



View in Aladin • View in WorldWide Telescope



[adsass.org](https://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

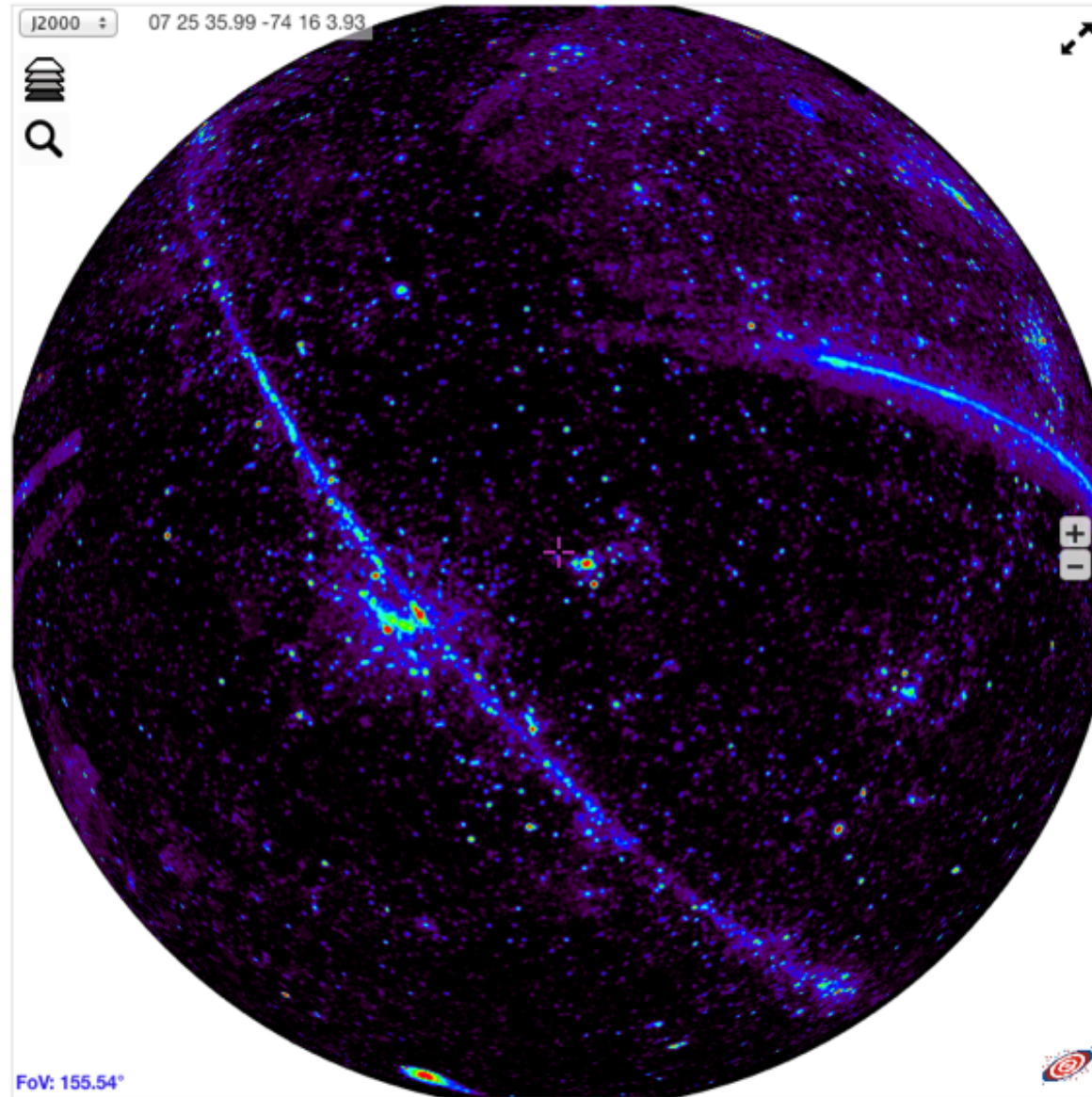
**Year**

Slider control

TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool





# let's zoom in (on Ophiuchus)

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Astronomy articles. In the sky

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

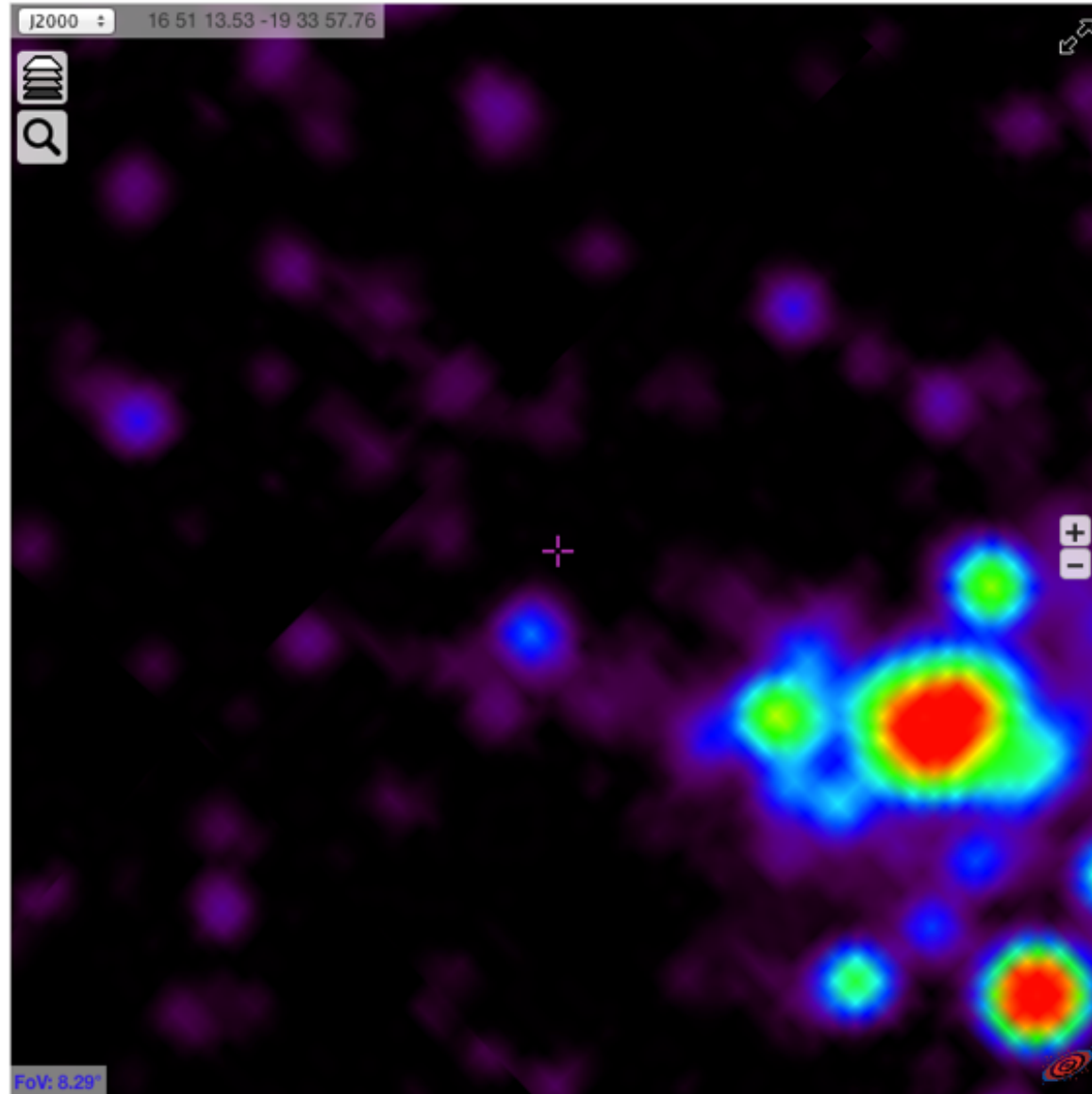
Year



TOGGLE BASE LAYER

Optical Mellinger GALEX AIS  
DSS2 Red IRIS 2MASS Halpha  
VTSS

Select tool



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

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Astronomy articles. In the sky

