



2311 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Cycle: 1, Proposal Category: GO

INVESTIGATORS

| <i>Name</i> | <i>Institution</i> |
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OBSERVATIONS

| <i>Folder</i> | <i>Observation</i> | <i>Label</i> | <i>Observing Template</i> | <i>Science Target</i> |
|--------------------|--------------------|--------------|---------------------------|-----------------------|
| Observation Folder | | | | |
| | 1 | | MIRI Imaging | (1) 2M0359+2009-B |
| | 2 | | MIRI Imaging | (2) FU-TAU-B |
| | 3 | | MIRI Imaging | (3) DH-TAU-B |
| | 4 | | MIRI Imaging | (4) 1RXS1609-B |
| | 5 | | MIRI Imaging | (5) CT-CHA-B |
| | 6 | | MIRI Imaging | (6) GSC6214-210-B |
| | 7 | | MIRI Imaging | (7) SR-12-C |

ABSTRACT

Probing the accretion disks around long-period planetary-mass companions (PMCs; mass < 20 Jupiter masses with orbits > 100 AU) is valuable to study the origin of gas giants and their satellites at a level of detail not accessible to imaged planets at small separations. In theory, these disks are expected to be large and bright at radio wavelengths. Nonetheless, dedicated ALMA surveys at 0.88 mm and 1.3 mm have all yielded non-detections,

indicating that PMC disks are distinct from those around free-floating brown dwarfs/planets. One hypothesis is that PMC disks are fainter than expected because they are very compact and optically thick, with disk radii <0.5 AU (1000 Jupiter radii). Since compact disks are brighter at mid-infrared wavelengths, JWST is advantageous to detect PMC disks and characterize their bulk properties at a population level. Here we propose a JWST MIRI imaging survey of 7 young PMCs that have comparable masses and accretion signatures. We aim to directly image PMC disks for the first time, model the spectral energy distribution of the disks between 5 and 21 micron, and definitively test the compact disk hypothesis. This imaging survey has the potential to discover additional companions, and will help design future spectroscopic programs to probe the mineralogy and structure of circumplanetary disks.

OBSERVING DESCRIPTION

Over the past few years, ALMA observations on young and accreting planetary-mass companions (PMCs) have all yielded non-detections, which is puzzling and challenges our understanding of disk formation and evolution around substellar companions. As disks should be brighter at mid-infrared wavelengths, JWST has a better opportunity to image these enigmatic disks and test specific predictions. Here we request 16.24 hr to perform MIRI imaging for 7 accreting PMCs at 5-21 micron (F560W, F770W, F1000W, F1280W, F1500W, F1800W, and F2100W). As shown in the Visit Planner, all of our targets have months of observing windows in a year. We aim to directly image PMC disks at mid-infrared wavelengths and model disk SEDs to examine if PMC disks are indeed very compact, as hinted by ALMA non-detections. These filters are selected to well sample the disk SEDs and facilitate disk modeling. In addition, the F770W, F1000W, F1280W, and F1800W filters can probe silicate emission from the disk. Coronagraphic imaging is not needed for this program as all of the targets are rather separated from the host stars. The total exposure time for each filter is determined such that even if there is no disk emission, we can still detect the photospheric emission at $S/N > 10$. To reduce the readout time, we will adopt the SUB256 array with a 4-point dither pattern.

Proposal 2311 - Targets - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|--|---------------|--|--|---------------|
| (1) | 2M0359+2009-B | RA: 03 59 9.7122 (59.7904675d) Dec: +20 09 35.66 (20.15991d) Equinox: J2000 | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.8 | |
| <i>Comments: Category=Star Description=[Exoplanet Systems]</i> | | | | |
| (2) | FU-TAU-B | RA: 04 23 35.5853 (65.8982721d) Dec: +25 03 0.59 (25.05016d) Equinox: J2000 | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.1 | |
| <i>Comments: Category=Star Description=[Exoplanet Systems]</i> | | | | |
| (3) | DH-TAU-B | RA: 04 29 41.5643 (67.4231846d) Dec: +26 32 57.81 (26.54939d) Equinox: J2000 | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2012.1 | |
| <i>Comments: Category=Star Description=[Exoplanet Systems]</i> | | | | |
| (4) | 1RXS1609-B | RA: 16 09 30.3080 (242.3762833d) Dec: -21 04 58.95 (-21.08304d) Equinox: J2000 | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2000 | |
| <i>Comments: Category=Star Description=[Exoplanet Systems]</i> | | | | |
| (5) | CT-CHA-B | RA: 11 04 8.9423 (166.0372596d) Dec: -76 27 19.23 (-76.45534d) Equinox: J2000 | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.2 | |
| <i>Comments: Category=Star Description=[Exoplanet Systems]</i> | | | | |
| (6) | GSC6214-210-B | RA: 16 21 54.6530 (245.4777208d) Dec: -20 43 9.46 (-20.71929d) Equinox: J2000 | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2012.2 | |
| <i>Comments: Category=Star Description=[Exoplanet Systems]</i> | | | | |
| (7) | SR-12-C | RA: 16 27 19.5685 (246.8315354d) Dec: -24 41 45.18 (-24.69588d) Equinox: J2000 | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.3 | |
| <i>Comments: Category=Star Description=[Exoplanet Systems]</i> | | | | |

