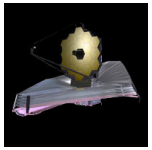

1554 - Nebular line diagnostics in a merger at cosmic dawn

Cycle: 1, Proposal Category: GO

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Roberto Decarli (PI) (ESA Member)	**INAF, Osservatorio di Astrofisica e Scienza dello Spazio**	**roberto.decarli@inaf.it**
Dr. Fabian Walter (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	walter@mpia.de
Dr. Chris Carilli (CoI)	Associated Universities, Inc.	ccarilli@nrao.edu
Dr. Massimo Dotti (CoI) (ESA Member)	Universita di Milano-Bicocca	massimo.dotti@mib.infn.it
Dr. Michael A. Strauss (CoI)	Princeton University	strauss@astro.princeton.edu
Dr. Maxime Trebitsch (CoI) (ESA Member)	University of Groningen	m.trebitsch@rug.nl
Prof. Marta Volonteri (CoI) (ESA Member)	CNRS, Institut d'Astrophysique de Paris	martav@iap.fr
Dr. Chiara Giulia Mazzucchelli (CoI) (ESA Member)	European Southern Observatory - Chile	chiara.mazzucchelli@eso.org
Dr. Sarah Bosman (CoI) (ESA Member)	Max Planck Institute for Astronomy	bosman@mpia.de
Dr. Anna-Christina Eilers (CoI)	Massachusetts Institute of Technology	eilers@mit.edu
Eduardo Banados (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	banados@mpia.de
Dr. Feige Wang (CoI)	University of Arizona	feigewang@email.arizona.edu
Dr. Thomas Connor (CoI)	Jet Propulsion Laboratory	thomas.p.connor@jpl.nasa.gov
Dr. Bram Venemans (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	venemans@mpia-hd.mpg.de
Dr. Laura Blecha (CoI)	University of Florida	lblecha@ufl.edu
Dr. Yujin Yang (CoI)	Korea Astronomy and Space Science Institute (KASI)	yyang@kasi.re.kr
Dr. Madeline Marshall (CoI) (CSA Member)	Dominion Astrophysical Observatory	madeline_marshall@outlook.com
Dr. Roderik A. Overzier (CoI)	Observatorio Nacional	overzier@on.br
Jan-Torge Schindler (CoI) (ESA Member)	Max Planck Institute for Astronomy	schindler@mpia.de
Dr. Marcel Neeleman (CoI) (ESA Member)	Max-Planck-Institut fur Astronomie, Heidelberg	neeleman@mpia.de
Mr. Antonio Pensabene (CoI) (ESA Member)	INAF, Osservatorio di Astrofisica e Scienza dello Spazio	antonio.pensabene2@unibo.it
Dr. Benny Trakhtenbrot (CoI)	Tel Aviv University	benny.trakht@gmail.com

Name	***Institution***	***E-Mail***
Prof. Xiaohui Fan (CoI) (US Admin CoI)	University of Arizona	xfan@email.arizona.edu
Dr. Dominik A. Riechers (CoI)	Cornell University	riechers@cornell.edu
Dr. Andrea Comastri (CoI) (ESA Member)	INAF, Osservatorio di Astrofisica e Scienza dello Spazio	andrea.comastri@inaf.it
Dr. Roberto Gilli (CoI) (ESA Member)	INAF, Osservatorio di Astrofisica e Scienza dello Spazio	roberto.gilli@inaf.it
Dr. Hans-Walter R Rix (CoI)		rix@mpia.de

OBSERVATIONS

Folder	***Observation***	***Label***	***Observing Template***	***Science Target***
Observation Folder				
	1	IFU PJ308-21	NIRSpec IFU Spectroscopy	(1) Group PJ308-21

