



[View in Aladin](#) • [View in WorldWide Telescope](#)

[adsass.org](http://adsass.org)

here is a 180-degree heatmap of article density on **all** kinds of objects, on the Sky, over **all** time

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

Year

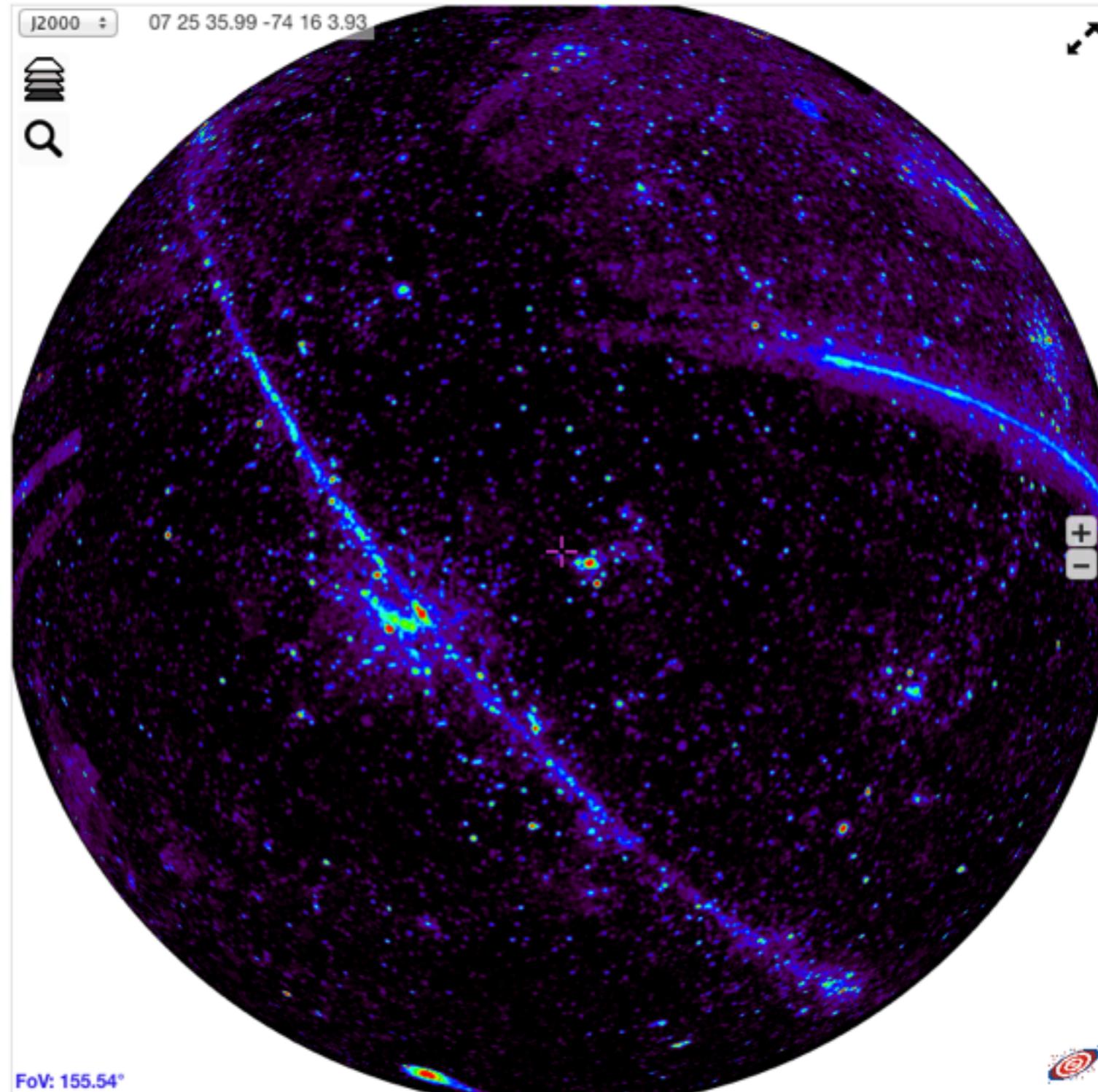


TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool

J2000 07 25 35.99 -74 16 3.93



FoV: 155.54°



# let's zoom in (on Ophiuchus)

The ADS All Sky Survey

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FILTER BY

Object

**All** Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

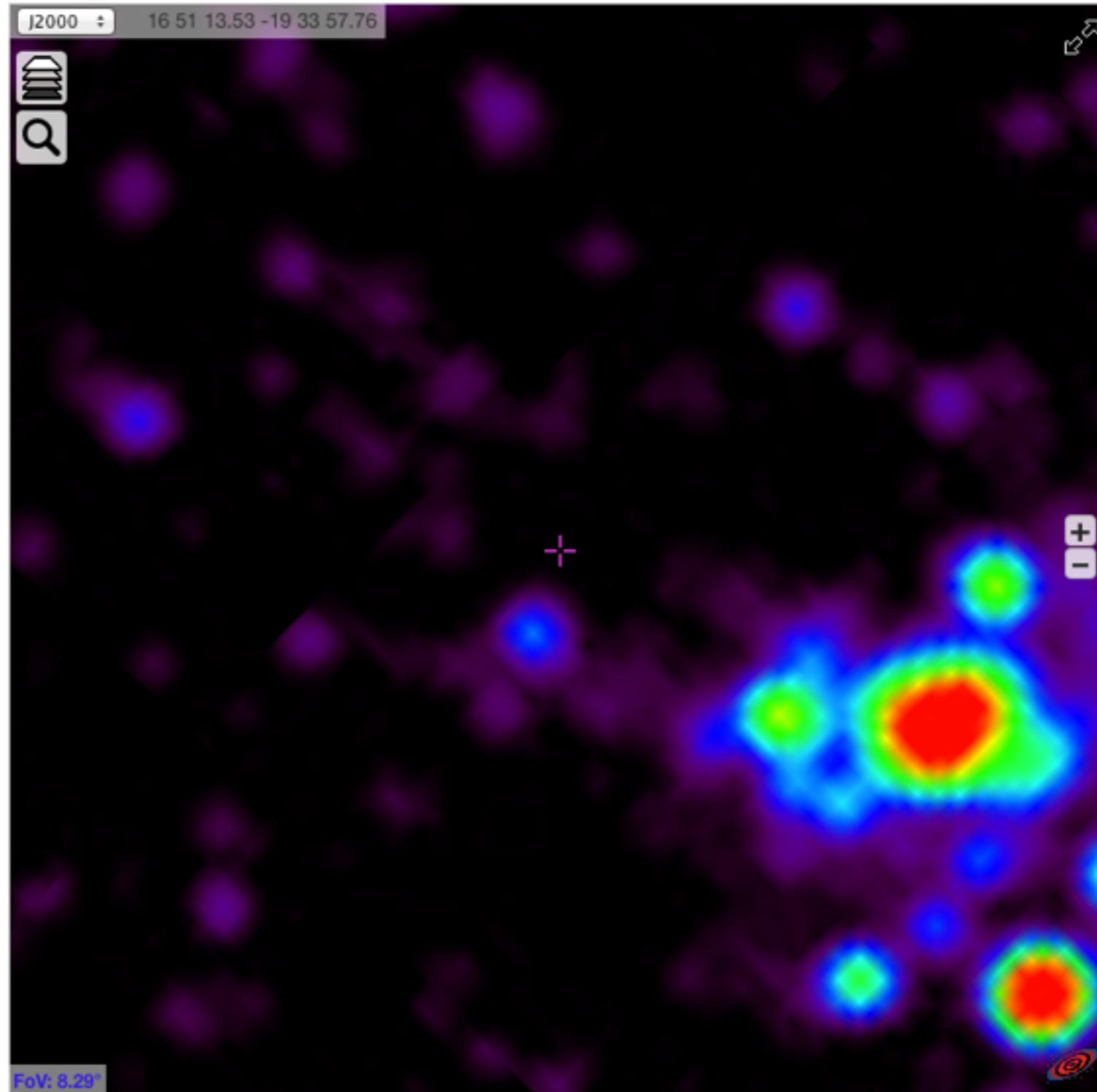
Year



TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool



# now, let's toggle on the "Mellinger" view of the Sky ...to see a nice optical image of Ophiuchus

The ADS All Sky Survey

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🔄 Open WWT version

Astronomy articles. In the sky.

FILTER BY

**Object**

All Stars Galaxies HII regions  
Nebulae Other

**Band**

Radio Infrared Ultraviolet X-ray

**Custom**

Harvard

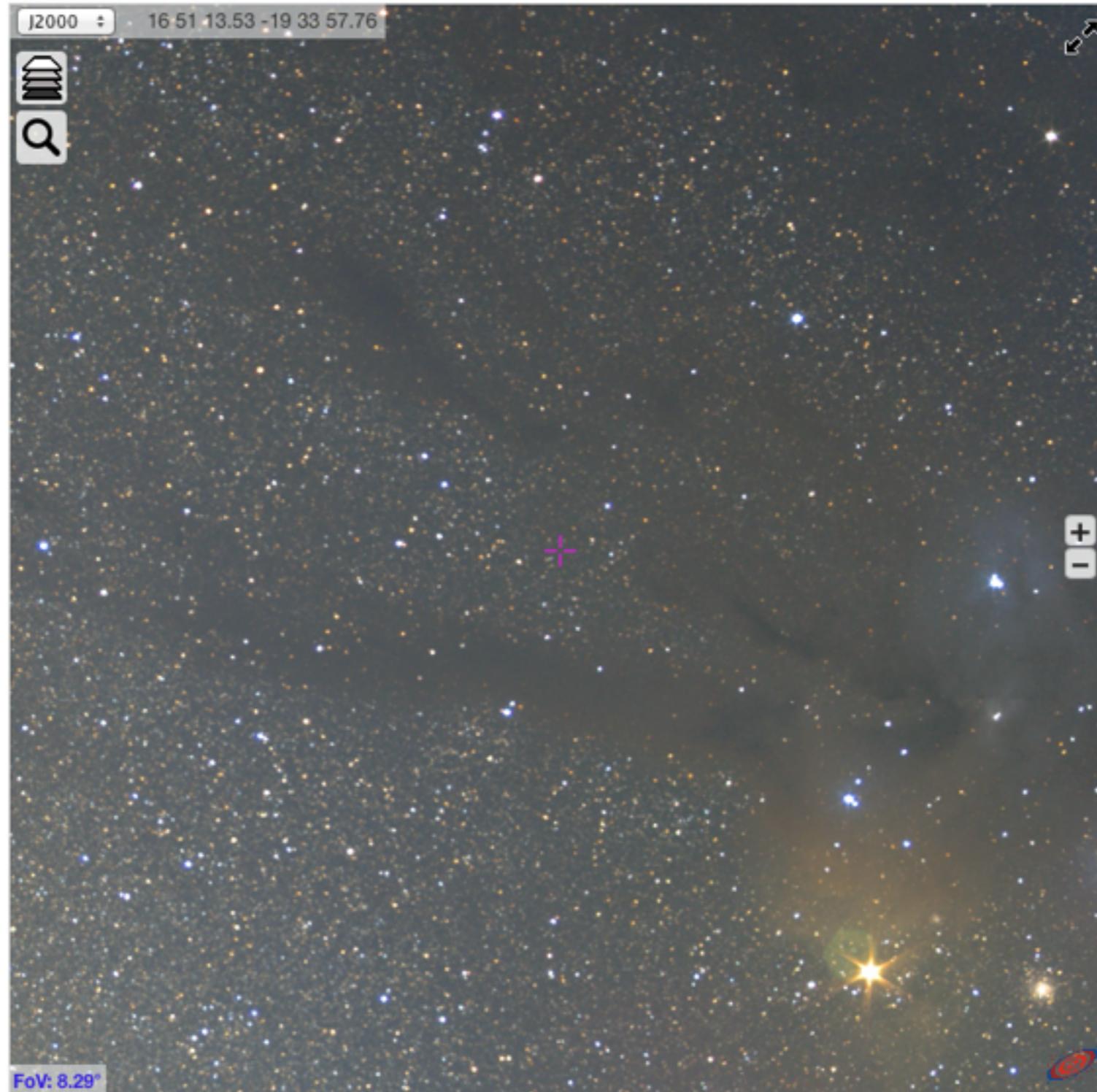
**Year**



TOGGLE BASE LAYER

Optical **Mellinger** GALEX AIS  
DSS2 Red IRIS XMMSS Halpha  
VTSS

Select tool



to add **markers** for SIMBAD sources, we can click the **Select Tool**

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

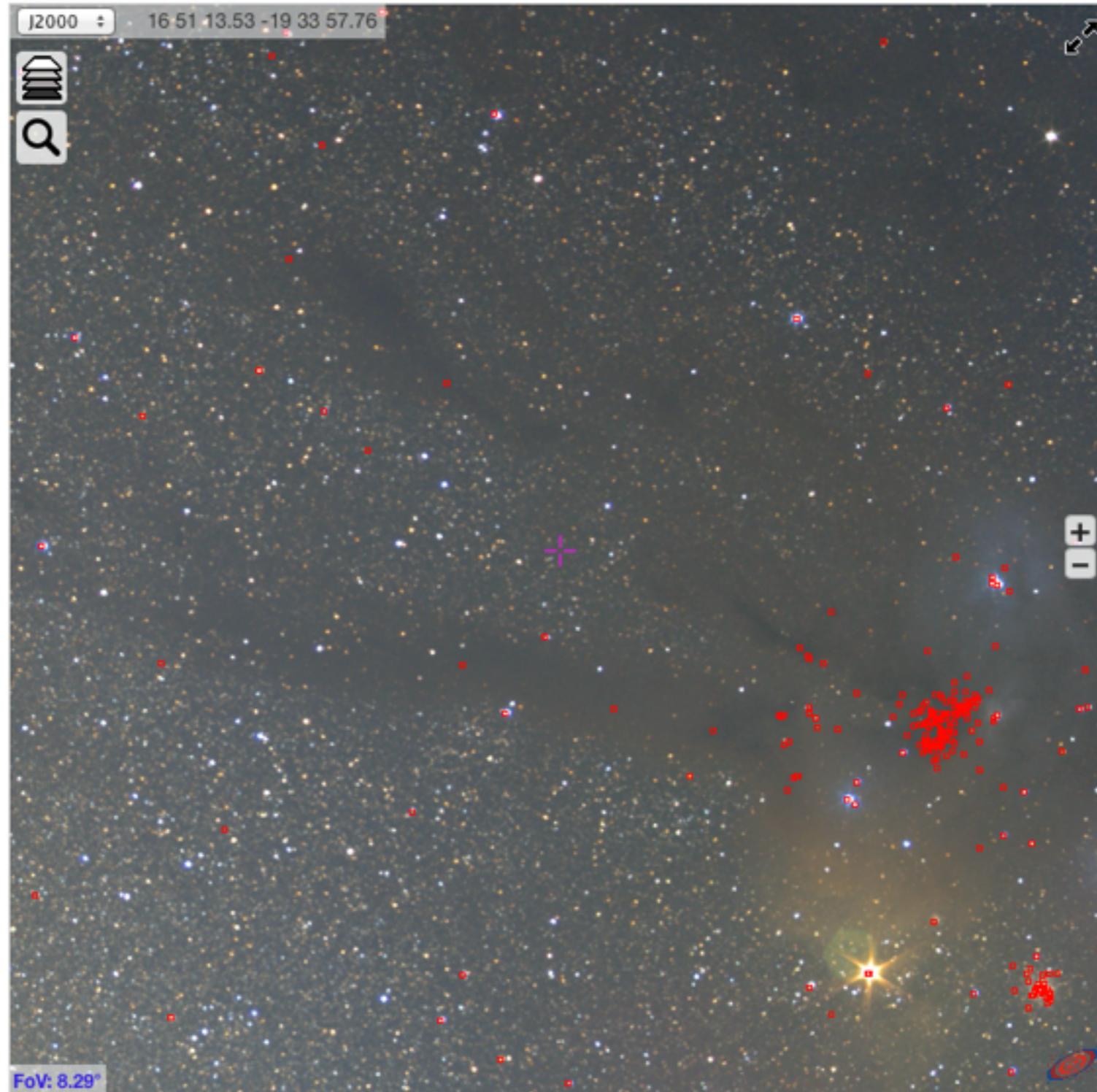
Year



TOGGLE BASE LAYER

Optical **Mellinger** GALEX AIS  
DSS2 Red IRIS ZMASS Halpha  
VTSS

Select tool



now, if we re-select "All," we see **sources** on article distribution

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

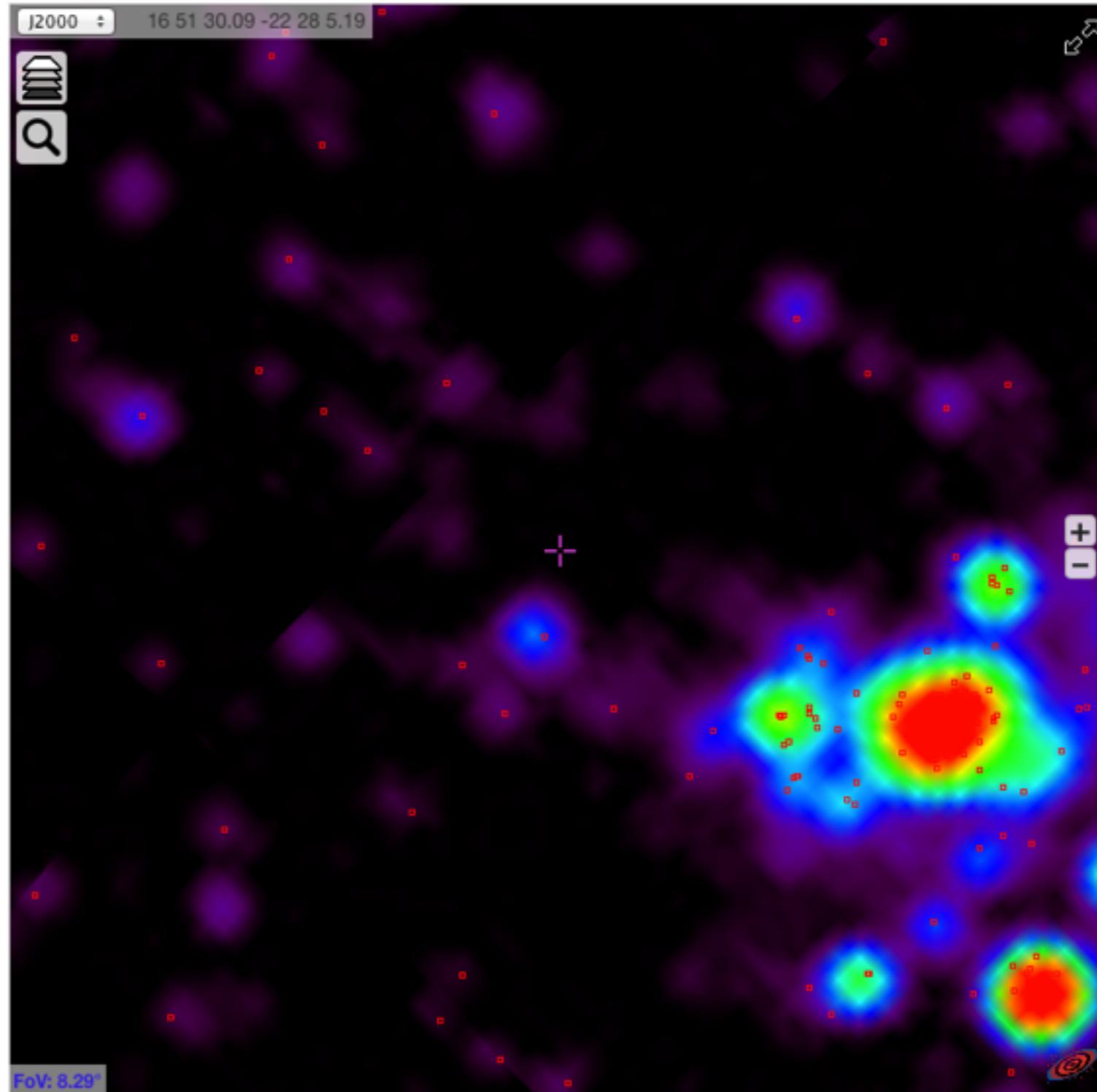
Year



TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool



panning over a bit, we can center our region of interest

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About

Watch videos

Tour

Open WWT version

Astronomy articles. In the sky.

