11535 - COS-GTO: Deep Search for an Oxygen Atmosphere on Callisto

Cycle: 17, Proposal Category: GTO/COS

(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?*
02	(1) CALLISTO	COS/FUV COS/NUV	2	27-Sep-2011 21:01:35.0	yes
04	(2) CALLISTO-COPY	COS/FUV COS/NUV	2	27-Sep-2011 21:01:51.0	yes
03	(1) CALLISTO	COS/FUV COS/NUV	2	27-Sep-2011 21:02:08.0	yes

6 Total Orbits Used

ABSTRACT

We plan a deep search for 1304? and 1356? O emission from Callisto, to detect or place strong limits on the presence of a hypothesized O2 atmosphere on this moon (Liang et al. 2005). Tenuous oxygen atmospheres on Europa and Ganymede have been detected by HST using these emission lines, but searches for O emission from Callisto have not been successful (Strobel et al. 2002). The Liang et al. models predict O emission at levels comparable to the Strobel et al. upper limit, so the improved sensitivity of COS may be able to detect the emission, and thus Callisto's O2

atmosphere, for the first time.

OBSERVING DESCRIPTION

Four orbits with the G130M grating at 1300?, to achieve >= 8000s.

Proposal 11535 - Visit 02 - COS-GTO: Deep Search for an Oxygen Atmosphere on Callisto

Visit

Proposal 11535, Visit 02, failed Wed Sep 28 01:02:16 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	CALLISTO	STD=JUPITER	STD=CALLISTO		CML OF JUPITER FROM CALLISTO BETWEEN 42 148, SEP OF CALLISTO SUN FROM EARTH GT 150D	EARTH

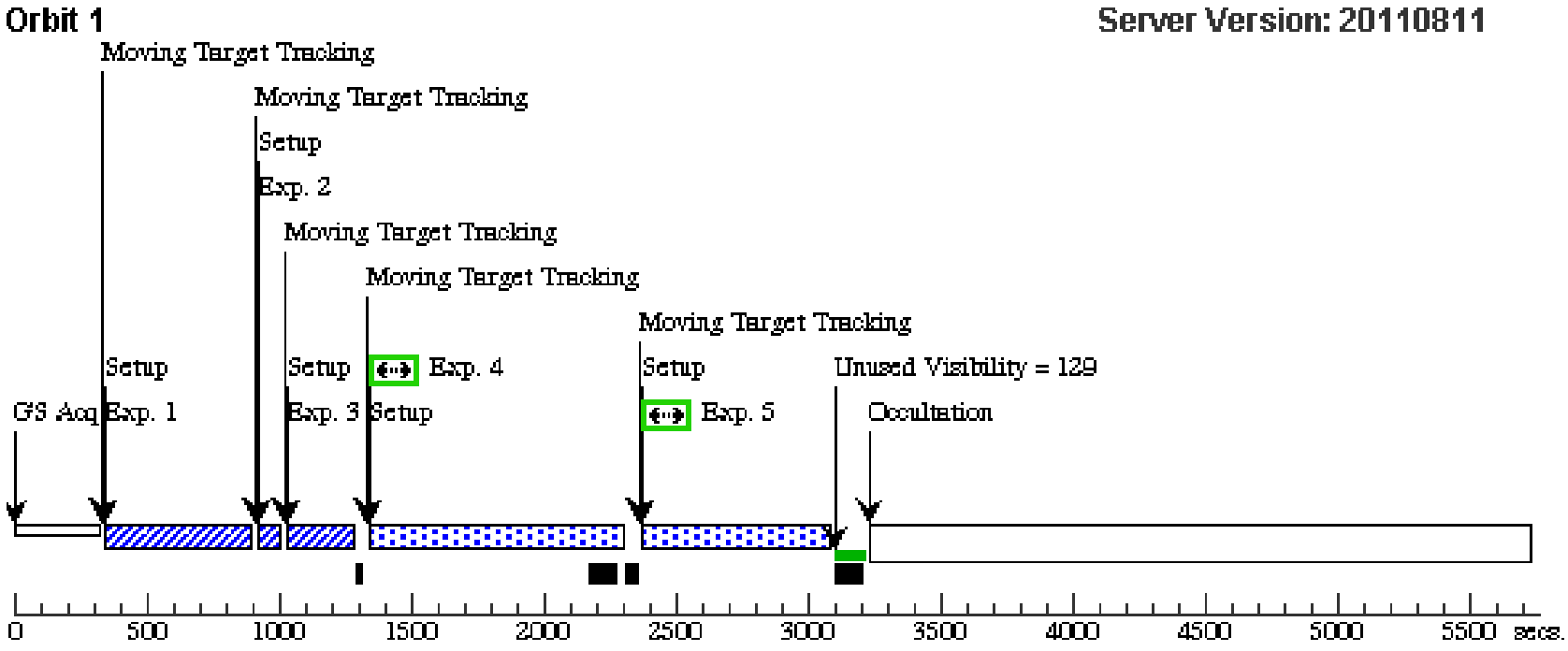
Comments: We want to observe Callisto during each visit when it is impacted by Jupiter's tilted & warped current sheet. The Jupiter system III longitudes where Callisto crosses the current sheet are 296 and 116 degrees; we (arbitrarily) choose to observe the crossing centered on 116 degrees. The sheet should cross Callisto during the 1st half of the 2nd orbit; this allows ~25 minutes of flexibility.

