# 15870 - Search for UV aurora from the Brown Dwarf 2MASS J1237+6526

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) 2MASS-J12373919+6526148 | STIS/CCD<br>STIS/FUV-MAMA<br>STIS/NUV-MAMA | 2 | 25-Feb-2020 10:01:19.0 | yes |
| 02 | (1) 2MASS-J12373919+6526148 | STIS/CCD<br>STIS/FUV-MAMA | 3 | 25-Feb-2020 10:01:22.0 | yes |

5 Total Orbits Used

**ABSTRACT**

The T6.5 brown dwarf 2MASS J1237+6526, in the following abbreviated as 2M-1237, displays exceptionally bright H-alpha emission among late L- and T-dwarfs. It also exhibits circularly polarised radio emission indicating that 2M-1237 possesses a very strong surface magnetic field of at least 2.9 kG. Here we propose to observe the spectrum of 2M-1237 through the UV to test whether the radio and H-alpha emission is due to auroral processes similar to those known from the massive magnetized planets of the solar system or if the cool T6.5 dwarf has UV properties similar to those of low mass stars. Based on observed UV spectra of Jupiter and a very late M-dwarf, both scenarios are detectable with sufficient signal to noise. First observations of UV aurora outside of the solar system would be highly exciting. Detection of auroral emission would provide a new means to detect or provide constraints on a close-in planet or gas torus around the dwarf 2M-1237. The proposed observations also serve as a benchmark study whether UV emission from other brown dwarfs with less intense H-alpha and radio emission can be detected in the future.

**OBSERVING DESCRIPTION**

We will use STIS with three different gratings to explore the UV emission of the brown dwarf 2M-1237 over a broad spectral range and to search for auroral emission. We propose 2 visits. Visit 1 constains one orbit for the Ly-wings and one orbit at NUV wavlengths. Visit 2 contains three consecutive orbits in the FUV (without Ly-alpha) to resolve possible time-variability

NUV-Range

We will use STIS and first order grating G230L (1570-3180 A) to investigate and confirm the emission from 2M-1237 in the NUV range. The grating has a dispersion of 1.58 A/pixel and an average throughput of approximately 0.01. Because geocoronal light is not an issue at the wavelengths of interest, we will use the 52" x 0.2" slit.  We expect to detect the Mg II doublet near 2800 A with a S/N = 6 within one HST orbit of approx. 40 min (Fig. 2b). We will additionally search for other lines typical of chromospheric emission known from M-dwarfs in this band pass, e.g., Fe II.

FUV-Range without Ly-ALPHA

We will use STIS and first order grating G140L (1150-1730 A) in order to investigate the auroral FUV emission, its spectral structure and time-variability. The grating has a dispersion of 0.6 A/pixel and an average throughput of approximately 0.015. Similarly to the NUV-range, we will use the 52" x 0.2" slit. Depending on the physics driving the emission within the FUV-range we expect an S/N up to 9. To resolve possible time-variability we ask the three orbits in the FUV to be consecutive.

Ly-ALPHA wings

We will use STIS and first order grating G140M (1190-1245 A) at central wavelength = 1218 A to observe the Ly-ALPHA wings. STIS with this grating provides a good compromise between spectral resolution and sensitivity. The dispersion of the grating is 0.04 A/pixel. The throughput at Ly-ALPHA wavelengths Lambda_Ly-ALPHA =1215.67 A is ~0.015. We use the 52 arcsec x 0.2 arcsec slit to minimize the geocoronal background. We expect to detect the Ly-ALPHA wings with an S/N of approx. 5.

We need to observe in Earth shadow and ask for a maximum angular separation between the sun and 2M-1237 to minimize geocoronal effects.

