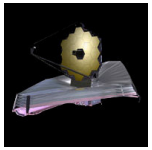

# 1186 - Protostar (YSO) Spectroscopy

Cycle: 1, Proposal Category: GTO

**INVESTIGATORS**


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**OBSERVATIONS**

| *Folder* | *Observation* | *Label* | *Observing Template* | *Science Target* |
|---|---|---|---|---|
| NIRSpec IFU Class 0 protostars | | | | |
| | 1 | Ser S68N | NIRSpec IFU Spectroscopy | (4) SER-S68N |
| | 2 | Ser S68N | NIRSpec IFU Spectroscopy | (4) SER-S68N |
| | 3 | Ser SMM 3 | NIRSpec IFU Spectroscopy | (5) SER-SMM-3 |
| | 4 | Ser SMM 3 | NIRSpec IFU Spectroscopy | (5) SER-SMM-3 |

**ABSTRACT**

We will use the NIRSpec IFU to search for absorption and emission features in the K-band spectra of Class 0 protostars. These are the youngest stars and have yet to accrete the majority of their masses. NIRSpec IFU spectra should show photospheric absorption features that constrain the effective temperatures and surface gravities of accreting Class 0 protostars. We will use absorption line data to assess effective temperatures and judge whether the lines form in the photospheres of protostar or disk atmospheres (via surface gravities). We will also assess the likely origin and excitation mechanism of any H2, H Br gamma, or other emission lines and use their strengths to estimate the presence of jets, UV, X-rays, and accretion. This information will inform theories of how the accretion rates of protostars evolve over time, how quickly they assemble their masses, what high energy

processes are at work, and how they generate their luminosities. These NIRSpec IFU observations correspond to Observation IDs MRIEKE_2500-2504 in the summary observation specification spreadsheet submitted in March 2017. We are collaborating with MIRI team members E. van Dishoeck and M. Ressler who will observe some of these targets with the MIRI MRS.

Modified Jan 2020 to:
1. Eliminate Perseus sources due to outburst activity and emission lines in Keck MOSFIRE spectra
2. Switch Ser S68N and SMM3 G2235M observations to G235H and increase their integration times (IFU detector gap at ~2.36 - 2.49 microns now). Lengthen exposure times to achieve similar SNR ~200(?)

Modified March 2020 to:
1. Change all integrations to NRSIRS2RAPID. Limit individual integration times to ~1000 s to avoid > ~20% cosmic ray fraction.
2. Eliminate all target acquisition given 0.1" RMS pointing
3. Drop the G395H leakcal and do G235M exposure instead

Modified March 2021:

1. Set PA constraints on observations to limit MSA leakage contamination of IFU spectra and confirm reasonable visibility in Visit Planner
2. Correct the description of the observations (gratings, dithers, and leakcals for each object) in the Proposal Description section

Modified September 20, 2021:
Change the long G235H exposures from 68 Ints / NRSIRS2RAPID to 13 Ints / NRSIRS2 to eliminate 18.3 GB total data excess:
1. Change Obs 1 from 68 Ints of NRSIRS2RAPID to 13 ints of NRSIRS2 (S68N G235H; ~5 min less total)
2. Change Obs 3 from 68 Ints of NRSIRS2RAPID to 13 ints of NRSIRS2 (SMM3 G235H; ~5 min less total)
- Charged time drops to 12.06 hours vs. 12.4 hours with NRSIRS2RAPID parameters
- Total data excess is now ~ -14.4 GB (surplus) instead of +18.3 GB excess

**OBSERVING DESCRIPTION**

All observations will be made with the NIRSpec IFU with the G235H, G235M (for H2 lines in gap), and G395M gratings. These are slightly extended (up to ~1") embedded protostar sources, and 2 - 6 small (0.2") cycling dithers will be performed for each. Backgrounds will be taken from

within the target pointings themselves. A single MSA leak calibration exposure will be made for the G235H observations of each target.

The NRSIRS2RAPID readout mode is used to maximize S/N of each spectral observation. Integration times are limited to <~0100s to reduce the impact of cosmic rays. JWST blind pointing of ~0.1" RMS per axis  is sufficient for these observations.

Here is a summary of the observations

| OBS# | TARGET | GRATING | DITHERS |
|---|---|---|---|
| 1 | SER-S68N | G235H | 6 |
| | | G395H | 6 |
| 2 | SER-S68N | G253M | 2 |
| 3 | SER-SMM-3 | G235H | 4 |
| | | G395H | 4 |
| 4 | SER-SMM-3 | G235M | 2 |

## Proposal 1186 - Targets - Protostar (YSO) Spectroscopy

**Fixed Targets**

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|---|---|---|---|---|
| (4) | SER-S68N | RA: 18 29 48.1200 (277.4505000d)<br>Dec: +01 16 44.60 (1.27906d)<br>Equinox: J2000 | Epoch of Position: 2000.0 | |
| *Comments: This object was generated by the targetselector and retrieved from the SIMBAD database, and I updated the coordinates by about 0.2 - 0.5" each axis*<br>*Category=Star*<br>*Description=[Protostars]*<br>*Extended=YES* | | | | |
| (5) | SER-SMM-3 | RA: 18 29 59.3100 (277.4971250d)<br>Dec: +01 14 1.90 (1.23386d)<br>Equinox: J2000 | Proper Motion RA: 0<br>Proper Motion Dec: 0<br>Epoch of Position: 2000.0 | |
| *Comments: UJIDSS image position of 2 micron component of Serpens SMM 3 mm source.*<br>*WIthin ~0.5" of Spitzer position and within ~ 1.5" of mm position*<br>*There is a K =9.5 star about 6" to N*<br>*Category=Star*<br>*Description=[Protostars]*<br>*Extended=YES* | | | | |

