



15259 - UV Spectroscopy of Lucy Mission Targets

Cycle: 25, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Cristina Thomas (PI) (Contact)	Planetary Science Institute	cthomas@psi.edu
Dr. Keith S. Noll (CoI)	NASA Goddard Space Flight Center	keith.s.noll@nasa.gov
Dr. Joshua P Emery (CoI)	University of Tennessee at Knoxville	jemery2@utk.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) 617-PATROCLUS	WFC3/UVIS	1	20-Jul-2017 21:04:50.0	yes
02	(2) 11351-LEUCUS	WFC3/UVIS	2	20-Jul-2017 21:04:51.0	yes

3 Total Orbits Used

ABSTRACT

The Trojan asteroids are a significant population of primitive bodies trapped in Jupiter's stable L4 and L5 Lagrange regions. Their physical properties and existence in these particular orbits constrain the chemical and dynamical processes in our early Solar System. NASA's recently selected Lucy mission will perform the first reconnaissance of these asteroids and will answer many fundamental questions about the population. The compositions of the Trojans are not well understood. Spectroscopy and spectrophotometry in visible and near-infrared wavelengths show red slopes (spectra with reflectivity increasing towards the long wavelength end of the spectrum) and no diagnostic spectral absorption features. However, past spectral and photometric observations suggest there are unobserved features in ultraviolet wavelengths.

We propose to obtain ultraviolet spectroscopy with WFC3 of four Trojan asteroids that are targets of the Lucy mission. Lucy will not have the capability to obtain ultraviolet spectra. The proposed observations can only be made using Hubble. We will determine if there are UV spectral features, as suggested by visible wavelength observations, and connect these features to candidate compositional components. These observations will enable connections between the compositions of Trojans and dynamical models of the early Solar System.

OBSERVING DESCRIPTION

During Cycle 25, we will obtain UV spectra of 2 Jovian Trojan asteroids that are targets of NASA's recently selected Lucy mission: (617) Patroclus and (11351) Leucus. Another two targets, (3548) Eurybates and (21900) Orus, will be observed in Cycle 26. Together, these objects span the range of compositions observed in the Trojan population. The proposed targets span three spectral types (C, D, P) and include members of the "red" and "less red" spectral groups.

We will observe these objects with the Wide Field Camera 3 UVIS configuration with the G280 spectral element and F300X for the complementary direct imaging. The wavelength range provided by the G280 spectral element (200-400 nm, spectral resolution of ~ 70) will complement the visible spectroscopy data already available for Trojan asteroids from ground based observatories. This instrument configuration was also chosen because its resolution and throughput enable observations of appropriate signal-to-noise to be done efficiently for each object.

Our required signal-to noise ratio (SNR) is ~ 50 at 3000 Angstroms. We have two scientific goals which define our observing requirements: (1) examining the downturn toward the UV (~ 0.43 microns) that is suggestive of an unobserved UV spectral feature for less-red objects and (2) searching for absorption features that are diagnostic of volatiles, organics, and salts. This SNR requirement guarantees adequate signal to noise in the spectral region ~ 0.4 microns where the downturn has been observed previously and near the spectral features observed on other small bodies. By setting our SNR requirements at 3000 Angstroms, we avoid the sharp dropoff in flux at shorter wavelengths which would dramatically increase our required exposure time.

We used the Wide Field Camera 3 Spectroscopic Exposure Time Calculator (ETC) to determine our total exposure times for each object. Each calculation used a point source and the HST Solar Spectrum spectral distribution. In order to give a conservative estimate of SNR, we used high values for standard zodiacal light normalizations, standard earth shine light normalizations, and air glow.

The target ephemerides were examined in Aladin for a period when the object is brightest and can be observed with HST during Cycle 25. The

Proposal 15259 (STScI Edit Number: 0, Created: Thursday, July 20, 2017 8:04:52 PM EST) - Overview

magnitudes calculated by JPL Horizons are determined using the object's H (Solar System absolute magnitude) value. These values are subject to uncertainties resulting from the rotational light curves of the targets. Therefore, we need to take into consideration the light curve variation for each target. In order to calculate the minimum SNR for the observing window, we add the maximum light curve variation from the Minor Planet Center Lightcurve Database (<http://www.minorplanetcenter.net/iau/lists/LightcurveDat.html>) to the predefined faintest magnitude. This precaution gives us conservative estimates which guarantee acceptable SNR.

(617) Patroclus requires a single orbit and (11351) Leucus requires two orbits. For our defined sequence, we use two dither positions. We take a direct image with $\text{SNR} > 50$ for Patroclus and $\text{SNR} > 30$ for Leucus and the total exposure time at each object is determined by the time available in each orbit. The observing window is defined by the $\text{SNR} > 50$ at 3000 Angstrom requirement.