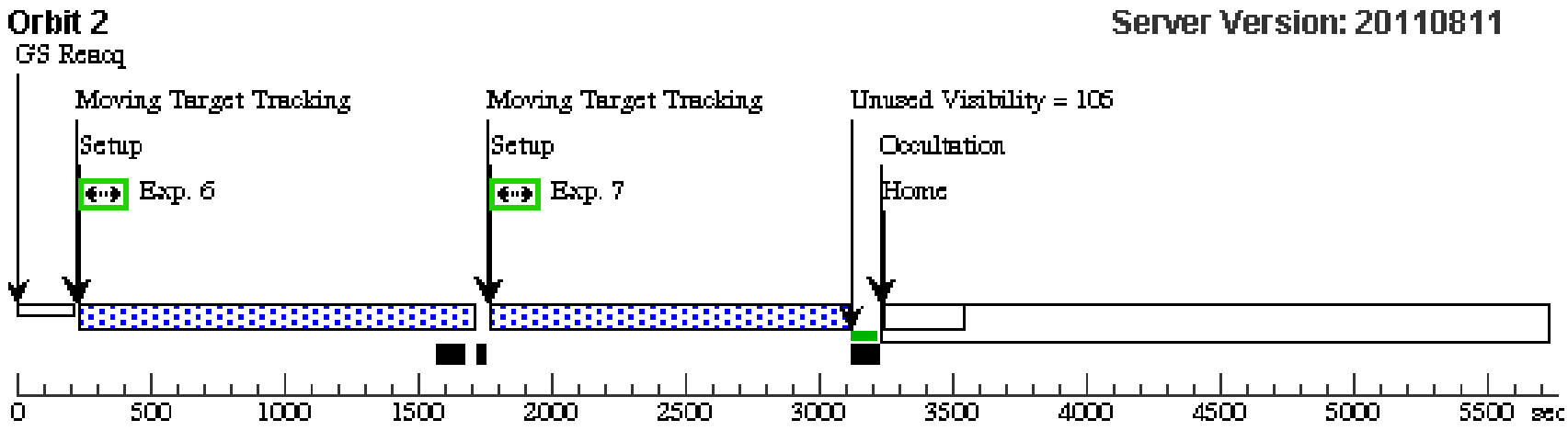
Additionally, as the oxygen lines to be observed are also present in terrestrial airglow, we choose to observe near opposition to maximize time in Earth's shadow. We specify this by requiring that the solar elongation of Callisto be greater than 150 degrees (we would prefer >160 degrees, but the period with >160 degree elongation is excluded from the observing window for some reason).

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) CALLISTO	COS/NUV, ACQ/SEARCH, PSA	G285M 2709 A	SCAN-SIZE=3	GS ACQ SCENARIO BASE1B3		5 Secs *[==>]*	 ***[1]***
	Comments: Callisto is 6.2 +/- 0.5 mags over 2009 (based on JPL ephem generator), and is effectively 1.1 mag dimmer in this grating bandpass than in the visible (based on albedo = 0.06 here vs. 0.17 in visible).								
	So I use mV_effective = 7.3 and get 0.44/0.96 seconds for ACQ-Search/ACQ-PeakXD modes to reach S/N = 40 (ETC IDs COS78131 / COS78132). 5 seconds gives plenty of margin								
2		(1) CALLISTO	COS/NUV, ACQ/PEAKXD, PSA	G285M 2709 A				5 Secs *[==>]*	 ***[1]***
	Comments: Callisto is 6.2 +/- 0.5 mags over 2009 (based on JPL ephem generator), and is effectively 1.1 mag dimmer in this grating bandpass than in the visible (based on albedo = 0.06 here vs. 0.17 in visible).								
	So I use mV_effective = 7.3 and get 0.44/0.96 seconds for ACQ-Search/ACQ-PeakXD modes to reach S/N = 40 (ETC IDs COS78131 / COS78132)								
3		(1) CALLISTO	COS/NUV, ACQ/PEAKD, PSA	G285M 2709 A	NUM-POS=7; STEP-SIZE=1.2			5 Secs *[==>]*	 ***[1]***
	Comments: estimates are same as for exposure 1, ACQ/SEARCH								
4		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=1; BUFFER-TIME=685			795 Secs *[==>]*	 ***[1]***
	*Comments: COS76584 for calculation of buffer time. Assumes effective mV = 6.8 and 15 Rayleigh (8.2e-16 ergs/cm^2/s) 1356? line. Gives buffer time = 2/3 * 5939s.*								
5		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=2; BUFFER-TIME=660			660 Secs *[==>]*	 ***[1]***
6		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=3; BUFFER-TIME=1311			1421 Secs *[==>]*	 ***[2]***
7		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=4; BUFFER-TIME=1290			1290 Secs *[==>]*	 ***[2]***

