Charlie Lada's Universe, Past, Present & Future

Alyssa Goodman

with many thanks to Catherine Zucker, João Alves, Tom Robitaille, Curtis Wong, Jonathan Fay & Peter Williams

September 27, 2019, Crete

The Pas

Crete I

The Past

Crete III
Through dark lanes to new stars
Celebrating the career of Prof. Charles Lada
Crete, 23-27 Sep 2019

CO clouds

YSO classes

Clusters

Dust Extinction

SF Laws

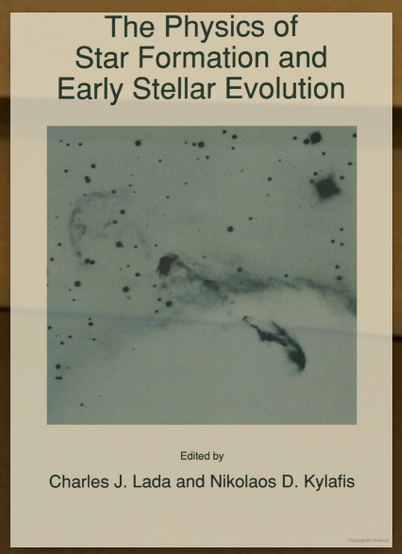
The Past

.Daniele Galli

The Crete-I School that I attended as a student was an extraordinary event that opened up my mind. The Proceedings volume of that School is the most worn-out science book I keep in my office. For all students of my generation, the two complementary reviews, by Charlie on observations, and Frank Shu on theory, were basic references to study over and over again, every time trying to go deeper and deeper.

I am very grateful to Charlie and Nick, among many other things, for making possible such an influential and absolutely unforgettable School.

Crete I



Unforgettable” Past

.Daniele Galli

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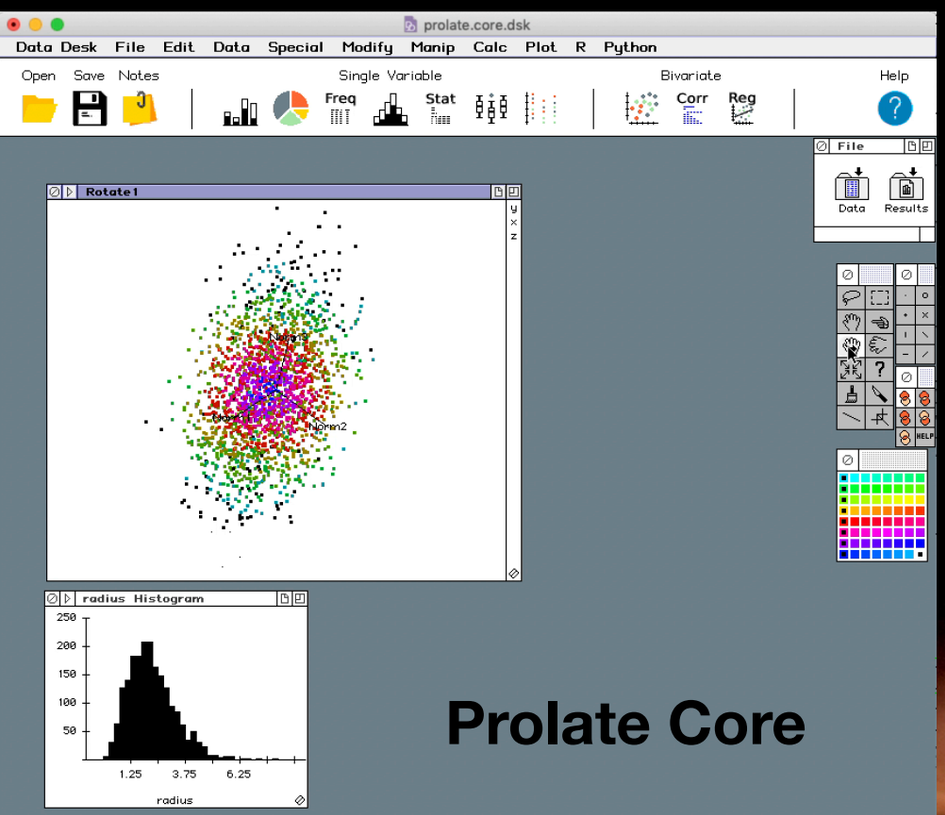
Crete I

Unforgettable” Past



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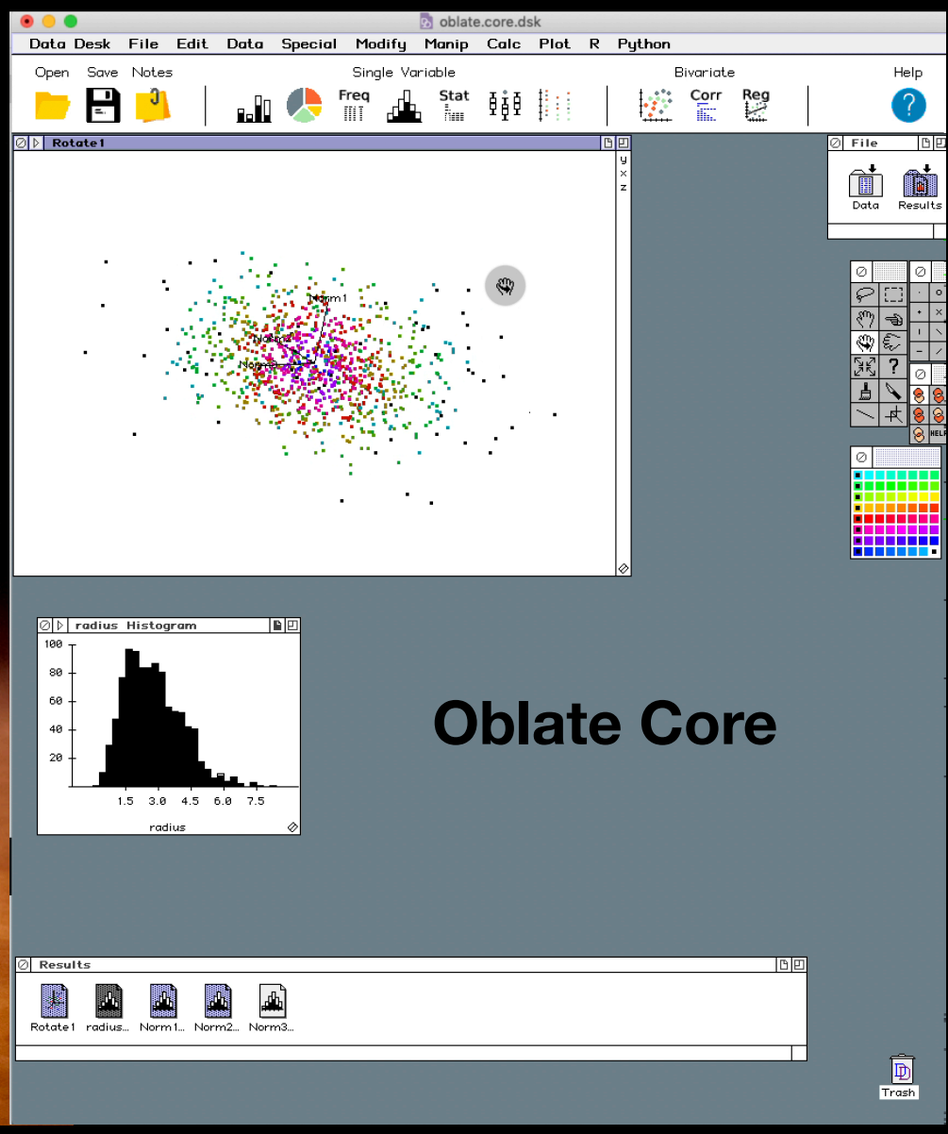

Oblate Core

Crete I

At Present

ads

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- Lombardi, M 40
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1 2019A&A...622A.149G 2019/02 cited: 7
VISION - Vienna survey in Orion. III. Young stellar objects in Orion A
Großschedl, Josefa Elisabeth; Alves, João; Teixeira, Paula S. *and 14 more*

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Gathering dust: A galaxy-wide study of dust emission from cloud

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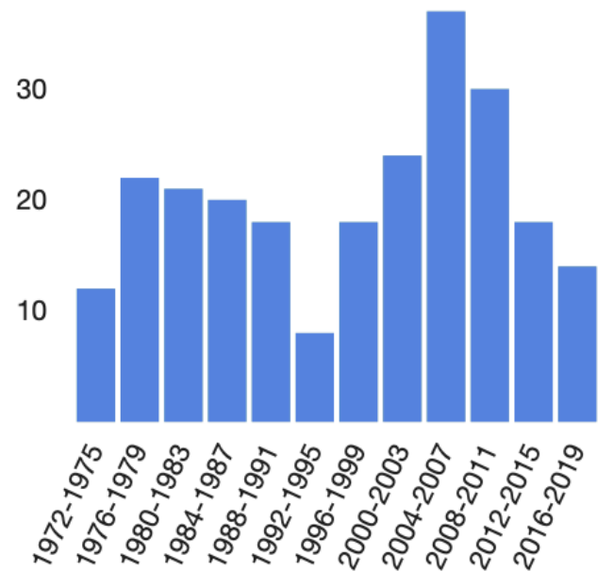