## Observation

**Proposal 1186, Observation 1: Ser S68N** Fri Feb 03 22:00:29 GMT 2023

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## Diagnostics

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:1) 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) | SER-S68N | RA: 18 29 48.1200 (277.4505000d)<br>Dec: +01 16 44.60 (1.27906d)<br>Equinox: J2000 | Epoch of Position: 2000.0 | |

*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database, and I updated the coordinates by about 0.2 - 0.5" each axis*
*Category=Star*
*Description=[Protostars]*
*Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | CYCLING | SMALL | 1 | 6 | |

## Spectral Elements

| # | Grating/Filter | Readout Pattern | Groups/Int | Integrations/Exp | Leakcal | Dither | Autocal | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G235H/F170LP | NRSIRS2 | 13 | 2 | false | true | NONE | 6 | 12 | 11554.401 | 88506.5 |
| 2 | G235H/F170LP | NRSIRS2 | 13 | 2 | true | false | NONE | 1 | 2 | 1925.733 | 88506.5 |
| 3 | G395H/F290LP | NRSIRS2RAPID | 16 | 1 | false | true | NONE | 6 | 6 | 1488.067 | 88506.10 |

## Special Requirements

Aperture PA Range 133.892975 to 156.892975 Degrees (V3 354.92044082 to 17.92044082)
Aperture PA Range 278.892975 to 43.892975 Degrees (V3 139.92044082 to 264.92044082)

## Observation

**Proposal 1186, Observation 2: Ser S68N** Fri Feb 03 22:00:29 GMT 2023

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## Diagnostics

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:1) 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) | SER-S68N | RA: 18 29 48.1200 (277.4505000d)<br>Dec: +01 16 44.60 (1.27906d)<br>Equinox: J2000 | Epoch of Position: 2000.0 | |

*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database, and I updated the coordinates by about 0.2 - 0.5" each axis*
*Category=Star*
*Description=[Protostars]*
*Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | CYCLING | SMALL | 1 | 2 | |

## Spectral Elements

| # | Grating/Filter | Readout Pattern | Groups/Int | Integrations/Exp | Leakcal | Dither | Autocal | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G235M/F170LP | NRSIRS2RAPID | 30 | 1 | false | true | NONE | 2 | 2 | 904.511 | 88506.14 |

## Special Requirements

Aperture PA Range 133.892975 to 156.892975 Degrees (V3 354.92044082 to 17.92044082)
Aperture PA Range 278.892975 to 43.892975 Degrees (V3 139.92044082 to 264.92044082)

## Observation

**Proposal 1186, Observation 3: Ser SMM 3** Fri Feb 03 22:00:29 GMT 2023

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## 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) | SER-SMM-3 | RA: 18 29 59.3100 (277.4971250d) | Proper Motion RA: 0 | |
| | | Dec: +01 14 1.90 (1.23386d) | Proper Motion Dec: 0 | |
| | | Equinox: J2000 | Epoch of Position: 2000.0 | |

*Comments: UJIDSS image position of 2 micron component of Serpens SMM 3 mm source.*
*WIthin ~0.5" of Spitzer position and within ~ 1.5" of mm position*
*There is a K =9.5 star about 6" to N*
*Category=Star*
*Description=[Protostars]*
*Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | CYCLING | SMALL | 1 | 4 | |

## Spectral Elements

| # | Grating/Filter | Readout Pattern | Groups/Int | Integrations/Exp | Leakcal | Dither | Autocal | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G235H/F170LP | NRSIRS2 | 13 | 2 | false | true | NONE | 4 | 8 | 7702.934 | 88506.7 |
| 2 | G235H/F170LP | NRSIRS2 | 13 | 2 | true | false | NONE | 1 | 2 | 1925.733 | 88506.7 |
| 3 | G395H/F290LP | NRSIRS2RAPID | 18 | 1 | false | true | NONE | 4 | 4 | 1108.756 | 88506.12 |

## Special Requirements

Aperture PA Range 185.892975 to 239.892975 Degrees (V3 46.92044082 to 100.92044082)

## Observation

**Proposal 1186, Observation 4: Ser SMM 3**

Fri Feb 03 22:00:29 GMT 2023

**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

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|---|---|---|---|---|
| (5) | SER-SMM-3 | RA: 18 29 59.3100 (277.4971250d) | Proper Motion RA: 0 | |
| | | Dec: +01 14 1.90 (1.23386d) | Proper Motion Dec: 0 | |
| | | Equinox: J2000 | Epoch of Position: 2000.0 | |

*Comments: UJIDSS image position of 2 micron component of Serpens SMM 3 mm source.*
*WIthin ~0.5" of Spitzer position and within ~ 1.5" of mm position*
*There is a K =9.5 star about 6" to N*
*Category=Star*
*Description=[Protostars]*
*Extended=YES*

## Template

| TA Method |
|---|
| NONE |

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | CYCLING | SMALL | 1 | 2 | |

## Spectral Elements

| # | Grating/Filter | Readout Pattern | Groups/Int | Integrations/Exp | Leakcal | Dither | Autocal | Total Dithers | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G235M/F170LP | NRSIRS2RAPID | 25 | 1 | false | true | NONE | 2 | 2 | 758.622 | 88506.15 |

## Special Requirements

Aperture PA Range 185.892975 to 239.892975 Degrees (V3 46.92044082 to 100.92044082)