



6719 - Mapping Cold Gas and Star Formation in Gas Rich Post-Starburst Galaxies Near Cosmic Noon

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
J0907+0423				
	1	G395M	NIRSpec IFU Spectroscopy	(1) J0907+0423
J9010+0218				
	2	G395M	NIRSpec IFU Spectroscopy	(2) J0910+0218
J1157+0132				
	3	G395M	NIRSpec IFU Spectroscopy	(3) J1157+0132

ABSTRACT

While quenching mechanisms in massive galaxies are hotly debated, it is generally agreed that the removal of the neutral interstellar medium (ISM) is a crucial precursor to the shutdown of star formation. As such, the detection of significant residual molecular gas reservoirs ($>10^{10.8}$ Msun) in massive ($\sim 10^{11.5}$ Msun) post-starburst galaxies caught ~ 100 Myrs after shutting down at $z \sim 0.7$ has challenged assumptions about how the quenching progresses. A number of models have been proposed to explain the lack of star formation in these systems, including turbulent, outflowing, diffuse, or still-star-forming dusty ISMs, but existing data has yet to provide discriminating evidence. We propose to leverage the high resolution and sensitivity of ALMA, along with the near-IR spectroscopic coverage of the JWST/NIRSpec G395M IFU, to map the molecular and ionized gas the three most gas-rich post-starburst galaxies in the SQuIGGLE sample. Together, these diagnostics will conclusively distinguish between the aforementioned models to ascertain why such large molecular gas reservoirs exist in systems that have, by all rest-optical measures, ended their life as star forming galaxies.

This proposal is being submitted jointly with ALMA Proposal 2024.1.01064.S

OBSERVING DESCRIPTION

We request NIRSpec G395M IFU observations of three galaxies to spatially resolve Paschen Alpha emission. In order to assess the necessary JWST exposure time, we take the best-fitting continuum models of our galaxies from Suess et al. 2022, which are constrained at ~ 3 microns by WISE W1 photometry. All galaxies are quite bright in the NIR, with W1 magnitudes of ~ 18 AB. We supply these curves to the ETC with a deliberately broad ($\sim 1.4''$) Sersic effective radius, among the largest observed for any of the galaxies in the SQuIGGLE sample. We then simulate two star formation scenarios, $\text{SFR} = 100$ Msun/yr ($\sim 2-5$ x lower than the SFR required to deplete the gas reservoirs in 100 Myr) and 5 Msun/yr, converting to Paschen Alpha luminosity following Neufeld et al. 2024. We then tune our exposure times such that the continuum signal to noise in individual spaxels within $1''$ is > 3 . We find that, at the redshift of our sources, this corresponds to 30 minutes of science-time-per-galaxy. In order to achieve this while oversampling the PSF, we divide this integration into an 8 point small cycle dither pattern, with 15 groups/integration using the NSIRS2 readout mode.

These exposure times will result in an integrated signal-to-noise of ~ 15 in the continuum at 3 microns, the location of Paschen Alpha, allowing us to be sensitive to star formation rates on the order of ~ 2 Msun/year throughout the galaxy at the assumed continuum level. If star formation rates are high or there are significant ionized outflows, we will easily spatially resolve the PaAlpha at our requested sensitivity. Because we are using the reddest arm of NIRSpec, we elect not to perform any dedicated background observations. We configure our observations within the ETC and the

APT and find that our 1.5 hours of science time results in a total JWST charged time of 4.7 hours, a factor of 3 lower than our requested ALMA time of 15.47 hours.

Proposal 6719 - Targets - Mapping Cold Gas and Star Formation in Gas Rich Post-Starburst Galaxies Near Cosmic Noon

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	J0907+0423	RA: 09 07 57.8798 (136.9911658d) Dec: +04 23 3.34 (4.38426d) Equinox: J2000	Epoch of Position: 2000	
<i>Comments:</i> Category=Galaxy Description=[Elliptical galaxies, Infrared galaxies] Extended=YES				
(2)	J0910+0218	RA: 09 10 28.5718 (137.6190492d) Dec: +02 18 33.52 (2.30931d) Equinox: J2000	Epoch of Position: 2000	
<i>Comments:</i> Category=Galaxy Description=[Elliptical galaxies, Interacting galaxies] Extended=YES				
(3)	J1157+0132	RA: 11 57 57.3126 (179.4888025d) Dec: +01 32 15.12 (1.53753d) Equinox: J2000	Epoch of Position: 2000	
<i>Comments:</i> Category=Galaxy Description=[Elliptical galaxies, Interacting galaxies] Extended=YES				

Fixed Targets

Proposal 6719 - Observation 1 - Mapping Cold Gas and Star Formation in Gas Rich Post-Starburst Galaxies Near Cosmic Noon

Tue Feb 04 21:00:33 GMT 2025

Observation	<p>Proposal 6719, Observation 1: G395M</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
Diagnostics	(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)	J0907+0423	RA: 09 07 57.8798 (136.9911658d) Dec: +04 23 3.34 (4.38426d) Equinox: J2000			Epoch of Position: 2000						
	<p><i>Comments:</i> <i>Category=Galaxy</i> <i>Description=[Elliptical galaxies, Infrared galaxies]</i> <i>Extended=YES</i></p>											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size	Starting Point		Number of Points	Points				
	1	CYCLING		SMALL	1		8					
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	G395M/F290LP	NRSIRS2RAPID	15	1	false	true	NONE	8	8	1867.378	198486

Proposal 6719 - Observation 2 - Mapping Cold Gas and Star Formation in Gas Rich Post-Starburst Galaxies Near Cosmic Noon

Tue Feb 04 21:00:33 GMT 2025

Observation	<p>Proposal 6719, Observation 2: G395M</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
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			
	(2)	J0910+0218	RA: 09 10 28.5718 (137.6190492d) Dec: +02 18 33.52 (2.30931d) Equinox: J2000			Epoch of Position: 2000						
	<p><i>Comments:</i> <i>Category=Galaxy</i> <i>Description=[Elliptical galaxies, Interacting galaxies]</i> <i>Extended=YES</i></p>											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size	Starting Point		Number of Points		Points			
	1	CYCLING		SMALL	1		8					
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	G395M/F290LP	NRSIRS2RAPID	15	1	false	true	NONE	8	8	1867.378	198486

Proposal 6719 - Observation 3 - Mapping Cold Gas and Star Formation in Gas Rich Post-Starburst Galaxies Near Cosmic Noon

Tue Feb 04 21:00:33 GMT 2025

Observation	<p>Proposal 6719, Observation 3: G395M</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec IFU Spectroscopy</p>											
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			
	(3)	J1157+0132	RA: 11 57 57.3126 (179.4888025d) Dec: +01 32 15.12 (1.53753d) Equinox: J2000			Epoch of Position: 2000						
	<p><i>Comments:</i> <i>Category=Galaxy</i> <i>Description=[Elliptical galaxies, Interacting galaxies]</i> <i>Extended=YES</i></p>											
Template	TA Method						HFF Readout Mode					
	NONE						false					
Dithers	#	Dither Type		Size	Starting Point		Number of Points		Points			
	1	CYCLING		SMALL	1		8					
Spectral Elements	#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Ex p	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
	1	G395M/F290LP	NRSIRS2RAPID	15	1	false	true	NONE	8	8	1867.378	198486