15379 - Characterizing Enigmatic Phaethon in the UV

Cycle: 25, Proposal Category: GO/DD

(Availability Mode: AVAILABLE)

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	(2) PHAETHON-COPY	STIS/CCD STIS/NUV-MAMA	1	14-Dec-2017 23:00:14.0	yes
02	(1) PHAETHON	STIS/CCD STIS/FUV-MAMA	1	14-Dec-2017 23:00:15.0	yes
51	(3) PHAETHON-NEW	S/C STIS/CCD	1	14-Dec-2017 23:00:17.0	yes

3 Total Orbits Used

ABSTRACT

(3200) Phaethon is a curious object: just 5 km in diameter, it is a near-Earth asteroid that shows signs of being active and is the parent body of the Geminid meteor stream. Phaethon is a B-class asteroid, as is Bennu, the target of the upcoming NASA OSIRIS-REx mission. As a B-class asteroid, Phaethon is linked with carbonaceous species and phyllosilicates; both of these types of materials exhibit diagnostic spectral features in the UV, yet Phaethon has not been observed deep in the UV. Phaethon's UV-visible observations (near 400 nm) suggest spectral variability, spatially and/or

temporally. In December 2017, Phaethon will be at its closest approach to Earth in decades. We propose 2 orbits of DD time to observe Phaethon for the first time using STIS deep in the UV to investigate the 400 nm region (potentially diagnostic of phyllosilicates), characterize its spectral shape deeper in the UV (to look for carbon signatures) and to understand the spectral character of Phaethon for better understanding of OSIRIS-REx target Bennu. UV-visible laboratory measurements of candidate materials will be made through our recently-selected NASA SSERVI program, for comparison with Phaethon STIS data.

OBSERVING DESCRIPTION

Our goal is to observe Phaethon using the STIS G140L (115-174 nm), G230L (157-318 nm) and G430L (290-570 nm) gratings to obtain full spectral coverage in the ~100-570 nm range, gaining new insights into Phaethon's surface composition and possible activity, investigating its UV absorption edge and spectral shape, and ensuring spectral overlap with existing ground-based data. We will employ the strategies we used for our Ceres program (13693), observing Phaethon in 2 HST orbits.

On Dec 9 2017, Phaethon will be 0.043arcsec in diameter and the solar phase angle will be ~19.6deg; the apparent size increases with time up until Dec 17, when it reaches 0.1arcsec; the phase angle also increases in this period as Phaethon approaches periapsis, to 65.7deg on Dec 17. Ideally our STIS observations would occur at a sweet spot between angular size and phase angle. In our ETC calculations, we find that the best opportunities to maximize UV SNR, while not getting close to saturating the CCD, are on Dec 14-15.

We have run ETC based on our experience observing Ceres, which has a similar albedo (Ceres' albedo is ~0.08 compared to Phaethon's of ~0.11, but the Phaethon phase angle will be higher than Ceres'). Though we don't expect Phaethon's spectral shape to match Ceres', we expect that using Ceres' spectral shape in ETC is a good enough approximation to make sure that the CCD isn't saturated and MAMA count rates are not exceeded.

As with the Cycle 22 Ceres observations, we will combine the spectra from each grating into a composite spectrum. The G140L data will be critical for testing whether a Ceres-like bump near 160 nm is observed; the G430L data will be used to confirm the spectral shape in this contentious region and possibly look for spatial variations if the timing of the two HST orbits occurs

such that different hemispheres of Phaethon are observed (Phaethon's rotational period is 3.6 hr); the G230L spectra are important for connecting the G140L and G430L regions and understanding the overall spectral shape.

We can achieve the required spectral coverage using 2 2-sec G430L exposures, along with 2 700-sec G230L exposures on one orbit; on the second orbit we will do one ~2000-sec G140L exposure plus 2 more 2-sec G430L exposures. We will use the 0.1arcsec slit. Our ETC estimates indicate that the G140L SNR will be even higher for Phaethon than for Ceres, demonstrating the excellent quality of this observing opportunity.