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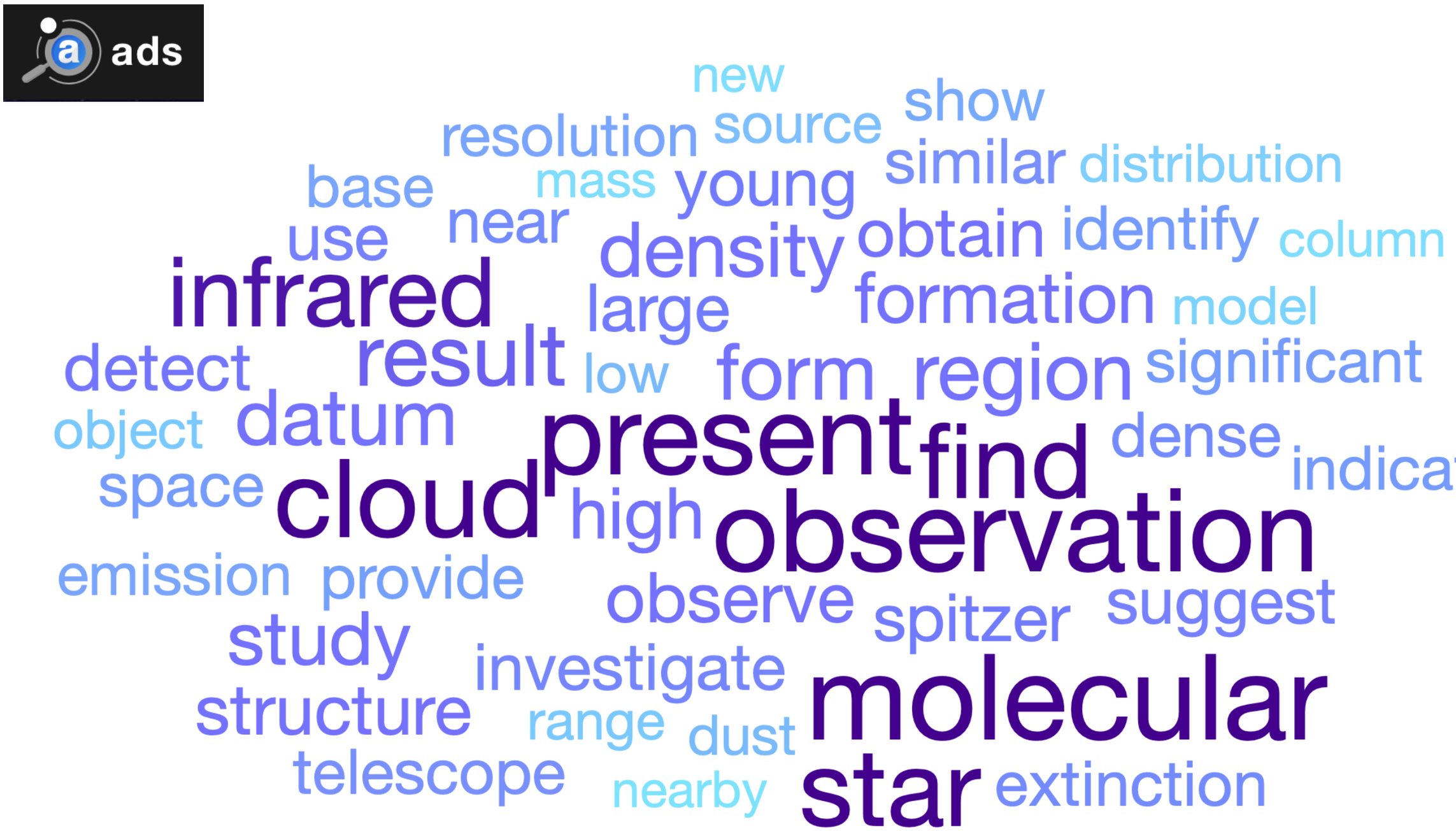
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cloud
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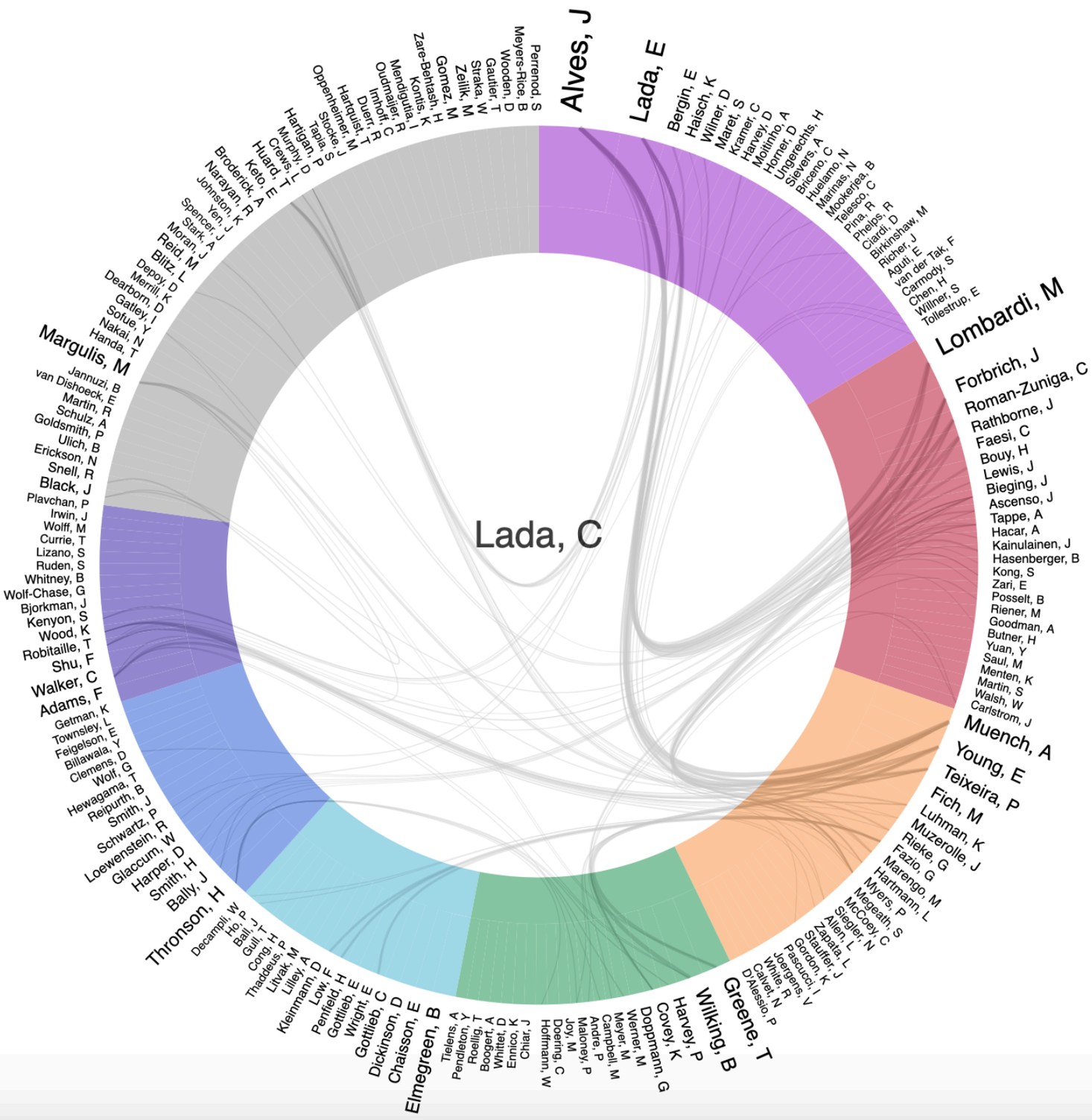
suggest
study
investigate
molecular
structure
range
dust
telescope
nearby
star
extinction

At Present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Covey, K
Doppmann, G
Elmegreen, B
Chaisson, E
Dickinson, D
Gottlieb, C
Wright, E
Gottlieb, D
Penfield, H
Low, F
Kleinmann, D
Lilley, A
Litvak, M
Thaddeus, P
Cong, H
Guill, T
Bally, J
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Harper, D
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Loewenstein, R
Schwarz, P
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Wolf, G
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Feigelson, E
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Adams, F
Walker, C
Shu, F
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Wood, K
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Ruden, S
Lizano, S
Currie, T
Wolff, M
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Black, J
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Sofue, Y
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Pina, R
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Mookerjea, B
Marinas, N
Huelamo, N
Sievers, A
Ungerechts, H
Horner, D
Mottinho, A
Harvey, D
Kramer, C
Maret, S
Wilner, D
Haisch, K
Bergin, E

(I can predict)

The Future

PredictionX: The Past & Present of the Future

Essentials

- **Phenomena →Predictions**
- **Predictive Systems Framework**
- **Understanding Uncertainty**
- **Study Design**
- ▶ **Why Predict?**

Omens, Oracles & Prophecies

- *Mesopotamian Haruspicy*
- *Egyptian Priests*
- *Yoruba Ifa*
- *Tarot*
- *Roman Augury*
- **The Diviner's Guide**
- *Casting Lots*
- *Chinese Oracle Bones*
- *Greek Astronomy*
- *Oracle of Delphi*
- *Turkish Tasseography*
- *Astrology*
- *Aztec Rituals*
- *Maya Spacetime*
- *Comets of Doom*

- ▶ **cross-cultural conversations**

The Rise of Theory

- *Ancient Mesopotamia, Egypt, Greece & Rome*
- *Islamic Science*
- **The Path to Newton**
- ▶ *Indian Mathematics*
- *European Renaissance*
- ▶ *The Royal Society*

- **John Snow & Cholera**
- *Cholera Map*

- **Lost without Longitude (Navigation)**
- *Help, I'm Lost!*
- *Tools of the Navigator*

Modern Simulation

- **Health**
  - ▶ *Epidemiology*
  - ▶ *Personal Genomics*
  - ▶ *Population Genetics*
- **Wealth**
  - ▶ *Personal Finance*
  - ▶ *(Global) Economics*
- **The Future of the Future**
  - ▶ *Artificial Intelligence*
  - *Derek's Day*
- **Earth**
  - ▶ *Climate Change*
  - ▶ *Tent Tarot*
  - ▶ *Earthquakes*
- **Space**
  - *Futures of our Universe*

Finished | Coming Soon | Planned | Interactive Resource | ▶ video(s) | edX link to edX (often contains videos + interactives, not marked separately here)

The Future

Charlie Lada's Universe

ads

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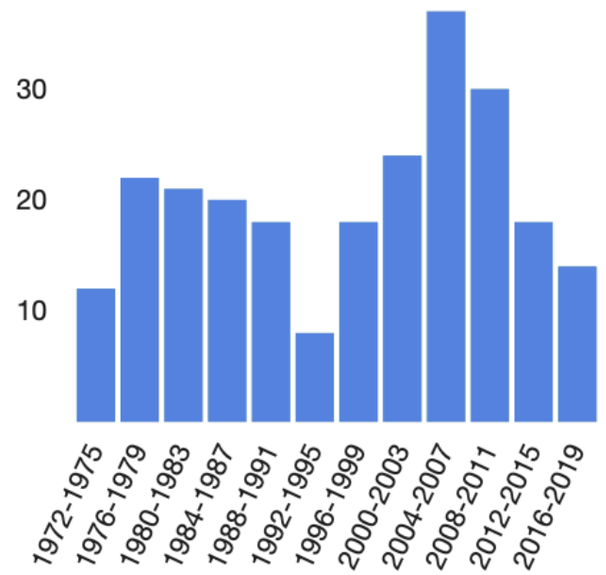

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Charlie Lada's Universe

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SIMBAD query result

other query modes : Identifier query | Coordinate query | Criteria query | Reference query | Basic query | Script submission | TAP | Output options | Help

Query : IdentList submit id C.D.S. - SIMBAD4 rel 1.7 - 2019.09.21CEST15:21:09

Show 100 entries Search:

N	Identifier	*typed ident*	Otype	ICRS (J2000) RA	ICRS (J2000) DEC	Mag U	Mag B	Mag V
1	M 42	*Orion*	HII	05 35 17.3	-05 23 28			
2	NGC 300	*NGC300*	GiG	00 54 53.4460065856	-37 41 03.182962667	8.83	8.69	8.13
3	NAME Mon OB1 G	*NGC2264G*	PoC	06 41 12	+09 55.6			
4	NGC 2264	*NGC2264*	OpC	06 40 58	+09 53.7			3.9
5	IRAS 03407+3152	*HH211*	cor	03 43 56.52	+32 00 52.8			
6	NAME Mon R2	*Mon R2*	HII	06 07 46.6	-06 22 59			
7	IC 5146	*IC 5146*	SFR	21 53 24	+47 16.0		7.82	7.2
8	NAME Taurus Dark Cloud	*Taurus*	SFR	04 41.0	+25 52			
9	NGC 2547	*NGC 2547*	OpC	08 09 52.360	-49 10 35.01			
10	NGC 2362	*NGC 2362*	OpC	07 18 41	-24 57.3			4.1
11	NAME Coalsack Nebula	*Coalsack*	DNe	12 31 19	-63 44.6			

Charlie Lada's Universe

Open Session | Export Session | Import Data | Export Data/Subsets | Terminal

Data Collection

- Major Cloud Catalog
- Maser Catalog (Reid+2014,2016)
- Sagittarius Arm Fit (Reid+2016)
- Tenuous Connections
- Sun
- lada_sources_w_distances

Subsets

- Sagittarius Arm Masers
- Local Arm Masers
- RadWave

Plot Layers - WorldWideTelescope (WWT)

- RadWave (lada_sources_w_distances)
- Local Arm Masers (lada_sources_w_distances
- Sagittarius Arm Masers (lada_sources_w_dist
- lada_sources_w_distances
- Subset 6 (lada_sources_w_distances)

