



15142 - Orbit of a Resolved Trojan Binary

Cycle: 25, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Keith S. Noll (PI) (Contact)	NASA Goddard Space Flight Center	keith.s.noll@nasa.gov
Dr. Will M. Grundy (CoI)	Lowell Observatory	w.grundy@lowell.edu
Dr. Harold F. Levison (CoI)	Southwest Research Institute	hal@boulder.swri.edu

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) TROJAN16974	WFC3/UVIS	1	08-Mar-2018 15:01:44.0	yes
02	(1) TROJAN16974	WFC3/UVIS	1	08-Mar-2018 15:01:45.0	yes
03	(1) TROJAN16974	WFC3/UVIS	1	08-Mar-2018 15:01:47.0	yes
04	(1) TROJAN16974	WFC3/UVIS	1	08-Mar-2018 15:01:49.0	yes
05	(1) TROJAN16974	WFC3/UVIS	1	08-Mar-2018 15:01:50.0	yes

5 Total Orbits Used

ABSTRACT

We have identified the Jupiter Trojan (16974) 1998 WR21 as a binary, making it only the third known resolvable binary in this population. We will use HST to determine its orbit from which we will determine the system mass. Using the mass and WISE-derived albedo, we will derive the density. Density can be used to constrain planetary migration models; low density is characteristic of bodies found in the Kuiper Belt, a remnant of the solar system's protoplanetary disk. Only one undisputed density has been measured in the Trojans, that of the binary (617) Patroclus, which has a low density of 800 kg/m³. The density of WR21 will test whether Patroclus is an anomaly or whether low densities might be the norm, as they are in the

Kuiper Belt.

OBSERVING DESCRIPTION

Five single orbit visits to 1998 WR21 spaced at the presumed synchronous orbital period. Timings spaced at 1/5 fractional orbit phase. Integer full phase(s) can occur between visits.

