15868 - Constraining the UV-absorbing material on Jupiter's icy moons through comparative reflectance spectroscopy

Cycle: 27, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

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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) EUROPA-EAST	COS/FUV COS/NUV	1	24-Jul-2019 11:03:01.0	yes
02	(2) EUROPA-WEST	COS/FUV COS/NUV	1	24-Jul-2019 11:03:02.0	yes
03	(3) CALLISTO-EAST	COS/FUV COS/NUV	1	24-Jul-2019 11:03:02.0	yes
04	(4) CALLISTO-WEST	COS/FUV COS/NUV	1	24-Jul-2019 11:03:03.0	yes

4 Total Orbits Used

ABSTRACT

The far-UV (FUV) spectrum of water ice contains a sharp absorption edge around 165 nm, becoming highly reflective at wavelengths longer than this. This feature has been observed in lab measurements and in Cassini UVIS observations of Saturn's moons. However, Ganymede's FUV spectrum (derived from COS G140L observations in 2014) does not exhibit a sharp increase in reflectance near 165 nm as expected; instead, the reflectance gradually increases at wavelengths >170 nm, implying that there is a UV-absorbing contaminant present. Observations of Europa just outside of the critical region around 165 nm suggest that the water ice feature may be similarly modified there, and Callisto's reflectance in this region is currently unknown. We therefore propose to observe Europa and Callisto using COS G140L, to determine whether the spectral reflectance of the two moons close to the 165 nm water ice edge is modified similarly to Ganymede's. We will use four HST orbits to observe the leading and trailing hemispheres of each satellite. The leading and trailing hemispheres of the Galilean moons experience different radiation environments, with Jovian magnetospheric plasma predominantly impacting the trailing hemispheres. By comparing the observed reflectance of Jupiter's icy moons, and by assessing differences between the leading and trailing hemispheres, we can investigate whether a single contaminant modifies the spectra of all three satellites, and whether this may be a product of radiolytic processing of the surfaces by the Jovian plasma.

OBSERVING DESCRIPTION

The orbital leading and trailing hemispheres of Europa and Callisto will each be observed in four single orbit visits, using the COS G140L grating with central wavelength setting 1280. We have requested observations within +/- 6 weeks of Jupiter opposition to maximize the angular size of the targets, but if scheduling is a problem we can relax this slightly.

We plan to use the same target acquistion strategy as used in program 13328 for FUV observations of Ganymede. That program followed the ACQ/SEARCH with a COS/NUV ACCUM exposure to verify Ganymede's position in the aperture. We have not included this step because we do not require precise centering information, and because programs 13803 and 14903 successfully observed Europa with COS following a single ACQ/SEARCH exposure.

For ETC target acquisition runs we used surface brightness values from JPL Horizons (Europa: 5.2 Vmag/arcsec2; Callisto: 6.5 Vmag/arcsec2) and scaled them based on the difference between the visible and NUV albedos of Europa and Callisto. Europa's visible albedo is ~67%, and its average albedo in the 240-320 nm range is ~ 13% (trailing hemisphere) to ~27% (leading hemisphere) [Nelson et al. 1987], so it is ~1 to 1.8 magnitudes dimmer in the NUV. Callisto's visible albedo is ~22%, its average albedo in the 240-320 nm range is ~5.2% (leading hemisphere) to ~ 7.5% (trailing

hemisphere), and it is therefore ~1.2 to 1.6 magnitudes dimmer in the NUV.

ETC runs for the science exposures used Ganymede COS G140L data from Program 13328 as input spectra. Europa may be up to ~1.6 x brighter than Ganymede at wavelengths >160 nm, based on the ratio of their NUV albedos, but even if this is the case the maximum count rate will be well below the COS FUV count rate limits.

