11187 - A Deep Search for Martian Dust Rings

Cycle: 16, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
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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) MARS	WFPC2	2	26-Nov-2007 21:11:25.0	yes
02	(1) MARS	WFPC2	2	26-Nov-2007 21:11:32.0	yes
03	(1) MARS	WFPC2	1	26-Nov-2007 21:11:37.0	yes

5 Total Orbits Used

ABSTRACT

It has been long suspected that Mars is encircled by two faint rings of dust, one originating from each of its moons Phobos and Deimos. Similar dust rings are associated with many of the small, inner moons orbiting Jupiter, Saturn, Uranus and Neptune. On December 31, 2007, Earth will pass through Mars' equatorial plane just a week after its December 24 opposition, providing an exceedingly rare opportunity to image the rings under nearly ideal viewing geometry. The next equivalent viewing opportunity occurs in 2022. Using the Wide Fields of WFPC2 and a highly optimized observing plan, we expect to be able to detect rings with edge-on reflectivities of ~ 10^-8, which is at or below the level where most dynamicists expect rings to be visible. This is a factor of 10-30 more sensitive than the detection limit we achieved during a slightly inferior viewing opportunity

in 2001. The rings have been predicted to show some interesting dynamical properties, including large asymmetries and inclinations. A positive detection will test these predictions, serving as an effective test of dynamical models developed to account for the properties of other faint planetary rings as well. With such a stringent limit, even a negative result will be of considerable interest, challenging dynamicists to explain the remarkably low density of dust within the Martian system.

OBSERVING DESCRIPTION

We position the hypothetical ring vertically (parallel to the PC1 y-axis) in one field of view, while Mars is positioned in an adjacent frame and substantially over-exposed. We use broad filter F606W and 180-sec exposures; CLOCKS=YES is used to limit the danger of saturation. Visits 01 and 02 are identical: one orbit with Mars in WF3 and the ring in WF2, followed by another with Mars in PC1 and the ring in WF4. A third visit uses the same pointings but rotates the ring plane by 45 degrees; these images are used to model and subtract the background light gradient within the other images. Each visit includes a brief unsaturated image of Mars through filter F502N to provide pointing and photometric reference.

Visit

Proposal 11187, Visit 01, scheduling Tue Nov 27 02:11:41 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: SCHED 100%; ORIENT 198.0D TO 203.0 D; ORIENT 18.0D TO 23.0 D; BETWEEN 22-DEC-2007:00:00:00 AND 26-DEC-2007:00:00:00

Comments: One orbit spent imaging each side of the Martian rings. Rings oriented parallel to the PC y-axis. First orbit positions Mars in WF3 with the ring extending vertically into WF2. The second orbit positions Mars in the PC with the ring extending into WF4. In both cases, Mars's limb is positioned ~ 1" off the edge of the frame targeting the rings. POS TARG values are derived as follows.

Orbit 1: The WF3 pixel size is 0.1". The edge of the WF2 overlaps with Y ~ 95 of the WF3. Allowing a 1" or 10-pixel margin for pointing error, the limb of Mars should not extend below Y ~ 105 on WF3. Mars has radius 7.92" = 79.2 pixels, so Mars should be centered at Y ~ 185. The center of the WF3-FIX aperture is (416.5,424.5), so the Y offset is -240 pixels in WF3 coordinates or POS TARG = (0,+24).

Orbit 2: The PC pixel size is 0.0455". The edge of the WF4 field overlaps with Y ~ 150 on PC1. Allowing for 1" or ~ 25-pixel margin, the limb should be at Y ~ 175. We also need Mars entirely inside the PC, so its limb should not extend past X ~ 775, allowing for buffer. Mars has radius 7.92" = 175 PC pixels. Thus the center of Mars should fall at (600,350). The center of the PC1-FIX aperture is (420,424.5) so the offset is (180,-75) in pixels or POS TARG = (8.2,-3.4).