Proposal 15142 - Visit 01 - Orbit of a Resolved Trojan Binary

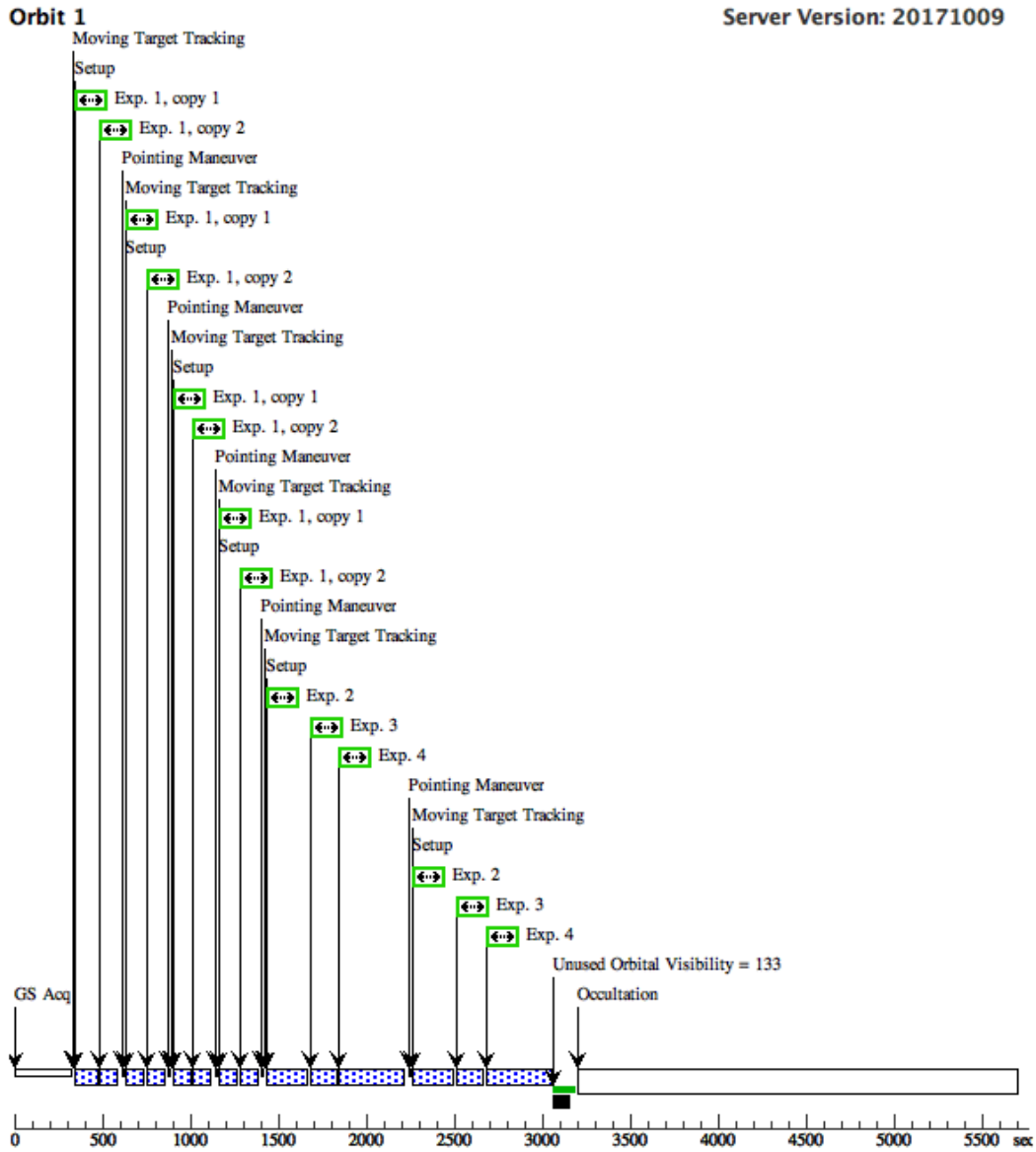
Thu Mar 08 20:01:51 GMT 2018

Visit	<p>Proposal 15142, Visit 01, implementation</p> <p>Diagnostic Status: No Diagnostics</p> <p>Scientific Instruments: WFC3/UVIS</p> <p>Special Requirements: (none)</p> <p><i>Comments: First visit can schedule at any time, t_1, in the range window (better early in the window for flexibility). Subsequent visits should schedule at a time defined by:</i></p> $t_n = t_1 + (n+f)*78.9 \text{ hr}$ <p><i>where n is an integer from 0 to 10 (upper limit to avoid accumulating period uncertainty error) and f is a fraction that is different for each visit in the following sequence</i></p> <table border="1"> <thead> <tr> <th>visit</th> <th>f</th> <th>err</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>n/a</td> </tr> <tr> <td>2</td> <td>0.2</td> <td>+/-0.05</td> </tr> <tr> <td>3</td> <td>0.4</td> <td>+/-0.05</td> </tr> <tr> <td>4</td> <td>0.6</td> <td>+/-0.05</td> </tr> <tr> <td>5</td> <td>0.8</td> <td>+/-0.05</td> </tr> </tbody> </table>				visit	f	err	1	0	n/a	2	0.2	+/-0.05	3	0.4	+/-0.05	4	0.6	+/-0.05	5	0.8	+/-0.05
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	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false	(1)																		
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Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center															
	(1)	TROJAN16974	TYPE=ASTEROID,A=5.20380706168 9808,E=0.06936961003515499,I=15.0 1910777363845,O=241.596971207468 4,W=136.4884726334601,M=72.5945 0393874381,EQUINOX=J2000,EPOC H=27-JAN- 2012:00:00:00,EpochTimeScale=TDB			RANGE EARTH TROJAN16974 LT 4.50	EARTH															