Visit

Proposal 15868, ELead (01) Wed Jul 24 15:03:04 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: BETWEEN 02-JUN-2020:00:00:00 AND 25-AUG-2020:00:00:00

Comments: Europa leading hemisphere

Diagnostics

(Exposure 2 (ELead (01))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Exposure 3 (ELead (01))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

Solar System Targets

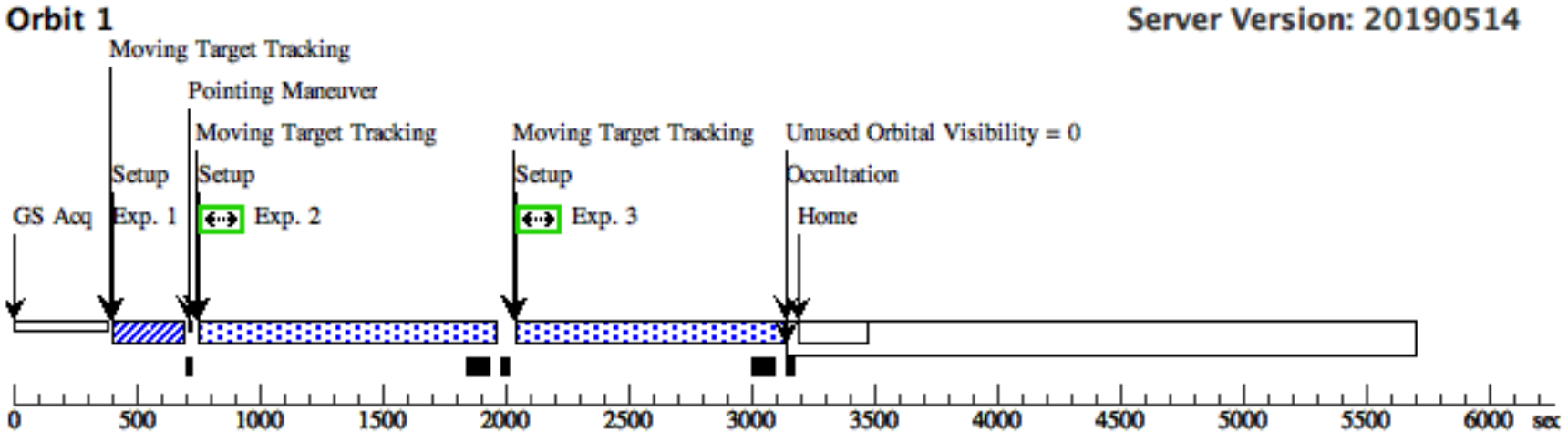
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	EUROPA-EAST	STD=JUPITER	STD=EUROPA		NOT OCC OF EUROPA-EAST BY JUPITER FROM EARTH, SEP OF EUROPA-EAST IO FROM EARTH GT 10", SEP OF EUROPA-EAST GANYMEDE FROM EARTH GT 10", SEP OF EUROPA-EAST CALLISTO FROM EARTH GT 10", OLG OF EUROPA-EAST BETWEEN 75 105	EARTH

Comments: Description=SATELLITE EUROPA
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1369448)	(1) EUROPA-EAST	COS/NUV, ACQ/SEARCH, BOA	MIRRORA	SCAN-SIZE=2			3 Secs (3 Secs) *[==>]*	 ***[1]***
Comments: ETC run assumes surface brightness of 6.1 Vmag/arcsec2									
2	(COS.sp.1345663)	(1) EUROPA-EAST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=1			950 Secs (1035 Secs) *[==>1035.0 Secs]*	 ***[1]***
3	(COS.sp.1345663)	(1) EUROPA-EAST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=2			950 Secs (1035 Secs) *[==>1035.0 Secs]*	 ***[1]***

Orbit Structure



Visit

Proposal 15868, ETrail (02) Wed Jul 24 15:03:04 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: BETWEEN 02-JUN-2020:00:00:00 AND 25-AUG-2020:00:00:00

Comments: Europa trailing hemisphere

Diagnostics

(Exposure 2 (ETrail (02))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Exposure 3 (ETrail (02))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