(617) Patroclus, 1 orbit

Patroclus is a less red P-type object. Patroclus can be observed with $V < 16.1$ (lightcurve corrected to $V < 16.22$) from Feb 2 to Apr 8 2018. With a total spectral exposure time of $t = 1924\text{s}$, we expect $\text{SNR} \sim 98$ at 3000 Angstroms. Patroclus is known to be a binary system (e.g., Marchis et al. 2006). Component resolved spectroscopic observations (H+K, 1.45-2.45 micron) of the Patroclus binary system demonstrate that the two components have identical reflectance spectra (Marchis et al. 2013). Therefore, we do not require a specific orientation of the system for the observation.

(11351) Leucus, 2 orbits

Leucus is a D-type object. Leucus can be observed with $V < 17.86$ from Jul 23 to Aug 20 2018. With a total exposure time of $t = 4228\text{s}$, we expect $\text{SNR} \sim 49$ at 3000 Angstroms.

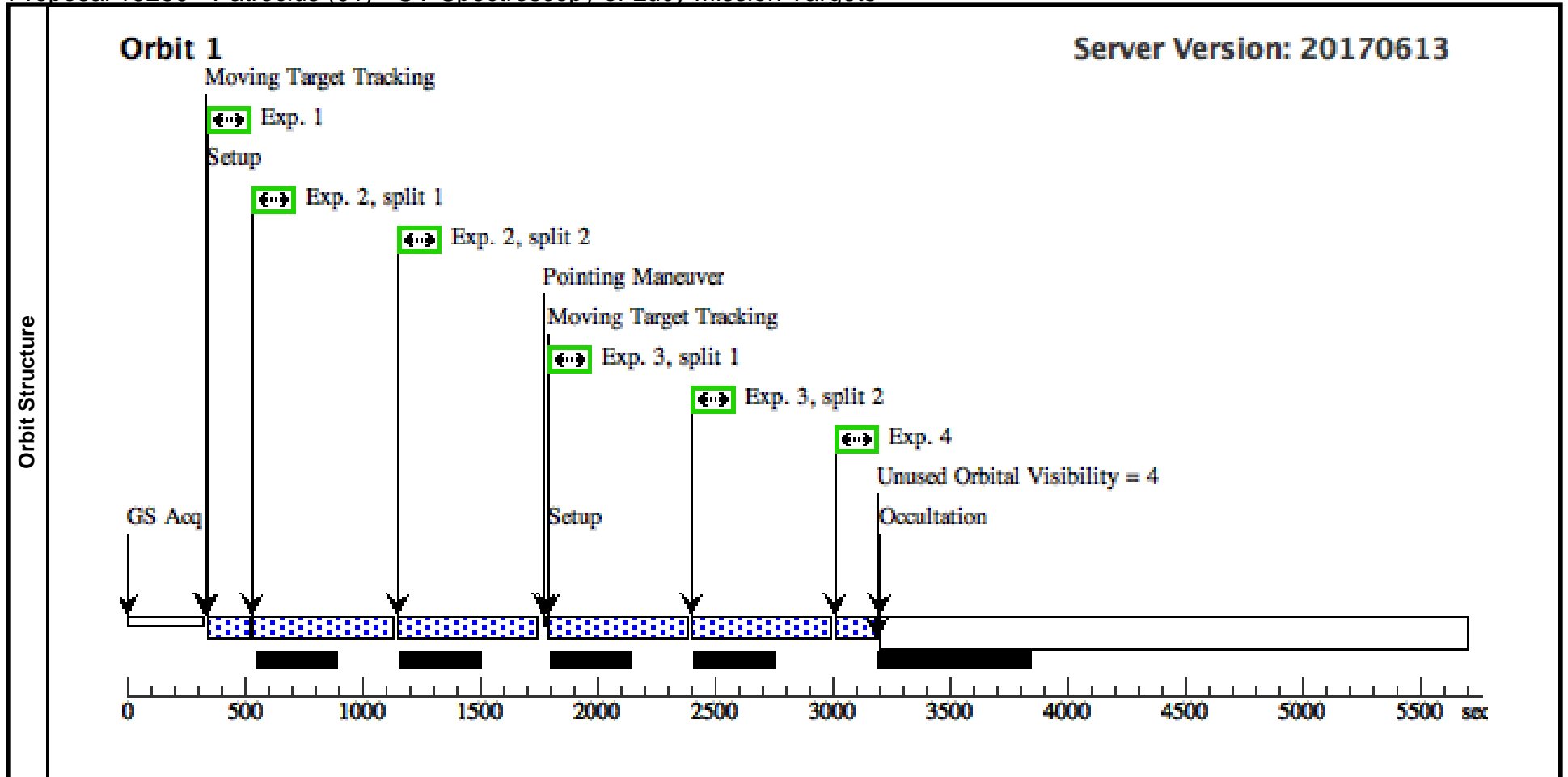
Proposal 15259 - Patroclus (01) - UV Spectroscopy of Lucy Mission Targets