## FILTER BY

### Object

All Stars Galaxies HII regions  
Nebulae Other

### Band

Radio Infrared Ultraviolet X-ray

### Custom

Harvard

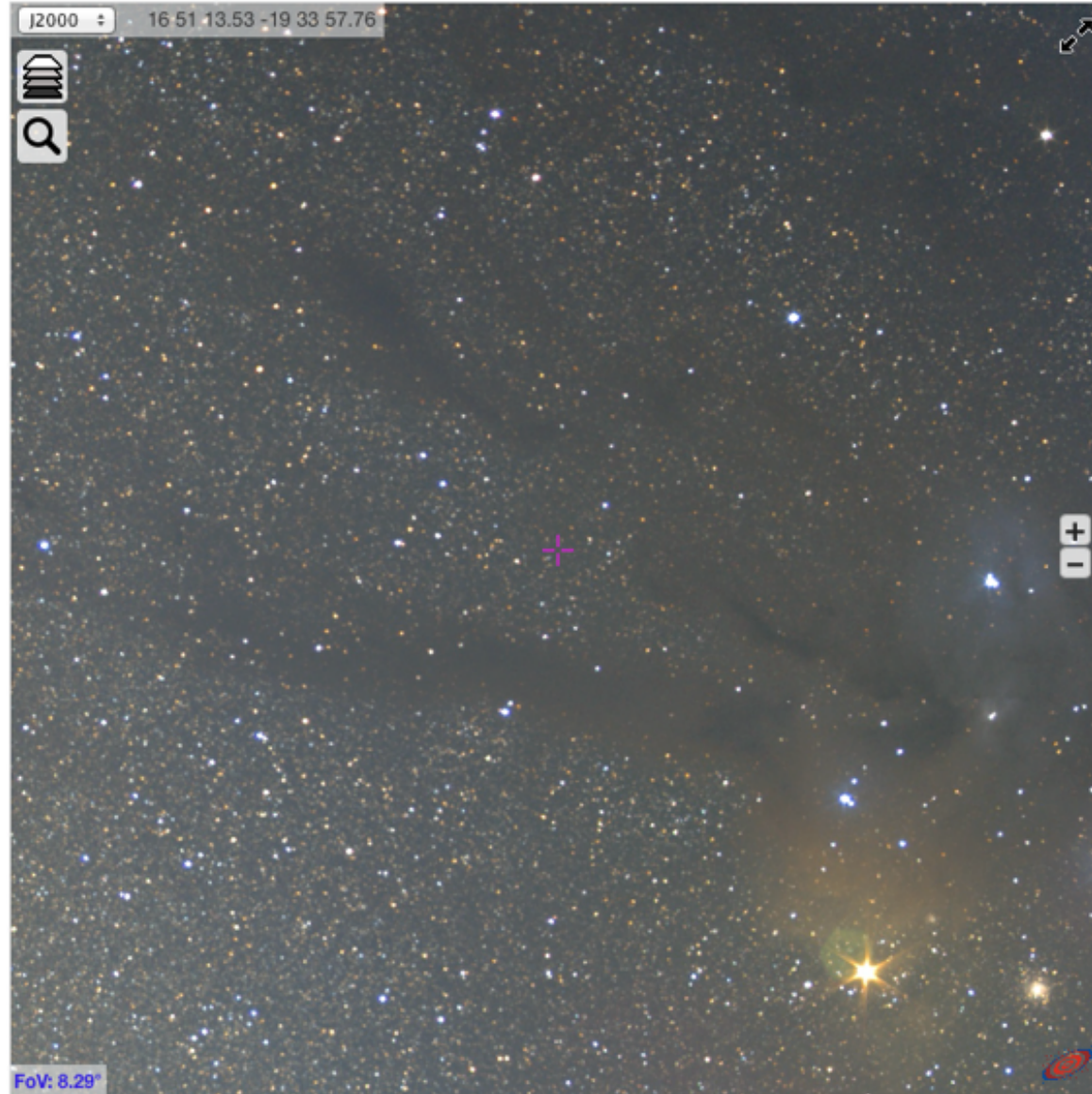
### Year



## TOGGLE BASE LAYER

Optical **Mellinger** GALEX AIS  
DSS2 Red IRIS XMM/ISS Halpha  
VTSS

Select tool



FoV: 8.29°





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

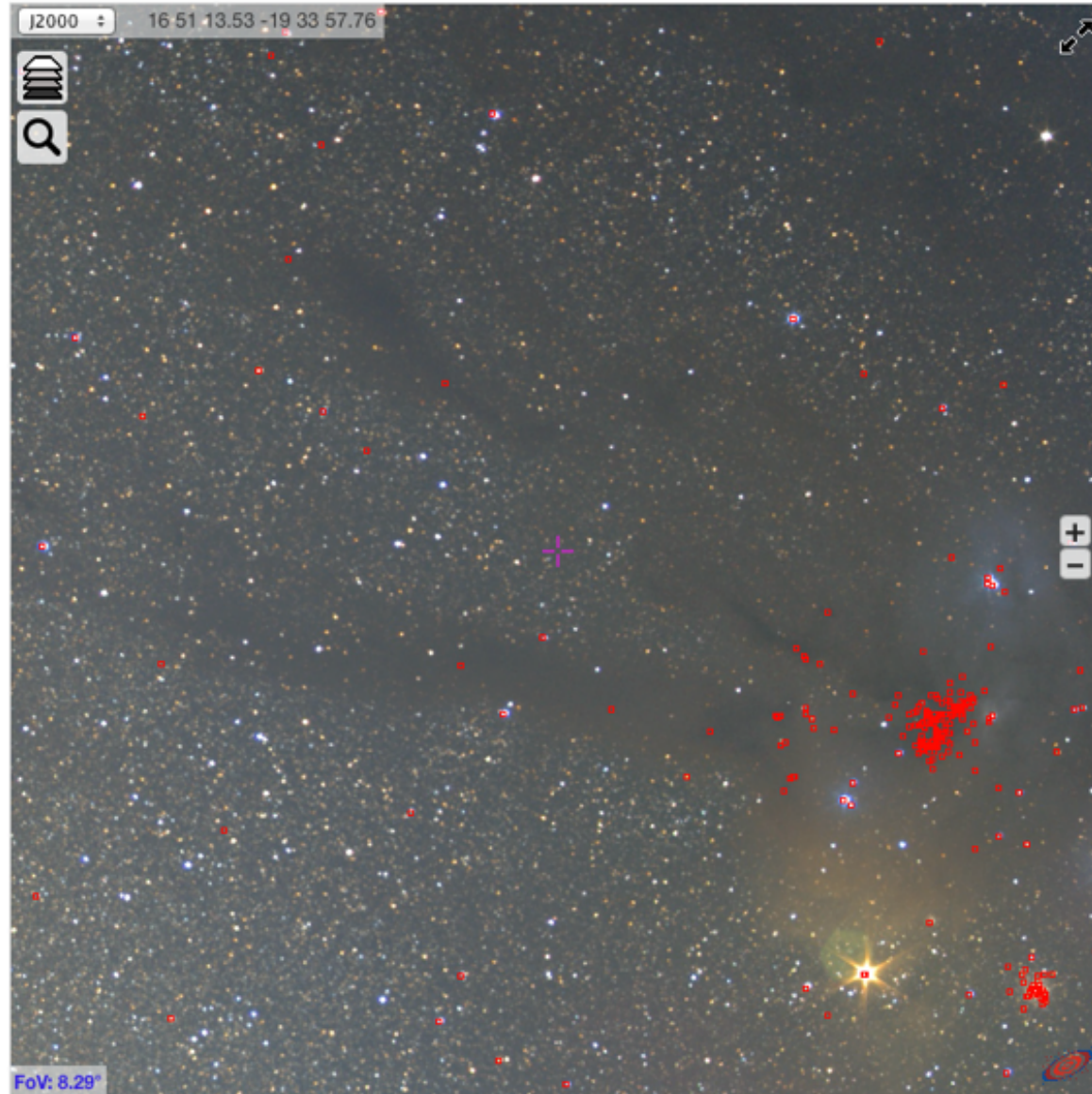
Year



TOGGLE BASE LAYER

Optical **Mellinger** GALEX AIS  
DSS2 Red IRIS zWASS 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**

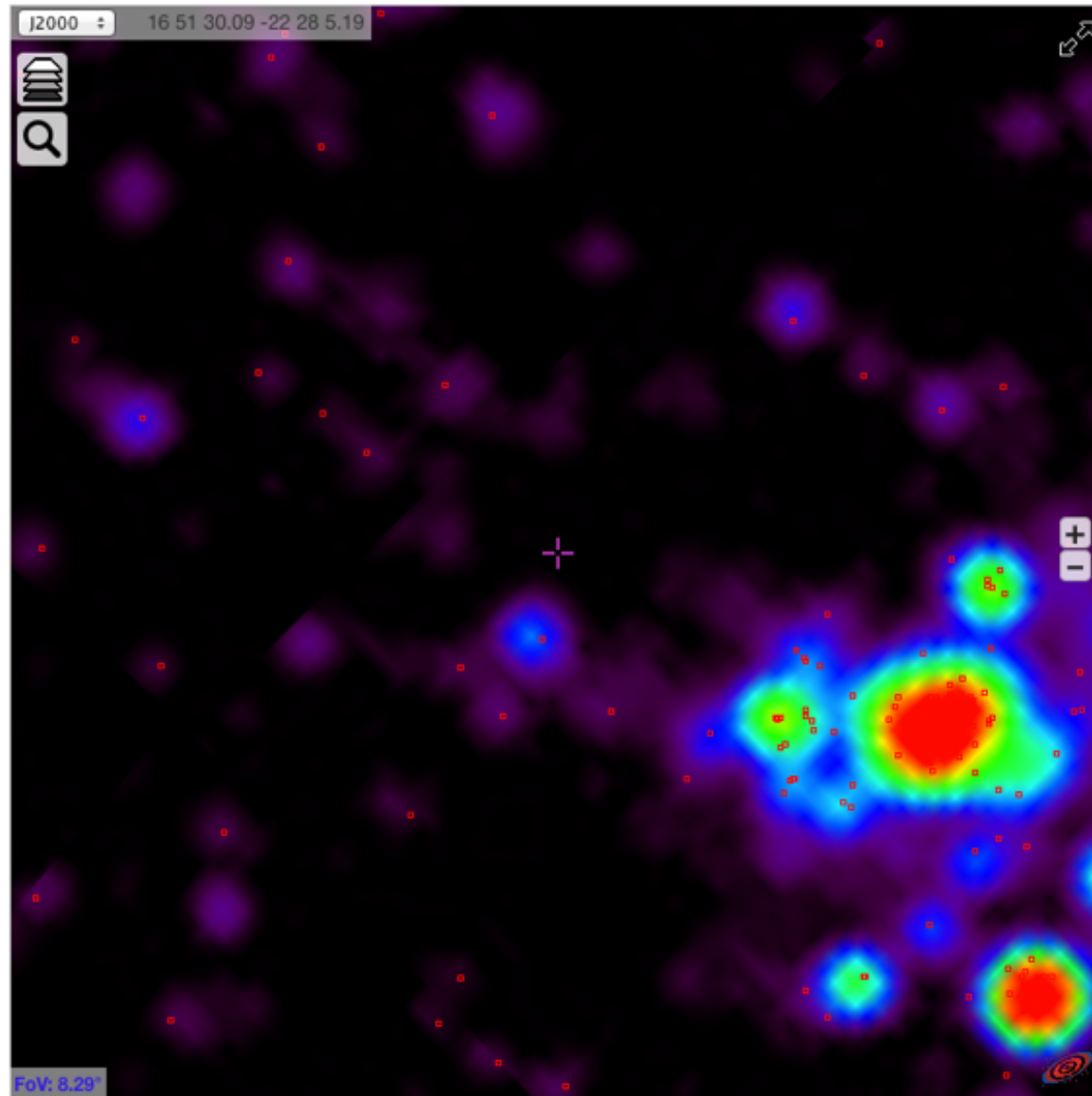
[Harvard](#)

**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

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio Infrared Ultraviolet X-ray