NOTE: These observations take advantage of a viewing geometry that does not recur until 2022. Timing and orientation constraints have very little flexibility. However, if absolutely necessary, Visits 01 and 02 can be split into single-orbit visits to enhance schedulability.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window
(1)	MARS	STD=MARS			

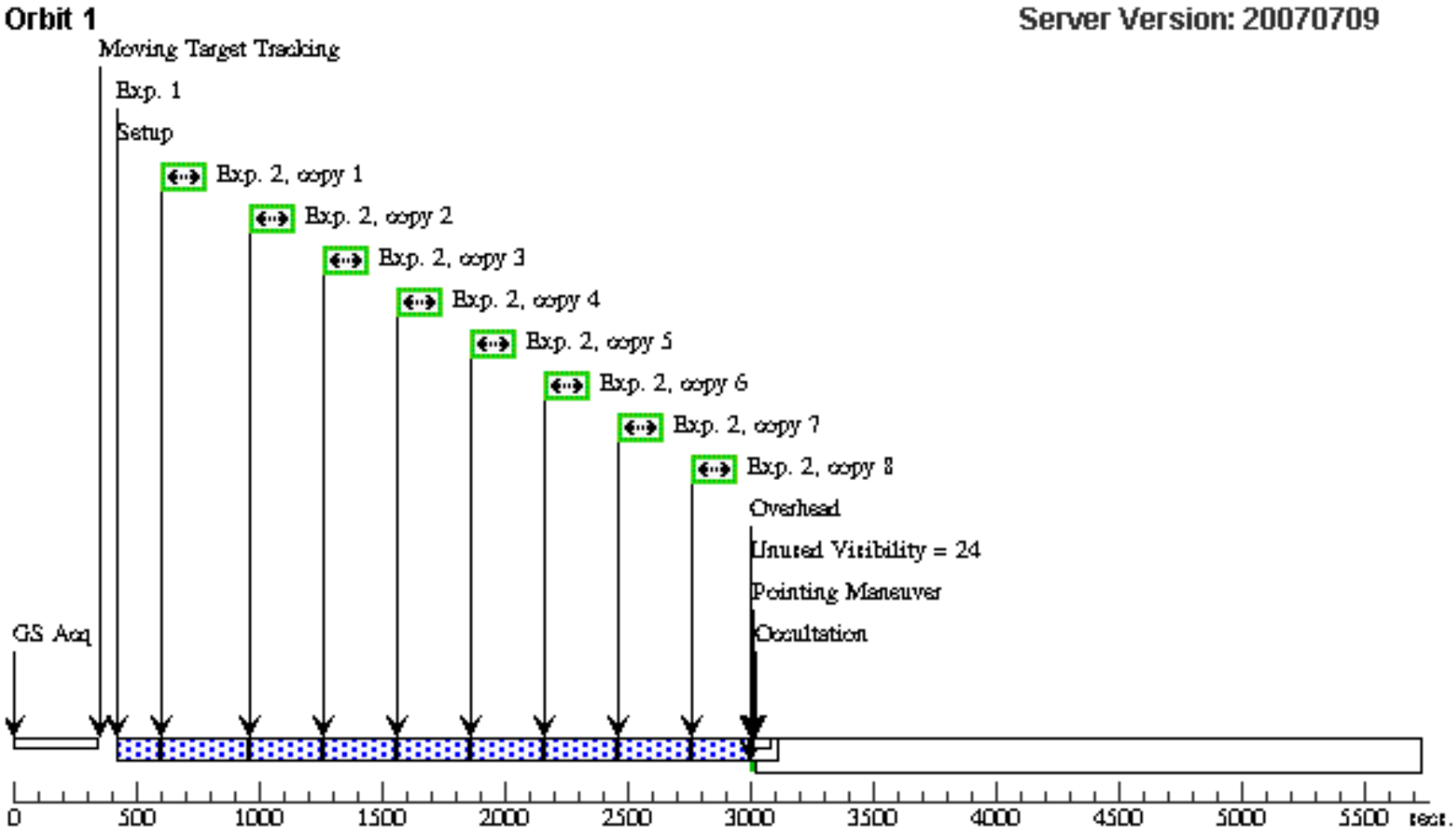
Exposures

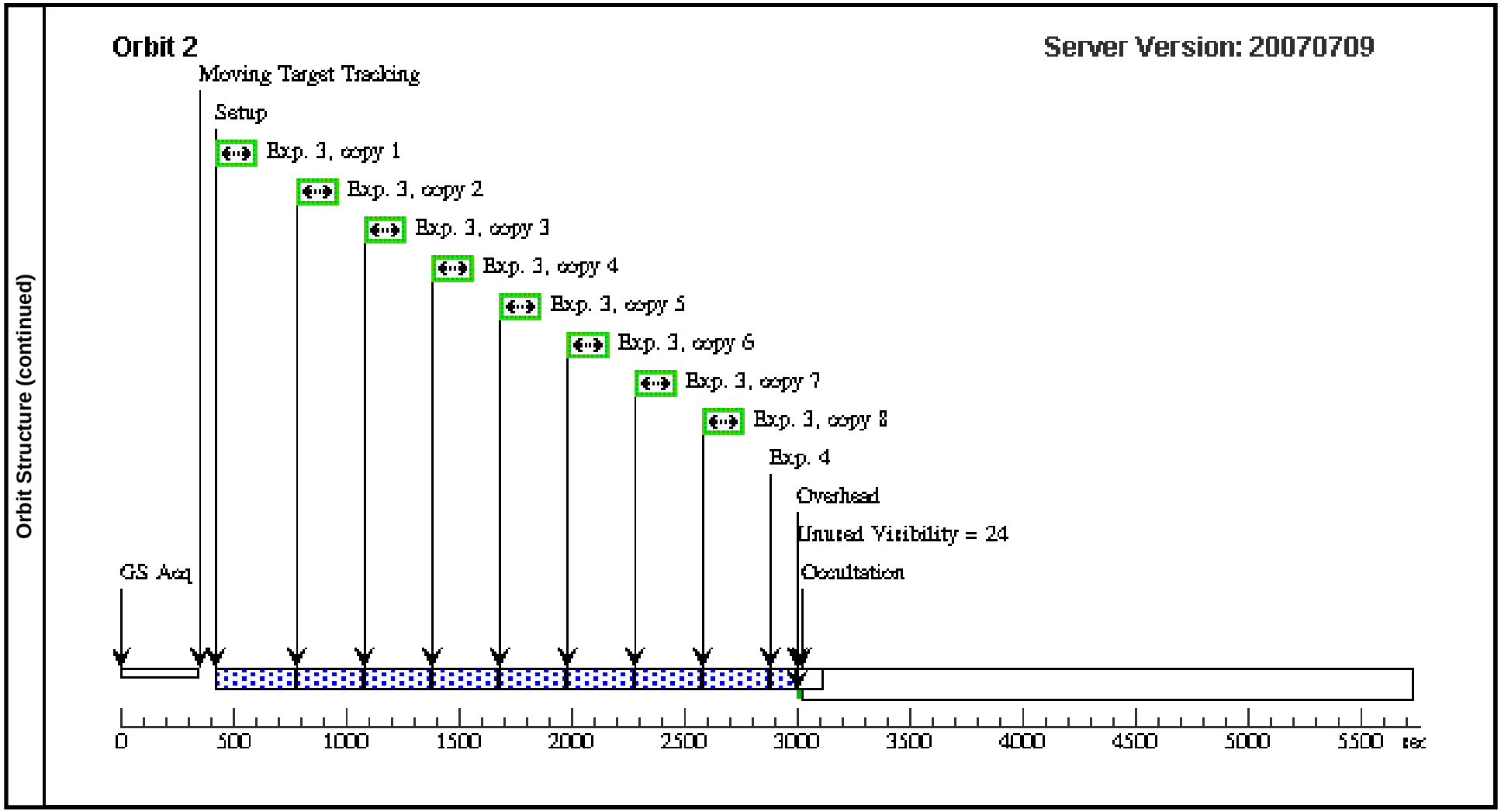
#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F502N, 0.23 sec, Mars in WF3	(1) MARS	WFPC2, IMAGE, WF3-FIX	F502N	CR-SPLIT=NO	POS TARG 0,24	Sequence 1-2 Non-Int	0.23 Secs	
								[==>]	***[1]***
2	F606W, 8 x 180 sec, Mars in WF3, Ring in WF2	(1) MARS	WFPC2, IMAGE, WF3-FIX	F606W	CLOCKS=YES; CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	180.0 Secs X 8	
								[==>(Copy 1)]	***[1]***
								[==>(Copy 2)]	
								[==>(Copy 3)]	
								[==>(Copy 4)]	
								[==>(Copy 5)]	
								[==>(Copy 6)]	
								[==>(Copy 7)]	
								[==>(Copy 8)]	

