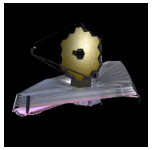

# 1219 - NIRSpec and MIRI spectroscopy of QSOs - part #3

Cycle: 1, Proposal Category: GTO

**INVESTIGATORS**



| *Name* | *Institution* |
|---|---|
| **Nora Luetzgendorf (PI) (ESA Member)** | **Space Telescope Science Institute - ESA - JWST** |
| Dr. Santiago Arribas (CoI) (ESA Member) (Contact) | Consejo Superior de Investigaciones Cientificas |
| Dr. Chris J. Willott (CoI) (CSA Member) (Contact) | NRC Herzberg Institute of Astrophysics |
| Prof. Roberto Maiolino (CoI) (ESA Member) (Contact) | University of Cambridge |
| Dr. Javier Alvarez-Marquez (CoI) (ESA Member) (Contact) | Centro de Astrobiologia (CSIC/INTA) Inst. Nac. de Tec. Aero. |
| Luis Colina Robledo (CoI) (ESA Member) | Centro de Astrobiologia (CSIC/INTA) Inst. Nac. de Tec. Aero. |
| Dr. Alvaro Labiano (CoI) (ESA Member) | ESA-European Space Astronomy Centre |
| Dr. Thomas Martinsson (CoI) (ESA Member) | Centro de Astrobiologia (CSIC/INTA) Inst. Nac. de Tec. Aero. |
| Dr. Pierre Ferruit (CoI) (ESA Member) | ESA-European Space Astronomy Centre |



**OBSERVATIONS**

| *Folder* | *Observation* | *Label* | *Observing Template* | *Science Target* |
|---|---|---|---|---|
| NIRSpec MSA of J1342 | | | | |
| | 6 | Q in A1 Extra, Q in A2 Extra | NIRSpec MultiObject Spectroscopy | (6) J1342-CAT-CORR-EXTRA |
| NIRSpec IFU of J1342 | | | | |
| | 7 | NIRSpec IFU | NIRSpec IFU Spectroscopy | (2) ULASJ1342+0928 |
| | 8 | IFU PSF observation for J1342 | NIRSpec IFU Spectroscopy | (5) PSFSTARULASJ1342 |
| MIRI observations of J1342 | | | | |
| | 4 | MRS-J1342 | MIRI Medium Resolution Spectroscopy | (2) ULASJ1342+0928 |
| | 9 | MRS-J1342 | MIRI Medium Resolution Spectroscopy | (2) ULASJ1342+0928 |

**ABSTRACT**

MIRI, with its spectral coverage from 5 to 28 um and sensitivity, is the only instrument onboard JWST able to explore the optical and near-infrared spectrum and light distribution of galaxies and QSOs at redshifts above 6.7. A complete 5 to 28 spectrum (~0.6 to 3.5 microns rest-frame) of the highest redshift (z=7.54) QSO J1342+0928, will be obtained, and simultaneous MIRI imaging of a nearby field will be taken with the F560W and F1000W filters.

The same APT file includes the NIRSpec observation of the same target with the IFU with the G395H grating (aimed primarily at mapping the main optical nebular lines Hbeta, [OIII], Halpha, [NII]) and the PRISM (for continuum; includes observing a PSF star) and with the fixed slit with the G140H and G235H gratings (aimed primarily at detecting IGM metal absorption systems). Simultaneously with the fixed slit observation (centered onto the quasar) the MSA will be used to observe galaxies imaged by the HST in the field of view, therefore these observations have been set up in MOS mode.

**OBSERVING DESCRIPTION**

NIRSpec MSA OBSERVATION

---

This corresponds to NIRSpec Proposal IDs:  FERRUIT_4004 and FERRUIT_4104

(NIRSpec Contact Person: Chris Willott, chriswillott1@gmail.com)

The quasar will be placed in the fixed slits S200A1 and S200A2 whilst simultaneously configuring MSA shutters to target other galaxies identified in HST imaging. We use NIRSpec team software to design the MSA configurations and ensure they agree with positions in the APT MPT software.