Fixed Targets

Proposal 2311 - Observation 1 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Wed Apr 23 19:00:13 GMT 2025

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|--------------------------|--|--------------------|---|-------------------------|-------------------------|--|-----------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 2311, Observation 1 Diagnostic Status: Warning Observing Template: MIRI 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 | | |
| | (1) | 2M0359+2009-B | RA: 03 59 9.7122 (59.7904675d) Dec: +20 09 35.66 (20.15991d) Equinox: J2000 | | | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.8 | | | | | |
| | <i>Comments:</i> <i>Category=Star</i> <i>Description=[Exoplanet Systems]</i> | | | | | | | | | | |
| Template | Subarray SUB256 | | | | | | | | | | |
| Dithers | # | Dither Type | Starting Point | Number of Points | Points | Starting Set | Number of Sets | Optimized For | Direction | Pattern Size | |
| | 1 | 4-Point-Sets | | | | 1 | 1 | POINT SOURCE | POSITIVE | DEFAULT | |
| Spectral Elements | # | Filter | Readout Pattern | Groups/Int | Integrations/Exp | Exposures/Dith | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | F560W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 2 | F770W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 3 | F1000W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 4 | F1280W | FASTR1 | 20 | 5 | 1 | Dither 1 | 4 | 20 | 124.6 | |
| | 5 | F1500W | FASTR1 | 25 | 10 | 1 | Dither 1 | 4 | 40 | 310.303 | |
| | 6 | F1800W | FASTR1 | 50 | 10 | 1 | Dither 1 | 4 | 40 | 609.823 | |
| | 7 | F2100W | FASTR1 | 100 | 10 | 1 | Dither 1 | 4 | 40 | 1208.863 | |

Proposal 2311 - Observation 2 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Wed Apr 23 19:00:13 GMT 2025

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|--|--|--------------------|---|-------------------------|-------------------------|--|-----------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 2311, Observation 2 Diagnostic Status: Warning Observing Template: MIRI Imaging | | | | | | | | | | |
| | (Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. | | | | | | | | | | |
| Fixed Targets | # | Name | Target Coordinates | | | Targ. Coord. Corrections | | | Miscellaneous | | |
| | (2) | FU-TAU-B | RA: 04 23 35.5853 (65.8982721d) Dec: +25 03 0.59 (25.05016d) Equinox: J2000 | | | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.1 | | | | | |
| <i>Comments:</i> <i>Category=Star</i> <i>Description=[Exoplanet Systems]</i> | | | | | | | | | | | |
| Template | Subarray | | | | | | | | | | |
| | SUB256 | | | | | | | | | | |
| Dithers | # | Dither Type | Starting Point | Number of Points | Points | Starting Set | Number of Sets | Optimized For | Direction | Pattern Size | |
| | 1 | 4-Point-Sets | | | | 1 | 1 | POINT SOURCE | POSITIVE | DEFAULT | |
| Spectral Elements | # | Filter | Readout Pattern | Groups/Int | Integrations/Exp | Exposures/Dith | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | F560W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 2 | F770W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 3 | F1000W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 4 | F1280W | FASTR1 | 20 | 5 | 1 | Dither 1 | 4 | 20 | 124.6 | |
| | 5 | F1500W | FASTR1 | 25 | 10 | 1 | Dither 1 | 4 | 40 | 310.303 | |
| | 6 | F1800W | FASTR1 | 50 | 10 | 1 | Dither 1 | 4 | 40 | 609.823 | |
| | 7 | F2100W | FASTR1 | 100 | 10 | 1 | Dither 1 | 4 | 40 | 1208.863 | |

Proposal 2311 - Observation 3 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Wed Apr 23 19:00:13 GMT 2025