Proposal 15142 - Visit 01 - Orbit of a Resolved Trojan Binary

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F555W	FLASH=11	GS ACQ SCENARI O BASE1B3	Pattern 1, Exps 1-1 i n Visit 01 (1)	50 Secs X 2 (400 Secs) [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)]	[1]
	2	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F438W	FLASH=11		Pattern 2, Exps 2-4 i n Visit 01 (2)	160 Secs (320 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1]
	3	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F814W	FLASH=11		Pattern 2, Exps 2-4 i n Visit 01 (2)	80 Secs (160 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1]
	4	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	FLASH=11		Pattern 2, Exps 2-4 i n Visit 01 (2)	300 Secs (600 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1]

Orbit Structure



Proposal 15142 - Visit 02 - Orbit of a Resolved Trojan Binary

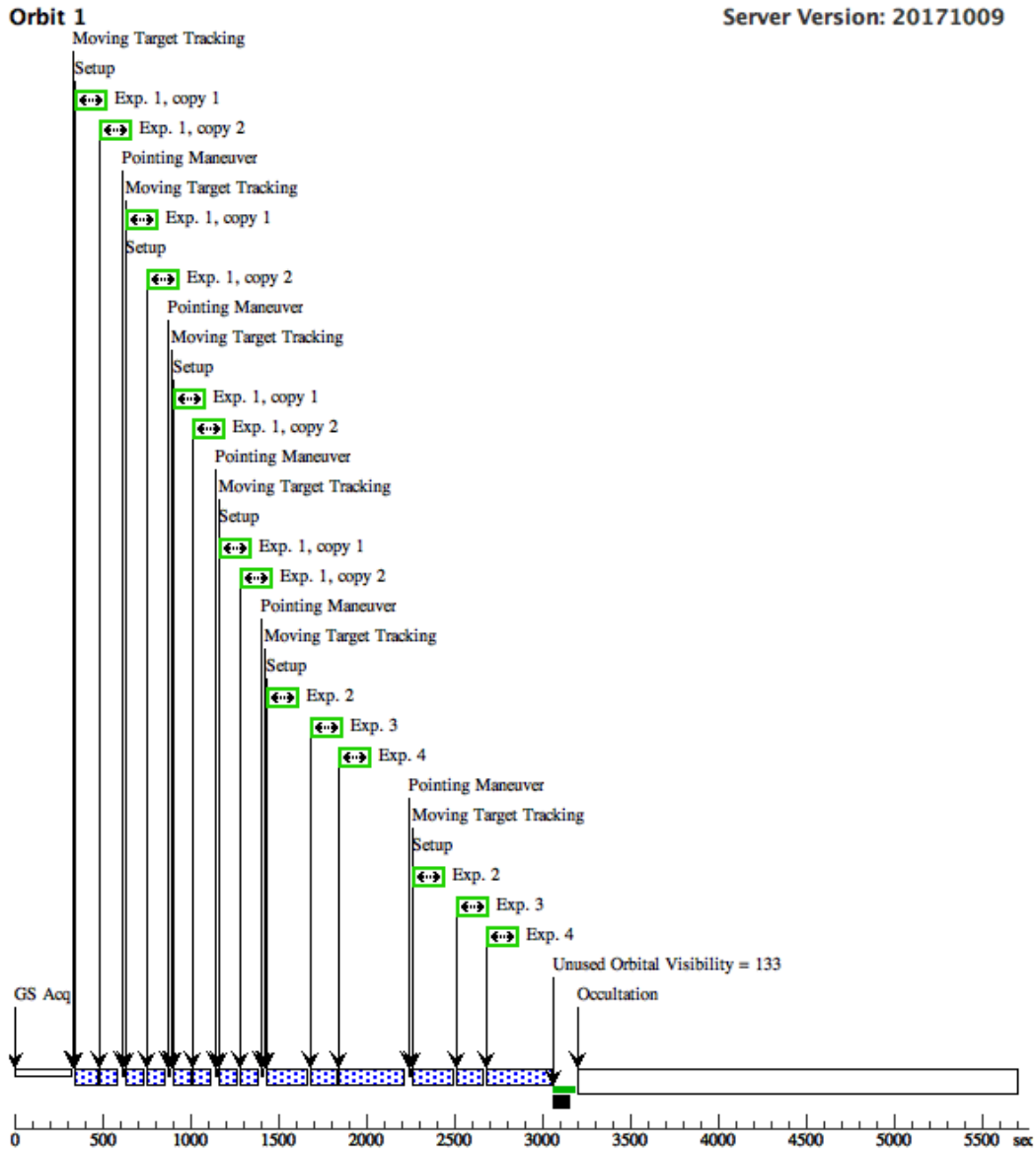
Thu Mar 08 20:01:52 GMT 2018

Visit	Proposal 15142, Visit 02, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none) Comments: this visit should follow visit 1 by $(n + 0.2 \pm 0.05) * 78.9 \text{ hrs}$ where n is an integer ≤ 10						
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures		
	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false		(1)		
	(2)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(2-4)		
Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
	(1)	TROJAN16974	TYPE=ASTEROID,A=5.20380706168 9808,E=0.06936961003515499,I=15.0 1910777363845,O=241.596971207468 4,W=136.4884726334601,M=72.5945 0393874381,EQUINOX=J2000,EPOC H=27-JAN- 2012:00:00:00,EpochTimeScale=TDB			RANGE EARTH TROJAN16974 LT 4.50	EARTH

Proposal 15142 - Visit 02 - Orbit of a Resolved Trojan Binary

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F555W	FLASH=11	GS ACQ SCENARI O BASE1B3	Pattern 1, Exps 1-1 i n Visit 02 (1)	50 Secs X 2 (400 Secs)	
									[==>(Pattern 1, Copy 1)]	
									[==>(Pattern 1, Copy 2)]	
									[==>(Pattern 2, Copy 1)]	
								[==>(Pattern 2, Copy 2)]		
								[==>(Pattern 3, Copy 1)]		
								[==>(Pattern 3, Copy 2)]		
								[==>(Pattern 4, Copy 1)]		
								[==>(Pattern 4, Copy 2)]		
2		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F438W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 02 (2)	160 Secs (320 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]
3		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F814W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 02 (2)	80 Secs (160 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]
4		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 02 (2)	300 Secs (600 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]