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

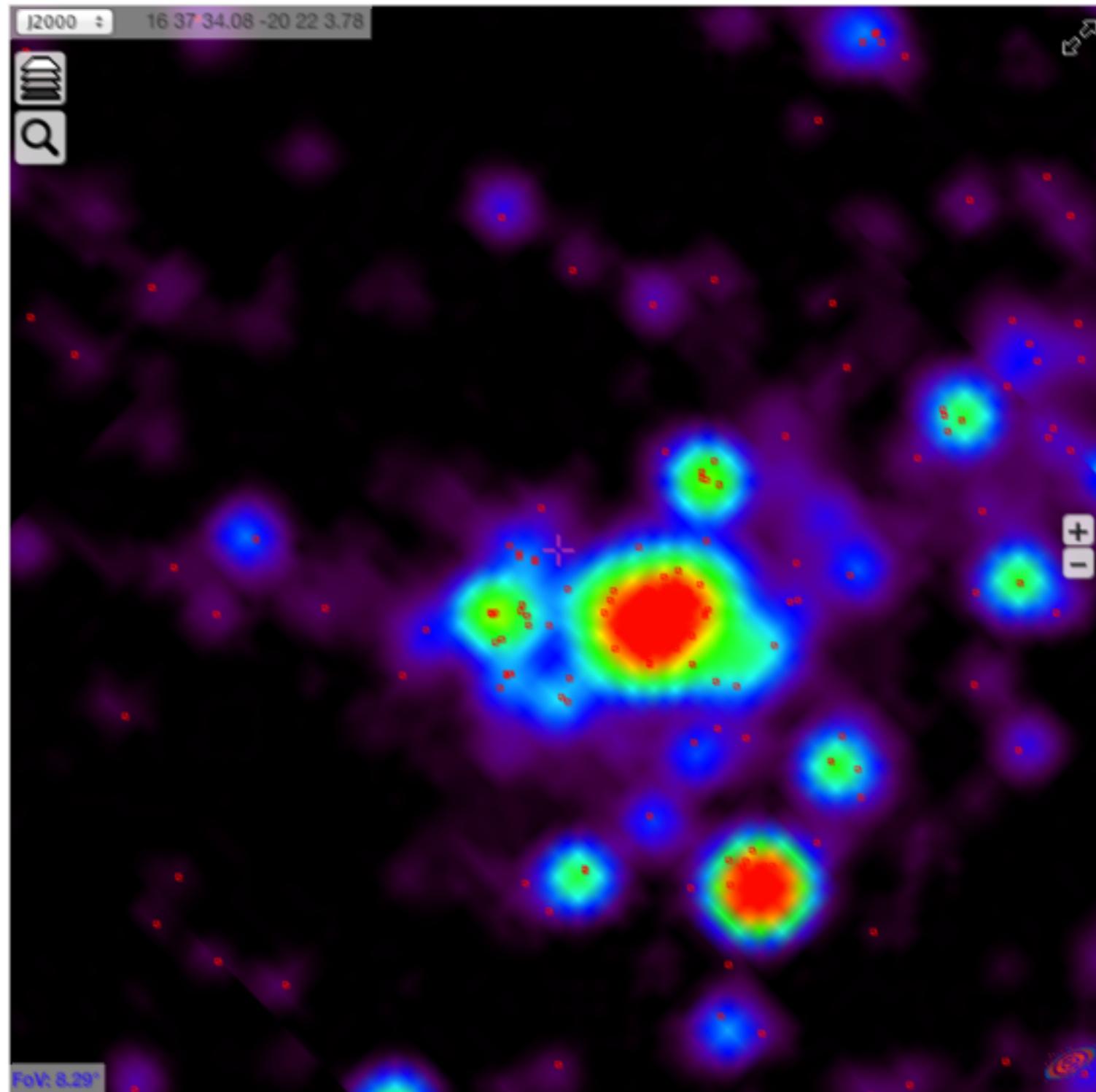
Year



TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool



# let's change the color table from rainbow to greyscale to make sources more apparent

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

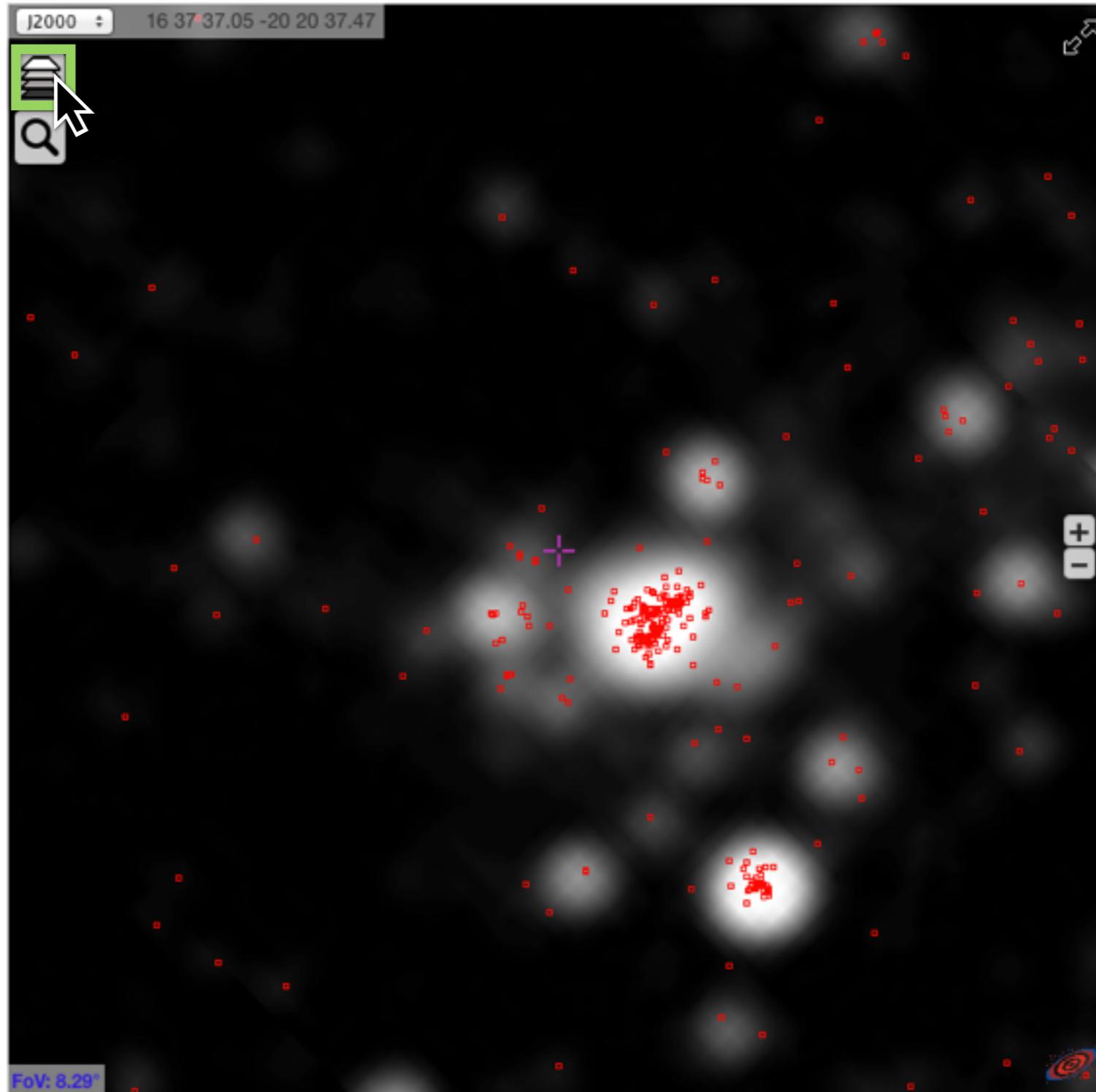
Year



TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool



let's look now at the distribution of articles about "HII regions" and select an area we're curious about

**FILTER BY**

**Object**  
[All Stars](#) [Galaxies](#) **HII regions** [Nebulae](#) [Other](#)

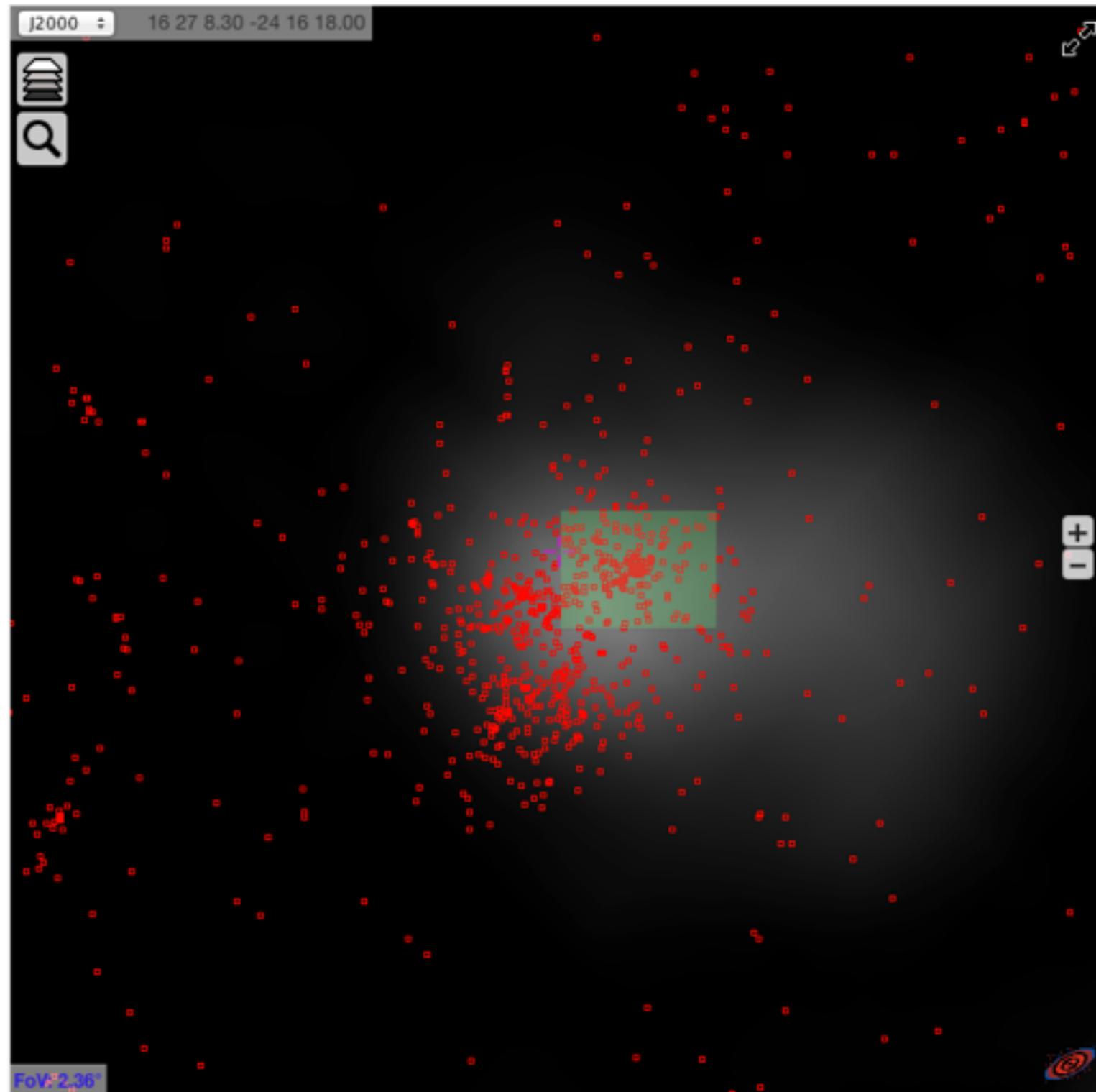
**Band**  
[Radio](#) [Infrared](#) [Ultraviolet](#) [X-ray](#)

**Custom**  
[Harvard](#)

**Year**

**TOGGLE BASE LAYER**  
[Optical](#) [Mellinger](#) [GALEX](#) [AIS](#)  
[DSS2 Red](#) [IRIS](#) [2MASS](#) [Halpha](#)  
[VTSS](#)

Select tool



when we release the selection rectangle, we get a pop-up list of papers (ADS) mentioning these objects, or a list of the objects (CDS/SIMBAD) we highlighted

The screenshot shows the ALADIN web interface. At the top, there are navigation links: "The ADS All Sky Survey", "About", "Watch videos", "Tour", and "Open WWT version". On the right, it says "Astronomy articles. In the sky." The left sidebar contains filter options under "FILTER BY": "Object" (All Stars, Galaxies, HII regions, Nebulae, Other), "Band" (Radio, Infrared, Ultraviolet, X-ray), "Custom" (Harvard), and "Year" (a slider). Below this is a "TOGGLE BASE LAYER" section with options: Optical, Mellinger, GALEX, AIS, DSS2, Red, IRIS, 2MASS, Halpha, and VTSS. A "Select tool" button is at the bottom of the sidebar. The main content area is a pop-up window titled "Selected papers/objects". It has two tabs: "Papers" (selected) and "Objects". The "Papers" tab shows a list of 200 most recent papers, truncated. The list includes authors and journal information, such as "NISINI B., et al. Astron. Astrophys., 549A, 16-16 (2013)". The "Objects" tab is currently empty. The pop-up window has a close button (X) in the top right corner. The background shows a dark sky with a red selection rectangle and a mouse cursor pointing at the "Open papers in ADS" button.

The ADS All Sky Survey About Watch videos Tour Open WWT version Astronomy articles. In the sky.

Selected papers/objects Open papers in ADS Open object list

Papers Objects

Note: List truncated to 200 most recent papers

NISINI B., et al. Astron. Astrophys., 549A, 16-16 (2013)  
TAFALLA M., et al. Astron. Astrophys., 551A, 116-116 (2013)  
BJERKELI P., et al. Astron. Astrophys., 552, L8-8 (2013)  
ZHANG M., et al. Astron. Astrophys., 553A, 41-41 (2013)  
VAN DER MAREL N., et al. Astron. Astrophys., 556A, 76-76 (2013)  
MURILLO N.M., et al. Astrophys. J., 764, L15 (2013)  
STUTZ A.M., et al. Astrophys. J., 767, 36 (2013)  
CHEN X., et al. Astrophys. J., 768, 110 (2013)  
HULL C.L.H., et al. Astrophys. J., 768, 159 (2013)  
GREEN J.D., et al. Astrophys. J., 770, 123 (2013)  
HSIEH T.-H., et al. Astrophys. J., Suppl. Ser., 205, 5 (2013)  
MAURY A., et al. Astron. Astrophys., 539A, 130-130 (2012)  
LISEAU R., et al. Astron. Astrophys., 541A, 73-73 (2012)  
ROBERTS J.F., et al. Astron. Astrophys., 544A, 150-150 (2012)  
BJERKELI P., et al. Astron. Astrophys., 546A, 29-29 (2012)  
PEZZUTO S., et al. Astron. Astrophys., 547A, 54-54 (2012)  
BOURKE T.L., et al. Astrophys. J., 745, 117 (2012)  
BARSONY M., et al. Astrophys. J., 751, 22 (2012)  
CHIANG H.-F., et al. Astrophys. J., 756, 168 (2012)  
NAKAMURA F., et al. Astrophys. J., 758, L25 (2012)  
BUSQUET G., et al. Astron. Astrophys., 525A, 141-141 (2011)  
BERGMAN P., et al. Astron. Astrophys., 527A, 39-39 (2011)  
NAKAMURA F., et al. Astrophys. J., 726, 46 (2011)  
GIANNINI T., et al. Astrophys. J., 738, 80 (2011)  
VELUSAMY T., et al. Astrophys. J., 741, 60 (2011)  
WARD-THOMPSON D., et al. Mon. Not. R. Astron. Soc., 415, 2812-2817 (2011)  
SIMPSON R.J., et al. Mon. Not. R. Astron. Soc., 417, 216-227 (2011)  
VAN DISHOECK E.F., et al. Publ. Astron. Soc. Pac., 123, 138-170 (2011)  
LISEAU R., et al. Astron. Astrophys., 510, A98-98 (2010)  
MAURY A.J., et al. Astron. Astrophys., 512, A40-40 (2010)  
LAHUIS F., et al. Astron. Astrophys., 519, A3-3 (2010)

ALADIN

# selecting "Open Papers in ADS" opens the paper list in ADS Labs

(From here, we can filter the list more, and more. e.g. clicking "SIMBAD Objects" lets us see particular objects in context on the Sky in WWT or Aladin.)

The screenshot shows the ADS Labs Streamlined Search interface. At the top, there is a header with the ADS Labs logo, the text "ADS Labs Streamlined Search", and the NASA logo. Below the header is a navigation bar with links for "Home", "Labs Home", "ADS Classic", and "Help". The user's email address "agoodman@cfa.harvard.edu" and a "Sign off" link are also visible.

The main content area is titled "Advanced query - Advanced Search" and shows "200 results". A search bar contains the text "NO FILTERS APPLIED". On the left side, there is a "FILTER BY:" section with several filter categories: "Authors", "Keywords", "Data", "SIMBAD Objects", "VizieR Tables", "Refereed status", and "Dates". The "Authors" filter is expanded, showing a list of authors with their respective paper counts: Andre, P (20), van Dishoeck, E (17), Smith, M (14), Ward-Thompson, D (14), and Jorgensen, J (12). Below the "Dates" filter, there is a date range selector set to "from 1996 to 2013" and a bar chart showing the distribution of papers over time.