Orbit Structure





Proposal 11535 - Visit 04 - COS-GTO: Deep Search for an Oxygen Atmosphere on Callisto

Visit

Proposal 11535, Visit 04, implementation Wed Sep 28 01:02:18 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	CALLISTO-COPY	STD=JUPITER	STD=CALLISTO		CML OF JUPITER FROM CALLISTO BETWEEN 42 148, SEP OF CALLISTO SUN FROM EARTH GT 150D	EARTH

Comments: We want to observe Callisto during each visit when it is impacted by Jupiter's tilted & warped current sheet. The Jupiter system III longitudes where Callisto crosses the current sheet are 296 and 116 degrees; we (arbitrarily) choose to observe the crossing centered on 116 degrees. The sheet should cross Callisto during the 1st half of the 2nd orbit; this allows ~25 minutes of flexibility.

Additionally, as the oxygen lines to be observed are also present in terrestrial airglow, we choose to observe near opposition to maximize time in Earth's shadow. We specify this by requiring that the solar elongation of Callisto be greater than 150 degrees (we would prefer >160 degrees, but the period with >160 degree elongation is excluded from the observing window for some reason).

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) CALLISTO-COPY	COS/NUV, ACQ/SEARCH, PSA	G285M 2709 A	SCAN-SIZE=3	GS ACQ SCENARIO BASE1B3		5 Secs *[==>]*	 ***[1]***

Comments: Callisto is 6.2 +/- 0.5 mags over 2009 (based on JPL ephem generator), and is effectively 1.1 mag dimmer in this grating bandpass than in the visible (based on albedo = 0.06 here vs. 0.17 in visible).

So I use mV_effective = 7.3 and get 0.44/0.96 seconds for ACQ-Search/ACQ-PeakXD modes to reach S/N = 40 (ETC IDs COS78131 / COS78132). 5 seconds gives plenty of margin

2		(2) CALLISTO-COPY	COS/NUV, ACQ/PEAKXD, PSA	G285M 2709 A				5 Secs *[==>]*	 ***[1]***

Comments: Callisto is 6.2 +/- 0.5 mags over 2009 (based on JPL ephem generator), and is effectively 1.1 mag dimmer in this grating bandpass than in the visible (based on albedo = 0.06 here vs. 0.17 in visible).

So I use mV_effective = 7.3 and get 0.44/0.96 seconds for ACQ-Search/ACQ-PeakXD modes to reach S/N = 40 (ETC IDs COS78131 / COS78132)