Size | Color

Fixed 5

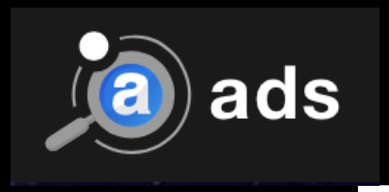
Center view on layer

Plot Options - WorldWideTelescope (WWT)

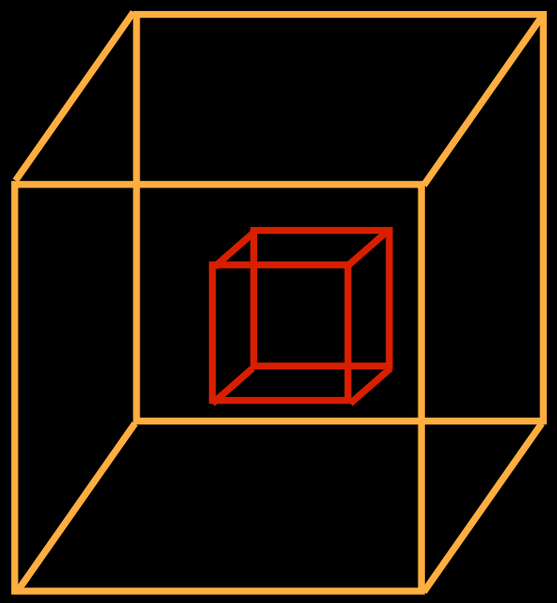
Mode: Sky
Frame: ICRS
RA: RA
Dec: DEC
Foreground: 2Mass: Imagery (Infrared)
Opacity:
Background: IRIS: Improved Reprocessing of IR
Galactic Plane mode

Tab 1

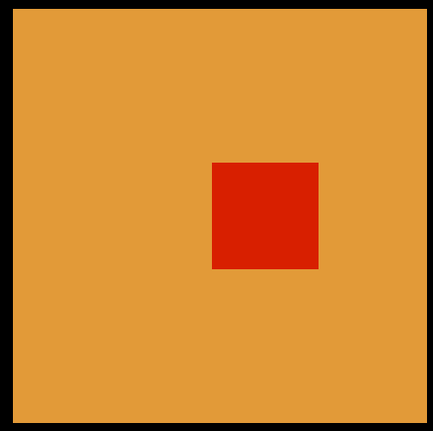
WorldWideTelescope (WWT)



Past ⟶ Present ⟶ Future

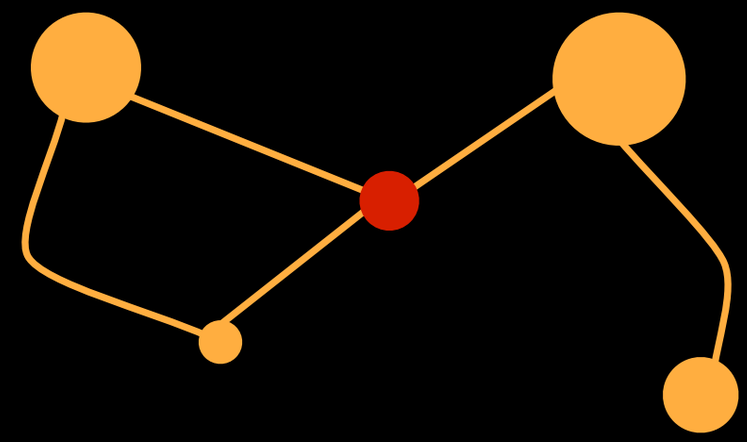


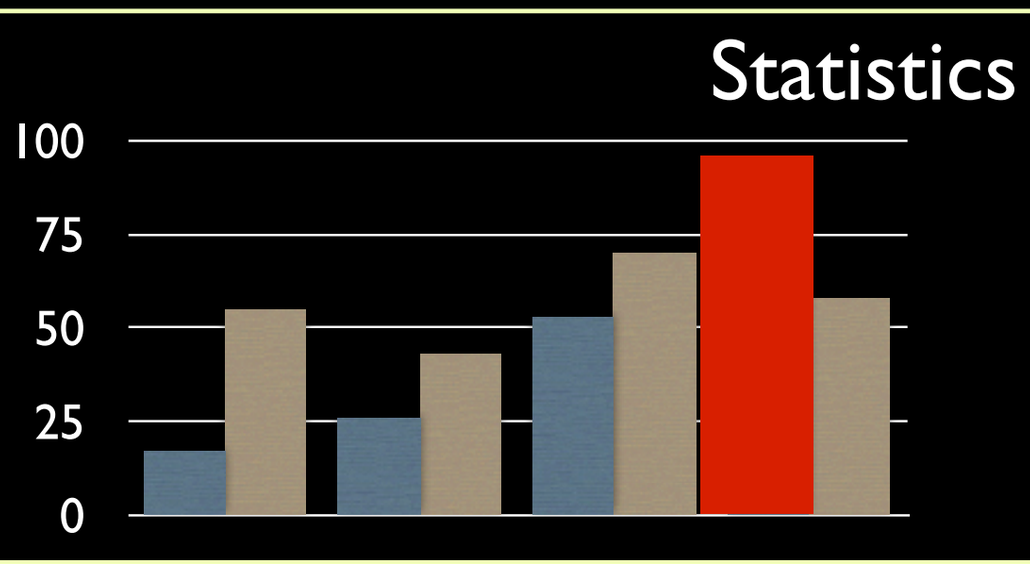
3D



2D

Data Abstraction





Linked views of high-dimensional data

glue
multidimensional data exploration

The Future

DEMO: 4 steps to revealing a wispy veil in 3D

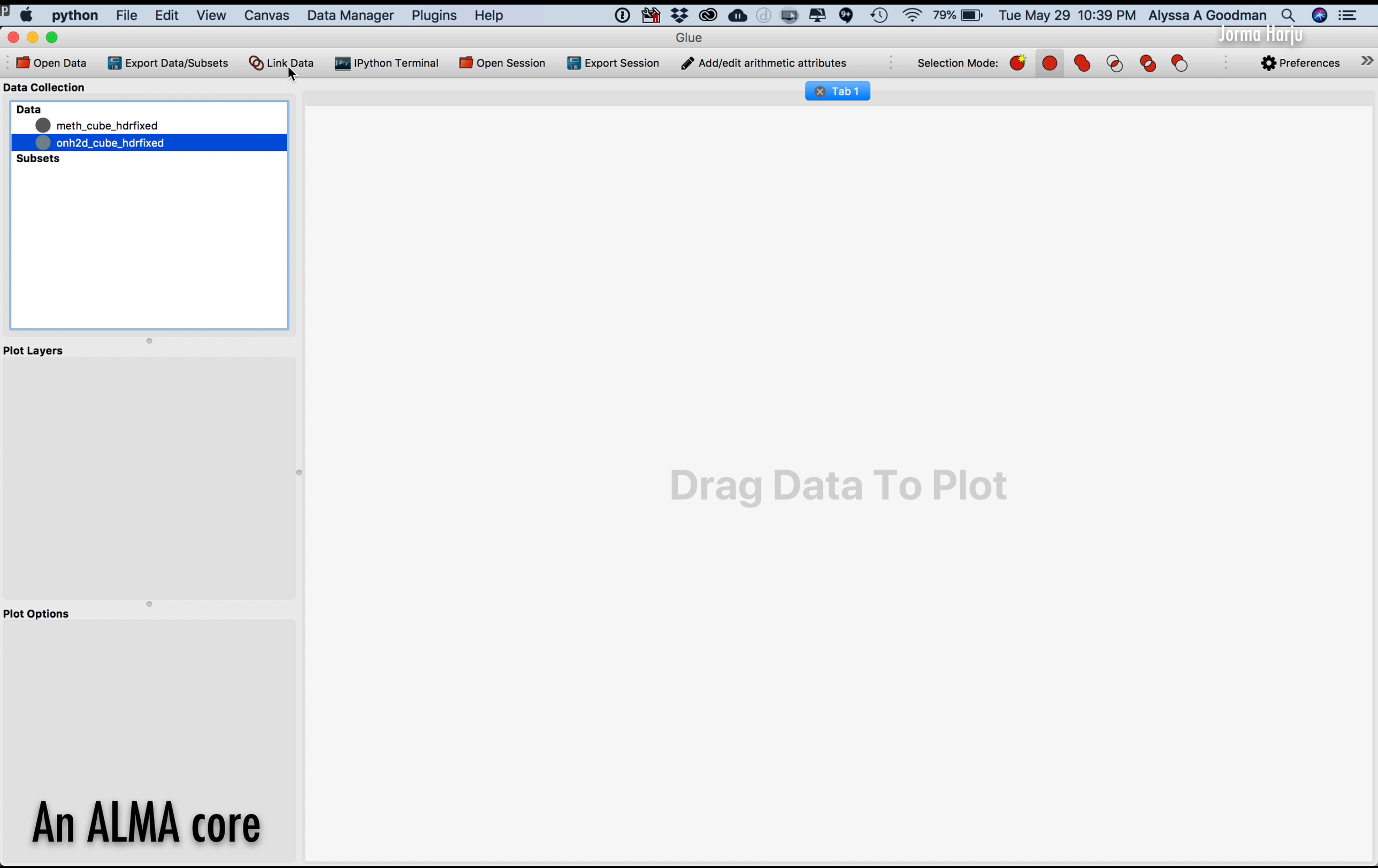
1. "glue" data sets to each other
2. drag data sets to visualize
3. inspect cubes with 2D sliders
4. adjust color
5. inspect cubes as (superimposed) 3D volumes

+ bonus—comparison with traditional views & sliders

sample ALMA (spectral-line) data cubes courtesy of Jorma Harju

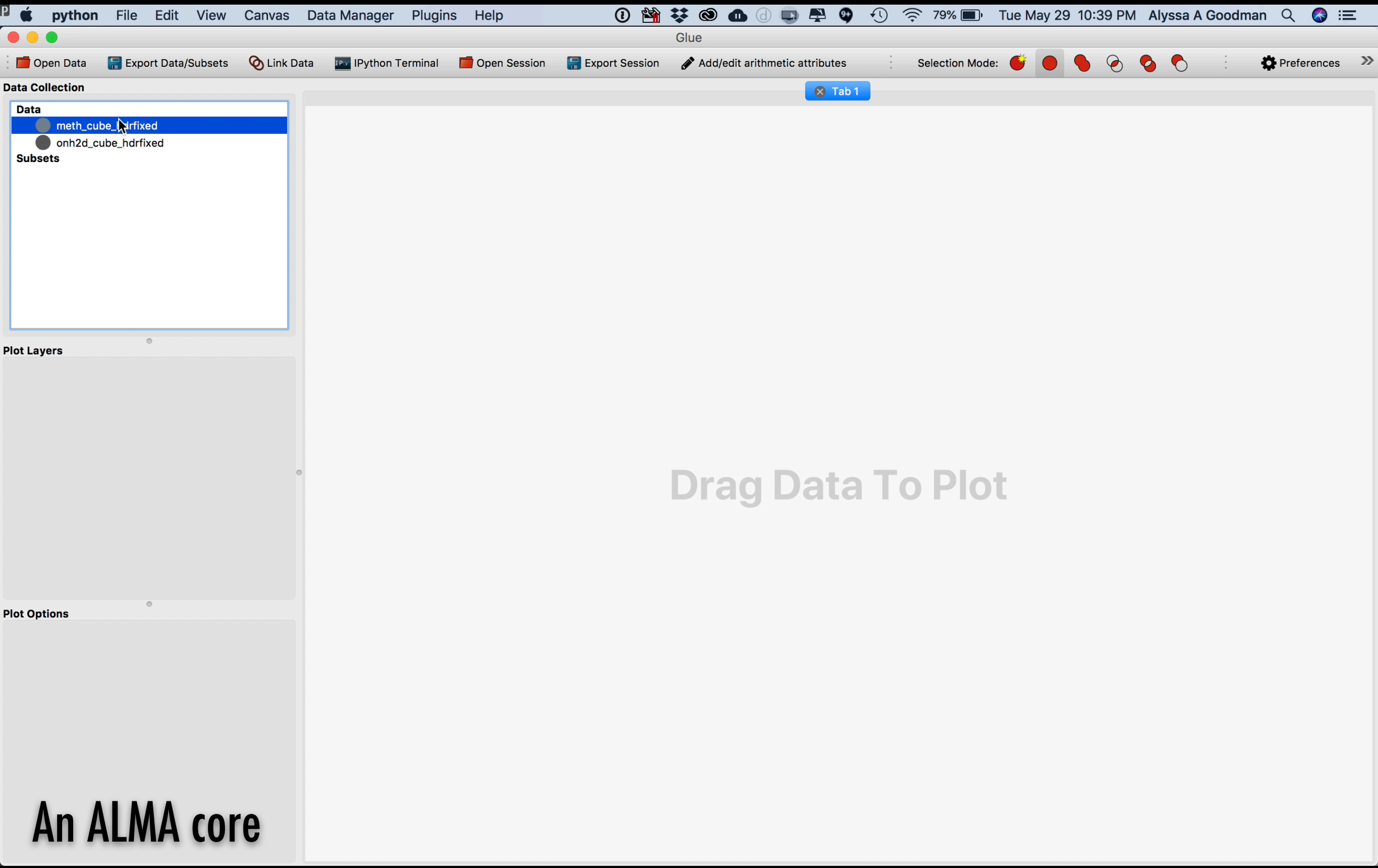
Find out more about glue, and download for free, at glueviz.org