Custom

Harvard

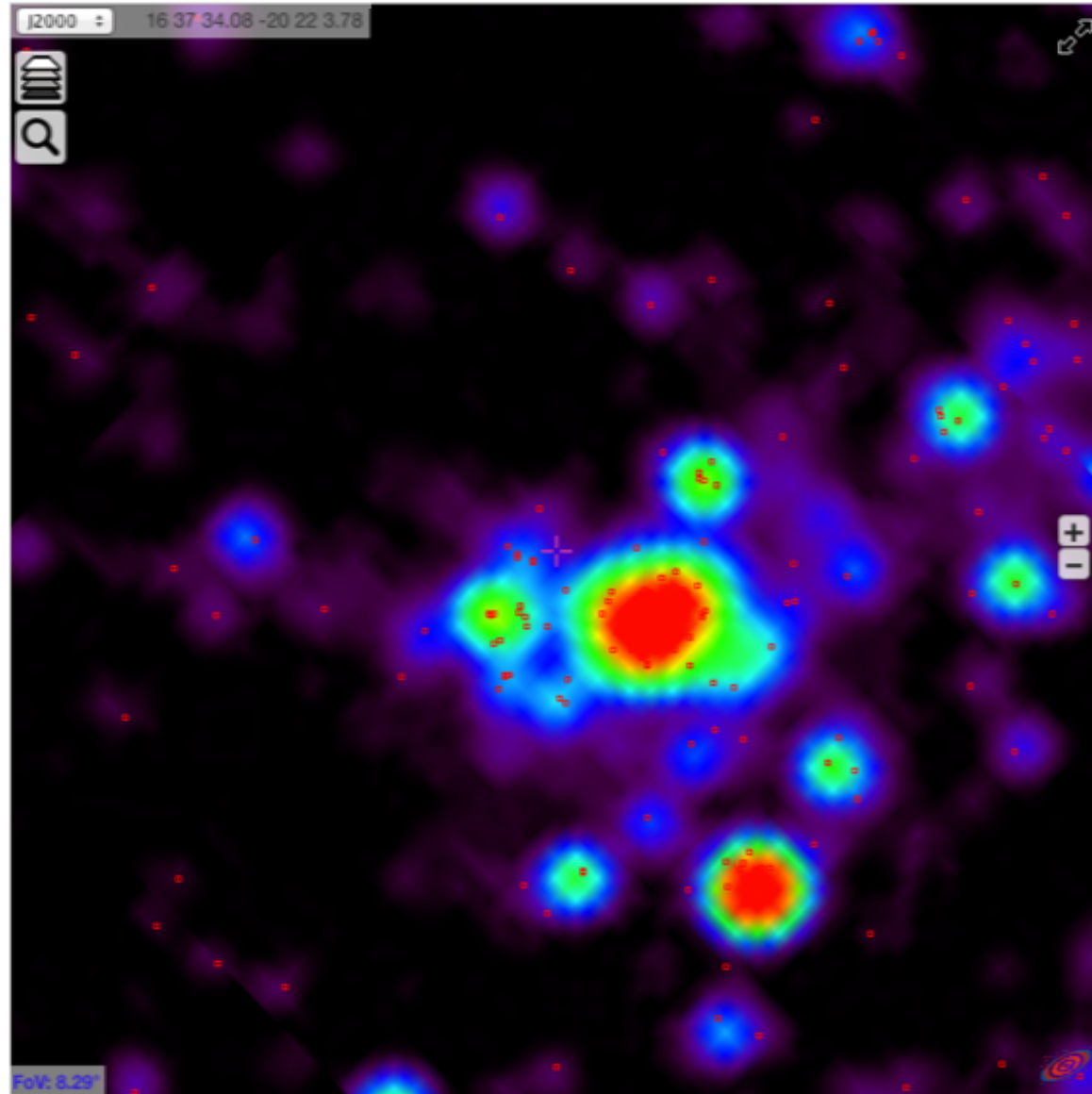
Year



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**

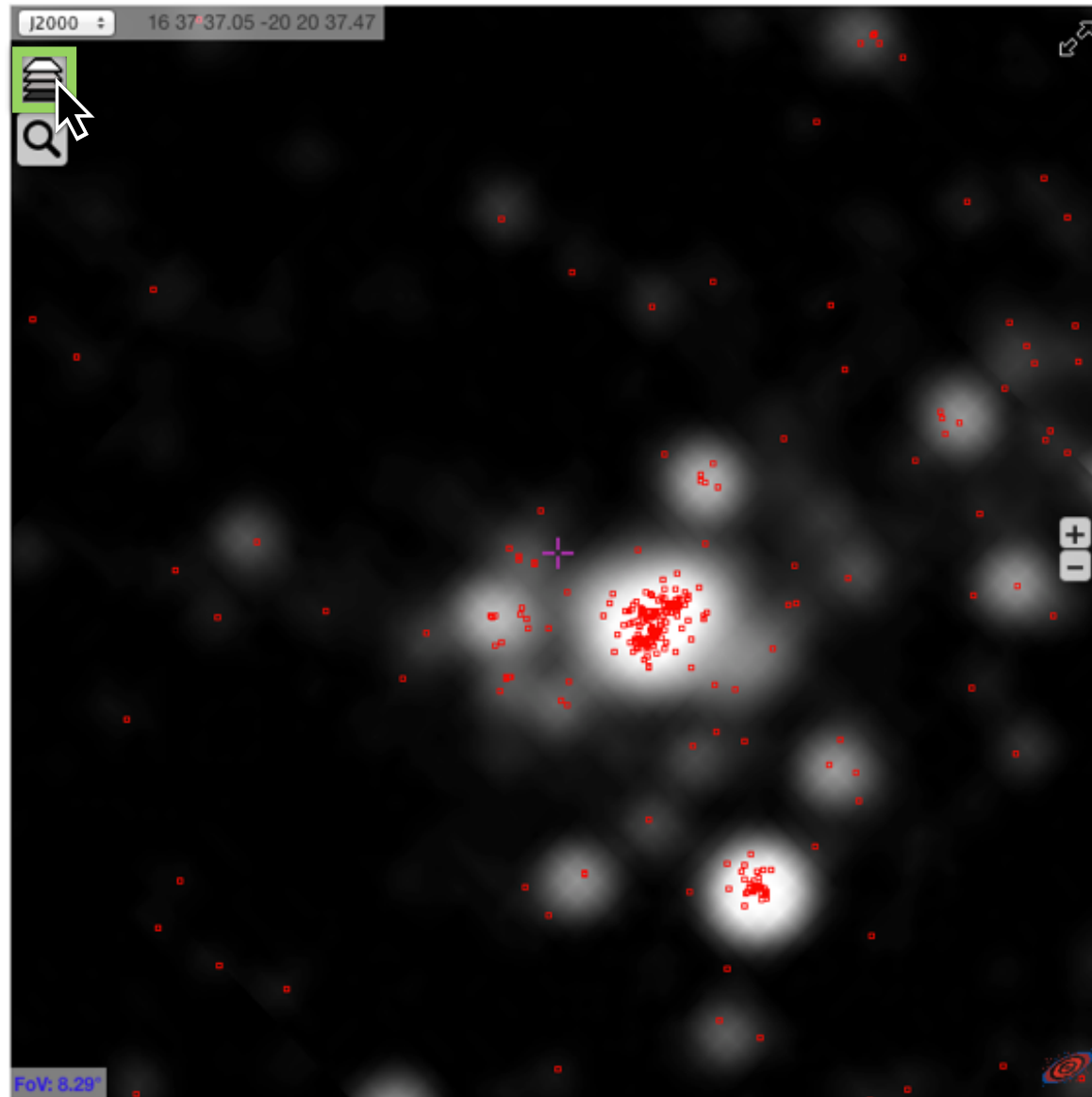
Harvard

**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](#)

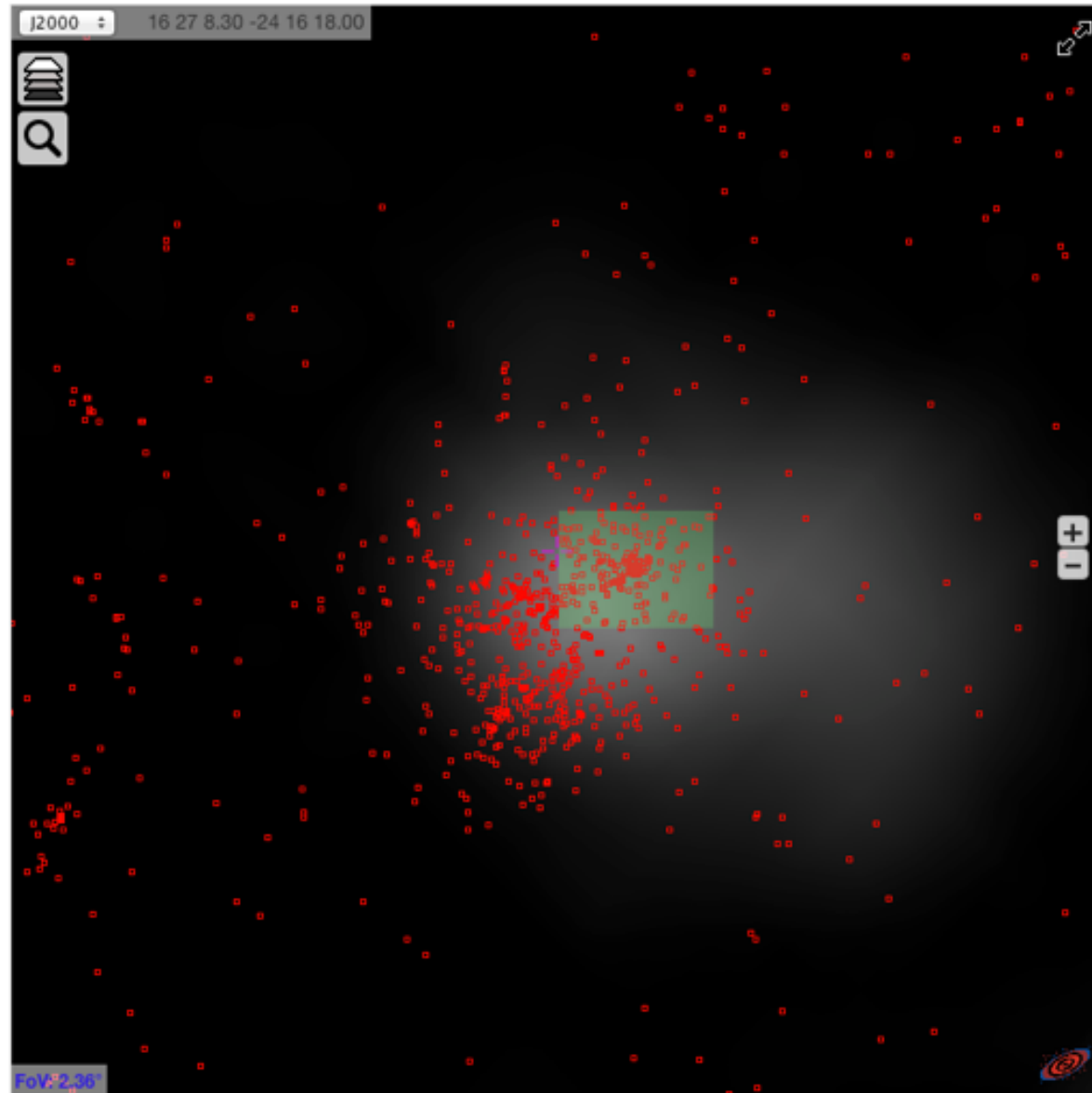
**Band**  
[Radio](#) [Infrared](#) [Ultraviolet](#) [X-ray](#)