Exposures (continued)

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
3	F606W, 8 x 180 sec, Mars in PC1, Ring in WF4	(1) MARS	WFPC2, IMAGE, PC1-FIX	F606W	CLOCKS=YES; CR-SPLIT=NO	POS TARG 8.2,-3.4; NEW OBSET FULL ACQ	Sequence 3-4 Non-Int	180.0 Secs X 8	
								[==>(Copy 1)] *[==>(Copy 2)]* *[==>(Copy 3)]* *[==>(Copy 4)]* *[==>(Copy 5)]* *[==>(Copy 6)]* *[==>(Copy 7)]* *[==>(Copy 8)]*	***[2]***
4	F502N, 0.23 sec, Mars in PC1	(1) MARS	WFPC2, IMAGE, PC1-FIX	F502N	CR-SPLIT=NO	SAME POS AS 3	Sequence 3-4 Non-Int	0.23 Secs	
								[==>]	***[2]***

Orbit Structure




Orbit Structure (continued)
Orbit 2
Server Version: 20070709
Moving Target Tracking
Setup
Exp. 3, copy 1
Exp. 3, copy 2
Exp. 3, copy 3
Exp. 3, copy 4
Exp. 3, copy 5
Exp. 3, copy 6
Exp. 3, copy 7
Exp. 3, copy 8
Exp. 4
Overhead
Unused Visibility = 24
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11187, Visit 02, scheduling Tue Nov 27 02:11:43 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: SCHED 100%; ORIENT 198.0D TO 203.0 D; ORIENT 18.0D TO 23.0 D; BETWEEN 22-DEC-2007:00:00:00 AND 26-DEC-2007:00:00:00

Comments: One orbit spent imaging each side of the Martian rings. Rings oriented parallel to the PC y-axis. First orbit positions Mars in WF3 with the ring extending vertically into WF2. The second orbit positions Mars in the PC with the ring extending into WF4. In both cases, Mars's limb is positioned ~ 1" off the edge of the frame targeting the rings. POS TARG values are the same as in Visit 01.