Solar System Targets

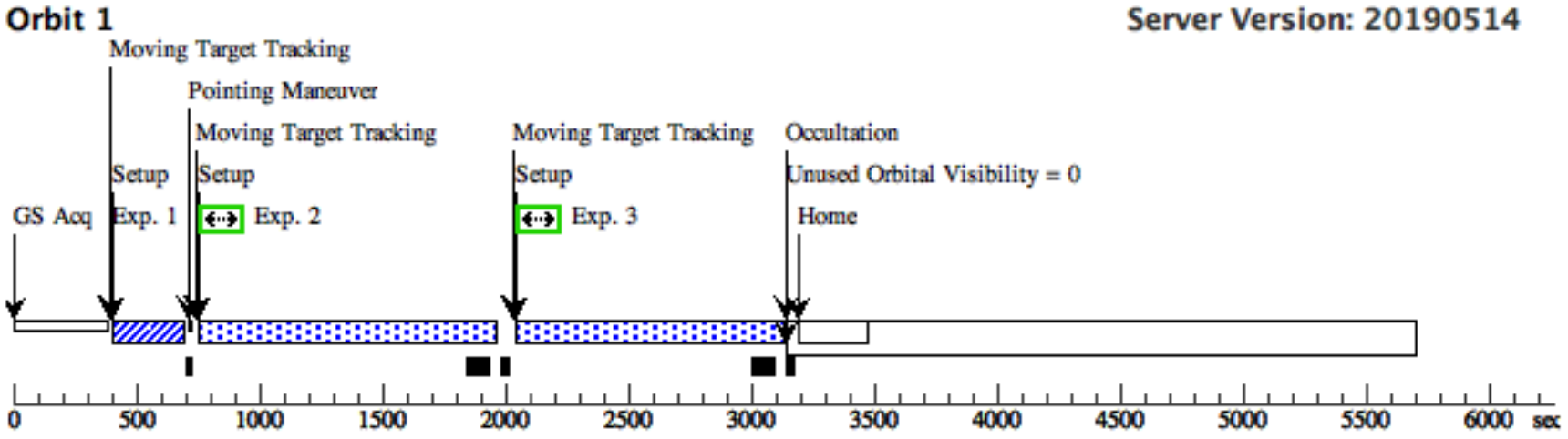
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	EUROPA-WEST	STD=JUPITER	STD=EUROPA		NOT OCC OF EUROPA-WEST BY JUPITER FROM EARTH, SEP OF EUROPA-WEST IO FROM EARTH GT 10", SEP OF EUROPA-WEST GANYMEDE FROM EARTH GT 10", SEP OF EUROPA-WEST CALLISTO FROM EARTH GT 10", OLG OF EUROPA-WEST BETWEEN 255 285	EARTH

Comments: Description=SATELLITE EUROPA
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(COS.ta.1369450)	(2) EUROPA-WEST	COS/NUV, ACQ/SEARCH, BOA	MIRRORA	SCAN-SIZE=2			3 Secs (3 Secs) *[==>]*	 ***[1]***
Comments: ETC run assumes surface brightness of 7.0 Vmag/arcsec2									
2	(COS.sp.1345642)	(2) EUROPA-WEST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=3			950 Secs (1035 Secs) *[==>1035.0 Secs]*	 ***[1]***
3	(COS.sp.1345642)	(2) EUROPA-WEST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=4			950 Secs (1035 Secs) *[==>1035.0 Secs]*	 ***[1]***

Orbit Structure



Visit

Proposal 15868, CLead (03) Wed Jul 24 15:03:04 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: BETWEEN 02-JUN-2020:00:00:00 AND 25-AUG-2020:00:00:00