No merging of data sets—just glue them.



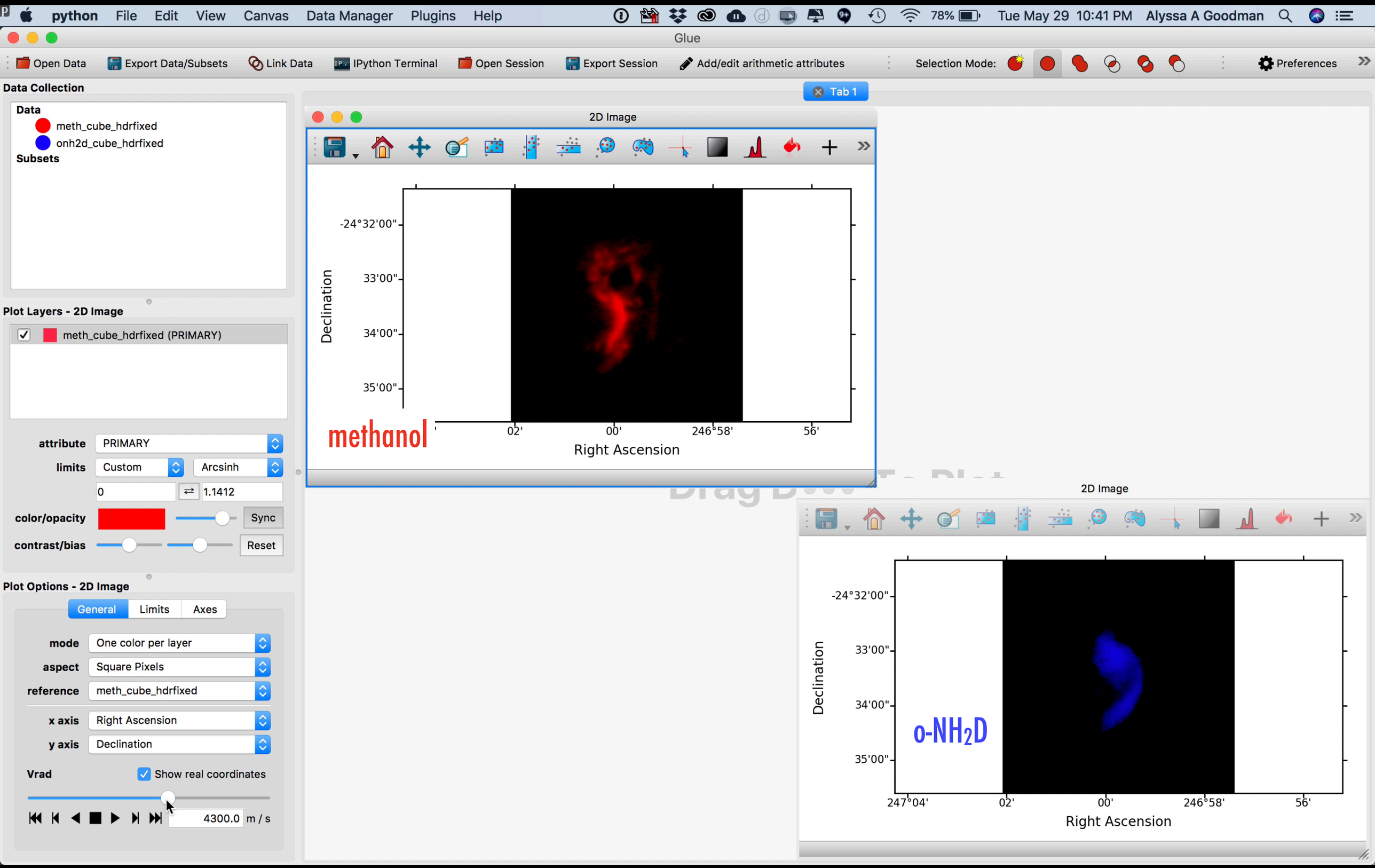
An ALMA core

Just drag to visualize, e.g. series of 2D "channel maps."

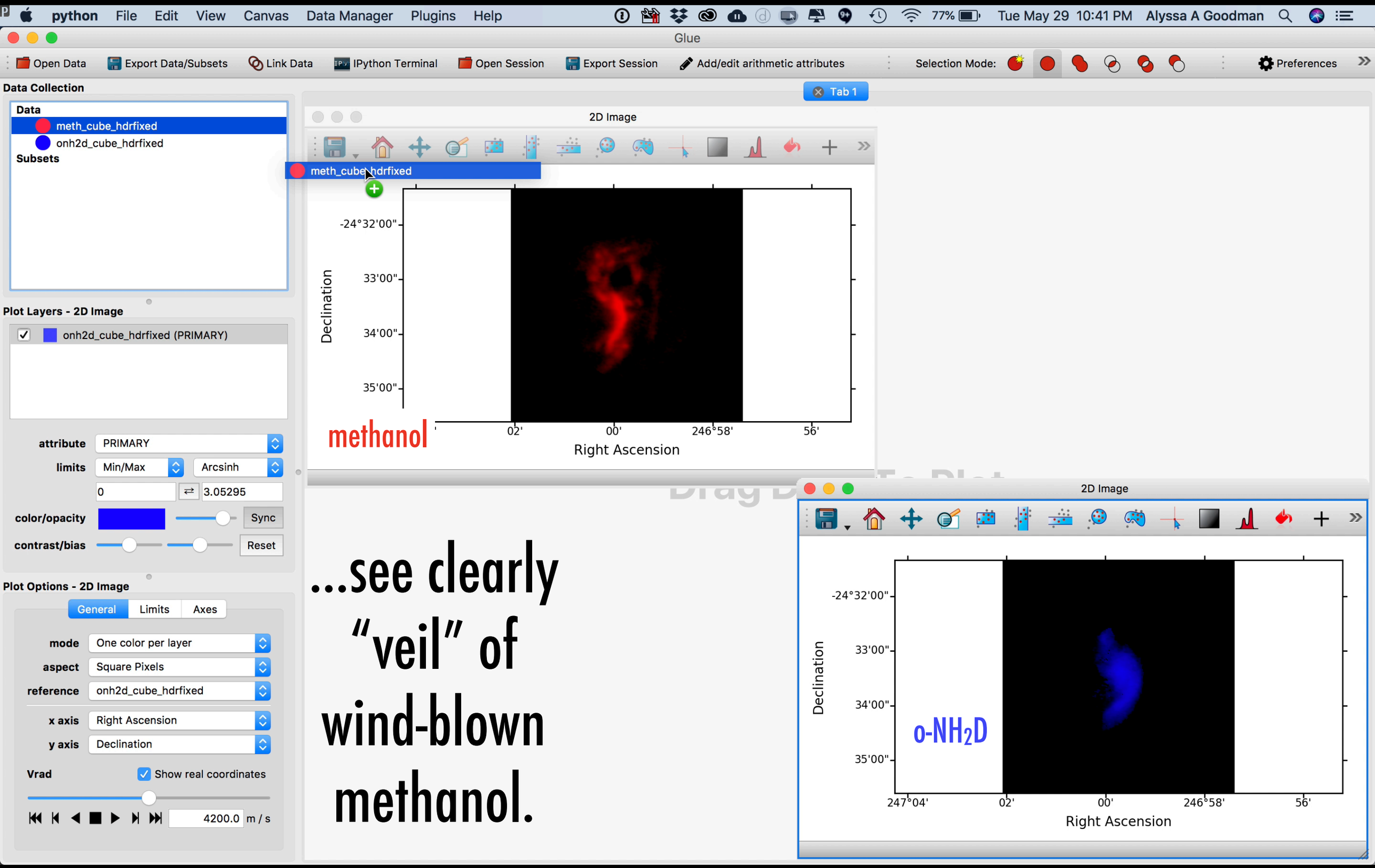


An ALMA core

Adjust so each tracer is a different color.



Create 3D views...

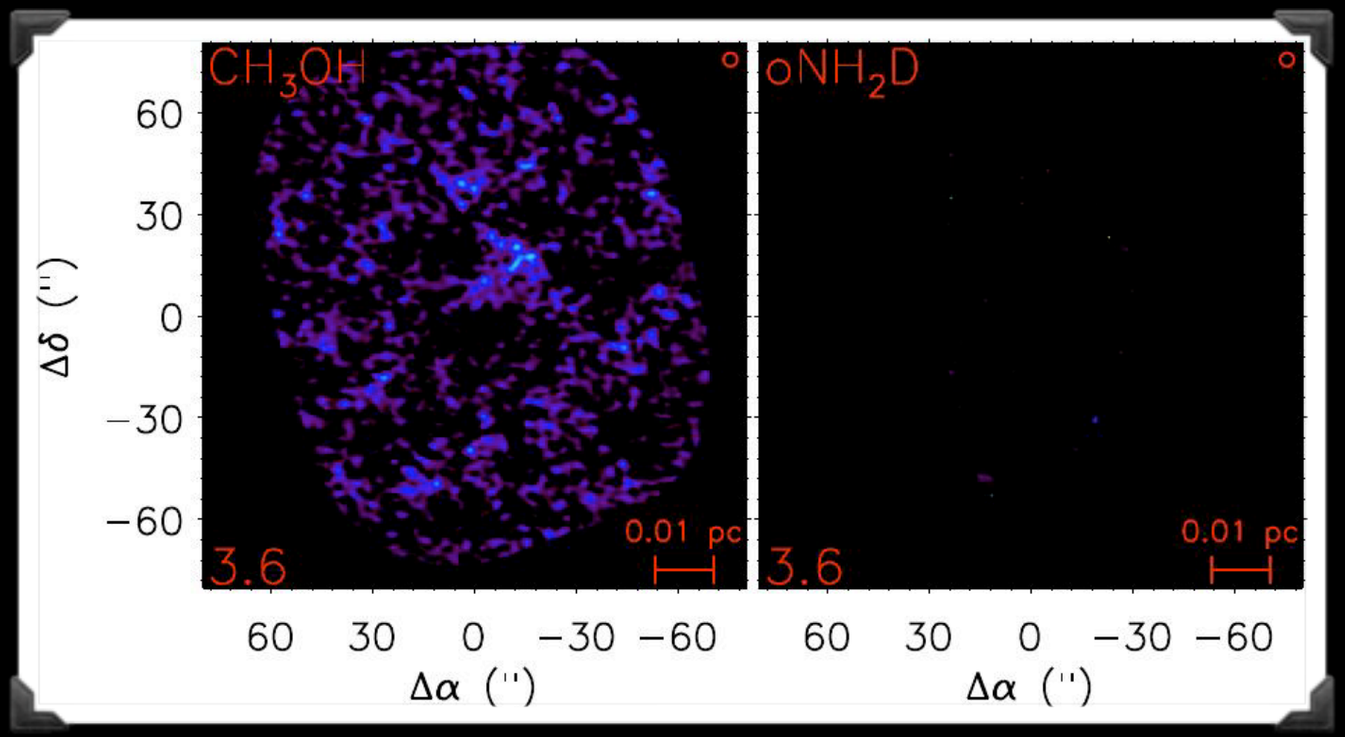


...see clearly "veil" of wind-blown methanol.

