

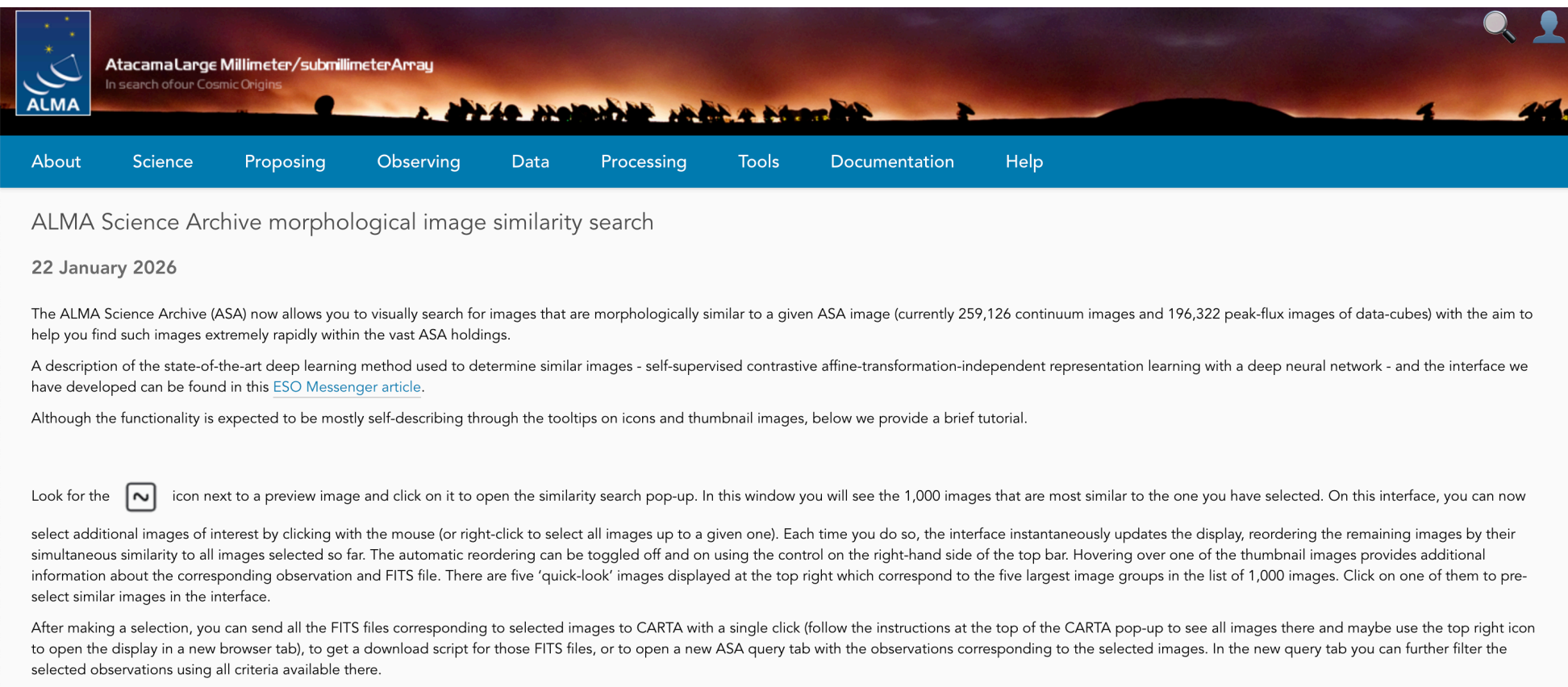
New ALMA archive capability

Tien-Hao Hsieh & Arc-Taiwan

ALMA-Taiwan Users workshop, March 27, 2026

Introduction

► ALMA Science Archive morphological image similarity search



The screenshot shows the ALMA Science Archive website. The header features the ALMA logo and the text "Atacama Large Millimeter/submillimeter Array In search of our Cosmic Origins". A navigation bar includes links for About, Science, Proposing, Observing, Data, Processing, Tools, Documentation, and Help. The main content area is titled "ALMA Science Archive morphological image similarity search" and dated "22 January 2026". The text describes the new search functionality, which allows users to find morphologically similar images from a vast archive. It mentions a state-of-the-art deep learning method and provides a brief tutorial on how to use the search interface, including selecting images, viewing similar results, and downloading data.


ALMA Science Archive morphological image similarity search

22 January 2026

The ALMA Science Archive (ASA) now allows you to visually search for images that are morphologically similar to a given ASA image (currently 259,126 continuum images and 196,322 peak-flux images of data-cubes) with the aim to help you find such images extremely rapidly within the vast ASA holdings.

A description of the state-of-the-art deep learning method used to determine similar images - self-supervised contrastive affine-transformation-independent representation learning with a deep neural network - and the interface we have developed can be found in this [ESO Messenger article](#).

Although the functionality is expected to be mostly self-describing through the tooltips on icons and thumbnail images, below we provide a brief tutorial.

Look for the  icon next to a preview image and click on it to open the similarity search pop-up. In this window you will see the 1,000 images that are most similar to the one you have selected. On this interface, you can now select additional images of interest by clicking with the mouse (or right-click to select all images up to a given one). Each time you do so, the interface instantaneously updates the display, reordering the remaining images by their simultaneous similarity to all images selected so far. The automatic reordering can be toggled off and on using the control on the right-hand side of the top bar. Hovering over one of the thumbnail images provides additional information about the corresponding observation and FITS file. There are five 'quick-look' images displayed at the top right which correspond to the five largest image groups in the list of 1,000 images. Click on one of them to pre-select similar images in the interface.

After making a selection, you can send all the FITS files corresponding to selected images to CARTA with a single click (follow the instructions at the top of the CARTA pop-up to see all images there and maybe use the top right icon to open the display in a new browser tab), to get a download script for those FITS files, or to open a new ASA query tab with the observations corresponding to the selected images. In the new query tab you can further filter the selected observations using all criteria available there.

Stoehr et al.

<https://almascience.eso.org/news/alma-science-archive-morphological-image-similarity-search>

Introduction

► ALMA Science Archive morphological image similarity search

Astronomical News

DOI: 10.18727/0722-6691/5396

Morphological Image Similarity Search on the ALMA Science Archive Query Interface Using Deep Unsupervised Contrastive Representation Learning

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Alisdair Manning¹
Jorge Garcia²
Pei-Ying Hsieh³
Andrew Lipnicky⁴
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image similarity search has been offered in an astronomical science archive.

