



1257 - The Young Protostellar Outflow HH211

Cycle: 1, Proposal Category: GTO

INVESTIGATORS

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OBSERVATIONS

| <i>Folder</i> | <i>Observation</i> | <i>Label</i> | <i>Observing Template</i> | <i>Science Target</i> |
|-------------------------------|--------------------|-----------------------------------|-------------------------------------|------------------------|
| MIRI MRS mapping | | | | |
| | 1 | MIRI MRS mapping | MIRI Medium Resolution Spectroscopy | (1) HH211 |
| | 2 | HH211 background | MIRI Medium Resolution Spectroscopy | (2) HH211-BACKGROUND |
| NIRCAM & NIRSPEC observations | | | | |
| | 3 | NIRCAM imaging of HH211 | NIRCam Imaging | (5) HH211NIRCAM |
| | 4 | NIRSPEC map of HH211 SW bow shock | NIRSpec IFU Spectroscopy | (4) HH211-SW-BOW-SHOCK |

ABSTRACT

This project is a combined effort of MIRI GTO team (PI G. Wright, WRIGHT_4035-4036) and Dr. M. McCaughrean GTO (PI. McCaughrean, MCCAUGHREAN_0401-0409, MCCAUGHREAN_0501). Note that the original 22.8 hrs allocated time has been extended to 23.93 hrs, which includes 8.13 hrs (originally 7 hrs) from Dr. McCaughrean GTO and additional 15.8 hrs from Wright GTO. Drs. Wright and McCaughrean can confirm the new settings.

We will carry out MIRI MRS and NIRSpect IFU spectral mapping, as well as NIRCcam imaging of the young HH211 protostellar outflow. By examining spectra at different positions along the outflow, density, ionization fraction, temperature, dust content, etc., can be determined as a function of distance from the source, offering a chance to study how the outflow gas interacts with the surrounding medium on larger scales. This will allow us to make the direct connection with the traditional optical/nearIR diagnostics and study the bowshocks at the tip of the outflow lobes where the jet directly impacts the surrounding cloud and which are known to be very rich spectroscopically. The aim is a comprehensive study of the physical conditions throughout this prototypical deeply-embedded young outflow driven by a Class 0 object, including the density, ionisation fraction, temperature, dust content, etc. This will make it possible to understand the energetics of the flow and its interaction with the ambient molecular cloud on both the large and small scales. The outflow is compact, with an estimated age of only a few thousand years. Substantial existing additional near-IR, mid-IR, and millimetre data will be analysed as part of this study.

OBSERVING DESCRIPTION

We will carry out MIRI MRS and NIRSpect IFU spectral mapping, as well as NIRCcam imaging of the young HH211 protostellar outflow.

MIRI MRS 12x2 map (channels 1,2,3,4) are designed to encompass the whole blue-shifted lobe of the flow, as well as the embedded protostar and part of the red-shifted lobe.

As MIRI orientation in the sky cannot follow the outflow PA (~204 degrees), we shift each mosaic row by 31 rows to mimic the PA.

We link complementary observation of the background within 1 day to be used to remove telescope and sky emission.

NIRSpect IFU (G325H & G395H gratings) will perform spectral imaging of the brightest (SE) bowshock in the outflow, using a 2x5 map, with 4 tiles removed.

As for MIRI, PA constraints are set to encompass the bow-shock shape.

JWST Proposal 1257 (Created: Monday, February 22, 2021 at 1:00:14 PM Eastern Standard Time) - Overview

NIRCam will map the whole outflow in 5 narrow-band filters (F164N, F212N, F323N, F466N, F470N to isolate specific molecular and atomic emission lines) and 4 medium-band filters (162M, 210M, 335M, 460M, to remove continuum emission) over a field of ~ 2.2 arcmin x 4.4 arcmin. Selected PAs and coordinates allow us to map HH211 flow with module B as well as 2 additional flows from young protostars with module A.

Proposal 1257 - Targets - The Young Protostellar Outflow HH211

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|---|--------------------|--|---|---------------|
| (1) | HH211 | RA: 03 43 58.0951 (55.9920629d) Dec: +32 00 43.03 (32.01195d) Equinox: J2000 | | |
| <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> <i>Category=ISM</i> <i>Description=[Herbig-Haro objects]</i> <i>Extended=YES</i></p> | | | | |
| (2) | HH211-BACKGROUND | RA: 03 43 55.2800 (55.9803333d) Dec: +32 00 41.30 (32.01147d) Equinox: J2000 | | |
| <p><i>Comments:</i> <i>Category=Star</i> <i>Description=[Pre-main sequence stars, Protostars]</i></p> | | | | |
| (4) | HH211-SW-BOW-SHOCK | RA: 03 43 59.4861 (55.9978588d) Dec: +32 00 35.46 (32.00985d) Equinox: J2000 | Proper Motion RA: 0.0689 arcsec/yr Proper Motion Dec: -0.0579 arcsec/yr Epoch of Position: 2002.5 | |
| <p><i>Comments:</i> <i>Category=ISM</i> <i>Description=[Herbig-Haro objects]</i> <i>Extended=YES</i></p> | | | | |
| (5) | HH211NIRCAM | RA: 03 43 56.4000 (55.9850000d) Dec: +32 01 55.10 (32.03197d) Equinox: J2000 | | |
| <p><i>Comments:</i> <i>Category=Unidentified</i> <i>Description=[Blank field]</i></p> | | | | |