Visit

Proposal 15379, Visit 01, failed Fri Dec 15 04:00:19 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 29-NOV-2017:00:00:00 AND 01-DEC-2017:00:00:00

Solar System Targets

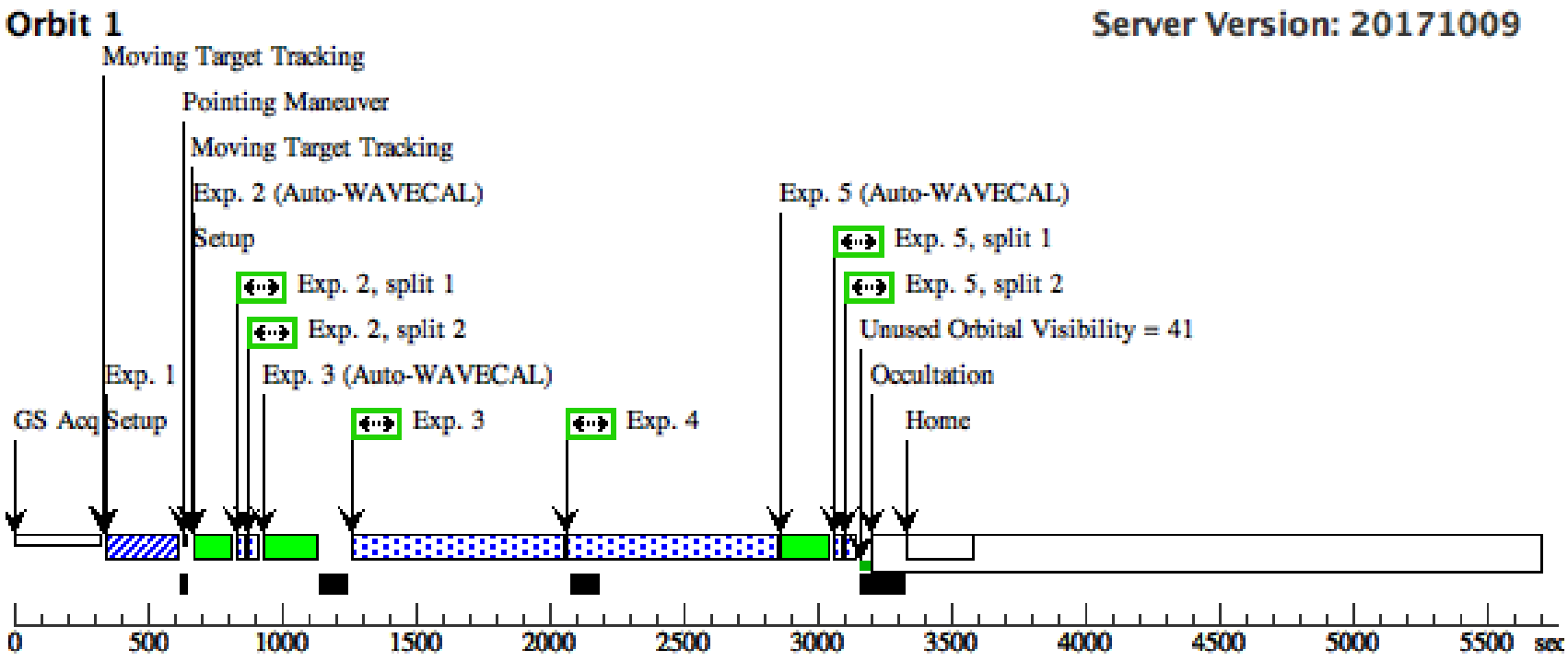
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(2)	PHAETHON-COPY	TYPE=ASTEROID,A=1.27127649259 4683,E=0.890010915974444,I=22.198 47903363508,O=265.3465654874296, W=322.0555020924195,M=139.75458 7559709,EQUINOX=J2000,EPOCH= 17-JUN- 2011:00:00:00,EpochTimeScale=TDB				HUBBLE