We use the G140H/F070LP grating and filter combination to do spectroscopy at 0.7 to 1.8 microns. We realise there will be some spectral overlap at >1.4 microns but our prime targets have almost zero flux below 0.9 microns so this will not strongly affect the spectra. We also use the G235H/F170LP grating and filter combination to do spectroscopy at 1.7 to 3.1 microns.

NIRSpec IFU OBSERVATION

---

This corresponds to NIRSpec Proposal ID: FERRUIT_3054

(NIRSpec Contact Persons: Roberto Maiolino, r.maiolino@mrao.cam.ac.uk ; Santiago Arribas, arribas@cab.inta-csic.es

The NIRSpec IFU observation is done with the G395H grating and it is aimed aimed primarily at mapping the strongest optical nebular lines (Hbeta, [OIII], Halpha, [NII]).
We also include R100 observation (+ 1 leakcal) for the continuum (and the fluxes of other lines)

We are using no target acquisition (i.e. point-and-shoot).
At any of the constrained PA range there are Gaia GS that can be selected for guiding and which will
ensure the proper location of the target within the IFU aperture, with the required accuracy.

We are using NRSIRS2RAPID for a better identification and rejection of cosmic rays for the R100 observations. For the longer grating observations we use NRSIRS2 to reduce data volume.

Justification of Special Requirements:

An offset has been applied to reduce the effects of the gap on the Hbeta line (center at @4.15 microns).
According to https://jwst-docs.stsci.edu/jppom/special-requirements/general-special-requirements#GeneralSpecialRequirements-Offset , the center target will be located in slice ~ 19, for wich the gap wavelength range is ~ 4.025-4.12 mu

Observation 8 is a PSF calibration standard star at R100 (PRISM) only. This observation should be done as a non-interruptible sequence with no change of telescope roll angle. The same offset as was used for the science target has been applied to the PSF star.

MIRI OBSERVING DESCRIPTIONS:

---

This corresponds to MIRI Proposal ID: WRIGHT_0601 and WRIGHT_0602

(MIRI Contact Person: Javier Alvarez-Marquez, javier.alvarez@cab.inta-csic.es)

The purpose of the program is to get a full 5 - 30 um spectrum of J2348 using the 3 MRS configurations with simultaneous Imager observations (see additional note 1). In addition, we request the imaging of the target in two filters: F560W, F770W.

The dithering strategies (4-pt, point source) were selected to optimize the PSF and detector effects in all MRS channels, and IMAGER filters. These strategies could be subject to change without modifying the total time.

Justification MIRI Special requirements:

The range of PAs has been selected such to avoid the presence of bright stars that would saturate the MIRIM simultaneous observations while MRS prime.

The background requirement has been selected to reduce the impact of the thermal background in the SNR of these faint high-redshift targets in channels 3 and 4.

**Fixed Targets**

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|---|---|---|---|---|
| (2) | ULASJ1342+0928 | RA: 13 42 8.0970 (205.5337375d)<br>Dec: +09 28 38.28 (9.47730d)<br>Equinox: J2000 | | |
| *Comments:*<br>*Category=Galaxy*<br>*Description=[Quasars]*<br>*Extended=YES* | | | | |
| (5) | PSFSTARULASJ1342 | RA: 13 42 10.0171 (205.5417379d)<br>Dec: +09 30 4.03 (9.50112d)<br>Equinox: J2000 | Proper Motion RA: 0.20483 mas/yr<br>Proper Motion Dec: -32.17222 mas/yr<br>Parallax: 0.002257"<br>Epoch of Position: 2016.0 | |
| *Comments: PSF star. Isolated in Gaia and HST 814nm imaging. Spectral type M2I.*<br>*2MASS magnitudes: Jmag=14.81 Hmag=14.15 Kmag=13.87*<br>*Category=Calibration*<br>*Description=[Point spread function]*<br>*Extended=NO* | | | | |
| (6) | J1342-CAT-CORR-EXTRA | RA: 13 42 8.3128 (205.5346367d)<br>Dec: +09 28 32.72 (9.47576d)<br>Equinox: J2000 | | |
| *Comments:*<br>*Description=[]* | | | | |

