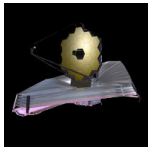

4924 - A Novel Wavelength Calibration of NIRCam WFSS with a Nearby Star-Forming Galaxy

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
NGC2835				
	1	NIRCam WFSS	NIRCam Wide Field Slitless Spectroscopy	(1) NGC-2835
	2	NIRCam NB imaging	NIRCam Imaging	(1) NGC-2835

ABSTRACT

As one of the most powerful observing modes of JWST, NIRCam WFSS can efficiently obtain spectroscopic redshifts of a huge sample of distant galaxies through the detections of strong emission lines. However, ironically, all the wavelength calibrations of NIRCam WFSS rely on very limited data taken so far: one post-AGB star with a dozen of emission lines at a few dithering positions. This hampers the accurate redshift determinations for thousands of galaxies, which have been discovered with hundreds of hours of precious JWST time.

We propose a novel and efficient wavelength calibration of NIRCam WFSS, specifically for its field-dependence (i.e., distortion / curvature) with all

the four module x grism combinations. This will be achieved by observing the Brackett alpha (BrA, 4.05 um) emission from the HII regions of a nearby face-on spiral galaxy. The galaxy NGC 2835 has been observed with HST, JWST NIRCam, MIRI, VLT/MUSE and ALMA through the PHANGS survey, and therefore the astrometry and velocity field are highly accurate. We will model the offset between BrA emission detected with narrow-band imaging and grism spectroscopy, and thus provide the most accurate wavelength calibration model to the broader JWST user community. Scientifically, this program can also search for highly dust-obscured star-forming clusters through BrA and Paschen-alpha line imaging, providing the last missing piece for a comprehensive study of star clusters, gas clouds and HII regions in a paradigmatic nearby galactic ecosystem.

OBSERVING DESCRIPTION

We will obtain (1) NIRCam wide-field slitless spectroscopic (WFSS) observations of NGC 2835 with F410M as the long-wavelength (LW) filter and F200W as the short-wavelength (SW) direct imaging filter, and (2) NIRCam direct imaging observation of the same galaxy with F187N and F444W+F405N filter (F405N filter is in the pupil wheel and F444W is the block filter).

The target NGC 2835 is a nearby (z=0.003, D=12 Mpc) face-on star-forming galaxy with numerous bright HII regions on its spiral arms. The target has been observed with JWST/NIRCam and MIRI through Cycle-1 program GO-2107. HST, VLT/MUSE and ALMA CO (2-1) observations have also been obtained through the PHANGS program.

(1) NIRCam WFSS:

We carefully design a two-column mosaic pattern to sequentially obtain Brackett alpha (BrA, 4.05um) spectroscopy of NGC 2835 with module A Grism-R, C, and then module B Grism-R, C. The targeted BrA line is redshifted to 4.06 um, which is at the center of F410M bandwidth and also only 0.12 um off from the undeflected wavelength of NIRCam WFSS (3.94 um, at this wavelength the spectral pixel along dispersion direction remains undeflected from the direct imaging position). Therefore, we are able to obtain Grism-R and C observations for the BrA line in the same field without changing the pointing.

For each grism integration, we adopt a 8-group MEDIUM8 readout pattern, and the integration time per exposure is 14 minutes. We will obtain a 4-point INTRAMODULEX dithering. The total WFSS observing time for each module x grism combination is therefore ~1 hour, and thus the total WFSS observing time for all grisms (AR, AC, BR, BC) will be 4 hours.

(2) NIRCam Direct Imaging:

We will use the F187N and F405N+F444W filter to directly image the Paschen alpha (PaA) and BrA emission of the galaxy. Both the PaA and BrA lines will be therefore be covered in two filters (F187N + F200W, F405N + F410M, respectively), and therefore we can easily decompose the emission lines from the underlying stellar continuum. We have carefully pointed the galaxy at the center of NIRCam module A. We will use a 5-group MEDIUM8 readout pattern and a 4-point INTRAMODULEX dither pattern, and the total exposure time will be 34 minutes. This is longer than the single NIRCam WFSS exposure (14-min), and therefore enables the secure identification of BrA-emitting regions for WFSS data analyses.

