



## 5451 - Resolving the Dynamic ISM with IR Echoes around Cas A

Cycle: 3, Proposal Category: GO

### INVESTIGATORS

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|----------------------------------------|-----------------------------------------------|
| <b>Dr. Jacob Jencson (PI)</b>          | <b>California Institute of Technology</b>     |
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| Dr. Eli Dwek (CoI)                     | NASA Goddard Space Flight Center              |
| Prof. Ilse De Looze (CoI) (ESA Member) | Universiteit Gent                             |
| Dr. Kishalay De (CoI)                  | Massachusetts Institute of Technology         |
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| Dr. Karl D. Gordon (CoI)               | Space Telescope Science Institute             |
| Dr. Martha L. Boyer (CoI)              | Space Telescope Science Institute             |
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**OBSERVATIONS**

| <b>Folder</b> | <b>Observation</b> | <b>Label</b>                  | <b>Observing Template</b>           | <b>Science Target</b> |
|---------------|--------------------|-------------------------------|-------------------------------------|-----------------------|
| ECHOW1        |                    |                               |                                     |                       |
|               | 1                  | ECHOW1-NIRCAM-P<br>re1        | NIRCam Imaging                      | (4) ECHOW1-NIRCAM     |
|               | 2                  | ECHOW1-NIRCAM-P<br>re2        | NIRCam Imaging                      | (4) ECHOW1-NIRCAM     |
|               | 3                  | ECHOW1-NIRCAM-<br>Main1       | NIRCam Imaging                      | (4) ECHOW1-NIRCAM     |
|               | 4                  | ECHOW1-NIRCAM-<br>Main2       | NIRCam Imaging                      | (4) ECHOW1-NIRCAM     |
|               | 5                  | ECHOW1-NIRCAM-<br>Main3       | NIRCam Imaging                      | (4) ECHOW1-NIRCAM     |
|               | 6                  | ECHOW1-MIRI-Main1             | MIRI Medium Resolution Spectroscopy | (5) ECHOW1-MIRI       |
|               | 7                  | ECHOW1-MIRIBKG-<br>Main1      | MIRI Medium Resolution Spectroscopy | (2) MIRI-BKG          |
|               | 8                  | ECHOW1-MIRI-Main2             | MIRI Medium Resolution Spectroscopy | (5) ECHOW1-MIRI       |
|               | 9                  | ECHOW1-MIRIBKG-<br>Main2      | MIRI Medium Resolution Spectroscopy | (2) MIRI-BKG          |
|               | 10                 | ECHOW1-MIRI-Main3             | MIRI Medium Resolution Spectroscopy | (5) ECHOW1-MIRI       |
|               | 11                 | ECHOW1-MIRIBKG-<br>Main3      | MIRI Medium Resolution Spectroscopy | (2) MIRI-BKG          |
|               | 12                 | ECHOW1-NIRCAM-P<br>re1-repeat | NIRCam Imaging                      | (4) ECHOW1-NIRCAM     |

**ABSTRACT**

The content and structure of the interstellar medium (ISM) plays an influential role in the overall evolution of galaxies and the formation of stars within them. Importantly, the ISM is also shaped by the massive stars formed out of its gas and dust and the energetic supernovae (SNe) they produce. JWST opens new pathways to investigate the detailed structure and composition of ISM clouds and to witness the effects of SN explosions on their surroundings. This proposal outlines a carefully designed program of time-series NIRCam imaging and MIRI/IFU spectroscopy to observe

bright infrared (IR) echoes around the young SN remnant Cassiopeia A. This provides a unique window to view the effects of the high-energy burst of SN radiation as it interacts with the surrounding ISM dust clouds in real time. The requested observations exploit JWST's unique ability to 1) provide 3D maps at milli-pc scales of the structure of the echoing clouds, 2) determine the precise compositions of dust grains and molecules, and 3) measure the changes in, e.g., the sizes, shapes, and ionization states, of the same, in situ populations of dust grains and large molecules induced by the passage of the SN radiation field. These findings will have broad implications in unraveling the connections of ISM clouds and filaments to their role as the seeds of star formation, and how cloud properties are then set by the stars and SNe they produce.

## **OBSERVING DESCRIPTION**

We propose to obtain five epochs of NIRCcam imaging, including two epochs of pre-imaging to monitor the motion of IR echos around Cas A. We will use F444W filter, and a combination of F300M/F335M/F360M to map the morphology of the echos and measure the flux of the 3.3  $\mu$ m PAH feature. We will obtain simultaneous SW imaging with the F200W, F150W, F115W (to search for dust heated to high temperatures) and F070W (to search for reflected-light optical echoes).

We will also obtain 3 epochs of MIRI/MRS spectroscopy on a specific sub-component of the echo (determined from our pre-imaging), to observe the dust pre-, during, and post-heating by the SN radiation as the echo passes over the field. We will also obtain simultaneous imaging in the F560W, F770W, and F1000W to provide excellent relative astrometry.

## Proposal 5451 - Targets - Resolving the Dynamic ISM with IR Echoes around Cas A

| #   | Name                | Target Coordinates                                                                                                                                                                                                                                                                                                                  | Targ. Coord. Corrections | Miscellaneous |
|-----|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------|
| (2) | MIRI-BKG            | RA: 23 16 25.2600 (349.1052500d)<br>Dec: +54 57 44.62 (54.96239d)<br>Equinox: J2000<br><br>Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                                                                                                                |                          |               |
| (4) | ECHOW1-NIRCAM       | RA: 23 16 2.7800 (349.0115833d)<br>Dec: +58 20 57.38 (58.34927d)<br>Equinox: J2000<br><br>Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                                                                                                                 |                          |               |
| (5) | ECHOW1-MIRI         | RA: 23 16 2.9570 (349.0123208d)<br>Dec: +58 20 54.30 (58.34842d)<br>Equinox: J2000<br><br>Comments: The precise pointing position for this target will be determined based on earlier observations in this program.<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES |                          |               |
| (6) | ECHOW1-MIRI-OFFSET1 | RA: 23 16 3.3602 (349.0140008d)<br>Dec: +58 20 55.86 (58.34885d)<br>Equinox: J2000<br><br>Comments:<br>Category=Calibration<br>Description=[Target acquisition test]<br>Extended=NO                                                                                                                                                 |                          |               |
| (7) | ECHOW1-MIRI-OFFSET2 | RA: 23 16 3.4960 (349.0145667d)<br>Dec: +58 20 46.40 (58.34622d)<br>Equinox: J2000<br><br>Comments:<br>Category=Calibration<br>Description=[Target acquisition test]<br>Extended=NO                                                                                                                                                 |                          |               |