**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 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

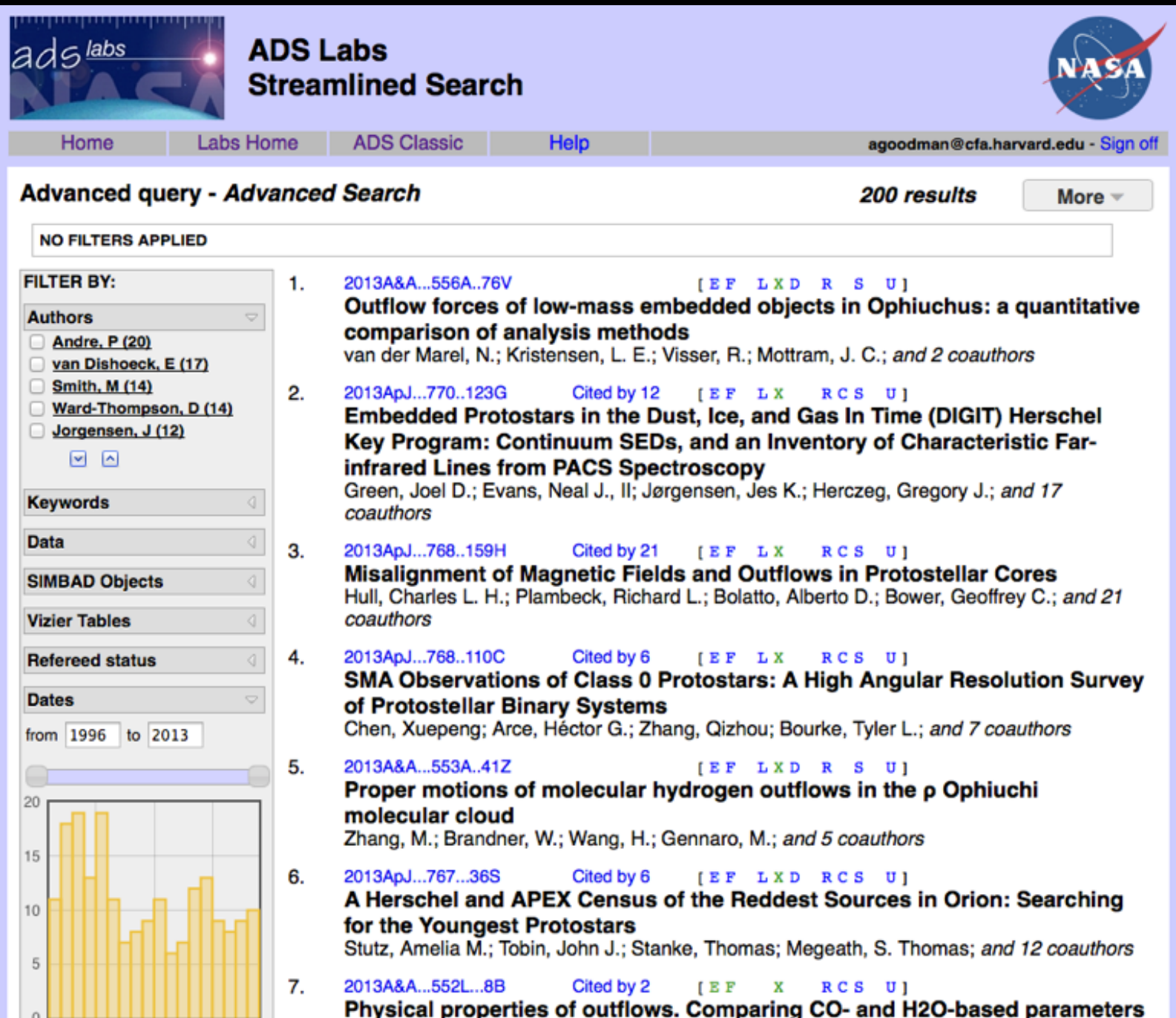
NISINI B., et al. Astron. Astrophys., 549A, 16-16 (2013)  
TAFALLA M., et al. Astron. Astrophys., 551A, 116-116 (2013)  
BJERKELI P., et al. Astron. Astrophys., 552, L8-8 (2013)  
ZHANG M., et al. Astron. Astrophys., 553A, 41-41 (2013)  
VAN DER MAREL N., et al. Astron. Astrophys., 556A, 76-76 (2013)  
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 displays the ADS Labs Streamlined Search interface. At the top, there are navigation links: 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 heading is "Advanced query - Advanced Search" with "200 results" and a "More" dropdown menu. Below this, a search bar indicates "NO FILTERS APPLIED".

On the left side, there is a "FILTER BY:" section with several categories:

- Authors:** A dropdown menu is open, 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). There are also up and down arrow icons.
- Keywords:** A dropdown menu.
- Data:** A dropdown menu.
- SIMBAD Objects:** A dropdown menu.
- Vizier Tables:** A dropdown menu.
- Refereed status:** A dropdown menu.
- Dates:** A dropdown menu with a date range from 1996 to 2013 and a corresponding bar chart showing the distribution of papers over time.

The main content area displays a list of 7 search results:

- 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
- 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
- 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
- 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
- 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
- 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
- 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

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Astronomy articles. In the sky

FILTER BY

Object

All Stars Galaxies HII regions  
Nebulae Other

Band

Radio **Infrared** Ultraviolet X-ray

Custom

Harvard

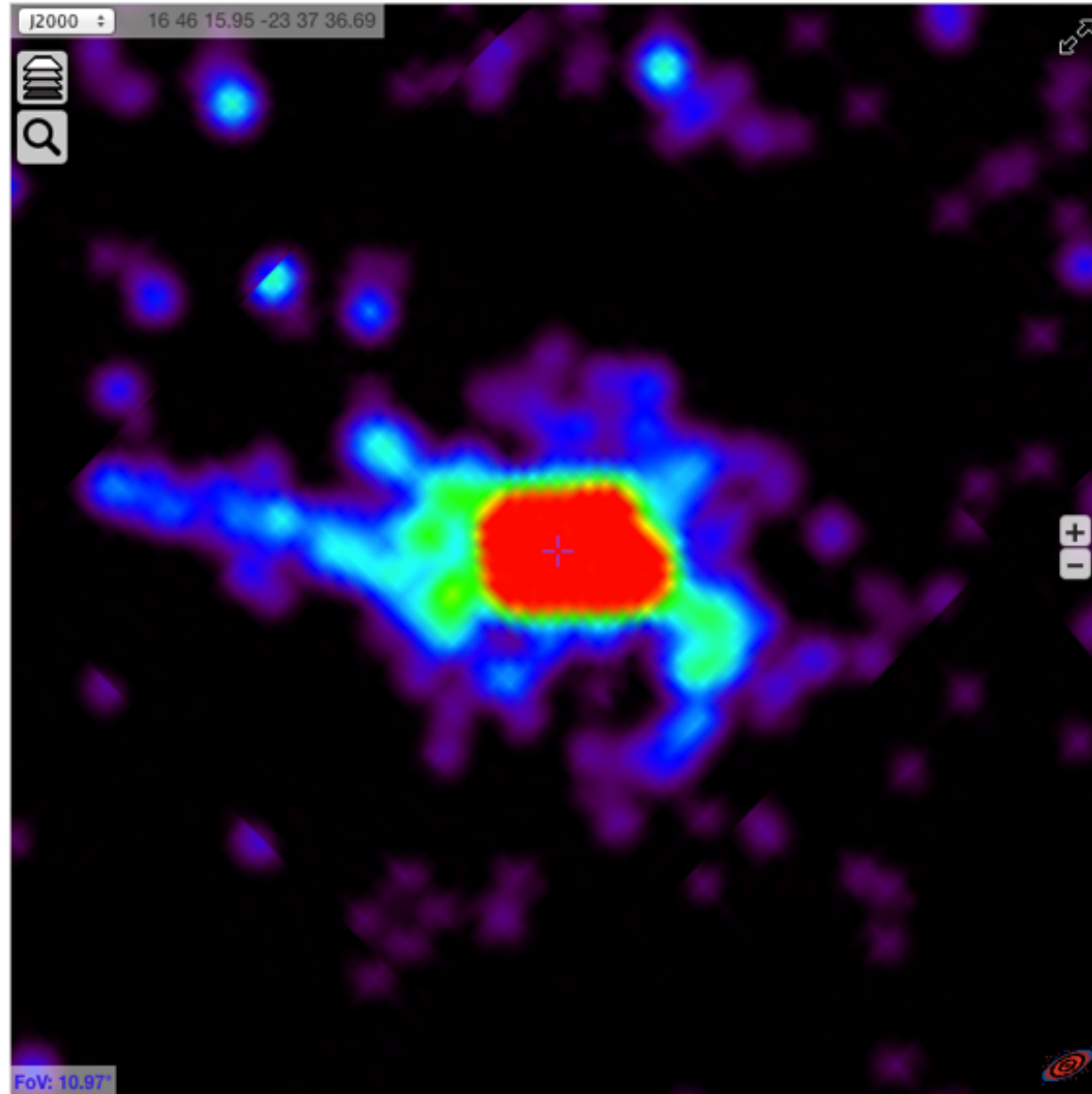
Year



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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[Astronomy articles. In the sky](#)

## 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°, -24.55° FOV= 11°



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

The ADS All Sky Survey

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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

H-alpha  X-ray



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

ADS All-Sky Survey is a NASA-funded project





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...

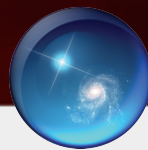
BACKGROUND LAYER

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°, -23.97° FOV= 3°



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.

**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

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

**Papers**

ESPAILLAT C., et al. *Astrophys. J.*, 762, 62 (2013)

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JENSEN E.L.N., et al. *Astrophys. J.*, 458, 212-226 (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