## Observation

**Proposal 1219, Observation 6: Q in A1 Extra, Q in A2 Extra** Mon Jun 26 16:00:38 GMT 2023

**Diagnostic Status: Warning**

Observing Template: NIRSpec MultiObject Spectroscopy

## Diagnostics

(Q in A1 Extra, Q in A2 Extra (Obs 6)) Warning (Form): Config c1 : Q in A1 Extra (#1) has 1 primary slits affected by failed closed shutters.

(Q in A1 Extra, Q in A2 Extra (Obs 6)) Warning (Form): Config c1 : Q in A1 Extra (#2) has 1 primary slits affected by failed closed shutters.

(Visit 6:1) Warning (Form): Data Excess over lower threshold

(Visit 6:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 6:1) Warning (Form): The recommended value is 8 Reference Stars for this template.

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|---|---|---|---|---|
| (6) | J1342-CAT-CORR-EXTRA | RA: 13 42 8.3128 (205.5346367d)<br>Dec: +09 28 32.72 (9.47576d)<br>Equinox: J2000 | | |

*Comments:*
*Description=[]*

## Acquisition

| # | Reference Star Bin | Target | Filter | MSA Configuration | Readout Pattern | Groups/Int | Integrations/Exp | Total Integrations | Total Exposure Time | ETC Wkbk.Calc ID |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Filter: F140X; Readout: NRSRAPID; 6 sources in 3 quads; [ Reduced Accuracy ] | SAME | F140X | Auto Acq MSA Config | NRSRAPID | 3 | 1 | 4 | 171.788 | |

## Template

| TA Method | Obtain Confirmation Images | Science Aperture | Primary Candidate List | Filler Candidate List | Spectral Overlap Map | Spectral Overlap Threshold |
|---|---|---|---|---|---|---|
| MSATA | No | MSA Center | weight > 0 (21 sources) | | jwst-nirspec-hr | 1.5 |

## Reference Stars

| Visit | ID | RA | Dec | Magnitude | Visit | ID | RA | Dec | Magnitude |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2287 | 205.509615 | 9.499962 | 21.69 | 1 | 8207 | 205.527165 | 9.469337 | 22.17 |
| 1 | 3175 | 205.545892 | 9.491979 | 22.48 | 1 | 8365 | 205.511235 | 9.469817 | 21.39 |
| 1 | 3523 | 205.546574 | 9.490210 | 21.45 | 1 | 8553 | 205.520773 | 9.468232 | 22.89 |

**Spectral Elements**

| # | Exposure Specification | MSA Configuration | Nod Pattern | Pointing | Aperture PA | Dispersion Offset (Shutters) | Cross-Dispersion Offset (Shutters) | Total Dithers | Total Integrations | Total Exposure Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 (G140H/F070LP) | c1 : Q in A1 Extra | 3 Shutter Slitlet | 205.52419666666665 Degrees 9.4940694444444 44 Degrees | 66.784480658617 9 | | | 3 | 6 | 5777.2 |
| 2 | 2 (G235H/F170LP) | c1 : Q in A1 Extra | 3 Shutter Slitlet | 205.52419666666665 Degrees 9.4940694444444 44 Degrees | 66.784480658617 9 | | | 3 | 3 | 2888.6 |
| 3 | 3 (G235H/F170LP) | c1 : Q in A2 Extra | 3 Shutter Slitlet | 205.52297958333332 Degrees 9.4994833333333 32 Degrees | 66.784290570299 15 | | | 3 | 3 | 2888.6 |
| 4 | 4 (G140H/F070LP) | c1 : Q in A2 Extra | 3 Shutter Slitlet | 205.52297958333332 Degrees 9.4994833333333 32 Degrees | 66.784290570299 15 | | | 3 | 6 | 5777.2 |

