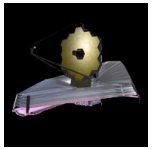

3510 - Calibrating the Balmer Decrement against Everything in NGC 4214

Cycle: 2, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
NIRCam				
	1	F090WF444W_F200WF300M_F187NF335M_F182MF360M	NIRCam Imaging	(1) NGC-4214

ABSTRACT

Dust is ubiquitous where star formation takes place, and thus has a strong impact on emerging photons from star-forming galaxies. Thus, accurate dust correction is essential to derive the intrinsic properties of a galaxy. The Balmer decrement is one of the most widely used methods for dust corrections up to intermediate-redshift Universe, and it will play the key role in the JWST era because the Balmer emission lines are now accessible in earlier Universe. Despite its widespread use and future potential, the Balmer decrement is known to underestimate the optical depth, which inevitably propagate into the inferred properties of galaxies. The underestimation is magnified at higher redshift, where it is extremely challenging to constrain the detailed knowledge of underlying mechanisms governing dust/starlight interaction at ~1 pc scale.

We propose to leverage the unique capability of the NIRCam's HST/UVIS-comparable spatial resolution in the near-infrared to tackle this problem. We will obtain panchromatic NIRCam imaging of the low-metallicity starburst galaxy NGC 4214 to establish a robust empirical calibration for the Balmer decrement down to ~0.5 pc. By combining our proposed imaging with archival HST data, we will investigate the degree of underestimation in the Balmer decrement as a function of local interstellar medium conditions, local dust properties, star formation rate intensity, and spatial resolution from ~0.5 pc to ~2 kpc scales. Our measurements will serve as the new standard for determining dust corrections for distant galaxies.

OBSERVING DESCRIPTION

We will observe NGC 4214 in four filters in the shortwavelegnth (SW) and four filters in the longwavelegnth (LW) channels simultaneously. We pair one SW and one LW filters based on the desired exposure times, position angles, and readout pattern. Requiring exposure times are set by the observation with longer exposure time in each pair. The pairs are F090W/F444W, F182M/F360M, F187N/F335M, and F200W/F300M. We request a total allocation of 5.53h of JWST time to obtain NIRCam imaging.

The point spread functions (PSFs) of the F187N and F182M filters for the Paschen-alpha (Paa) measurement well match to those of the HST UVIS H-alpha (Ha) and H-beta (Hb) narrow-band imaging. However, the LW filters for measuring PAH emission have a ~2x larger PSF width than that of our SW filters. By adding the standard 4-point subpixel dither pattern on top of the primary 4-point dither pattern, we will improve the spatial resolution of the final combined image in the LW channels by a factor of 2. We will be able to put all the HST emission-line images from the WFC3/UVIS and the NIRCam emission-line images both from the SW and LW channels into the same spatial resolution. This will be the first time to make detailed comparison between images from optical to NIR on the sub-parsec scale.

The F090W/F444W pair: We need deep observations in the SW channel F090W to detect highly embedded massive stars within HII regions while not being saturated at the bright end (i.e., unobscured O-type stars). For complete census of embedded young stars, we require early B-type stars with Av=10, which is the faintest target young stars in our program, with to be detected in F090W with photometric S/N > 5. When observing in the SW F090W filter, we will simultaneously image the galaxy in the LW F444W filter. The expected SNR in F444W for the highly obscured early B-type star is ~6.5. ETC calculations show that we need the BRIGHT2 readout pattern in these filters to avoid saturation for the expected brightest star in NGC 4214. The combination of 10 Groups/Integration, 3 Integrations/Exposures, and 4 Exposures returns the required depth.

The F182M/F360M pair: The main purpose of imaging in these filters is to conduct sufficient continuum subtraction as well as reliable stellar SED fitting. The exposure time is set to capture the stellar continuum contribution even from relatively faint stars. To avoid saturation in the bright end,

reach the desired depth, and achieve the required spatial resolution in the LW F360M filter, we use the BRIGHT2 readout pattern, 6 Groups/Integration, 1 Integrations/Exposures, and 16 Exposures.

The F187N/F335M pair: The pixel-by-pixel analysis of emission lines requires sufficient signal-to-noise ratio (SNR) in the continuum-subtracted line flux in each pixel. Thus, we request to obtain observations in F187N and F335M for their continuum-subtracted emission to meet SNR > 5 in each pixel. We use the BRIGHT2 readout patterns, 7 Groups/Integration, 1 Integrations/Exposures, and 16 Exposures. ETC calculations show that the SNR in the continuum-subtracted Pa emission (3.3um PAH emission) line will be slightly above 5 (6) in each pixel across the scene.

The F200W/F300M pair: F300M is the primary filter to set the exposure time in this pair. Together with F360M, this filter will be used to subtract continuum around the PAH emission. The requirements are the same for the F182M/F360M pair, which can be met with shorter exposure time. For this pair, we use the BRIGHT2 readout pattern, 5 Groups/Integration, 1 Integrations/Exposures, and 16 Exposures. With this exposure time, we will get SNR~12 for the highly obscured early B-type stars in F200W with no saturation at the bright end.

We only utilize the module B, which sufficiently covers the optical extent of the galaxy where the HST WFC3/UVIS imaging data are also available. Since there is no need to fill the gap between the two modules, we can benefit from the more compact INTRAMODULEBOX pattern resulting in more area observed at full depth. For all of our observations, we will use the FULL subarray.

Proposal 3510 - Targets - Calibrating the Balmer Decrement against Everything in NGC 4214

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC-4214	RA: 12 15 39.1704 (183.9132100d) Dec: +36 19 36.80 (36.32689d) Equinox: J2000		

Comments: This object was generated by the targetselector and retrieved from the NED database.
Category=Galaxy
Description=[Dwarf irregular galaxies, Starburst galaxies]

Observation

Proposal 3510, Observation 1: F090WF444W_F200WF300M_F187NF335M_F182MF360M Fri Mar 08 01:00:11 GMT 2024

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Comments: X value in F444W for our target is ~0.18, well exceeds the htreshold of 5% background variation.

Diagnostics

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

(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)	NGC-4214	RA: 12 15 39.1704 (183.9132100d) Dec: +36 19 36.80 (36.32689d) Equinox: J2000		

Comments: This object was generated by the targetselector and retrieved from the NED database.
Category=Galaxy
Description=[Dwarf irregular galaxies, Starburst galaxies]

Template

Module	Subarray	Target Placement
B	FULL	Module Gap

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	4	STANDARD		4

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
1	F090W	F444W	BRIGHT2	8	1	16	16	2748.613	
2	F200W	F300M	BRIGHT2	5	1	16	16	1717.883	
3	F187N	F335M	BRIGHT2	7	1	16	16	2405.036	
4	F182M	F360M	BRIGHT2	6	1	16	16	2061.46	

Special Requirements

Aperture PA Range 111.91262691 to 138.05262691 Degrees (V3 111.86 to 138.0)
Aperture PA Range 149.05262691 to 153.05262691 Degrees (V3 149.0 to 153.0)
Aperture PA Range 154.05262691 to 167.72262691 Degrees (V3 154.0 to 167.67)
Aperture PA Range 176.05262691 to 305.05262691 Degrees (V3 176.0 to 305.0)
Background Limited. Background no more than 10th percentile above minimum