



# 4967 - Dwarfs of Fire and Ice: Mapping the Irradiated Atmospheres of White Dwarf-Brown Dwarf Binaries with NIRSpec PRISM Phase Curves

Cycle: 3, Proposal Category: GO

## INVESTIGATORS

| <i>Name</i>                              | <i>Institution</i>                                      |
|--|---|
| <b>Dr. Yifan Zhou (PI)</b>               | <b>The University of Virginia</b>                       |
| Prof. Daniel Apai (CoI)                  | University of Arizona                                   |
| Ben Wei Peng Lew (CoI)                   | Bay Area Environmental Research Institute               |
| Dr. Mark S. Marley (CoI)                 | University of Arizona                                   |
| Dr. Laura C Mayorga (CoI)                | The Johns Hopkins University Applied Physics Laboratory |
| Dr. Vivien Parmentier (CoI) (ESA Member) | Universite Cote d Azur                                  |
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| Dr. Sarah Casewell (CoI) (ESA Member)    | University of Leicester                                 |
| Dr. Joshua D. Lothringer (CoI)           | Space Telescope Science Institute                       |
| Dr. Siyi Xu (CoI)                        | NOIRLab - Gemini North (HI)                             |
| Rachael C Amaro (CoI)                    | University of Arizona                                   |
| Ms. Jenni French (CoI) (ESA Member)      | University of Leicester                                 |

## OBSERVATIONS

| <i>Folder</i>      | <i>Observation</i> | <i>Label</i> | <i>Observing Template</i>         | <i>Science Target</i> |
|--------------------|--------------------|--------------|-----------------------------------|-----------------------|
| Observation Folder |                    |              |                                   |                       |
|                    | 1                  | WD1202       | NIRSpec Bright Object Time Series | (1) WD1202            |
|                    | 2                  | WD-0137-349  | NIRSpec Bright Object Time Series | (2) WD0137            |
|                    | 3                  | SDSS1411     | NIRSpec Bright Object Time Series | (3) SDSS1411          |
|                    | 4                  | ZTF0038      | NIRSpec Bright Object Time Series | (5) ZTFJ0038+2030     |
|                    | 5                  | WD1032       | NIRSpec Bright Object Time Series | (4) WD1032            |

## **ABSTRACT**

Spectral phase curves are the most powerful tool for probing the processes that shape the three-dimensional structures in tidally-locked and highly irradiated atmospheres. White dwarf-brown dwarf (WD-BD) binary systems, characterized by high phase-curve amplitudes and short orbital periods, are particularly advantageous for such observations. Phase-resolved spectroscopy of these irradiated brown dwarfs offers the most rigorous validation for planetary atmospheric and circulation models.

We propose NIRSpec PRISM BOT observations of five WD-BD binaries. Our targets straddle the temperature ranges of hot and ultra-hot Jupiters. The extremely high signal-to-noise spectral phase curves allow us to map the thermal profiles, clouds, and molecular features in the five irradiated brown dwarfs. These maps constrain four key processes --- circulation, vertical mixing, condensate clouds, and photochemistry --- and their impact on the spectral appearance of planetary atmospheres. The high-precision phase curves will challenge planetary atmospheric models and thereby catalyzing breakthroughs in the atmospheric characterization of exoplanets. NIRSpec PRISM's unparalleled time-series capabilities and wavelength coverage are indispensable for achieving our scientific objectives.

## **OBSERVING DESCRIPTION**

We will conduct NIRSpec/Prism bright object time series (BOT) observations of five white dwarf/ brown dwarf binaries. The aim of the observations is to obtain 0.6-5.3 micron thermal emission phase curves of the brown dwarfs.

Instrument setups for the observation of each target are almost identical. Before the spectroscopic observations, one set of target acquisition exposures will be taken. The target acquisition images will have SNRs above 25. The Sub512 subarray will be used. Exposure readout pattern will be NRS for all five targets. The groups per integration numbers are set to maximize the SNR and ensure good cadence. And the total integration number is set to ensure the target is monitored for one period. ETC predicts that the SNRs per resolution unit are above 140 at 1.2 microns and above 20 at 4.5 microns for one integration in all three cases. After binning the phase curves to a cadence of 10 samples per period, the average SNRs are above 150 per resolution units for all cases. These are sufficient for our science goals.