COMPARISON

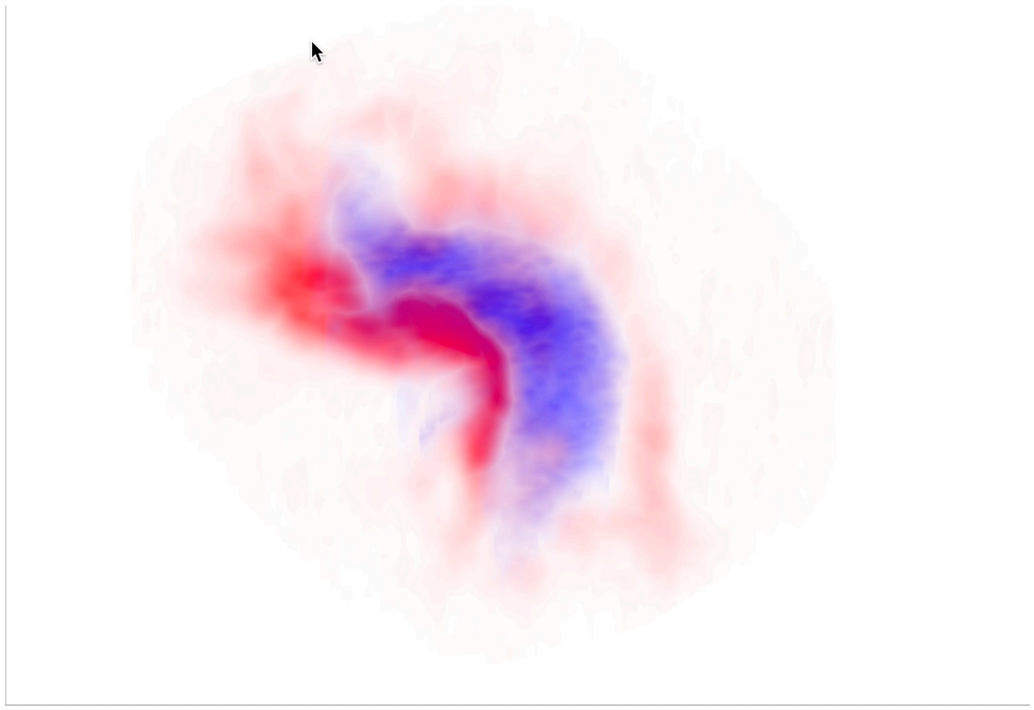
glue

traditional rainbow channel maps



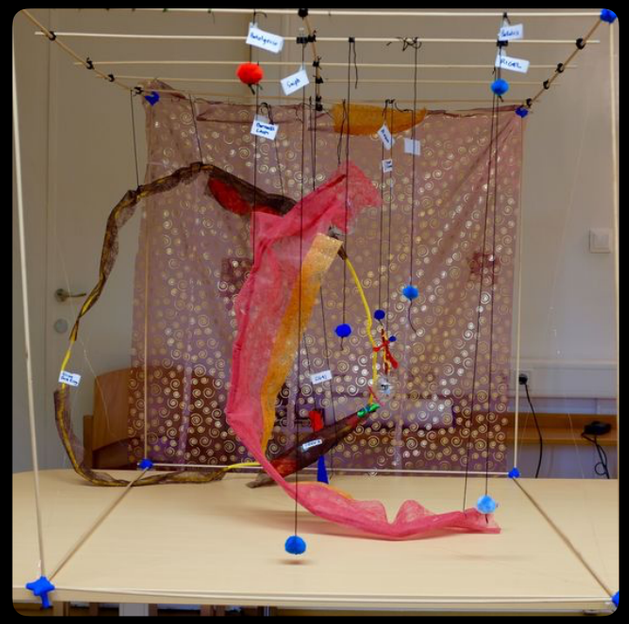
result: happy unicorns

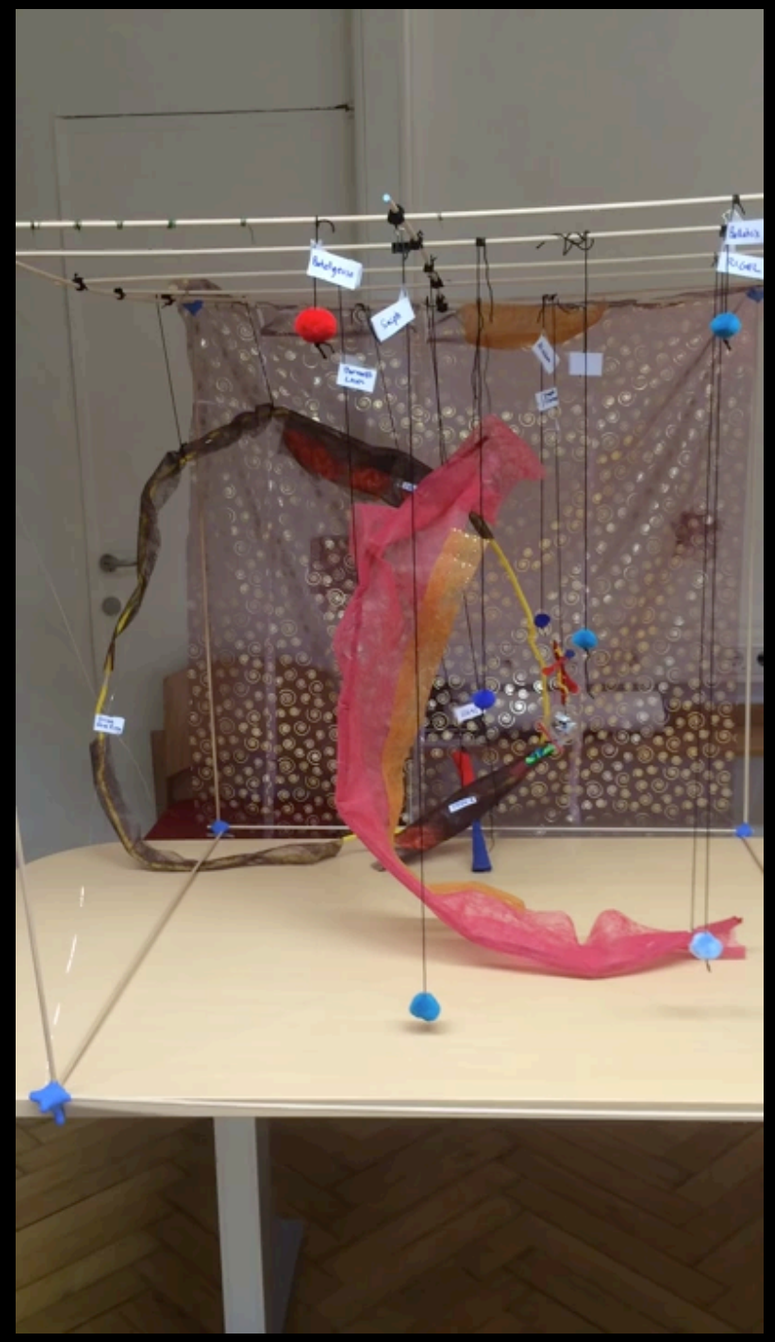
glue volume visualization

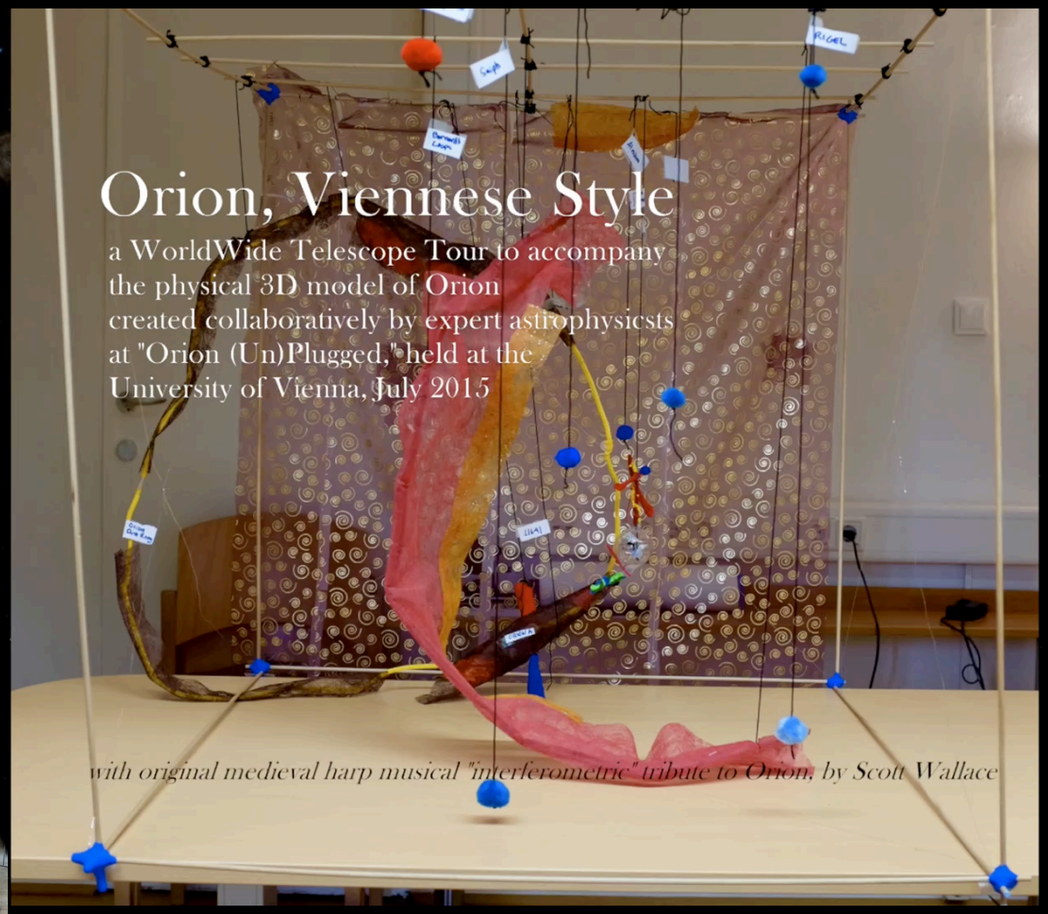


result: previously unknown phenomenon (veil of emission) revealed

VIENN





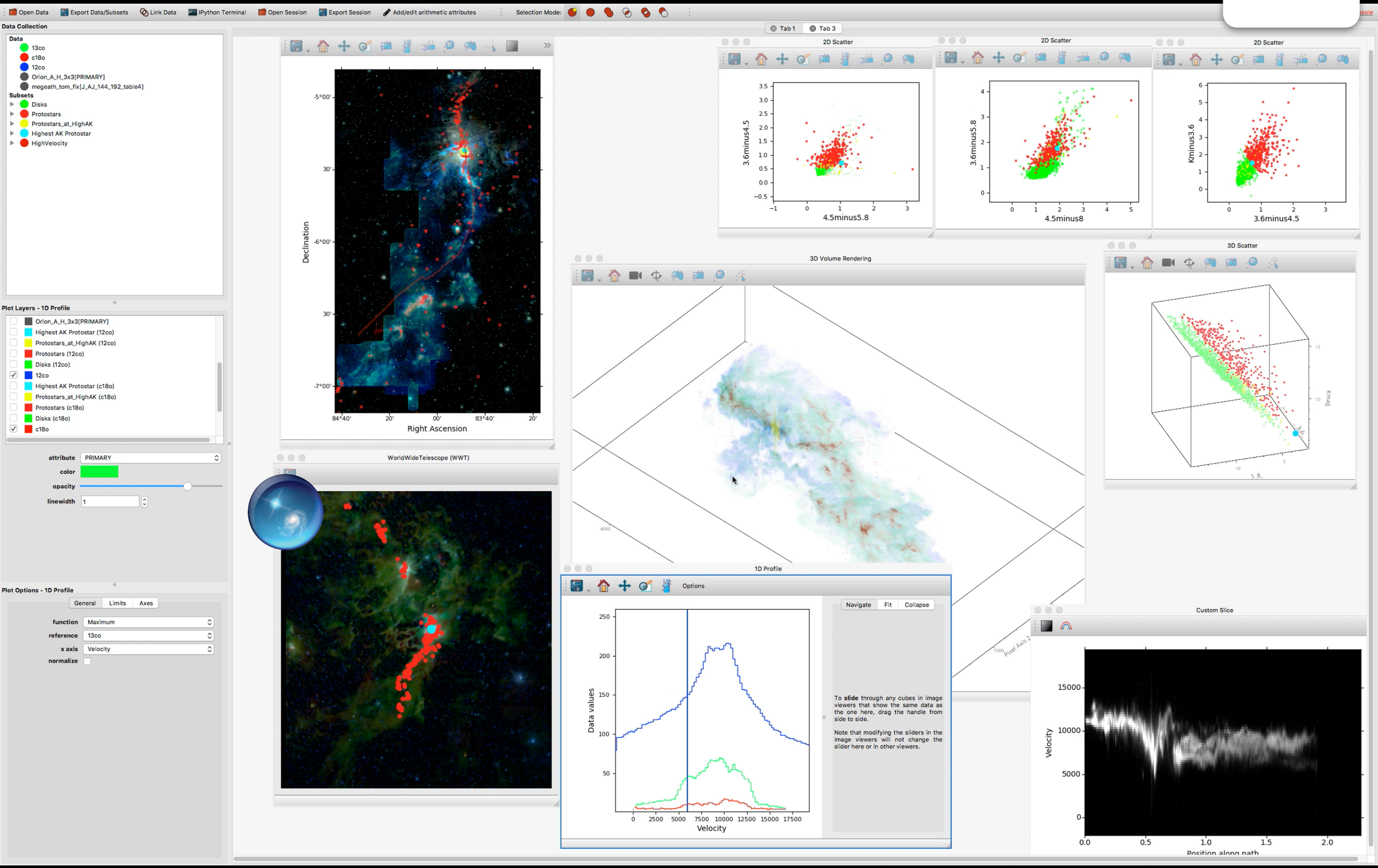


Orion, Viennese Style

a WorldWide Telescope Tour to accompany
the physical 3D model of Orion
created collaboratively by expert astrophysicsts
at "Orion (Un)Plugged," held at the