3		(2) CALLISTO-COPY	COS/NUV, ACQ/PEAKD, PSA	G285M 2709 A	NUM-POS=7; STEP-SIZE=1.2			5 Secs *[==>]*	 ***[1]***

Comments: estimates are same as for exposure 1, ACQ/SEARCH

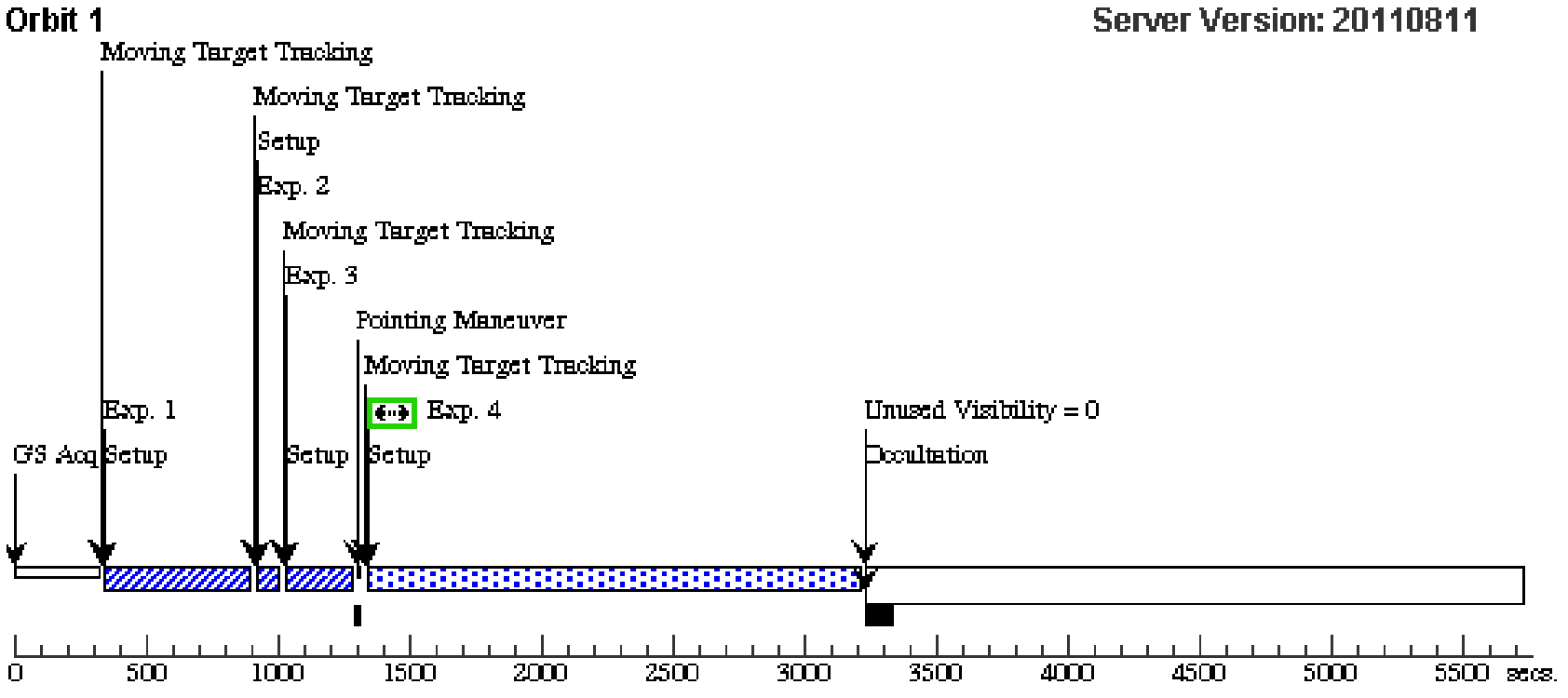
4		(2) CALLISTO-COPY	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=1; BUFFER-TIME=1712	POS TARG null,0.9		1712 Secs *[==>]*	 ***[1]***

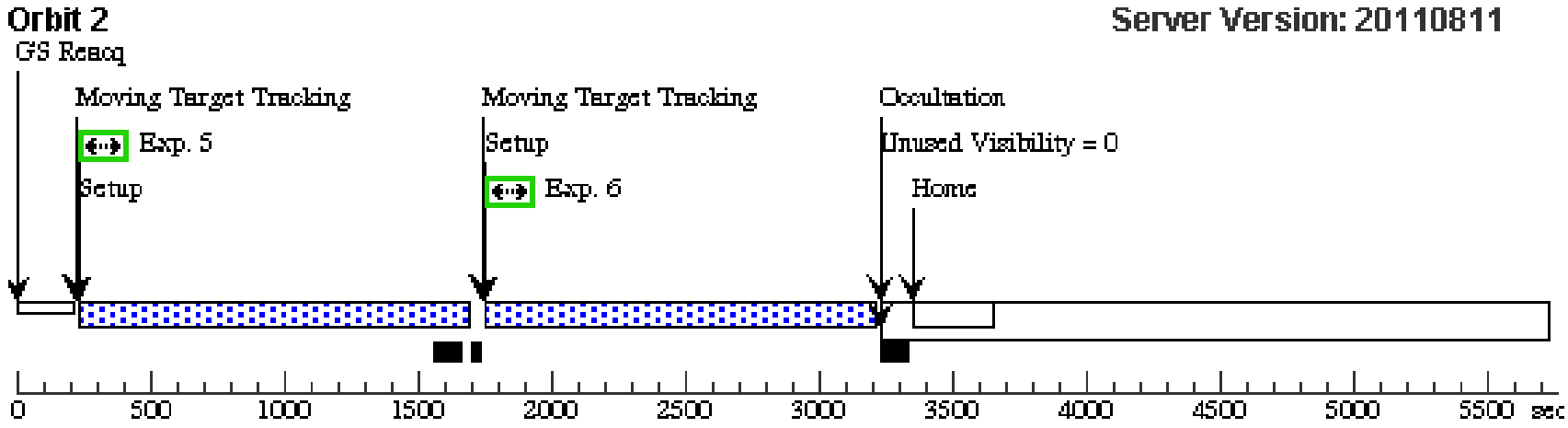
*Comments: COS76584 for calculation of buffer time. Assumes effective mV = 6.8 and 15 Rayleigh (8.2e-16 ergs/cm^2/s) 1356? line. Gives buffer time = 2/3 * 5939s.*