Fri Jul 21 01:04:52 GMT 2017

Visit	<p>Proposal 15259, Patroclus (01)</p> <p>Diagnostic Status: No Diagnostics</p> <p>Scientific Instruments: WFC3/UVIS</p> <p>Special Requirements: BETWEEN 14-FEB-2018:00:00:00 AND 19-FEB-2018:22:00:00; BETWEEN 21-FEB-2018:00:00:00 AND 26-FEB-2018:22:00:00; BETWEEN 01-MAR-2018:00:00:00 AND 02-MAR-2018:06:00:00; BETWEEN 03-MAR-2018:00:00:00 AND 05-MAR-2018:00:00:00; BETWEEN 09-MAR-2018:00:00:00 AND 11-MAR-2018:00:00:00; BETWEEN 12-MAR-2018:00:00:00 AND 13-MAR-2018:22:00:00; BETWEEN 15-MAR-2018:00:00:00 AND 23-MAR-2018:12:00:00; BETWEEN 24-MAR-2018:12:00:00 AND 27-MAR-2018:12:00:00; BETWEEN 04-FEB-2018:12:00:00 AND 11-FEB-2018:12:00:00; BETWEEN 29-MAR-2018:00:00:00 AND 30-MAR-2018:00:00:00; BETWEEN 31-MAR-2018:00:00:00 AND 08-APR-2018:00:00:00</p> <p><i>Comments: This observation is organized as followed:</i></p> <ol style="list-style-type: none"> <i>Direct Image A. exposure time=25 seconds. post flash=12 Pos Targ X=0, Y=-50 to get it in the center of chip 2.</i> <i>Spec 1. exposure time=962 seconds, cr_split=2. Pos Targ X=0, Y=-50.</i> <p><i>dither= 13x distance of WFC3-UVIS-DITHER-LINE. (point spacing 0.145 x 13= 1.885")</i></p> <ol style="list-style-type: none"> <i>Spec 2. exposure time=962 seconds, cr_split=2. Pos Targ X=1.287, Y=-48.622</i> <i>Direct Image A. exposure time=25 seconds. post flash=12 Pos Targ X=1.287, Y=-48.622</i> <p><i>1 & 2 are at the same position, 3 & 4 are at the same position. These are paired to place the direct image in the same location as the dispersed images.</i></p> <p><i>The observability windows are dictated by V<16.1 (with lightcurve added V<16.22). This window opens on Feb 2 and closes on Apr 8 2018. The specific windows were determined by investigating when other bright and/or numerous objects would be in the field.</i></p>						
	Solar System Targets	#	Name	Level 1	Level 2	Level 3	Window
(1)		617-PATROCLUS	TYPE=ASTEROID,A=5.21849969455 3197.E=0.1399500456355474,I=22.05 269861079197,O=44.36596299545594 ,W=307.8595259822105,M=325.1954 514012491,EQUINOX=J2000,EPOCH =08-JUN- 2011:00:00,EpochTimeScale=TDB				EARTH
	<i>Comments: Extended=NO</i>						

Proposal 15259 - Patroclus (01) - UV Spectroscopy of Lucy Mission Targets

	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
Exposures	1	Patroclus-Direct Image A (WFC3UVI S.im.1013051)	(1) 617-PATROCLUS	WFC3/UVIS, ACCUM, G280-REF	F300X	FLASH=12	POS TARG null,-50	Sequence 1-4 Non-Int in Patroclus (01)	25 Secs (25 Secs) [==>]	[1]
	2	Patroclus-Spec 1 (WFC3UVI S.sp.1013077)	(1) 617-PATROCLUS	WFC3/UVIS, ACCUM, UVIS	G280	CR-SPLIT=2	POS TARG null,-50	Sequence 1-4 Non-Int in Patroclus (01)	962 Secs (962 Secs) [==>(Split 1)] [==>(Split 2)]	[1]
	3	Patroclus-Spec 2 (WFC3UVI S.sp.1013077)	(1) 617-PATROCLUS	WFC3/UVIS, ACCUM, UVIS	G280	CR-SPLIT=2	POS TARG 1.287,-48.622	Sequence 1-4 Non-Int in Patroclus (01)	962 Secs (962 Secs) [==>(Split 1)] [==>(Split 2)]	[1]
	4	Patroclus-Direct Image B (WFC3UVI S.im.1013051)	(1) 617-PATROCLUS	WFC3/UVIS, ACCUM, G280-REF	F300X	FLASH=12	POS TARG 1.287,-48.622	Sequence 1-4 Non-Int in Patroclus (01)	25 Secs (25 Secs) [==>]	[1]