The main list of results contains 7 entries, each with a citation ID, a list of available filters in brackets, a title, and the authors. The results are:

1. [2013A&A...556A..76V](#) [EF LXD R S U] **Outflow forces of low-mass embedded objects in Ophiuchus: a quantitative comparison of analysis methods**  
van der Marel, N.; Kristensen, L. E.; Visser, R.; Mottram, J. C.; and 2 coauthors
2. [2013ApJ...770..123G](#) Cited by 12 [EF LX RCS U] **Embedded Protostars in the Dust, Ice, and Gas In Time (DIGIT) Herschel Key Program: Continuum SEDs, and an Inventory of Characteristic Far-infrared Lines from PACS Spectroscopy**  
Green, Joel D.; Evans, Neal J., II; Jørgensen, Jes K.; Herczeg, Gregory J.; and 17 coauthors
3. [2013ApJ...768..159H](#) Cited by 21 [EF LX RCS U] **Misalignment of Magnetic Fields and Outflows in Protostellar Cores**  
Hull, Charles L. H.; Plambeck, Richard L.; Bolatto, Alberto D.; Bower, Geoffrey C.; and 21 coauthors
4. [2013ApJ...768..110C](#) Cited by 6 [EF LX RCS U] **SMA Observations of Class 0 Protostars: A High Angular Resolution Survey of Protostellar Binary Systems**  
Chen, Xuepeng; Arce, Héctor G.; Zhang, Qizhou; Bourke, Tyler L.; and 7 coauthors
5. [2013A&A...553A..41Z](#) [EF LXD R S U] **Proper motions of molecular hydrogen outflows in the  $\rho$  Ophiuchi molecular cloud**  
Zhang, M.; Brandner, W.; Wang, H.; Gennaro, M.; and 5 coauthors
6. [2013ApJ...767...36S](#) Cited by 6 [EF LXD RCS U] **A Herschel and APEX Census of the Reddest Sources in Orion: Searching for the Youngest Protostars**  
Stutz, Amelia M.; Tobin, John J.; Stanke, Thomas; Megeath, S. Thomas; and 12 coauthors
7. [2013A&A...552L...8B](#) Cited by 2 [EF X RCS U] **Physical properties of outflows. Comparing CO- and H<sub>2</sub>O-based parameters**

Let's try "Open WWT Version," so we can see this same view in WWT, and use a transparency slider

The ADS All Sky Survey

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📄 Tour

🔗 Open WWT version

Astronomy articles. In the sky.

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio **Infrared** Ultraviolet X-ray

Custom

Harvard

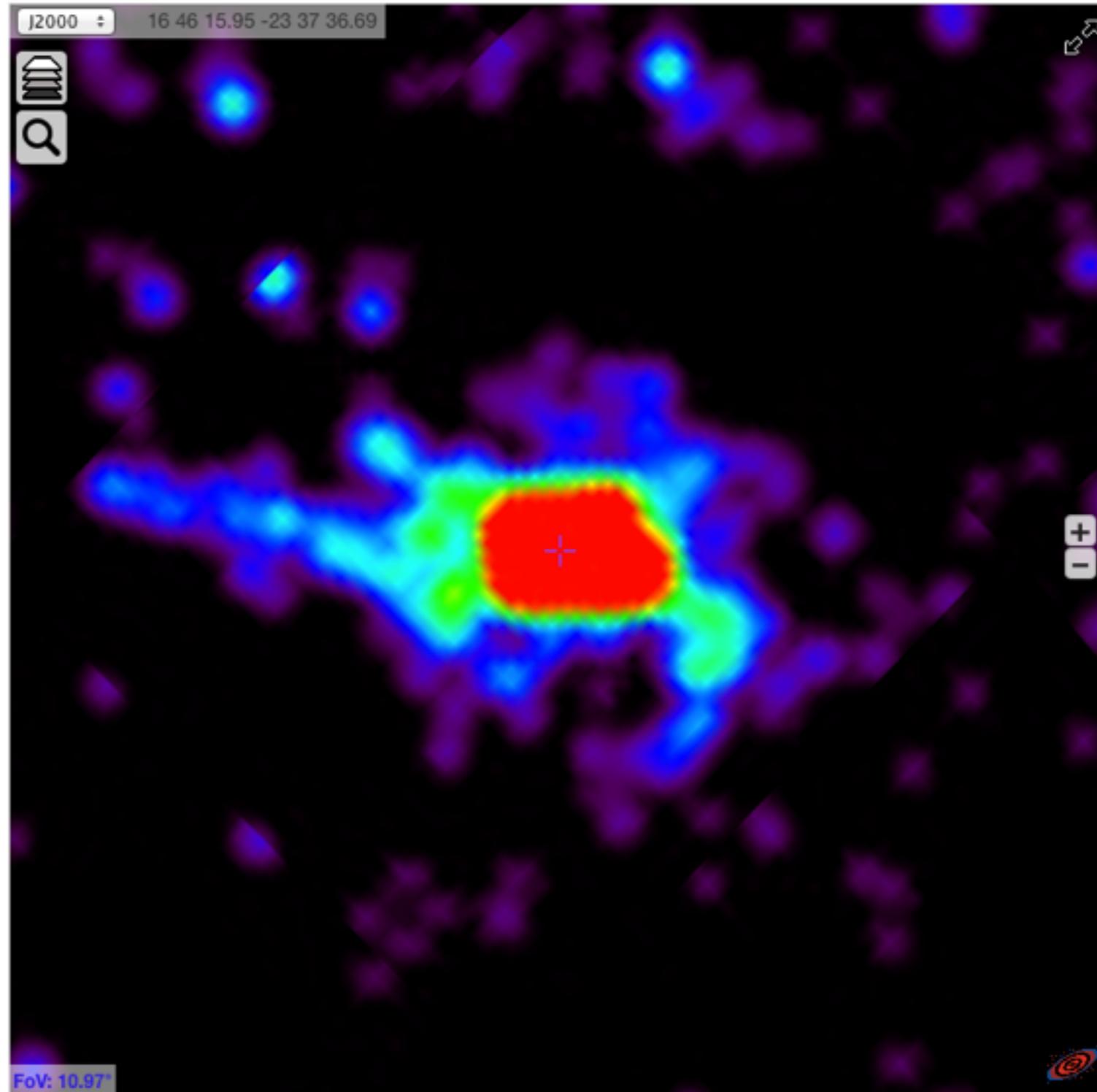
Year



TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool



# let's try the transparency (layer) slider in WorldWide Telescope

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## CHOOSE HEATMAP

**Object** All Stars Galaxies HII regions Nebulae Other

**Band** Radio **Infrared** Ultraviolet X-ray

**Custom** Harvard/All

**Year**

Show Sources

Go to...



## BACKGROUND LAYER

Optical 2MASS **WISE** SFD IRIS GLIMPSE H-alpha ROSAT Fermi VLSS

**WISE**  **Infrared**

position slider  
move slider to  
"WISE" all the way to  
"infrared"

$(\alpha, \delta) = 246.78^\circ, -24.55^\circ$  FOV =  $11^\circ$



dust is nice, but we're curious about HII regions, let's change view to **H-alpha**

CHOOSE HEATMAP

**Object** All Stars Galaxies HII regions Nebulae Other

**Band** Radio Infrared Ultraviolet X-ray

**Custom** Harvard/All

**Year**

Show Sources

Go to...

BACKGROUND LAYER

Optical 2MASS WISE SFD IRIS GLIMPSE H-alpha ROSAT Fermi VLSS

H-alpha  X-ray



( $\alpha, \delta$ )=246.78°, -24.55° FOV= 11°



now we want to find **X-ray** observations and see if any are near the HII regions, so we can slide between H-alpha and X-ray

CHOOSE HEATMAP

**Object** All Stars Galaxies HII regions Nebulae Other

**Band** Radio Infrared Ultraviolet **X-ray**

**Custom** Harvard/All

**Year**

Show Sources

Go to...

BACKGROUND LAYER

Optical 2MASS WISE SFD IRIS GLIMPSE **H-alpha** ROSAT Fermi VLSS

**H-alpha**  **X-ray**



( $\alpha, \delta$ )=246.78°, -24.55° FOV= 11°



now let's zoom in, and try "Show Sources" to see what the SIMBAD X-ray sources really are

CHOOSE HEATMAP

**Object** All Stars Galaxies HII regions Nebulae Other

**Band** Radio Infrared Ultraviolet **X-ray**

**Custom** Harvard/All

**Year**

Show Sources

Go to...



BACKGROUND LAYER

Optical 2MASS WISE SFD IRIS GLIMPSE **H-alpha** ROSAT Fermi VLSS

**H-alpha**  X-ray



select an interesting source

$(\alpha, \delta) = 246.72^\circ, -23.97^\circ$  FOV =  $3^\circ$



and, we can have plenty of information on the source, via CDS/SIMBAD or via ADS.

The ADS All Sky Survey [Open Aladin version](#) Astronomy articles. In the sky.

**V\* V2503 Oph** [SIMBAD Entry](#) [Open papers in ADS](#)

**CHOOSE HEATMAP**  
Object: All Stars Galaxies HII regions Nebulae  
Band: Radio Infrared Ultraviolet X-ray  
Custom: Harvard/All  
Year:

**BACKGROUND LAYER**  
Optical 2MASS WISE SFD IRIS GLIMPSE  
H-alpha  X-ray

**Papers**

- ESPAILLAT C., et al. *Astrophys. J.*, 762, 62 (2013)
- BROWN J.M., et al. *Astrophys. J.*, 770, 94 (2013)
- ARTEMENKO S.A., et al. *Astron. Lett.*, 38, 783-792 (2012)
- BAST J.E., et al. *Astron. Astrophys.*, 527A, 119-119 (2011)
- SALYK C., et al. *Astrophys. J.*, 731, 130 (2011)
- GUEDEL M., et al. *Astron. Astrophys.*, 519, A113-113 (2010)
- OLOFSSON J., et al. *Astron. Astrophys.*, 520, A39-39 (2010)
- PONTOPPIDAN K.M., et al. *Astrophys. J.*, 720, 887-903 (2010)
- McCLURE M.K., et al. *Astrophys. J., Suppl. Ser.*, 188, 75-122 (2010)
- VAN KEMPEN T.A., et al. *Astron. Astrophys.*, 498, 167-194 (2009)
- OLOFSSON J., et al. *Astron. Astrophys.*, 507, 327-345 (2009)
- FURLAN E., et al. *Astrophys. J.*, 703, 1964-1983 (2009)
- PADGETT D.L., et al. *Astrophys. J.*, 672, 1013-1037 (2008)
- GRANKIN K.N., et al. *Astron. Astrophys.*, 461, 183-195 (2007)
- GUENTHER E.W., et al. *Astron. Astrophys.*, 467, 1147-1155 (2007)
- LAHUIS F., et al. *Astrophys. J.*, 665, 492-511 (2007)
- ANDREWS S.M., et al. *Astrophys. J.*, 671, 1800-1812 (2007)
- MONIN J.-L., et al. *Astron. Astrophys.*, 446, 201-210 (2006)
- CORREIA S., et al. *Astron. Astrophys.*, 459, 909-926 (2006)
- McCABE C., et al. *Astrophys. J.*, 636, 932-951 (2006)
- RATZKA T., et al. *Astron. Astrophys.*, 437, 611-626 (2005)
- DUCOURANT C., et al. *Astron. Astrophys.*, 438, 769-778 (2005)
- MAHESWAR G., et al. *Astron. Astrophys.*, 402, 963-970 (2003)
- SARTORI M.J., et al. *Astron. Astrophys.*, 404, 913-926 (2003)
- MELO C.H.F. *Astron. Astrophys.*, 410, 269-282 (2003)
- BARSONY M., et al. *Astrophys. J.*, 591, 1064-1074 (2003)
- GEOFFRAY H., et al. *Astron. Astrophys.*, 369, 239-248 (2001)
- KAZAROVETS E.V., et al. *IAU Inform. Bull. Var. Stars*, 5135, 1 (2001)
- TEIXEIRA R., et al. *Astron. Astrophys.*, 361, 1143-1151 (2000)
- SHEVCHENKO V.S., et al. *Astron. J.*, 116, 1419-1431 (1998)
- JENSEN E.L.N., et al. *Astron. J.*, 114, 301-316 (1997)
- ASPIN C., et al. *Mon. Not. R. Astron. Soc.*, 284, 257-264 (1997)
- MONIN J.-L., et al. *The Messenger*, 89, 33-37 (1997)
- JENSEN E.L.N., et al. *Astrophys. J.*, 459, 310-326 (1996)

( $\alpha, \delta$ )=246.72°, -23.97° FOV= 3°



# Credits

funding **NASA ADAP** program

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Co-I: Alberto **Pepe**, Harvard-CfA & Authorea

Co-I: August **Muench**, Smithsonian-CfA

with

Alberto **Accomazzi**, Smithsonian Institution, NASA/ADS

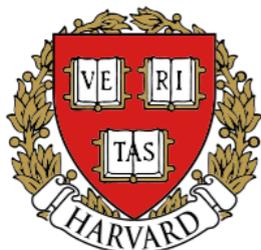
Christopher **Beaumont**, Harvard-CfA

Thomas **Boch**, CDS Strasbourg

Jonathan **Fay**, Microsoft Research

David **Hogg**, NYU, [astrometry.net](http://astrometry.net)

Alberto **Conti**, NASA/STScI, Northrup Grumman



Stephen

all lines

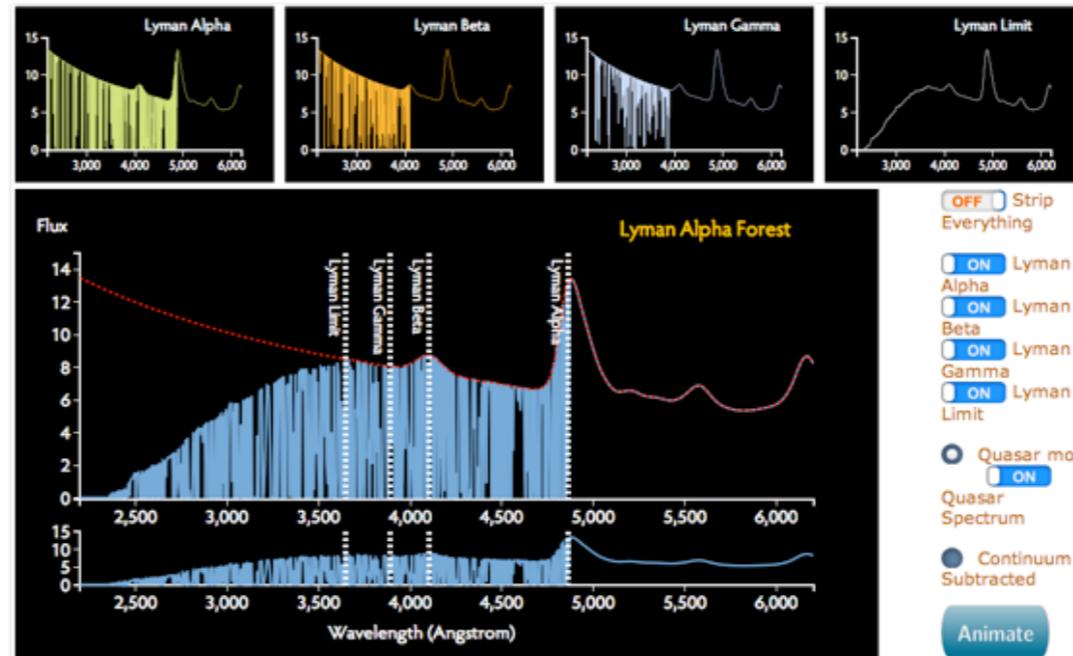
SII 6716/6731 Å

He 6563 Å

OIII 5007 Å

Yuan-Sen  
Ting

Interstellar  
Absorption  
and the  
Lyman Alpha  
Forest



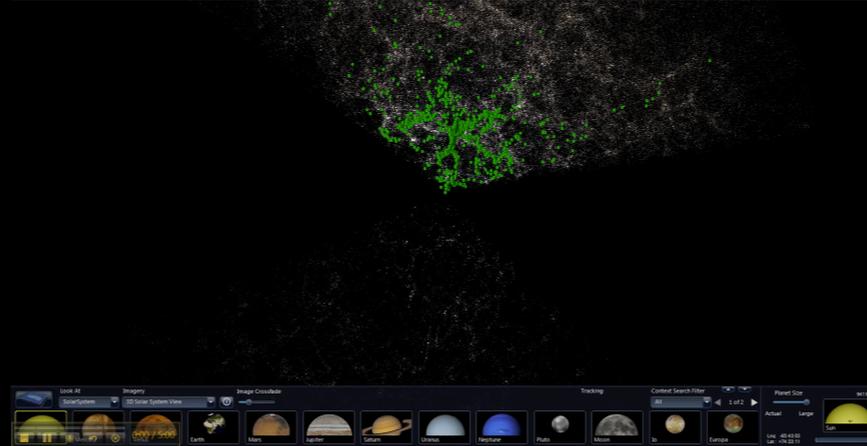
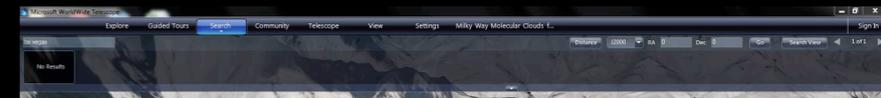
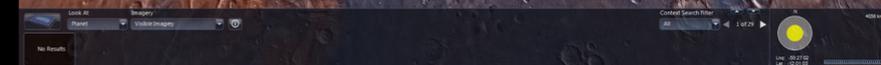
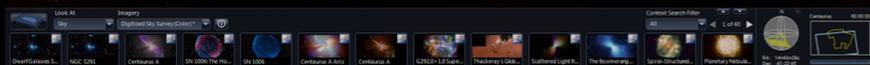
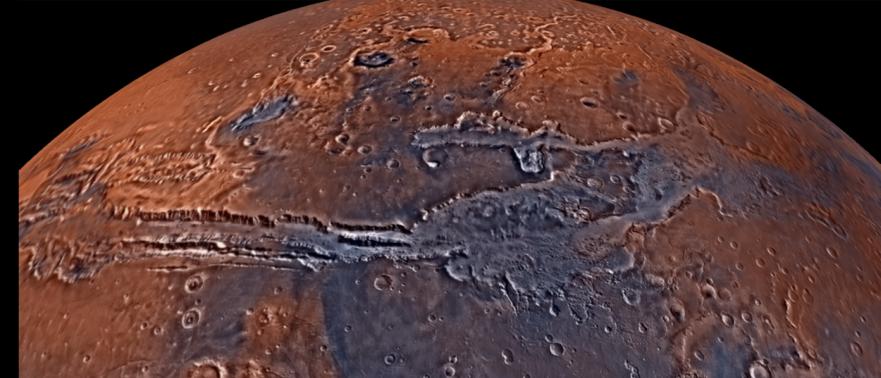
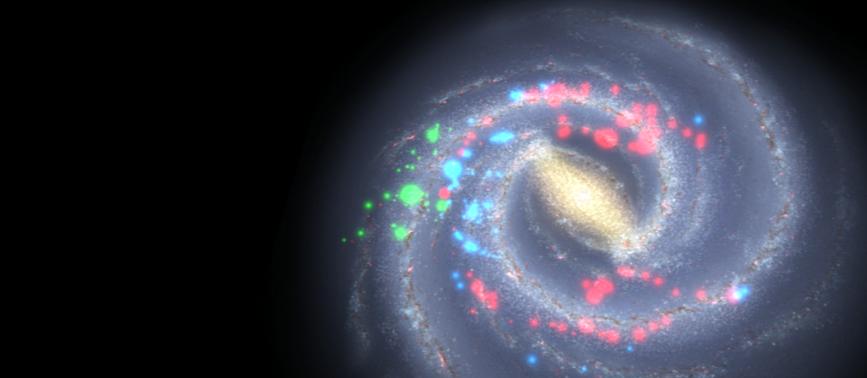
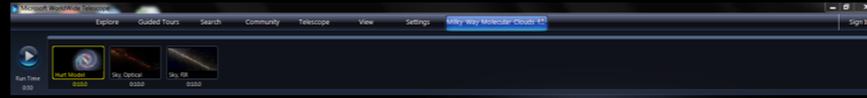
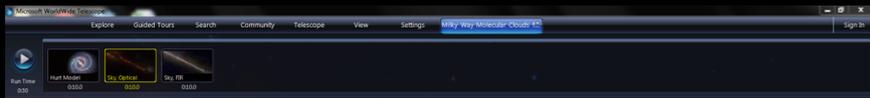
JavaScript