Fixed Targets

Proposal 1257 - Observation 1 - The Young Protostellar Outflow HH211

Mon Feb 22 18:00:14 GMT 2021

| | | | | | | | | | | | | | |
|--------------------------|---|-------------------------|---|-------------------------|------------------------|-----------------------------|---------------------------------|-----------------------|------------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 1257, Observation 1: MIRI MRS mapping Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy <i>Comments: Position angle : 110 deg.</i> | | | | | | | | | | | | |
| | (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) | HH211 | RA: 03 43 58.0951 (55.9920629d) Dec: +32 00 43.03 (32.01195d) Equinox: J2000 <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> Category=ISM Description=[Herbig-Haro objects] Extended=YES | | | | | | | | | | |
| Acquisition | # | Target | | | | | | | | | | | |
| | 1 | NONE | | | | | | | | | | | |
| Template | AcqFilter | Primary Channel | | | | Simultaneous Imaging | | | Imager Subarray | | | | |
| | F1500W | ALL | | | | NO | | | FULL | | | | |
| Mosaic | Rows | Columns | Row Overlap % | Column Overlap % | Row shift | Column shift | Tile Order | | | | | | |
| | 12 | 2 | 5.0 | 0.0 | 20.0 | 0.0 | DEFAULT | | | | | | |
| 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 | SHORT(A) | MRSLONG | | FAST | 18 | 1 | 1 | Dither 1 | 4 | 4 | 199.803 | |
| | 1 | SHORT(A) | MRSSHORT | | FAST | 18 | 1 | 1 | Dither 1 | 4 | 4 | 199.803 | |
| | 2 | MEDIUM(B) | MRSLONG | | FAST | 18 | 1 | 1 | Dither 1 | 4 | 4 | 199.803 | |
| | 2 | MEDIUM(B) | MRSSHORT | | FAST | 18 | 1 | 1 | Dither 1 | 4 | 4 | 199.803 | |
| | 3 | LONG(C) | MRSLONG | | FAST | 18 | 1 | 1 | Dither 1 | 4 | 4 | 199.803 | |
| | 3 | LONG(C) | MRSSHORT | | FAST | 18 | 1 | 1 | Dither 1 | 4 | 4 | 199.803 | |

Proposal 1257 - Observation 1 - The Young Protostellar Outflow HH211

Special Requirements

Aperture PA Range 83 to 86 Degrees (V3 83.0 to 86.0)
Offset 1.3701701442374796 arcsec, -2.543883161700922 arcsec

Sequence Observations 1, 2, Non-interruptible

Proposal 1257 - Observation 2 - The Young Protostellar Outflow HH211

Mon Feb 22 18:00:14 GMT 2021

| | | | | | | | | | | | | | |
|--|---|-------------------------|--|---------------|------------------------|-----------------------------|---------------------------------|------------------------|------------------------|----------------------|---------------------------|----------------------------|-------------------------|
| Observation | Proposal 1257, Observation 2: HH211 background Diagnostic Status: Warning Observing Template: MIRI Medium Resolution Spectroscopy | | | | | | | | | | | | |
| | (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) | HH211-BACKGROUND | RA: 03 43 55.2800 (55.9803333d) Dec: +32 00 41.30 (32.01147d) Equinox: J2000 | | | | | | | | | | |
| <i>Comments:</i> <i>Category=Star</i> <i>Description=[Pre-main sequence stars, Protostars]</i> | | | | | | | | | | | | | |
| Acquisition | # | | | | | | | | | | | Target | |
| | 1 | | | | | | | | | | | NONE | |
| Template | AcqFilter | Primary Channel | | | | Simultaneous Imaging | | | Imager Subarray | | | | |
| | F560W | ALL | | | | NO | | | FULL | | | | |
| Dithers | # | Dither Type | | | | Optimized For | | | Direction | | | | |
| | 1 | 2-Point | | | | POINT SOURCE | | | NEGATIVE | | | | |
| Spectral Elements | # | Wavelength Range | Detector | Filter | Readout Pattern | Groups/Int | Integrations/E xp | Exposures/Dit h | Dither | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
| | 1 | SHORT(A) | MRSLONG | | FAST | 18 | 1 | 1 | Dither 1 | 2 | 2 | 99.901 | |
| | 1 | SHORT(A) | MRSSHORT | | FAST | 18 | 1 | 1 | Dither 1 | 2 | 2 | 99.901 | |
| | 2 | MEDIUM(B) | MRSLONG | | FAST | 18 | 1 | 1 | Dither 1 | 2 | 2 | 99.901 | |
| | 2 | MEDIUM(B) | MRSSHORT | | FAST | 18 | 1 | 1 | Dither 1 | 2 | 2 | 99.901 | |
| | 3 | LONG(C) | MRSLONG | | FAST | 18 | 1 | 1 | Dither 1 | 2 | 2 | 99.901 | |
| | 3 | LONG(C) | MRSSHORT | | FAST | 18 | 1 | 1 | Dither 1 | 2 | 2 | 99.901 | |