# Proposal 5451 - Observation 1 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                                                                                                                  |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------|-----------------|------------|--------------------------|----------------------|---------------|---------------------|------------------------------|--|
| Observation          | Proposal 5451, Observation 1: ECHOW1-NIRCAM-Pre1                                                                                                 |                     |                                 |                 |            |                          |                      |               |                     | Wed Oct 02 18:00:21 GMT 2024 |  |
|                      | Diagnostic Status: Warning                                                                                                                       |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|                      | Observing Template: NIRCam Imaging                                                                                                               |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Diagnostics          | (Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                                                      |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Fixed Targets        | #                                                                                                                                                | Name                | Target Coordinates              |                 |            | Targ. Coord. Corrections |                      | Miscellaneous |                     |                              |  |
|                      | (4)                                                                                                                                              | ECHOW1-NIRCAM       | RA: 23 16 2.7800 (349.0115833d) |                 |            |                          |                      |               |                     |                              |  |
|                      |                                                                                                                                                  |                     | Dec: +58 20 57.38 (58.34927d)   |                 |            |                          |                      |               |                     |                              |  |
|                      |                                                                                                                                                  |                     | Equinox: J2000                  |                 |            |                          |                      |               |                     |                              |  |
|                      | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                        |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Template             | Module                                                                                                                                           |                     | Subarray                        |                 |            |                          | Target Placement     |               |                     |                              |  |
|                      | ALL                                                                                                                                              |                     | FULL                            |                 |            |                          | Module B (B4 corner) |               |                     |                              |  |
| Dithers              | #                                                                                                                                                | Primary Dither Type |                                 | Primary Dithers |            | Subpixel Dither Type     |                      | Dither Size   |                     | Subpixel Positions           |  |
|                      | 1                                                                                                                                                | INTRAMODULEBOX      |                                 | 4               |            | STANDARD                 |                      |               |                     | 1                            |  |
| Spectral Elements    | #                                                                                                                                                | Short Filter        | Long Filter                     | Readout Pattern | Groups/Int | Integrations/Exp         | Total Integrations   | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID             |  |
|                      | 1                                                                                                                                                | F164N+F150W2        | F300M                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
|                      | 2                                                                                                                                                | F090W               | F335M                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
|                      | 3                                                                                                                                                | F150W               | F360M                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
|                      | 4                                                                                                                                                | F200W               | F444W                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
| Special Requirements | Aperture PA Range 195 to 210 Degrees (V3 194.94737309 to 209.94737309)<br>Offset 20.0 arcsec, -10.0 arcsec<br>Fiducial Point Override NRCBS_FULL |                     |                                 |                 |            |                          |                      |               |                     |                              |  |

# Proposal 5451 - Observation 2 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                                                                        |                                                                                                                              |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------|-----------------|------------|--------------------------|----------------------|---------------|---------------------|------------------------------|--|
| Observation                                                            | Proposal 5451, Observation 2: ECHOW1-NIRCAM-Pre2                                                                             |                     |                                 |                 |            |                          |                      |               |                     | Wed Oct 02 18:00:21 GMT 2024 |  |
|                                                                        | Diagnostic Status: Warning                                                                                                   |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Observing Template: NIRCam Imaging                                     |                                                                                                                              |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Diagnostics                                                            | (Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                                  |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|                                                                        | (ECHOW1-NIRCAM-Pre2 (Obs 2)) Informational (Form): The Visit Planner and Spike may produce different schedulability results. |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Fixed Targets                                                          | #                                                                                                                            | Name                | Target Coordinates              |                 |            | Targ. Coord. Corrections |                      |               | Miscellaneous       |                              |  |
|                                                                        | (4)                                                                                                                          | ECHOW1-NIRCAM       | RA: 23 16 2.7800 (349.0115833d) |                 |            |                          |                      |               |                     |                              |  |
|                                                                        |                                                                                                                              |                     | Dec: +58 20 57.38 (58.34927d)   |                 |            |                          |                      |               |                     |                              |  |
|                                                                        |                                                                                                                              |                     | Equinox: J2000                  |                 |            |                          |                      |               |                     |                              |  |
| Template                                                               | Comments:                                                                                                                    |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|                                                                        | Category=ISM                                                                                                                 |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|                                                                        | Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]                                                 |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|                                                                        | Extended=YES                                                                                                                 |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Module                                                                 | Module                                                                                                                       |                     |                                 | Subarray        |            |                          | Target Placement     |               |                     |                              |  |
|                                                                        | ALL                                                                                                                          |                     |                                 | FULL            |            |                          | Module B (B4 corner) |               |                     |                              |  |
| #                                                                      | #                                                                                                                            | Primary Dither Type |                                 | Primary Dithers |            | Subpixel Dither Type     |                      | Dither Size   |                     | Subpixel Positions           |  |
|                                                                        | 1                                                                                                                            | INTRAMODULEBOX      |                                 | 4               |            | STANDARD                 |                      |               |                     | 1                            |  |
| Spectral Elements                                                      | #                                                                                                                            | Short Filter        | Long Filter                     | Readout Pattern | Groups/Int | Integrations/Exp         | Total Integrations   | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID             |  |
|                                                                        | 1                                                                                                                            | F164N+F150W2        | F300M                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
|                                                                        | 2                                                                                                                            | F090W               | F335M                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
|                                                                        | 3                                                                                                                            | F150W               | F360M                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
|                                                                        | 4                                                                                                                            | F200W               | F444W                           | BRIGHT2         | 5          | 1                        | 4                    | 4             | 429.471             |                              |  |
| Special Requirements                                                   | Between Dates 2024.260 and 2024.267                                                                                          |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
|                                                                        | Aperture PA Range 173.05262691 to 223.05262691 Degrees (V3 173.0 to 223.0)                                                   |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Offset 20.0 arcsec, 42.0 arcsec                                        |                                                                                                                              |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Fiducial Point Override NRCBS_FULL                                     |                                                                                                                              |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| 12 After 2 by 5 Days to 16 Days                                        |                                                                                                                              |                     |                                 |                 |            |                          |                      |               |                     |                              |  |
| Aperture PA Offset 12 from 2 by -10 to 10 Degrees (Same offsets in V3) |                                                                                                                              |                     |                                 |                 |            |                          |                      |               |                     |                              |  |