[https://www.cfa.harvard.edu/~yuan-sen.ting/lyman\\_alpha.html](https://www.cfa.harvard.edu/~yuan-sen.ting/lyman_alpha.html)



JavaScript

<http://portillo.ca/nebula/>



Experience WorldWide Telescope, free from Microsoft Research at [worldwidetelescope.org](http://worldwidetelescope.org)

# The Past, Present & Future of Scholarship, with Pictures



Alyssa A. Goodman

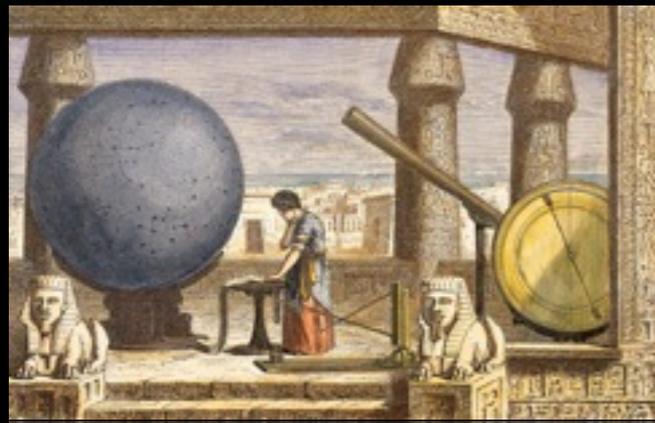
Harvard-Smithsonian Center for Astrophysics

# 3500 years of Astronomy

Stonehenge, 1500 BC



Ptolemy in Alexandria, 100 AD



Observatory Tower, Lincolnshire, UK, c. 1300



Galileo, 1600



The "Scientific Revolution"

Reber's Radio Telescope, 1937



NASA/Explorer 7  
(Space-based Observing)  
1959

"The Internet"



Long-distance remote-control/  
"robotic"  
telescopes  
1990s



"Virtual Observatories"  
21st century

"Seamless Astronomy"

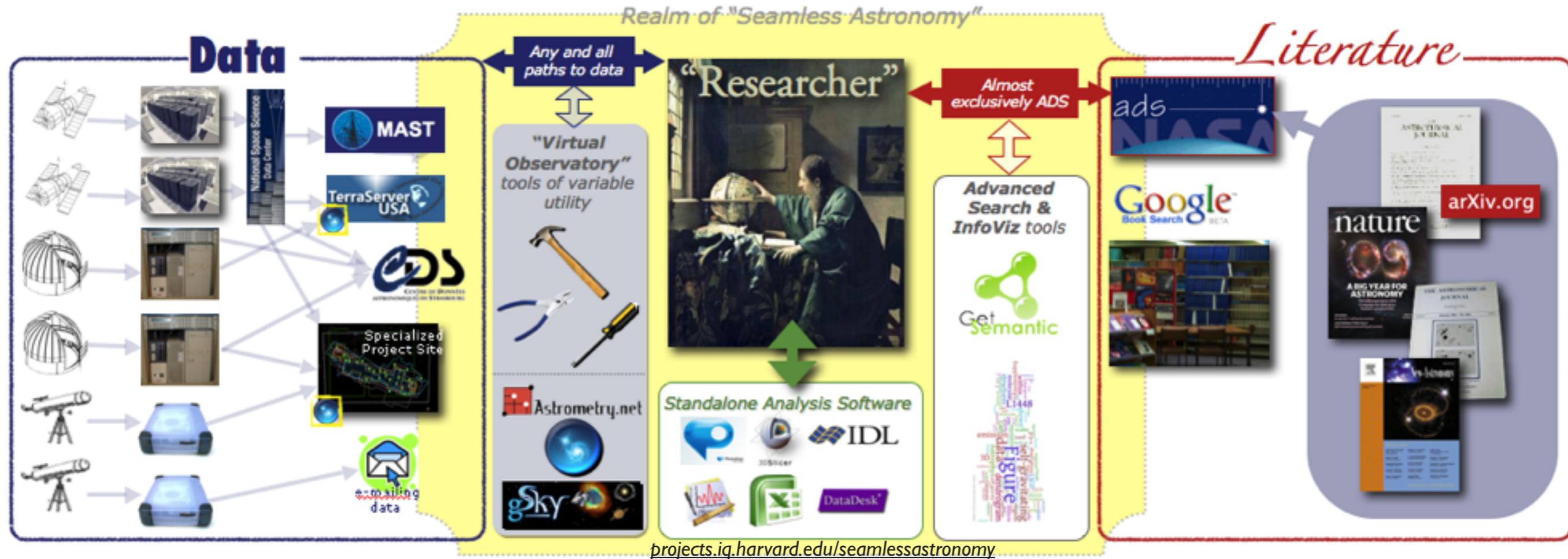
# 3500 Years of Writing





# SEAMLESS ASTRONOMY

Linking scientific data, publications, and communities



Alberto Accomazzi, Christopher Beaumont, Douglas Burke, Raffaele D’Abrusco, Rahul Davé, Christopher Erdmann, Pepi Fabbiano, Alyssa Goodman, Edwin Henneken, Jay Luker, Gus Muench, Michael Kurtz, Max Lu, Victoria Mittelbach, Alberto Pepe, Arnold Rots, Patricia Udomprasert (Harvard-Smithsonian CfA); Mercé Crosas (Harvard Institute for Quantitative Social Science); Christine Borgman (UCLA); Jonathan Fay & Curtis Wong (Microsoft Research); Alberto Conti (Space Telescope Science Institute)





# Rome2rio

Transport

Hotels

Cars

Discover how to get anywhere by plane, train, bus, ferry and automobile

**FROM** Harvard University, MA, USA

**TO** University of Oxford, England

 SEARCH

FROM Harvard University, MA, USA

TO University of Oxford, England

Add date for accurate airfares

APPROX \$ USD EACH WAY

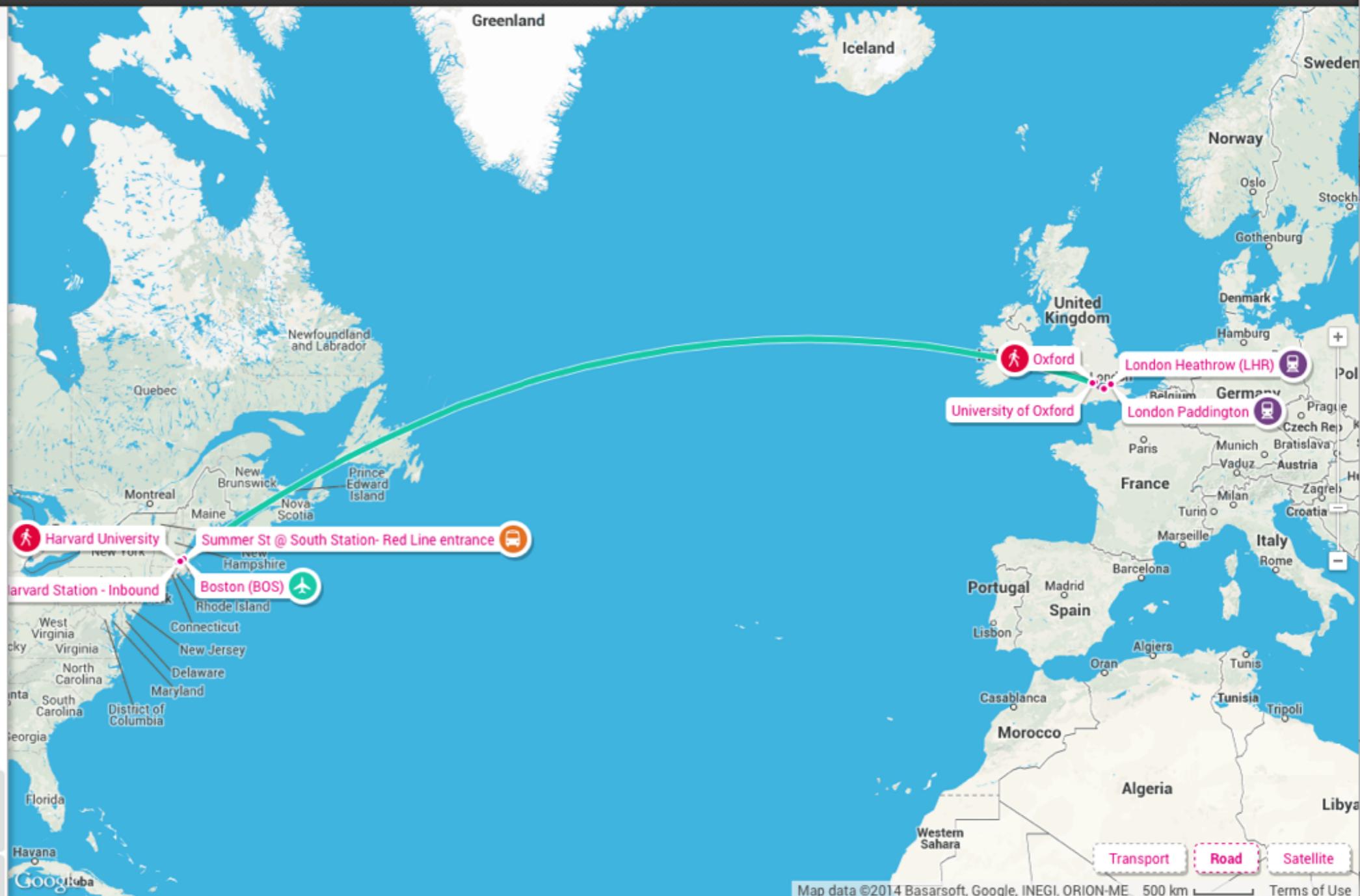
1 Fly to London Heathrow, train \$539

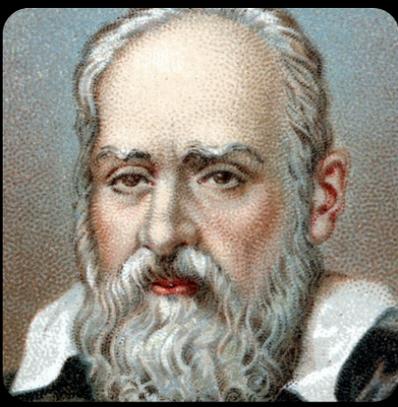
11hrs 12min

- Harvard University: 9min - 2035 feet
- Harvard Station - Inbound: 15min - every 5 minutes \$2
- Summer St @ South Station- Red: 13min - every 20 minutes \$2
- Boston (BOS): 6hrs 20min - non-stop \$470
- London Heathrow (LHR): 16min - every 10 minutes \$35
- London Paddington: 58min - every 20 minutes \$30
- Oxford: 33min - 1.4 miles
- University of Oxford: 58 hotels

2 Fly to Bristol, train \$605 14hrs 08min

3 Fly to Manchester, train \$492





# Galileo Galilei (1564–1642)



*Scipio Principe.*

Galileo Galilei, Familiari. Seruo della Ser. V. inuigilato  
 do assiduum, et in ogni spirito di bene non solo satisfatto  
 aluano che non della lettera di Madonati, nelle Scuole  
 Vie di Padova,

Inuice diuere determinate di presentare al Scipio Principe  
 l'occhio et il pensiero di giuamenti inestimabile di ogni  
 negozio et in breua marittima o terrestre stimo di tenere que  
 sto nuovo artificio nel maggior segreto et solam a disposizione  
 di V. Ser. L. Galileo conato dalle piu uide speculazioni di  
 pros, pettina in l'uantaggio di scoprire Legni et Vele dell' inimici  
 di due hore et piu di tempo prima di essi scoupra noi et distinguend  
 il numero et la qualita de i Vasselli, giudicare le sue forze  
 balloptirsi alla caccia et combattimento o alla fuga, o pure uale  
 nella campagna aperta uedere et particolarly distinguere ogni suo  
 posto et fortificamento.

Adi 7. di gennaio  
 Giove si uede a 7 \* ucci: 10. 11.

Adi 8. uci: 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30.

Adi 12. si uede in tale uisione \* \* \* \*

Adi 13. si uede in tal uisione a Giove 4 stelle \* \* \* \*

Adi 14. è angelo uci: 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30.

Adi 15. si uede in tal uisione \* \* \* \*

La spatio delle 3 uide et ad om  
 maggio del diuano di 7. et c.

7	* * ○ *	17	* ○
8	○ * * *	18	* ○ *
10	* * ○	19	* ○ * *
11	* * ○	19	* ○ * *
12	* ○ *	20	○ * ○ ○ ○
13	* ○ * *	21	... ○ *
15	○ * * * *	22	* ○ * *
15	○ * * *	22	* ○ * *
16	* ○ *	23	* ○ *
17	* ○ *	24	* ○ *

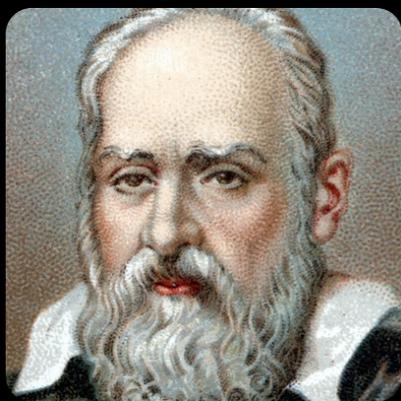
On the third, at the seventh hour, the stars were arranged in this  
 sequence. The eastern one was 1 minute, 30 seconds from Jupiter  
 the closest western one 2 minutes; and the other western one was  
 3 minutes removed from this one. They were absolutely on the same  
 straight line and of equal magnitude.

On the fourth, at the second hour, there were four stars around  
 Jupiter, two to the east and two to the west, and arranged precisely  
 in a straight line, as in the adjoining figure. The easternmost was  
 distant 3 minutes from the next one, while this one was 40 seconds  
 from Jupiter; Jupiter was 4 minutes from the nearest western one  
 and this one 6 minutes from the westernmost one. Their magnitude  
 were nearly equal; the one closest to Jupiter appeared a little smaller  
 than the rest. But at the seventh hour the eastern stars were only  
 30 seconds apart. Jupiter was 2 minutes from the nearer eastern  
 star, while he was 4 minutes from the next western one, and this  
 one was 3 minutes from the westernmost one. They were all equal  
 and extended on the same straight line along the ecliptic.

On the fifth, the sky was cloudy.

On the sixth, only two stars appeared flanking Jupiter, as is seen  
 in the adjoining figure. The eastern one was 2 minutes and the  
 western one 3 minutes from Jupiter. They were on the same straight  
 line with Jupiter and equal in magnitude.