## Visit

**Proposal 15870, 2-Orbit Visit (01), completed** Tue Feb 25 15:01:22 GMT 2020

**Diagnostic Status: Warning**

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

Special Requirements: (none)

## Diagnostics

(2-Orbit Visit (01)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | 2MASS-J12373919+6526148 | RA: 12 37 39.1963 (189.4133179d)<br>Dec: +65 26 14.81 (65.43745d)<br>Equinox: J2000 | Proper Motion RA: -1.002 arcsec/yr<br>Proper Motion Dec: -0.525 arcsec/yr<br>Parallax: 0.09607"<br>Epoch of Position: 1999.1973 | V=25.0<br>Spectral Type: T6.5; J (V): 16.053 [0.087],<br>H (V): 15.739 [0.145],<br>K (V): 16.40 [0.10],<br>u (AB): 25.06 [0.97],<br>g (AB): 24.96 [0.61],<br>r (AB): 24.55 [0.65],<br>i (AB): 23.54 [0.62],<br>z (AB): 19.57 [0.08] (Fluxes in order of: filter-name (system): flux-value [error]; reference: SIMBAD) | Reference Frame: ICRS |

*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*

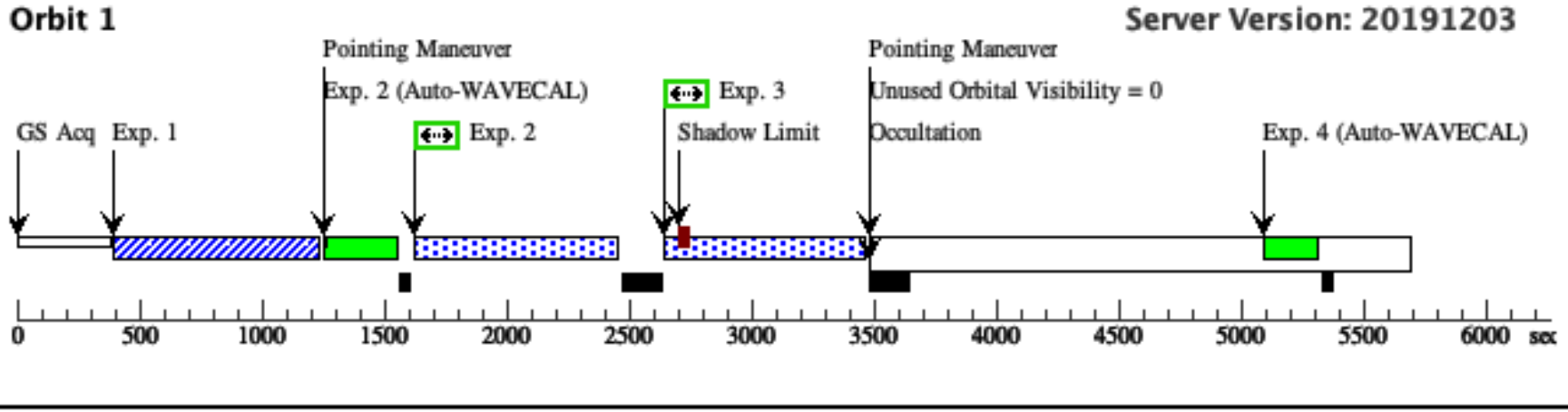
*The V-magnitude is not been determined to the proposer's knowledge. It is at least V=25, but might be 26, 27, ...*
*Category=STAR*
*Description=[BROWN DWARF]*

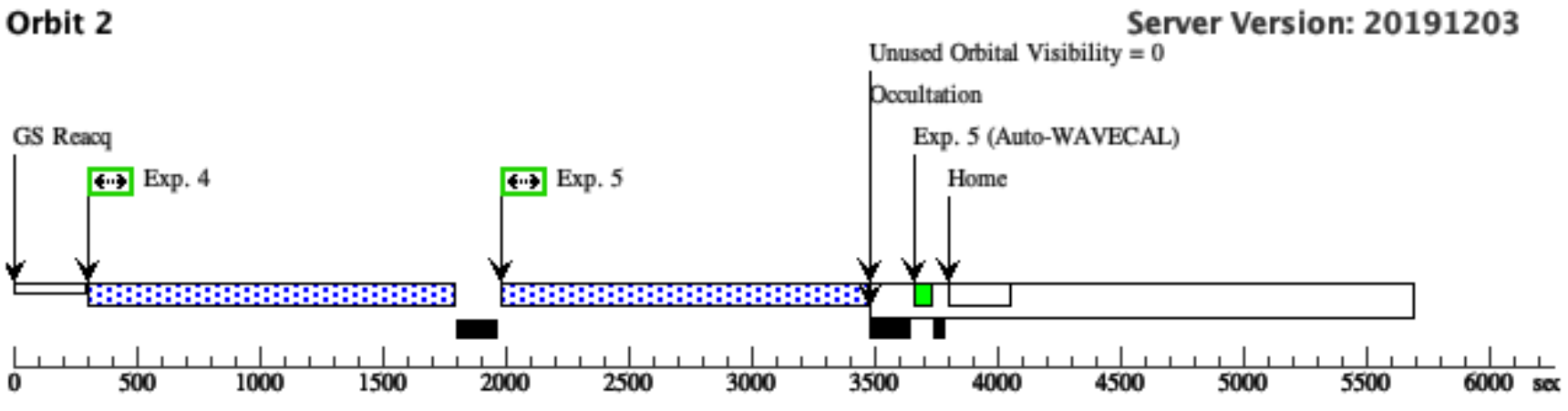
## Proposal 15870 - 2-Orbit Visit (01) - Search for UV aurora from the Brown Dwarf 2MASS J1237+6526

