17477 - HST Spectroscopy of a Fast-Rising Luminous Ultraviolet Transient

Cycle: 31, Proposal Category: GO
(Proposal Category: GO)
(Availability Mode: SUPPORTED)

INVESTIGATORS

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Daniel Perley</td>
<td>Liverpool John Moores University</td>
</tr>
<tr>
<td>Dr. Lin Yan</td>
<td>California Institute of Technology</td>
</tr>
<tr>
<td>Anna Yen Qin Ho</td>
<td>Cornell University</td>
</tr>
<tr>
<td>Prof. Shrinivas R. Kulkarni</td>
<td>California Institute of Technology</td>
</tr>
<tr>
<td>Dr. Christoffer Fremling</td>
<td>California Institute of Technology</td>
</tr>
<tr>
<td>Dr. Ragnhild Lunnan</td>
<td>Stockholm University</td>
</tr>
</tbody>
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VISITS

<table>
<thead>
<tr>
<th>Visit</th>
<th>Targets used in Visit</th>
<th>Configurations used in Visit</th>
<th>Orbits Used</th>
<th>Last Orbit Planner Run</th>
<th>OP Current with Visit?</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>(1) TOO</td>
<td>COS/FUV, COS/NUV</td>
<td>2</td>
<td>08-Sep-2023 13:00:15.0</td>
<td>yes</td>
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<tr>
<td>02</td>
<td>(1) TOO</td>
<td>COS/FUV, COS/NUV</td>
<td>2</td>
<td>08-Sep-2023 13:00:16.0</td>
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<tr>
<td>03</td>
<td>(1) TOO</td>
<td>STIS/CCD, STIS/NUV-MAMA</td>
<td>2</td>
<td>08-Sep-2023 13:00:17.0</td>
<td>yes</td>
</tr>
</tbody>
</table>

6 Total Orbits Used

ABSTRACT
High-cadence time-domain surveys have unveiled a population of fast-evolving, luminous extragalactic transients with SEDs that remain dominated by ultraviolet emission for long after peak and also exhibit luminous X-ray and radio counterparts. While they show some observational similarities with strongly-interacting supernovae, optical follow-up has failed to identify any recognizable supernova features and the extreme properties of these events strain theoretical models for what is possible in a supernova explosion. Ultraviolet spectroscopy has the power to reveal similarities or differences between this event and other supernova classes not apparent from optical observations alone, and offers a means of identifying the progenitor star via transmission spectroscopy of the dense stellar wind before the explosion sweeps it up. We propose to obtain target-of-opportunity UV spectroscopy of a new event of this type in Cycle 31 or 32 to secure the physical origins of this class while HST's unique UV spectroscopic resource is still available.

**OBSERVING DESCRIPTION**

Our objective is to carry out low-resolution FUV and NUV spectroscopy of a fast-luminous UV transient with COS (G140L) and STIS (G230L). Fast turnaround is helpful for many reasons - both to optimize the S/N (the target will not be bright) and to decrease the risk of acquisition failure if the target's UV flux evolution is different than expected. A turnaround of up to 1 week is acceptable, although for a sufficiently nearby event we may accept a longer delay. Using fewer guide stars may be acceptable to achieve faster turnaround. It is desirable in principle to obtain the COS and STIS observations close in time to each other but observing sooner in one band will almost always be preferred if the option is available.

Rapid two-way communication with STScI will be necessary to correctly configure the observations and perform all safety checks to ensure a successful acquisition. The PI's mobile number is +44 745 6339330 and can be contacted 24 hours a day.
Visit

Proposal 17477, COS FUV spectrum (01)
Diagnostic Status: No Diagnostics
Scientific Instruments: COS/FUV, COS/NUV
Special Requirements: ON HOLD; TOO RESPONSE TIME 4.0D
Comments: Exposure times will need to be changed depending on the visibility of the actual target at time of trigger.
On Hold Comments: Target of opportunity awaiting a suitable trigger from ZTF or another survey. The anticipated rate of fading is 0.25 mag/day, so sooner observations is always better. A longer response may be acceptable depending on the initial brightness of the event.

Generic Targets

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>TOO</td>
<td>Fast rise (&lt;3 days) to high luminosity (M ~ -20) without cooling</td>
<td>SUPERNOVA</td>
</tr>
</tbody>
</table>

Comments: The target will be identified from ZTF or potentially another high-cadence optical survey. The trigger will be submitted at or after peak and there will be a clear upper limit on the flux of the target based on this. The source will probably be close to V=18.5, UV=17.5 mag at peak (AB). The source is expected to fade rapidly after peak, but this is difficult to project. The target is a point source and we expect it will be brighter than its host galaxy (in UV) but will confirm at the time of triggering.

Exposures

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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acquisition (COS.ta.152 9624)</td>
<td>(1) TOO</td>
<td>COS/NUV, ACQ/IMAGE, PSA</td>
<td>MIRRORB</td>
<td></td>
<td></td>
<td></td>
<td>180 Secs (180 Secs)</td>
<td>[1]</td>
</tr>
</tbody>
</table>

Comments: There will be uncertainty in the target magnitude, although most of the uncertainty will be in the downward direction (how fast will it fade) once the time of observation is determined.

| 2 | COS spectrum (COS.sp.152 9625) | (1) TOO | COS/FUV, TIME-TAG, PSA | G140L 1105 A | FLASH=YES; BUFFER-TIME=64 00; FP-POS=ALL | | | 1000 Secs (4454 Secs) | [1] |

Comments: The exposure times will need to be changed depending on the visibility of the actual target at time of trigger.
Orbit Structure