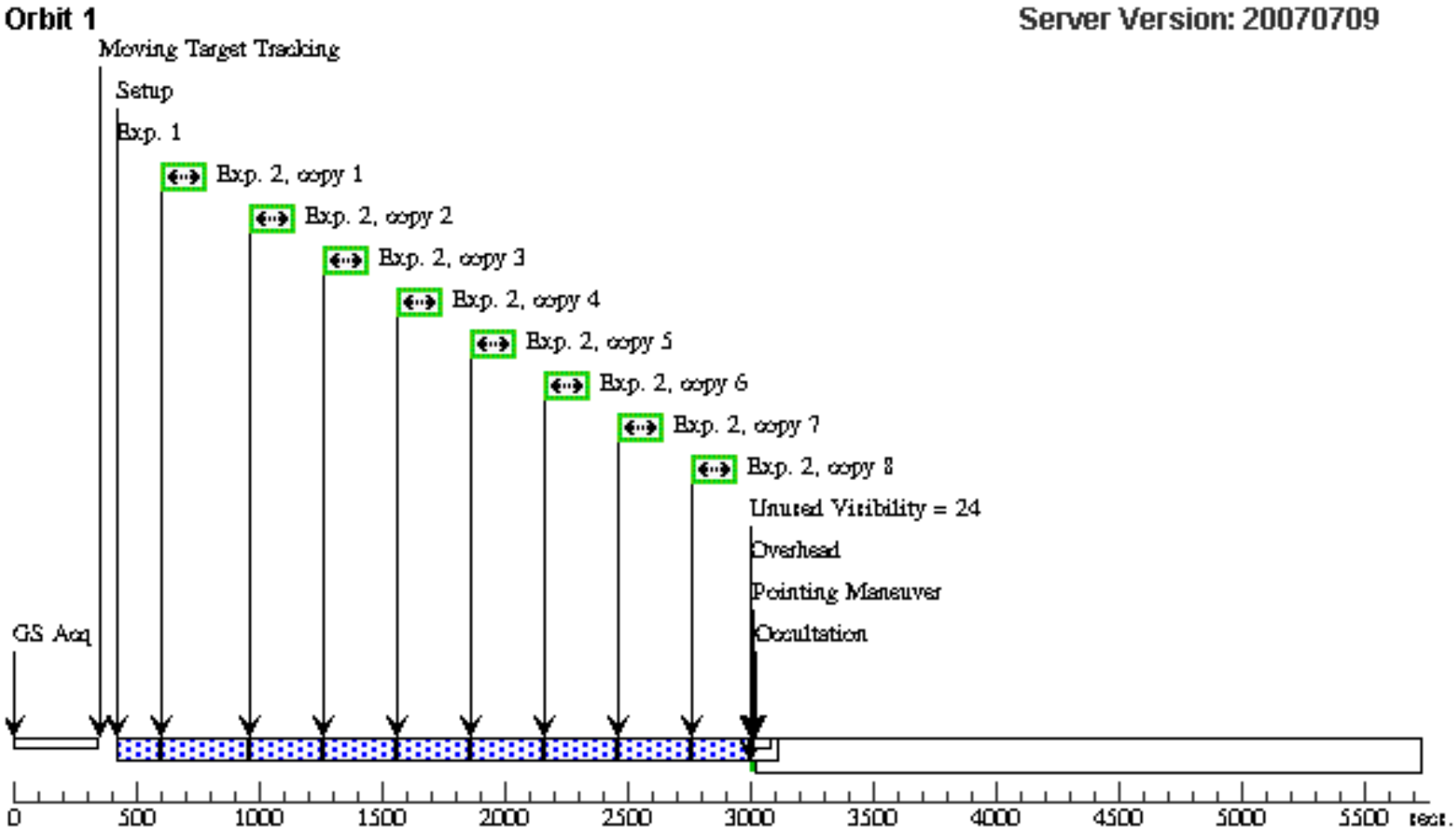
Solar System Targets

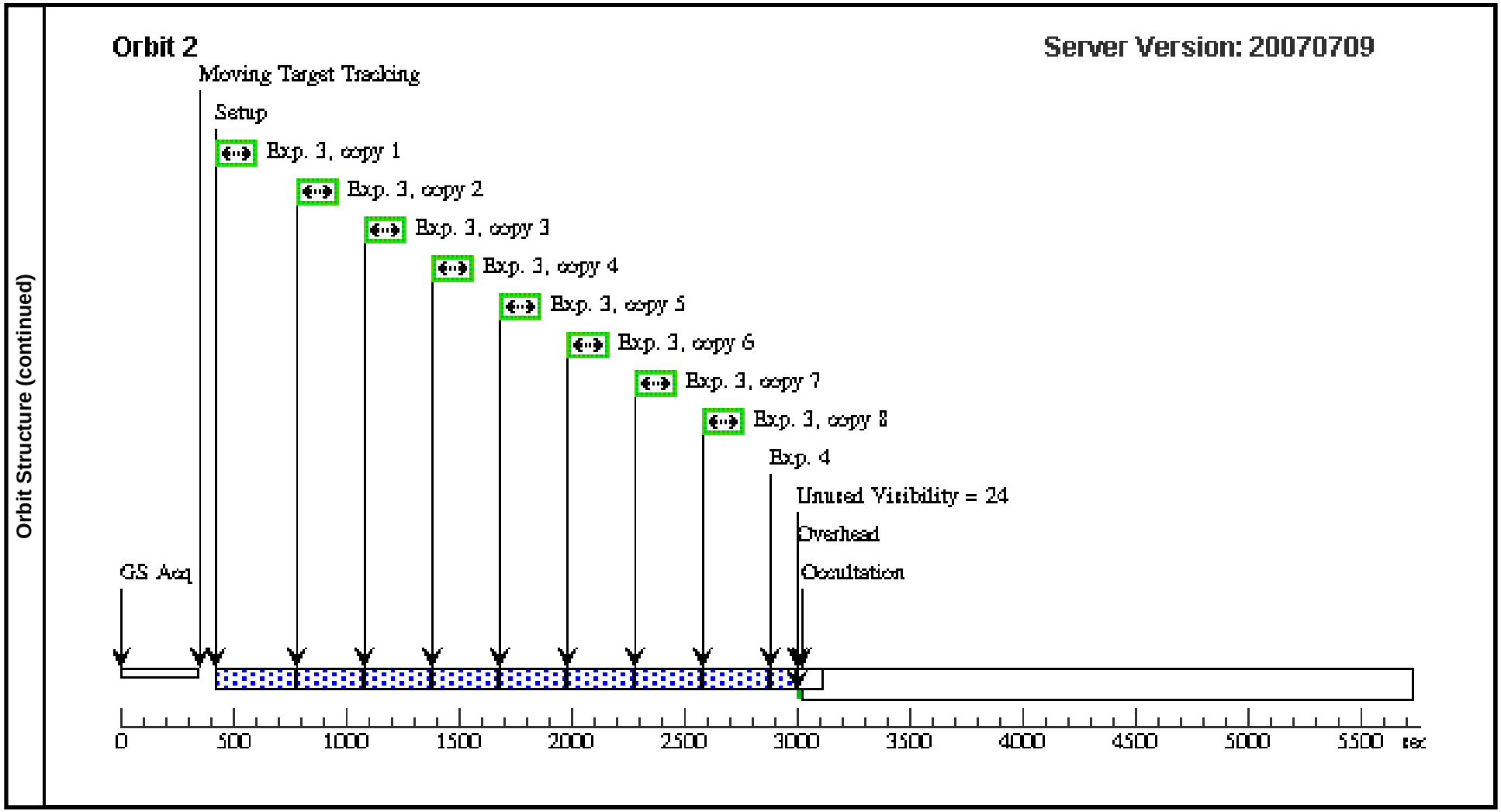
#	Name	Level 1	Level 2	Level 3	Window
(1)	MARS	STD=MARS			

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F502N, 0.23 sec, Mars in WF3, Ring in WF2	(1) MARS	WFPC2, IMAGE, WF3-FIX	F502N	CR-SPLIT=NO	POS TARG 0,24	Sequence 1-2 Non-Int	0.23 Secs	
								[==>]	***[1]***
2	F606W, 8 x 180 sec, Mars in WF3, Ring in WF2	(1) MARS	WFPC2, IMAGE, WF3-FIX	F606W	CLOCKS=YES; CR-SPLIT=NO	SAME POS AS 1	Sequence 1-2 Non-Int	180.0 Secs X 8	
								[==>(Copy 1)]	***[1]***
								[==>(Copy 2)]	
								[==>(Copy 3)]	
								[==>(Copy 4)]	
								[==>(Copy 5)]	
								[==>(Copy 6)]	
								[==>(Copy 7)]	
								[==>(Copy 8)]	
3	F606W, 8 x 180 sec, Mars in PC1, Ring in WF4	(1) MARS	WFPC2, IMAGE, PC1-FIX	F606W	CLOCKS=YES; CR-SPLIT=NO	POS TARG 8.2,-3.4; NEW OBSET FULL ACQ	Sequence 3-4 Non-Int	180.0 Secs X 8	
								[==>(Copy 1)]	***[2]***
								[==>(Copy 2)]	
								[==>(Copy 3)]	
								[==>(Copy 4)]	
								[==>(Copy 5)]	
								[==>(Copy 6)]	
								[==>(Copy 7)]	
								[==>(Copy 8)]	
4	F502N, 0.23 sec, Mars in PC1	(1) MARS	WFPC2, IMAGE, PC1-FIX	F502N	CR-SPLIT=NO	SAME POS AS 3	Sequence 3-4 Non-Int	0.23 Secs	
								[==>]	***[2]***