Introduction

The amount of astronomical data is growing exponentially (for example, Stoehr, 2019) resulting in an exponential increase of data available per astronomer. No longer data but now astronomers are becoming — or have already become — the rare resource in astronomy (Stoehr et al., 2015). For science archives like the

learning without using human classification (labels). Recently, however, a breakthrough has been achieved such that contrastive unsupervised methods perform as well as, or even better than, supervised methods. Such methods have already been applied successfully to astrophysics. For a summary see Huertas-Company et al. (2023).

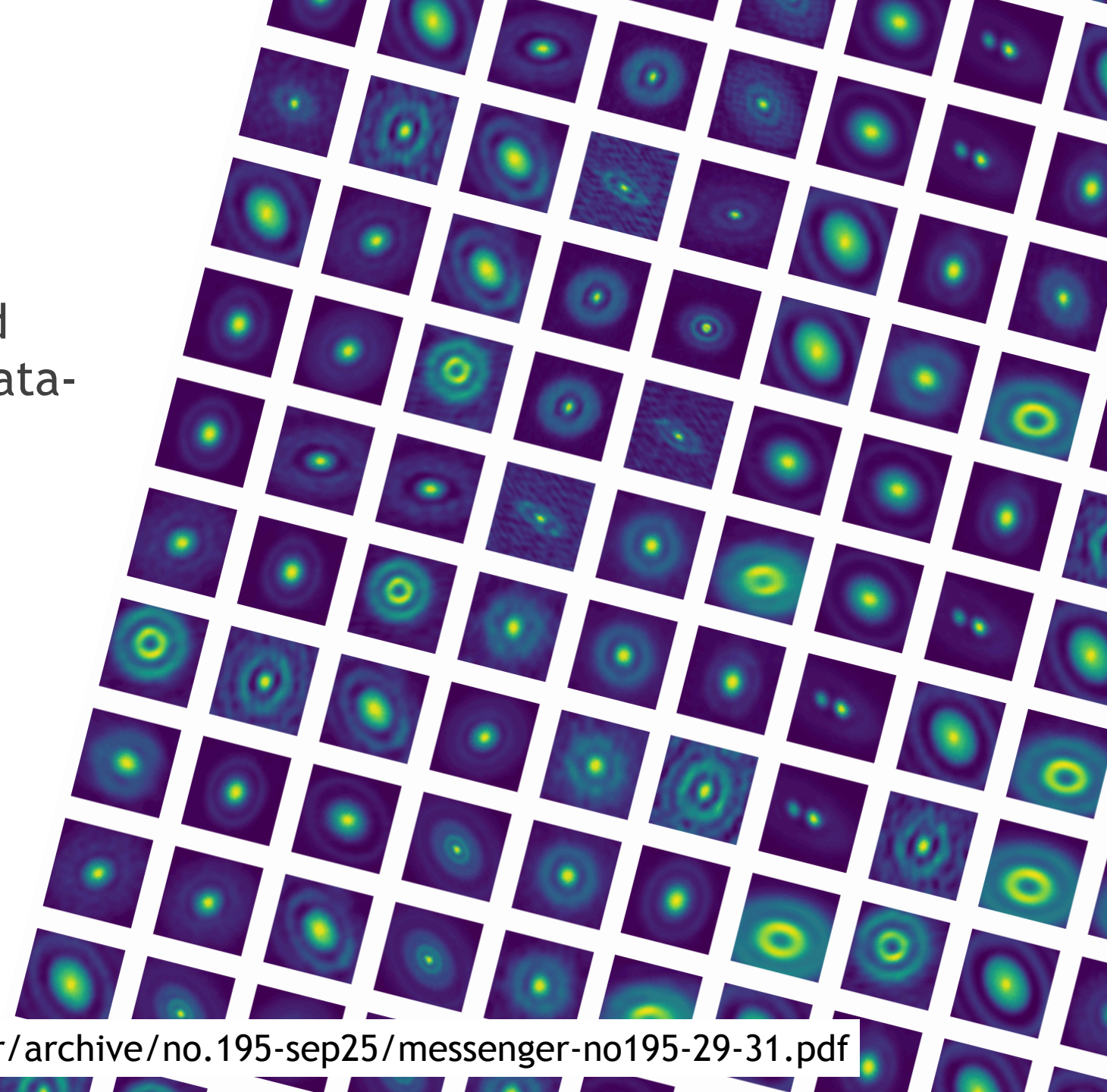
Here, we use the SimCLR algorithm (Chen et al., 2020) in the implementation made by da Costa et al. (2022)². SimCLR uses self-supervised learning by applying

Stoehr et al.

<https://almascience.eso.org/news/alma-science-archive-morphological-image-similarity-search>

Introduction

- ▶ Applied to a vast archive of 259,126 continuum images and 196,322 peak-flux images of data-cubes
- ▶ Model: A deep neural network utilizing self-supervised contrastive representation learning