ABSTRACT

At z>6 (when the Universe is <1 Gyr old), luminous quasars are exceptionally active: their central engine is a rapidly accreting supermassive (~1e9 Msun) black hole which resides in an intensely star-forming galaxy that is ab order of magnitude more massive than typical galaxies at these redshifts. How can we account for such a rapid growth of these extreme sources? The exceptional quasar PJ308-21 may offer an answer. High-resolution HST and ALMA imaging demonstrates that the quasar host is undergoing a merger with one or more satellite galaxies. For the first time at these redshifts, host galaxy starlight is detected around a luminous quasar. A prominent Ly-alpha halo, detected with MUSE on the ESO/VLT, partially overlaps the companion galaxy. The data in hand already show all the agents of rapid galaxy growth at play: gas, dust, star formation, and nuclear activity. Here we propose to capitalize on the unprecedented capabilities of JWST to secure NIRSpec IFU observations, creating Halpha, Hbeta, [OIII] and [NII] maps which will enable: 1) a characterization of the ionized gas physical properties (metallicity, ionization parameter, powering mechanism) and a test for the presence of outflows; 2) an estimate of the stellar mass of the satellite galaxy; 3) a precise timing of the star formation event, which we will use to understand the role of the gravitational interaction in triggering the starburst; 4) a test of the origin of the Ly-alpha halo. These observations will lead to a fundamental new understanding of the build-up of massive galaxies and black holes in the early universe.

OBSERVING DESCRIPTION

We propose to secure NIRSpec IFU observations of the quasar+galaxy merging system PJ308-21 at z=6.234. Very recently, ALMA has provided first unambiguous evidence of satellite galaxies around quasars. The targeted system is the poster child of merging galaxies at z>6: High angular

resolution (~0.2" or ~1 kpc) observations of the rest-frame UV starlight emission (from HST) and of the [CII] and rest-frame FIR dust continuum (from ALMA) reveal the interplay of gas, dust, star formation, and nuclear activity. We can explain the intricate morphology with a current dynamical model invoking the tidal stripping of one or more satellite galaxies orbiting in close proximity to the quasar host galaxy. In addition, a bright Ly-alpha halo extends on the Eastern side of the quasar host, partially overlapping the satellite galaxy.

The system can be covered in only two IFU pointings. A third pointing off-source will be used for background subtraction. We will target key optical diagnostic emission lines: Halpha, Hbeta, [OIII], [NII], as well as the stellar optical continuum emission, all in a single spectral setup. The goals of the project include measuring the instantaneous star formation rate, reconstructing the kinematics of the ionized gas, constraining metallicity, ionization parameter, probing the origin of the Ly-alpha halo, measuring its metallicity and ionization parameter, and assessing the stellar mass budget of the system.

Proposal 1554 - Targets - Nebular line diagnostics in a merger at cosmic dawn

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	Group PJ308-21			
Comments: Targets 2, 3 are science targets; target 4 is background. *Target Selection=[2 PJ308-21.W, 3 PJ308-21.E, 4 PJ308-21.BACKGROUND]*				
(2)	PJ308-21.W	RA: 20 32 9.9510 (308.0414625d) Dec: -21 14 2.05 (-21.23390d) Equinox: J2000	Parallax: 0" Epoch of Position: 2000.0	
Comments: *Category=Galaxy* *Description=[High-redshift galaxies, Interacting galaxies, Quasar-galaxy pairs]* *Extended=YES*				
(3)	PJ308-21.E	RA: 20 32 10.0900 (308.0420417d) Dec: -21 14 2.45 (-21.23401d) Equinox: J2000	Parallax: 0" Epoch of Position: 2000	
Comments: *Category=Galaxy* *Description=[High-redshift galaxies, Interacting galaxies, Quasar-galaxy pairs]* *Extended=YES*				
(4)	PJ308-21.BACKGROUND	RA: 20 32 9.6710 (308.0402958d) Dec: -21 13 59.07 (-21.23307d) Equinox: J2000	Parallax: 0" Epoch of Position: 2000.0	
Comments: Background pointing *Category=Calibration* *Description=[Telescope/sky background]* *Extended=YES*				

Observation

Proposal 1554, Observation 1: IFU PJ308-21 Wed Jul 14 00:00:22 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Background Observations:[]

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)	Group PJ308-21			

Comments: Targets 2, 3 are science targets; target 4 is background.
Target Selection=[2 PJ308-21.W, 3 PJ308-21.E, 4 PJ308-21.BACKGROUND]

Acquisition

#	Target	TA Method	Subarray	Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	SAME	WATA	FULL	F110W	NRSRAPID	3	1	1	42.947	53817

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	CYCLING	SMALL	1	6	

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	NRSIRS2RAPID	5	1	true	false	NONE	1	1	87.533	
2	G395H/F290LP	NRSIRS2	13	1	false	true	NONE	6	6	5777.2	53817