17739 - A UV eclipse test for Callisto's atmosphere, plasma interaction and water ocean

Cycle: 32, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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Dr. Andrew Poppe (CoI)	University of California - Berkeley

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) CALLISTO-SUBJOVIAN	COS/FUV COS/NUV	5	09-Oct-2025 09:00:28.0	yes
03	(2) CALLISTO-OFFSET	COS/FUV	1	09-Oct-2025 09:00:28.0	yes
04	(2) CALLISTO-OFFSET	COS/FUV	1	09-Oct-2025 09:00:29.0	yes

7 Total Orbits Used

ABSTRACT

Jupiter moon Callisto might have a subsurface ocean as well as the fourth densest atmosphere of all solar system moons. The primary O2 atmosphere was inferred indirectly through sensitive HST/COS observations of electron-excited UV oxygen emissions. Because the interaction of Callisto's atmosphere-ionosphere leads to a strong diversion of the magnetospheric electrons, the UV emissions were interpreted to be from photo-electrons. However, optical oxygen emissions were detected in 2021 when Callisto was in eclipse of Jupiter and thus must be excited by magnetospheric electrons and not photo-electrons. Archival COS observation of Callisto in sunlight can not resolve the question of the excitation, but interestingly they suggest O or H2O must be abundant in addition to O2.

After a 3-year period without eclipses, Callisto will be again eclipsed by Jupiter in the coming HST cycle. We propose sensitive COS observations of the diagnostic 1304 A and at 1356 A emissions from before ingress, through the eclipse passage until after egress. The changes in UV emissions over eclipse will reveal the excitation mechanism and provide constraints on the composition of the atmosphere. If the UV emissions disappear in eclipse, a strong plasma diversion and dense ionosphere are confirmed, which challenges the necessity of a subsurface ocean to explain magnetic induction. ESA's JUpiter Icy Moon Explorer and NASA's Europa Clipper mission will carry out several flybys at Callisto. An improved understanding of the moon's atmosphere and ocean delivers important information for optimal science planning and addressing the habitability goals for these milestone missions.

OBSERVING DESCRIPTION

We observe Callist with 7 orbits to cover the complete transition from before ingress to after egress from eclipse.
1 visit with 2 orbits around ingress into eclipse,
1 visit with 3 orbits starting in eclipse and continuing to 1 hour after egress.
2 orbits for reference spectra at an offset from the target for background correction.

Crucially, the moment of going into and emerging from total umbral shadow should be within an exposure. For the egress visit, the first orbit should be at the egress and the second orbit/exposure will be ~1 hour after egress, as the time scale for recovery of a sublimated H2O component are on this order.

After a season without eclipses, Callisto is eclipsed again from August 2025. Optimally, the visits are scheduled as close in time as possible (same or consecutive eclipse passages).

For the offset, the aperture is placed 5" away along the detector y axis, identical for the large offsets used in GO 14755. The offset exposures can be taken when Callisto is eclipsed or in sunlight.

We do not set parameter to constrain exact geometries (like ingress) but will look into possible scheduling options case by case.

Proposal 17739 - Ingress (01) - A UV eclipse test for Callisto's atmosphere, plasma interaction and water ocean

Visit

Proposal 17739, Ingress (01), implementation Thu Oct 09 13:00:29 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: BETWEEN 2025.316:12:18:00 AND 2025.316:13:18:00

Diagnostics

(Ingress (01)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS

(Ingress (01)) Warning (Orbit Planner): INEFFICIENT ORDERING OF FP-POS POSITIONS

(Acq (01.001)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Science 1 (01.002)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Science 1 (01.002)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Science 2 (01.003)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Science 2 (01.003)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Science 1 (01.004)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Science 1 (01.004)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Science 2 (01.005)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Science 2 (01.005)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Science 3 (01.006)) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Science 3 (01.006)) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Ingress (01)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