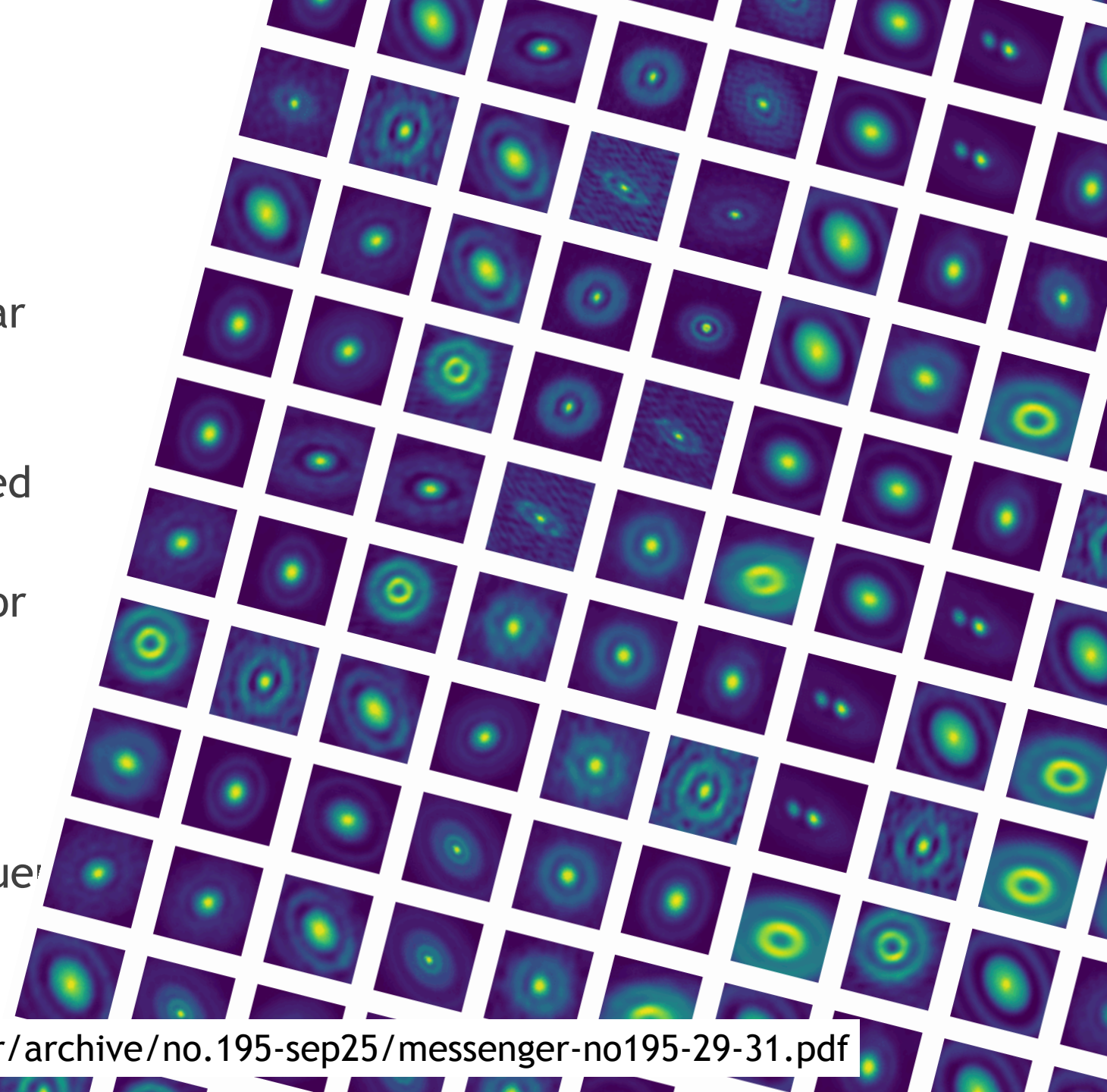


Stoehr et al.

<https://www.eso.org/sci/publications/messenger/archive/no.195-sep25/messenger-no195-29-31.pdf>

Introduction

- ▶ **Search:** Click the icon next to a preview image to find 1,000 similar images
- ▶ **Refine:** Select images to instantly reorder the remaining results based on your combination
- ▶ **Explore:** Hover over thumbnails for FITS details, or click the top-right 'quick-look' images to find major groups
- ▶ **Export:** Send files to CARTA, get a download script, or open a new query tab



ALMA Archive

Data — ALMA Science Portal x +

almascience.eso.org/alma-data

Google NASA/ADS Overleaf MIOP 漫畫 Job booking stock IAA internal TARA-ALMA Meeting Google 地圖 所有書籤



- About
- Science
- Proposing
- Observing
- Data**
- Processing
- Tools
- Documentation
- Help

Data

Archive	holds all public and proprietary
Large Programs	A list of Large Programs with lir
ACA Observatory Filler Programs	Observatory programs designe
Science Verification	Data from observations perform
ARI-L	The Additional Representative
EHT	The Event Horizon Telescope 2
Calibrator Catalog	A web-based user interface to
Publication Acknowledgement	

- Archive
 - Archive Query Interface
 - Archive Documentation
- Large Programs
- ACA Observatory Filler Programs
- Observatory Projects
- Science Verification
- ARI-L
- EHT
- Calibrator Catalogue
- Publication acknowledgement
- Request raw data



Observations (69) Projects (48) Publications (62)

Project code	ALMA source name	Ra	Dec	Band	Cont. sens.	Frequency support	Release date	Publications	Ang. res.	Min. vel. res.	Array	Mosaic	Max. reco. scale	FOV	Scientific category	Science keyword	Int. Time	Gal. lon.	Gal. lat.
2013.1.00196.S	TW_Hya	11:01:51.875	-34:42:17.155	7	0.0620	329.56-341.01GHz	2016-06-12	2	0.648	0.108	12m	7.027	17.367	Disks and planet formati...	Disks around low-mass s...	6441.120	278.679	22.955	
2011.0.00001.SV	TW_Hya	11:01:51.906	-34:42:17.021	7	0.3687	343.51-358.23GHz	2016-06-24	8	1.671	0.204	12m	10.917	16.596	Disks and planet formati...	Disks around low-mass s...	7106.400	278.679	22.955	
2015.A.00005.S	TW_Hya	11:01:51.824	-34:42:17.267	6	0.0146	223.00-242.98GHz	2016-07-05	6	0.045	38.872	12m	0.613	24.992	Disks and planet formati...	Disks around low-mass s...	2431.296	278.679	22.954	
2013.1.01397.S	TW_Hya	11:01:51.824	-34:42:17.246	7	0.1805	329.27-342.94GHz	2016-07-14	2	0.378	0.027	12m	3.642	17.325	Disks and planet formati...	Disks around low-mass s...	3144.918	278.679	22.954	
2012.1.00400.S	TW_Hya	11:01:51.826	-34:42:17.242	7	0.2276	358.48-372.79GHz	2016-07-28	0	0.588	0.098	12m	7.484	15.949	Disks and planet formati...	Disks around low-mass s...	6217.762	278.679	22.954	
2012.1.00422.S	TW_Hya	11:01:51.768	-34:42:17.514	7	0.0833	328.94-332.19GHz	2016-08-20	7	0.320	0.221	12m	4.457	17.652	Solar system	Solar system - Comets	1149.120	278.678	22.954	
2013.1.00192.S	TW_Hya	11:01:51.824	-34:42:17.247	7	0.0508	279.45-294.99GHz	2016-09-10	0	0.362	0.129	12m	4.087	20.274	Disks and planet formati...	Disks around low-mass s...	1028.160	278.679	22.954	
2013.1.00387.S	TW_Hya	11:01:51.824	-34:42:17.246	6	0.0263	226.64-244.96GHz	2016-09-16	9	0.530	0.037	12m	5.551	24.694	Disks and planet formati...	Disks around low-mass s...	2661.120	278.679	22.954	

- Site Map
- Accessibility
- Contact
- Privacy Statement

<https://almascience.eso.org/alma-data/archive/archive-query-interface>

ALMA Archive

ALMA Science Archive

almscience.nrao.edu/aq/?result_view=observations&sourceNameResolver=HL%20Tau&spatialResolution=<0.1&band=7

Angular Resolution: <0.1 | Source name: HL Tau | Band: 7

Search filters: Position (Source name: HL Tau, ALMA source name, RA Dec, Galactic, Ecliptic, Target List), Target (Band: 7), Project (Project name, Project abstract, PI Full Name, Proposal authors, Science keyword), Publication (BibCode, Publication Title, Abstract, First Author, Authors), Observation (Observation Date, Polarisation Type, Member ous id, Object type, Public data only, Calibration observations).