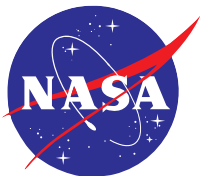
Christopher **Beaumont**, Harvard-CfA

Thomas **Boch**, CDS Strasbourg

Jonathan **Fay**, Microsoft Research

David **Hogg**, NYU, astrometry.net

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





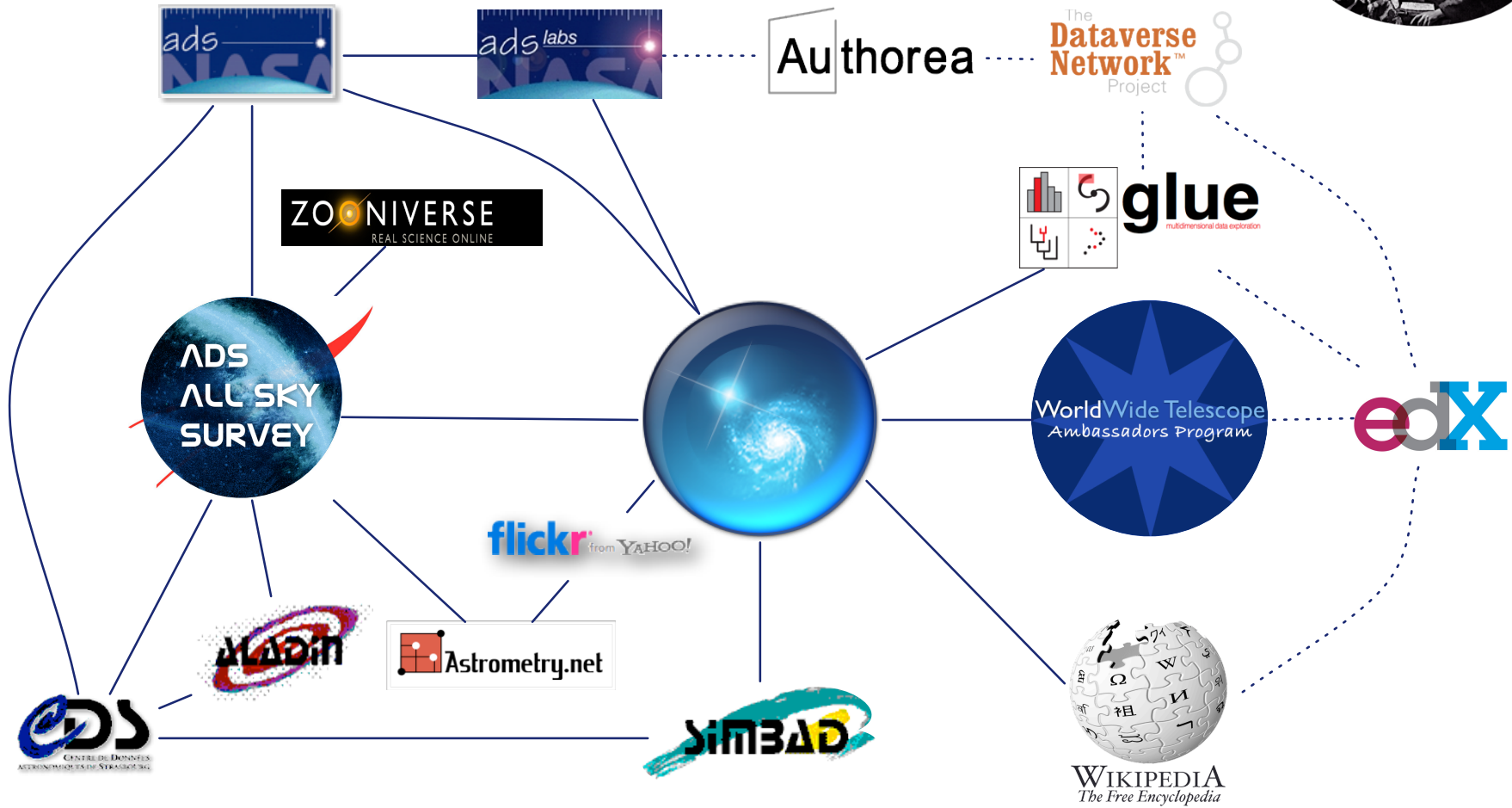
SCIENTIFIC COMMUNICATION FOR  
THE 21<sup>ST</sup> CENTURY

**Alyssa Goodman**  
**Harvard-Smithsonian Center for Astrophysics**



# SEAMLESS ASTRONOMY

Linking scientific data, publications, and communities

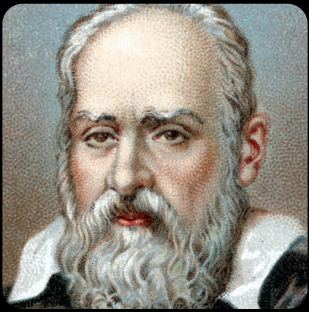


<https://www.cfa.harvard.edu/~agoodman/seamless/>

Supported by



Made possible by MANY collaborators, listed at [projects.iq.harvard.edu/seamlessastronomy](https://projects.iq.harvard.edu/seamlessastronomy)



# GALILEO GALILEI

(1564-1642)



*Scipio Principe.*

Galileo Galilei, Familius. Servus della Ser. V. inuigilanti  
 no amidiuano, et de ogni spirito se bene no soloa satisfare  
 aliaris che non della laurea di Matematica nella sua  
 Vniuersita di Padoua,

Diuino Deuote determinato di presentare al Scipio Principe  
 l'Utile et di piacere di giuamenti inestimabile se ogni  
 regio et in terra marittima o terreste stano di tenere per  
 de nuovi artificio ne l'ingegno per se et aliaro a disposizione  
 di i. ser. L'Utile auato dalle piu di dite speculazioni di  
 pro, potua in l'auantaggio di scoprire Legni et Vole dell'inimico  
 di far loro et piu di tempo prima et gli iustitia non et distinguend  
 il numero et la qualita dei Vesselli giudiare la sua forte  
 ballastini alla caccia al ambramento o alla fuga, o pure assai  
 nella la pugna aperta vedere et particolarmente distinguere ogni sua  
 moto et propriamente.

Apr. 7. di gennaio  
 Giove si vede usi  
 Apr. 8. usi  
 Apr. 12. si vede in tale uisione  
 Apr. 13. si vede usi in 4 stelle  
 Apr. 14. è anglo  
 Apr. 15. si vede in 4 stelle  
 Apr. 16. si vede in 4 stelle  
 Apr. 17. si vede in 4 stelle

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

*SIDERIUS NUNCIUS*

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 wa  
 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 precise  
 ly on a straight line, as in the adjoining figure. The easternmost wa  
 distant 3 minutes from the next one, while this one was 40 second  
 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  
 one, 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