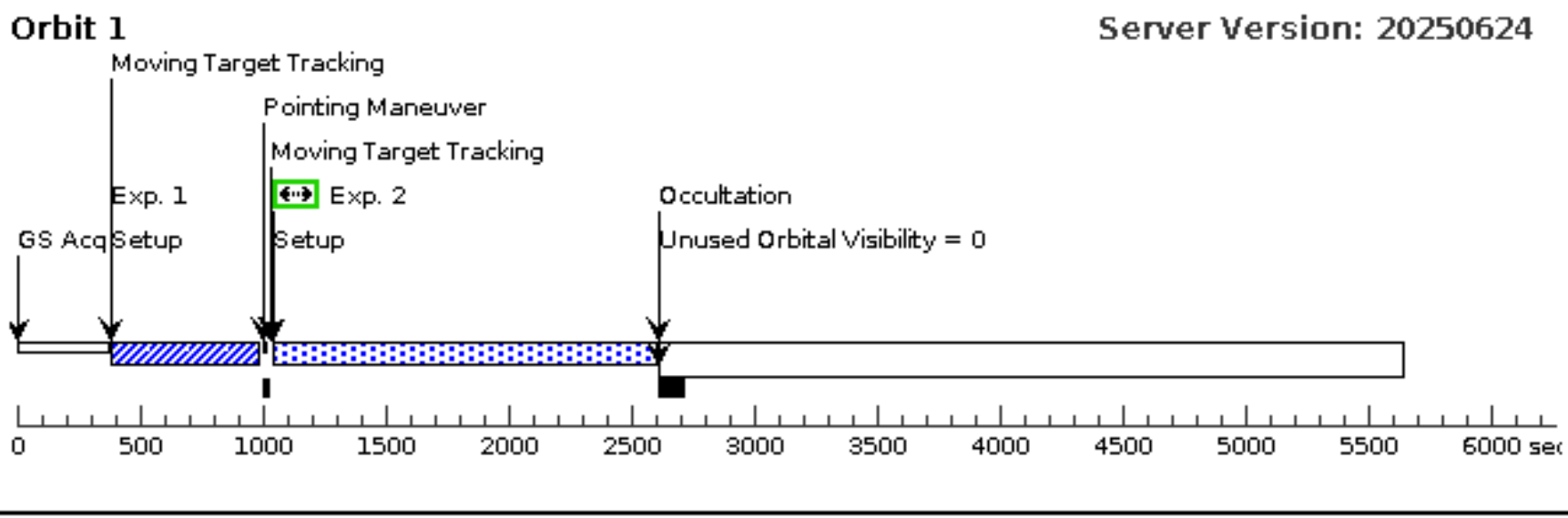
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	CALLISTO-SUBJOVIAN	STD=JUPITER	STD=CALLISTO		NOT OCC OF CALLISTO-SUBJOVIAN BY JUPITER FROM EARTH, SEP OF CALLISTO-SUBJOVIAN IO FROM EARTH GT 10", SEP OF CALLISTO-SUBJOVIAN EUROPA FROM EARTH GT 10", SEP OF CALLISTO-SUBJOVIAN GANYMEDE FROM EARTH GT 10", CML OF CALLISTO-SUBJOVIAN FROM EARTH BETWEEN 330 30	EARTH

