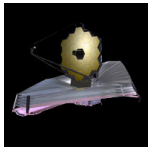

1657 - Anchoring z>6 Galaxy Metallicities using T_e and n_e Diagnostics Enabled by JWST and ALMA Spectroscopy

Cycle: 1, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
NIRSpec IFU				
	1	J0218	NIRSpec IFU Spectroscopy	(1) J0218-0519
	2	J0217	NIRSpec IFU Spectroscopy	(2) J0217-0208
	3	J1211	NIRSpec IFU Spectroscopy	(3) J1211-0118
MIRI IFU				
	4	J0218	MIRI Medium Resolution Spectroscopy	(1) J0218-0519
NIRCam				

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	5	J0218	NIRCam Imaging	(1) J0218-0519
	6	J0217	NIRCam Imaging	(2) J0217-0208
	7	J1211	NIRCam Imaging	(3) J1211-0118

ABSTRACT

We propose deep NIRSpec and MIRI IFU spectroscopy targeting 3 galaxies at z=6.0-7.2 covered by ALMA [OIII]88um observations in order to derive gas-phase metallicities at z>6 using the reliable direct electron temperature method. Accurate gas-phase metallicities are crucial for understanding the formation and growth of early galaxies, but diagnostic calibrations to infer metallicity from strong-line ratios have not yet been established at high redshifts. Obtaining temperature-based metallicities of z>6 sources represents the most direct and robust solution to this problem. Although the direct method usually relies on temperature-sensitive auroral lines that are too faint to detect at z>6, we will accomplish this goal by combining measures of the temperature-sensitive far-infrared fine structure line [OIII]88um (from ALMA) with rest-frame optical lines (Ha, Hb, [OIII]4959,5007, and density-sensitive [OII]3726,3729 from JWST). Our program will deliver robust measures of the mass-metallicity relation to z~6-7 along with accompanying constraints on dynamical and gas masses, ionization parameter, and ionizing spectral shape. These constraints will allow us to understand the formation of luminous z~6 sources, the role of feedback in governing their growth, and their impact on cosmic reionization. Most significantly, direct-method metallicities derived from this program will serve as the first calibrating `anchor' for statistical studies of metallicities and ionization parameters for galaxies in GTO/ERS and other samples, derived using the strong-line method. The combination will provide robust data for understanding early galaxy formation and the sources of cosmic reionization.

OBSERVING DESCRIPTION

We will conduct NIRSpec and MIRI IFU spectroscopy and NIRCam imaging for three galaxies: J1211-0118 (z = 6.029), J0217-0208 (z = 6.204), and J0218-0519 (z = 7.215).

For J1211-0118 and J0217-0208 at z=6.0-6.2, we will use NIRSpec G235H/F170LP for [OII]3726,3729 and G395H/F290LP for Hb, [OIII]4959,5007, and Ha.For J0218-0519 at z=7.2, we will use NIRSpec G395H/F290LP for [OII]3726,3729, Hb, and [OIII]4959, and MIRI Channel 1 Short (A) for Ha. Although the [OIII]5007 line of J0218-0519 falls in a detector gap, we can estimate the line flux from [OIII]4959 using the fixed flux ratio of [OIII]5007/[OIII]4959=2.98. We choose the high resolution NIRSpec gratings that provide R~2,700, sufficiently high to study kinematics (FWHM~100 km/s) and resolve the [OII] doublet. The NRSIRS2RAPID readout mode is used to better identify and remove cosmic rays, except the G235H/F170LP spectroscopy for J0217-0208, where we use NRSIRS2 to reduce the data volume.

We will conduct NIRCam F150W+F300M and F200W+F410M imaging for J1211-0118 and J0217-0208 at z=6.0-6.2, and F150W+F360M and F200W+F430M imaging for J0218-0519 at z=7.2, to estimate robust stellar masses and measure the inclinations required to correct the kinematic calculations. The Background Limited special requirement is used for NIRCam imaging, as the achieved S/N changes by ~10-20% between low and high background.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	J0218-0519	RA: 02 18 56.5360 (34.7355667d) Dec: -05 19 58.87 (-5.33302d) Equinox: J2000		
Comments: z=7.215, SFR=68 Msun/yr, FWHM=80 km/s *Category=Galaxy* *Description=[High-redshift galaxies]*				
(2)	J0217-0208	RA: 02 17 21.6030 (34.3400125d) Dec: -02 08 52.78 (-2.14799d) Equinox: J2000		
Comments: z=6.204, SFR=96 Msun/yr, FWHM=350 km/s *Category=Galaxy* *Description=[High-redshift galaxies]*				
(3)	J1211-0118	RA: 12 11 37.1120 (182.9046333d) Dec: -01 18 16.50 (-1.30458d) Equinox: J2000		
Comments: z=6.029, SFR=86 Msun/yr, FWHM=200 km/s *Category=Galaxy* *Description=[High-redshift galaxies]*				

Observation

Proposal 1657, Observation 1: J0218

Wed May 25 06:00:13 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

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)	J0218-0519	RA: 02 18 56.5360 (34.7355667d) Dec: -05 19 58.87 (-5.33302d) Equinox: J2000		