**Exposures**

| # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Acquisition (STIS.ta.1368337) | (1) 2MASS-J12373919+6526148 | STIS/CCD, ACQ, 50CCD | MIRROR | | | | 150 Secs (150 Secs)<br>*[==>]* | ***[1]*** |
| | *Comments: For the acquisition we used wavelength dependent flux measurements for lambda >6000 A obtained by Burgasser et al. 2002 and Liebert & Burgasser 2007.* | | | | | | | | |
| 2 | Ly-ALPHA-Science (STIS.sp.1368376) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140M 1218 A | BUFFER-TIME=1000 | SHADOW | | 814 Secs (814 Secs)<br>*[==>]* | ***[1]*** |
| | *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | |
| 3 | Ly-ALPHA-Science (STIS.sp.1368376) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140M 1218 A | BUFFER-TIME=1000 | SHADOW | | 807 Secs (807 Secs)<br>*[==>]* | ***[1]*** |
| | *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | |
| 4 | NUV-Science-1 (STIS.sp.1368378) | (1) 2MASS-J12373919+6526148 | STIS/NUV-MAMA, TIME-TAG, 52X0.2 | G230L 2376 A | BUFFER-TIME=1000 | | | 1475 Secs (1475 Secs)<br>*[==>]* | ***[2]*** |
| | *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | |
| 5 | NUV-Science-2 (STIS.sp.1368378) | (1) 2MASS-J12373919+6526148 | STIS/NUV-MAMA, TIME-TAG, 52X0.2 | G230L 2376 A | BUFFER-TIME=1000 | | | 1475 Secs (1475 Secs)<br>*[==>]* | ***[2]*** |
| | *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | |

Orbit Structure



## Visit

**Proposal 15870, 3-Orbit Visit (02), implementation** Tue Feb 25 15:01:23 GMT 2020

**Diagnostic Status: Warning**

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

Special Requirements: AFTER_01 BY 0 D TO 120 D

## Diagnostics

(3-Orbit Visit (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

(3-Orbit Visit (02)) Warning (Orbit Planner): ORBITAL VISIBILITY OVERRUN

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | 2MASS-J12373919+6526148 | RA: 12 37 39.1963 (189.4133179d)<br>Dec: +65 26 14.81 (65.43745d)<br>Equinox: J2000 | Proper Motion RA: -1.002 arcsec/yr<br>Proper Motion Dec: -0.525 arcsec/yr<br>Parallax: 0.09607"<br>Epoch of Position: 1999.1973 | V=25.0<br>Spectral Type: T6.5; J (V): 16.053 [0.087],<br>H (V): 15.739 [0.145],<br>K (V): 16.40 [0.10],<br>u (AB): 25.06 [0.97],<br>g (AB): 24.96 [0.61],<br>r (AB): 24.55 [0.65],<br>i (AB): 23.54 [0.62],<br>z (AB): 19.57 [0.08] (Fluxes in order of: filter-name (system): flux-value [error]; reference: SIMBAD) | Reference Frame: ICRS |