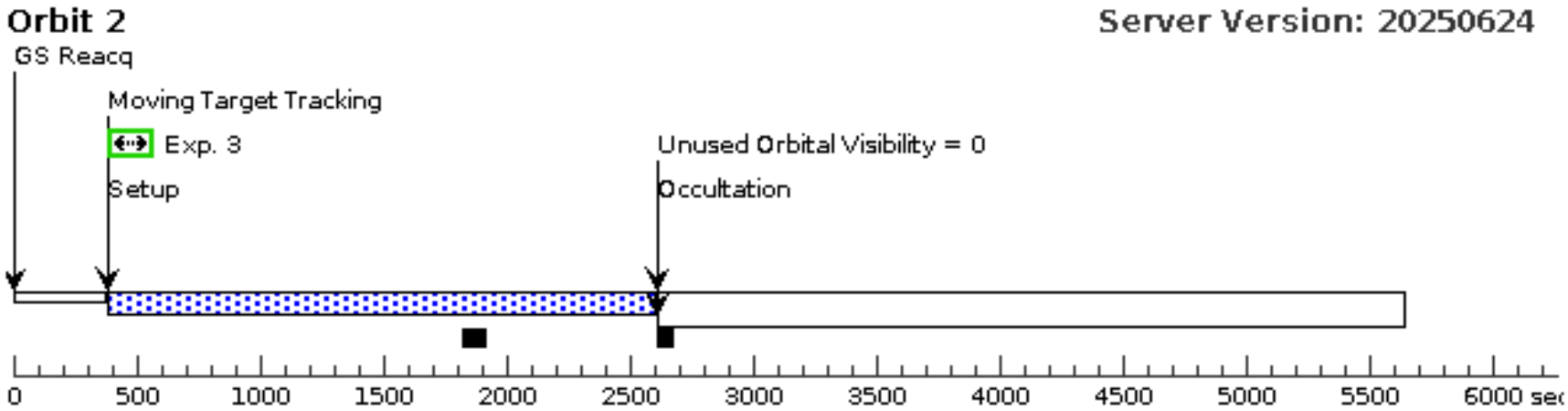
Comments: Description=Jupiter moon Callisto
Extended=YES

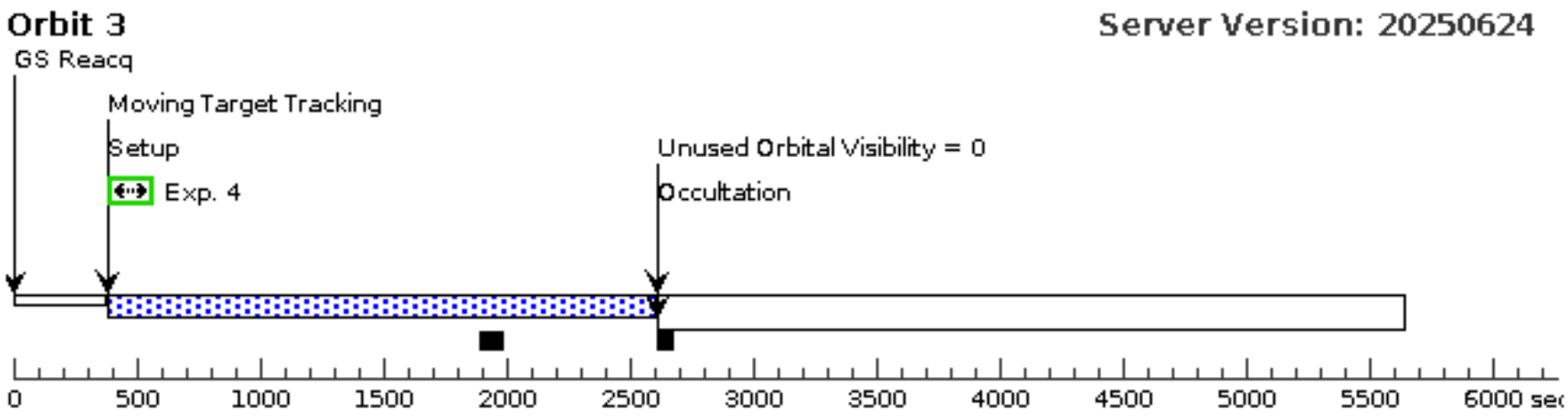
Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acq	(1) CALLISTO-SUB JOVIAN	COS/NUV, ACQ/SEARCH, PSA	G230L 3000 A	SCAN-SIZE=3; CENTER=FLUX-WT-FLR			10 Secs (10 Secs) *[==>]*	*[1]*
2	Science 1	(1) CALLISTO-SUB JOVIAN	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; BUFFER-TIME=1400; FP-POS=3			1200 Secs (1388 Secs) *[==>1388.0 Secs]*	*[1]*
3	Science 2	(1) CALLISTO-SUB JOVIAN	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; BUFFER-TIME=1400; FP-POS=4			2000 Secs (2163 Secs) *[==>2163.0 Secs]*	*[2]*
4	Science 1	(1) CALLISTO-SUB JOVIAN	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; BUFFER-TIME=1400; FP-POS=3			1200 Secs (2096 Secs) *[==>2096.0 Secs]*	*[3]*
5	Science 2	(1) CALLISTO-SUB JOVIAN	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; BUFFER-TIME=1400; FP-POS=4			2000 Secs (2163 Secs) *[==>2163.0 Secs]*	*[4]*
6	Science 3	(1) CALLISTO-SUB JOVIAN	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; BUFFER-TIME=1400; FP-POS=3			2000 Secs (2096 Secs) *[==>2096.0 Secs]*	*[5]*