Notes for & re-productions of Siderius Nuncius





# GALILEO GALILEI



## GALILEO'S "NEW ORDER"

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



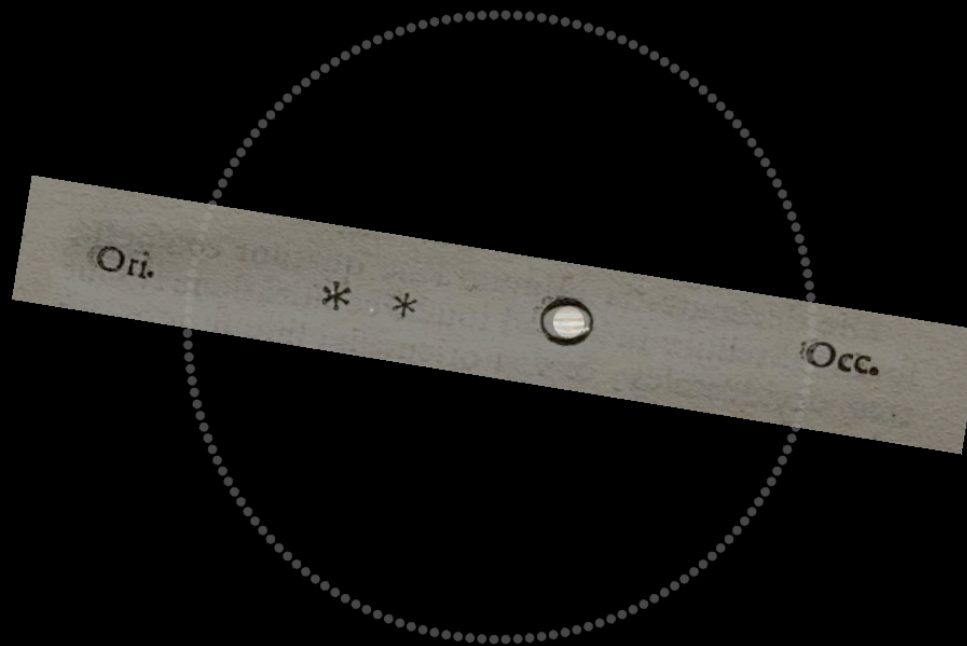




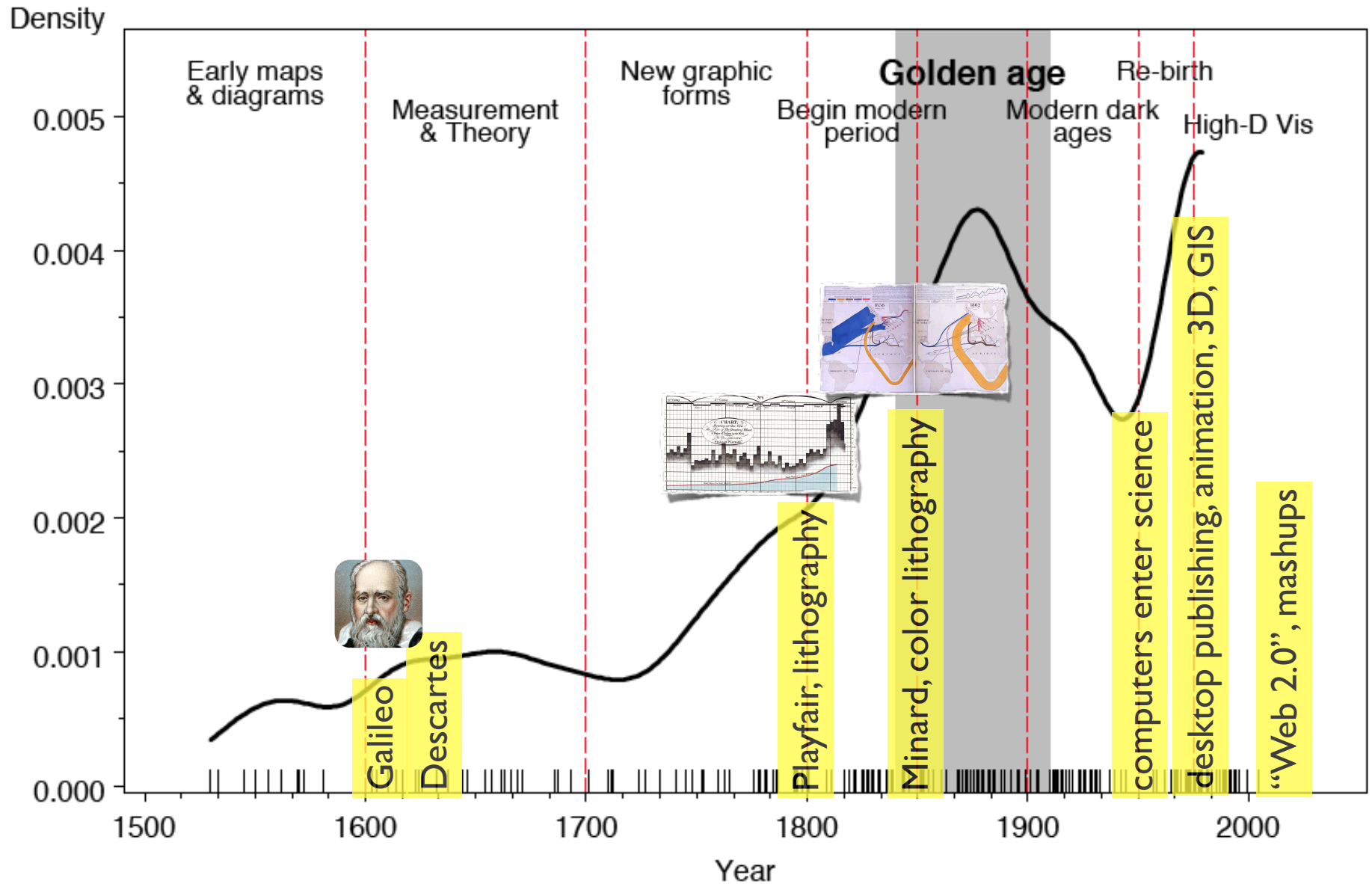
# GALILEO GALILEI



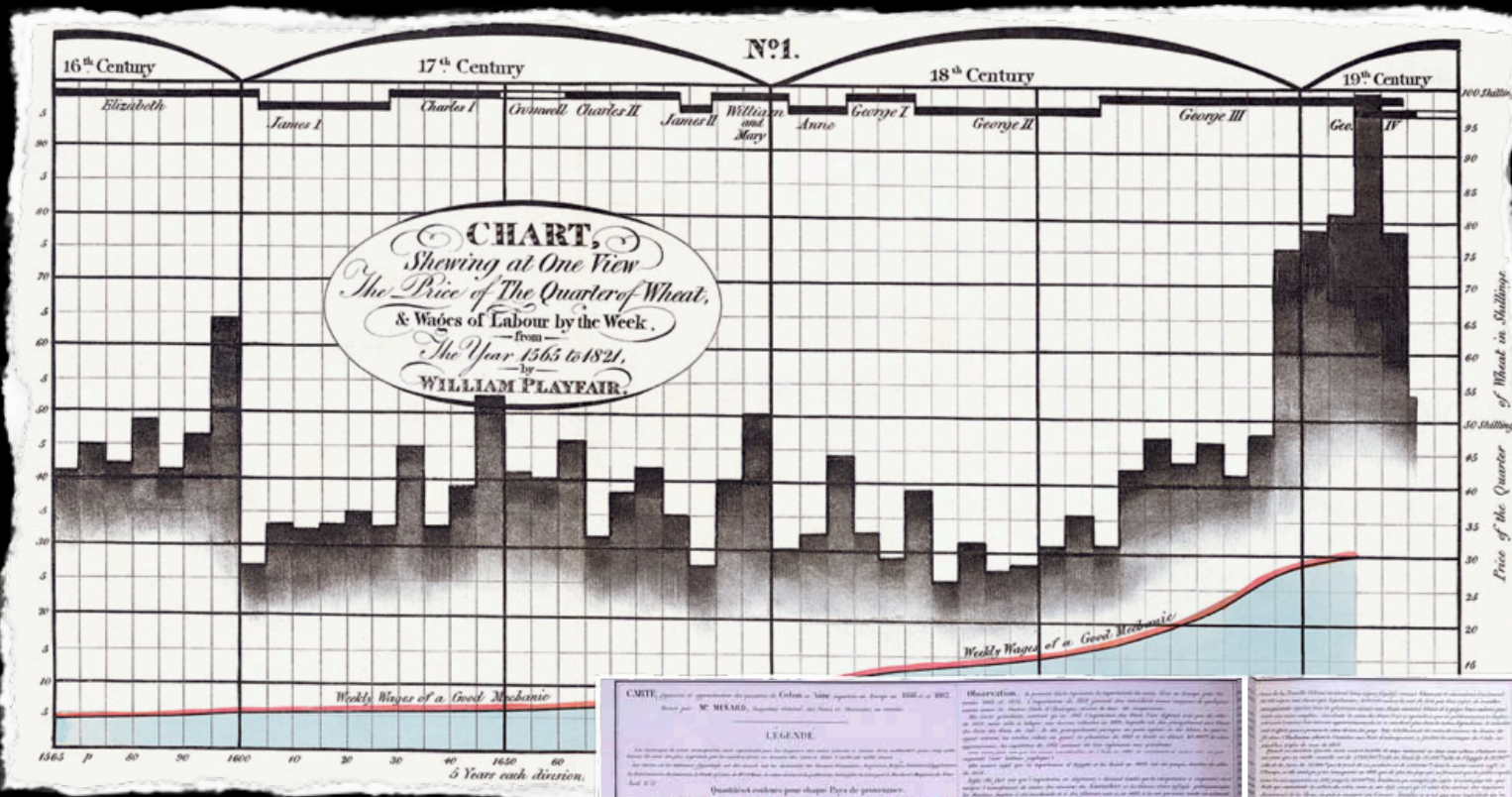
January 11, 1610



# Milestones: Time course of developments

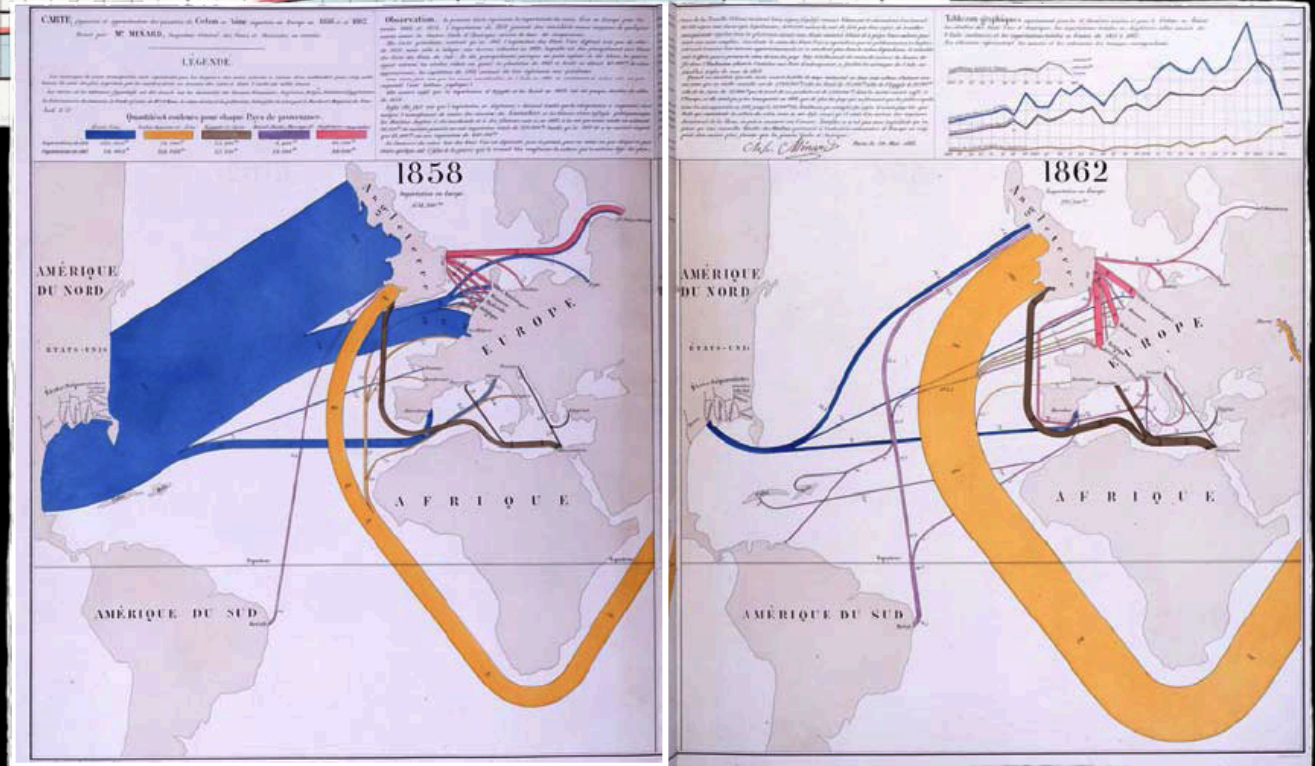


adapted from Friendly, "The Golden Age of Statistical Graphics," *Statistical Science*, 2009



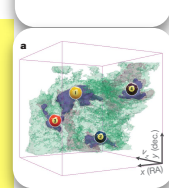
Playfair, lithography

William Playfair (1759-1823)

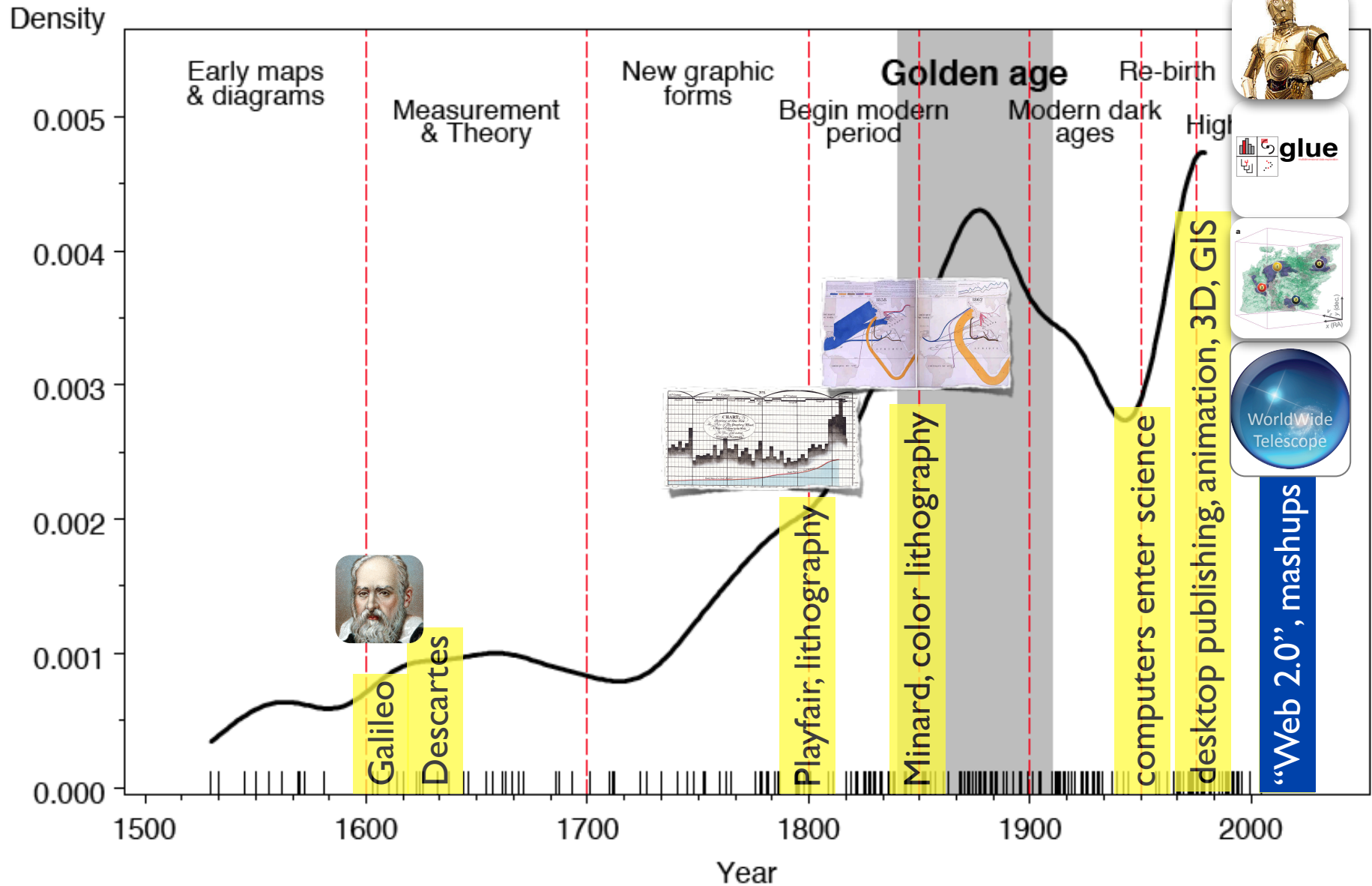


Minard, color lithography

Charles Joseph Minard (1781-1870)