POS TARG is designed to place Callisto 0.9" in the cross-dispersion (+Y) direction. This is intended to allow a portion of the the aperture, and therefore a portion of the spectrum, to contain purely airglow, while the upper part of the aperture contains Callisto's spectrum in addition to oxygen airglow. The cross-dispersion variation in oxygen emission line intensity will help indicate whether Callisto has a significant additional oxygen signal.

5		(2) CALLISTO-COPY	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=2; BUFFER-TIME=1298	SAME POS AS 4		1408 Secs *[==>]*	 ***[2]***
6		(2) CALLISTO-COPY	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=4; BUFFER-TIME=1408	SAME POS AS 4		1408 Secs *[==>]*	 ***[2]***

Orbit Structure





Proposal 11535 - Visit 03 - COS-GTO: Deep Search for an Oxygen Atmosphere on Callisto

Visit

Proposal 11535, Visit 03, completed Wed Sep 28 01:02:19 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: COS/NUV, COS/FUV

Special Requirements: (none)

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	CALLISTO	STD=JUPITER	STD=CALLISTO		CML OF JUPITER FROM CALLISTO BETWEEN 42 148, SEP OF CALLISTO SUN FROM EARTH GT 150D	EARTH

Comments: We want to observe Callisto during each visit when it is impacted by Jupiter's tilted & warped current sheet. The Jupiter system III longitudes where Callisto crosses the current sheet are 296 and 116 degrees; we (arbitrarily) choose to observe the crossing centered on 116 degrees. The sheet should cross Callisto during the 1st half of the 2nd orbit; this allows ~25 minutes of flexibility.

Additionally, as the oxygen lines to be observed are also present in terrestrial airglow, we choose to observe near opposition to maximize time in Earth's shadow. We specify this by requiring that the solar elongation of Callisto be greater than 150 degrees (we would prefer >160 degrees, but the period with >160 degree elongation is excluded from the observing window for some reason).

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) CALLISTO	COS/NUV, ACQ/SEARCH, PSA	G285M 2709 A	SCAN-SIZE=3	GS ACQ SCENARIO BASE1B3		5 Secs *[==>]*	 ***[1]***

Comments: Callisto is 6.2 +/- 0.5 mags over 2009 (based on JPL ephem generator), and is effectively 1.1 mag dimmer in this grating bandpass than in the visible (based on albedo = 0.06 here vs. 0.17 in visible).

So I use mV_effective = 7.3 and get 0.44/0.96 seconds for ACQ-Search/ACQ-PeakXD modes to reach S/N = 40 (ETC IDs COS78131 / COS78132)

2		(1) CALLISTO	COS/NUV, ACQ/PEAKXD, PSA	G285M 2709 A				5 Secs *[==>]*	 ***[1]***

Comments: Callisto is 6.2 +/- 0.5 mags over 2009 (based on JPL ephem generator), and is effectively 1.1 mag dimmer in this grating bandpass than in the visible (based on albedo = 0.06 here vs. 0.17 in visible).

So I use mV_effective = 7.3 and get 0.44/0.96 seconds for ACQ-Search/ACQ-PeakXD modes to reach S/N = 40 (ETC IDs COS78131 / COS78132)

3		(1) CALLISTO	COS/NUV, ACQ/PEAKD, PSA	G285M 2709 A	NUM-POS=7; STEP-SIZE=1.2			5 Secs *[==>]*	 ***[1]***

Comments: estimates are same as for exposure 1, ACQ/SEARCH

4		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=1; BUFFER-TIME=685			795 Secs *[==>]*	 ***[1]***
5		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=2; BUFFER-TIME=660			660 Secs *[==>]*	 ***[1]***
6		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=3; BUFFER-TIME=1311			1421 Secs *[==>]*	 ***[2]***
7		(1) CALLISTO	COS/FUV, TIME-TAG, PSA	G130M 1291 A	FP-POS=4; BUFFER-TIME=1290			1290 Secs *[==>]*	 ***[2]***

Orbit Structure