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|--|--|--------------------|--|-------------------------|-------------------------|--|-----------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 2311, Observation 3 Diagnostic Status: Warning Observing Template: MIRI Imaging | | | | | | | | | | |
| | (Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. | | | | | | | | | | |
| Fixed Targets | # | Name | Target Coordinates | | | Targ. Coord. Corrections | | | Miscellaneous | | |
| | (3) | DH-TAU-B | RA: 04 29 41.5643 (67.4231846d) Dec: +26 32 57.81 (26.54939d) Equinox: J2000 | | | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2012.1 | | | | | |
| <i>Comments:</i> <i>Category=Star</i> <i>Description=[Exoplanet Systems]</i> | | | | | | | | | | | |
| Template | Subarray | | | | | | | | | | |
| | SUB256 | | | | | | | | | | |
| Dithers | # | Dither Type | Starting Point | Number of Points | Points | Starting Set | Number of Sets | Optimized For | Direction | Pattern Size | |
| | 1 | 4-Point-Sets | | | | 1 | 1 | POINT SOURCE | POSITIVE | DEFAULT | |
| Spectral Elements | # | Filter | Readout Pattern | Groups/Int | Integrations/Exp | Exposures/Dith | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | F560W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 2 | F770W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 3 | F1000W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 4 | F1280W | FASTR1 | 20 | 5 | 1 | Dither 1 | 4 | 20 | 124.6 | |
| | 5 | F1500W | FASTR1 | 25 | 10 | 1 | Dither 1 | 4 | 40 | 310.303 | |
| | 6 | F1800W | FASTR1 | 50 | 10 | 1 | Dither 1 | 4 | 40 | 609.823 | |
| | 7 | F2100W | FASTR1 | 100 | 10 | 1 | Dither 1 | 4 | 40 | 1208.863 | |

Proposal 2311 - Observation 4 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Wed Apr 23 19:00:13 GMT 2025

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|--------------------------|--|--------------------|--|-------------------------|-------------------------|--|-----------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 2311, Observation 4 Diagnostic Status: Warning Observing Template: MIRI 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) | 1RXS1609-B | RA: 16 09 30.3080 (242.3762833d) Dec: -21 04 58.95 (-21.08304d) Equinox: J2000 | | | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2000 | | | | | |
| | <i>Comments:</i> Category=Star Description=[Exoplanet Systems] | | | | | | | | | | |
| Template | Subarray SUB256 | | | | | | | | | | |
| Dithers | # | Dither Type | Starting Point | Number of Points | Points | Starting Set | Number of Sets | Optimized For | Direction | Pattern Size | |
| | 1 | 4-Point-Sets | | | | 1 | 1 | POINT SOURCE | POSITIVE | DEFAULT | |
| Spectral Elements | # | Filter | Readout Pattern | Groups/Int | Integrations/Exp | Exposures/Dith | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | F560W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 2 | F770W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 3 | F1000W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 4 | F1280W | FASTR1 | 20 | 5 | 1 | Dither 1 | 4 | 20 | 124.6 | |
| | 5 | F1500W | FASTR1 | 25 | 10 | 1 | Dither 1 | 4 | 40 | 310.303 | |
| | 6 | F1800W | FASTR1 | 50 | 10 | 1 | Dither 1 | 4 | 40 | 609.823 | |
| | 7 | F2100W | FASTR1 | 100 | 10 | 1 | Dither 1 | 4 | 40 | 1208.863 | |

Proposal 2311 - Observation 5 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Wed Apr 23 19:00:13 GMT 2025

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|--------------------------|--|--------------------|---|-------------------------|-------------------------|--|-----------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 2311, Observation 5 Diagnostic Status: Warning Observing Template: MIRI Imaging | | | | | | | | | | |
| | (Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. | | | | | | | | | | |
| Fixed Targets | # | Name | Target Coordinates | | | Targ. Coord. Corrections | | | Miscellaneous | | |
| | (5) | CT-CHA-B | RA: 11 04 8.9423 (166.0372596d) Dec: -76 27 19.23 (-76.45534d) Equinox: J2000 | | | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.2 | | | | | |
| Template | <i>Comments:</i> <i>Category=Star</i> <i>Description=[Exoplanet Systems]</i> | | | | | | | | | | |
| | Subarray SUB256 | | | | | | | | | | |
| Dithers | # | Dither Type | Starting Point | Number of Points | Points | Starting Set | Number of Sets | Optimized For | Direction | Pattern Size | |
| | 1 | 4-Point-Sets | | | | 1 | 1 | POINT SOURCE | POSITIVE | DEFAULT | |
| Spectral Elements | # | Filter | Readout Pattern | Groups/Int | Integrations/Exp | Exposures/Dith | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | F560W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 2 | F770W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 3 | F1000W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 4 | F1280W | FASTR1 | 20 | 5 | 1 | Dither 1 | 4 | 20 | 124.6 | |
| | 5 | F1500W | FASTR1 | 25 | 10 | 1 | Dither 1 | 4 | 40 | 310.303 | |
| | 6 | F1800W | FASTR1 | 50 | 10 | 1 | Dither 1 | 4 | 40 | 609.823 | |
| | 7 | F2100W | FASTR1 | 100 | 10 | 1 | Dither 1 | 4 | 40 | 1208.863 | |