Because our observations are time series, we require no parallel observations to be scheduled.

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March 7: New phase constraints added to Observation 3 and 5.

Rationale is the same as Observation 4: avoid target acquisition to occur during the eclipse

Observation 3: The Ephemeris for SDSS1411 is refined by a recent ground-based observations

$P = 0.08453275008 \pm 0.00000000012$  days

$T_0 = 2460702.0535490$  (BJD)

Eclipse duration: 0.04 of a full phase.

5-sigma Transit timing uncertainties in Aug 2025: 0.005 of a full phase

Time difference between WATA and the start of the observations: 20 minutes, or 0.16 of a full phase.

To ensure the start of the observation is 5-sigma away from the eclipse, minimal starting phase:  $0.04 + 0.005 + 0.16 = 0.20$

To ensure the eclipse happens at least 20 minutes (0.16 of a full phase) after the start of the observations: maximum phase is 0.84

To satisfy the requirement of "A visit's scheduling duration may not be longer than the gap between PHASE ranges," we double the periods and use halves of the two phases.

The final phase constraints for Observation 3:

Period = 0.1690655002 days

$T_0 = 2460702.0535490$

minimum phase = 0.10

maximum phase = 0.42

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Observation 4: Ephemeris from Casewell et al. 2020 (<https://academic.oup.com/mnras/article/497/3/3571/5892577>)

$P = 0.09155899610(45)$

## JWST Proposal 4967 (Created: Tuesday, March 11, 2025, 11:00:15AM Eastern Standard Time) - Overview

$T_0 = 2458381.7439008(10)$  (BJD)

Eclipse duration: 0.05 of a full phase

5-sigma Transit timing uncertainties in Aug 2025: 0.007 of a full phase

Time difference between WATA and the start of the observations: 20 minutes, or 0.15 of a full phase.

To ensure the start of the observation is 5-sigma away from the eclipse, minimal starting phase:  $0.05 + 0.007 + 0.15 = 0.20$

To ensure the eclipse happens at least 20 minutes (0.15 of a full phase) after the start of the observations: maximum phase is 0.85

To satisfy the requirement of "A visit's scheduling duration may not be longer than the gap between PHASE ranges," we double the periods and use halves of the two phases.

The final phase constraints for Observation 4:

Period = 0.1831179922 days

$T_0 = 2458381.7439008$

minimum phase = 0.10

maximum phase = 0.425

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Phase constraint is applied to Observation 4 (ZTF0038), an eclipsing system with a cold brown dwarf. The phase constraint is applied to ensure target acquisition does not occur during the eclipse.

ZTF0038's system ephemeris based on van Roestel+2021 (<https://ui.adsabs.harvard.edu/abs/2021ApJ...919L..26V/abstract>):

$P = 0.4319208 \pm 0.0000014$  days

$T_0$  (defined as transit midtime) = 2459045.985194 (BJD)

Eclipse duration: 0.013 of a full phase

## JWST Proposal 4967 (Created: Tuesday, March 11, 2025, 11:00:15AM Eastern Standard Time) - Overview

Transit timing uncertainties in Dec 2024: 0.0052 days or 0.012 of a full phase

Time difference between WATA and the start of the observations: 20 minutes or 0.03 of a full phase

To ensure the start of the observation is 10-sigma away from the eclipse, the minimal starting phase is  $0.013 + 0.012 * 10 + 0.03 = 0.16$

The maximum starting phase should ensure the eclipse happens at least 30 minutes (0.05 of a full phase) after the start of the observations. So the maximum phase is 0.95.

To satisfy the requirement of "A visit's scheduling duration may not be longer than the gap between PHASE ranges," we double the periods and use halves of the two phases.