# Proposal 5451 - Observation 3 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                                                                                                                                      |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------|-----------------|------------|--------------------------|--------------------|---------------|---------------------|--------------------|------------------------------|
| Observation          | Proposal 5451, Observation 3: ECHOW1-NIRCAM-Main1                                                                                                                    |                     |                                                                                    |                 |            |                          |                    |               |                     |                    | Wed Oct 02 18:00:21 GMT 2024 |
|                      | Diagnostic Status: Warning                                                                                                                                           |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
|                      | Observing Template: NIRCIm Imaging                                                                                                                                   |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
| Diagnostics          | (Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                                                                          |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
| Fixed Targets        | #                                                                                                                                                                    | Name                | Target Coordinates                                                                 |                 |            | Targ. Coord. Corrections |                    |               | Miscellaneous       |                    |                              |
|                      | (4)                                                                                                                                                                  | ECHOW1-NIRCAM       | RA: 23 16 2.7800 (349.0115833d)<br>Dec: +58 20 57.38 (58.34927d)<br>Equinox: J2000 |                 |            |                          |                    |               |                     |                    |                              |
|                      | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                                            |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
| Template             | Module                                                                                                                                                               |                     |                                                                                    |                 |            | Subarray                 |                    |               |                     |                    |                              |
|                      | B                                                                                                                                                                    |                     |                                                                                    |                 |            | FULL                     |                    |               |                     |                    |                              |
| Dithers              | #                                                                                                                                                                    | Primary Dither Type |                                                                                    | Primary Dithers |            | Subpixel Dither Type     |                    | Dither Size   |                     | Subpixel Positions |                              |
|                      | 1                                                                                                                                                                    | INTRAMODULEBOX      |                                                                                    | 4               |            | STANDARD                 |                    |               |                     | 1                  |                              |
| Spectral Elements    | #                                                                                                                                                                    | Short Filter        | Long Filter                                                                        | Readout Pattern | Groups/Int | Integrations/Exp         | Total Integrations | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID   |                              |
|                      | 1                                                                                                                                                                    | F164N+F150W2        | F300M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
|                      | 2                                                                                                                                                                    | F070W               | F335M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
|                      | 3                                                                                                                                                                    | F070W               | F360M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
|                      | 4                                                                                                                                                                    | F200W               | F444W                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
| Special Requirements | Aperture PA Range 120 to 150 Degrees (V3 119.94737309 to 149.94737309)<br>Offset 20.0 arcsec, 20.0 arcsec                                                            |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
|                      | 3 After 12 by 14 Days to 21 Days<br>4 After 3 by 72 Days to 78 Days<br>5 After 3 by 150 Days to <None specified><br>Sequence Observations 3, 6, 7, Non-interruptible |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |

# Proposal 5451 - Observation 4 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                                                                                           |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
|----------------------|---------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------|-----------------|------------|--------------------------|--------------------|---------------|---------------------|--------------------|------------------------------|
| Observation          | Proposal 5451, Observation 4: ECHOW1-NIRCAM-Main2                                                                         |                     |                                                                                    |                 |            |                          |                    |               |                     |                    | Wed Oct 02 18:00:21 GMT 2024 |
|                      | Diagnostic Status: Warning                                                                                                |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
|                      | Observing Template: NIRCcam Imaging                                                                                       |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
| Diagnostics          | (Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                               |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
| Fixed Targets        | #                                                                                                                         | Name                | Target Coordinates                                                                 |                 |            | Targ. Coord. Corrections |                    |               | Miscellaneous       |                    |                              |
|                      | (4)                                                                                                                       | ECHOW1-NIRCAM       | RA: 23 16 2.7800 (349.0115833d)<br>Dec: +58 20 57.38 (58.34927d)<br>Equinox: J2000 |                 |            |                          |                    |               |                     |                    |                              |
|                      | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
| Template             | Module                                                                                                                    |                     |                                                                                    |                 |            | Subarray                 |                    |               |                     |                    |                              |
|                      | B                                                                                                                         |                     |                                                                                    |                 |            | FULL                     |                    |               |                     |                    |                              |
| Dithers              | #                                                                                                                         | Primary Dither Type |                                                                                    | Primary Dithers |            | Subpixel Dither Type     |                    | Dither Size   |                     | Subpixel Positions |                              |
|                      | 1                                                                                                                         | INTRAMODULEBOX      |                                                                                    | 4               |            | STANDARD                 |                    |               |                     | 1                  |                              |
| Spectral Elements    | #                                                                                                                         | Short Filter        | Long Filter                                                                        | Readout Pattern | Groups/Int | Integrations/Exp         | Total Integrations | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID   |                              |
|                      | 1                                                                                                                         | F164N+F150W2        | F300M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
|                      | 2                                                                                                                         | F070W               | F335M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
|                      | 3                                                                                                                         | F070W               | F360M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
|                      | 4                                                                                                                         | F200W               | F444W                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                    |                              |
| Special Requirements | Aperture PA Range 50 to 70 Degrees (V3 49.94737309 to 69.94737309)<br>Offset -10.0 arcsec, 20.0 arcsec                    |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |
|                      | 4 After 3 by 72 Days to 78 Days<br>Sequence Observations 4, 8, 9, Non-interruptible                                       |                     |                                                                                    |                 |            |                          |                    |               |                     |                    |                              |