**Special Requirements**

MSA Scheduled Aperture PA 66.7862 to 66.7862 Degrees (V3 288.2116 to 288.2116)

## Observation

**Proposal 1219, Observation 7: NIRSpec IFU** Mon Jun 26 16:00:39 GMT 2023

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

*Comments: An off-set has been applied, to reduce the effects of the gap on the Hbeta line (center at @4.15 microns).*
*According to https://jwst-docs.stsci.edu/jppom/special-requirements/general-special-requirements#GeneralSpecialRequirements-Offset , the center target will be located in slice ~ 19 (following slice numbering of, e.g., Fig. 2 TB paper), for wich the gap wavelength range is ~ 4.025-4.12 mu*

## Diagnostics

(Visit 7:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(NIRSpec IFU (Obs 7)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|---|---|---|---|---|
| (2) | ULASJ1342+0928 | RA: 13 42 8.0970 (205.5337375d)<br>Dec: +09 28 38.28 (9.47730d)<br>Equinox: J2000 | | |

*Comments:*
*Category=Galaxy*
*Description=[Quasars]*
*Extended=YES*

## Template

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

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | CYCLING | MEDIUM | 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 | G395H/F290LP | NRSIRS2 | 25 | 1 | false | true | NONE | 6 | 6 | 11029.201 | |
| 2 | PRISM/CLEAR | NRSIRS2RAPID | 41 | 1 | false | true | NONE | 6 | 6 | 3676.4 | |
| 3 | PRISM/CLEAR | NRSIRS2RAPID | 41 | 1 | true | false | NONE | 1 | 1 | 612.733 | |

## Special Requirements

Offset 0.5 arcsec, 0.0 arcsec

Sequence Observations 7, 8, Non-interruptible
Same Aperture PA 7, 8

## Observation

**Proposal 1219, Observation 8: IFU PSF observation for J1342** Mon Jun 26 16:00:39 GMT 2023

**Diagnostic Status: Warning**

Observing Template: NIRSpec IFU Spectroscopy

## Diagnostics

(Visit 8:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(IFU PSF observation for J1342 (Obs 8)) Informational (Form): The Visit Planner and Spike may produce different schedulability results.

## Fixed Targets

| # | Name | Target Coordinates | Targ. Coord. Corrections | Miscellaneous |
|---|---|---|---|---|
| (5) | PSFSTARULASJ1342 | RA: 13 42 10.0171 (205.5417379d)<br>Dec: +09 30 4.03 (9.50112d)<br>Equinox: J2000 | Proper Motion RA: 0.20483 mas/yr<br>Proper Motion Dec: -32.17222 mas/yr<br>Parallax: 0.002257"<br>Epoch of Position: 2016.0 | |

*Comments: PSF star. Isolated in Gaia and HST 814nm imaging. Spectral type M2I.*
*2MASS magnitudes: Jmag=14.81 Hmag=14.15 Kmag=13.87*
*Category=Calibration*
*Description=[Point spread function]*
*Extended=NO*

## Template

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

## Dithers

| # | Dither Type | Size | Starting Point | Number of Points | Points |
|---|---|---|---|---|---|
| 1 | CYCLING | MEDIUM | 1 | 12 | |

## 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 | PRISM/CLEAR | NRSIRS2RAPID | 3 | 2 | false | true | NONE | 12 | 24 | 1400.533 | |

## Special Requirements

Offset 0.5 arcsec, 0.0 arcsec

Sequence Observations 7, 8, Non-interruptible
Same Aperture PA 7, 8

## Observation

**Proposal 1219, Observation 4: MRS-J1342**

Mon Jun 26 16:00:39 GMT 2023

**Diagnostic Status: Warning**

Observing Template: MIRI Medium Resolution 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 |
|---|---|---|---|---|
| (2) | ULASJ1342+0928 | RA: 13 42 8.0970 (205.5337375d)<br>Dec: +09 28 38.28 (9.47730d)<br>Equinox: J2000 | | |