Orbit Structure



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GS Reacq
Moving Target Tracking
Setup
Exp. 4
Unused Orbital Visibility = 0
Occultation
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3500
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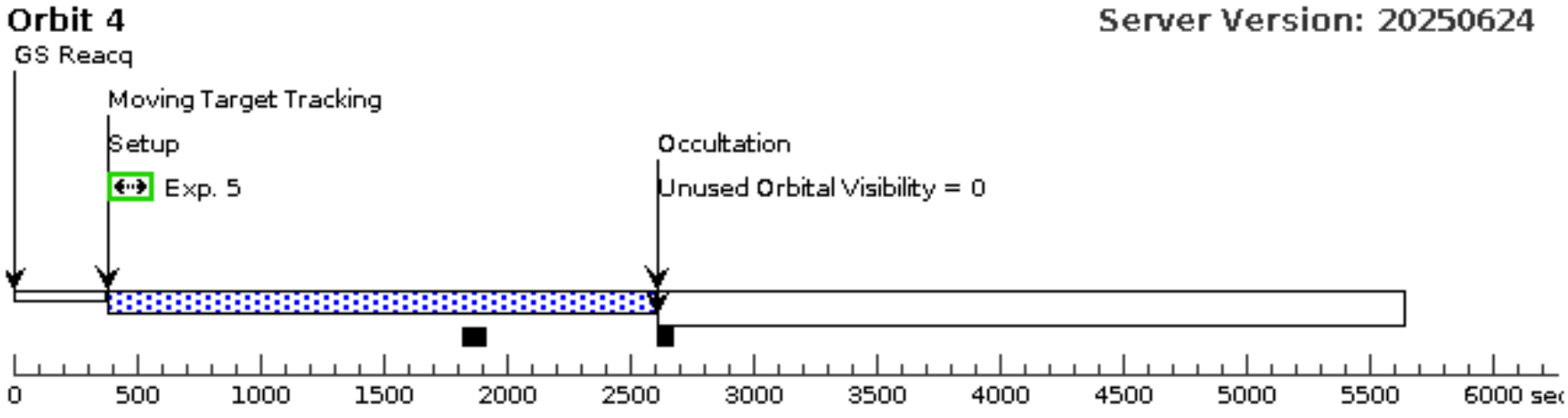
4500
5000
5500
6000 sec