The final phase constraints for Observation 4:

Period = 0.8638416 days

T0 = 2459045.985194 (HJD)

minimum phase = 0.08

maximum phase = 0.475

Proposal 4967 - Targets - Dwarfs of Fire and Ice: Mapping the Irradiated Atmospheres of White Dwarf-Brown Dwarf Binaries with NIR...

| #   | Name          | Target Coordinates  | Targ. Coord. Corrections   | Miscellaneous |
|---|---------------|---|--|---------------|
| (1)   | WD1202        | RA: 12 05 15.8130 (181.3158875d)<br>Dec: -02 42 22.75 (-2.70632d)<br>Equinox: J2000 | Proper Motion RA: -19.760 mas/yr<br>Proper Motion Dec: 9.059 mas/yr<br>Parallax: 0.0015038"<br>Epoch of Position: 2000   |               |
| <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i><br/>           Category=Star<br/>           Description=[Brown dwarfs, White dwarfs]<br/>           Extended=NO</p> |               |   |  |               |
| (2)   | WD0137        | RA: 01 39 42.8532 (24.9285550d)<br>Dec: -34 42 39.58 (-34.71099d)<br>Equinox: J2000 | Proper Motion RA: -42.059 mas/yr<br>Proper Motion Dec: -48.895 mas/yr<br>Parallax: 0.0098472"<br>Epoch of Position: 2000 |               |
| <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i><br/>           Category=Star<br/>           Description=[Brown dwarfs, White dwarfs]<br/>           Extended=NO</p> |               |   |  |               |
| (3)   | SDSS1411      | RA: 14 11 26.2221 (212.8592588d)<br>Dec: +20 09 11.04 (20.15307d)<br>Equinox: J2000 | Proper Motion RA: -45.928 mas/yr<br>Proper Motion Dec: 16.231 mas/yr<br>Parallax: 0.00565"<br>Epoch of Position: 2000    |               |
| <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i><br/>           Category=Star<br/>           Description=[Brown dwarfs, White dwarfs]<br/>           Extended=NO</p> |               |   |  |               |
| (4)   | WD1032        | RA: 10 34 48.9329 (158.7038871d)<br>Dec: +00 52 1.37 (.86705d)<br>Equinox: J2000    | Proper Motion RA: -94.813 mas/yr<br>Proper Motion Dec: 20.112 mas/yr<br>Parallax: 0.0032"<br>Epoch of Position: 2000     |               |
| <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i><br/>           Category=Star<br/>           Description=[White dwarfs]<br/>           Extended=NO</p>               |               |   |  |               |
| (5)   | ZTFJ0038+2030 | RA: 00 38 54.9991 (9.7291629d)<br>Dec: +20 30 26.15 (20.50726d)<br>Equinox: J2000   | Proper Motion RA: -24.288 mas/yr<br>Proper Motion Dec: -41.680 mas/yr<br>Parallax: 0.0071986"<br>Epoch of Position: 2000 |               |
| <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i><br/>           Category=Star<br/>           Description=[White dwarfs]<br/>           Extended=NO</p>               |               |   |  |               |

Fixed Targets

Proposal 4967 - Observation 1 - Dwarfs of Fire and Ice: Mapping the Irradiated Atmospheres of White Dwarf-Brown Dwarf Binaries wit...