# Proposal 5451 - Observation 5 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                                                                                                                                                                                       |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------|-----------------|------------|--------------------------|--------------------|---------------|---------------------|------------------------------|--|
| Observation          | Proposal 5451, Observation 5: ECHOW1-NIRCAM-Main3                                                                                                                                                                     |                     |                                                                                    |                 |            |                          |                    |               |                     | Wed Oct 02 18:00:21 GMT 2024 |  |
|                      | Diagnostic Status: Warning                                                                                                                                                                                            |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
|                      | Observing Template: NIRCcam Imaging                                                                                                                                                                                   |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
|                      | Comments: Can be executed in Cycle 3.                                                                                                                                                                                 |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
| Diagnostics          | (Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                                                                                                                           |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
|                      | (Visit 5:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements. |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
| Fixed Targets        | #                                                                                                                                                                                                                     | Name                | Target Coordinates                                                                 |                 |            | Targ. Coord. Corrections |                    |               | Miscellaneous       |                              |  |
|                      | (4)                                                                                                                                                                                                                   | ECHOW1-NIRCAM       | RA: 23 16 2.7800 (349.0115833d)<br>Dec: +58 20 57.38 (58.34927d)<br>Equinox: J2000 |                 |            |                          |                    |               |                     |                              |  |
|                      | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                                                                                             |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
|                      |                                                                                                                                                                                                                       |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
| Template             | Module                                                                                                                                                                                                                |                     |                                                                                    |                 |            | Subarray                 |                    |               |                     |                              |  |
|                      | B                                                                                                                                                                                                                     |                     |                                                                                    |                 |            | FULL                     |                    |               |                     |                              |  |
| Dithers              | #                                                                                                                                                                                                                     | Primary Dither Type |                                                                                    | Primary Dithers |            | Subpixel Dither Type     |                    | Dither Size   |                     | Subpixel Positions           |  |
|                      | 1                                                                                                                                                                                                                     | INTRAMODULEBOX      |                                                                                    | 4               |            | STANDARD                 |                    |               |                     | 1                            |  |
| Spectral Elements    | #                                                                                                                                                                                                                     | Short Filter        | Long Filter                                                                        | Readout Pattern | Groups/Int | Integrations/Exp         | Total Integrations | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID             |  |
|                      | 1                                                                                                                                                                                                                     | F164N+F150W2        | F300M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                              |  |
|                      | 2                                                                                                                                                                                                                     | F070W               | F335M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                              |  |
|                      | 3                                                                                                                                                                                                                     | F070W               | F360M                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                              |  |
|                      | 4                                                                                                                                                                                                                     | F200W               | F444W                                                                              | BRIGHT2         | 5          | 1                        | 4                  | 4             | 429.471             |                              |  |
| Special Requirements | 5 After 3 by 150 Days to <None specified><br>Sequence Observations 5, 10, 11, Non-interruptible                                                                                                                       |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |
|                      |                                                                                                                                                                                                                       |                     |                                                                                    |                 |            |                          |                    |               |                     |                              |  |

# Proposal 5451 - Observation 6 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                   |                                                                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|-------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------|-----------------|-----------------|------------------|--------------------------|--------------------|-------------------------|------------------|--------------------|---------------------|------------------------------|
| Observation       | Proposal 5451, Observation 6: ECHOW1-MIRI-Main1                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     | Wed Oct 02 18:00:21 GMT 2024 |
|                   | Diagnostic Status: Warning                                                                                                |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Observing Template: MIRI Medium Resolution Spectroscopy                                                                   |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Background Observations:[ECHOW1-MIRIBKG-Main1 (Obs 7)]                                                                    |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
| Diagnostics       | (Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                               |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
| Fixed Targets     | #                                                                                                                         | Name                  | Target Coordinates                                                                 |                 |                 |                  | Targ. Coord. Corrections |                    |                         | Miscellaneous    |                    |                     |                              |
|                   | (5)                                                                                                                       | ECHOW1-MIRI           | RA: 23 16 2.9570 (349.0123208d)<br>Dec: +58 20 54.30 (58.34842d)<br>Equinox: J2000 |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Comments: The precise pointing position for this target will be determined based on earlier observations in this program. |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Category=ISM                                                                                                              |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                              |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
| Acquisition       | #                                                                                                                         | Target                | Filter                                                                             | Readout Pattern | Groups/Int      | Integrations/Exp |                          | Total Integrations | Total Exposure Time     | ETC Wkbk.Calc ID |                    |                     |                              |
|                   | 1                                                                                                                         | 6 ECHOW1-MIRI-OFFSET1 | F1000W                                                                             | FAST            | 8               | 1                |                          | 1                  | 22.2                    | 220401.77        |                    |                     |                              |
| Template          | Primary Channel                                                                                                           |                       | Simultaneous Imaging                                                               |                 |                 | Imager Subarray  |                          |                    | Grating Wheel Direction |                  |                    |                     |                              |
|                   | All MRS                                                                                                                   |                       | YES                                                                                |                 |                 | FULL             |                          |                    | Allow Auto Reorder      |                  |                    |                     |                              |
| Dithers           | #                                                                                                                         | Dither Type           |                                                                                    |                 |                 | Optimized For    |                          |                    |                         | Direction        |                    |                     |                              |
|                   | 1                                                                                                                         | 4-Point               |                                                                                    |                 |                 | EXTENDED SOURCE  |                          |                    |                         | NEGATIVE         |                    |                     |                              |
| Spectral Elements | #                                                                                                                         | Wavelength Range      | Detector                                                                           | Filter          | Readout Pattern | Groups/Int       | Integrations/Exp         | Exposures/Dith     | Dither                  | Total Dithers    | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID             |
|                   | 1                                                                                                                         |                       | IMAGER                                                                             | F560W           | FASTR1          | 60               | 1                        | 1                  | Dither 1                | 4                | 4                  | 666.01              |                              |
|                   | 1                                                                                                                         | SHORT(A)              | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 1                                                                                                                         | SHORT(A)              | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 2                                                                                                                         |                       | IMAGER                                                                             | F770W           | FASTR1          | 60               | 1                        | 1                  | Dither 1                | 4                | 4                  | 666.01              |                              |
|                   | 2                                                                                                                         | MEDIUM(B)             | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 2                                                                                                                         | MEDIUM(B)             | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 3                                                                                                                         |                       | IMAGER                                                                             | F1000W          | FASTR1          | 60               | 1                        | 1                  | Dither 1                | 4                | 4                  | 666.01              |                              |
|                   | 3                                                                                                                         | LONG(C)               | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 3                                                                                                                         | LONG(C)               | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   |                                                                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   |                                                                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |

Proposal 5451 - Observation 6 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                                                                                  |
|----------------------|------------------------------------------------------------------------------------------------------------------|
| Special Requirements | Aperture PA Range 132.0 to 138.0 Degrees (V3 132.0 to 138.0)<br>Sequence Observations 3, 6, 7, Non-interruptible |
|----------------------|------------------------------------------------------------------------------------------------------------------|

# Proposal 5451 - Observation 7 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                   |                                                                                                                           |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|-------------------|---------------------------------------------------------------------------------------------------------------------------|------------------|----------|--------|----------------------------------|------------|------------------|--------------------------|----------|---------------|-------------------------|---------------------|------------------------------|--|
| Observation       | Proposal 5451, Observation 7: ECHOW1-MIRIBKG-Main1                                                                        |                  |          |        |                                  |            |                  |                          |          |               |                         |                     | Wed Oct 02 18:00:21 GMT 2024 |  |
|                   | Diagnostic Status: Warning                                                                                                |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   | Observing Template: MIRI Medium Resolution Spectroscopy                                                                   |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   | Background Observation For: [ECHOW1-MIRI-Main1 (Obs 6)]                                                                   |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Diagnostics       | (Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                               |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Fixed Targets     | #                                                                                                                         | Name             |          |        | Target Coordinates               |            |                  | Targ. Coord. Corrections |          |               | Miscellaneous           |                     |                              |  |
|                   | (2)                                                                                                                       | MIRI-BKG         |          |        | RA: 23 16 25.2600 (349.1052500d) |            |                  |                          |          |               |                         |                     |                              |  |
|                   |                                                                                                                           |                  |          |        | Dec: +54 57 44.62 (54.96239d)    |            |                  |                          |          |               |                         |                     |                              |  |
|                   |                                                                                                                           |                  |          |        | Equinox: J2000                   |            |                  |                          |          |               |                         |                     |                              |  |
|                   | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Acquisition       | #                                                                                                                         | Target           |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   | 1                                                                                                                         | NONE             |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Template          | AcqFilter                                                                                                                 | Primary Channel  |          |        | Simultaneous Imaging             |            |                  | Imager Subarray          |          |               | Grating Wheel Direction |                     |                              |  |
|                   |                                                                                                                           | All MRS          |          |        | YES                              |            |                  | FULL                     |          |               | Allow Auto Reorder      |                     |                              |  |
| Dithers           | #                                                                                                                         | Dither Type      |          |        |                                  |            |                  | Optimized For            |          |               | Direction               |                     |                              |  |
|                   | 1                                                                                                                         | 4-Point          |          |        |                                  |            |                  | EXTENDED SOURCE          |          |               | NEGATIVE                |                     |                              |  |
| Spectral Elements | #                                                                                                                         | Wavelength Range | Detector | Filter | Readout Pattern                  | Groups/Int | Integrations/Exp | Exposures/Dith           | Dither   | Total Dithers | Total Integrations      | Total Exposure Time | ETC Wkbk.Calc ID             |  |
|                   | 1                                                                                                                         |                  | IMAGER   | F560W  | FASTR1                           | 60         | 1                | 1                        | Dither 1 | 4             | 4                       | 666.01              |                              |  |
|                   | 1                                                                                                                         | SHORT(A)         | MRSLONG  |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 1                                                                                                                         | SHORT(A)         | MRSSHORT |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 2                                                                                                                         |                  | IMAGER   | F770W  | FASTR1                           | 60         | 1                | 1                        | Dither 1 | 4             | 4                       | 666.01              |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)        | MRSLONG  |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)        | MRSSHORT |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 3                                                                                                                         |                  | IMAGER   | F1000W | FASTR1                           | 60         | 1                | 1                        | Dither 1 | 4             | 4                       | 666.01              |                              |  |
|                   | 3                                                                                                                         | LONG(C)          | MRSLONG  |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 3                                                                                                                         | LONG(C)          | MRSSHORT |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   |                                                                                                                           |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   |                                                                                                                           |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   |                                                                                                                           |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |

Proposal 5451 - Observation 7 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                  |
|----------------------|--------------------------------------------------|
| Special Requirements | Sequence Observations 3, 6, 7, Non-interruptible |
|----------------------|--------------------------------------------------|

# Proposal 5451 - Observation 8 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                   |                                                                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
|-------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------|-----------------|-----------------|------------------|--------------------------|--------------------|---------------------|------------------|-------------------------|---------------------|------------------------------|--|
| Observation       | Proposal 5451, Observation 8: ECHOW1-MIRI-Main2                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     | Wed Oct 02 18:00:21 GMT 2024 |  |
|                   | Diagnostic Status: Warning                                                                                                |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
|                   | Observing Template: MIRI Medium Resolution Spectroscopy                                                                   |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
|                   | Background Observations:[ECHOW1-MIRIBKG-Main2 (Obs 9)]                                                                    |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
| Diagnostics       | (Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                               |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
| Fixed Targets     | #                                                                                                                         | Name                  | Target Coordinates                                                                 |                 |                 |                  | Targ. Coord. Corrections |                    |                     |                  | Miscellaneous           |                     |                              |  |
|                   | (5)                                                                                                                       | ECHOW1-MIRI           | RA: 23 16 2.9570 (349.0123208d)<br>Dec: +58 20 54.30 (58.34842d)<br>Equinox: J2000 |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
|                   | Comments: The precise pointing position for this target will be determined based on earlier observations in this program. |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
|                   | Category=ISM                                                                                                              |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
|                   | Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                              |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |
| Acquisition       | #                                                                                                                         | Target                | Filter                                                                             | Readout Pattern | Groups/Int      | Integrations/Exp |                          | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |                         |                     |                              |  |
|                   | 1                                                                                                                         | 6 ECHOW1-MIRI-OFFSET1 | F1000W                                                                             | FAST            | 8               | 1                |                          | 1                  | 22.2                | 220401.77        |                         |                     |                              |  |
| Template          | Primary Channel                                                                                                           |                       | Simultaneous Imaging                                                               |                 |                 |                  | Imager Subarray          |                    |                     |                  | Grating Wheel Direction |                     |                              |  |
|                   | All MRS                                                                                                                   |                       | YES                                                                                |                 |                 |                  | FULL                     |                    |                     |                  | Allow Auto Reorder      |                     |                              |  |
| Dithers           | #                                                                                                                         | Dither Type           |                                                                                    |                 |                 | Optimized For    |                          |                    |                     | Direction        |                         |                     |                              |  |
|                   | 1                                                                                                                         | 4-Point               |                                                                                    |                 |                 | EXTENDED SOURCE  |                          |                    |                     | NEGATIVE         |                         |                     |                              |  |
| Spectral Elements | #                                                                                                                         | Wavelength Range      | Detector                                                                           | Filter          | Readout Pattern | Groups/Int       | Integrations/Exp         | Exposures/Dith     | Dither              | Total Dithers    | Total Integrations      | Total Exposure Time | ETC Wkbk.Calc ID             |  |
|                   | 1                                                                                                                         |                       | IMAGER                                                                             | F560W           | FASTR1          | 60               | 1                        | 1                  | Dither 1            | 4                | 4                       | 666.01              |                              |  |
|                   | 1                                                                                                                         | SHORT(A)              | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1            | 4                | 4                       | 854.712             |                              |  |
|                   | 1                                                                                                                         | SHORT(A)              | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1            | 4                | 4                       | 854.712             |                              |  |
|                   | 2                                                                                                                         |                       | IMAGER                                                                             | F770W           | FASTR1          | 60               | 1                        | 1                  | Dither 1            | 4                | 4                       | 666.01              |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)             | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1            | 4                | 4                       | 854.712             |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)             | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1            | 4                | 4                       | 854.712             |                              |  |
|                   | 3                                                                                                                         |                       | IMAGER                                                                             | F1000W          | FASTR1          | 60               | 1                        | 1                  | Dither 1            | 4                | 4                       | 666.01              |                              |  |
|                   | 3                                                                                                                         | LONG(C)               | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1            | 4                | 4                       | 854.712             |                              |  |
|                   | 3                                                                                                                         | LONG(C)               | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1            | 4                | 4                       | 854.712             |                              |  |
|                   |                                                                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                     |                  |                         |                     |                              |  |