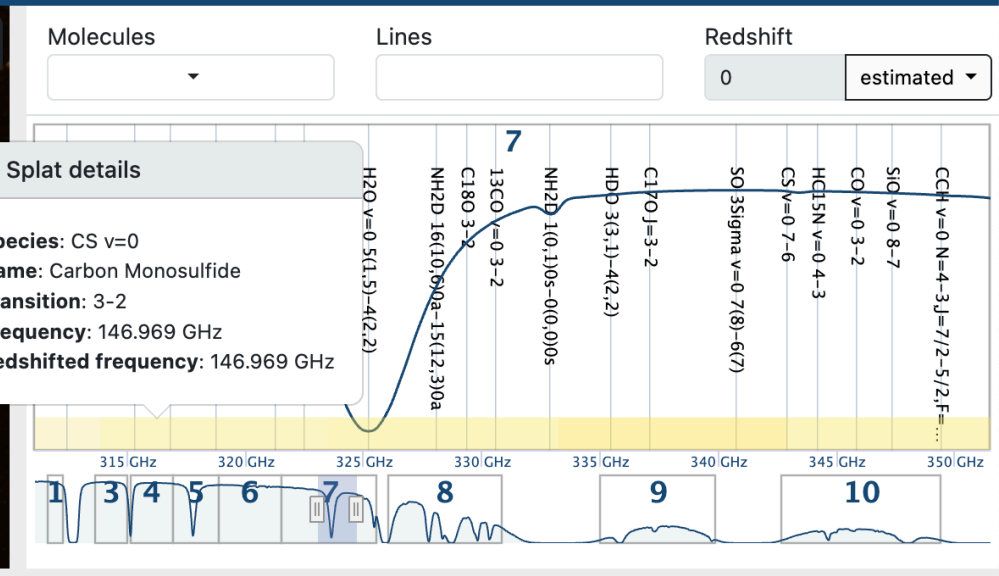
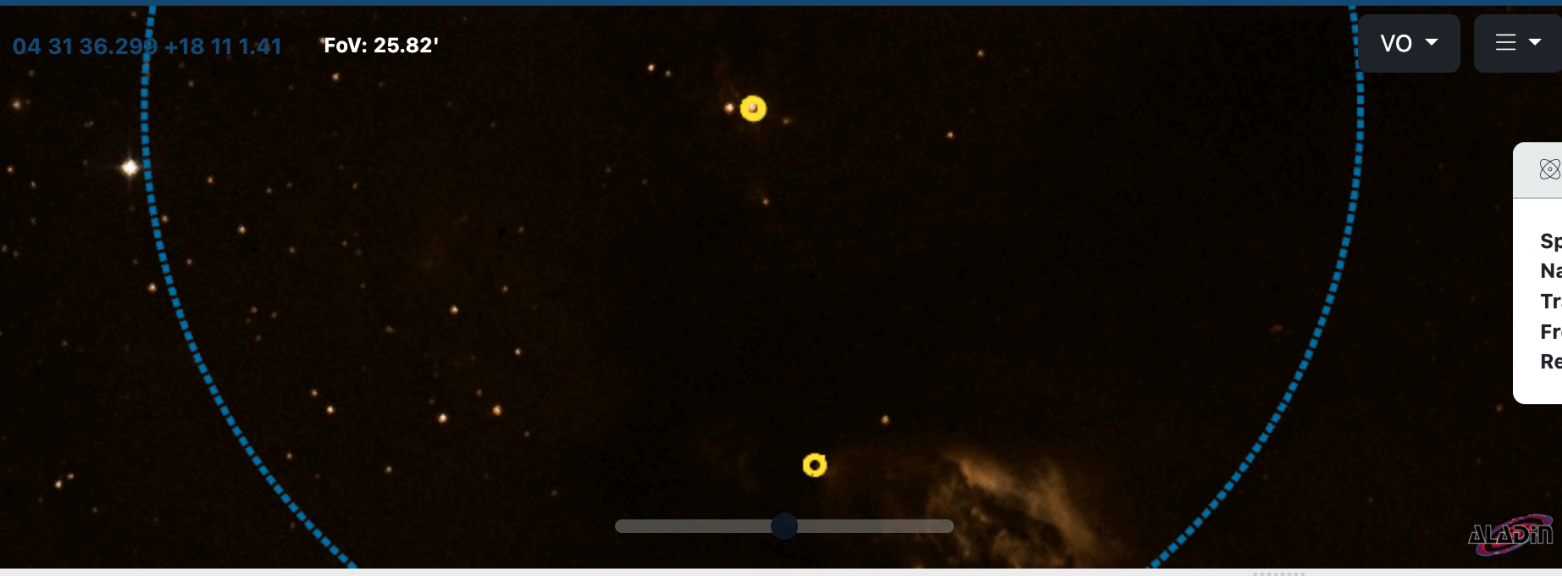
Redshift: 0 (estimated)

Spectral plot showing lines: CCH v=0 N=4-3 J=7/2-5/2 F..., SiO v=0 8-7, CO v=0 3-2, HD15N v=0 4-3, CS v=0 7-6, SO 3Sigma v=0 7(8)-6(7), C17O J=3-2, HD 3(3,1)-4(2,2), NH2D 1(0,1)0s-0(0,0)0s, C18O J=3-2, C18O 3-2, NH2D 1(0,1)0s-1(1,1)2,3(0a), H2O v=0 5(1,5)-4(2,2), H2O v=0 2(0,2)9(1-3)6, H218O v=0 5(1,5)-4(2,2).