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|                             |  |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
|-----------------------------|--|-----------------------|---|-------------------|-------------------------|--|----------------------|---------------------------|----------------------------|----------------------------|-------------------------|
| <b>Observation</b>          | <p><b>Proposal 4967, Observation 1: WD1202</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec Bright Object Time Series</p>   |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Diagnostics</b>          | (Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.  |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Fixed Targets</b>        | <b>#</b>   | <b>Name</b>           | <b>Target Coordinates</b>   |                   |                         | <b>Targ. Coord. Corrections</b>  |                      |                           | <b>Miscellaneous</b>       |                            |                         |
|                             | (1)  | WD1202                | RA: 12 05 15.8130 (181.3158875d)<br>Dec: -02 42 22.75 (-2.70632d)<br>Equinox: J2000 |                   |                         | Proper Motion RA: -19.760 mas/yr<br>Proper Motion Dec: 9.059 mas/yr<br>Parallax: 0.0015038"<br>Epoch of Position: 2000 |                      |                           |                            |                            |                         |
|                             | <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Brown dwarfs, White dwarfs]</i></p> <p><i>Extended=NO</i></p> |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Acquisition</b>          | <b>#</b>   | <b>Target</b>         | <b>TA Method</b>  | <b>Subarray</b>   | <b>Filter</b>           | <b>Readout Pattern</b>   | <b>Groups/Int</b>    | <b>Integrations/Exp</b>   | <b>Total Integrations</b>  | <b>Total Exposure Time</b> | <b>ETC Wkbk.Calc ID</b> |
|                             | 1  | 1 WD1202              | WATA  | SUB2048           | F110W                   | NRSRAPIDD6   | 3                    | 1                         | 1                          | 14.452                     | 171260.9                |
| <b>Template</b>             | <p>Subarray</p> <p>SUB512</p>  |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Spectral Elements</b>    | <b>#</b>   | <b>Grating/Filter</b> | <b>Readout Pattern</b>  | <b>Groups/Int</b> | <b>Integrations/Exp</b> | <b>Exposures/Dith</b>  | <b>Total Dithers</b> | <b>Total Integrations</b> | <b>Total Exposure Time</b> | <b>ETC Wkbk.Calc ID</b>    |                         |
|                             | 1  | PRISM/CLEAR           | NRS   | 120               | 50                      | 1  | 1                    | 50                        | 5440.172                   | 171260.5                   |                         |
| <b>Special Requirements</b> | <p>Time Series Observation</p> <p>No Parallel Attachments</p>  |                       |   |                   |                         |  |                      |                           |                            |                            |                         |

Proposal 4967 - Observation 2 - Dwarfs of Fire and Ice: Mapping the Irradiated Atmospheres of White Dwarf-Brown Dwarf Binaries wit...