*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*

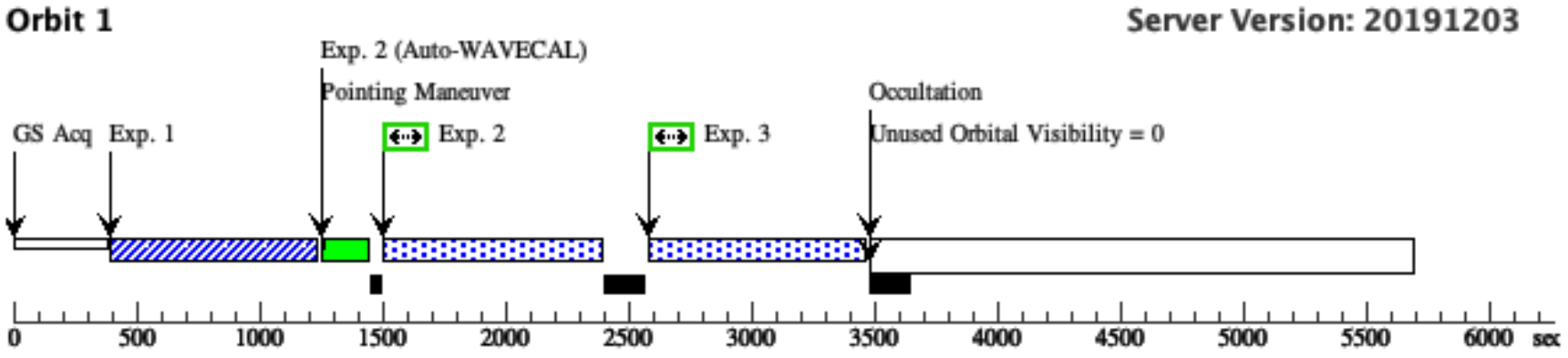
*The V-magnitude is not been determined to the proposer's knowledge. It is at least V=25, but might be 26, 27, ...*
*Category=STAR*
*Description=[BROWN DWARF]*

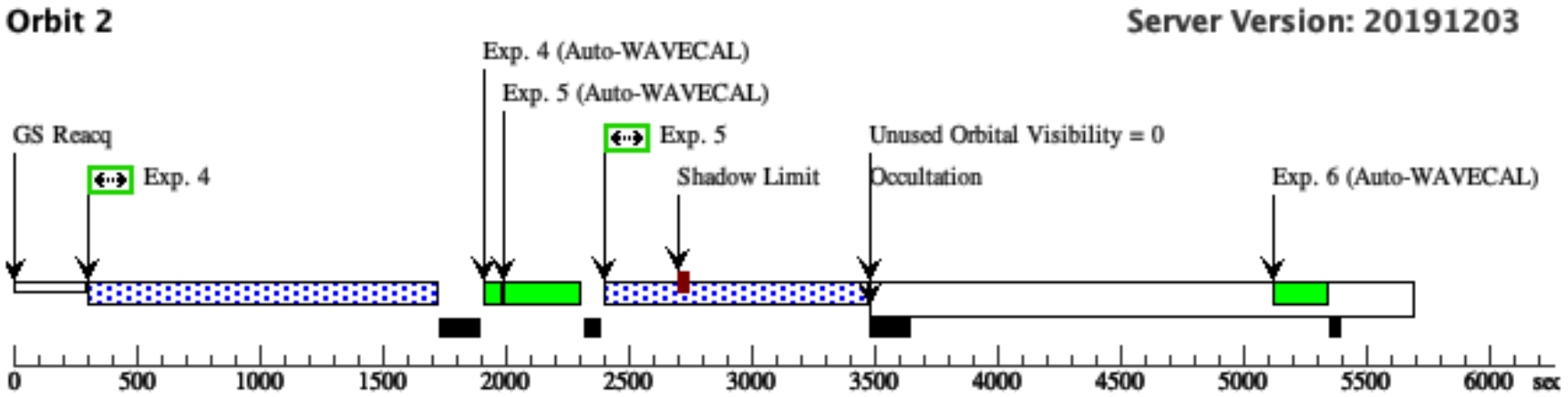
## Proposal 15870 - 3-Orbit Visit (02) - Search for UV aurora from the Brown Dwarf 2MASS J1237+6526