Orbit Structure




Orbit Structure (continued)
Orbit 2
Server Version: 20070709
Moving Target Tracking
Setup
Exp. 3, copy 1
Exp. 3, copy 2
Exp. 3, copy 3
Exp. 3, copy 4
Exp. 3, copy 5
Exp. 3, copy 6
Exp. 3, copy 7
Exp. 3, copy 8
Exp. 4
Unused Visibility = 24
Overhead
Occultation
GS Acq
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec

Visit

Proposal 11187, Visit 03, scheduling Tue Nov 27 02:11:44 GMT 2007

Diagnostic Status: No Diagnostics

Scientific Instruments: WFPC2

Special Requirements: SCHED 100%; ORIENT 243.0D TO 248.0 D; ORIENT 333.0D TO 338.0 D; ORIENT 153.0D TO 158.0 D; ORIENT 63.0D TO 68.0 D; BETWEEN 22-DEC-2007:00:00:00 AND 26-DEC-2007:00:00:00

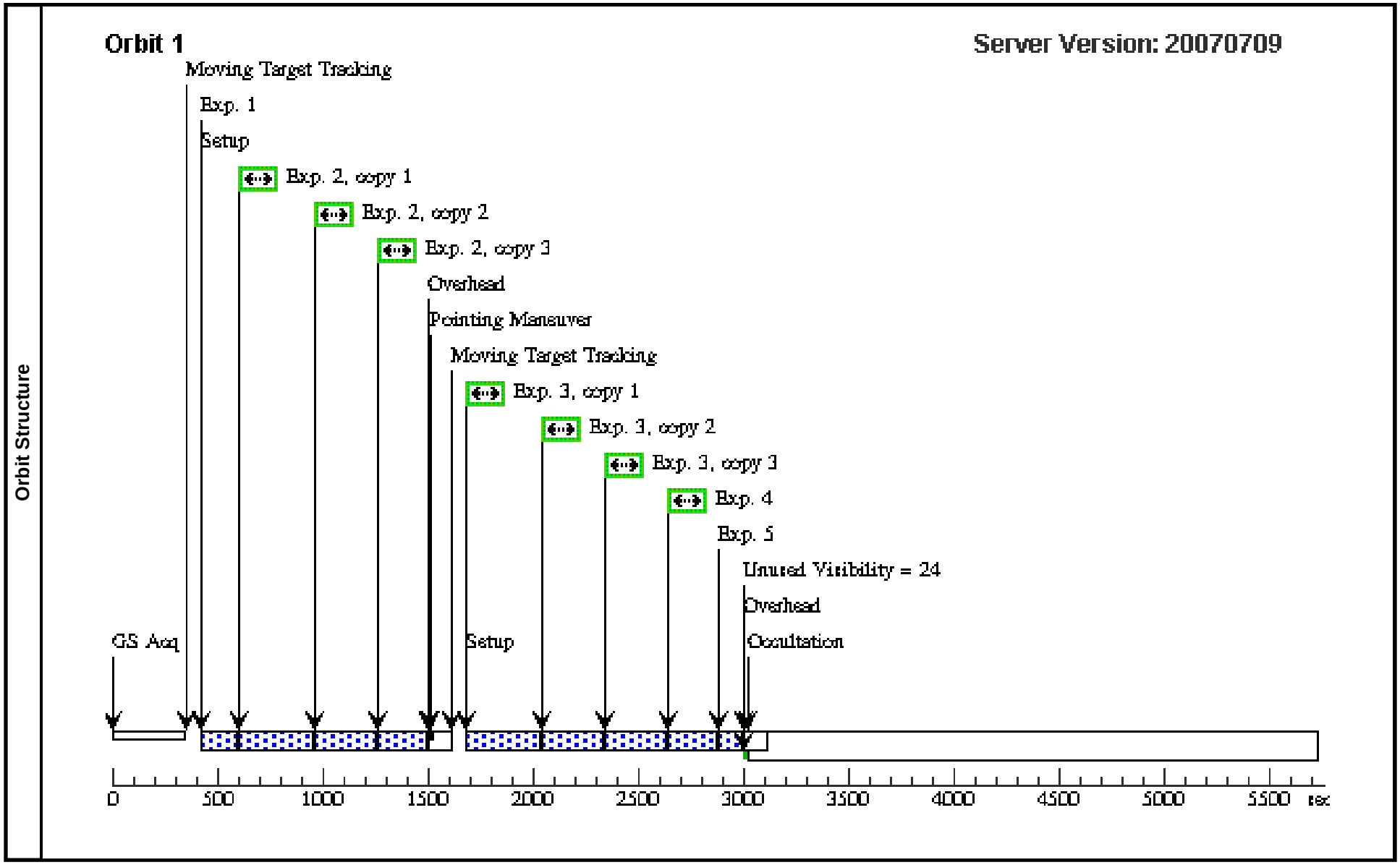
Comments: One orbit spent imaging the scattered light pattern from Mars with the rings rotated 45 degrees to fall atop the diffraction spikes. POS TARG values are the same as in Visits 01 and 02.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window
(1)	MARS	STD=MARS			