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| <b>Observation</b>          | <p><b>Proposal 4967, Observation 2: WD-0137-349</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec Bright Object Time Series</p>   |   |  |                  |                 |               |                    |                     |                     |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
|-----------------------------|---|---|--|------------------|-----------------|---------------|--------------------|---------------------|---------------------|------------------|---|----------------|--------------------|--------------------------|------------------|-----------------|---------------|--------------------|---------------------|---------------------|------------------|-------------|----------|---|--|-------|----------|-----|----------|----------|------|-----------|
| <b>Diagnostics</b>          | (Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.   |   |  |                  |                 |               |                    |                     |                     |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| <b>Fixed Targets</b>        | <table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th colspan="4">Targ. Coord. Corrections</th> <th colspan="4">Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(2)</td> <td>WD0137</td> <td>RA: 01 39 42.8532 (24.9285550d)<br/>Dec: -34 42 39.58 (-34.71099d)<br/>Equinox: J2000</td> <td colspan="4">Proper Motion RA: -42.059 mas/yr<br/>Proper Motion Dec: -48.895 mas/yr<br/>Parallax: 0.0098472"<br/>Epoch of Position: 2000</td> <td colspan="4"></td> </tr> </tbody> </table> <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i><br/> <i>Category=Star</i><br/> <i>Description=[Brown dwarfs, White dwarfs]</i><br/> <i>Extended=NO</i></p> |   |  |                  |                 |               |                    |                     |                     |                  | # | Name           | Target Coordinates | Targ. Coord. Corrections |                  |                 |               | Miscellaneous      |                     |                     |                  | (2)         | WD0137   | RA: 01 39 42.8532 (24.9285550d)<br>Dec: -34 42 39.58 (-34.71099d)<br>Equinox: J2000 | Proper Motion RA: -42.059 mas/yr<br>Proper Motion Dec: -48.895 mas/yr<br>Parallax: 0.0098472"<br>Epoch of Position: 2000 |       |          |     |          |          |      |           |
| #                           | Name  | Target Coordinates  | Targ. Coord. Corrections   |                  |                 |               | Miscellaneous      |                     |                     |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| (2)                         | WD0137  | RA: 01 39 42.8532 (24.9285550d)<br>Dec: -34 42 39.58 (-34.71099d)<br>Equinox: J2000 | Proper Motion RA: -42.059 mas/yr<br>Proper Motion Dec: -48.895 mas/yr<br>Parallax: 0.0098472"<br>Epoch of Position: 2000 |                  |                 |               |                    |                     |                     |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| <b>Acquisition</b>          | <table border="1"> <thead> <tr> <th>#</th> <th>Target</th> <th>TA Method</th> <th>Subarray</th> <th>Filter</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>ETC Wkbk.Calc ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2 WD0137</td> <td>WATA</td> <td>SUB32</td> <td>CLEAR</td> <td>NRSRAPID</td> <td>3</td> <td>1</td> <td>1</td> <td>0.08</td> <td>171260.10</td> </tr> </tbody> </table>  |   |  |                  |                 |               |                    |                     |                     |                  | # | Target         | TA Method          | Subarray                 | Filter           | Readout Pattern | Groups/Int    | Integrations/Exp   | Total Integrations  | Total Exposure Time | ETC Wkbk.Calc ID | 1           | 2 WD0137 | WATA  | SUB32  | CLEAR | NRSRAPID | 3   | 1        | 1        | 0.08 | 171260.10 |
| #                           | Target  | TA Method   | Subarray   | Filter           | Readout Pattern | Groups/Int    | Integrations/Exp   | Total Integrations  | Total Exposure Time | ETC Wkbk.Calc ID |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| 1                           | 2 WD0137  | WATA  | SUB32  | CLEAR            | NRSRAPID        | 3             | 1                  | 1                   | 0.08                | 171260.10        |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| <b>Template</b>             | <p>Subarray</p> <p>SUB512</p>   |   |  |                  |                 |               |                    |                     |                     |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| <b>Spectral Elements</b>    | <table border="1"> <thead> <tr> <th>#</th> <th>Grating/Filter</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Exposures/Dith</th> <th>Total Dithers</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>ETC Wkbk.Calc ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>PRISM/CLEAR</td> <td>NRS</td> <td>20</td> <td>430</td> <td>1</td> <td>1</td> <td>430</td> <td>7885.959</td> <td>171260.1</td> </tr> </tbody> </table>  |   |  |                  |                 |               |                    |                     |                     |                  | # | Grating/Filter | Readout Pattern    | Groups/Int               | Integrations/Exp | Exposures/Dith  | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID    | 1                | PRISM/CLEAR | NRS      | 20  | 430  | 1     | 1        | 430 | 7885.959 | 171260.1 |      |           |
| #                           | Grating/Filter  | Readout Pattern   | Groups/Int   | Integrations/Exp | Exposures/Dith  | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID    |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| 1                           | PRISM/CLEAR   | NRS   | 20   | 430              | 1               | 1             | 430                | 7885.959            | 171260.1            |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |
| <b>Special Requirements</b> | <p>Time Series Observation</p> <p>No Parallel Attachments</p>   |   |  |                  |                 |               |                    |                     |                     |                  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |   |  |       |          |     |          |          |      |           |

Proposal 4967 - Observation 3 - Dwarfs of Fire and Ice: Mapping the Irradiated Atmospheres of White Dwarf-Brown Dwarf Binaries wit...