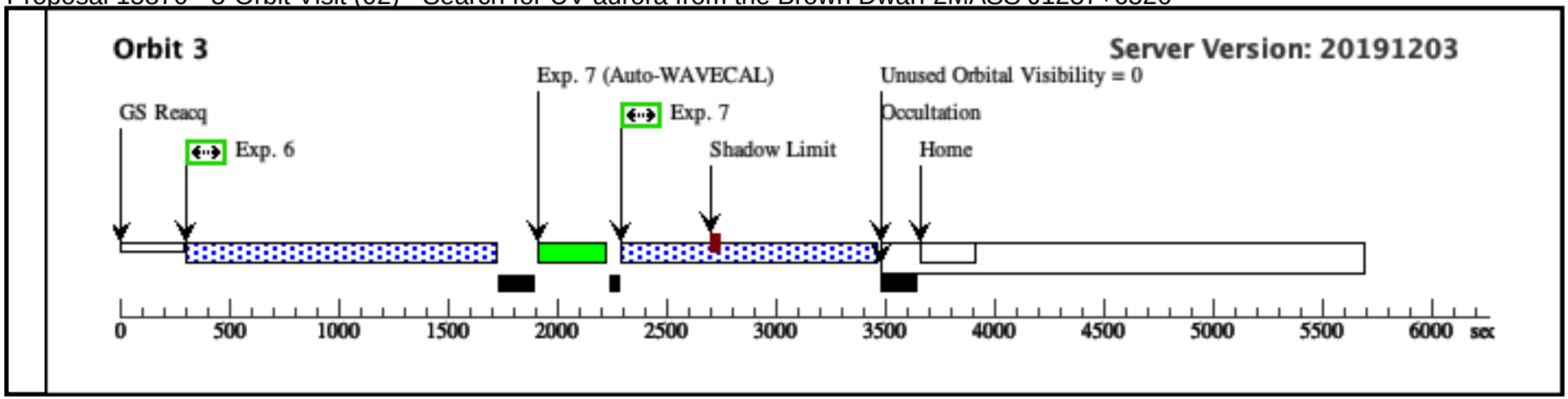
**Exposures**

| # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Acquisition (STIS.ta.1368337) | (1) 2MASS-J12373919+6526148 | STIS/CCD, ACQ, 50CCD | MIRROR | | | | 150 Secs (150 Secs)<br>*[==>]* | ***[1]*** |
| *Comments: For the acquisition we used wavelength dependent flux measurements for lambda >6000 A obtained by Burgasser et al. 2002 and Liebert & Burgasser 2007.* | | | | | | | | | |
| 2 | FUV-Science (STIS.sp.1368379) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140L 1425 A | BUFFER-TIME=1000 | | | 872 Secs (872 Secs)<br>*[==>]* | ***[1]*** |
| *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | | |
| 3 | FUV-Science (STIS.sp.1368379) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140L 1425 A | BUFFER-TIME=1000 | | | 871 Secs (871 Secs)<br>*[==>]* | ***[1]*** |
| *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | | |
| 4 | FUV-Science (STIS.sp.1368379) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140L 1425 A | BUFFER-TIME=750 | | | 1404 Secs (1404 Secs)<br>*[==>]* | ***[2]*** |
| *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | | |
| 5 | Ly-ALPHA-Science (STIS.sp.1368376) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140M 1218 A | BUFFER-TIME=1000 | SHADOW | | 1055 Secs (1055 Secs)<br>*[==>]* | ***[2]*** |
| *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | | |
| 6 | FUV-Science (STIS.sp.1368379) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140L 1425 A | BUFFER-TIME=750 | | | 1404 Secs (1404 Secs)<br>*[==>]* | ***[3]*** |
| *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | | |
| 7 | Ly-ALPHA-Science (STIS.sp.1368376) | (1) 2MASS-J12373919+6526148 | STIS/FUV-MAMA, TIME-TAG, 52X0.2D1 | G140M 1218 A | BUFFER-TIME=1000 | SHADOW | | 1159 Secs (1159 Secs)<br>*[==>]* | ***[3]*** |
| *Comments: Exposure time calculator generates unrelatistic long exposure times as it calculates S/N for each resolution element. We will integrate flux over all wavenlengths or target certain lines within the spectrum, see feasibility discussion in proposal.* | | | | | | | | | |

Orbit Structure

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