Comments: Callisto leading hemisphere

Diagnostics

(Exposure 2 (CLead (03))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

(Exposure 3 (CLead (03))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

Solar System Targets

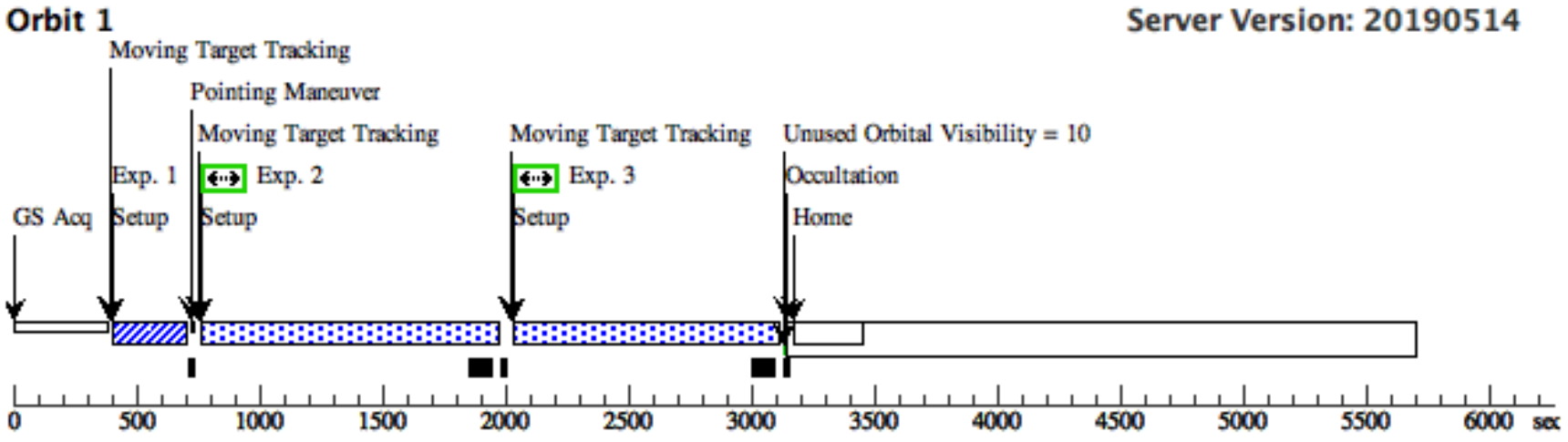
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	CALLISTO-EAST	STD=JUPITER	STD=CALLISTO		NOT OCC OF CALLISTO-EAST BY JUPITER FROM EARTH, SEP OF CALLISTO-EAST IO FROM EARTH GT 10", SEP OF CALLISTO-EAST EUROPA FROM EARTH GT 10", SEP OF CALLISTO-EAST GANYMEDE FROM EARTH GT 10", OLG OF CALLISTO-EAST BETWEEN 75 105	EARTH

Comments: Description=SATELLITE CALLISTO
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acq (COS.ta.1369453)	(3) CALLISTO-EAST	COS/NUV, ACQ/SEARCH, BOA	MIRRORA	SCAN-SIZE=2			5 Secs (5 Secs) *[==>]*	 ***[1]***
Comments: ETC run assumes surface brightness of 8.2 Vmag/arcsec2									
2	(COS.sp.1345619)	(3) CALLISTO-EAST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=1			950 Secs (1031 Secs) *[==>1031.0 Secs]*	 ***[1]***
3	(COS.sp.1345619)	(3) CALLISTO-EAST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=2			950 Secs (1031 Secs) *[==>1031.0 Secs]*	 ***[1]***

Orbit Structure



Visit

Proposal 15868, CTrail (04) Wed Jul 24 15:03:04 GMT 2019

Diagnostic Status: Warning

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: BETWEEN 02-JUN-2020:00:00:00 AND 25-AUG-2020:00:00:00

Comments: Callisto trailing hemisphere

Diagnostics

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

(Exposure 3 (CTrail (04))) Warning (Form): COS FUV PSA science exposures with extended targets have special calibration limitations. See "Errors and Warnings" for more details.

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(4)	CALLISTO-WEST	STD=JUPITER	STD=CALLISTO		NOT OCC OF CALLISTO-WEST BY JUPITER FROM EARTH, SEP OF CALLISTO-WEST IO FROM EARTH GT 10", SEP OF CALLISTO-WEST EUROPA FROM EARTH GT 10", SEP OF CALLISTO-WEST GANYMEDE FROM EARTH GT 10", OLG OF CALLISTO-WEST BETWEEN 255 285	EARTH

Comments: Description=SATELLITE CALLISTO
Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Acq (COS.ta.1369451)	(4) CALLISTO-WEST	COS/NUV, ACQ/SEARCH, BOA	MIRRORA	SCAN-SIZE=2			5 Secs (5 Secs) *[==>]*	 ***[1]***
Comments: ETC run assumes surface brightness of 7.6 Vmag/arcsec2									
2	(COS.sp.1345619)	(4) CALLISTO-WEST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=3			950 Secs (1031 Secs) *[==>1031.0 Secs]*	 ***[1]***
3	(COS.sp.1345619)	(4) CALLISTO-WEST	COS/FUV, TIME-TAG, PSA	G140L 1280 A	BUFFER-TIME=930; FP-POS=4			950 Secs (1031 Secs) *[==>1031.0 Secs]*	 ***[1]***

Orbit Structure