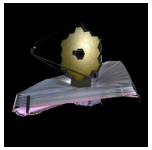

2186 - NIRSpec IFU spectroscopy of the high-density starburst in ultra-luminous infrared galaxies

Cycle: 1, Proposal Category: GO

INVESTIGATORS

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Mrk273	NIRSpec IFU Spectroscopy	(1) MRK-273
	2	IRAS10565	NIRSpec IFU Spectroscopy	(2) IRAS-10565+2448
	3	IRAS10494	NIRSpec IFU Spectroscopy	(3) IRAS-10494+4424
	4	UGC5101	NIRSpec IFU Spectroscopy	(4) UGC-5101
	5	IRAS04074	NIRSpec IFU Spectroscopy	(5) IRAS-04074-2801

ABSTRACT

The aim of this proposal is to investigate a recently suggested hypothesis of high-density starburst in ULIRGs. This hypothesis stems from systematic observations of Br-alpha (4.05 microns) and Br-beta (2.63 micon) lines in ULIRGs conducted by the space infrared telescope AKARI. The observed Br-beta/Br-alpha flux ratio exceeds the upper limit of the well-known Case B and corresponds to apparently negative extinction. This suggests that Case B no longer holds in the star-forming regions of ULIRGs and that due to an extreme number density as high as 10^8 cm^-3, the Br-alpha line is

optically thick and saturated. To test this hypothesis, NIRSpec IFU observations are proposed to follow up the five ULIRGs that showed anomalous Br-beta/Br-alpha ratios. By examining the spatial distribution of Br-beta/Br-alpha the site of the harsh star-formation can be investigated. This Br-beta/Br-alpha anomaly is not only a criticla issue to understand the star-formation in ULIRGs but also a challenge to the fundamental method in astronomy that measures the star formation rate and dust extinction from recombination lines. These Br-alpha and Br-beta lines cannot be observed from the ground, and the new channel provided by JWST will make this science possible for the first time.

OBSERVING DESCRIPTION

A series of NIRSpec IFU spectroscopy is proposed to observe the Br-alpha (4.05 micron) and Br-beta (2.63 micron) lines at the nuclear regions of five ultra-luminous infrared galaxies: Mrk 273, IRAS 10565+2448, IRAS 10494+4424, UGC 5101, and IRAS 04074-2801.
The combinations of G395M/F290LP and G235M/F170LP are used for Br-alpha and Br-beta, respectively, except for the most distant target, IRAS 04074. For IRAS 04074, only G395M/F290LP is used because the Br-beta line is redshifted into the coverage of F290LP. To improve spatial sampling and correct for the micro-shutter-assembly leakage, 4-point-dither is adopted. The detector readout pattern NRSIRS2RAPID is chosen except for UGC 5101. For UGC 5101, NRSRAPID is employed instead because the observation would saturate within five groups per integration if NRSIRS2RAPID is used.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	MRK-273	RA: 13 44 42.0600 (206.1752500d) Dec: +55 53 13.20 (55.88700d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: The coordinates refer to the midpoint of Mrk 273 N and SW. The positions of the two nuclei listed in SIMBAD seem to be shifted by (delta-ra, delta-dec) = (+0".7, -0"6). The positions measured from a HST F160W image are adopted. This image has a WCS close to that of the Chandra observation of Mrk 273 done by Iwasawa et al. 2011, A&A, 528, A137, and that of the NOEMA observation of Mrk 273 N done by Aladro et al. 2018, A&A, 617, A20. *Category=Galaxy* *Description=[Starburst galaxies, Ultraluminous infrared galaxies]* *Extended=YES*				
(2)	IRAS-10565+2448	RA: 10 59 18.1345 (164.8255604d) Dec: +24 32 34.54 (24.54293d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: The coordinates are quoted from the 2MASS catalog. *Category=Galaxy* *Description=[Starburst galaxies, Ultraluminous infrared galaxies]* *Extended=YES*				
(3)	IRAS-10494+4424	RA: 10 52 23.5750 (163.0982292d) Dec: +44 08 47.09 (44.14641d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: The coordinates are quoted from the 2MASS catalog. *Category=Galaxy* *Description=[Starburst galaxies, Ultraluminous infrared galaxies]* *Extended=YES*				
(4)	UGC-5101	RA: 09 35 51.5990 (143.9649958d) Dec: +61 21 11.33 (61.35315d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: The coordinates were quoted from Imanishi et al. 2006, AJ, 131, 2888. The difference from the SIMBAD coordinates is 0".1. *Category=Galaxy* *Description=[Active galactic nuclei, Ultraluminous infrared galaxies]* *Extended=YES*				
(5)	IRAS-04074-2801	RA: 04 09 30.4439 (62.3768496d) Dec: -27 53 43.01 (-27.89528d) Equinox: J2000	Epoch of Position: 2015.5	
Comments: The coordinates are quoted from the 2MASS catalog. *Category=Galaxy* *Description=[Starburst galaxies, Ultraluminous infrared galaxies]* *Extended=YES*				

Observation

Proposal 2186, Observation 1: Mrk273

Tue Sep 28 17:01:57 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: No special requirement on the PA is needed. There is no possible MSA bright spoiler. The star TYC 3854-131-1 is ~78 arcsec away and possibly fall in the MSA. But this is only 0.9 mag brighter than Mrk 273 in the K-band. The star HD 119992 is moderately brighter than Mrk 273 in the K-band (5.9 mag). But this is ~263 arcsec away and does not fall in the MSA.
No special TA is needed. The FoV margin to cover the three nuclei is suffiently large (~0.6 arcsec).