On the seventh, two stars stood near Jupiter, both to the east

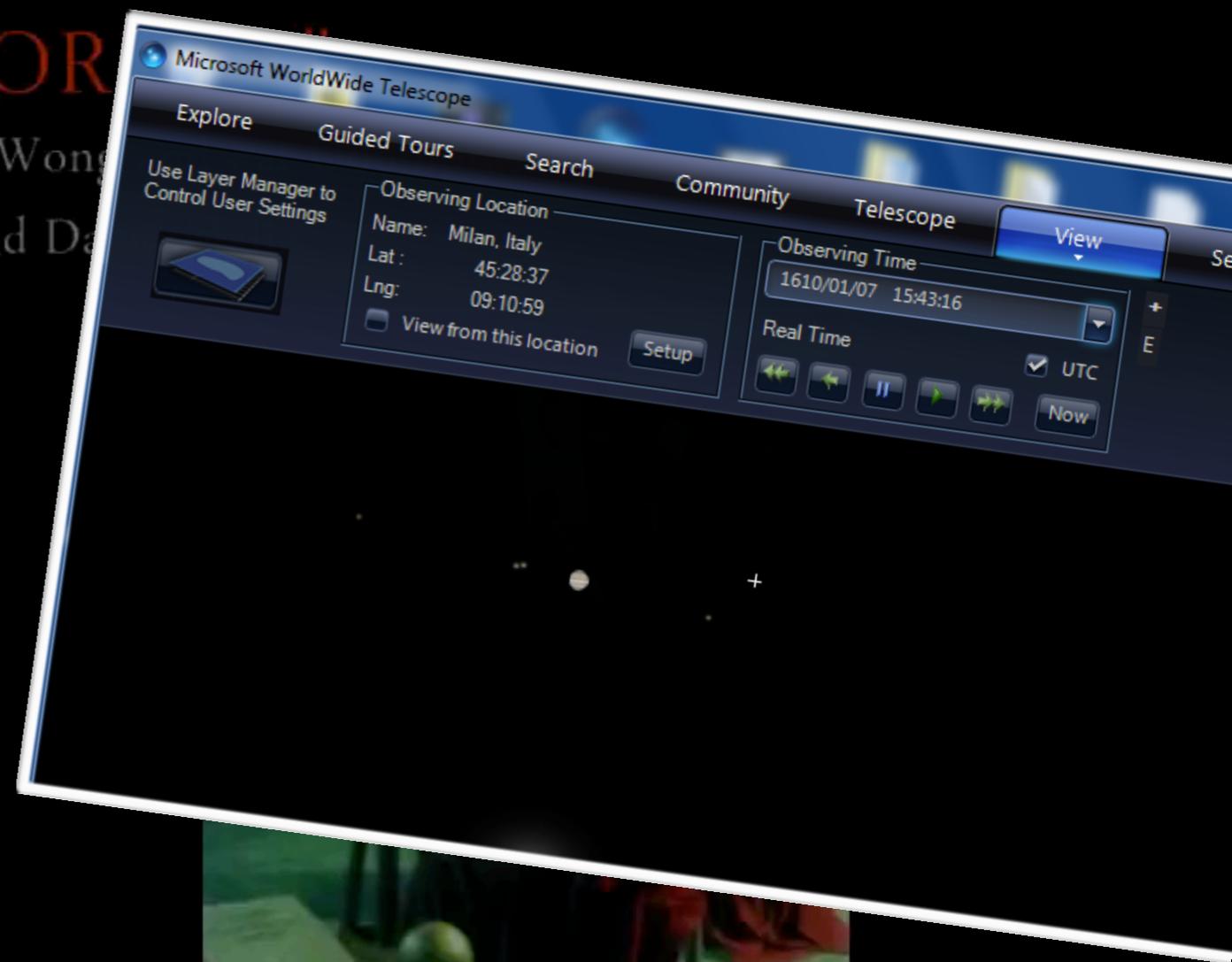


# Galileo Galilei



## GALILEO'S "NEW ORDER"

Created by Alyssa Goodman, Curtis Wong  
with advice from Owen Gingerich and Dan

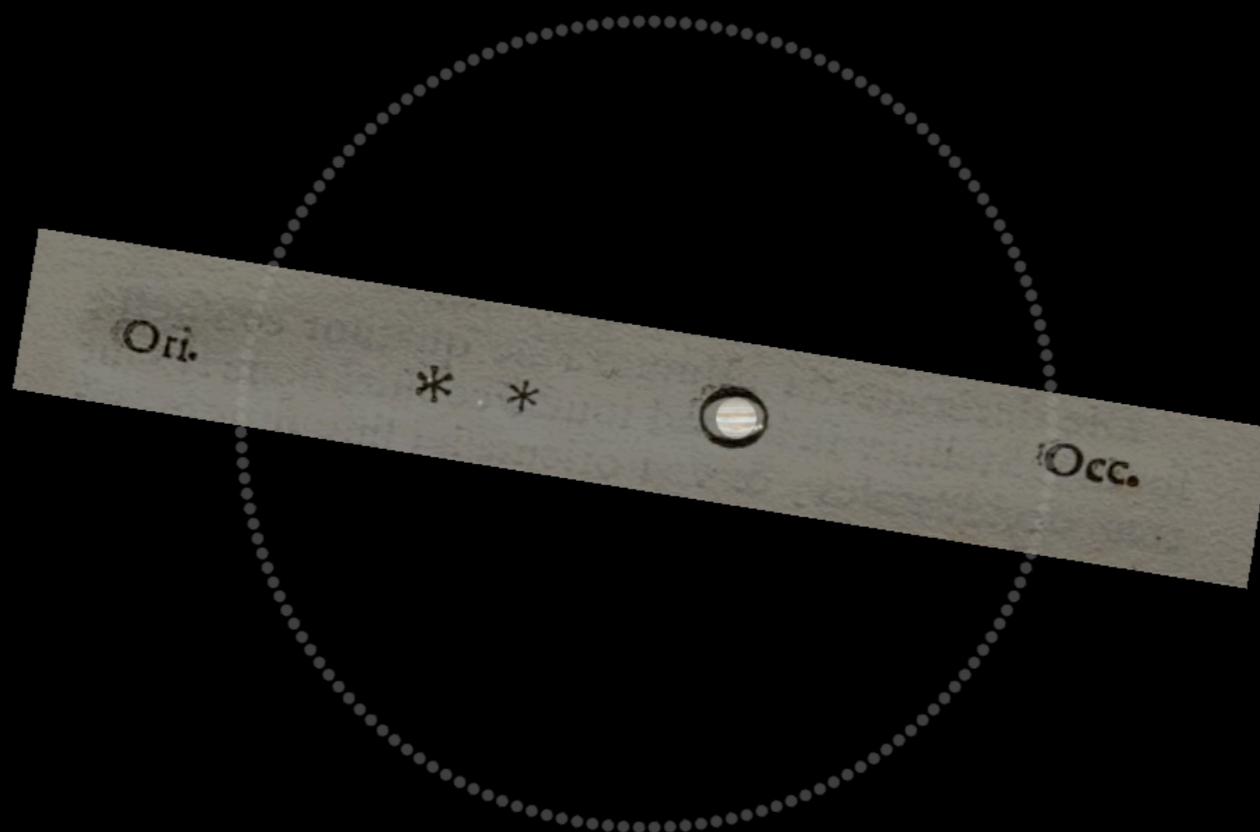




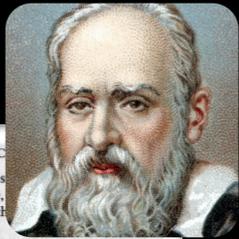
# Galileo Galilei



January 11, 1610



1610



SIDEREUS NUNCIUS

On the third, at the seventh hour, the sequence. The eastern one was 1 minute, the closest western one 2 minutes; and the

East \* ○ \* West

10 minutes removed from this one. They were absolutely on the same straight line and of equal magnitude.

On the fourth, at the second hour, there were four stars around Jupiter, two to the east and two to the west, and arranged precisely

East \* ○ \* \* West

on a straight line, as in the adjoining figure. The easternmost was distant 3 minutes from the next one, while this one was 40 seconds from Jupiter; Jupiter was 4 minutes from the nearest western one, and this one 6 minutes from the westernmost one. Their magnitudes were nearly equal; the one closest to Jupiter appeared a little smaller than the rest. But at the seventh hour the eastern star was 30 seconds apart. Jupiter was 2 minutes from the

East \*\* ○ \* \*

one, while he was 4 minutes from the next western one was 3 minutes from the westernmost one. They and extended on the same straight line along the ecliptic.

On the fifth, the sky was cloudy.

On the sixth, only two stars appeared flanking Jupiter

East \* ○ \*

in the adjoining figure. The eastern one was 2 minutes from the western one 3 minutes from Jupiter. They were on the same straight line with Jupiter and equal in magnitude.

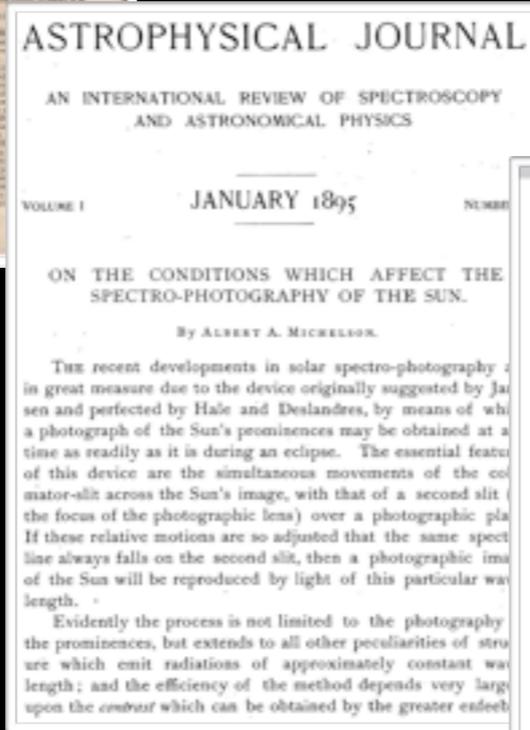
On the seventh, two stars stood near Jupiter, but not arranged in this manner.

# what do we publish?

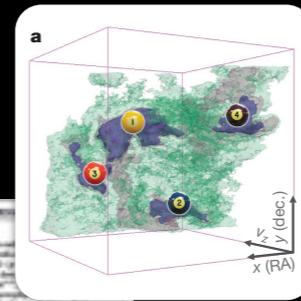
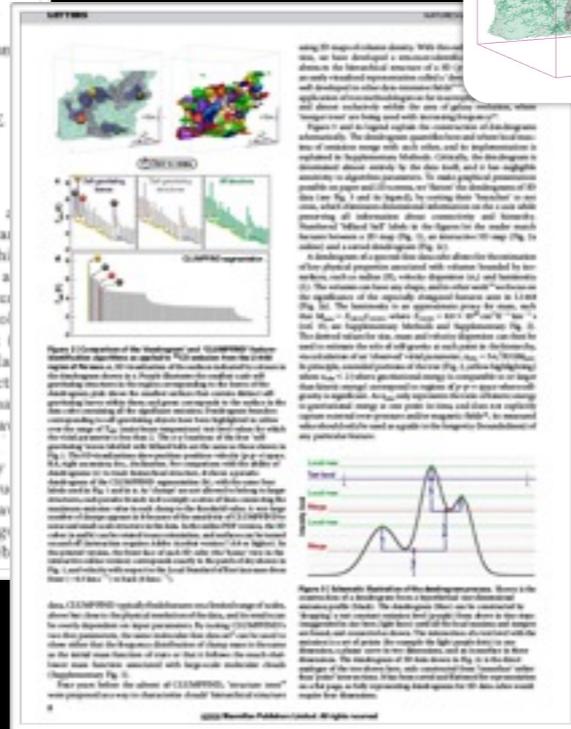
1665

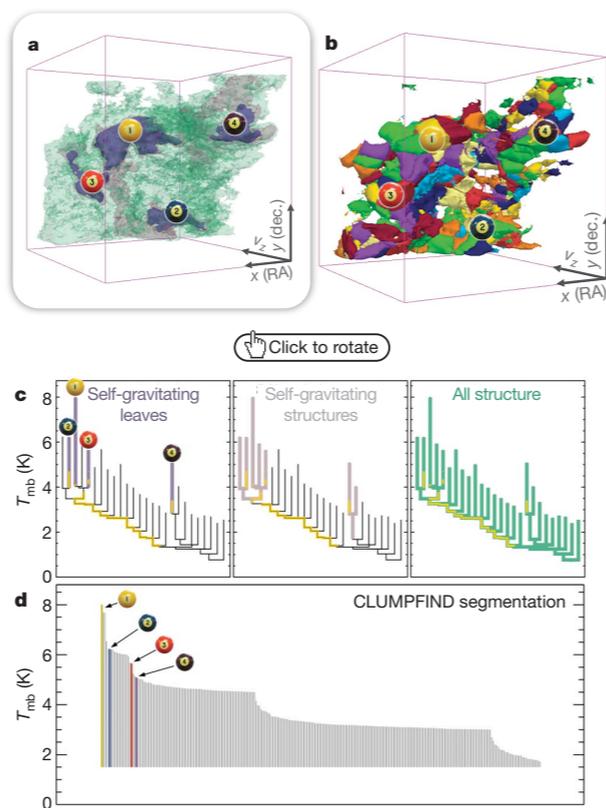


1895



2009





**Figure 2 | Comparison of the 'dendrogram' and 'CLUMPFIND' feature-identification algorithms as applied to  $^{13}\text{CO}$  emission from the L1448 region of Perseus.** **a**, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating structures in the region corresponding to the leaves of the dendrogram; pink shows the smallest surfaces that contain distinct self-gravitating leaves within them; and green corresponds to the surface in the data cube containing all the significant emission. Dendrogram branches corresponding to self-gravitating objects have been highlighted in yellow over the range of  $T_{\text{mb}}$  (main-beam temperature) test-level values for which the virial parameter is less than 2. The  $x$ - $y$  locations of the four 'self-gravitating' leaves labelled with billiard balls are the same as those shown in Fig. 1. The 3D visualizations show position-position-velocity ( $p$ - $p$ - $v$ ) space. RA, right ascension; dec., declination. For comparison with the ability of dendrograms (**c**) to track hierarchical structure, **d** shows a pseudo-dendrogram of the CLUMPFIND segmentation (**b**), with the same four labels used in Fig. 1 and in **a**. As 'clumps' are not allowed to belong to larger structures, each pseudo-branch in **d** is simply a series of lines connecting the maximum emission value in each clump to the threshold value. A very large number of clumps appears in **b** because of the sensitivity of CLUMPFIND to noise and small-scale structure in the data. In the online PDF version, the 3D cubes (**a** and **b**) can be rotated to any orientation, and surfaces can be turned on and off (interaction requires Adobe Acrobat version 7.0.8 or higher). In the printed version, the front face of each 3D cube (the 'home' view in the interactive online version) corresponds exactly to the patch of sky shown in Fig. 1, and velocity with respect to the Local Standard of Rest increases from front ( $-0.5 \text{ km s}^{-1}$ ) to back ( $8 \text{ km s}^{-1}$ ).

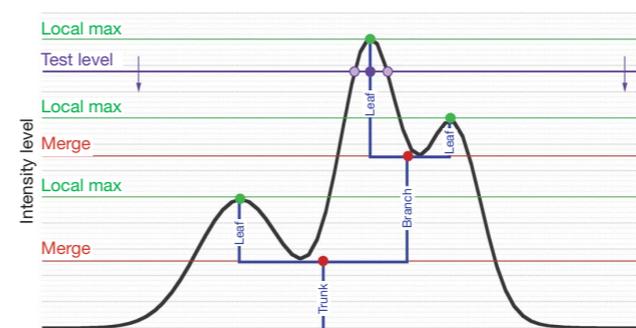
data, CLUMPFIND typically finds features on a limited range of scales, above but close to the physical resolution of the data, and its results can be overly dependent on input parameters. By tuning CLUMPFIND's two free parameters, the same molecular-line data set<sup>8</sup> can be used to show either that the frequency distribution of clump mass is the same as the initial mass function of stars or that it follows the much shallower mass function associated with large-scale molecular clouds (Supplementary Fig. 1).

Four years before the advent of CLUMPFIND, 'structure trees'<sup>9</sup> were proposed as a way to characterize clouds' hierarchical structure

using 2D maps of column density. With the help of previous 2D work as inspiration, we have developed a structure-identification algorithm that abstracts the hierarchical structure of a data set into an easily visualized representation called a dendrogram. This method, well developed in other data-intensive applications such as image segmentation and almost exclusively within the area of computer vision, 'merger trees' are being used with increasing frequency.

Figure 3 and its legend explain the dendrogram process schematically. The dendrogram was constructed from the data set determined almost entirely by the sensitivity to algorithm parameters. The dendrogram is possible on paper and 2D screen space (see Fig. 3 and its legend) and is a 2D cross, which eliminates dimensions while preserving all information. The dendrogram is a 'billiard ball' labelled with numbers 1-4, and features between a 2D map and a sorted dendrogram.

A dendrogram of a spectral line emission cube, such as radius ( $R$ ), length ( $L$ ). The volumes can have any shape, and the dendrogram's self-gravitating 'leaves'. As these peaks mark the location of key physical properties, such as luminosity ( $L_{\text{lum}}$ ), mass ( $M_{\text{lum}}$ ), and velocity dispersion ( $\sigma_v$ ), the derived values for size, mass and velocity dispersion can then be used to estimate the role of self-gravity at each point in the hierarchy, via calculation of an 'observed' virial parameter,  $\alpha_{\text{obs}} = 5\sigma_v^2 R / GM_{\text{lum}}$ . In principle, extended portions of the tree (Fig. 2, yellow highlighting) where  $\alpha_{\text{obs}} < 2$  (where gravitational energy is comparable to or larger than kinetic energy) correspond to regions of  $p$ - $p$ - $v$  space where self-gravity is significant. As  $\alpha_{\text{obs}}$  only represents the ratio of kinetic energy to gravitational energy at one point in time, and does not explicitly capture external over-pressure and/or magnetic fields<sup>16</sup>, its measured value should only be used as a guide to the longevity (boundedness) of any particular feature.



**Figure 3 | Schematic illustration of the dendrogram process.** Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in size here, light lines) until all the local maxima and mergers are found, and connected as shown. The intersection of a test level with the emission is a set of points (for example the light purple dots) in one dimension, a planar curve in two dimensions, and an isosurface in three dimensions. The dendrogram of 3D data shown in Fig. 2c is the direct analogue of the tree shown here, only constructed from 'isosurface' rather than 'point' intersections. It has been sorted and flattened for representation on a flat page, as fully representing dendrograms for 3D data cubes would require four dimensions.

Vol 457 | 1 January 2009 | doi:10.1038/nature07609

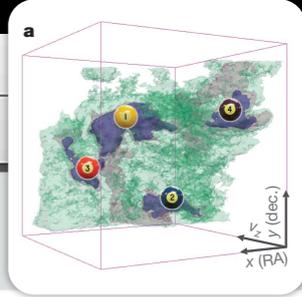
## A role for self-gravity at multiple length scales in the process of star formation

Alyssa A. Goodman<sup>1,2</sup>, Erik W. Rosolowsky<sup>2,3</sup>, Michelle A. Borkin<sup>1†</sup>, Jonathan B. Foster<sup>2</sup>, Michael Halle<sup>1,4</sup>, Jens Kauffmann<sup>1,2</sup> & Jaime E. Pineda<sup>2</sup>

Self-gravity plays a decisive role in the final stages of star formation, where dense cores (size  $\sim 0.1$  parsecs) inside molecular clouds collapse to form star-plus-disk systems'. But self-gravity's role at earlier times (and on larger length scales, such as  $\sim 1$  parsec) is unclear; some molecular cloud simulations that do not include self-gravity suggest that 'turbulent fragmentation' alone is sufficient to create a mass distribution of dense cores that resembles the stellar initial mass function'. Here we report a 'dendrogram' (hierarchical tree-diagram) analysis that reveals, but not everywhere in the observed region. In particular, more than 90 per cent of the compact 'pre-stellar cores' traced by peaks of dust emission' are projected on the sky within one of the dendrogram's self-gravitating 'leaves'. As these peaks mark the loca-



overlapping features as an option, significant emission found between prominent clumps is typically either appended to the nearest clump or turned into a small, usually 'pathological', feature needed to encompass all the emission being modelled. When applied to molecular-line



# LETTERS

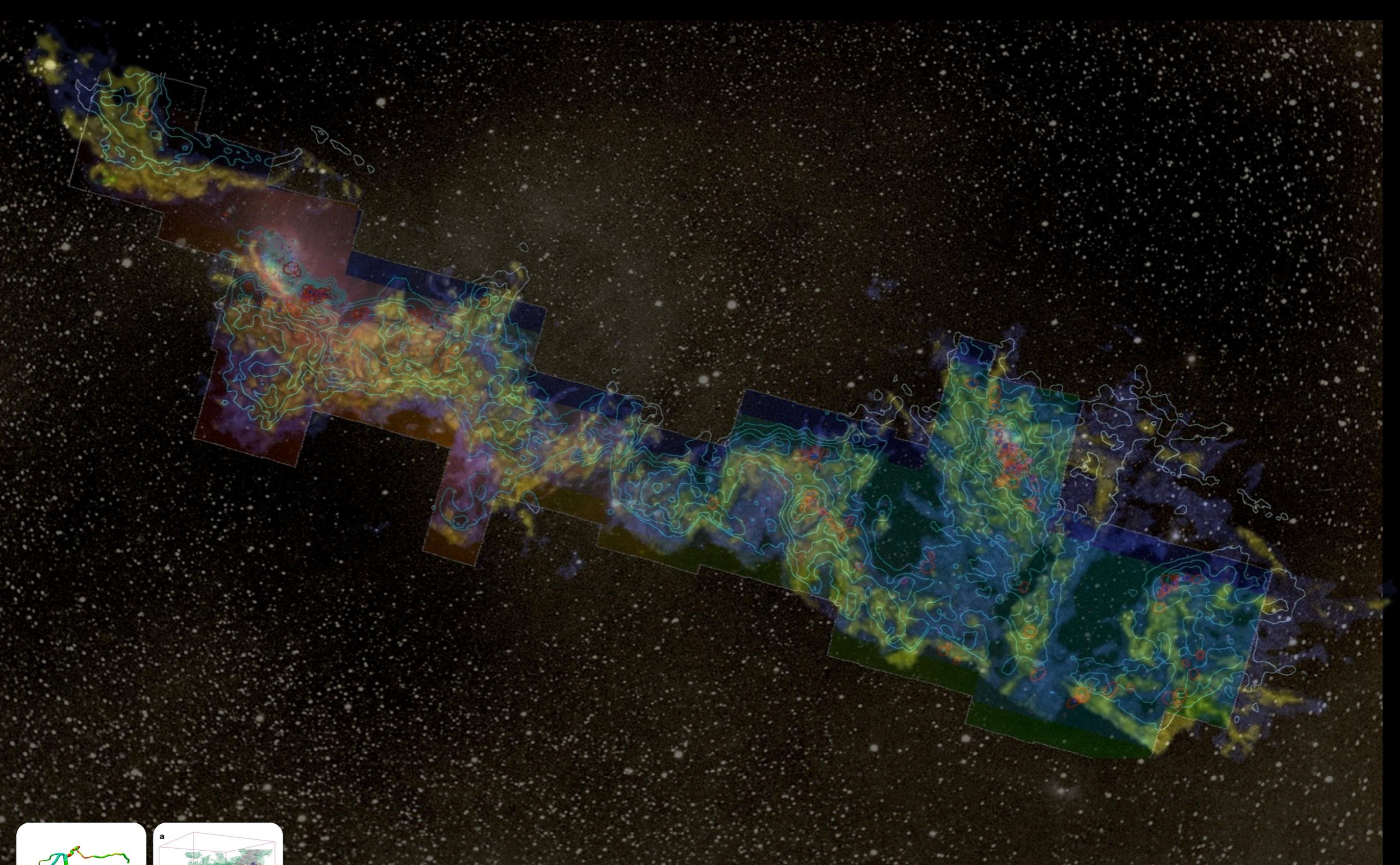
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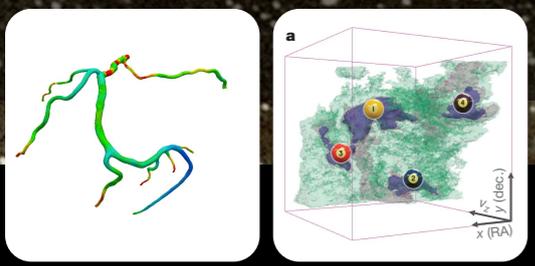
Self-gravity plays a decisive role in the final stages of star formation, where dense cores (size ~0.1 parsecs) inside molecular clouds collapse to form star-plus-disk systems<sup>1</sup>. But self-gravity's role at earlier times (and on larger length scales, such as ~1 parsec) is unclear; some molecular cloud simulations that do not include self-gravity suggest that 'turbulent fragmentation' alone is sufficient to create a mass distribution of dense cores that resembles, and sets, the stellar initial mass function<sup>2</sup>. Here we report a 'dendrogram' (hierarchical tree-diagram) analysis that reveals that self-gravity plays a significant role over the full range of possible scales traced by <sup>13</sup>CO observations in the L1448 molecular cloud, but not everywhere in the observed region. In particular, more than 90 per cent of the compact 'pre-stellar cores' traced by peaks of dust emission<sup>3</sup> are projected on the sky within one of the dendrogram's self-gravitating 'leaves'. As these peaks mark the locations of already-forming stars, or of those probably about to form, a self-gravitating cocoon seems a critical condition for their exist-

overlapping features as an option, significant emission found between prominent clumps is typically either appended to the nearest clump or turned into a small, usually 'pathological', feature needed to encompass all the emission being modelled. When applied to molecular-line