University of Vienna, July 2015

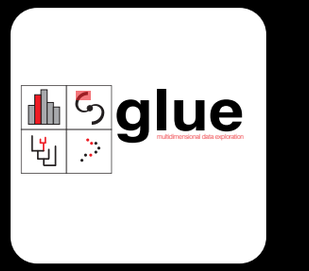
with original medieval harp musical "interferometric" tribute to Orion, by Scott Wallace

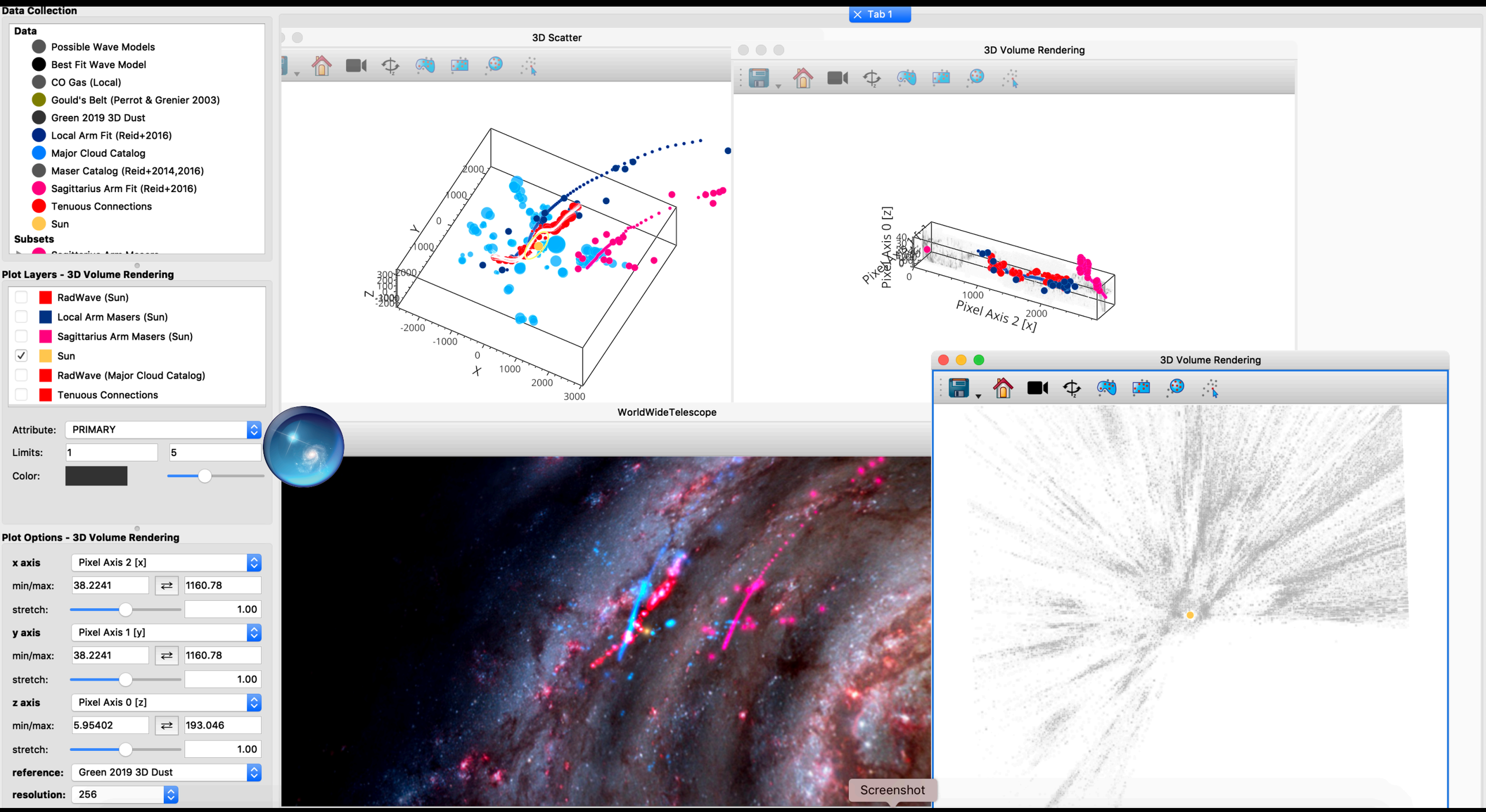
The Future



Data: CARMA-ORION (cubes), VISION survey (images), Alvaro Hacar (ALMA), Megeath catalog; demo online via Seamless Astronomy web site

he “Radcliffe” Wave

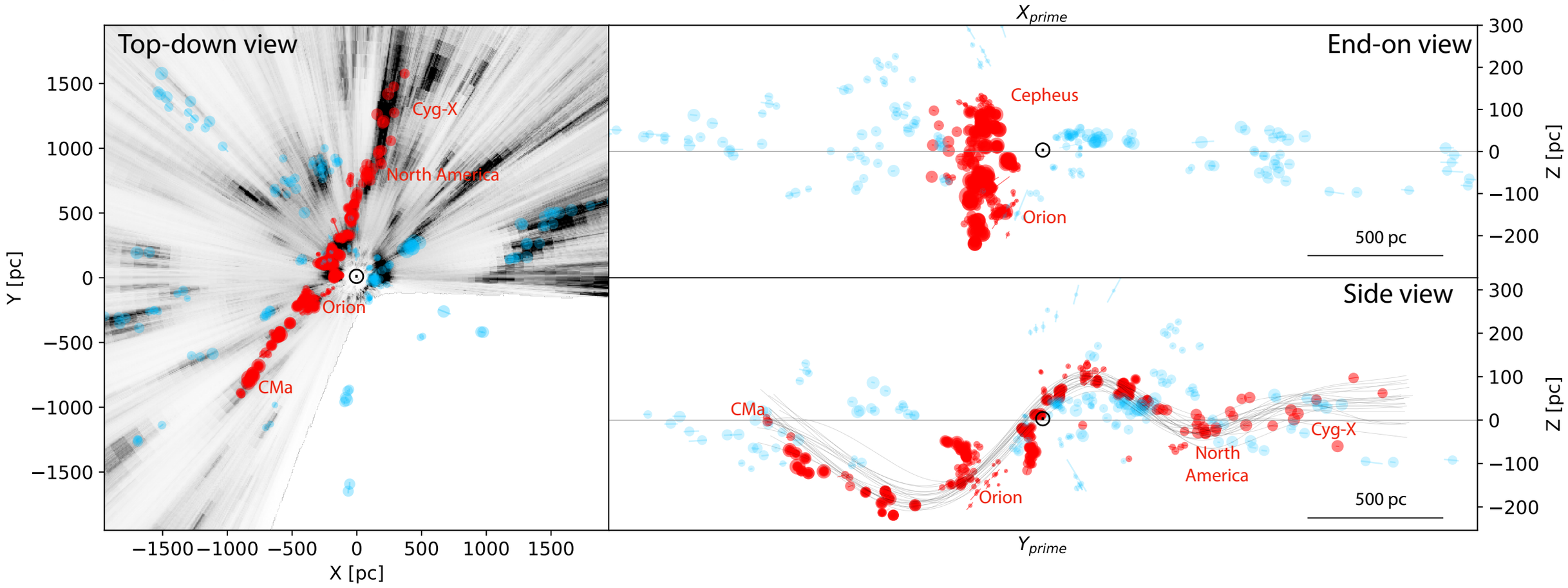




glue: glueviz.org WorldWide Telescope: worldwidetelescope.org

he “Radcliffe” Wave

(embargoed, please do not distribute)