Changes by FS on 2025/03/07:

- OBSNUM 001: Further refinement of the mosaic pattern (40% -> 44% columne overlap) to maximize the overlap with NIRCam NB imaging;

- OBSNUM 002: Use 5-point instead of 4-point INTRAMODULEX dither to slightly increase the depth and edge imaging quality of NB image.

The new submission of the APT file validates our original technical designs and the new charged time is still within our 8.6-hr allocation.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC-2835	RA: 09 17 52.8524 (139.4702183d)	Proper Motion RA: 0.725 mas/yr	
		Dec: -22 21 16.84 (-22.35468d)	Proper Motion Dec: 0.103 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Galaxy
Description=[Disk galaxies, Emission line galaxies, Spiral galaxies]

Observation

Proposal 4924, Observation 1: NIRCam WFSS Fri Mar 07 20:00:08 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Wide Field Slitless Spectroscopy

Diagnostics

(NIRCam WFSS (Obs 1)) Warning (Form): For Module=ALL the default target location is in the gap between the modules.

(NIRCam WFSS (Obs 1)) Warning (Form): This observation is split across multiple visits using multiple filters. Not selecting the sequence option may result in execution of the visits in a non-numerical order and is not recommended.

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

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC-2835	RA: 09 17 52.8524 (139.4702183d)	Proper Motion RA: 0.725 mas/yr	
		Dec: -22 21 16.84 (-22.35468d)	Proper Motion Dec: 0.103 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Galaxy
Description=[Disk galaxies, Emission line galaxies, Spiral galaxies]

Template

Module	Subarray	Grism (Long Wavelength)
ALL	FULL	BOTH

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
1	2	10.0	44.0	0.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Positions
1	INTRAMODULEX	4	NONE

Direct Image

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	Grism (Long Wavelength)	Exposure Type	Total Dithers
1	F200W	F410M	BRIGHT2	5	1	1	107.368		GRISMR	Direct Image	1
2	F200W	F410M	BRIGHT2	5	1	1	107.368		GRISMC	Direct Image	1

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID	Grism (Long Wavelength)	Exposure Type	Total Dithers
1	F200W	F410M	MEDIUM8	8	1	4	3349.872	176032	GRISMR	Grism (Long Wavelength)	4
2	F200W	F410M	BRIGHT2	5	1	2	214.735			Out of Field	2
3	F200W	F410M	MEDIUM8	8	1	4	3349.872	176032	GRISMC	Grism (Long Wavelength)	4
4	F200W	F410M	BRIGHT2	5	1	2	214.735			Out of Field	2

Special Requirements	
	Group Visits within 53.0 Days Aperture PA Range 100 to 110 Degrees (V3 100.0 to 110.0) Visits Same PA Same Aperture PA 1, 2 (V3 PAs differ)

Observation

Proposal 4924, Observation 2: NIRCam NB imaging Fri Mar 07 20:00:08 GMT 2025

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC-2835	RA: 09 17 52.8524 (139.4702183d)	Proper Motion RA: 0.725 mas/yr	
		Dec: -22 21 16.84 (-22.35468d)	Proper Motion Dec: 0.103 mas/yr	
		Equinox: J2000	Epoch of Position: 2000	

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Category=Galaxy
Description=[Disk galaxies, Emission line galaxies, Spiral galaxies]

Template

Module	Subarray	Target Placement
ALL	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEX	5	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	F187N	F405N+F444W	MEDIUM8	5	1	5	5	2576.825	176032

Special Requirements

Offset -90.0 arcsec, 0.0 arcsec

Same Aperture PA 1, 2 (V3 PAs differ)