Orbit 4
Server Version: 20250624
GS Reacq
Moving Target Tracking
Setup
Exp. 5
Occultation
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3000
3500
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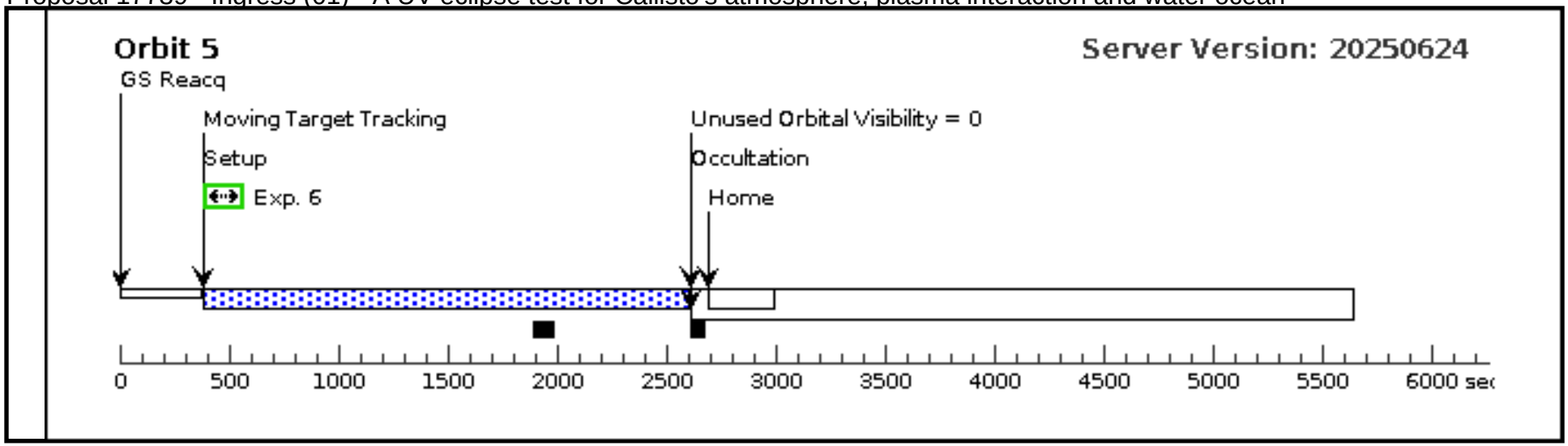
5500
6000 sec


Orbit 5
Server Version: 20250624
GS Reacq
Moving Target Tracking
Setup
Exp. 6
Unused Orbital Visibility = 0
Occultation
Home
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000 sec

Visit

Proposal 17739, Offset 5.0 #1 (03), implementation Thu Oct 09 13:00:30 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: (none)

Comments: Offset exposure using POS TARG (x=0, y=5) for background measurement. Offset setup identical to large offset in GO 14755 for comparability.

Diagnostics

(Offset 5.0 #1 (03)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronography with STIS or COS.

(Offset 5.0 #1 (03)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions at a given COS cenwave (or 2 positions for certain exception cases). See extended explanation in the diagnostic browser.

(Offset 5.0 #1 (03)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Offset 5.0 #1 (03)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Offset 5.0 #1 (03)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE NO ORIENT

(Exposure 1 (Offset 5.0 #1 (03))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Exposure 1 (Offset 5.0 #1 (03))) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Offset 5.0 #1 (03)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