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|                             |  |                       |   |                   |                         |   |                      |                           |                            |                            |                         |
|-----------------------------|--|-----------------------|---|-------------------|-------------------------|---|----------------------|---------------------------|----------------------------|----------------------------|-------------------------|
| <b>Observation</b>          | <p><b>Proposal 4967, Observation 3: SDSS1411</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec Bright Object Time Series</p>   |                       |   |                   |                         |   |                      |                           |                            |                            |                         |
| <b>Diagnostics</b>          | (Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.  |                       |   |                   |                         |   |                      |                           |                            |                            |                         |
| <b>Fixed Targets</b>        | <b>#</b>   | <b>Name</b>           | <b>Target Coordinates</b>   |                   |                         | <b>Targ. Coord. Corrections</b>   |                      |                           | <b>Miscellaneous</b>       |                            |                         |
|                             | (3)  | SDSS1411              | RA: 14 11 26.2221 (212.8592588d)<br>Dec: +20 09 11.04 (20.15307d)<br>Equinox: J2000 |                   |                         | Proper Motion RA: -45.928 mas/yr<br>Proper Motion Dec: 16.231 mas/yr<br>Parallax: 0.00565"<br>Epoch of Position: 2000 |                      |                           |                            |                            |                         |
|                             | <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[Brown dwarfs, White dwarfs]</i></p> <p><i>Extended=NO</i></p> |                       |   |                   |                         |   |                      |                           |                            |                            |                         |
| <b>Acquisition</b>          | <b>#</b>   | <b>Target</b>         | <b>TA Method</b>  | <b>Subarray</b>   | <b>Filter</b>           | <b>Readout Pattern</b>  | <b>Groups/Int</b>    | <b>Integrations/Exp</b>   | <b>Total Integrations</b>  | <b>Total Exposure Time</b> | <b>ETC Wkbk.Calc ID</b> |
|                             | 1  | 3 SDSS1411            | WATA  | SUB32             | CLEAR                   | NRSRAPIDD6  | 3                    | 1                         | 1                          | 0.26                       | 171260.12               |
| <b>Template</b>             | <p>Subarray</p> <p>SUB512</p>  |                       |   |                   |                         |   |                      |                           |                            |                            |                         |
| <b>Spectral Elements</b>    | <b>#</b>   | <b>Grating/Filter</b> | <b>Readout Pattern</b>  | <b>Groups/Int</b> | <b>Integrations/Exp</b> | <b>Exposures/Dith</b>   | <b>Total Dithers</b> | <b>Total Integrations</b> | <b>Total Exposure Time</b> | <b>ETC Wkbk.Calc ID</b>    |                         |
|                             | 1  | PRISM/CLEAR           | NRS   | 120               | 75                      | 1   | 1                    | 75                        | 8160.258                   | 171260.6                   |                         |
| <b>Special Requirements</b> | <p>Phase 0.10 to 0.42 with period 0.1690655002 Days and zero-phase 2460702.0535490 HJD</p> <p>Time Series Observation</p> <p>No Parallel Attachments</p>   |                       |   |                   |                         |   |                      |                           |                            |                            |                         |

Proposal 4967 - Observation 4 - Dwarfs of Fire and Ice: Mapping the Irradiated Atmospheres of White Dwarf-Brown Dwarf Binaries wit...