3D Viz made with VolView



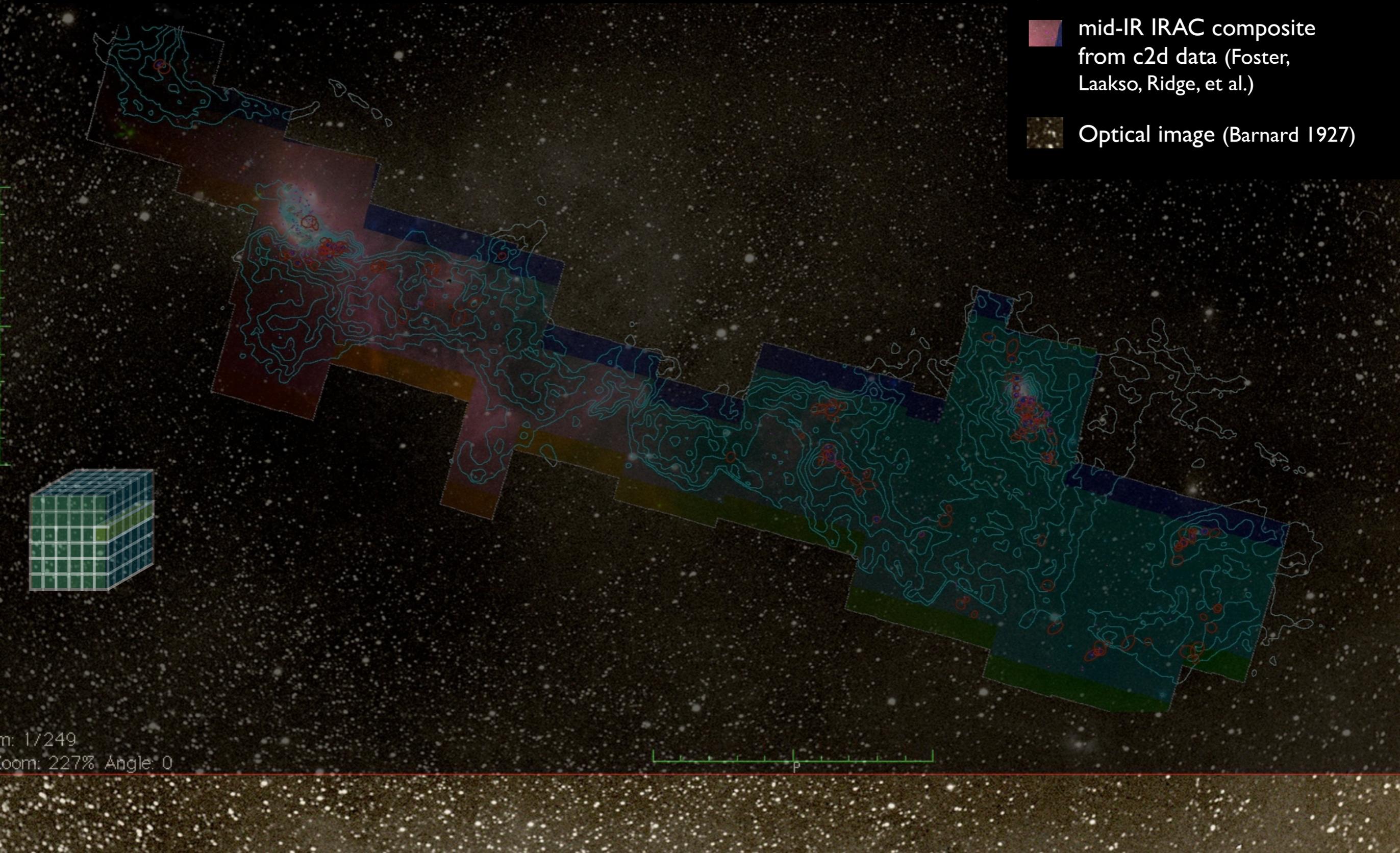
AstronomicalMedicine@



COMPLETE

# The “old” way

-  mm peak (Enoch et al. 2006)
-  sub-mm peak (Hatchell et al. 2005, Kirk et al. 2006)
-   $^{13}\text{CO}$  (Ridge et al. 2006)
-  mid-IR IRAC composite from c2d data (Foster, Laakso, Ridge, et al.)
-  Optical image (Barnard 1927)



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Index

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13 Comments

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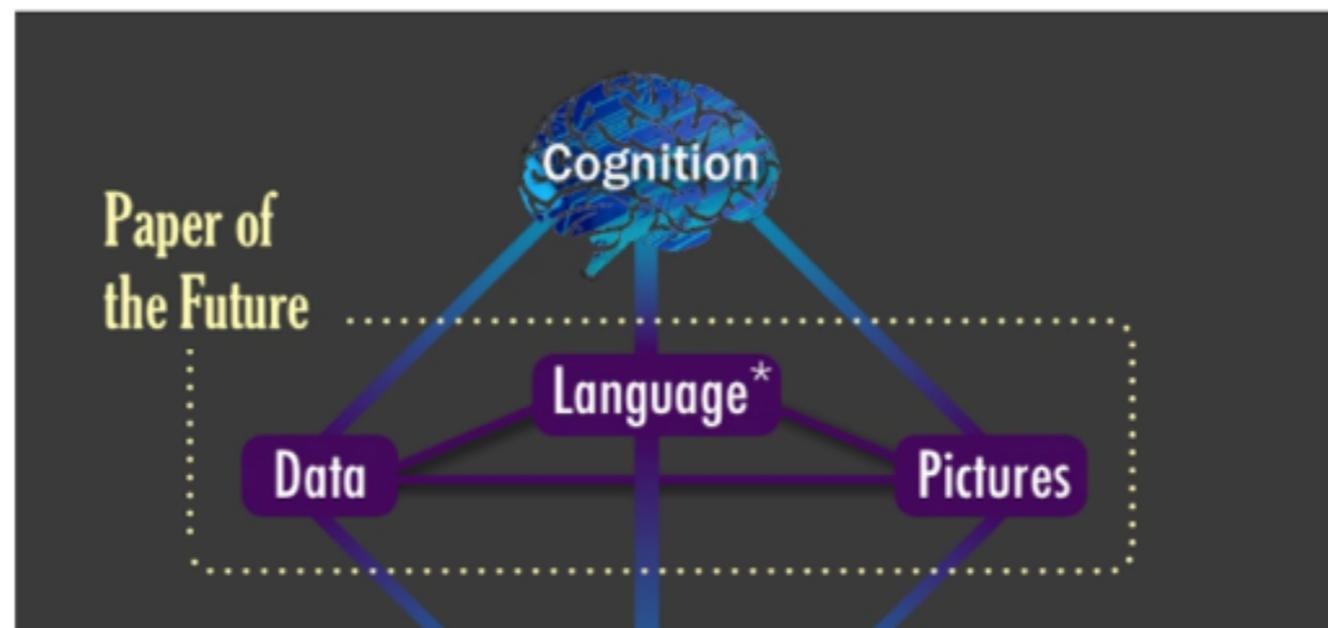
# The "Paper" of the Future

[Alyssa Goodman](#), [Josh Peek](#), [How-Huan Hope Chen](#), [Nathan Jenkins](#), [August Muench](#), [Chris Beaumont](#), [Christine L. Borgman](#), [Alberto Pepe](#), [Alberto Accomazzi](#), [Christopher Erdmann](#), [Curtis Wong](#) [+ Add author](#)

## 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. Thus, when considering the future of scholarly communication, we should be careful not to blithely do away with the linear narrative format that articles and books have followed for centuries: instead, we should enrich it.

Much more than text is used to communicate in Science. "Figures," which include images, diagrams, graphs, charts, and more, have enriched scholarly articles since the time of Galileo, and ever-growing volumes of data underpin most scientific papers. When scientists communicate face-to-face, as in talks or small discussions, these figures are often the focus of the conversation. In the best discussions, scientists have the ability to manipulate the figures, and to access underlying data, in real-time, so as to test out various what-if scenarios, and to explain findings more clearly. **This short article explains--and shows with demonstrations--how scholarly "publications" can morph into long-lasting rich records of scientific discourse**, enriched with deep data and code linkages, interactive figures, audio, video, and commenting.



# The Present

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7.2 km s<sup>-1</sup> (see, respectively, As its position explains in detail, Figure 10.10, colored lines are associated with the near part of the Scutum-Centaurus Arm. The versions of the Sky view shown, one pointing to the Galactic Center, the other also accounting for the tilt of the Galactic coordinate system caused by the Galactic rotation, are shown in the top panel. The dashed lines in Figure 10.10, indicating the predicted position of the Galactic Plane on the Sky when viewed from the Sun, are shown in the bottom panel. The distance to the near part of the Scutum-Centaurus Arm, passing directly through Nessie, regardless of whether or not color-coded, "tilt" the coordinate system caused by SgrA's offset. Solid colored lines show 20 pc above and below the Plane at the distance to the Scutum-Centaurus Arm, so Figure 10.10 (colored lines) makes it is very clear that Nessie lies within just a few pc of the Plane, along its entire length. This is either an extremely fortuitous coincidence, or an indication that Nessie is tracing a significant feature that effectively marks the mean location of the Galactic Plane. Given the waviness of the plane on 10 pc scales (see above, [Lalor&Mahotra1994](#)), the location at even less than 10 pc from the mean plane may be fortuitous—but the location so close to the mean is not.

In terms of total mass, there is about 1,000 times more phytomass (photosynthetic plants, phytoplankton, and so on) on the planet than animals. Yet animals consume almost 20% of the total phytomass produced each year by nibbling, scraping, and filter-feeding through the microbial pastures of the ocean. Who owns the planet, plants or animals?

Plants paint a record of climate conditions on the face of the earth. In response to extended warming trends, plant hardiness zones move north. The Carolina perennial becomes a Maryland perennial.

Readers of *Life on Earth* will understand how environmental factors like temperature and precipitation act like control handles that govern the functioning of the ecosystem and determine the regional viability of plants and animals.

As the keystone species of the Earth, proprietors of an industrial civilization, we have choices to make. Education now is the key to wisdom later.

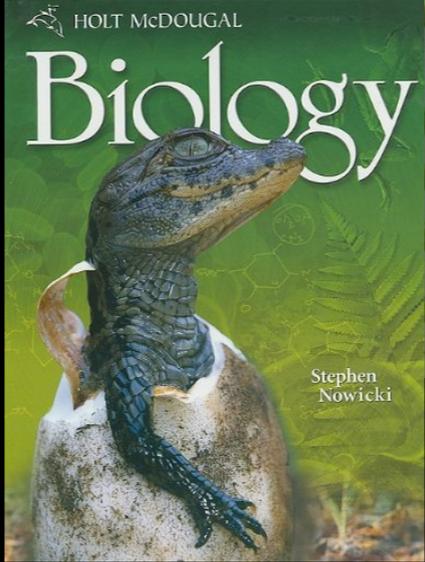


Fig. 4 — For the fourth quadrant of the Milky Way, contours of constant LSR velocity (30, 40, and 50 km s<sup>-1</sup>) (using a rotation curve from McClure-O'Griffiths & Dickey 2007, ) superimposed on a cartoon model of the Milky Way. CO and dense gas observations (see below) give LSR velocities associated with Nessie (shown here as rainbow curve) near 40 km s<sup>-1</sup>, placing Nessie in the Scutum-Centaurus arm (highlighted in black), about 3.1 kpc from the Sun. Yellow-highlighted curves show positions in the Galaxy that would have labeled value of Galactic Latitude (l) when viewed from the Sun. In the top panel, only height of the Sun off the plane (taken to be 25 pc in this example) is considered in drawing the iso-b curves, and in the bottom panel, a 7 pc offset of the Galactic Center (see text), which causes an overall tilt of 0.12° (see text) taken into account. ) curves, and in the bottom panel, a 7 pc offset of the Galactic Center (see text) causes an overall tilt of 0.12° is also taken into account.

Figure 10.10 Comparison of the kinematic and kinematic features of the Scutum-Centaurus arm. The top panel shows the kinematic features of the Scutum-Centaurus arm, including the LSR velocity contours and the location of Nessie. The bottom panel shows the kinematic features of the Scutum-Centaurus arm, including the LSR velocity contours and the location of Nessie.



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# Real Life

# 2000

# "Science"

The screenshot shows the KAYAK website interface for a flight search. The search parameters are London, United Kingdom to Boston, MA, United States, from 06/03/2013 to 13/03/2013. The results show 55 of 1327 flights, sorted by Price - Low to High. The first flight is Delta for £420, and the second is Virgin Atlantic for £445. The interface includes a 'Check Fares' section with a promotional offer for up to 10% off flights and 15% off hotels in Boston. There are also sections for 'Price Trend', 'Stops', 'Times', and 'Airports'.

The screenshot shows the VAO Data Discovery Tool interface. The search query is 'ngc1333' with a radius of 1. The results table lists various data sources and their titles. The table has columns for Type, Short Name, and Title. The results include ADS (Astrophysics Data System), CADC (CADC Image Search), SIMBAD (The SIMBAD astronomical database), NOMAD (NOMAD Catalogue), and UKIDSS DR5 SPAP (UKIDSS DR5 SPAP Service).

Type	Short Name	Title
ADS	ADS	Astrophysics Data System
CADC	CADC	CADC Image Search
CADC/CFHT	CADC/CFHT	CADC/CFHT Image Search
CADC/3DMT	CADC/3DMT	CADC/3DMT Image Search
Simbad	Simbad	The SIMBAD astronomical database
NOMAD	NOMAD	NOMAD Catalogue
ZMASS QL	ZMASS QL	ZMASS All-Sky Quicklook Image Service
MAST-Scrapbook	MAST-Scrapbook	The MAST Image Scrapbook
IRSA	IRSA	The IRAS Sky Survey Atlas
UKIDSS DR5 SPAP	UKIDSS DR5 SPAP	UKIDSS DR5 SPAP Service
UKIDSS DR7 SPAP	UKIDSS DR7 SPAP	UKIDSS DR7 SPAP Service
UKIDSS DR8 SPAP	UKIDSS DR8 SPAP	UKIDSS DR8 SPAP Service
UKIDSS DR4 SPAP	UKIDSS DR4 SPAP	UKIDSS DR4 SPAP Service
UKIDSS DR3 SPAP	UKIDSS DR3 SPAP	UKIDSS DR3 SPAP Service
HLA [1]	HLA [1]	Hubble Legacy Archive
NED(sources)	NED(sources)	The NASA/IPAC Extragalactic Database
NED/SED	NED/SED	The NASA/IPAC Extragalactic Database SED
NED(images)	NED(images)	The NASA/IPAC Extragalactic Database Images