Orbit 1

- GS Acq
- Exp. 1
- Pointing Maneuver
- Exp. 2, split 1
- Exp. 2, split 2
- Unused Orbital Visibility = 1
- Occultation

Orbit 2

- GS Reacq
- Exp. 2, split 3
- Exp. 2, split 4
- Unused Orbital Visibility = 1
- Occultation
- Home

Server Version: 20230626
Proposal 17477 - COS FUV spectrum (02) - HST Spectroscopy of a Fast-Rising Luminous Ultraviolet Transient

Visit

Proposal 17477, COS FUV spectrum (02)
Diagnostic Status: No Diagnostics
Scientific Instruments: COS/FUV, COS/NUV
Special Requirements: ON HOLD ; TOO RESPONSE TIME 4.0D
Comments: Exposure times will need to be changed depending on the visibility of the actual target at time of trigger.
This visit is currently identical to the other COS visit. The observation is broken into two separate visits to increase scheduling flexibility. Our general expectation is that the two visits will be executed back to back, but if the TOO target is sufficiently bright we may request a time constraint on the second visit to delay the observation for a few days to study time evolution.
On Hold Comments: Target of opportunity awaiting a suitable trigger from ZTF or another survey. The anticipated rate of fading is 0.25 mag/day, so sooner observations is always better. A longer response may be acceptable depending on the initial brightness of the event.

Generic Targets

# Name Criteria Description
(1) TOO Fast rise (<3 days) to high luminosity (M ~ -20) without cooling SUPERNOVA
Comments: The target will be identified from ZTF or potentially another high-cadence optical survey. The trigger will be submitted at or after peak and there will be a clear upper limit on the flux of the target based on this. The source will probably be close to V=18.5, UV=17.5 mag at peak (AB). The source is expected to fade rapidly after peak, but this is difficult to project. The target is a point source and we expect it will be brighter than its host galaxy (in UV) but will confirm at the time of triggering.

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<td>180 Secs (180 Secs)</td>
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<td>COS spectrum (COS.sp.152 9625)</td>
<td>(1) TOO</td>
<td>COS/FUV, TIME-TAG, PSA</td>
<td>G140L 1105 A</td>
<td>FLASH=YES; BUFFER-TIME=64 00; FP-POS=ALL</td>
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<td>1000 Secs (4454 Secs)</td>
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Proposal 17477 - COS FUV spectrum (02) - HST Spectroscopy of a Fast-Rising Luminous Ultraviolet Transient

**Orbit Structure**

**Orbit 1**
- GS Acq
- Exp. 1
- Pointing Maneuver
- Exp. 2, split 1
- Exp. 2, split 2
- Unused Orbital Visibility = 1
- Occultation

**Orbit 2**
- GS Reacq
- Exp. 2, split 3
- Exp. 2, split 4
- Unused Orbital Visibility = 1
- Occultation
- Home

Server Version: 20230626
Proposal 17477 - STIS NUV spectrum (03) - HST Spectroscopy of a Fast-Rising Luminous Ultraviolet Transient

Visit

Proposal 17477, STIS NUV spectrum (03)

Diagnostic Status: No Diagnostics

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

Special Requirements: ON HOLD ; TOO RESPONSE TIME 4.0D

Comments: Exposure times will need to be changed depending on the visibility of the actual target at time of trigger.

On Hold Comments: Target of opportunity awaiting a suitable trigger from ZTF or another survey. The anticipated rate of fading is 0.25 mag/day, so sooner observations is always better. A longer response may be acceptable depending on the initial brightness of the event.

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<tbody>
<tr>
<td>1</td>
<td>Acquisition (STIS.ta.1527057)</td>
<td>(1) TOO</td>
<td>STIS/CCD, ACQ, F28X50LP</td>
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<td>60 Secs (60 Secs)</td>
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Comments: There will be uncertainty in the target magnitude, and it is very important that the acquisition succeeds in spite of this, so we will likely want to execute an acquisition exposure longer than one might normally choose for the estimated magnitude.

Exposures

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<tbody>
<tr>
<td>2</td>
<td>STIS orbit 1 (STIS.sp.1527040)</td>
<td>(1) TOO</td>
<td>STIS/NUV-MAMA, TIME-TAG, 52X0.2</td>
<td>G230L 2376 A</td>
<td>BUFFER-TIME=66 3</td>
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<td></td>
<td>2100 Secs (1926 Secs)</td>
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</tbody>
</table>

Comments: There will be uncertainty in the target magnitude, and it is very important that the acquisition succeeds in spite of this, so we will likely want to execute an acquisition exposure longer than one might normally choose for the estimated magnitude.

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</thead>
<tbody>
<tr>
<td>3</td>
<td>STIS orbit 2 (STIS.sp.1527040)</td>
<td>(1) TOO</td>
<td>STIS/NUV-MAMA, TIME-TAG, 52X0.2</td>
<td>G230L 2376 A</td>
<td>BUFFER-TIME=66 3</td>
<td></td>
<td></td>
<td>2100 Secs (2716 Secs)</td>
<td></td>
</tr>
</tbody>
</table>

Comments: There will be uncertainty in the target magnitude, and it is very important that the acquisition succeeds in spite of this, so we will likely want to execute an acquisition exposure longer than one might normally choose for the estimated magnitude.
Proposal 17477 - STIS NUV spectrum (03) - HST Spectroscopy of a Fast-Rising Luminous Ultraviolet Transient

Orbit 1
- GS Acq
- Exp. 1
- Pointing Maneuver
- Exp. 2 (Auto-WAVECAL)
- Unused Orbital Visibility = 0
- Occultation

Orbit 2
- GS Reacq
- Exp. 3
- Unused Orbital Visibility = 0
- Occultation
- Exp. 3 (Auto-WAVECAL)
- Home