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|                             |   |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
|-----------------------------|---|-----------------------|---|-------------------|-------------------------|--|----------------------|---------------------------|----------------------------|----------------------------|-------------------------|
| <b>Observation</b>          | <p><b>Proposal 4967, Observation 4: ZTF0038</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec Bright Object Time Series</p> <p><i>Comments: Phase constraints are set to avoid target acquisition occurring during the eclipse. The detailed justification is provided in proposal description.</i></p> |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Diagnostics</b>          | (Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.   |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Fixed Targets</b>        | <b>#</b>  | <b>Name</b>           | <b>Target Coordinates</b>   |                   |                         | <b>Targ. Coord. Corrections</b>  |                      |                           | <b>Miscellaneous</b>       |                            |                         |
|                             | (5)   | ZTFJ0038+2030         | RA: 00 38 54.9991 (9.7291629d)<br>Dec: +20 30 26.15 (20.50726d)<br>Equinox: J2000 |                   |                         | Proper Motion RA: -24.288 mas/yr<br>Proper Motion Dec: -41.680 mas/yr<br>Parallax: 0.0071986"<br>Epoch of Position: 2000 |                      |                           |                            |                            |                         |
|                             | <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[White dwarfs]</i></p> <p><i>Extended=NO</i></p>  |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Acquisition</b>          | <b>#</b>  | <b>Target</b>         | <b>TA Method</b>  | <b>Subarray</b>   | <b>Filter</b>           | <b>Readout Pattern</b>   | <b>Groups/Int</b>    | <b>Integrations/Exp</b>   | <b>Total Integrations</b>  | <b>Total Exposure Time</b> | <b>ETC Wkbk.Calc ID</b> |
|                             | 1   | 5<br>ZTFJ0038+2030    | WATA  | SUB32             | CLEAR                   | NRSRAPIDD6   | 3                    | 1                         | 1                          | 0.26                       | 171260.13               |
| <b>Template</b>             | <p>Subarray</p> <p>SUB512</p>   |                       |   |                   |                         |  |                      |                           |                            |                            |                         |
| <b>Spectral Elements</b>    | <b>#</b>  | <b>Grating/Filter</b> | <b>Readout Pattern</b>  | <b>Groups/Int</b> | <b>Integrations/Exp</b> | <b>Exposures/Dith</b>  | <b>Total Dithers</b> | <b>Total Integrations</b> | <b>Total Exposure Time</b> | <b>ETC Wkbk.Calc ID</b>    |                         |
|                             | 1   | PRISM/CLEAR           | NRS   | 50                | 208                     | 4  | 1                    | 832                       | 37838.228                  | 171260.8                   |                         |
| <b>Special Requirements</b> | <p>Phase 0.08 to 0.475 with period 0.8638416 Days and zero-phase 2459045.985194 HJD</p> <p>Time Series Observation</p> <p>No Parallel Attachments</p>   |                       |   |                   |                         |  |                      |                           |                            |                            |                         |

Proposal 4967 - Observation 5 - Dwarfs of Fire and Ice: Mapping the Irradiated Atmospheres of White Dwarf-Brown Dwarf Binaries wit...