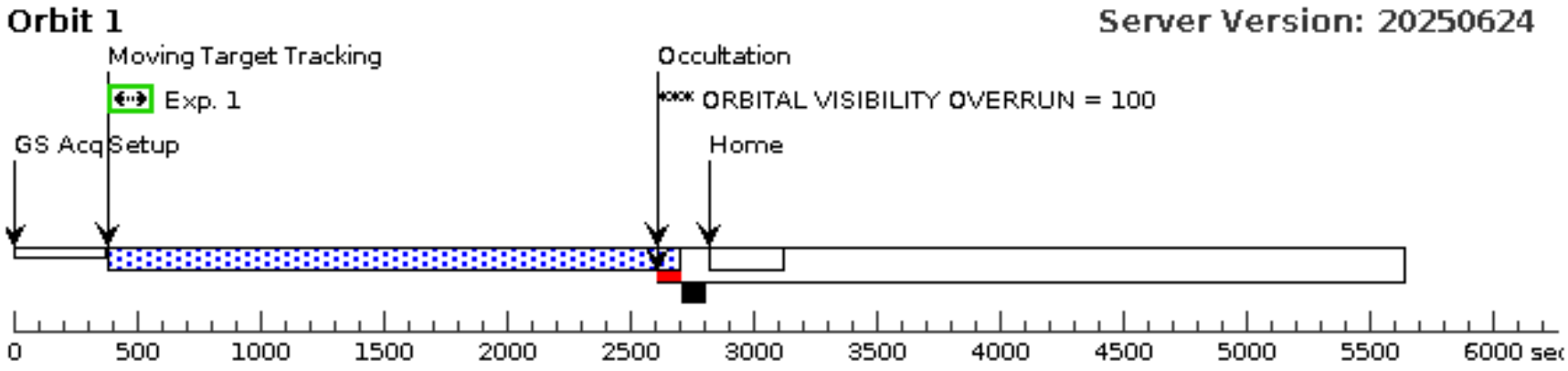
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	CALLISTO-OFFSET	STD=JUPITER	STD=CALLISTO		NOT OCC OF CALLISTO-OFFSET BY JUPITER FROM EARTH, SEP OF CALLISTO-OFFSET IO FROM EARTH GT 10", SEP OF CALLISTO-OFFSET EUROPA FROM EARTH GT 10", SEP OF CALLISTO-OFFSET GANYMEDE FROM EARTH GT 10", CML OF CALLISTO-OFFSET FROM EARTH BETWEEN 330 30	EARTH

Comments: Description=Offset from Callisto for reference
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) CALLISTO-OFFSET	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; FP-POS=3; BUFFER-TIME=2500	POS TARG null,5		2000 Secs (2192 Secs) *[==>2192.0 Secs]*	*[1]*

Orbit Structure



Visit

Proposal 17739, Offset 5.0 #2 (04), implementation Thu Oct 09 13:00:30 GMT 2025

Diagnostic Status: Warning

Scientific Instruments: COS/FUV

Special Requirements: (none)

Comments: Offset exposure using POS TARG (x=0, y=5) for background measurement. Offset setup identical to large offset in GO 14755 for comparability.

Diagnostics

(Offset 5.0 #2 (04)) Warning (Form): A target acquisition should probably be performed before doing spectroscopy or coronography with STIS or COS.

(Offset 5.0 #2 (04)) Warning (Form): For the best data quality, it is generally required to use all four FP-POS positions at a given COS cenwave (or 2 positions for certain exception cases). See extended explanation in the diagnostic browser.

(Offset 5.0 #2 (04)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(Offset 5.0 #2 (04)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE

(Offset 5.0 #2 (04)) Warning (Orbit Planner): POS TARG OUTSIDE OF APERTURE NO ORIENT

(Exposure 1 (Offset 5.0 #2 (04))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Exposure 1 (Offset 5.0 #2 (04))) Warning (Form): Sensitive exposures should have an ETC run number provided.

(Offset 5.0 #2 (04)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	CALLISTO-OFFSET	STD=JUPITER	STD=CALLISTO		NOT OCC OF CALLISTO-OFFSET BY JUPITER FROM EARTH, SEP OF CALLISTO-OFFSET IO FROM EARTH GT 10", SEP OF CALLISTO-OFFSET EUROPA FROM EARTH GT 10", SEP OF CALLISTO-OFFSET GANYMEDE FROM EARTH GT 10", CML OF CALLISTO-OFFSET FROM EARTH BETWEEN 330 30	EARTH

Comments: Description=Offset from Callisto for reference
Extended=YES

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) CALLISTO-OFFSET	COS/FUV, TIME-TAG, PSA	G130M 1291 A	SEGMENT=BOTH; FP-POS=4; BUFFER-TIME=2500	POS TARG null,5		2000 Secs (2189 Secs) *[==>2189.0 Secs]*	*[1]*

Orbit Structure