Proposal 1257 - Observation 2 - The Young Protostellar Outflow HH211

Special Requirements

Sequence Observations 1, 2, Non-interruptible

Proposal 1257 - Observation 3 - The Young Protostellar Outflow HH211

Mon Feb 22 18:00:14 GMT 2021

| | | | | | | | | | | |
|-----------------------------|---|----------------------------|--|------------------------|---------------------------------|-------------------------|---------------------------|---------------------------|----------------------------|-------------------------|
| Observation | <p>Proposal 1257, Observation 3: NIRCAM imaging of HH211</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCAM Imaging</p> | | | | | | | | | |
| 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 | | |
| | (5) | HH211NIRCAM | RA: 03 43 56.4000 (55.9850000d) Dec: +32 01 55.10 (32.03197d) Equinox: J2000 | | | | | | | |
| | <p><i>Comments:</i> <i>Category=Unidentified</i> <i>Description=[Blank field]</i></p> | | | | | | | | | |
| Template | Module | | | | | Subarray | | | | |
| | ALL | | | | | FULL | | | | |
| Dithers | # | Primary Dither Type | | Primary Dithers | Subpixel Dither Type | | Dither Size | Subpixel Positions | | |
| | 1 | INTRAMODULEX | | 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 | F466N+F444W | BRIGHT1 | 8 | 1 | 4 | 4 | 644.206 | |
| | 2 | F164N+F150W2 | F470N+F444W | BRIGHT1 | 8 | 1 | 4 | 4 | 644.206 | |
| | 3 | F212N | F323N+F322W2 | BRIGHT1 | 8 | 1 | 4 | 4 | 644.206 | |
| | 4 | F210M | F460M | BRIGHT1 | 4 | 1 | 4 | 4 | 300.63 | |
| | 5 | F162M+F150W2 | F335M | BRIGHT1 | 4 | 1 | 4 | 4 | 300.63 | |
| Special Requirements | <p>Aperture PA Range 250 to 263 Degrees (V3 250.11255124 to 263.11255124) No Parallel</p> <p>Sequence Observations 3, 4 within 30 Days</p> | | | | | | | | | |

