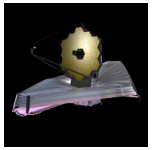

1225 - Star formation in the local group - NGC3603

Cycle: 1, Proposal Category: GTO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1		NIRSpec MultiObject Spectroscopy	(1) NGC3603-EMPT+TA+SPITZER

ABSTRACT

This sub-program will showcase the multi-object spectroscopy capabilities of NIRSpec for stellar studies. We will obtain medium- and high-resolution spectroscopy of hundreds of known pre-main sequence (PMS) stars of different ages, hosted in massive starburst clusters located in different environments (metallicity) in the Local Group. The target clusters are NGC 3603 in the Galaxy, 30 Dor in the Large Magellanic Cloud, and NGC 346 in the Small Magellanic Cloud. These PMS stars have been identified photometrically as objects with strong H excess emission and equivalent width exceeding 10 Å, and as such appear to be actively accreting from a circumstellar disc. While for many of these objects comparison

with isochrones suggests young ages of the order of a few Myr, a large number of them appear older than 20 Myr, suggesting that in these environments accretion onto PMS stars lasts longer than in small nearby Galactic star forming regions. These NIRSpec observations will allow us to obtain accurate accretion luminosities, mass accretion rates, and in-falling gas kinematics for all these stars from the analysis of several Hydrogen recombination lines (Pa, Br, Br). The ultimate scientific goal of this project is to understand the very nature of the mass accretion process, and how it depends on the mass, age, and metallicity of the individual objects. This study is unique since existing spectroscopy of PMS stars is so far limited to the solar neighborhood and no information exists for starburst clusters or for non-solar metallicity. Coordinated NIRCam parallel observations in the periphery of the same star-forming regions will support the primary science program: by revealing many more PMS stars of lower mass, they will considerably extend both the number of targets and the parameter space in this investigation.

This APT file covers the observations of NGC 3603 and the list of observation IDs is: FERRUIT_6101, FERRUIT_6151, FERRUIT_6152, FERRUIT_6153

OBSERVING DESCRIPTION
Primary observations with NIRSpec

The NIRSpec primary observations are conceptually simple. We already know from accurate HST photometry in the V, I and Halpha bands the positions of PMS stars actively undergoing accretion in the fields of interest with 5 mas relative accuracy. Since the reference stars used for target acquisition are part of the same photometric catalogue, these observations do not need NIRCam pre-imaging.

The exact MSA configuration will only be generated when the assigned telescope orientation is known. However, with the typical density of primary targets (PMS stars) in our field of interest, extensive MPT simluations show that, regardless of orientation, at least 20 of these PMS stars can be placed within the acceptance zone of a MSA shutter, while still having the two neighbouring shutters in the cross dispersion direction free from other stars for background determination. Furthermore, the MSA configuration will be completed with several (~20) filler targets, namely older main-sequence and red-giant stars with similar colours as the PMS objects but no Halpha excess emission that are very abundant in the field. The typical MSA configuration will include ~40 targets and we will have three different configurations.

The MSA is configured in slitlet mode, so the dithering strategy to mitigate possible detector blemishes consists simply in a slew along the slitlet by one or two micro-shutters. Observations in the standard slitlet mode will simplify background subtraction, as per the standard NIRSpec pipeline.

The two practical goals of these observations are: (1) to measure spectroscopically the accretion luminosity and mass accretion rates of the target stars, to confirm that they are all accreting, even the older objects; and (2) to study more in-depth the accretion process, namely the kinematics and physical properties of the infalling gas.

For the first goal, we need to measure emission signatures in the Hydrogen recombination lines sampled by the spectra, and to derive their equivalent width and luminosity. The second goal is a more in-depth study of the accretion process, and of the kinematics and physical properties (e.g. opacity, temperature, density) of the infalling gas. We will use in both cases higher spectral resolution (R=2700) in order to sample the profile of the lines and reveal infalling gas with velocities above ~50 km/s. Therefore, we use the G235H/F170LP combination, since this again allows us to simultaneously sample Pa alpha, Br beta, and Br gamma. Regardless of where the sources are located in the field of view of NIRSpec, at least two of these lines will be recorded on the detectors.

Exposure times of ~ 40 min are sufficient to reach reach SNR~10 in the continuum at 2 micron for the typical 0.5 Msolar mass PMS strars with age 1 Myr.