Proposal 5451 - Observation 8 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                                                                              |
|----------------------|--------------------------------------------------------------------------------------------------------------|
| Special Requirements | Aperture PA Range 59.0 to 62.0 Degrees (V3 59.0 to 62.0)<br>Sequence Observations 4, 8, 9, Non-interruptible |
|----------------------|--------------------------------------------------------------------------------------------------------------|

# Proposal 5451 - Observation 9 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                   |                                                                                                                           |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|-------------------|---------------------------------------------------------------------------------------------------------------------------|------------------|----------|--------|----------------------------------|------------|------------------|--------------------------|----------|---------------|-------------------------|---------------------|------------------------------|--|
| Observation       | Proposal 5451, Observation 9: ECHOW1-MIRIBKG-Main2                                                                        |                  |          |        |                                  |            |                  |                          |          |               |                         |                     | Wed Oct 02 18:00:21 GMT 2024 |  |
|                   | Diagnostic Status: Warning                                                                                                |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   | Observing Template: MIRI Medium Resolution Spectroscopy                                                                   |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   | Background Observation For: [ECHOW1-MIRI-Main2 (Obs 8)]                                                                   |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Diagnostics       | (Visit 9:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                               |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Fixed Targets     | #                                                                                                                         | Name             |          |        | Target Coordinates               |            |                  | Targ. Coord. Corrections |          |               | Miscellaneous           |                     |                              |  |
|                   | (2)                                                                                                                       | MIRI-BKG         |          |        | RA: 23 16 25.2600 (349.1052500d) |            |                  |                          |          |               |                         |                     |                              |  |
|                   |                                                                                                                           |                  |          |        | Dec: +54 57 44.62 (54.96239d)    |            |                  |                          |          |               |                         |                     |                              |  |
|                   |                                                                                                                           |                  |          |        | Equinox: J2000                   |            |                  |                          |          |               |                         |                     |                              |  |
|                   | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Acquisition       | #                                                                                                                         | Target           |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   | 1                                                                                                                         | NONE             |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
| Template          | AcqFilter                                                                                                                 | Primary Channel  |          |        | Simultaneous Imaging             |            |                  | Imager Subarray          |          |               | Grating Wheel Direction |                     |                              |  |
|                   |                                                                                                                           | All MRS          |          |        | YES                              |            |                  | FULL                     |          |               | Allow Auto Reorder      |                     |                              |  |
| Dithers           | #                                                                                                                         | Dither Type      |          |        |                                  |            |                  | Optimized For            |          |               | Direction               |                     |                              |  |
|                   | 1                                                                                                                         | 4-Point          |          |        |                                  |            |                  | EXTENDED SOURCE          |          |               | NEGATIVE                |                     |                              |  |
| Spectral Elements | #                                                                                                                         | Wavelength Range | Detector | Filter | Readout Pattern                  | Groups/Int | Integrations/Exp | Exposures/Dith           | Dither   | Total Dithers | Total Integrations      | Total Exposure Time | ETC Wkbk.Calc ID             |  |
|                   | 1                                                                                                                         |                  | IMAGER   | F560W  | FASTR1                           | 60         | 1                | 1                        | Dither 1 | 4             | 4                       | 666.01              |                              |  |
|                   | 1                                                                                                                         | SHORT(A)         | MRSLONG  |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 1                                                                                                                         | SHORT(A)         | MRSSHORT |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 2                                                                                                                         |                  | IMAGER   | F770W  | FASTR1                           | 60         | 1                | 1                        | Dither 1 | 4             | 4                       | 666.01              |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)        | MRSLONG  |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)        | MRSSHORT |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 3                                                                                                                         |                  | IMAGER   | F1000W | FASTR1                           | 60         | 1                | 1                        | Dither 1 | 4             | 4                       | 666.01              |                              |  |
|                   | 3                                                                                                                         | LONG(C)          | MRSLONG  |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   | 3                                                                                                                         | LONG(C)          | MRSSHORT |        | FASTR1                           | 77         | 1                | 1                        | Dither 1 | 4             | 4                       | 854.712             |                              |  |
|                   |                                                                                                                           |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |
|                   |                                                                                                                           |                  |          |        |                                  |            |                  |                          |          |               |                         |                     |                              |  |

Proposal 5451 - Observation 9 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                  |
|----------------------|--------------------------------------------------|
| Special Requirements | Sequence Observations 4, 8, 9, Non-interruptible |
|----------------------|--------------------------------------------------|