# KAYAK

<http://www.rome2rio.com>

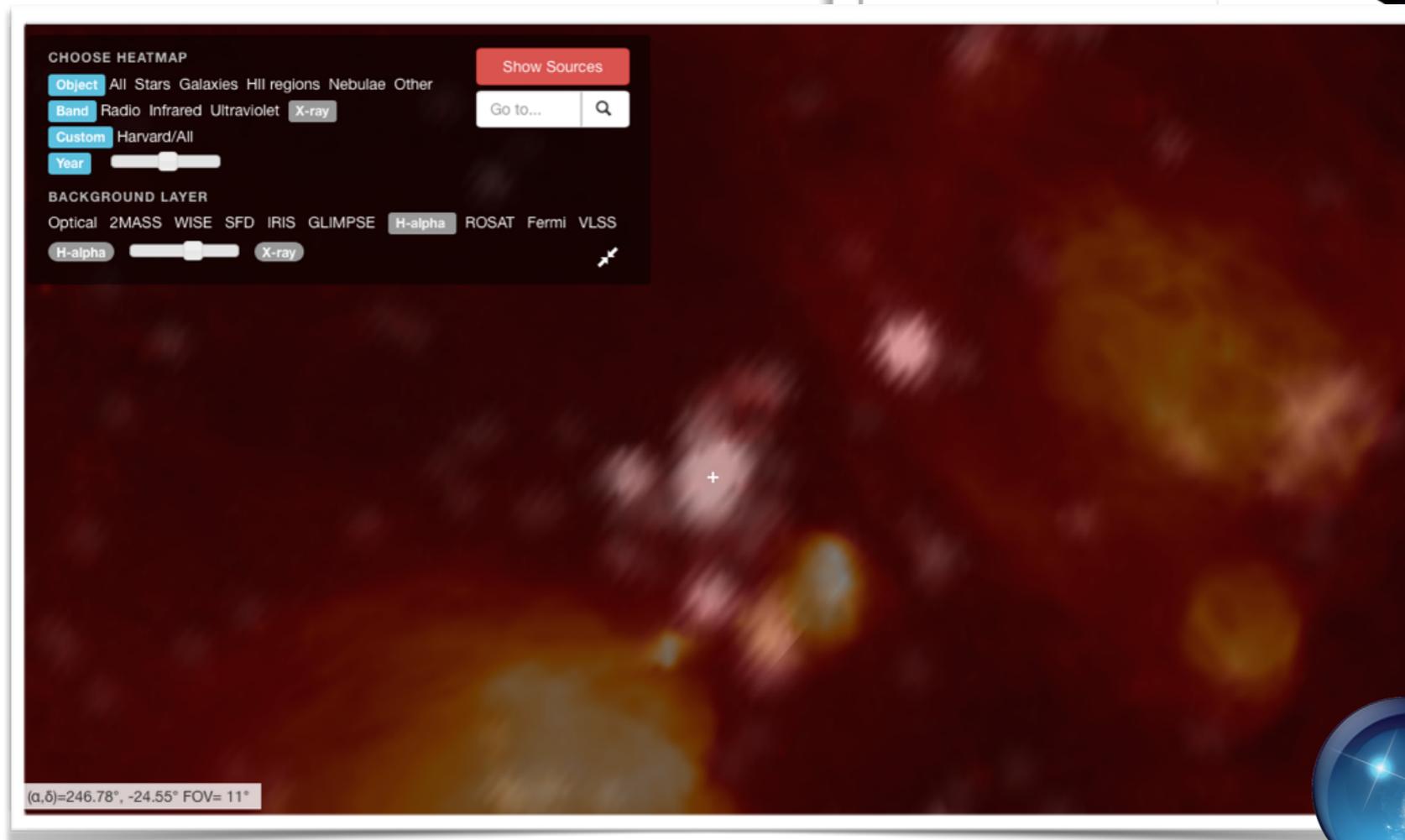
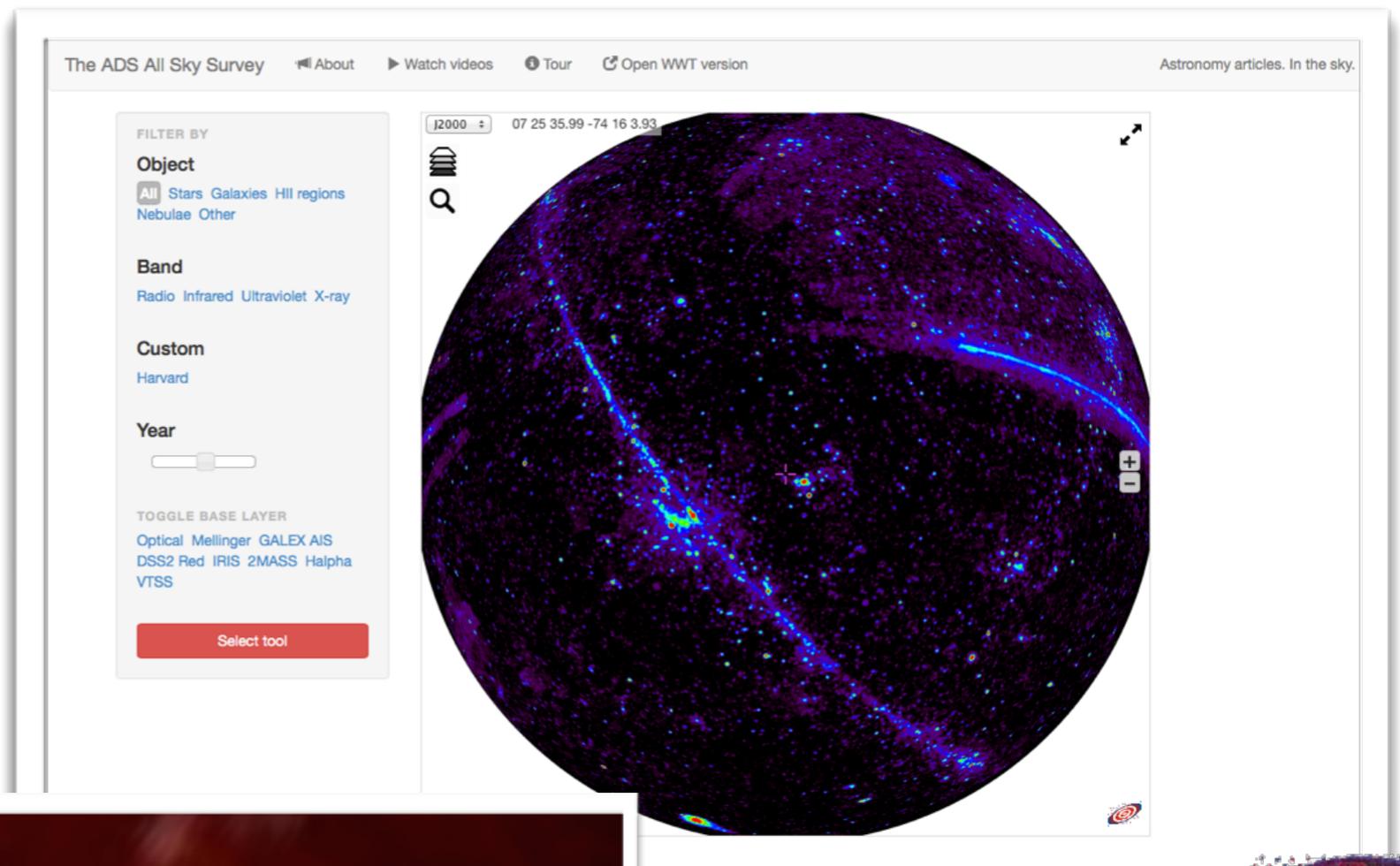
# VAO Data Discovery Tool

# The Present

A screenshot of a Facebook group page for "Astronomers". The page header shows the group name, a search bar, and navigation options like "Home", "Messages", and "Notifications". The main content area features a large, vibrant image of a galaxy or nebula. Below the image, there are tabs for "Astronomers", "Members", "Events", "Photos", and "Files". A "Write Post" section is visible with options to "Add Photo / Video", "Ask Question", and "Add File". A post by "JoEllen McBride via Julie Lauffenburger" is shown, with the text "This is an interesting breakdown by topic of ArXiv paper authorship." and an image of three stylized figures.

A screenshot of a Twitter search results page for the query "bicep2". The page shows a list of tweets related to the topic. The top tweet is from "Dark Matter Hunters" (@DMHunters) with the text "Neutrinos and dark energy after Planck and BICEP2: data consistency tests and cosmological parameter dmhunters.org/?p=10494 #darkmatt". Other tweets include a link to a Washington Post article, a tweet in Spanish from Antonio Herrera, and tweets from arXiver, Dr. Michael Reidinger, and Lindsworth Deer. The page also features a "Who to follow" section with suggestions like Barclaycard US, Astroinformatics, and Tanya Harrison.

# The Present



try it at  
[adsass.org](http://adsass.org)

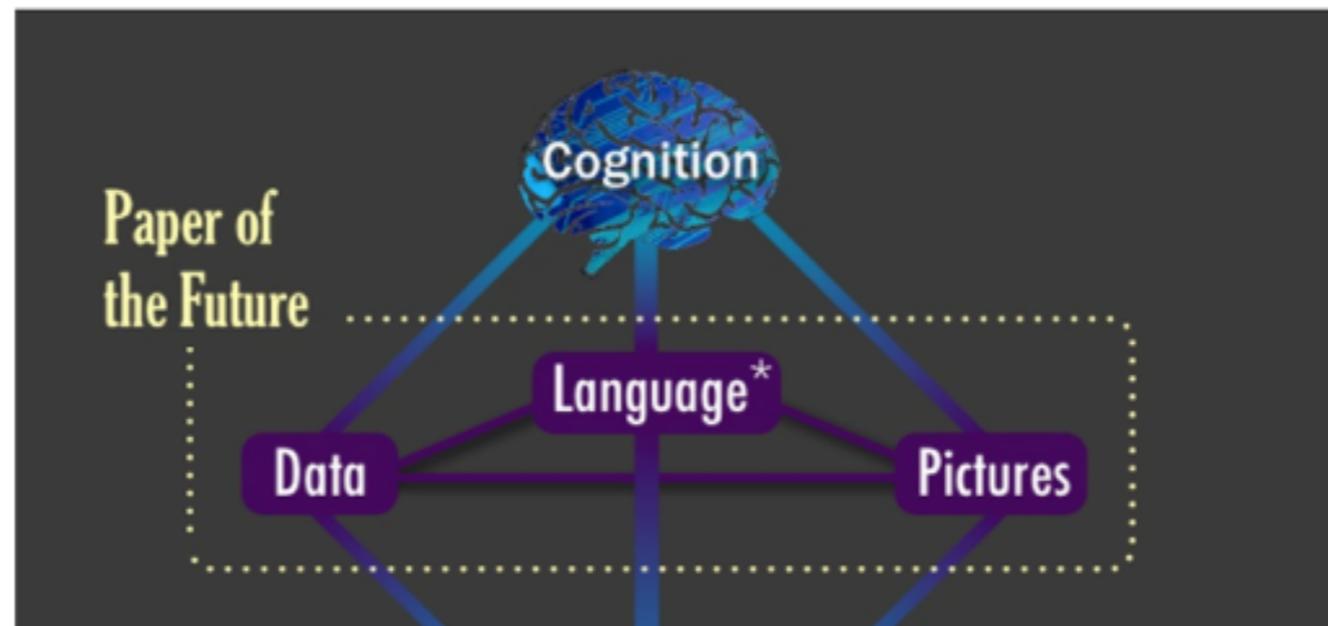
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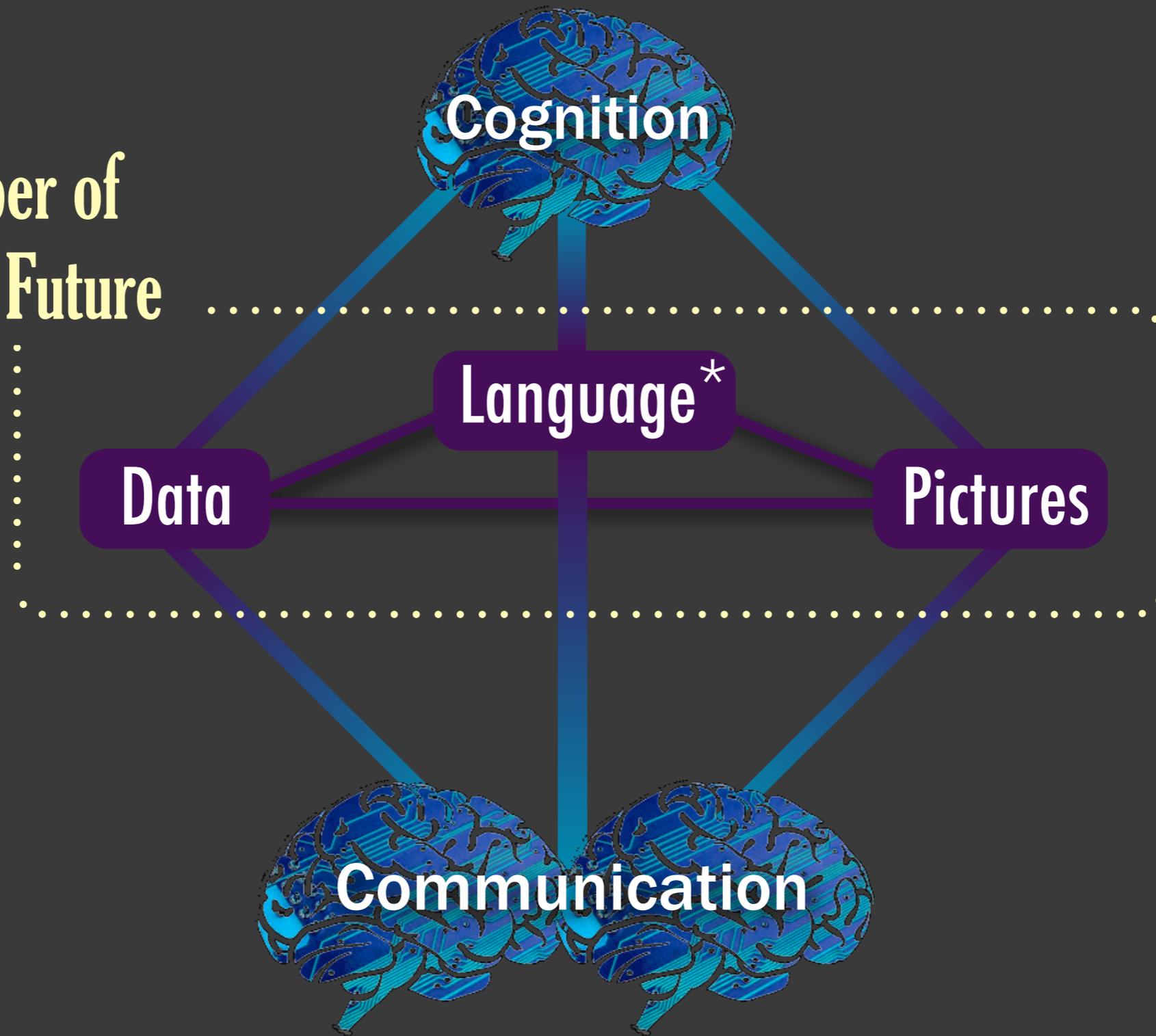
## 1 Preamble

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. Thus, when considering the future of scholarly communication, we should be careful not to blithely do away with the linear narrative format that articles and books have followed for centuries: instead, we should enrich it.

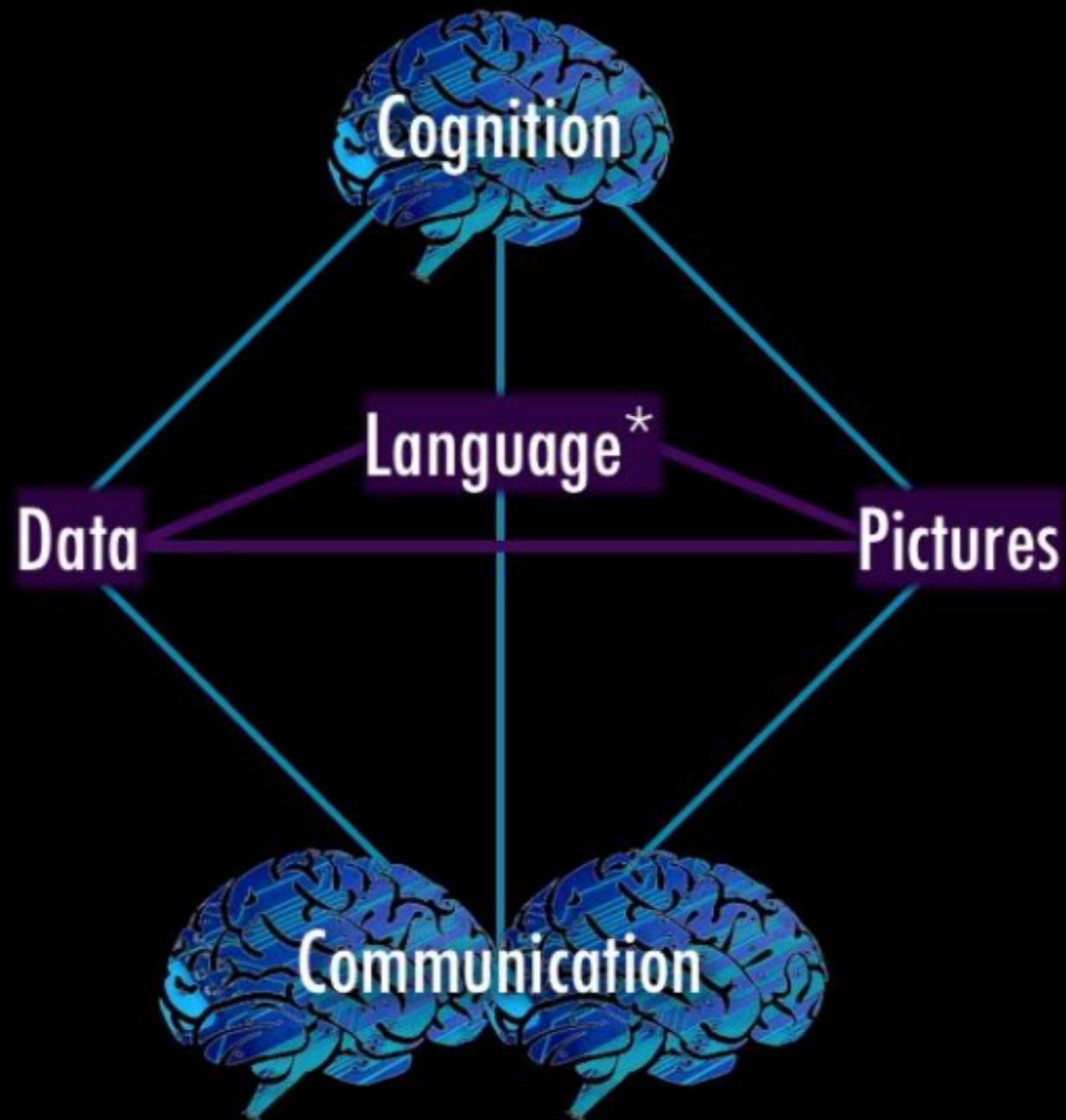
Much more than text is used to communicate in Science. "Figures," which include images, diagrams, graphs, charts, and more, have enriched scholarly articles since the time of Galileo, and ever-growing volumes of data underpin most scientific papers. When scientists communicate face-to-face, as in talks or small discussions, these figures are often the focus of the conversation. In the best discussions, scientists have the ability to manipulate the figures, and to access underlying data, in real-time, so as to test out various what-if scenarios, and to explain findings more clearly. **This short article explains--and shows with demonstrations--how scholarly "publications" can morph into long-lasting rich records of scientific discourse**, enriched with deep data and code linkages, interactive figures, audio, video, and commenting.



# Paper of the Future



\*"Language" includes words & math



\*"Language" includes words & math



55 Alyssa Goodman @aagie · 11s

Seen these relationships between data:words:pictures re:cognition & communication before? If so, where?

