEAR-MA RS-2	ACS/SBC, ACCUM, SBC-FIX	F115LP				100.0 Secs X 19		
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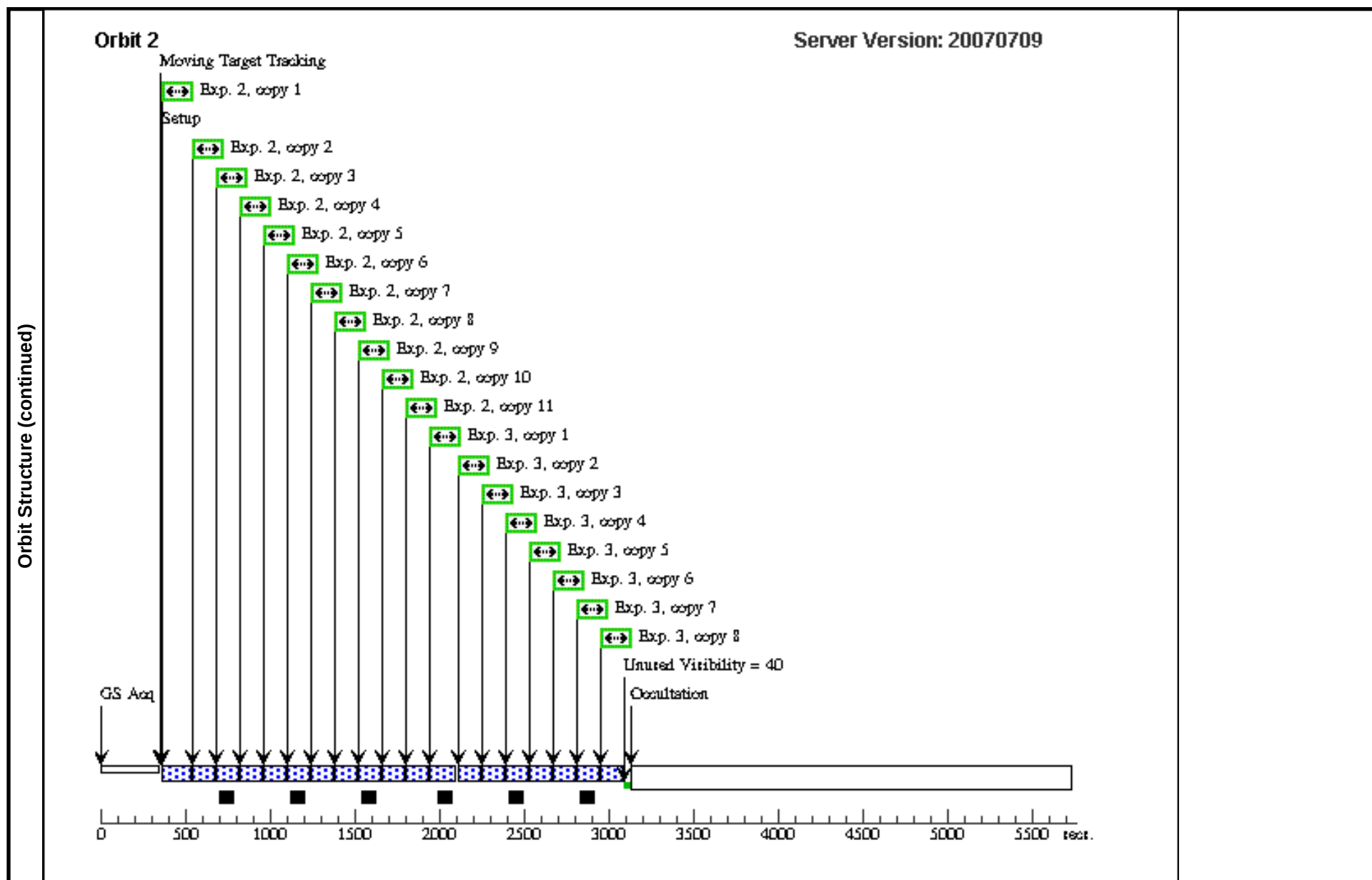
Proposal 11170 - Visit 02 - UV Imaging of the Martian Corona and the Escape of Hydrogen