# Proposal 5451 - Observation 10 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                   |                                                                                                                           |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|-------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------|-----------------|-----------------|------------------|--------------------------|--------------------|-------------------------|------------------|--------------------|---------------------|------------------------------|
| Observation       | Proposal 5451, Observation 10: ECHOW1-MIRI-Main3                                                                          |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     | Wed Oct 02 18:00:21 GMT 2024 |
|                   | Diagnostic Status: Warning                                                                                                |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Observing Template: MIRI Medium Resolution Spectroscopy                                                                   |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Background Observations:[ECHOW1-MIRIBKG-Main3 (Obs 11)]                                                                   |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
| Diagnostics       | (Visit 10:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                              |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
| Fixed Targets     | #                                                                                                                         | Name                  | Target Coordinates                                                                 |                 |                 |                  | Targ. Coord. Corrections |                    |                         | Miscellaneous    |                    |                     |                              |
|                   | (5)                                                                                                                       | ECHOW1-MIRI           | RA: 23 16 2.9570 (349.0123208d)<br>Dec: +58 20 54.30 (58.34842d)<br>Equinox: J2000 |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Comments: The precise pointing position for this target will be determined based on earlier observations in this program. |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Category=ISM                                                                                                              |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
|                   | Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                              |                       |                                                                                    |                 |                 |                  |                          |                    |                         |                  |                    |                     |                              |
| Acquisition       | #                                                                                                                         | Target                | Filter                                                                             | Readout Pattern | Groups/Int      | Integrations/Exp |                          | Total Integrations | Total Exposure Time     | ETC Wkbk.Calc ID |                    |                     |                              |
|                   | 1                                                                                                                         | 7 ECHOW1-MIRI-OFFSET2 | F1000W                                                                             | FAST            | 8               | 1                |                          | 1                  | 22.2                    | 220401.79        |                    |                     |                              |
| Template          | Primary Channel                                                                                                           |                       | Simultaneous Imaging                                                               |                 |                 | Imager Subarray  |                          |                    | Grating Wheel Direction |                  |                    |                     |                              |
|                   | All MRS                                                                                                                   |                       | YES                                                                                |                 |                 | FULL             |                          |                    | Allow Auto Reorder      |                  |                    |                     |                              |
| Dithers           | #                                                                                                                         | Dither Type           |                                                                                    |                 |                 | Optimized For    |                          |                    |                         | Direction        |                    |                     |                              |
|                   | 1                                                                                                                         | 4-Point               |                                                                                    |                 |                 | EXTENDED SOURCE  |                          |                    |                         | NEGATIVE         |                    |                     |                              |
| Spectral Elements | #                                                                                                                         | Wavelength Range      | Detector                                                                           | Filter          | Readout Pattern | Groups/Int       | Integrations/Exp         | Exposures/Dith     | Dither                  | Total Dithers    | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID             |
|                   | 1                                                                                                                         |                       | IMAGER                                                                             | F560W           | FASTR1          | 60               | 1                        | 1                  | Dither 1                | 4                | 4                  | 666.01              |                              |
|                   | 1                                                                                                                         | SHORT(A)              | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 1                                                                                                                         | SHORT(A)              | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 2                                                                                                                         |                       | IMAGER                                                                             | F770W           | FASTR1          | 60               | 1                        | 1                  | Dither 1                | 4                | 4                  | 666.01              |                              |
|                   | 2                                                                                                                         | MEDIUM(B)             | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 2                                                                                                                         | MEDIUM(B)             | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 3                                                                                                                         |                       | IMAGER                                                                             | F1000W          | FASTR1          | 60               | 1                        | 1                  | Dither 1                | 4                | 4                  | 666.01              |                              |
|                   | 3                                                                                                                         | LONG(C)               | MRSLONG                                                                            |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |
|                   | 3                                                                                                                         | LONG(C)               | MRSSHORT                                                                           |                 | FASTR1          | 77               | 1                        | 1                  | Dither 1                | 4                | 4                  | 854.712             |                              |

|                      |                                                    |
|----------------------|----------------------------------------------------|
| Special Requirements | Sequence Observations 5, 10, 11, Non-interruptible |
|----------------------|----------------------------------------------------|