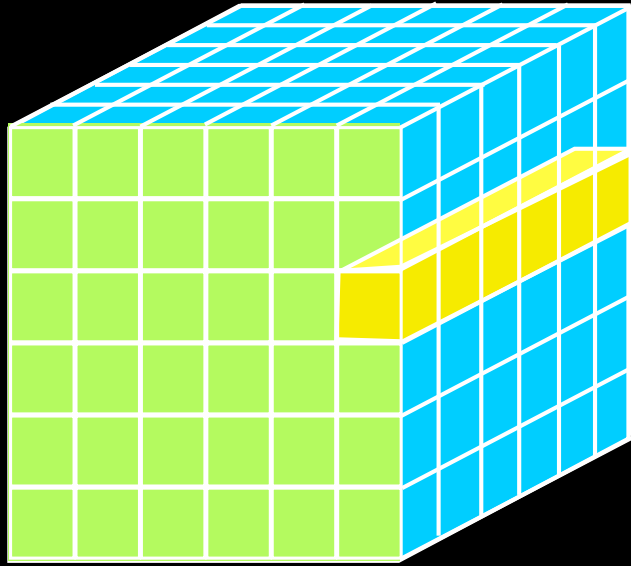


# Milestones: Time course of developments



adapted from Friendly, "The Golden Age of Statistical Graphics," *Statistical Science*, 2009





"DATA, DIMENSIONS, DISPLAY"

**1D:** Columns = "Spectra", "SEDs" or "Time Series"






**2D:** Faces or Slices = "Images"

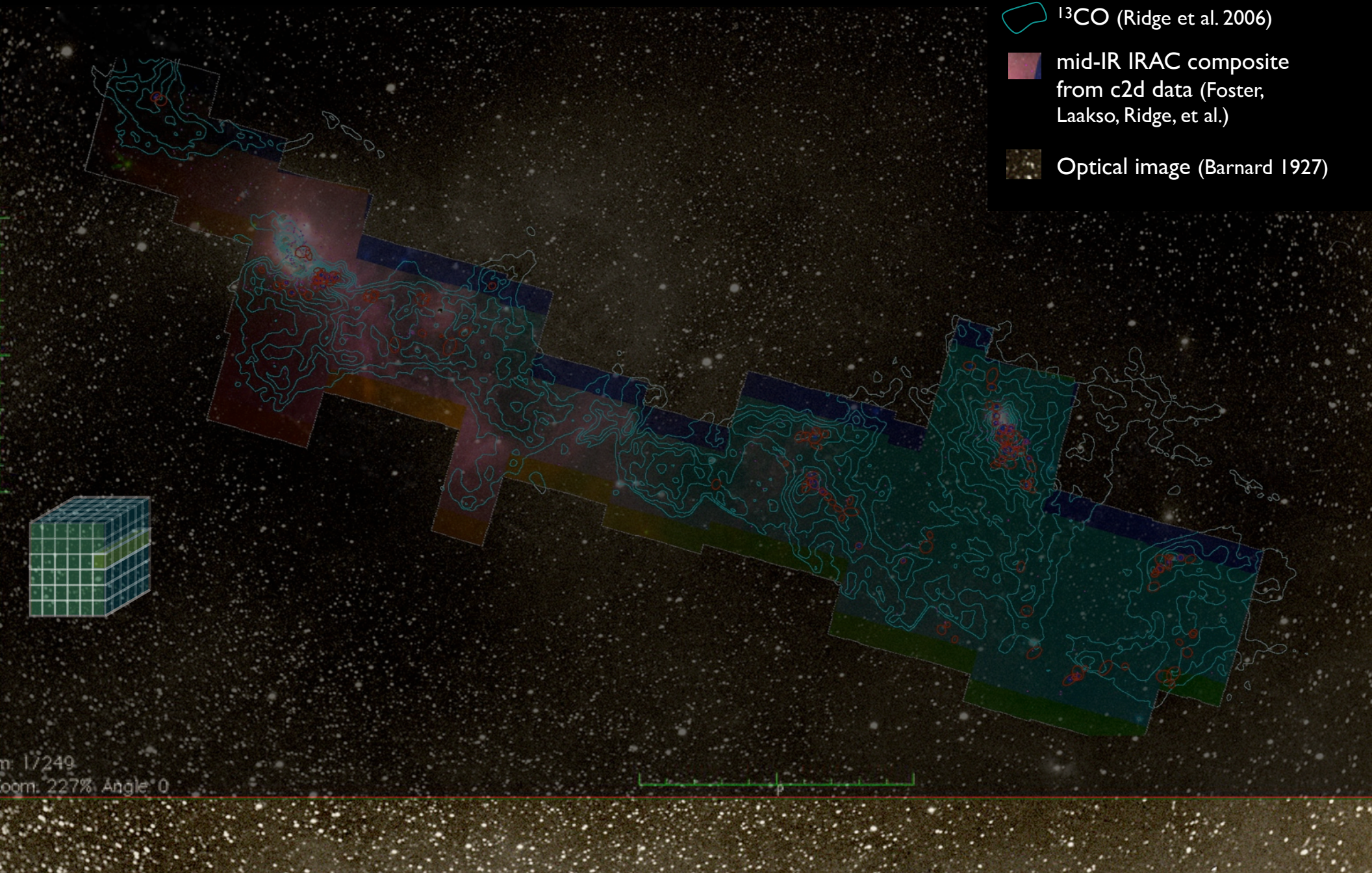
**3D:** Volumes = "3D Renderings", "2D Movies"

**4D:** Time Series of Volumes = "3D Movies"

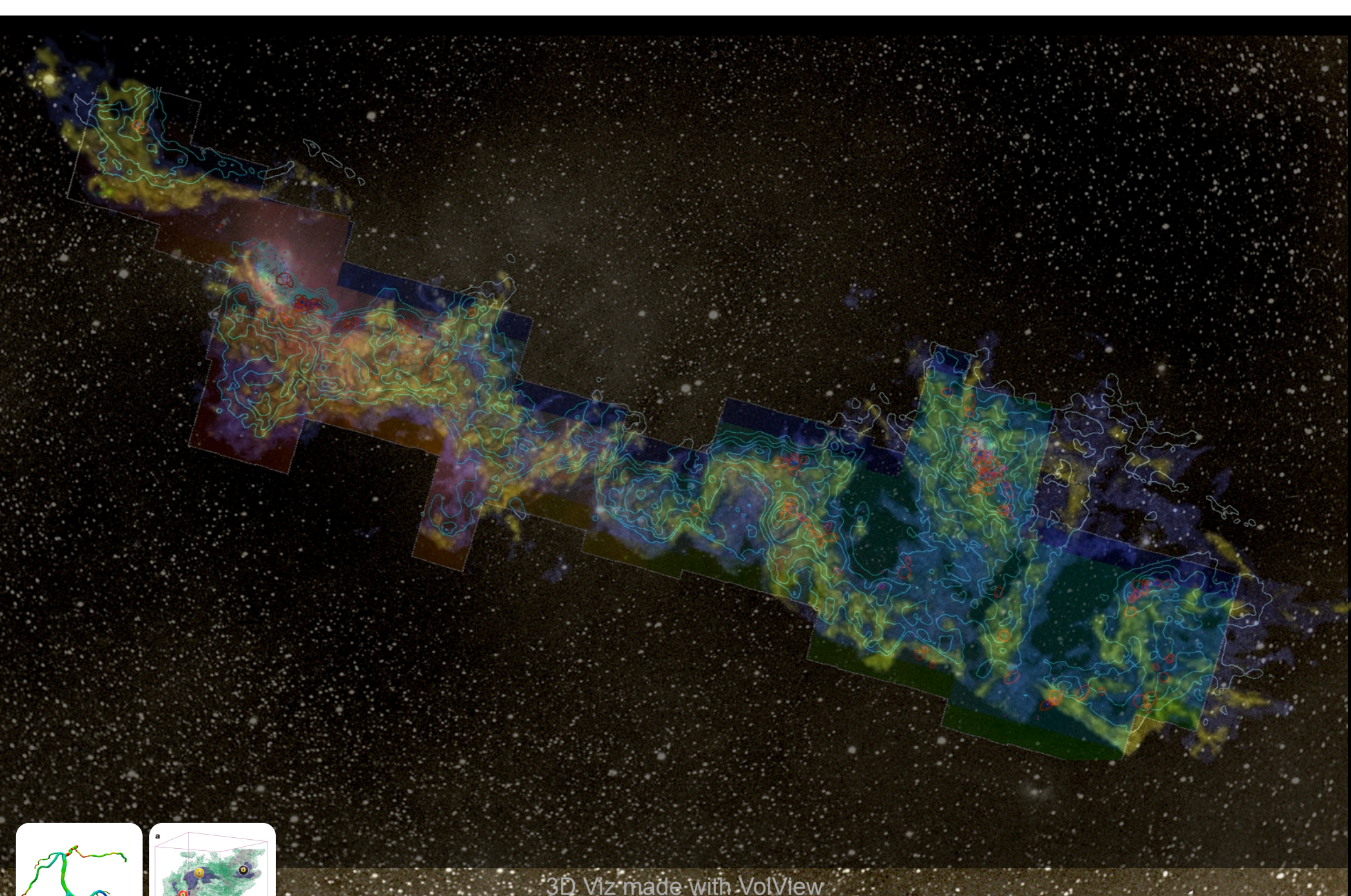


# WIDE DATA, "IN 3D"

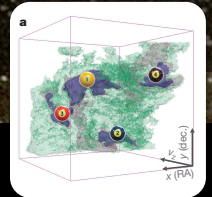
-  mm peak (Enoch et al. 2006)
-  sub-mm peak (Hatchell et al. 2005, Kirk et al. 2006)
-   $^{13}\text{CO}$  (Ridge et al. 2006)
-  mid-IR IRAC composite from c2d data (Foster, Laakso, Ridge, et al.)
-  Optical image (Barnard 1927)







3D Viz made with VolView



Astronomical**Medicine**@**iig**

COMPLETE



1610



SIDEREUS NUNCIIUS

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.