Comments: Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) PHAETHON-COPY	STIS/CCD, ACQ, F28X50LP	MIRROR	DIFFUSE-CENTER =GEOMETRIC-CENTER; ACQTYPE=DIFFUSE; CHECKBOX=3.0			0.5 Secs (0.5 Secs) *[==>]*	***[1]***
2		(2) PHAETHON-COPY	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				10 Secs (4 Secs) *[==>2.0 Secs (Split 1)]* *[==>2.0 Secs (Split 2)]*	***[1]***
3	(1014735)	(2) PHAETHON-COPY	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				800 Secs (777 Secs) *[==>777.0 Secs]*	***[1]***
4	(1014735)	(2) PHAETHON-COPY	STIS/NUV-MAMA, ACCUM, 52X0.2	G230L 2376 A				800 Secs (777 Secs) *[==>777.0 Secs]*	***[1]***
5		(2) PHAETHON-COPY	STIS/CCD, ACCUM, 52X0.2	G430L 4300 A				10 Secs (4 Secs) *[==>2.0 Secs (Split 1)]* *[==>2.0 Secs (Split 2)]*	***[1]***

Orbit Structure



Visit

Proposal 15379, Visit 02, completed Fri Dec 15 04:00:19 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/CCD, STIS/FUV-MAMA

Special Requirements: BETWEEN 30-NOV-2017:00:00:00 AND 01-DEC-2017:00:00:00

Solar System Targets

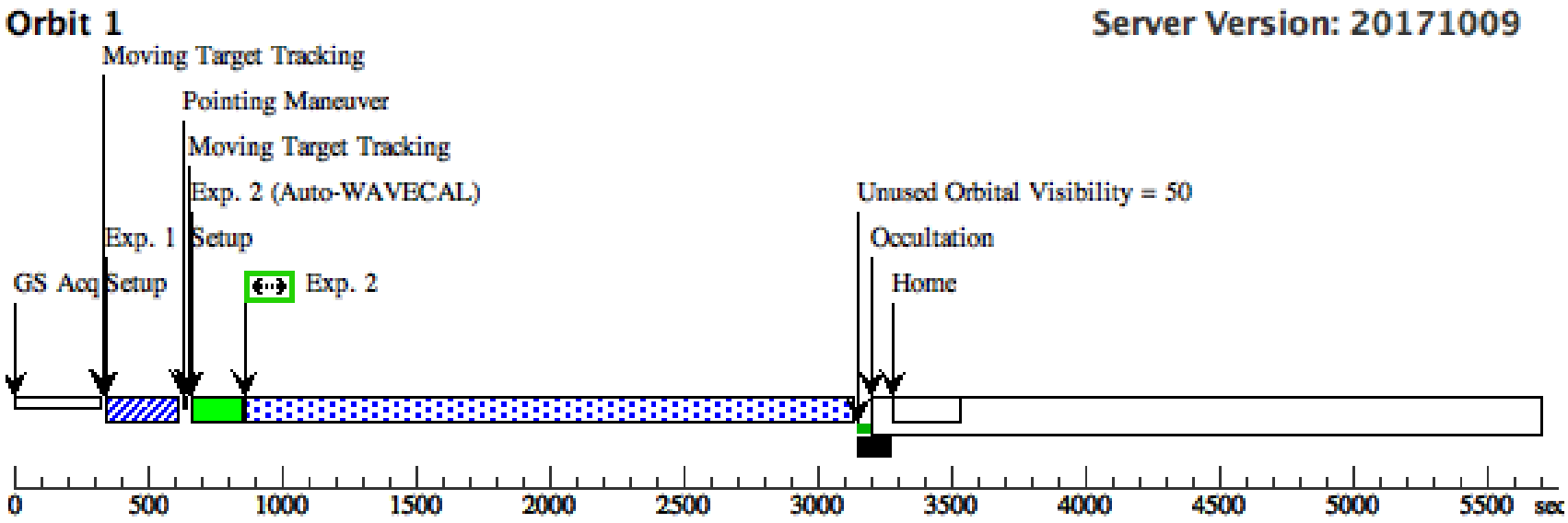
#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(1)	PHAETHON	TYPE=ASTEROID,A=1.27127649259 4683,E=0.890010915974444,I=22.198 47903363508,O=265.3465654874296, W=322.0555020924195,M=139.75458 7559709,EQUINOX=J2000,EPOCH= 17-JUN- 2011:00:00:00,EpochTimeScale=TDB				EARTH