Observation ID	Source Name	Coordinates	Resolution	Frequency	Date	Channels	Resolution	Array	Mosaic	Max.reco.scale	FOV
2011.0.00015.SV	HL_Tau	04:31:38.426 +18:13:57.0477	0.0357	335.498..351.486 GHz	2016-06-24	33	0.020	26.654	12m	1.719	16.953
2017.1.01178.S	HL_Tau	04:31:38.425 +18:13:57.2427	0.0310	320.991..336.737 GHz	2019-02-22	5	0.038	0.263	12m	0.763	17.706
2016.1.00138.S	L1551IRS5	04:31:34.140 +18:08:05.1017	0.0763	329.096..343.117 GHz	2019-05-09	11	0.083	0.214	12m	2.236	17.325
2017.1.01178.S	HL_Tau	04:31:38.425 +18:13:57.2427	0.0265	311.062..325.387 GHz	2021-02-12	5	0.082	0.260	12m	1.291	18.298
2019.1.01051.S	HL_Tau	04:31:38.449 +18:13:57.1797	0.0239	335.519..351.454 GHz	2023-07-26	6	0.023	53.612	12m	0.804	16.957

ALMA Archive

Search Angular Resolution: <0.1 Band: 7 Source name: HL Tau



Observations (5) Projects (4) Publications (54)

	Project code	ALMA source name	RA	h:m:s	Dec	d:m:s	Band	Cont.sens. mJy/beam	Frequency support	Release date	Publicator	Ang.res. arcsec	Min.vel.res. km/s	Array	Mosaic	Max.reco.scale arcsec	FOV	arc
<input type="checkbox"/>																		
<input type="checkbox"/>	2011.0.00015.SV	HL_Tau	04:31:38.426	+18:13:57.047	7		0.0357	335.498..351.486 GHz	2016-06-24	33	0.020	26.654	12m	1.719	16.953			
<input type="checkbox"/>	2017.1.01178.S	HL_Tau	04:31:38.425	+18:13:57.242	7		0.0310	320.991..336.737 GHz	2019-02-22	5	0.038	0.263	12m	0.763	17.706			
<input type="checkbox"/>	2017.1.01178.S	HL_Tau	04:31:38.425	+18:08:05.10	7		0.0763	329.096..343.117 GHz	2019-05-09	11	0.083	0.214	12m	2.236	17.325			
<input type="checkbox"/>	2017.1.01178.S	HL_Tau	04:31:38.425	+18:13:57.242	7		0.0265	311.062..325.387 GHz	2021-02-12	5	0.082	0.260	12m	1.291	18.298			
<input type="checkbox"/>	2019.1.01051.S	HL_Tau	04:31:38.449	+18:13:57.179	7		0.0239	335.519..351.454 GHz	2023-07-26	6	0.023	53.612	12m	0.804	16.957			

Download/view the data

ALMA Archive

Search Angular Resolution: <0.1 Band: 7 Source name: HL Tau

04 31 36.299 +18 11 1.41 FoV: 25.82' VO Molecules Lines Redshift 0 estimated

Previews for HL_Tau


ALMA

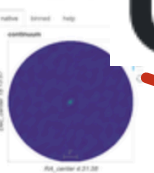
[README](#)


Combined ci

member.uid_A001_X1284_X1742.HL_Tau_sci.spw25_27_29_31.cont.l.manual.pbcor.fits 9 MB


iz, XX YY









SPW 0 : 311.062..312.936GHz, 1,128.906 kHz, XX YY







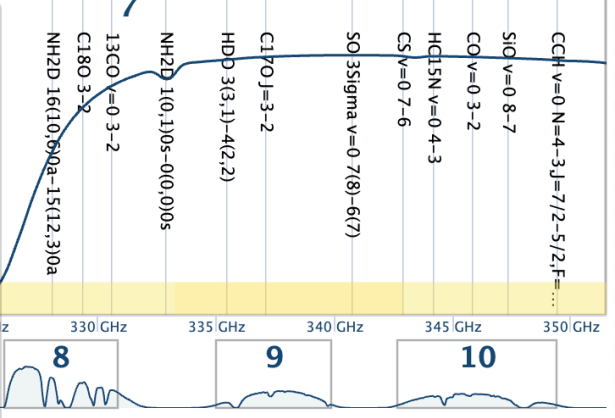
[member.uid_A001_X1284_X1742.HL_Tau_sci.spw25_27_29_31.cont.l.manual.pbcor.fits](#) 9 MB

Band: 7
Frequency type: line
Frequency range: 311.062..325.387
Continuum sensitivity: 0.026
Polarisations: XX YY
Array: 12m

[member.uid_A001_X1284_X1742.HL_Tau_sci.spw31.cube.l.manual.pbcor.fits](#) 18 GB

Band: 7
Frequency type: line
Frequency range: 311.062..312.936
Frequency resolution: 1,128.906 kHz

Find This icon



km/s	Array	Mosaic	Max.reco.scale	arcsec	FOV	arc
	12m		1.719		16.953	
	12m		0.763		17.706	
	12m		2.236		17.325	
	12m		1.291		18.298	
	12m		0.804		16.957	

2019.1.01051.S HL_Tau 04:31:38.449 +18:13:57.179 7 0.0239 335.519..351.454 GHz 2023-07-26 6 0.023 53.612 12m 0.804 16.957

ALMA Archive

Download 91 GB

Open legacy Request Handler



inchone

Project (1)

Group ObsUniSet (1)

Member ObsUniSet (1)

Source (1)

Collection (1)

Array (1)

File type (9)

File class (12)

Select all Readme Product tar Auxiliary tar Raw tgz Raw (semipass) tgz External tar

	Name		Size	↑ Project	↑ GOUS
<input type="checkbox"/>	uid_A002_Xdff8c		(auxiliary, qa) 30 KB	2017.1.01178.S	uid://A001/X128
<input type="checkbox"/>	member.uid_A001_X1284_X1742	31.cube.l.manual.pbcor.admit.native.xml	(auxiliary, admit) 77 KB	2017.1.01178.S	uid://A001/X128
<input checked="" type="checkbox"/>	2017.1.01178.S_uid_A001_X1284_X1742	tar	(auxiliary) 135 MB	2017.1.01178.S	uid://A001/X128
<input type="checkbox"/>	member.uid_A001_X1284_X1742	25_27_29_31.cont.l.manual.pbcor.fits	(product) 9 MB	2017.1.01178.S	uid://A001/X128
<input checked="" type="checkbox"/>	member.uid_A001_X1284_X1742.HL_Tau_sci.spw25.cube.l.manual.pbcor.admit.binned16.tgz		(auxiliary, admit) 4 MB	2017.1.01178.S	uid://A001/X128
<input type="checkbox"/>	uid_A002_Xdff8c8_X3ffc_qa2_part3.png		(auxiliary, qa) 6 MB	2017.1.01178.S	uid://A001/X128
<input type="checkbox"/>	member.uid_A001_X1284_X1742.calimage.product.rename.txt		(auxiliary, script) 5 KB	2017.1.01178.S	uid://A001/X128
<input type="checkbox"/>	member.uid_A001_X1284_X1742.scriptForPI.py		(auxiliary, script) 20 KB	2017.1.01178.S	uid://A001/X128
<input checked="" type="checkbox"/>	member.uid_A001_X1284_X1742.HL_Tau_sci.spw25_27_29_31.cont.l.manual.pbcor.admit.tgz		(auxiliary, admit) 1 MB	2017.1.01178.S	uid://A001/X128