Proposal 15259 - Leucus (02) - UV Spectroscopy of Lucy Mission Targets

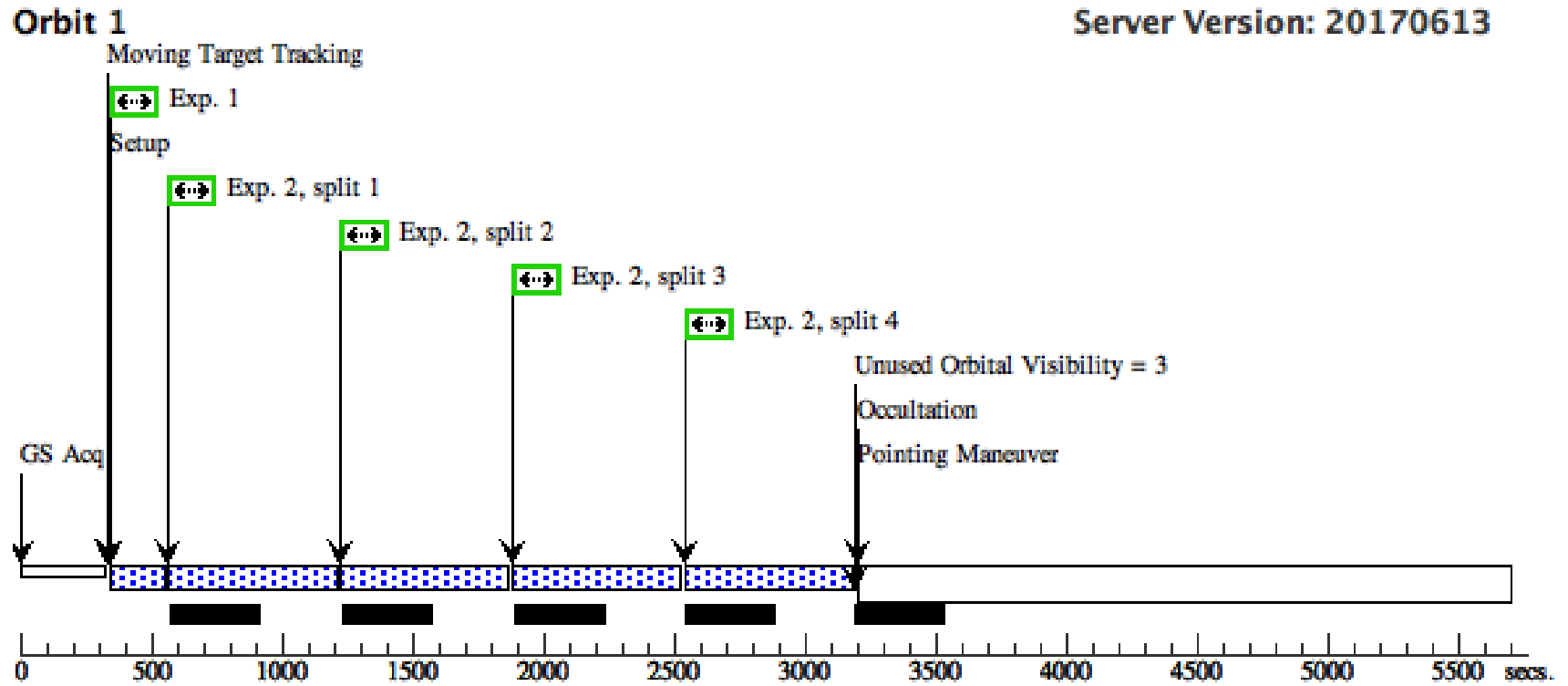
Fri Jul 21 01:04:53 GMT 2017

Visit	<p>Proposal 15259, Leucus (02)</p> <p>Diagnostic Status: No Diagnostics</p> <p>Scientific Instruments: WFC3/UVIS</p> <p>Special Requirements: BETWEEN 17-AUG-2018:00:00:00 AND 17-AUG-2018:06:00:00; BETWEEN 18-AUG-2018:01:00:00 AND 19-AUG-2018:00:00:00; BETWEEN 19-AUG-2018:12:00:00 AND 19-AUG-2018:18:00:00; BETWEEN 20-AUG-2018:12:00:00 AND 21-AUG-2018:12:00:00; BETWEEN 07-AUG-2018:00:00:00 AND 08-AUG-2018:00:00:00; BETWEEN 08-AUG-2018:11:00:00 AND 08-AUG-2018:15:00:00; BETWEEN 11-AUG-2018:14:00:00 AND 13-AUG-2018:14:00:00; BETWEEN 31-JUL-2018:12:00:00 AND 01-AUG-2018:12:00:00; BETWEEN 02-AUG-2018:06:00:00 AND 02-AUG-2018:16:00:00</p> <p><i>Comments: This observation is organized as followed:</i></p> <p><i>Orbit 1:</i> 1. Direct Image A. exposure time=60 seconds. post flash=12 Pos Targ X=0, Y=-50 to get it in the center of chip 2. 2. Spec 1. exposure time=2115 seconds, cr_split=2. Pos Targ X=0, Y=-50.</p> <p><i>Orbit 2:</i> dither= 13x distance of WFC3-UVIS-DITHER-LINE. (point spacing 0.145 x 13= 1.885") 3. Spec 2. exposure time=2115 seconds, cr_split=2. Pos Targ X=1.287, Y=-48.622</p> <p>4. Direct Image A. exposure time=50 seconds. post flash=12 Pos Targ X=1.287, Y=-48.622</p> <p><i>1 & 2 are at the same position, 3 & 4 are at the same position. These are paired to place the direct image in the same location as the dispersed images.</i></p> <p><i>The observability windows are dictated by V<17.86. This window opens on Jul 24 and closes on Aug 21 2018. The specific windows were determined by investigating when other bright and/or numerous objects would be in the field.</i></p>																		
	<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>(2)</td> <td>11351-LEUCUS</td> <td>TYPE=ASTEROID,A=5.26676963951 9152,E=0.06613217986623902,I=11.5 6549052270034,O=251.086937199050 1,W=160.0963195215948,M=66.3112 00245168,EQUINOX=J2000,EPOCH =29-SEP- 2011:00:00:00,EpochTimeScale=TDB</td> <td></td> <td></td> <td></td> <td>EARTH</td> </tr> </tbody> </table> <p><i>Comments: Extended=NO</i></p>						#	Name	Level 1	Level 2	Level 3	Window	Ephem Center	(2)	11351-LEUCUS	TYPE=ASTEROID,A=5.26676963951 9152,E=0.06613217986623902,I=11.5 6549052270034,O=251.086937199050 1,W=160.0963195215948,M=66.3112 00245168,EQUINOX=J2000,EPOCH =29-SEP- 2011:00:00:00,EpochTimeScale=TDB			
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Solar System Targets																			

Proposal 15259 - Leucus (02) - UV Spectroscopy of Lucy Mission Targets

Exposures	#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	Leucus-Direct Image A (WFC3UVI S.im.101352 3)	(2) 11351-LEUCUS	WFC3/UVIS, ACCUM, G280-REF	F300X	FLASH=12	POS TARG null,-50	Sequence 1-2 Non-Int in Leucus (02)	50 Secs (50 Secs) [==>]	[1]
	2	Leucus- Spect 1 (WFC3UVI S.sp.101358 9)	(2) 11351-LEUCUS	WFC3/UVIS, ACCUM, UVIS	G280	CR-SPLIT=4	POS TARG null,-50	Sequence 1-2 Non-Int in Leucus (02)	2114 Secs (2114 Secs) [==>(Split 1)] [==>(Split 2)] [==>(Split 3)] [==>(Split 4)]	[1]
	3	Leucus-Direct Image B (WFC3UVI S.im.101352 3)	(2) 11351-LEUCUS	WFC3/UVIS, ACCUM, G280-REF	F300X	FLASH=12	POS TARG 1.287,-4 8.622	Sequence 3-4 Non-Int in Leucus (02)	50 Secs (50 Secs) [==>]	[2]
	4	Leucus- Spect 2 (WFC3UVI S.sp.101358 9)	(2) 11351-LEUCUS	WFC3/UVIS, ACCUM, UVIS	G280	CR-SPLIT=4	POS TARG 1.287,-4 8.622	Sequence 3-4 Non-Int in Leucus (02)	2114 Secs (2114 Secs) [==>(Split 1)] [==>(Split 2)] [==>(Split 3)] [==>(Split 4)]	[2]

Orbit Structure



Orbit 2