Coordinated parallel observations with NIRCam

The NIRCam parallel observations consist of imaging in the F150W, F187N, and F182M bands for the short-wavelength (SW) camera and in the F277W, F405N, and F430M bands for the long-wavelength (LW) camera. In order to most effectively identify objects with excess emission in the Pa alpha and Br alpha bands, it is important to reach similar
continuum magnitude levels in the narrow bands as well as in the neighbouring broad bands. The NIRCam exposure time calculator indicates that for a typical PMS star with effective temperature T_eff ~ 4000 ,K, reaching the same SNR in F187N and F405N as in the neighbouring broad bands requires exposures in principle almost 20 times longer. Hence, a considerable fraction of the total exposure time (about 3/4) should be devoted to the narrow bands. However, since the overhead times have increased tremendously with every new version of APT, we are now forced to keep similar exposure times in the broad and narrow bands. This means that the study of the excess in Pa alph and Br alpha will be limited to the stronger accreting PMS stars.

The dithering pattern is set by NIRSpec's nodding in the slitlet approach. Therefore, the dithering pattern for NIRCam is fully constrained both in time and offset. The three NIRSpec pointings with G235H/F170LP accommodate each one nodding sequences, with ~11 min exposures (15 groups) and three different MSA configurations, for a total of 3 nodding sequences. During each nodding sequence the NIRCam filter does not change. One

sequence has the F150W/F277W pair, one sequence has the F182M/F430M pair, and one sequences has the F187N/F405N+F444W pair.

Proposal 1225 - Targets - Star formation in the local group - NGC3603

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	NGC3603-EMPT+TA+SPITZER	RA: 11 15 5.3247 (168.7721863d) Dec: -61 15 47.96 (-61.26332d) Equinox: J2000		
Comments: *Description=[]*				
(2)	NGC3603-EMPT+TA+SPITZER-OLD	RA: 11 15 5.9583 (168.7748262d) Dec: -61 15 47.75 (-61.26326d) Equinox: J2000		
Comments: *Description=[]*				

Observation

Proposal 1225, Observation 1 Thu Jun 23 20:00:50 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Coordinated Parallel Template(s): NIRCam Imaging

Diagnostics

(Observation 1) Warning (Form): Config c1 (#1) has 6 primary slit traces affected by failed open shutters.

(Observation 1) Warning (Form): Config c2 (#2) has 28 master background shutters affected by failed open or closed shutters.

(Observation 1) Warning (Form): Config c2 (#2) has 3 primary slit traces affected by failed open shutters.

(Observation 1) Warning (Form): Config c3 (#3) has 1 primary slit traces affected by failed open shutters.

(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)	NGC3603-EMPT+TA+SPITZER	RA: 11 15 5.3247 (168.7721863d) Dec: -61 15 47.96 (-61.26332d) Equinox: J2000		

Comments:
Description=[]

Acquisition

NIRSpec MultiObject Spectroscopy	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	Filter: F110W; Readout: NRSRAPID; 8 sources in 3 quads; [Optimal TA Accuracy]	SAME	F110W	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788	

Template

NIRSpec MultiObject Spectroscopy	NIRCam Imaging
TA Method: MSATA	Module: ALL
Obtain Confirmation Images: No	Subarray: FULL
Science Aperture: MSA Center	
Primary Candidate List: 100-eMPTselected (100 sources)	
Filler Candidate List: null	
Spectral Overlap Map: jwst-nirspec-g235h	
Spectral Overlap Threshold: 1.5	

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	2227	168.735626	-61.266018	20.01	1	4112	168.745438	-61.265556	20.13
1	2492	168.742645	-61.271420	20.14	1	4430	168.775024	-61.286690	20.39
1	2624	168.769669	-61.288891	20.11	1	4650	168.800613	-61.279171	20.32
1	3461	168.743637	-61.265457	19.69	1	8919	168.770340	-61.247707	20.28

Dithers

#	Dither Type
1	NONE

Spectral Elements

NIRSpec MultiObject Spectroscopy	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 (G235H/F170LP)	c1	3 Shutter Slitlet	168.78728625 Degrees -61.274744444444 42 Degrees	267.70776840051 815			3	3	1356.767
2	1 (G235H/F170LP)	c2	3 Shutter Slitlet	168.75824 Degrees -61.275277777777 774 Degrees	267.73325765866 747			3	3	1356.767
3	1 (G235H/F170LP)	c3	3 Shutter Slitlet	168.78825291666 666 Degrees -61.272663888888 87 Degrees	267.70691669005 146			3	3	1356.767

Spectral Elements

NIRCam Imaging	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	SHALLOW4	4	2	6	3	1256.202	
2	F182M	F430M	SHALLOW4	4	2	6	3	1256.202	
3	F150W	F277W	SHALLOW4	3	2	6	3	934.099	

Special Requirements

No Parallel
MSA Scheduled Aperture PA 267.72050521 to 267.72050521 Degrees (V3 129.15416 to 129.15416)