# Proposal 5451 - Observation 11 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                   |                                                                                                                           |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
|-------------------|---------------------------------------------------------------------------------------------------------------------------|------------------|-------------------------------------------------------------------------------------|--------|-----------------|----------------------|--------------------------|----------------|----------|-----------------|--------------------|-------------------------|------------------------------|--|
| Observation       | Proposal 5451, Observation 11: ECHOW1-MIRIBKG-Main3                                                                       |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         | Wed Oct 02 18:00:21 GMT 2024 |  |
|                   | Diagnostic Status: Warning                                                                                                |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
|                   | Observing Template: MIRI Medium Resolution Spectroscopy                                                                   |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
|                   | Background Observation For: [ECHOW1-MIRI-Main3 (Obs 10)]                                                                  |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
| Diagnostics       | (Visit 11:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                              |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
| Fixed Targets     | #                                                                                                                         | Name             | Target Coordinates                                                                  |        |                 |                      | Targ. Coord. Corrections |                |          |                 | Miscellaneous      |                         |                              |  |
|                   | (2)                                                                                                                       | MIRI-BKG         | RA: 23 16 25.2600 (349.1052500d)<br>Dec: +54 57 44.62 (54.96239d)<br>Equinox: J2000 |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
|                   | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
|                   |                                                                                                                           |                  |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
| Acquisition       | #                                                                                                                         | Target           |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
|                   | 1                                                                                                                         | NONE             |                                                                                     |        |                 |                      |                          |                |          |                 |                    |                         |                              |  |
| Template          | AcqFilter                                                                                                                 | Primary Channel  |                                                                                     |        |                 | Simultaneous Imaging |                          |                |          | Imager Subarray |                    | Grating Wheel Direction |                              |  |
|                   |                                                                                                                           | All MRS          |                                                                                     |        |                 | YES                  |                          |                |          | FULL            |                    | Allow Auto Reorder      |                              |  |
| Dithers           | #                                                                                                                         | Dither Type      |                                                                                     |        |                 | Optimized For        |                          |                |          | Direction       |                    |                         |                              |  |
|                   | 1                                                                                                                         | 4-Point          |                                                                                     |        |                 | EXTENDED SOURCE      |                          |                |          | NEGATIVE        |                    |                         |                              |  |
| Spectral Elements | #                                                                                                                         | Wavelength Range | Detector                                                                            | Filter | Readout Pattern | Groups/Int           | Integrations/Exp         | Exposures/Dith | Dither   | Total Dithers   | Total Integrations | Total Exposure Time     | ETC Wkbk.Calc ID             |  |
|                   | 1                                                                                                                         |                  | IMAGER                                                                              | F560W  | FASTR1          | 60                   | 1                        | 1              | Dither 1 | 4               | 4                  | 666.01                  |                              |  |
|                   | 1                                                                                                                         | SHORT(A)         | MRSLONG                                                                             |        | FASTR1          | 77                   | 1                        | 1              | Dither 1 | 4               | 4                  | 854.712                 |                              |  |
|                   | 1                                                                                                                         | SHORT(A)         | MRSSHORT                                                                            |        | FASTR1          | 77                   | 1                        | 1              | Dither 1 | 4               | 4                  | 854.712                 |                              |  |
|                   | 2                                                                                                                         |                  | IMAGER                                                                              | F770W  | FASTR1          | 60                   | 1                        | 1              | Dither 1 | 4               | 4                  | 666.01                  |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)        | MRSLONG                                                                             |        | FASTR1          | 77                   | 1                        | 1              | Dither 1 | 4               | 4                  | 854.712                 |                              |  |
|                   | 2                                                                                                                         | MEDIUM(B)        | MRSSHORT                                                                            |        | FASTR1          | 77                   | 1                        | 1              | Dither 1 | 4               | 4                  | 854.712                 |                              |  |
|                   | 3                                                                                                                         |                  | IMAGER                                                                              | F1000W | FASTR1          | 60                   | 1                        | 1              | Dither 1 | 4               | 4                  | 666.01                  |                              |  |
|                   | 3                                                                                                                         | LONG(C)          | MRSLONG                                                                             |        | FASTR1          | 77                   | 1                        | 1              | Dither 1 | 4               | 4                  | 854.712                 |                              |  |
|                   | 3                                                                                                                         | LONG(C)          | MRSSHORT                                                                            |        | FASTR1          | 77                   | 1                        | 1              | Dither 1 | 4               | 4                  | 854.712                 |                              |  |

Proposal 5451 - Observation 11 - Resolving the Dynamic ISM with IR Echoes around Cas A

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|----------------------|----------------------------------------------------|
| Special Requirements | Sequence Observations 5, 10, 11, Non-interruptible |
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# Proposal 5451 - Observation 12 - Resolving the Dynamic ISM with IR Echoes around Cas A

|                      |                                                                                                                                               |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------|-----------------|--------------------------|----------------------|----------------------|---------------|---------------------|------------------------------|--|
| Observation          | Proposal 5451, Observation 12: ECHOW1-NIRCAM-Pre1-repeat                                                                                      |                     |                                 |                 |                          |                      |                      |               |                     | Wed Oct 02 18:00:21 GMT 2024 |  |
|                      | Diagnostic Status: Warning                                                                                                                    |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |
|                      | Observing Template: NIRCam Imaging                                                                                                            |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |
| Diagnostics          | (Visit 12:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.                                                  |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |
|                      | (ECHOW1-NIRCAM-Pre1-repeat (Obs 12)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.          |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |
| Fixed Targets        | #                                                                                                                                             | Name                | Target Coordinates              |                 | Targ. Coord. Corrections |                      |                      | Miscellaneous |                     |                              |  |
|                      | (4)                                                                                                                                           | ECHOW1-NIRCAM       | RA: 23 16 2.7800 (349.0115833d) |                 |                          |                      |                      |               |                     |                              |  |
|                      |                                                                                                                                               |                     | Dec: +58 20 57.38 (58.34927d)   |                 |                          |                      |                      |               |                     |                              |  |
|                      |                                                                                                                                               |                     | Equinox: J2000                  |                 |                          |                      |                      |               |                     |                              |  |
|                      | Comments:<br>Category=ISM<br>Description=[Interstellar clouds, Interstellar dust, Interstellar molecules]<br>Extended=YES                     |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |
| Template             | Module                                                                                                                                        |                     | Subarray                        |                 |                          |                      | Target Placement     |               |                     |                              |  |
|                      | ALL                                                                                                                                           |                     | FULL                            |                 |                          |                      | Module B (B4 corner) |               |                     |                              |  |
| Dithers              | #                                                                                                                                             | Primary Dither Type |                                 | Primary Dithers |                          | Subpixel Dither Type |                      | Dither Size   |                     | Subpixel Positions           |  |
|                      | 1                                                                                                                                             | INTRAMODULEBOX      |                                 | 4               |                          | STANDARD             |                      |               |                     | 1                            |  |
| Spectral Elements    | #                                                                                                                                             | Short Filter        | Long Filter                     | Readout Pattern | Groups/Int               | Integrations/Exp     | Total Integrations   | Total Dithers | Total Exposure Time | ETC Wkbk.Calc ID             |  |
|                      | 1                                                                                                                                             | F164N+F150W2        | F300M                           | BRIGHT2         | 5                        | 1                    | 4                    | 4             | 429.471             |                              |  |
|                      | 2                                                                                                                                             | F090W               | F335M                           | BRIGHT2         | 5                        | 1                    | 4                    | 4             | 429.471             |                              |  |
|                      | 3                                                                                                                                             | F150W               | F360M                           | BRIGHT2         | 5                        | 1                    | 4                    | 4             | 429.471             |                              |  |
|                      | 4                                                                                                                                             | F200W               | F444W                           | BRIGHT2         | 5                        | 1                    | 4                    | 4             | 429.471             |                              |  |
| Special Requirements | Offset 20.0 arcsec, 42.0 arcsec<br>Fiducial Point Override NRCBS_FULL                                                                         |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |
|                      | 3 After 12 by 14 Days to 21 Days<br>12 After 2 by 5 Days to 16 Days<br>Aperture PA Offset 12 from 2 by -10 to 10 Degrees (Same offsets in V3) |                     |                                 |                 |                          |                      |                      |               |                     |                              |  |