Orbit Structure



Proposal 15142 - Visit 03 - Orbit of a Resolved Trojan Binary

Thu Mar 08 20:01:52 GMT 2018

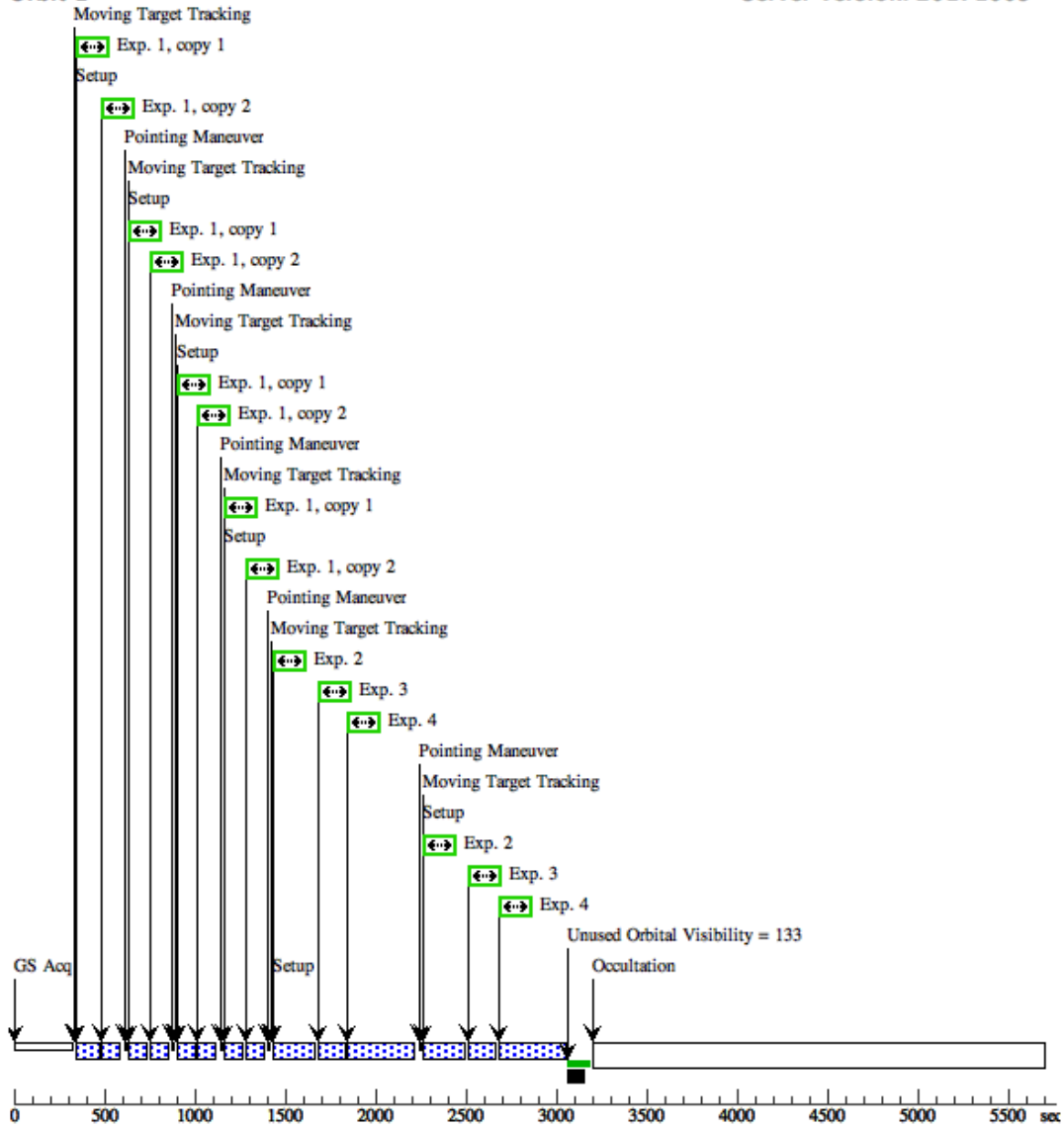
Visit	Proposal 15142, Visit 03, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none) <i>Comments: this visit should follow visit 1 by</i> $(n + 0.4 \pm 0.05) * 78.9 \text{ hrs}$ <i>where n is an integer ≤ 10</i>														
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Proposal 15142 - Visit 03 - Orbit of a Resolved Trojan Binary

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								[==>(Pattern 4, Copy 2)]		
2		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F438W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 03 (2)	160 Secs (320 Secs)	
									[==>(Pattern 1)]	
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3		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F814W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 03 (2)	80 Secs (160 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]
4		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 03 (2)	300 Secs (600 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]