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)	MRK-273	RA: 13 44 42.0600 (206.1752500d) Dec: +55 53 13.20 (55.88700d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: The coordinates refer to the midpoint of Mrk 273 N and SW. The positions of the two nuclei listed in SIMBAD seem to be shifted by (delta-ra, delta-dec) = (+0".7, -0"6). The positions measured from a HST F160W image are adopted. This image has a WCS close to that of the Chandra observation of Mrk 273 done by Iwasawa et al. 2011, A&A, 528, A137, and that of the NOEMA observation of Mrk 273 N done by Aladro et al. 2018, A&A, 617, A20.
Category=Galaxy
Description=[Starburst galaxies, Ultraluminous infrared galaxies]
Extended=YES

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

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	NRSRAPID	5	1	false	true	NONE	4	4	257.682	57772
2	G235M/F170LP	NRSRAPID	6	1	false	true	NONE	4	4	300.63	57772

Observation

Proposal 2186, Observation 2: IRAS10565

Tue Sep 28 17:01:57 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: No special requirement on the PA is needed. There is no possible MSA bright spoiler. The most bright source that may fall in the MSA is 2MASS J10591195+2428568, which is FAINTER than IRAS 10565+2448 by 1.5 mag in the K-band.

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)	IRAS-10565+2448	RA: 10 59 18.1345 (164.8255604d) Dec: +24 32 34.54 (24.54293d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: The coordinates are quoted from the 2MASS catalog.
Category=Galaxy
Description=[Starburst galaxies, Ultraluminous infrared galaxies]
Extended=YES

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

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	NRSRAPID	5	1	false	true	NONE	4	4	257.682	57772
2	G235M/F170LP	NRSRAPID	6	1	false	true	NONE	4	4	300.63	57772

Observation

Proposal 2186, Observation 3: IRAS10494

Tue Sep 28 17:01:57 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: No special requirement on the PA is needed. There is no possible MSA bright spoiler. The most bright source that may fall in the MSA is 2MASS J10521949+4410218, which is brighter than IRAS10494+4424 only by 0.9 mag in the K-band.

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)	IRAS-10494+4424	RA: 10 52 23.5750 (163.0982292d) Dec: +44 08 47.09 (44.14641d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: The coordinates are quoted from the 2MASS catalog.
Category=Galaxy
Description=[Starburst galaxies, Ultraluminous infrared galaxies]
Extended=YES

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

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	NRSRAPID	3	1	false	true	NONE	4	4	171.788	57772
2	G235M/F170LP	NRSRAPID	3	1	false	true	NONE	4	4	171.788	57772

Observation

Proposal 2186, Observation 4: UGC5101

Tue Sep 28 17:01:57 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: No special requirement on the PA is needed. There is no possible MSA bright spoiler. The most bright source that may fall in the MSA is 2MASS J09354722+6122291, which is brighter than UGC 5101 only by 1.2 mag in the K-band.

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
(4)	UGC-5101	RA: 09 35 51.5990 (143.9649958d) Dec: +61 21 11.33 (61.35315d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: The coordinates were quoted from Imanishi et al. 2006, AJ, 131, 2888. The difference from the SIMBAD coordinates is 0".1.
Category=Galaxy
Description=[Active galactic nuclei, Ultraluminous infrared galaxies]
Extended=YES

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

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	NRSRAPID	6	1	false	true	NONE	4	4	300.63	57772
2	G235M/F170LP	NRSRAPID	13	1	false	true	NONE	4	4	601.259	57772

Observation

Proposal 2186, Observation 5: IRAS04074

Tue Sep 28 17:01:57 GMT 2021

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: No special requirement on the PA is needed. There is no possible MSA bright spoiler. The most bright source that may fall in the MSA is 2MASS J04093788-2750237, which is brighter than IRAS 04074-2801 only by 4.9 mag in the K-band.

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
(5)	IRAS-04074-2801	RA: 04 09 30.4439 (62.3768496d) Dec: -27 53 43.01 (-27.89528d) Equinox: J2000	Epoch of Position: 2015.5	

Comments: The coordinates are quoted from the 2MASS catalog.
Category=Galaxy
Description=[Starburst galaxies, Ultraluminous infrared galaxies]
Extended=YES

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

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	10	1	false	true	NONE	4	4	641.911	57772