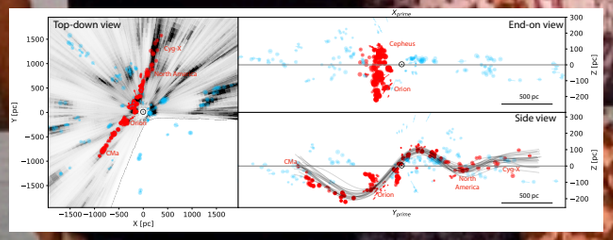


João Alves, Catherine Zucker, Alyssa Goodman, Joshua Speagle, Stefan Meingast, Thomas Robitaille, Douglas Finkbeiner, Edward F. Schlafly, and Gregory Green 2019,
Nature (soon, we hope)

Table 3: Physical Properties of the Radcliffe Wave

Name	Median with 95% CI
Length	2.7 ± 0.2 kpc
Scatter	60 ± 15 pc
Amplitude	160 ± 30 pc
Mass	$\geq 3 \times 10^6$ $M_\odot$

The Future



Crete III++

Astronomy Picture of the Day

Discover the cosmos! Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2019 September 25

apod.nasa.gov/apod/ap190925.html

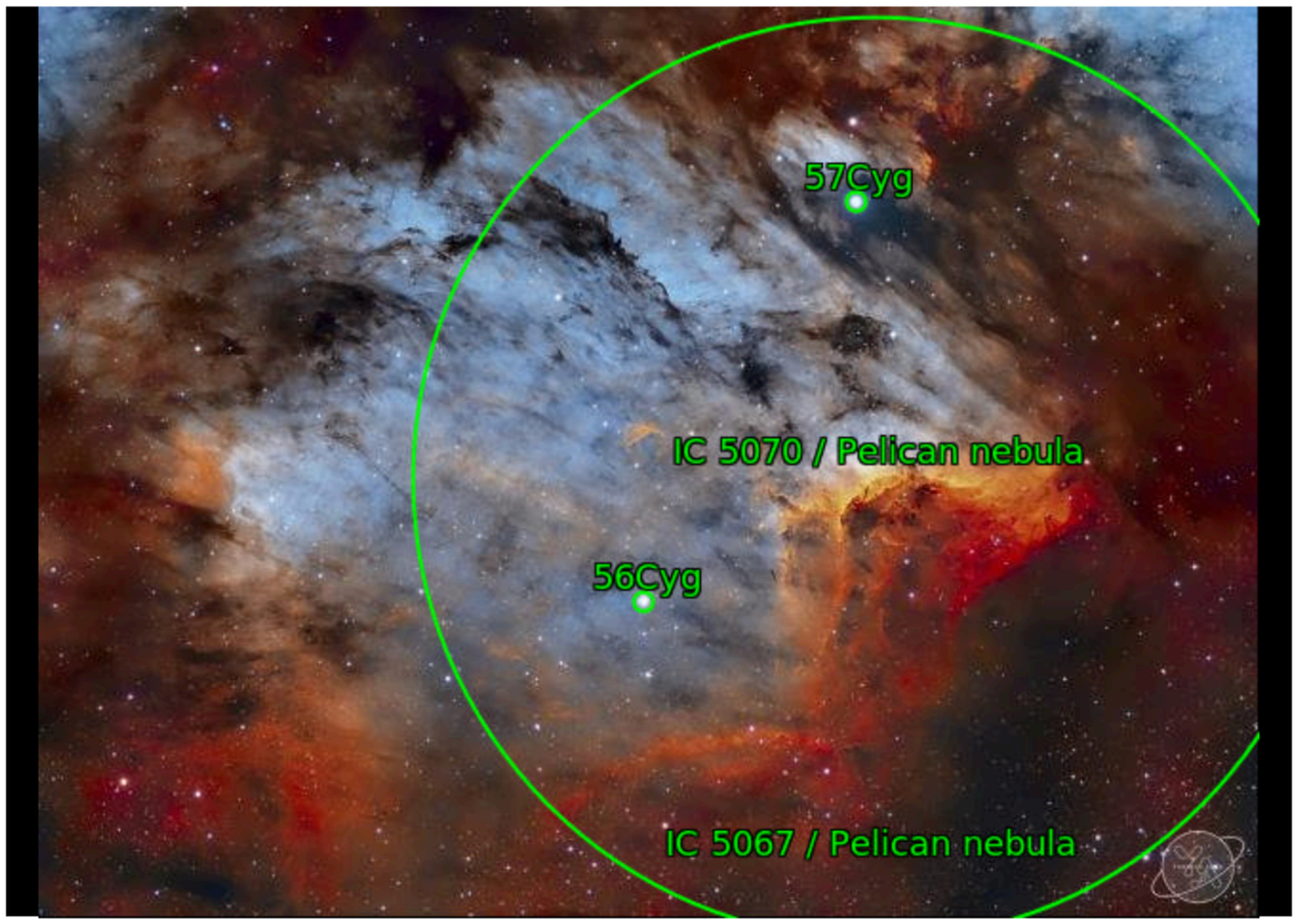
The Pelican Nebula in Gas, Dust, and Stars
Image Credit & Copyright: Yannick Akar

Explanation: The Pelican Nebula is slowly being transformed. IC 5070, the official designation, is divided from the larger North America Nebula by a molecular cloud filled with dark dust. The Pelican, however, receives much study because it is a particularly active mix of star formation and evolving gas clouds. The featured picture was produced in three specific colors -- light emitted by sulfur, hydrogen, and oxygen -- that can help us to better understand these interactions. The light from young energetic stars is slowly transforming the cold gas to hot gas, with the advancing boundary between the two, known as an ionization front, visible in bright orange on the right. Particularly dense tentacles of cold gas remain. Millions of years from now this nebula might no longer be known as the Pelican, as the balance and placement of stars and gas will surely leave something that appears completely different.

NOTE: signins should be working again... but read about account migration. Not signed in | Sign In

Astrometry.net

Images > Pelican_Akar_4554.jpg



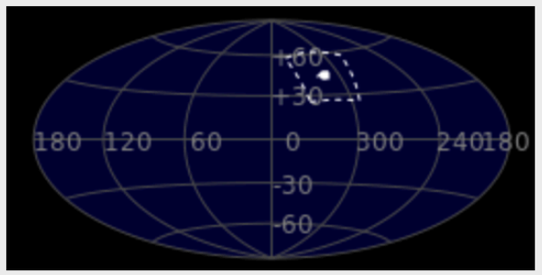
Submitted by (1)
on *2019-09-25T09:04:44Z*
as " Pelican_Akar_4554.jpg "
(Submission 2942576)
under *Attribution 3.0 Unported*

Job Status

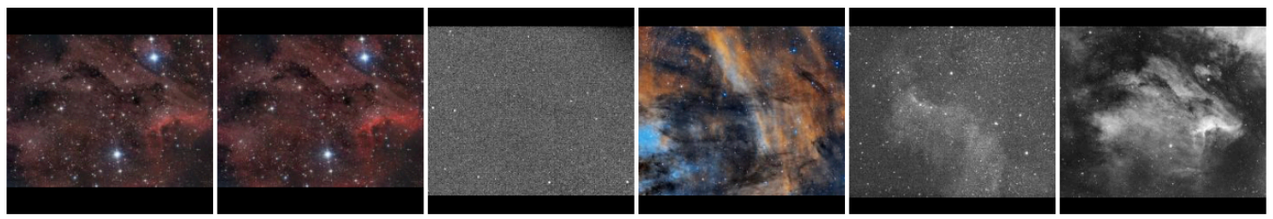
Job 3628789:
Success

Calibration

Center (RA, Dec):	(312.801, 44.074)
Center (RA, hms):	$20^h\ 51^m\ 12.352^s$
Center (Dec, dms):	+44° 04' 25.778"
Size:	1.76 x 1.32 deg
Radius:	1.099 deg
Pixel scale:	1.39 arcsec/pixel
Orientation:	Up is 272 degrees E of N
WCS file:	wcs.fits
New FITS image:	new-image.fits
Reference stars nearby (RA,Dec table):	rdls.fits
Stars detected in your images (x,y table):	axy.fits
Correspondences between image and reference stars (table):	corr.fits
KMZ (Google Sky):	image.kmz
World Wide Telescope:	view in WorldWideTelescope



Nearby Images (View All)

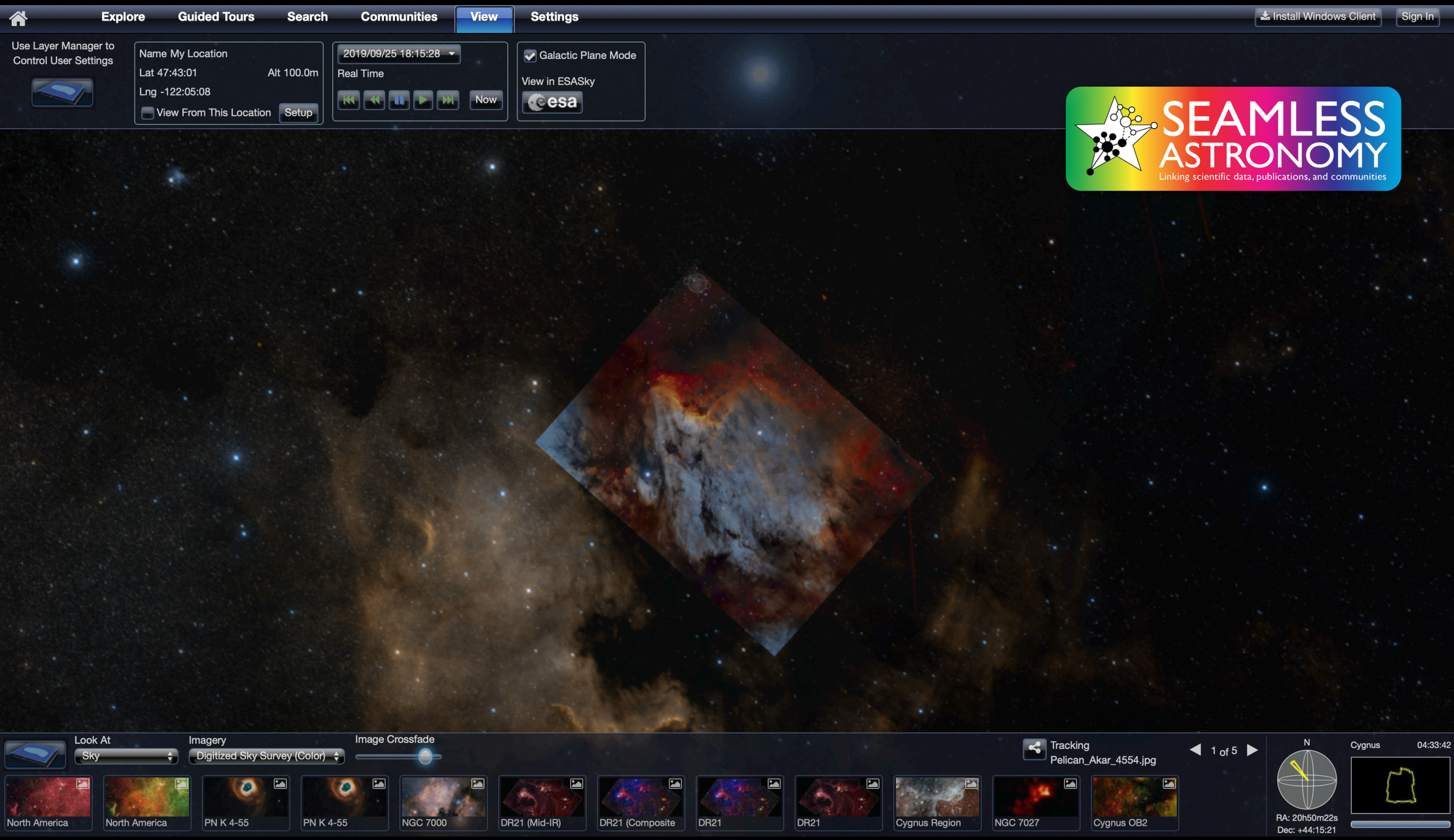


Comments

No comments.