Band: 7
Array: 12m

Find This icon



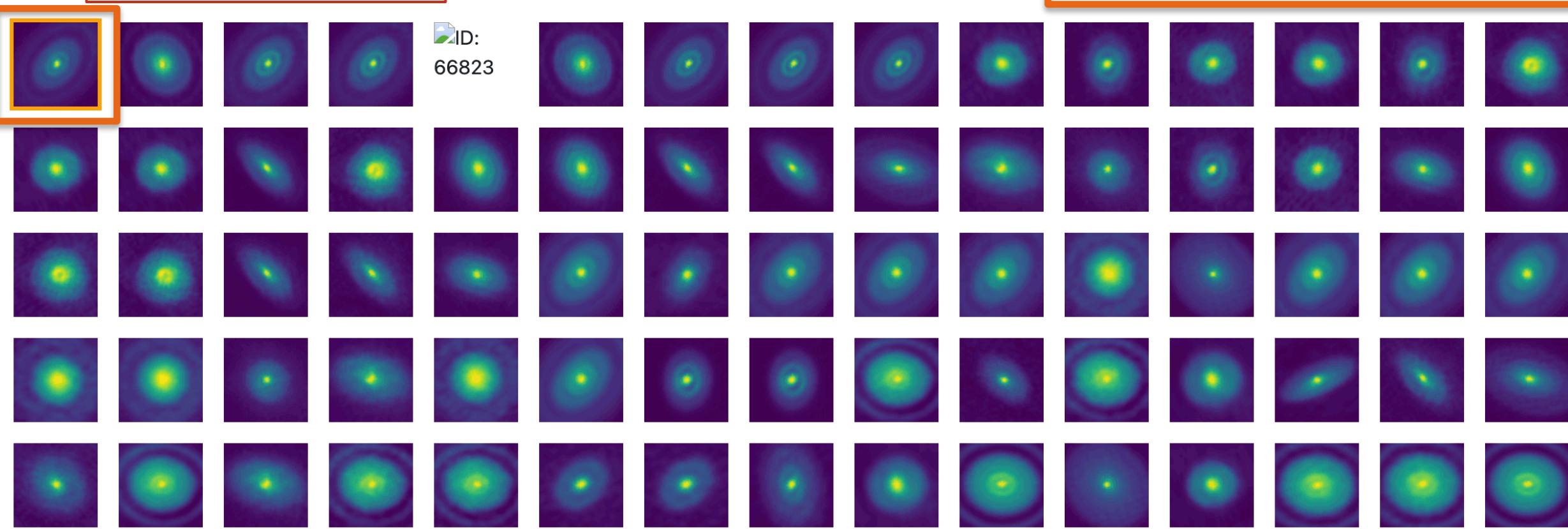
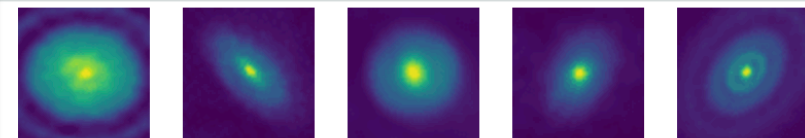
ALMA Archive

Image Morphology Similarity Search

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The chosen target image

Five major types of categories

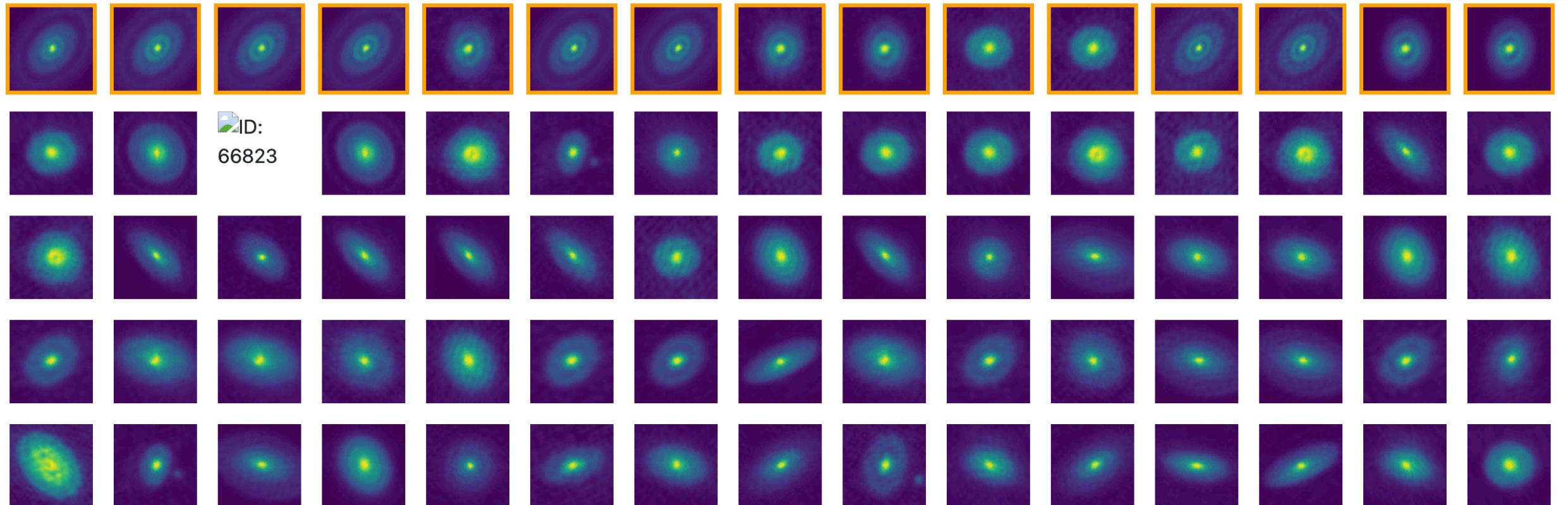
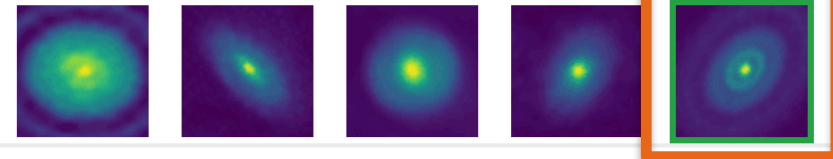