Comments: Extended=YES

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) PHAETHON	STIS/CCD, ACQ, F28X50LP	MIRROR	ACQTYPE=DIFFU SE; CHECKBOX=3.0; DIFFUSE-CENTER =GEOMETRIC-CE NTER			0.5 Secs (0.5 Secs) *[==>]*	*[1]*
2	(1014730)	(1) PHAETHON	STIS/FUV-MAMA, ACCUM, 52X0.2	G140L 1425 A				2260 Secs (2260 Secs) *[==>]*	*[1]*

Orbit Structure



Visit

Proposal 15379, Visit 51, implementation Fri Dec 15 04:00:19 GMT 2017

Diagnostic Status: No Diagnostics

Scientific Instruments: S/C, STIS/CCD

Special Requirements: SCHED 100%; ORIENT 67.0D TO 67.0 D

Solar System Targets

#	Name	Level 1	Level 2	Level 3	Window	Ephem Center
(3)	PHAETHON-NEW	TYPE=ASTEROID,A=1.27127649259 4683,E=0.890010915974444,I=22.198 47903363508,O=265.3465654874296, W=322.0555020924195,M=139.75458 7559709,EQUINOX=J2000,EPOCH= 17-JUN- 2011:00:00:00,EpochTimeScale=TDB				HUBBLE

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) PHAETHON-NEW	S/C, POINTING, V1			POS TARG -213.6796,-224.8351; SAA CONTOUR 24; GSPAIR N0PT000271F20000000000F0; GS ACQ SCENARIO ONEB1B3	Sequence 1-7 Non-Int in Visit 51	1 Secs (1 Secs) *[==>]*	***[1]***
2		(3) PHAETHON-NEW	STIS/CCD, ACQ, F28X50OII	MIRROR	DIFFUSE-CENTER=GEOMETRIC-CENTER; ACQTYPE=DIFFUSE; CHECKBOX=3.0	NEW OBSET; NEW ALIGNMENT; EXP PCS MODE GYRO	Sequence 1-7 Non-Int in Visit 51	4 Secs (4 Secs) *[==>]*	***[1]***
3	(STIS.sp.10 39948)	(3) PHAETHON-NEW	STIS/CCD, ACCUM, 52X2	G430L 4300 A		EXP PCS MODE GYRO	Sequence 1-7 Non-Int in Visit 51	2 Secs (2 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
4	(STIS.sp.10 39947)	(3) PHAETHON-NEW	STIS/CCD, ACCUM, 52X2	G230LB 2375 A		NEW ALIGNMENT; EXP PCS MODE GYRO	Sequence 1-7 Non-Int in Visit 51	150 Secs (150 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
5	(STIS.sp.10 39947)	(3) PHAETHON-NEW	STIS/CCD, ACCUM, 52X2	G230LB 2375 A		NEW ALIGNMENT; EXP PCS MODE GYRO	Sequence 1-7 Non-Int in Visit 51	150 Secs (150 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
6	(STIS.sp.10 39948)	(3) PHAETHON-NEW	STIS/CCD, ACCUM, 52X2	G430L 4300 A		NEW ALIGNMENT; EXP PCS MODE GYRO	Sequence 1-7 Non-Int in Visit 51	2 Secs (2 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***
7		(3) PHAETHON-NEW	STIS/CCD, ACCUM, 52X2	G230LB 2375 A		NEW ALIGNMENT; EXP PCS MODE GYRO	Sequence 1-7 Non-Int in Visit 51	150 Secs (150 Secs) *[==>(Split 1)]* *[==>(Split 2)]*	***[1]***

Orbit Structure