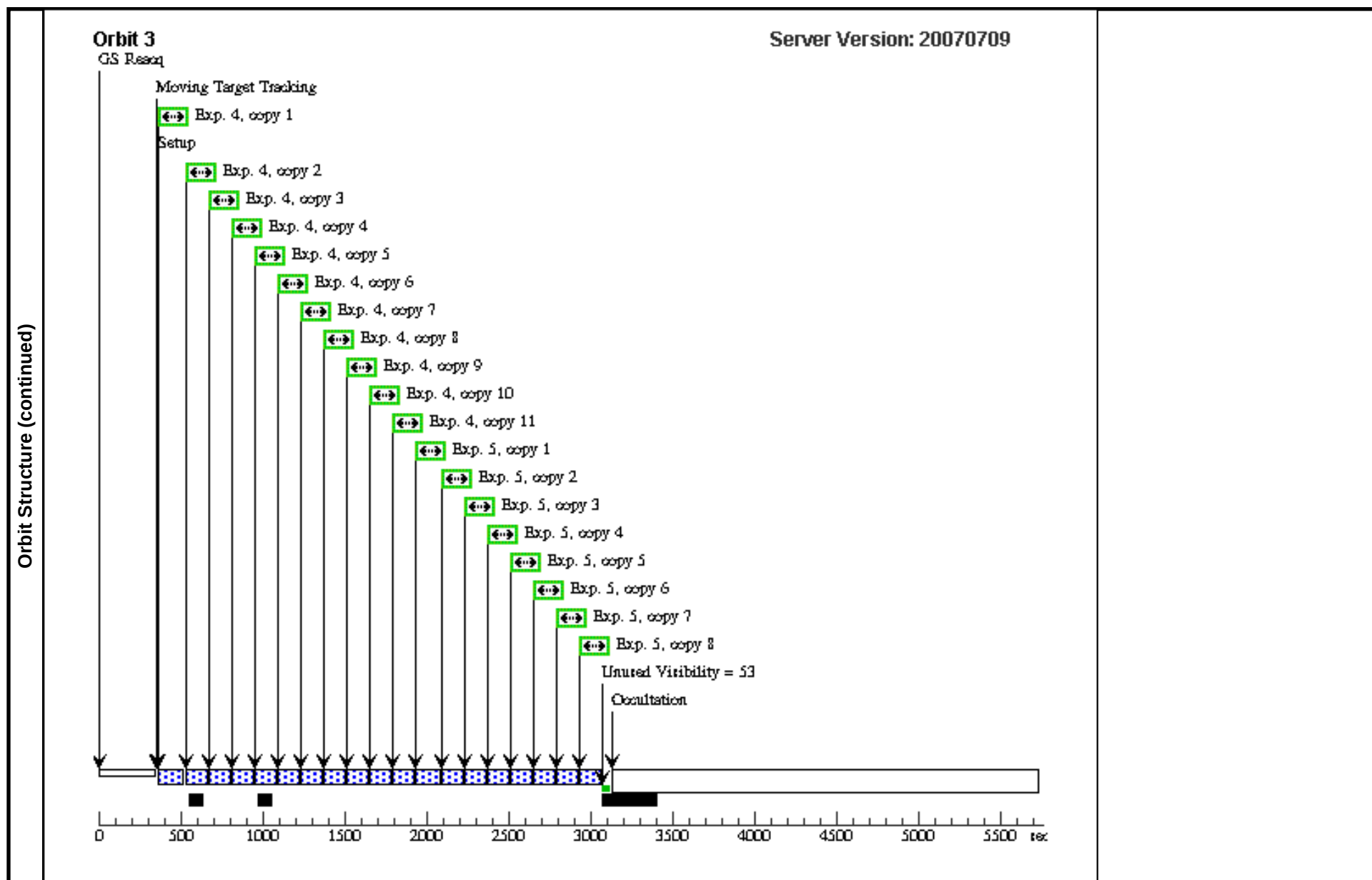
Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	2		(3) MARS-CORON A-2	ACS/SBC, ACCUM, SBC-FIX	F115LP		NEW OBSET FULL ACQ		100.0 Secs X 11	
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	3		(3) MARS-CORON A-2	ACS/SBC, ACCUM, SBC-FIX	F140LP				100.0 Secs X 8	
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	4		(3) MARS-CORON A-2	ACS/SBC, ACCUM, SBC-FIX	F115LP				100.0 Secs X 11	
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Proposal 11170 - Visit 02 - UV Imaging of the Martian Corona and the Escape of Hydrogen

Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	5		(3) MARS-CORON A-2	ACS/SBC, ACCUM, SBC-FIX	F140LP				100.0 Secs X 8	
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Proposal 11170 - Visit 11 - UV Imaging of the Martian Corona and the Escape of Hydrogen

Visit	Proposal 11170, Visit 11, implementation										Wed Oct 24 01:08:26 GMT 2007
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: ACS/SBC										
	Special Requirements: ORIENT 293.0D TO 295.0 D; BETWEEN 09-NOV-2007:19:30:00 AND 09-NOV-2007:20:30:00										
	Comments: Repeat of failed visit 01.										
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window					
	(5)	MARS-CORONA-11	STD=MARS	TYPE=POS_ANGLE,RAD=12.0,ANG=66.0,REF=NORTH							
	(6)	SKY-NEAR-MARS-11	STD=MARS	TYPE=POS_ANGLE,RAD=285.0,ANG=0.0,REF=NORTH							
	Comments: Offset ~5 arc min north of Mars, observations to measure variation in brightness of Ly alpha geocoronal background emission over course of orbit.										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]		Orbit
	1		(5) MARS-CORON A-11	ACS/SBC, ACCUM, SBC-FIX	F115LP				100.0 Secs X 11		
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2		(5) MARS-CORON A-11	ACS/SBC, ACCUM, SBC-FIX	F140LP				100.0 Secs X 8			
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Proposal 11170 - Visit 11 - UV Imaging of the Martian Corona and the Escape of Hydrogen

Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	3		(5) MARS-CORON A-11	ACS/SBC, ACCUM, SBC-FIX	F115LP				100.0 Secs X 11	
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									[==>(Copy 10)]	
									[==>(Copy 11)]	
	4		(5) MARS-CORON A-11	ACS/SBC, ACCUM, SBC-FIX	F140LP				100.0 Secs X 8	
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Proposal 11170 - Visit 11 - UV Imaging of the Martian Corona and the Escape of Hydrogen

Exposures (continued)	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	5		(6) SKY-NEAR-MA RS-11	ACS/SBC, ACCUM, SBC-FIX	F115LP		NEW OBSET FULL ACQ		100.0 Secs X 19	
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