Proposal 2311 - Observation 6 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Wed Apr 23 19:00:13 GMT 2025

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|--------------------------|--|--------------------|---|-------------------------|-------------------------|--|-----------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 2311, Observation 6 Diagnostic Status: Warning Observing Template: MIRI Imaging | | | | | | | | | | |
| 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 | | |
| | (6) | GSC6214-210-B | RA: 16 21 54.6530 (245.4777208d) Dec: -20 43 9.46 (-20.71929d) Equinox: J2000 | | | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2012.2 | | | | | |
| | <i>Comments:</i> Category=Star Description=[Exoplanet Systems] | | | | | | | | | | |
| Template | Subarray SUB256 | | | | | | | | | | |
| Dithers | # | Dither Type | Starting Point | Number of Points | Points | Starting Set | Number of Sets | Optimized For | Direction | Pattern Size | |
| | 1 | 4-Point-Sets | | | | 1 | 1 | POINT SOURCE | POSITIVE | DEFAULT | |
| Spectral Elements | # | Filter | Readout Pattern | Groups/Int | Integrations/Exp | Exposures/Dith | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | F560W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 2 | F770W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 3 | F1000W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 4 | F1280W | FASTR1 | 20 | 5 | 1 | Dither 1 | 4 | 20 | 124.6 | |
| | 5 | F1500W | FASTR1 | 25 | 10 | 1 | Dither 1 | 4 | 40 | 310.303 | |
| | 6 | F1800W | FASTR1 | 50 | 10 | 1 | Dither 1 | 4 | 40 | 609.823 | |
| | 7 | F2100W | FASTR1 | 100 | 10 | 1 | Dither 1 | 4 | 40 | 1208.863 | |

Proposal 2311 - Observation 7 - JWST MIRI Imaging Survey of Planetary-mass Companions: Testing the Compact Disk Hypothesis

Wed Apr 23 19:00:13 GMT 2025

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|--|--|--------------------|--|-------------------------|-------------------------|--|-----------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 2311, Observation 7 Diagnostic Status: Warning Observing Template: MIRI Imaging | | | | | | | | | | |
| | (Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. | | | | | | | | | | |
| Fixed Targets | # | Name | Target Coordinates | | | Targ. Coord. Corrections | | | Miscellaneous | | |
| | (7) | SR-12-C | RA: 16 27 19.5685 (246.8315354d) Dec: -24 41 45.18 (-24.69588d) Equinox: J2000 | | | Proper Motion RA: 0 arcsec/yr Proper Motion Dec: 0 arcsec/yr Epoch of Position: 2021.3 | | | | | |
| <i>Comments:</i> Category=Star Description=[Exoplanet Systems] | | | | | | | | | | | |
| Template | Subarray | | | | | | | | | | |
| | SUB256 | | | | | | | | | | |
| Dithers | # | Dither Type | Starting Point | Number of Points | Points | Starting Set | Number of Sets | Optimized For | Direction | Pattern Size | |
| | 1 | 4-Point-Sets | | | | 1 | 1 | POINT SOURCE | POSITIVE | DEFAULT | |
| Spectral Elements | # | Filter | Readout Pattern | Groups/Int | Integrations/Exp | Exposures/Dith | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | F560W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 2 | F770W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 3 | F1000W | FASTR1 | 10 | 5 | 1 | Dither 1 | 4 | 20 | 64.696 | |
| | 4 | F1280W | FASTR1 | 20 | 5 | 1 | Dither 1 | 4 | 20 | 124.6 | |
| | 5 | F1500W | FASTR1 | 25 | 10 | 1 | Dither 1 | 4 | 40 | 310.303 | |
| | 6 | F1800W | FASTR1 | 50 | 10 | 1 | Dither 1 | 4 | 40 | 609.823 | |
| | 7 | F2100W | FASTR1 | 100 | 10 | 1 | Dither 1 | 4 | 40 | 1208.863 | |