Orbit Structure

Orbit 1



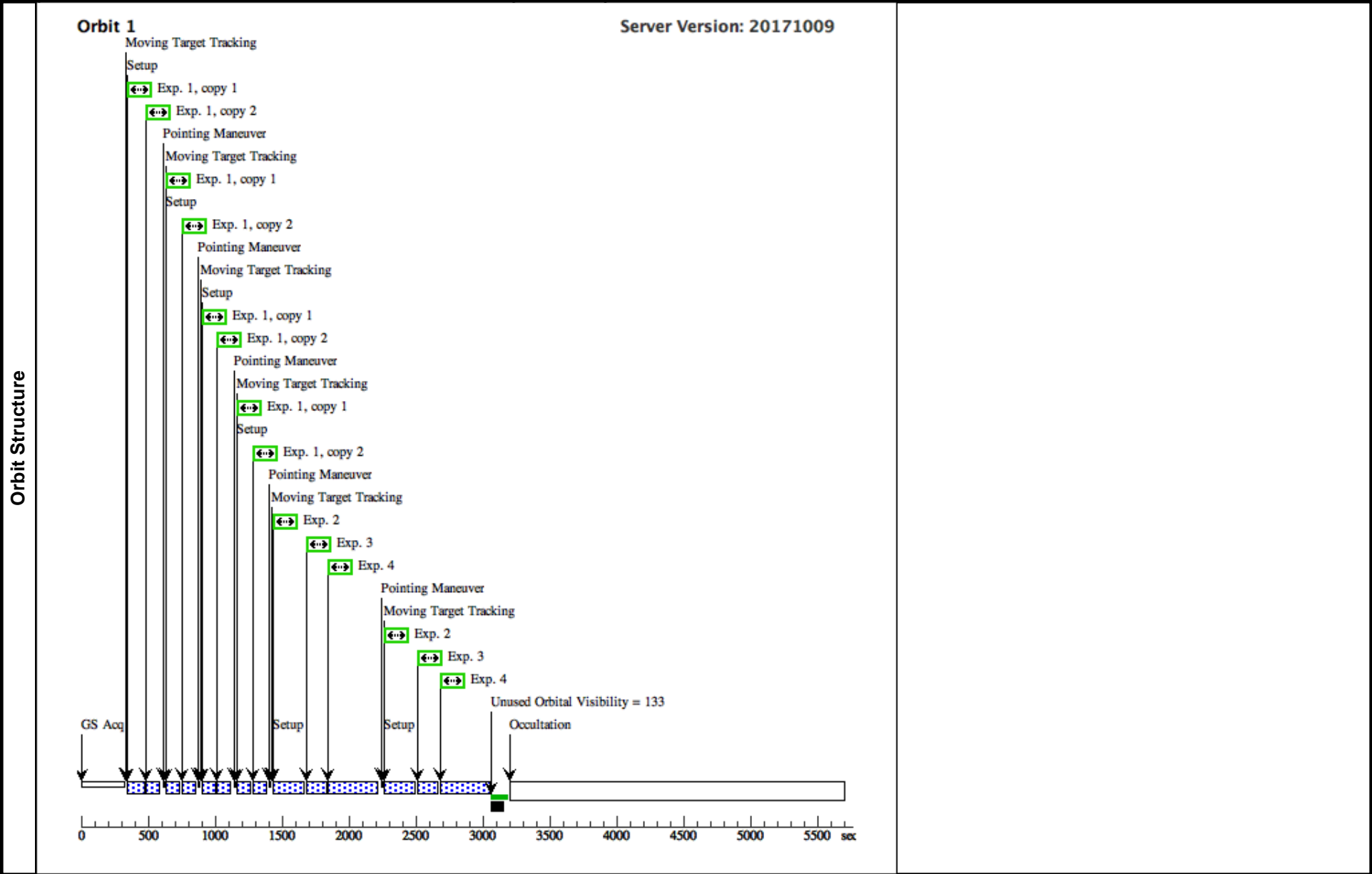
Proposal 15142 - Visit 04 - Orbit of a Resolved Trojan Binary

Thu Mar 08 20:01:52 GMT 2018

Visit	Proposal 15142, Visit 04, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none) <i>Comments: this visit should follow visit 1 by</i> $(n + 0.6 \pm 0.05) * 78.9 \text{ hrs}$ <i>where n is an integer ≤ 10</i>														
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Proposal 15142 - Visit 04 - Orbit of a Resolved Trojan Binary