@SciTechProf [pic.twitter.com/VTjjCzDZYc](https://pic.twitter.com/VTjjCzDZYc)

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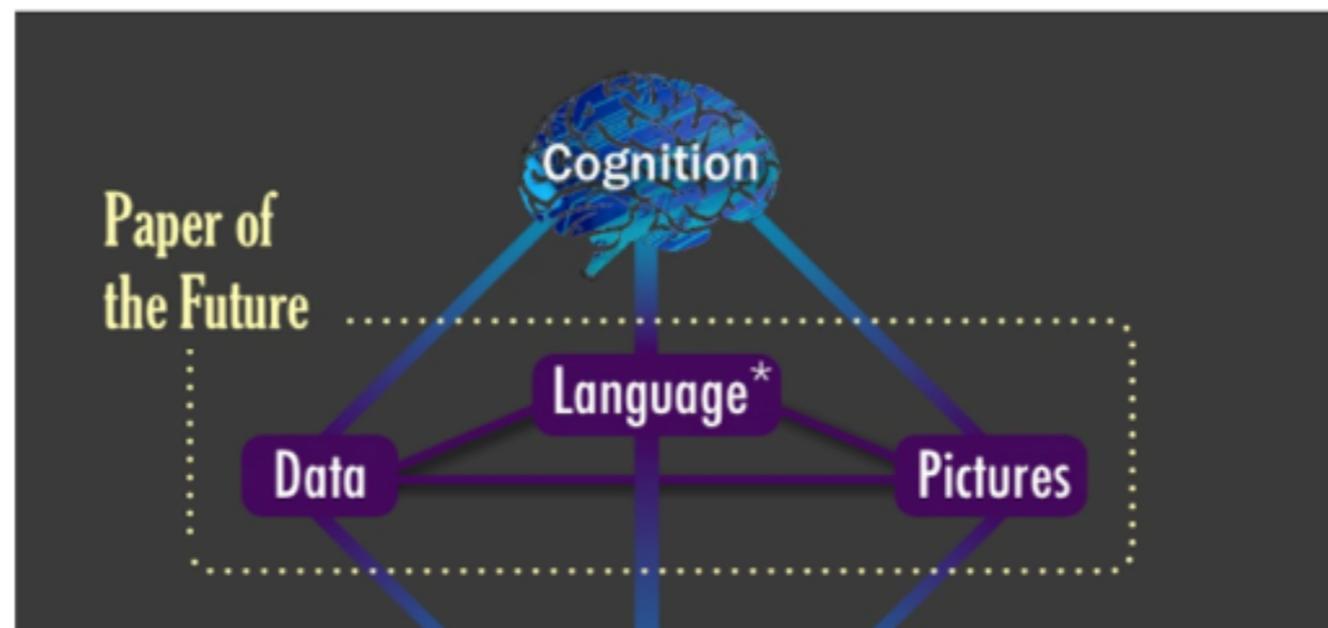
# The "Paper" of the Future

[Alyssa Goodman](#), [Josh Peek](#), [How-Huan Hope Chen](#), [Nathan Jenkins](#), [August Muench](#), [Chris Beaumont](#), [Christine L. Borgman](#), [Alberto Pepe](#), [Alberto Accomazzi](#), [Christopher Erdmann](#), [Curtis Wong](#) [+ Add author](#)

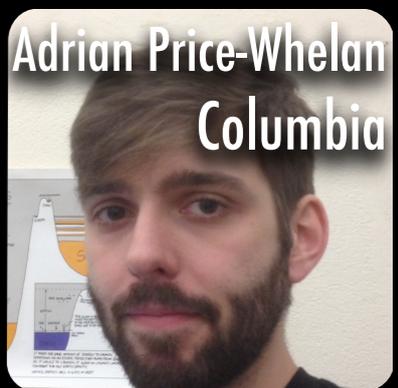
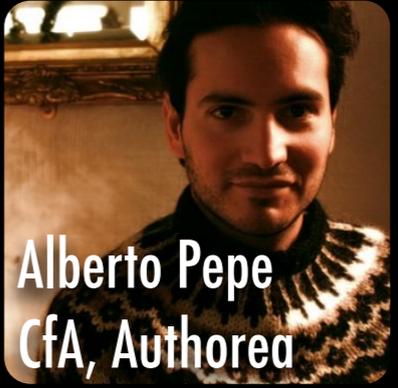
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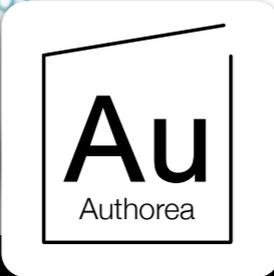
Much more than text is used to communicate in Science. "Figures," which include images, diagrams, graphs, charts, and more, have enriched scholarly articles since the time of Galileo, and ever-growing volumes of data underpin most scientific papers. When scientists communicate face-to-face, as in talks or small discussions, these figures are often the focus of the conversation. In the best discussions, scientists have the ability to manipulate the figures, and to access underlying data, in real-time, so as to test out various what-if scenarios, and to explain findings more clearly. **This short article explains--and shows with demonstrations--how scholarly "publications" can morph into long-lasting rich records of scientific discourse**, enriched with deep data and code linkages, interactive figures, audio, video, and commenting.



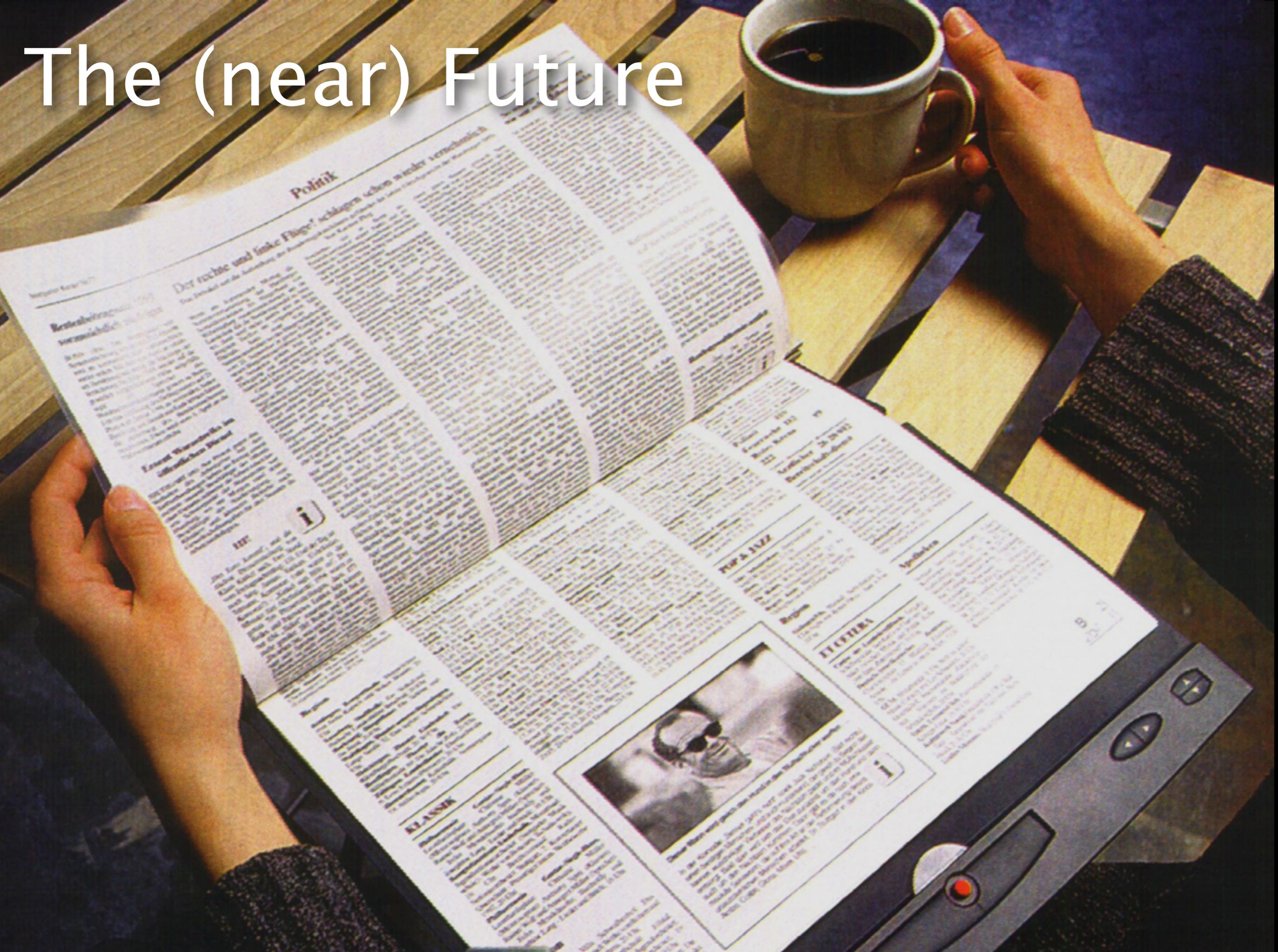
# “The Story & the Sandbox” (Glue:D3PO:Authorea)



The screenshot shows a web browser displaying an Authorea article. The URL is [https://www.authorea.com/users/2786/articles/4039/\\_show\\_article](https://www.authorea.com/users/2786/articles/4039/_show_article). The page features a navigation bar with links for BROWSE, ABOUT, CONTACT, PLANS, FEEDBACK, HELP, and a user profile for JOSH PEEK. The article title is "Beyond Galileo" by Josh Peek and Alberto Pepe. The article text discusses Galileo's discovery of four objects near Jupiter in 1610. A quote from Galileo's *Sidereus Nuncius* is included: "I therefore concluded and decided unhesitatingly, that there are three stars in the heavens moving about Jupiter, as Venus and Mercury round the Sun; which at length was established as clear as daylight by numerous subsequent observations. These observations also established that there are not only three, but four, erratic sidereal bodies performing their revolutions round Jupiter...the revolutions are so swift that an observer may generally get differences of position every hour." (Galilei 1610)



# The (near) Future



# 2002 Patent Application for e-Scroll

Patents

Application

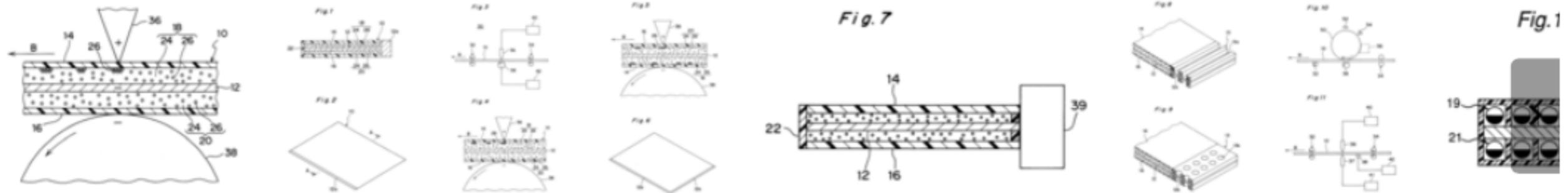
Grant

## Rewritable display sheet, image forming apparatus for displaying image on rewritable display sheet, and image displaying method US 6618188 B2

### ABSTRACT

Provided is a rewritable display sheet capable of displaying different images on both surfaces. The rewritable display sheet **10** of the present invention is provided with a conductive substrate **12** that has a voltage applying section **12 a** at an end portion, transparent sheets **14** and **16** provided on both sides of the conductive substrate **12**, and display layers **18** and **20** which are provided between the conductive substrate **12** and the transparent sheets **14** and **16** and in which an image is written with an electric field applied.

### IMAGES (8)



Publication number	US6618188 B2
Publication type	Grant
Application number	US 10/097,273
Publication date	Sep 9, 2003
Filing date	Mar 15, 2002
Priority date	Mar 23, 2001
Fee status	Paid

Also published as [US20020135859](#)

Inventors [Masayasu Haga](#)

Original Assignee [Minolta Co., Ltd.](#)

Export Citation [BiBTeX](#), [EndNote](#), [RefMan](#)

[Patent Citations](#) (12), [Classifications](#) (8), [Legal Events](#) (3)

External Links: [USPTO](#), [USPTO Assignment](#), [Espacenet](#)

# Future Learning

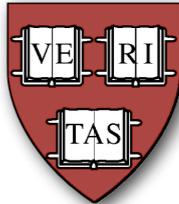
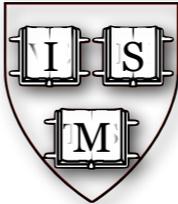
## WorldWide Telescope Ambassadors



## Higher Ed

the 2013 experiment

HARVARD UNIVERSITY  
ASTRONOMY 201B  
DEMOFEST



LOCATION  
Perkin Lobby and Wolbach Library, 60 Garden Street

TIME  
11-12 for drop-in demos  
12-12:45 lunch for students & their guests

PREVIEW  
<http://ay201b.wordpress.com/topical-modules>



# Microsoft World



Experience WWT at [worldwidetelescope.org](http://worldwidetelescope.org)

The screenshot shows the WWT interface with a top navigation bar containing 'Explore', 'Guided Tours', 'Search', 'View', and 'Settings'. Below this is a 'Collections > All-Sky Surveys >' section with a row of image thumbnails: 'Digitized Sky Survey', 'VLSS: VLA Low-frequency Sky Survey', 'WMAP ILC 5-Year Cosmic Microwave Background', 'SFD Dust Map (Infrared)', 'IRIS: Improved Resolution', '2MASS: Two Micron All Sky Survey', and 'Hydrogen Alpha Filter'. A central circular field of view shows a galaxy with a crosshair. A 'Finder Scope' window is open, displaying 'NGC224' with its classification as a 'Spiral Galaxy in Andromeda' and various astronomical coordinates (RA, Dec, Alt, Az, Rise, Transit, Set). Below the main view is a 'Look At' dropdown set to 'Sky', an 'Imagery' section with 'Digitized Sky Survey' and 'Three Faces of Andromeda', and a 'Context bar' showing 'NGC221' and 'M31'. A 'Context globe' on the right shows the current field of view on a celestial sphere.

Seamlessly explore imagery from the best ground and space-based telescopes in the world

Expert led tours of the Universe

Control time to study how the night sky changes

View and compare images from across the electromagnetic spectrum

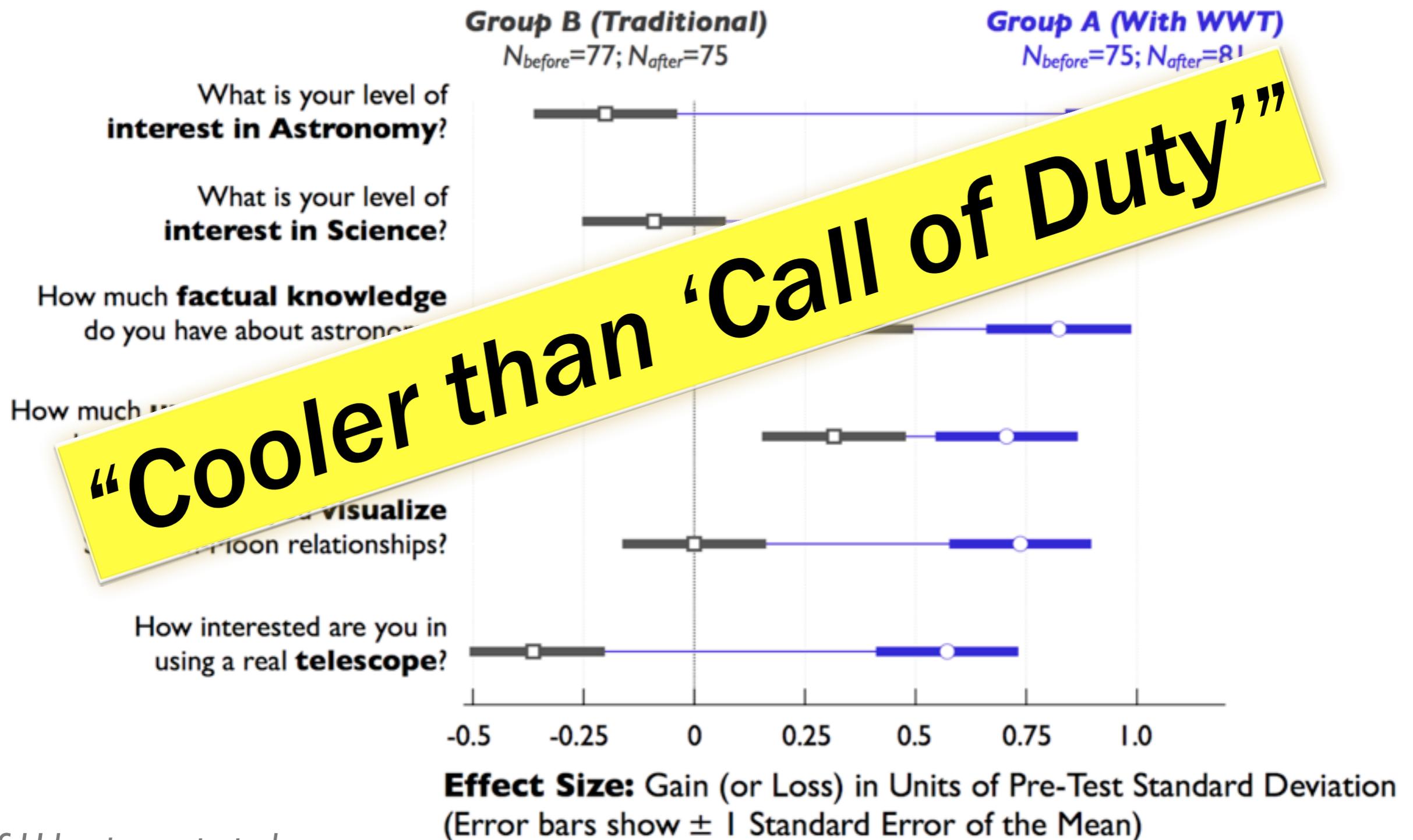
Much more than "just" the sky at night! 3D features can take you to other planets, stars & galaxies.

Finder Scope links to Wikipedia, publications, and data, so you can learn more

Context bar shows items of interest in current field of view

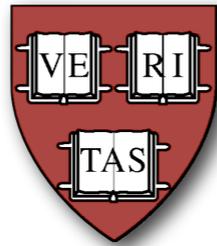
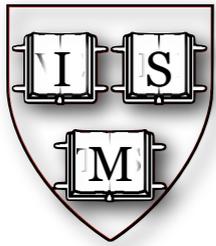
Context globe shows where you're looking.

# Gains in Student Interest and Understanding



the 2013 experiment

# HARVARD UNIVERSITY ASTRONOMY 201B DEMOFEST



## LOCATION

Perkin Lobby and Wolbach Library, 60 Garden Street

## TIME

11-12 for drop-in demos  
12-12:45 lunch for students & their guests

## PREVIEW

<http://ay201b.wordpress.com/topical-modules>



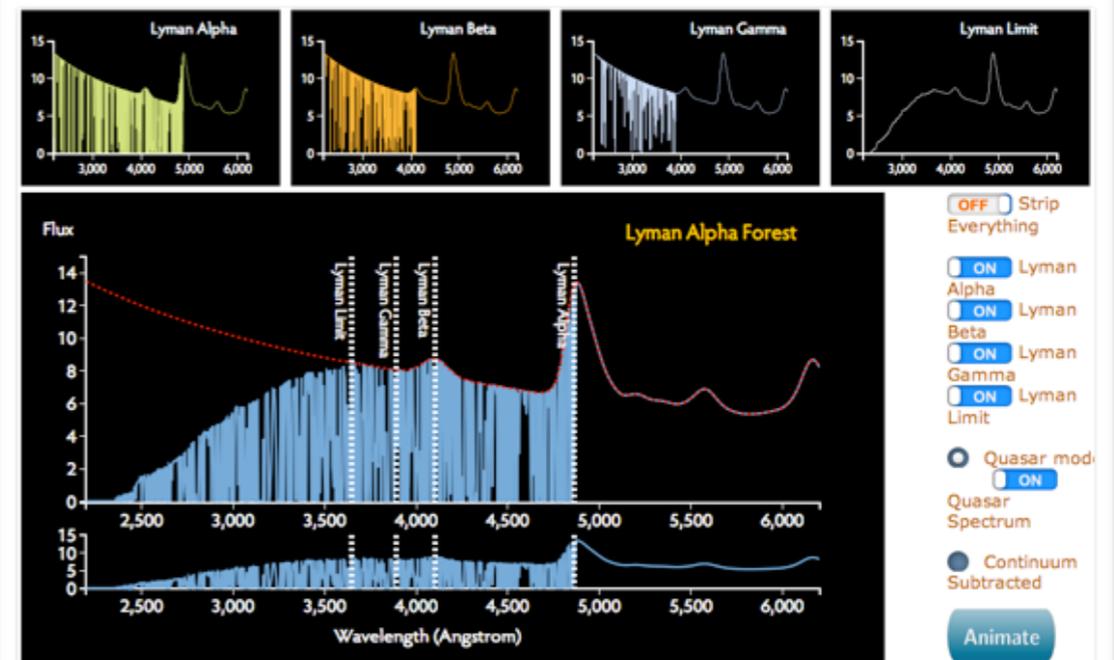
# Viz in Higher-Ed

Stephen

all lines SII 6716/6731 A He 6683 A OIII 5007 A

Yuan-Sen  
Ting

## Interstellar Absorption and the Lyman Alpha Forest



JavaScript

[https://www.cfa.harvard.edu/~yuan-sen.ting/lyman\\_alpha.html](https://www.cfa.harvard.edu/~yuan-sen.ting/lyman_alpha.html)

JavaScript

<http://portillo.ca/nebula/>

# The Future

bendable paper

everything is a screen

data are everywhere

everyone's data are shared

new data are community efforts, and community property

software is modular, seamless, and largely invisible