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	F502N, 0.23 sec, Mars in WF3	(1) MARS	WFPC2, IMAGE, WF3-FIX	F502N	CR-SPLIT=NO	POS TARG 0,24		0.23 Secs *[==>]*	 ***[1]***
2	F606W, 3 x 180 sec, Mars in WF3	(1) MARS	WFPC2, IMAGE, WF3-FIX	F606W	CLOCKS=YES; CR-SPLIT=NO	SAME POS AS 1		180.0 Secs X 3 *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]*	 ***[1]***
3	F606W, 3 x 180 sec, Mars in PC1	(1) MARS	WFPC2, IMAGE, PC1-FIX	F606W	CLOCKS=YES; CR-SPLIT=NO	POS TARG 8.2,-3.4		180.0 Secs X 3 *[==>(Copy 1)]* *[==>(Copy 2)]* *[==>(Copy 3)]*	 ***[1]***
4	F606W, 1 x 160 sec, Mars in PC1	(1) MARS	WFPC2, IMAGE, PC1-FIX	F606W	CLOCKS=YES; CR-SPLIT=NO	SAME POS AS 3		160.0 Secs *[==>]*	 ***[1]***
5	F502N, 0.23 sec, Mars in PC1	(1) MARS	WFPC2, IMAGE, PC1-FIX	F502N	CR-SPLIT=NO	SAME POS AS 3		0.23 Secs *[==>]*	 ***[1]***


Orbit Structure
Orbit 1
Server Version: 20070709
Moving Target Tracking
Exp. 1
Setup
Exp. 2, copy 1
Exp. 2, copy 2
Exp. 2, copy 3
Overhead
Pointing Maneuver
Moving Target Tracking
Exp. 3, copy 1
Exp. 3, copy 2
Exp. 3, copy 3
Exp. 4
Exp. 5
Unused Visibility = 24
Overhead
Occultation
GS Acq
Setup
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec