



## 18342 - Observing Titan's Haze Distribution: One (Titan) Year Later

Cycle: 34, Proposal Category: GO

(Availability Mode: SUPPORTED)

### INVESTIGATORS

| <i>Name</i>                                        | <i>Institution</i>                                             |
|----------------------------------------------------|----------------------------------------------------------------|
| <b>Dr. Kristin Showalter Sotzen (PI) (Contact)</b> | <b>The Johns Hopkins University Applied Physics Laboratory</b> |
| Dr. Ralph D. Lorenz (CoI) (CoPI) (Contact)         | The Johns Hopkins University Applied Physics Laboratory        |
| Dr. Erich Karkoschka (CoI) (Contact)               | University of Arizona                                          |

### 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) TITAN<br>CCDFLAT<br>WAVE | STIS/CCD                            | 1                  | 19-Aug-2026 10:00:15.0        | yes                           |
| 02           | (1) TITAN                    | WFC3/UVIS                           | 1                  | 19-Aug-2026 10:00:16.0        | yes                           |

2 Total Orbits Used

### ABSTRACT

Though Titan has been observed from Earth, Earth orbit, Cassini, and most recently JWST for the past several decades, with a year that spans just shy of 30 Earth years, there remain gaps in our observations of Titan's atmospheric variability over the course of its year. It is known that Titan displays interannual variability in seasonal albedo, haze distribution, and tropospheric activity. The time around equinox (i.e., now) when the subsolar point on Titan is changing latitude most quickly, sees the most rapid and profound changes as the asymmetric pole-to-pole Hadley circulation reverses, and substantial changes were observed from one Earth year to the next in previous equinoxes. We will observe Titan near equinox to provide additional data on Titan's seasonal and annual atmospheric variability. Our science objectives include:

- 1) STIS spectral imaging to build on previous data sets tracking Titan's north-south asymmetry over its year, the first HST observations of which

occurred approximately one Titan year ago.

2) WFC3/UVIS imaging in blue and green wavelengths as well as the 775nm, 889 nm, 953 nm methane absorption band to observe the north-south asymmetry and methane distribution as well as measure Titan's albedo for comparison to previous photometric campaigns.

## **OBSERVING DESCRIPTION**

The observations in Cycles 34 will use two HST orbits per cycle, one for the STIS observations and one for WFC3/UVIS.

As for previous successful STIS observations of Titan, the STIS orbit will consist of 15 exposures with the grating G750L for wavelengths 530-1000 nm at 0.5 nm/pixel, providing a spatially-resolved image cube. Each successive exposure is offset by 0.051 arc-sec perpendicular to the slit orientation from the previous one. The aperture is 52X0.05E1. The saved part of the image is 140 spatial rows and all 1024 spectral columns, which provides sufficient background sky while avoiding buffer dumps during the observation. STIS calibration exposures are a CCDFLAT and WAVECAL taken at start of Earth occultation. Acquisition is accomplished with a 1 sec exposure with the MIRROR and a F28X50LP aperture using ACQTYPE=DIFFUSE, CHECKBOX=19, DIFFUSE-CENTER = FLUX-CENTROID. Exposure times will be the longest possible to fit all Titan exposures into the orbit before occultation starts, about 73 sec each, providing signal-to-noise ratios (SNRs) of ~50 per pixel in the red continuum and ~1000 for the spectrally averaged quantities. These sensitivities enable measurement of relative radiance differences at the <1% level, sufficient to quantify the NSA, center-to-limb variations, and wavelength-dependent haze properties. The wavelength range over a factor of 1.9 probes haze optical depths varying over a factor of 4, including: the visible where haze absorbs; near-infrared wavelengths where haze is bright against absorbing gas (methane); and methane bands with absorption strengths ranging over three orders of magnitude probing eight scale heights in Titan's atmosphere. The spatial sampling provides well-sampled center-to-limb profiles for 15 latitudes, enabling characterization of hemispheric gradients and detection of latitudinal variations in haze opacity and methane absorption at the few-percent level.

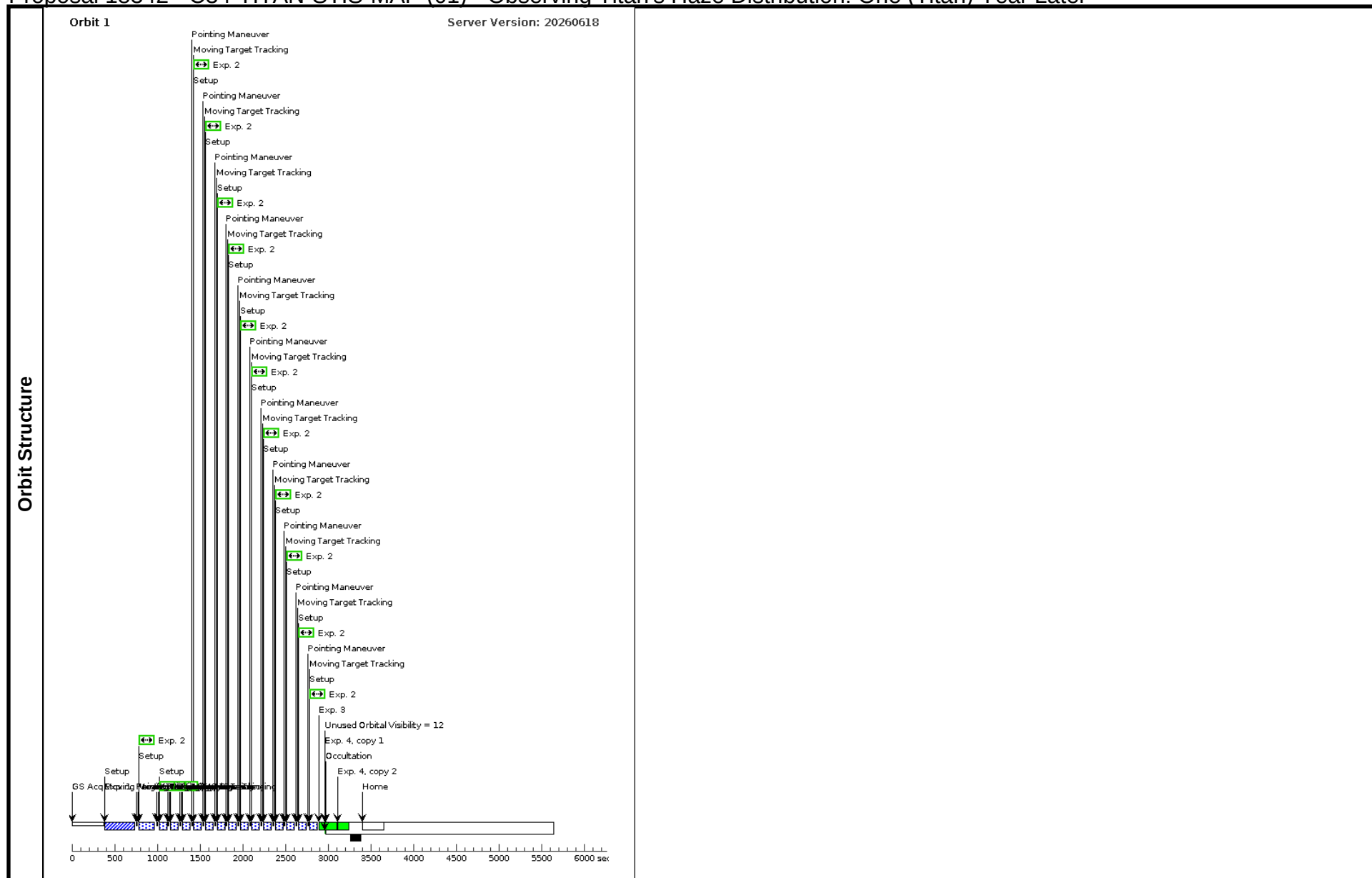
The WFC3/UVIS orbit will consist of 2 exposures each of the F438W, F336W, FQ889N, F673N, F547M, F953N, and F775W filters. These filters will show the NSA peak in the blue wavelengths and the reversal in the 889 nm methane band. Using the WFC3/UVIS online Exposure Time Calculator (ETC), we find that exposure times for our filters of 11 seconds (F438W), 64 seconds (F336W), 305 seconds (FQ889N), 16 seconds (F673N), 5 seconds (F547M), 175 seconds (F953N), and 4 seconds (F775W) give us SNRs > 175 without saturating. These data enable measurement of hemispheric brightness contrasts to ~1-2% and disk-integrated photometry to <1% precision. We will use a post-flash for each of our WFC3/UVIS exposures to mitigate CTE effects, and we will use the UVIS2-C512C-SUB sub-array to minimize the time needed for buffer dumps. Additionally, we could lengthen the FQ889N exposure time, without saturating, to accommodate a buffer dump to increase science return relative to instrument overhead.

# Proposal 18342 - C34-TITAN-STIS-MAP (01) - Observing Titan's Haze Distribution: One (Titan) Year Later

|                                       |                                                                                                                           |                                                                                                                 |                                                                                                     |           |                   |                                                                                     |              |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------|-------------------|-------------------------------------------------------------------------------------|--------------|
| Visit                                 | Proposal 18342, C34-TITAN-STIS-MAP (01)                                                                                   |                                                                                                                 |                                                                                                     |           |                   | Wed Aug 19 14:00:17 GMT 2026                                                        |              |
|                                       | Diagnostic Status: Informational                                                                                          |                                                                                                                 |                                                                                                     |           |                   |                                                                                     |              |
|                                       | Scientific Instruments: STIS/CCD                                                                                          |                                                                                                                 |                                                                                                     |           |                   |                                                                                     |              |
|                                       | Special Requirements: (none)                                                                                              |                                                                                                                 |                                                                                                     |           |                   |                                                                                     |              |
| Diagnosics                            | (C34-TITAN-STIS-MAP (01)) Informational (Form): The Visit Planner and Spike may produce different schedulability results. |                                                                                                                 |                                                                                                     |           |                   |                                                                                     |              |
| Patterns                              | #                                                                                                                         | Primary Pattern                                                                                                 |                                                                                                     |           | Secondary Pattern |                                                                                     | Exposures    |
|                                       | (1)                                                                                                                       | Pattern Type=STIS-PERP-TO-SLIT<br>Purpose=MOSAIC<br>Number Of Points=15<br>Point Spacing=0.051<br>Line Spacing= | Coordinate Frame=POS-TARG<br>Pattern Orientation=0.0<br>Angle Between Sides=<br>Center Pattern=true |           |                   | (2)                                                                                 |              |
| Solar System Targets                  | #                                                                                                                         | Name                                                                                                            | Level 1                                                                                             | Level 2   | Level 3           | Window                                                                              | Ephem Center |
|                                       | (1)                                                                                                                       | TITAN                                                                                                           | STD=SATURN                                                                                          | STD=TITAN |                   | NOT OCC OF TITAN BY SATURN<br>FROM EARTH,<br>SEP OF TITAN RHEA FROM<br>EARTH GT 10" | EARTH        |
| Comments: Description=SATELLITE TITAN |                                                                                                                           |                                                                                                                 |                                                                                                     |           |                   |                                                                                     |              |

# Proposal 18342 - C34-TITAN-STIS-MAP (01) - Observing Titan's Haze Distribution: One (Titan) Year Later

| Exposures | # | Label               | Target    | Config,Mode,Aperture       | Spectral Els.   | Opt. Params.                                                     | Special Reqs. | Groups                                             | Exp. Time (Total)/[Actual Dur.]                                                                                                                                                                                                                                                                                                       | Orbit |
|-----------|---|---------------------|-----------|----------------------------|-----------------|------------------------------------------------------------------|---------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|           | 1 | C34-TITAN-STIS-ACQ  | (1) TITAN | STIS/CCD, ACQ, F28X50LP    | MIRROR          | ACQTYPE=DIFFUSE;<br>CHECKBOX=19;<br>DIFFUSE-CENTER=FLUX-CENTROID |               |                                                    | 1.0 Secs (1 Secs)<br>[==>]                                                                                                                                                                                                                                                                                                            | [1]   |
|           | 2 | C34-TITAN-STIS-MAP  | (1) TITAN | STIS/CCD, ACCUM, 52X0.05E1 | G750L<br>7751 A | WAVECAL=NO;<br>CR-SPLIT=NO;<br>GAIN=1;<br>SIZEAXIS2=140          |               | Pattern 1, Exps 2-2 in C34-TITAN-STIS-MAP (01) (1) | 73 Secs (1095 Secs)<br>[==>(Pattern 1)]<br>[==>(Pattern 2)]<br>[==>(Pattern 3)]<br>[==>(Pattern 4)]<br>[==>(Pattern 5)]<br>[==>(Pattern 6)]<br>[==>(Pattern 7)]<br>[==>(Pattern 8)]<br>[==>(Pattern 9)]<br>[==>(Pattern 10)]<br>[==>(Pattern 11)]<br>[==>(Pattern 12)]<br>[==>(Pattern 13)]<br>[==>(Pattern 14)]<br>[==>(Pattern 15)] | [1]   |
|           | 3 | C34-TITAN-STIS-WAVE | WAVE      | STIS/CCD, ACCUM, 52X0.05   | G750L<br>7751 A |                                                                  |               |                                                    | [==>]                                                                                                                                                                                                                                                                                                                                 | [1]   |
|           | 4 | C34-TITAN-STIS-FLAT | CCDFLAT   | STIS/CCD, ACCUM, 52X0.05   | G750L<br>7751 A |                                                                  |               |                                                    | [==>(Copy 1)]<br>[==>(Copy 2)]                                                                                                                                                                                                                                                                                                        | [1]   |



# Proposal 18342 - C34-TITAN-WFC3-512 (02) - Observing Titan's Haze Distribution: One (Titan) Year Later

|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         |                                 |       |                              |  |  |  |
|----------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------|-----------------------------------|-----------------------------------|---------------|----------------------------------------------------------------------------|---------------|-------------------------|---------------------------------|-------|------------------------------|--|--|--|
| Visit                | Proposal 18342, C34-TITAN-WFC3-512 (02)                                                                                   |                         |                                   |                                   |               |                                                                            |               |                         |                                 |       | Wed Aug 19 14:00:17 GMT 2026 |  |  |  |
|                      | Diagnostic Status: Informational                                                                                          |                         |                                   |                                   |               |                                                                            |               |                         |                                 |       |                              |  |  |  |
|                      | Scientific Instruments: WFC3/UVIS                                                                                         |                         |                                   |                                   |               |                                                                            |               |                         |                                 |       |                              |  |  |  |
|                      | Special Requirements: (none)                                                                                              |                         |                                   |                                   |               |                                                                            |               |                         |                                 |       |                              |  |  |  |
| Diagnostics          | (C34-TITAN-WFC3-512 (02)) 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)                                                                                                                       | TITAN                   | STD=SATURN                        | STD=TITAN                         |               | NOT OCC OF TITAN BY SATURN FROM EARTH, SEP OF TITAN RHEA FROM EARTH GT 10" | EARTH         |                         |                                 |       |                              |  |  |  |
|                      | Comments: Description=SATELLITE TITAN                                                                                     |                         |                                   |                                   |               |                                                                            |               |                         |                                 |       |                              |  |  |  |
| Exposures            | #                                                                                                                         | Label                   | Target                            | Config,Mode,Aperture              | Spectral Els. | Opt. Params.                                                               | Special Reqs. | Groups                  | Exp. Time (Total)/[Actual Dur.] | Orbit |                              |  |  |  |
|                      | 1                                                                                                                         | C34-TITAN -WFC3-F43 8W  | (1) TITAN                         | WFC3/UVIS, ACCUM, UVIS2-C512C-SUB | F438W         | FLASH=20                                                                   |               |                         | 11 Secs X 2 (22 Secs)           |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 1)]                   |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 2)]                   |       | [1]                          |  |  |  |
|                      | 2                                                                                                                         | C34-TITAN -WFC3-F33 6W  | (1) TITAN                         | WFC3/UVIS, ACCUM, UVIS2-C512C-SUB | F336W         | FLASH=20                                                                   |               |                         | 64 Secs X 2 (128 Secs)          |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 1)]                   |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 2)]                   |       | [1]                          |  |  |  |
|                      | 3                                                                                                                         | C34-TITAN -WFC3-F67 3N  | (1) TITAN                         | WFC3/UVIS, ACCUM, UVIS2-C512C-SUB | F673N         | FLASH=20                                                                   |               |                         | 16 Secs X 2 (32 Secs)           |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 1)]                   |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 2)]                   |       | [1]                          |  |  |  |
|                      | 4                                                                                                                         | C34-TITAN -WFC3-F54 7M  | (1) TITAN                         | WFC3/UVIS, ACCUM, UVIS2-C512C-SUB | F547M         | FLASH=20                                                                   |               |                         | 5 Secs X 2 (10 Secs)            |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 1)]                   |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               |                         | [==>(Copy 2)]                   |       | [1]                          |  |  |  |
|                      | 5                                                                                                                         | C34-TITAN -WFC3-FQ8 89N | (1) TITAN                         | WFC3/UVIS, ACCUM, UVIS-QUAD-SUB   | FQ889N        | FLASH=20                                                                   |               |                         | 305 Secs X 2 (610 Secs)         |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               | [==>(Copy 1)]           |                                 |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               | [==>(Copy 2)]           |                                 | [1]   |                              |  |  |  |
| 6                    | C34-TITAN -WFC3-F95 3N                                                                                                    | (1) TITAN               | WFC3/UVIS, ACCUM, UVIS2-C512C-SUB | F953N                             | FLASH=20      |                                                                            |               | 175 Secs X 2 (350 Secs) |                                 |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               | [==>(Copy 1)]           |                                 |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               | [==>(Copy 2)]           |                                 | [1]   |                              |  |  |  |
| 7                    | C34-TITAN -WFC3-F77 5W                                                                                                    | (1) TITAN               | WFC3/UVIS, ACCUM, UVIS2-C512C-SUB | F775W                             | FLASH=20      |                                                                            |               | 4 Secs X 2 (8 Secs)     |                                 |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               | [==>(Copy 1)]           |                                 |       |                              |  |  |  |
|                      |                                                                                                                           |                         |                                   |                                   |               |                                                                            |               | [==>(Copy 2)]           |                                 | [1]   |                              |  |  |  |