Comments: z=7.215, SFR=68 Msun/yr, FWHM=80 km/s
Category=Galaxy
Description=[High-redshift galaxies]

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	MEDIUM	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	G395H/F290LP	NRSIRS2	15	1	false	true	NONE	8	8	8870.045	
2	G395M/F290LP	NRSIRS2RAPID	8	1	false	true	NONE	8	8	1050.4	

Observation

Proposal 1657, Observation 2: J0217

Wed May 25 06:00:13 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

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)	J0217-0208	RA: 02 17 21.6030 (34.3400125d) Dec: -02 08 52.78 (-2.14799d) Equinox: J2000		

Comments: z=6.204, SFR=96 Msun/yr, FWHM=350 km/s
Category=Galaxy
Description=[High-redshift galaxies]

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	MEDIUM	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	G235H/F170LP	NRSIRS2	14	1	false	true	NONE	8	8	8286.49	
2	G235H/F170LP	NRSIRS2	14	1	false	true	NONE	8	8	8286.49	
3	G395H/F290LP	NRSIRS2RAPID	35	1	false	true	NONE	8	8	4201.6	

Observation

Proposal 1657, Observation 3: J1211

Wed May 25 06:00:13 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

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)	J1211-0118	RA: 12 11 37.1120 (182.9046333d) Dec: -01 18 16.50 (-1.30458d) Equinox: J2000		

Comments: z=6.029, SFR=86 Msun/yr, FWHM=200 km/s
Category=Galaxy
Description=[High-redshift galaxies]

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	MEDIUM	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	G235H/F170LP	NRSIRS2	24	1	false	true	NONE	8	8	14122.046	
2	G395H/F290LP	NRSIRS2RAPID	20	1	false	true	NONE	8	8	2450.934	

Observation

Proposal 1657, Observation 4: J0218

Wed May 25 06:00:13 GMT 2022

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
(1)	J0218-0519	RA: 02 18 56.5360 (34.7355667d) Dec: -05 19 58.87 (-5.33302d) Equinox: J2000		

Comments: z=7.215, SFR=68 Msun/yr, FWHM=80 km/s
Category=Galaxy
Description=[High-redshift galaxies]

Acquisition

#	Target
1	NONE

Template

AcqFilter	Primary Channel	Simultaneous Imaging	Imager Subarray
	CHANNEL1	YES	FULL

Dithers

#	Dither Type	Optimized For	Direction
1	4-Point	POINT SOURCE	NEGATIVE
2	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	F770W	FASTR1	28	9	1	Dither 1	4	36	2886.042	
1	SHORT(A)	MRSLONG		FASTR1	65	4	1	Dither 1	4	16	2919.342	
1	SHORT(A)	MRSSHORT		FASTR1	65	4	1	Dither 1	4	16	2919.342	

Observation

Proposal 1657, Observation 5: J0218

Wed May 25 06:00:13 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Visit 5:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	J0218-0519	RA: 02 18 56.5360 (34.7355667d) Dec: -05 19 58.87 (-5.33302d) Equinox: J2000		

Comments: z=7.215, SFR=68 Msun/yr, FWHM=80 km/s
Category=Galaxy
Description=[High-redshift galaxies]

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	4	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	F150W	F360M	SHALLOW4	10	1	4	4	2104.407	
2	F200W	F430M	SHALLOW4	10	1	4	4	2104.407	

Special Requirements

Offset -25.0 arcsec, 35.0 arcsec
Background Limited. Background no more than 40th percentile above minimum

Observation

Proposal 1657, Observation 6: J0217

Wed May 25 06:00:13 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	J0217-0208	RA: 02 17 21.6030 (34.3400125d) Dec: -02 08 52.78 (-2.14799d) Equinox: J2000		

Comments: z=6.204, SFR=96 Msun/yr, FWHM=350 km/s
Category=Galaxy
Description=[High-redshift galaxies]

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	4	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	F150W	F300M	BRIGHT2	7	1	4	4	601.259	
2	F200W	F410M	BRIGHT2	7	1	4	4	601.259	

Special Requirements

Offset -25.0 arcsec, 35.0 arcsec
Background Limited. Background no more than 40th percentile above minimum

Observation

Proposal 1657, Observation 7: J1211

Wed May 25 06:00:13 GMT 2022

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	J1211-0118	RA: 12 11 37.1120 (182.9046333d) Dec: -01 18 16.50 (-1.30458d) Equinox: J2000		

Comments: z=6.029, SFR=86 Msun/yr, FWHM=200 km/s
Category=Galaxy
Description=[High-redshift galaxies]

Template

Module	Subarray
B	FULL

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	INTRAMODULEBOX	4	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	F150W	F300M	BRIGHT2	7	1	4	4	601.259	
2	F200W	F410M	BRIGHT2	7	1	4	4	601.259	

Special Requirements

Offset -25.0 arcsec, 35.0 arcsec
Background Limited. Background no more than 40th percentile above minimum