Please Sign In to post comments.

Present: APOD in WWT



Future: (all of) ADS in WWT

The Futur

AUTHOREA 3 SIGN UP

20 VIEWS · 1 DOWNLOAD

Harvard-Smithsonian Center for Astrophysics (CFA) · Harvard University · UCLA - University of California, Los Angeles · Authorea Team · North Carolina State University · Space Telescope Science Institute · UCLA GSEIS

The "Paper" of the Future

Alyssa Goodman (Harvard University)
Josh Peek (Space Telescope Science Institute)
Alberto Accomazzi (Harvard-Smithsonian Center for Astrophysics (CFA))
Chris Beaumont (Harvard-Smithsonian Center for Astrophysics (CFA))
Christine L. Borgman (UCLA - University of California, Los Angeles)
Hope How-Huan Chen (Harvard University)
Merce Crosas (Harvard University)
Christopher Erdmann (North Carolina State University)
And 3 more...

Cite as: Alyssa Goodman, Josh Peek, Alberto Accomazzi, et al. The "Paper" of the Future. *Authorea.* February 21, 2017. **DOI:** https://doi.org/10.22541/au.148769949.92783646 Download citation

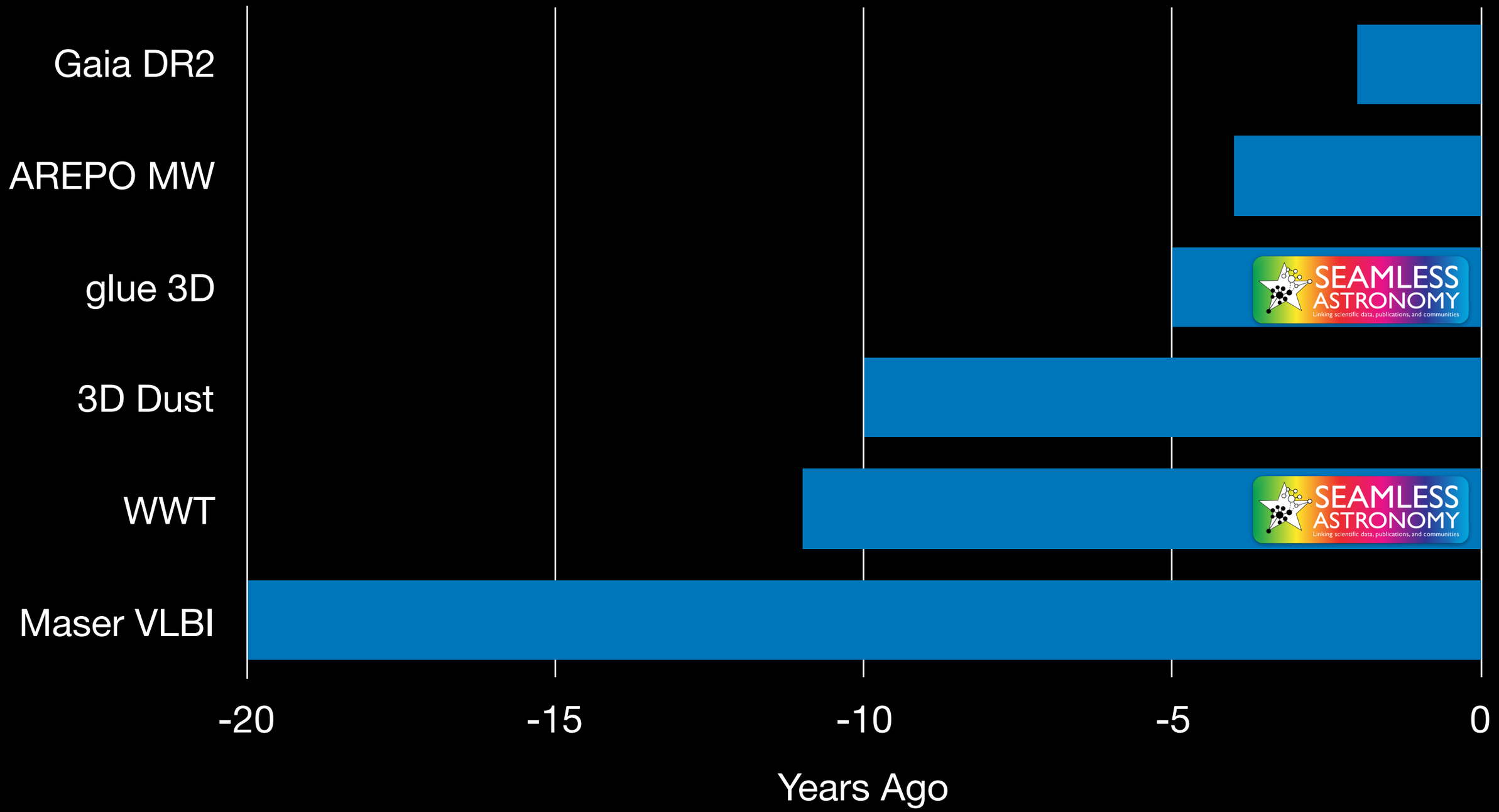
A 5-minute video demonstration of this paper is available at this YouTube link.

1 Preamble

A variety of research on human cognition demonstrates that humans learn and communicate best when more than one processing system (e.g. visual, auditory, touch) is used. And, related research also shows that, no matter how technical the material, most humans also retain and process information best when they can put a narrative "story" to it. So, when considering the future of scholarly communication, we should be careful not to do blithely away with the linear narrative format that articles and books have followed for centuries: instead, we should

Interactive Figures
Data-rich Literature
Code “in” Papers
Plug-n-Play Software

How/why is Catherine Zucker's thesis possible now?



GIFT CERTIFICATE

glue
multidimensional data exploration

ESPECIALLY FOR: Charlie Lada

COMPLIMENTS OF: Alyssa, Tom, Catherine & João

AUTHORIZED SIGNATURE: _____

EXPIRATION DATE: Soon!!!

CERTIFICATE NO: 5146

GIFT CERTIFICATE

WorldWide Telescope

ESPECIALLY FOR: Charlie Lada

COMPLIMENTS OF: Alyssa & Curtis Wong

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EXPIRATION DATE: Soon!!!

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h thanks to our sponsors…

glue

multidimensional data exploration

glueviz.org

built-in

standard data loaders

Data File 1

Data File 2

Data File N

define new variables, import/export insights, interactive plots for the web, save state, all from GUI

link data files' attributes

highlight live or algorithmic selections with Boolean logic

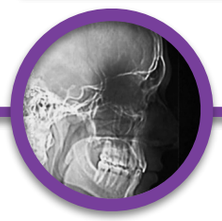
standard 1D, 2D & 3D plots

plug-in

custom data loaders

custom buttons, features

custom plots



?

+options

user config.py file (loaders, colors, plot types, +)

access to all matplotlib functions through built-in IPython terminal

run & interact with glue from Jupyter environments & other tools

MENU

TEN QUESTIONS TO ASK WHEN CREATING A VISUALIZATION

The 10 Questions

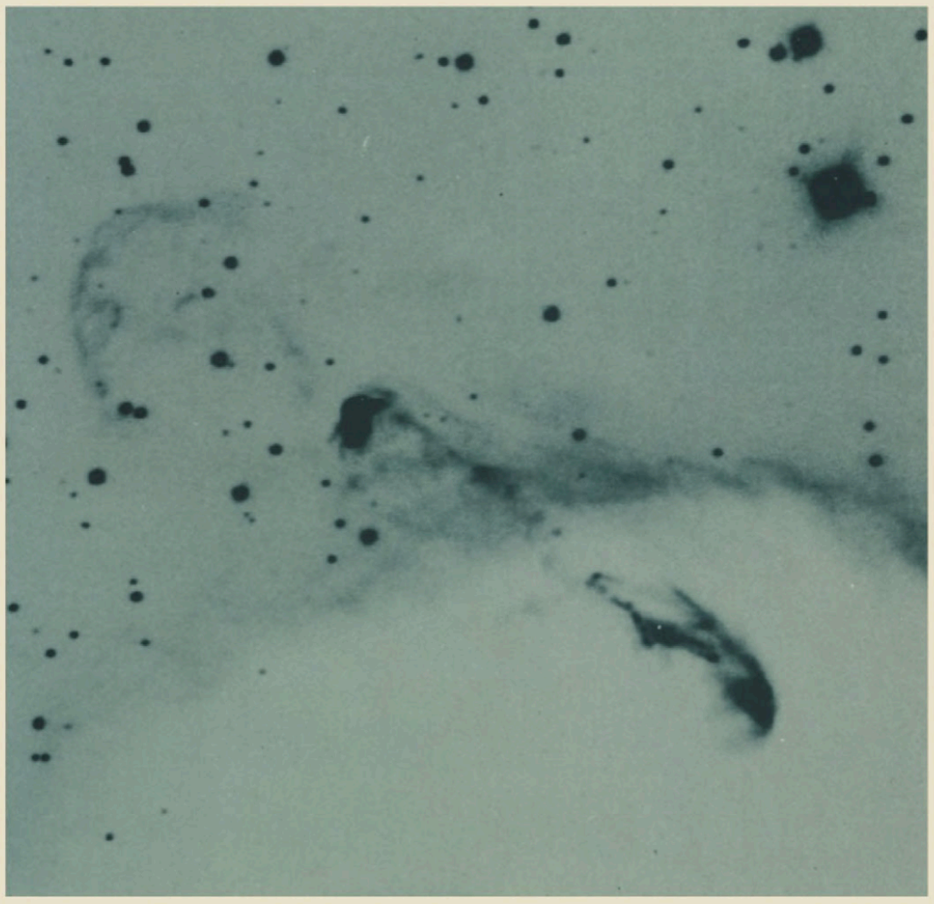
1. **Who** | Who is your audience? How expert will they be about the subject and/or display conventions?
2. **Explore-Explain** | Is your goal to explore, document, or explain your data or ideas, or a combination of these?
3. **Categories** |Do you want to show or explore pre-existing, known, human-interpretable, categories?
4. **Patterns** |Do you want to identify new, previously unknown or undefined patterns?
5. **Predictions & Uncertainty** | Are you making a comparison between data and/or predictions? Is representing uncertainty a concern?
6. **Dimensions** | What is the intrinsic number of dimensions (not necessarily spatial) in your data, and how many do you want to show at once?
7. **Abstraction & Accuracy** | Do you need to show all the data, or is summary or abstraction OK?
8. **Context & Scale** | Can you, and do you want to, put the data into a standard frame of reference, coordinate system, or show scale(s)?
9. **Metadata** | Do you need to display or link to non-quantitative metadata? (including captions, labels, etc.)
10. **Display Modes** | What display modes might be used in experiencing your display?

Now, visit the 10QViz conversation! There's so much more to talk about.

Curious about the **origins** of 10QViz? Try the About page.
Want to learn **how best to use** and **participate** in 10QViz? Try the How to page.
Want to read about the **scholarship** behind 10QViz.org's questions? Write to ask for a draft of our research paper, Coltekin & Goodman 2019.

10QViz.org

The Physics of Star Formation and Early Stellar Evolution



Edited by

Charles J. Lada and Nikolaos D. Kylafis

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