ALMA Archive

Image Morphology Similarity Search

Quickly select a group

member.uid__A001_X1284_X1742.HL_Tau_sci.spw25_27_29_31.cont.l.manual.pbcor.fits



ID:
66823

ALMA Archive

Create download script

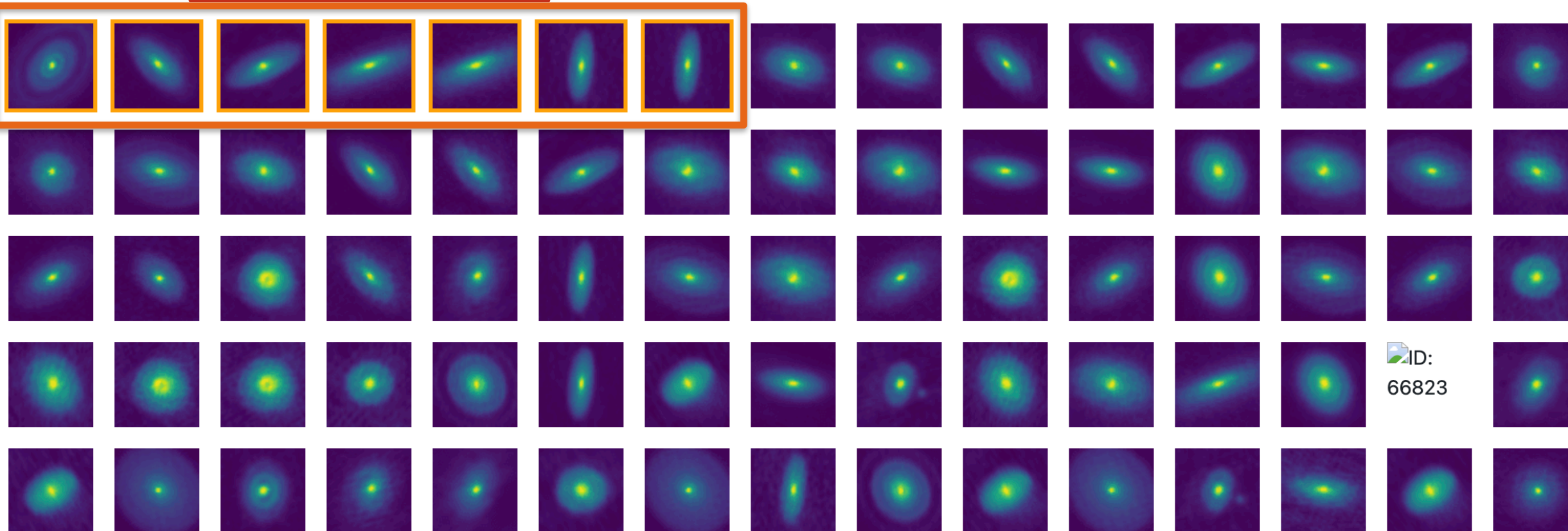
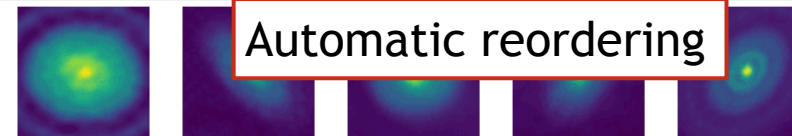
Image Morphology Similarity Search



member.uid__A001_X1284_Y4742_HL_Tex_sci_0025_07_00_01-cent.l.manual.pbcor.fits

Select multiple targets

Automatic reordering



ID:
66823

ALMA Archive

Image Morphology Similarity Search

member.uid__A001_X1284_X1742.HL_Tau_sci.spw25_27_29_31.cont.l.manual.pbcor.fits



ID:
241482

ID:
66823

Download the image

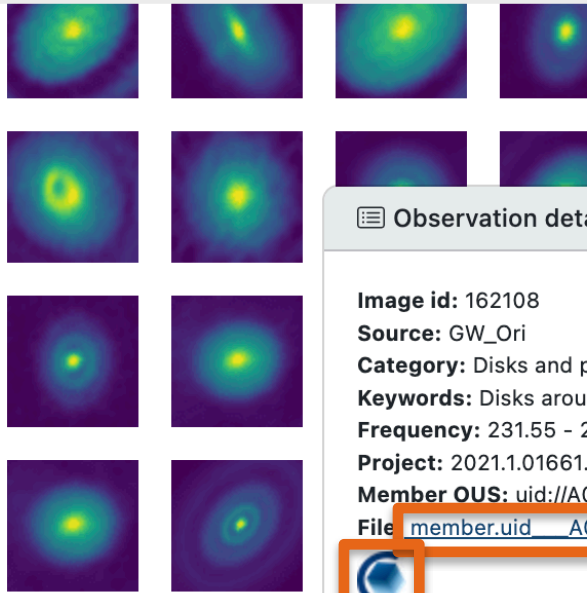
Open in CARTA

Stop your cursor on
the image you like

ALMA Archive

Image Morphology Similarity Search

member.uid__A001_X1284_X1742.HL_Tau_sci.



Observation details

Image id: 162108
Source: GW_Ori
Category: Disks and protoplanets
Keywords: Disks around stars
Frequency: 231.55 - 231.65 GHz
Project: 2021.1.01661.001
Member OUS: uid://ALMA/...
File: member.uid__A001_X1284_X1742.HL_Tau_sci.spw27.mfs.l.selfcal.pbcor.fits

Open in CARTA

WCS: (4:31:38.347, 18:13:57.07); Image: (943, 774); Value: 7.38936e-6 Jy/beam; Polarization: Stokes I

Declination (ICRS) 18:13:57.0

58.0
57.5
56.5
56.0

Right ascension (ICRS) 38.50 38.45 4:31:38.40 38.35

Z Profile

Image Active Region Active Statistic Mean

Value (Jy/beam) 8.00e-1 4.00e-1 0.00e+0

[LSRK] Frequency (GHz) 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Render Configuration