Proposal 1257 - Observation 4 - The Young Protostellar Outflow HH211

| Observation | Proposal 1257, Observation 4: NIRSPEC map of HH211 SW bow shock Mon Feb 22 18:00:14 GMT 2021 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------|--|--|---|--------------------------|--------------------------|------------------|--------------|--------------------|--|---|---------------------|---|------------------|------|--------------|--------------|---|---|-------|------|------|---|---|---------|--|---|--------------|--------------|---|---|------|------|------|---|---|---------|--|---|--------------|--------------|---|---|-------|------|------|---|---|---------|--|---|--------------|--------------|---|---|------|------|------|---|---|---------|--|--|--|--|--|--|--|--|--|--|--|--|
| | Diagnostic Status: Warning Observing Template: NIRSPEC IFU Spectroscopy | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Diagnostics | (Visit 4:1) Warning (Form): Overheads are provisional until the Visit Planner has been run. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fixed Targets | <table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(4)</td> <td>HH211-SW-BOW-SHOCK</td> <td>RA: 03 43 59.4861 (55.9978588d) Dec: +32 00 35.46 (32.00985d) Equinox: J2000</td> <td>Proper Motion RA: 0.0689 arcsec/yr Proper Motion Dec: -0.0579 arcsec/yr Epoch of Position: 2002.5</td> <td></td> </tr> </tbody> </table> | # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous | (4) | HH211-SW-BOW-SHOCK | RA: 03 43 59.4861 (55.9978588d) Dec: +32 00 35.46 (32.00985d) Equinox: J2000 | Proper Motion RA: 0.0689 arcsec/yr Proper Motion Dec: -0.0579 arcsec/yr Epoch of Position: 2002.5 | | <i>Comments:</i> Category=ISM Description=[Herbig-Haro objects] Extended=YES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (4) | HH211-SW-BOW-SHOCK | RA: 03 43 59.4861 (55.9978588d) Dec: +32 00 35.46 (32.00985d) Equinox: J2000 | Proper Motion RA: 0.0689 arcsec/yr Proper Motion Dec: -0.0579 arcsec/yr Epoch of Position: 2002.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Template | TA Method | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | NONE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mosaic | <table border="1"> <thead> <tr> <th>Rows</th> <th>Columns</th> <th>Row Overlap %</th> <th>Column Overlap %</th> <th>Row shift</th> <th>Column shift</th> <th>Tile Order</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>5</td> <td>10.0</td> <td>10.0</td> <td>10.0</td> <td>10.0</td> <td>ROW_MAJOR</td> </tr> </tbody> </table> | Rows | Columns | Row Overlap % | Column Overlap % | Row shift | Column shift | Tile Order | 2 | 5 | 10.0 | 10.0 | 10.0 | 10.0 | ROW_MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Rows | Columns | Row Overlap % | Column Overlap % | Row shift | Column shift | Tile Order | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 5 | 10.0 | 10.0 | 10.0 | 10.0 | ROW_MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dithers | <table border="1"> <thead> <tr> <th>#</th> <th>Dither Type</th> <th>Size</th> <th>Starting Point</th> <th>Number of Points</th> <th>Points</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2-POINT-NOD</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> | # | Dither Type | Size | Starting Point | Number of Points | Points | 1 | 2-POINT-NOD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | # | Dither Type | Size | Starting Point | Number of Points | Points | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 2-POINT-NOD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spectral Elements | <table border="1"> <thead> <tr> <th>#</th> <th>Grating/Filter</th> <th>Readout Pattern</th> <th>Groups/Int</th> <th>Integrations/Exp</th> <th>Leakcal</th> <th>Dither</th> <th>Autocal</th> <th>Total Dithers</th> <th>Total Integrations</th> <th>Total Exposure Time</th> <th>ETC Wkbk.Calc ID</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>G395H/F290LP</td> <td>NRSIRS2RAPID</td> <td>6</td> <td>2</td> <td>false</td> <td>true</td> <td>NONE</td> <td>2</td> <td>4</td> <td>408.489</td> <td></td> </tr> <tr> <td>2</td> <td>G395H/F290LP</td> <td>NRSIRS2RAPID</td> <td>6</td> <td>1</td> <td>true</td> <td>true</td> <td>NONE</td> <td>2</td> <td>2</td> <td>204.244</td> <td></td> </tr> <tr> <td>3</td> <td>G235H/F170LP</td> <td>NRSIRS2RAPID</td> <td>6</td> <td>2</td> <td>false</td> <td>true</td> <td>NONE</td> <td>2</td> <td>4</td> <td>408.489</td> <td></td> </tr> <tr> <td>4</td> <td>G235H/F170LP</td> <td>NRSIRS2RAPID</td> <td>6</td> <td>1</td> <td>true</td> <td>true</td> <td>NONE</td> <td>2</td> <td>2</td> <td>204.244</td> <td></td> </tr> </tbody> </table> | # | Grating/Filter | Readout Pattern | Groups/Int | Integrations/Exp | Leakcal | Dither | Autocal | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID | 1 | G395H/F290LP | NRSIRS2RAPID | 6 | 2 | false | true | NONE | 2 | 4 | 408.489 | | 2 | G395H/F290LP | NRSIRS2RAPID | 6 | 1 | true | true | NONE | 2 | 2 | 204.244 | | 3 | G235H/F170LP | NRSIRS2RAPID | 6 | 2 | false | true | NONE | 2 | 4 | 408.489 | | 4 | G235H/F170LP | NRSIRS2RAPID | 6 | 1 | true | true | NONE | 2 | 2 | 204.244 | | | | | | | | | | | | |
| | # | Grating/Filter | Readout Pattern | Groups/Int | Integrations/Exp | Leakcal | Dither | Autocal | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | G395H/F290LP | NRSIRS2RAPID | 6 | 2 | false | true | NONE | 2 | 4 | 408.489 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2 | G395H/F290LP | NRSIRS2RAPID | 6 | 1 | true | true | NONE | 2 | 2 | 204.244 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3 | G235H/F170LP | NRSIRS2RAPID | 6 | 2 | false | true | NONE | 2 | 4 | 408.489 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | G235H/F170LP | NRSIRS2RAPID | 6 | 1 | true | true | NONE | 2 | 2 | 204.244 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Proposal 1257 - Observation 4 - The Young Protostellar Outflow HH211

Special Requirements

Aperture PA Range 26.893 to 33.893 Degrees (V3 248.00002515 to 255.00002515)
Offset -1.1934741926915287 arcsec, -0.10666327935988085 arcsec

Sequence Observations 3, 4 within 30 Days