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F555W	FLASH=11	GS ACQ SCENARI O BASE1B3	Pattern 1, Exps 1-1 i n Visit 04 (1)	50 Secs X 2 (400 Secs) [==>(Pattern 1, Copy 1)] [==>(Pattern 1, Copy 2)] [==>(Pattern 2, Copy 1)] [==>(Pattern 2, Copy 2)] [==>(Pattern 3, Copy 1)] [==>(Pattern 3, Copy 2)] [==>(Pattern 4, Copy 1)] [==>(Pattern 4, Copy 2)]	[1]
	2	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F438W	FLASH=11		Pattern 2, Exps 2-4 i n Visit 04 (2)	160 Secs (320 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1]
	3	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F814W	FLASH=11		Pattern 2, Exps 2-4 i n Visit 04 (2)	80 Secs (160 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1]
	4	(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	FLASH=11		Pattern 2, Exps 2-4 i n Visit 04 (2)	300 Secs (600 Secs) [==>(Pattern 1)] [==>(Pattern 2)]	[1]



Proposal 15142 - Visit 05 - Orbit of a Resolved Trojan Binary

Thu Mar 08 20:01:52 GMT 2018

Visit	Proposal 15142, Visit 05, implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none) <i>Comments: this visit should follow visit 1 by</i> $(n + 0.8 \pm 0.05) * 78.9 \text{ hrs}$ <i>where n is an integer ≤ 10</i>														
	Patterns	<table border="1"> <thead> <tr> <th>#</th> <th>Primary Pattern</th> <th>Secondary Pattern</th> <th>Exposures</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td> Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112 </td> <td> Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false </td> <td>(1)</td> </tr> <tr> <td>(2)</td> <td> Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing= </td> <td> Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false </td> <td>(2-4)</td> </tr> </tbody> </table>	#	Primary Pattern	Secondary Pattern	Exposures	(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false	(1)	(2)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false	(2-4)	
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(1)	Pattern Type=WFC3-UVIS-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.173 Line Spacing=0.112	Coordinate Frame=POS-TARG Pattern Orientation=23.884 Angle Between Sides=81.785 Center Pattern=false	(1)												
(2)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false	(2-4)												
Solar System Targets	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Level 1</th> <th>Level 2</th> <th>Level 3</th> <th>Window</th> <th>Ephem Center</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>TROJAN16974</td> <td> TYPE=ASTEROID,A=5.20380706168 9808,E=0.06936961003515499,I=15.0 1910777363845,O=241.596971207468 4,W=136.4884726334601,M=72.5945 0393874381,EQUINOX=J2000,EPOC H=27-JAN- 2012:00:00:00,EpochTimeScale=TDB </td> <td></td> <td></td> <td>RANGE EARTH TROJAN16974 LT 4.50</td> <td>EARTH</td> </tr> </tbody> </table>	#	Name	Level 1	Level 2	Level 3	Window	Ephem Center	(1)	TROJAN16974	TYPE=ASTEROID,A=5.20380706168 9808,E=0.06936961003515499,I=15.0 1910777363845,O=241.596971207468 4,W=136.4884726334601,M=72.5945 0393874381,EQUINOX=J2000,EPOC H=27-JAN- 2012:00:00:00,EpochTimeScale=TDB			RANGE EARTH TROJAN16974 LT 4.50	EARTH
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Proposal 15142 - Visit 05 - Orbit of a Resolved Trojan Binary

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F555W	FLASH=11	GS ACQ SCENARI O BASE1B3	Pattern 1, Exps 1-1 i n Visit 05 (1)	50 Secs X 2 (400 Secs)	
									[==>(Pattern 1, Copy 1)]	
									[==>(Pattern 1, Copy 2)]	
									[==>(Pattern 2, Copy 1)]	
								[==>(Pattern 2, Copy 2)]		
								[==>(Pattern 3, Copy 1)]		
								[==>(Pattern 3, Copy 2)]		
								[==>(Pattern 4, Copy 1)]		
								[==>(Pattern 4, Copy 2)]		
2		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F438W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 05 (2)	160 Secs (320 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]
3		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F814W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 05 (2)	80 Secs (160 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]
4		(1) TROJAN16974	WFC3/UVIS, ACCUM, UVIS2-M512C-SUB	F336W	FLASH=11			Pattern 2, Exps 2-4 i n Visit 05 (2)	300 Secs (600 Secs)	
									[==>(Pattern 1)]	
									[==>(Pattern 2)]	[1]