Tue Mar 11 16:00:15 GMT 2025

| <b>Observation</b>   | <p><b>Proposal 4967, Observation 5: WD1032</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec Bright Object Time Series</p>  |  |  |                  |                 |               |                    |                     |                     |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
|--|---|--|--|------------------|-----------------|---------------|--------------------|---------------------|---------------------|------------------|--|---|----------------|--------------------|--------------------------|------------------|-----------------|---------------|--------------------|---------------------|---------------------|------------------|-------------|----------|--|--|-------|----------|----|----------|----------|-------|-----------|--|--|--|--|--|--|--|--|--|--|--|
| <b>Diagnostics</b>   | <p>(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.</p>  |  |  |                  |                 |               |                    |                     |                     |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| <b>Fixed Targets</b>   | <table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th colspan="4">Targ. Coord. Corrections</th> <th colspan="4">Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(4)</td> <td>WD1032</td> <td>RA: 10 34 48.9329 (158.7038871d)<br/>Dec: +00 52 1.37 (.86705d)<br/>Equinox: J2000</td> <td colspan="4">Proper Motion RA: -94.813 mas/yr<br/>Proper Motion Dec: 20.112 mas/yr<br/>Parallax: 0.0032"<br/>Epoch of Position: 2000</td> <td colspan="4"></td> </tr> <tr> <td colspan="11"> <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[White dwarfs]</i></p> <p><i>Extended=NO</i></p> </td> </tr> </tbody> </table> |  |  |                  |                 |               |                    |                     |                     |                  |  | # | Name           | Target Coordinates | Targ. Coord. Corrections |                  |                 |               | Miscellaneous      |                     |                     |                  | (4)         | WD1032   | RA: 10 34 48.9329 (158.7038871d)<br>Dec: +00 52 1.37 (.86705d)<br>Equinox: J2000 | Proper Motion RA: -94.813 mas/yr<br>Proper Motion Dec: 20.112 mas/yr<br>Parallax: 0.0032"<br>Epoch of Position: 2000 |       |          |    |          |          |       |           | <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[White dwarfs]</i></p> <p><i>Extended=NO</i></p> |  |  |  |  |  |  |  |  |  |  |
| #  | Name  | Target Coordinates   | Targ. Coord. Corrections   |                  |                 |               | Miscellaneous      |                     |                     |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| (4)  | WD1032  | RA: 10 34 48.9329 (158.7038871d)<br>Dec: +00 52 1.37 (.86705d)<br>Equinox: J2000 | Proper Motion RA: -94.813 mas/yr<br>Proper Motion Dec: 20.112 mas/yr<br>Parallax: 0.0032"<br>Epoch of Position: 2000 |                  |                 |               |                    |                     |                     |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p> <p><i>Category=Star</i></p> <p><i>Description=[White dwarfs]</i></p> <p><i>Extended=NO</i></p> |   |  |  |                  |                 |               |                    |                     |                     |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| <b>Acquisition</b>   | <table border="1"> <thead> <tr> <th>#</th> <th>Target</th> <th>TA Method</th> <th>Subarray</th> <th>Filter</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>ETC Wkbk.Calc ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4 WD1032</td> <td>WATA</td> <td>SUB2048</td> <td>CLEAR</td> <td>NRSRAPID</td> <td>3</td> <td>1</td> <td>1</td> <td>3.628</td> <td>171260.14</td> </tr> </tbody> </table>   |  |  |                  |                 |               |                    |                     |                     |                  |  | # | Target         | TA Method          | Subarray                 | Filter           | Readout Pattern | Groups/Int    | Integrations/Exp   | Total Integrations  | Total Exposure Time | ETC Wkbk.Calc ID | 1           | 4 WD1032 | WATA   | SUB2048  | CLEAR | NRSRAPID | 3  | 1        | 1        | 3.628 | 171260.14 |  |  |  |  |  |  |  |  |  |  |  |
| #  | Target  | TA Method  | Subarray   | Filter           | Readout Pattern | Groups/Int    | Integrations/Exp   | Total Integrations  | Total Exposure Time | ETC Wkbk.Calc ID |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| 1  | 4 WD1032  | WATA   | SUB2048  | CLEAR            | NRSRAPID        | 3             | 1                  | 1                   | 3.628               | 171260.14        |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| <b>Template</b>  | <p>Subarray</p> <p>SUB512</p>   |  |  |                  |                 |               |                    |                     |                     |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| <b>Spectral Elements</b>   | <table border="1"> <thead> <tr> <th>#</th> <th>Grating/Filter</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Exposures/Dith</th> <th>Total Dithers</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>ETC Wkbk.Calc ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>PRISM/CLEAR</td> <td>NRS</td> <td>150</td> <td>65</td> <td>1</td> <td>1</td> <td>65</td> <td>8836.272</td> <td>171260.7</td> </tr> </tbody> </table>   |  |  |                  |                 |               |                    |                     |                     |                  |  | # | Grating/Filter | Readout Pattern    | Groups/Int               | Integrations/Exp | Exposures/Dith  | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID    | 1                | PRISM/CLEAR | NRS      | 150  | 65   | 1     | 1        | 65 | 8836.272 | 171260.7 |       |           |  |  |  |  |  |  |  |  |  |  |  |
| #  | Grating/Filter  | Readout Pattern  | Groups/Int   | Integrations/Exp | Exposures/Dith  | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID    |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| 1  | PRISM/CLEAR   | NRS  | 150  | 65               | 1               | 1             | 65                 | 8836.272            | 171260.7            |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |
| <b>Special Requirements</b>  | <p>Phase 0.1 to 0.425 with period 0.1831179922 Days and zero-phase 2458381.7439008 HJD</p> <p>Time Series Observation</p> <p>No Parallel Attachments</p>  |  |  |                  |                 |               |                    |                     |                     |                  |  |   |                |                    |                          |                  |                 |               |                    |                     |                     |                  |             |          |  |  |       |          |    |          |          |       |           |  |  |  |  |  |  |  |  |  |  |  |