*Comments:*
*Category=Galaxy*
*Description=[Quasars]*
*Extended=YES*

## Acquisition

| # | Target |
|---|---|
| 1 | NONE |

## Template

| AcqFilter | Primary Channel | Simultaneous Imaging | Imager Subarray | Grating Wheel Direction |
|---|---|---|---|---|
| F560W | ALL | YES | FULL | NEUTRAL |

## Dithers

| # | Dither Type | Optimized For | Direction |
|---|---|---|---|
| 1 | 4-Point | POINT SOURCE | POSITIVE |

## 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 | F1000W | FASTR1 | 94 | 3 | 1 | Dither 1 | 4 | 12 | 3152.445 | |
| 1 | LONG(C) | MRSLONG | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 1 | LONG(C) | MRSSHORT | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 2 | | IMAGER | F1000W | FASTR1 | 94 | 3 | 1 | Dither 1 | 4 | 12 | 3152.445 | |
| 2 | MEDIUM(B) | MRSLONG | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 2 | MEDIUM(B) | MRSSHORT | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 3 | | IMAGER | F560W | FASTR1 | 94 | 3 | 1 | Dither 1 | 4 | 12 | 3152.445 | |
| 3 | SHORT(A) | MRSLONG | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 3 | SHORT(A) | MRSSHORT | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |

| Special Requirements | |
|---|---|
| | Aperture PA Range 107.0 to 135.0 Degrees (V3 107.0 to 135.0)<br>Aperture PA Range 270.0 to 297.0 Degrees (V3 270.0 to 297.0)<br>Background Limited. Background no more than 40th percentile above minimum |

## Observation

**Proposal 1219, Observation 9: MRS-J1342** Mon Jun 26 16:00:39 GMT 2023

**Diagnostic Status: Warning**

Observing Template: MIRI Medium Resolution Spectroscopy

*Comments: New visit that corresponds to the repeat of visit 4 after approval of WOPR 88809. Observing strategy the same as in visit 4. The special requirement regarding the background has been relaxed.*

*Visit 4 was degraded by a loss of lock on the guide star, leading to missed exposures. The problem was caused by an unmasked hot pixel near the guide star, so a different guide star should be used in the repeat.*

## 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) | ULASJ1342+0928 | RA: 13 42 8.0970 (205.5337375d)<br>Dec: +09 28 38.28 (9.47730d)<br>Equinox: J2000 | | |

*Comments:*
*Category=Galaxy*
*Description=[Quasars]*
*Extended=YES*

## Acquisition

| # | Target |
|---|---|
| 1 | NONE |

## Template

| AcqFilter | Primary Channel | Simultaneous Imaging | Imager Subarray | Grating Wheel Direction |
|---|---|---|---|---|
| F560W | ALL | YES | FULL | NEUTRAL |

## Dithers

| # | Dither Type | Optimized For | Direction |
|---|---|---|---|
| 1 | 4-Point | POINT SOURCE | POSITIVE |

## 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 | 94 | 3 | 1 | Dither 1 | 4 | 12 | 3152.445 | |
| 1 | SHORT(A) | MRSLONG | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 1 | SHORT(A) | MRSSHORT | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 2 | | IMAGER | F1000W | FASTR1 | 94 | 3 | 1 | Dither 1 | 4 | 12 | 3152.445 | |
| 2 | MEDIUM(B) | MRSLONG | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 2 | MEDIUM(B) | MRSSHORT | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 3 | | IMAGER | F1000W | FASTR1 | 94 | 3 | 1 | Dither 1 | 4 | 12 | 3152.445 | |
| 3 | LONG(C) | MRSLONG | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |
| 3 | LONG(C) | MRSSHORT | | SLOWR1 | 16 | 2 | 1 | Dither 1 | 4 | 8 | 3153.469 | |

| Special Requirements | |
|---|---|
| | Aperture PA Range 107.0 to 135.0 Degrees (V3 107.0 to 135.0)<br>Aperture PA Range 270.0 to 297.0 Degrees (V3 270.0 to 297.0) |