Clip Percentile Custom

Clip min -0.000167397895

Clip max 0.0044968250324

Scaling Square root

Colormap

Invert colormap

Bias / Contrast

Cursor: 7.76e-5 Jy/beam

Image List

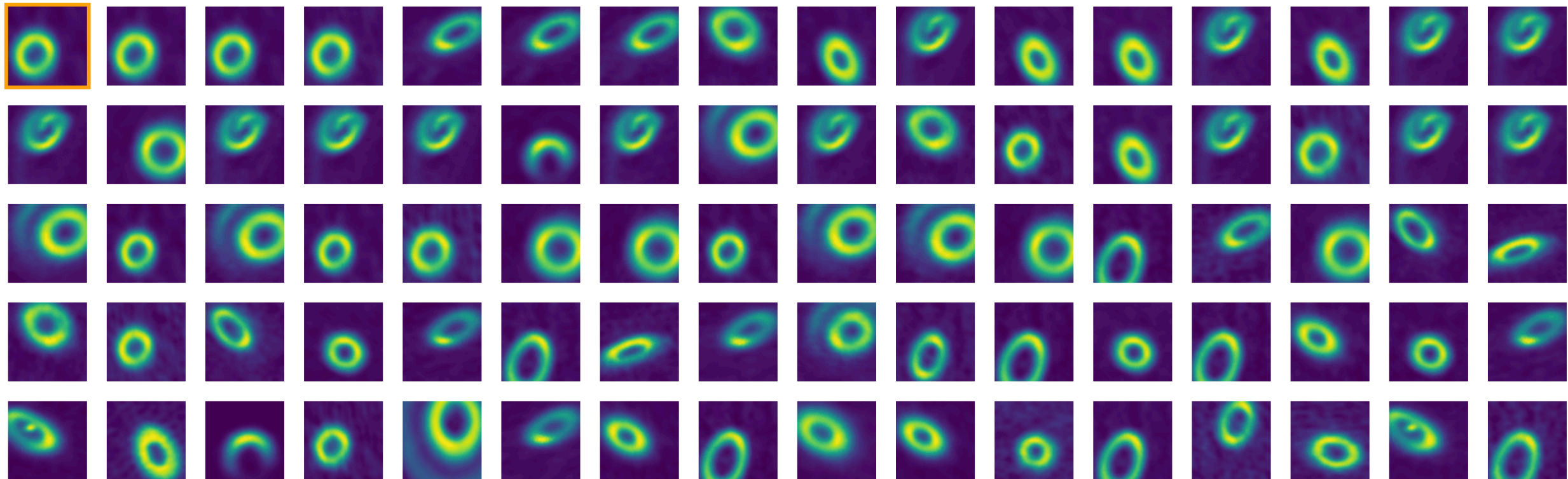
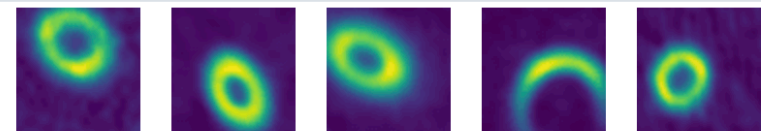
Image	Layers	Matching	Channel	Polarization
0 member.uid__A001_X1284_X1742.HL_Tau_sci.spw27.mfs.l.selfcal.pbcor.fits	R	XY R	0	Stokes I

ALMA Archive

Image Morphology Similarity Search



member.uid__A001_X2f6_X146.HD_100453_sci.spw19_21_25_27_29.cont.l.pbcor.fits

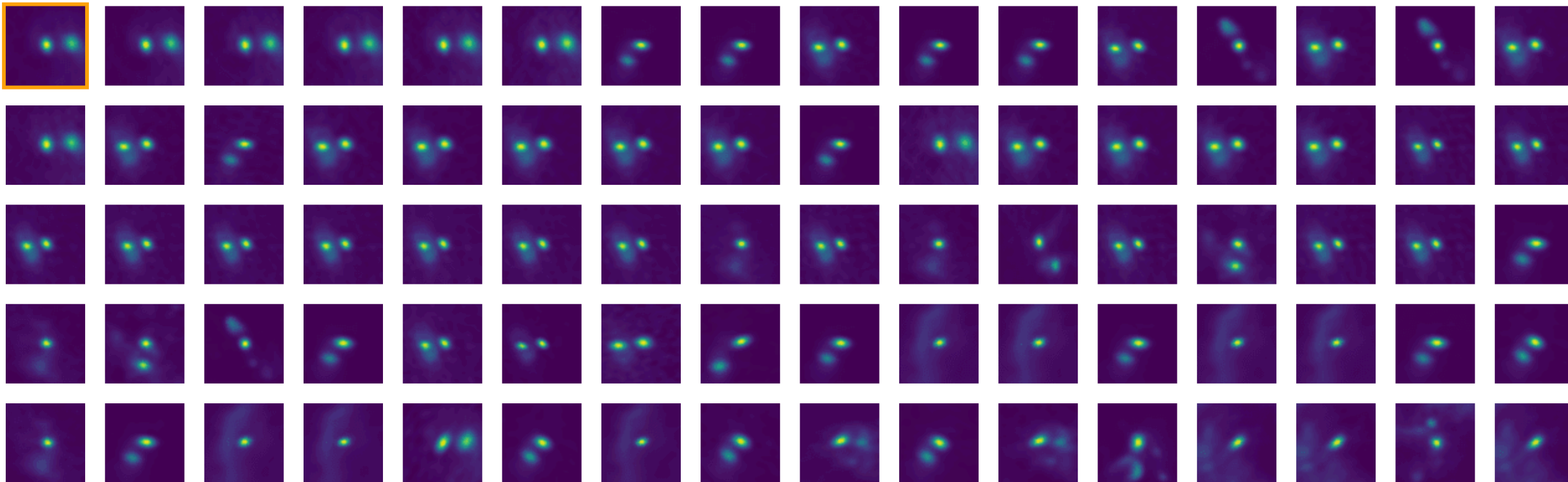
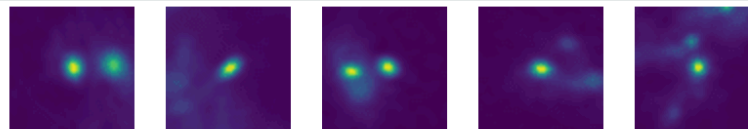


ALMA Archive

Image Morphology Similarity Search



member.uid__A001_X2d20_X2748.SVS13A_sci.spw25_27_29_31_33_35_37_39_41_43.cont.l.pbcor.fits



Thanks for your attention

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the right side of the slide, creating a modern, layered effect. The text is centered horizontally and vertically on the white background.