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East \* ○ \* \* West

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East \*\* ○ \* \*

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East \* ○ \*

in the adjoining figure. The eastern one was 2 minutes from Jupiter, 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.

1665

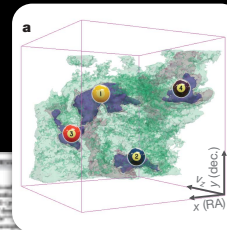


# WHAT DO WE PUBLISH?

1895

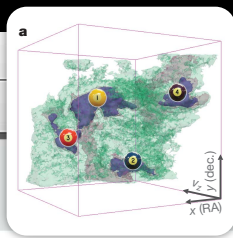


2009









# LETTERS

## 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<sup>1</sup>. 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, and sets, the stellar initial mass function<sup>2</sup>. Here we report a 'denrogram' (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 denrogram'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





# RIVETING SEQUEL TO COME, BUT, FIRST...

1610

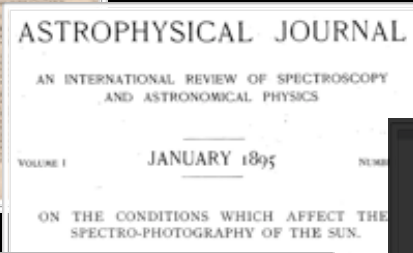


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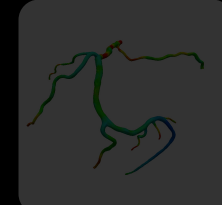


1895



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2009



2014

**Beyond Galileo**  
Josh Peek, Alberto Pele, Aidan Price-Whelan, Chris Beaman  
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Inclination (deg) vs Eccentricity  
log Mass (log kg) vs Semi-major axis (km)

Four Centares of Discovery | A Chain in Mass | Some are Similar... | Not Most are Different

1610



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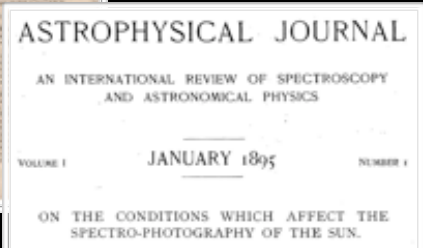
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# .....HOW TO "UN"PUBLISH GRAPHICAL DATA







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$\alpha$  (1875)  $3^h 30^m 30s$ ,  $\delta$  (1875)  $+31^{\circ} 00'$

Area  
In Perseus and Taurus

Galactic Coordinates  
 $127^{\circ}, -18^{\circ}$

Scale  
1 cm = 18'.2 or 1 in = 46'.2



Chart



Plate & Chart

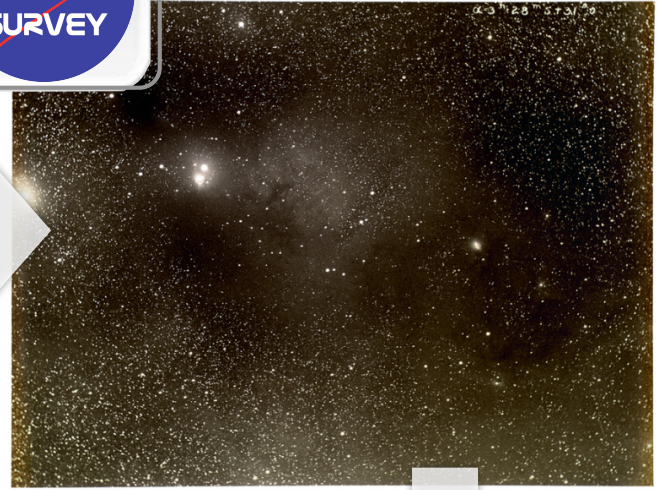


Table



Text

[enlarge \[+\]](#) [printable PDF](#)



Bar-pt1-p003\_sm

Barnard's Image of Perseus, from [www.library.gatech.edu/bpd/bpd.php](http://www.library.gatech.edu/bpd/bpd.php)

December 17, 2003

astrometry.net

Hello, this is the blind astrometry solver. Your results are: (RA, Dec) center: (54.3098782184, 31.431266374) degrees Orientation: 5.21349891764 deg E of N Pixel scale: 18.5163711997 arcsec/pixel Your field contains: NGC 1465 IC 1985 Per / Atk o Per 40Per 42Per NGC 1333 IC 348 IC 2003 [View in World Wide Telescope](#) — If you would like to have other images solved, please submit them to the



Explore Guided Tours Search View Settings

California Nebula

More Surveys

Digitized Sky Surv

VLSR: W.A Low-fre

Planck CMB

WMAP BLC 5-Year!

SFD Dust Map (Inf)

IRIS: Improved Re

WISE All Sky (Inf)

2Mass: Imagery (I)

2MASS: Catalog (5)

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ADS ALL SKY SURVEY

WorldWide Telescope

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Bar-pt1-p003\_sm

California Nebula

NGC 1333

California Nebula

IC348/IC 348

IC1911

IC1881

IC1985

IC1874

IC1900

ADS ALL SKY SURVEY

WorldWide Telescope



# AND, SOON...HUMANS WILL SEE THE INVISIBLE!



+

ZOONIVERSE

REAL SCIENCE ONLINE



CITIZEN SCIENCE ALLIANCE



ADS All-Sky Survey

oldAstronomy

No. 1, 1998

ORIGIN AND EVOLUTION OF THE CEPHEUS BUBBLE

243

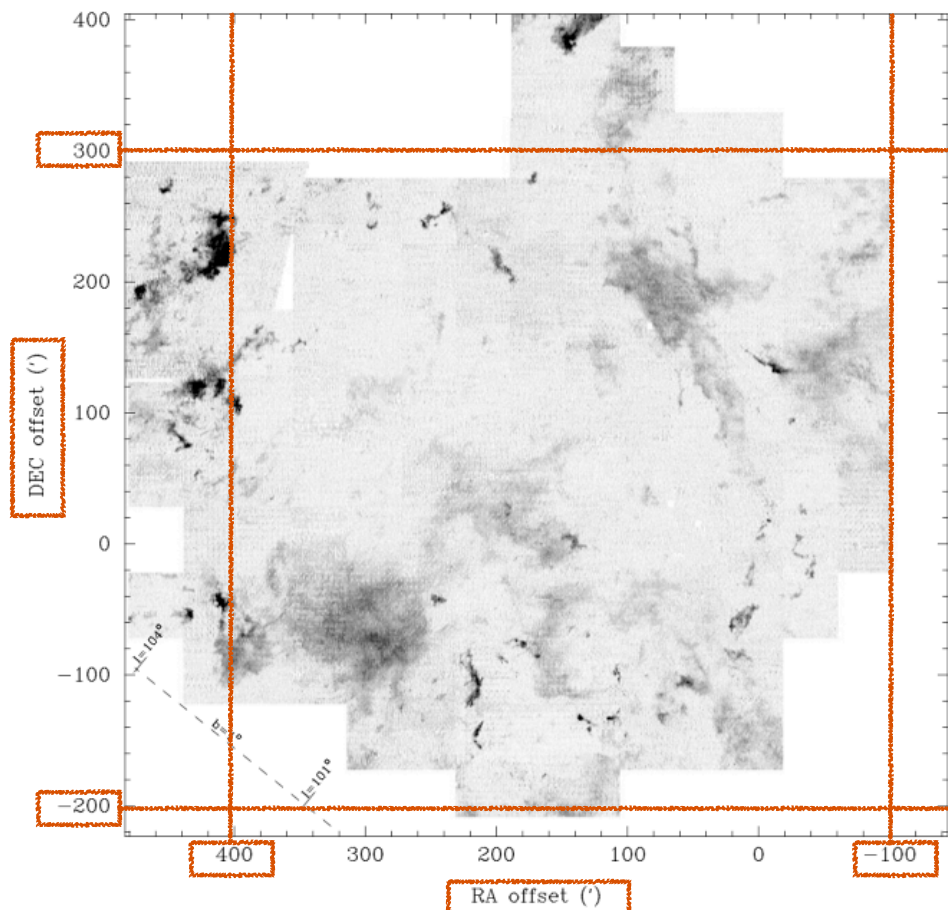
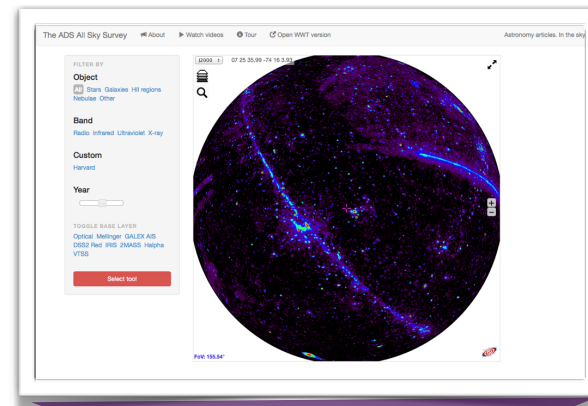


FIG. 1.—Peak intensity of CO 1–0 emission. The gray scale represents antenna temperature values scaled linearly between 0 and 3.5 K. The strongest emission occurs at the S140 region and globule A of IC 1396, where the peak antenna temperature is about 10 K. The position offsets are measured from  $\alpha(1950) = 21^{\text{h}}18^{\text{m}}00^{\text{s}}$ ,  $\delta(1950) = 59^{\circ}30'00''$ , near S129.

Patel et al. 1998, page 243, Figure 1, with markup (orange) to be made by a citizen scientist using oldAstronomy tools.





Object Data

ADDITIONAL DATABASE

Literature

PRIMARY DATABASE

IMAGE EXTRACTION

Optical images

Non Optical images

ARTICLE-OBJECT MATCHING

ASTROMETRIC MEASUREMENT



Astrotagged literature

Astro-referenced images

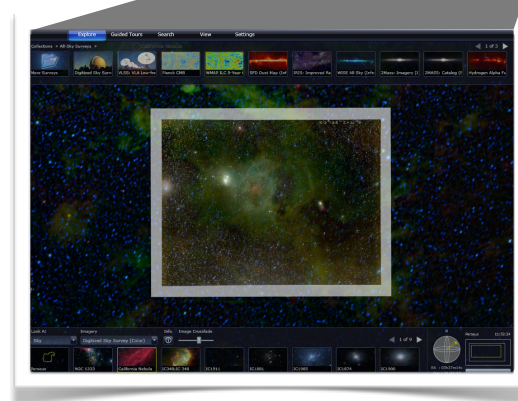


HISTORICAL DATA LAYER

ALL-SKY LITERATURE HEATMAP

NASA ARCHIVES

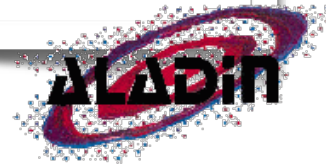
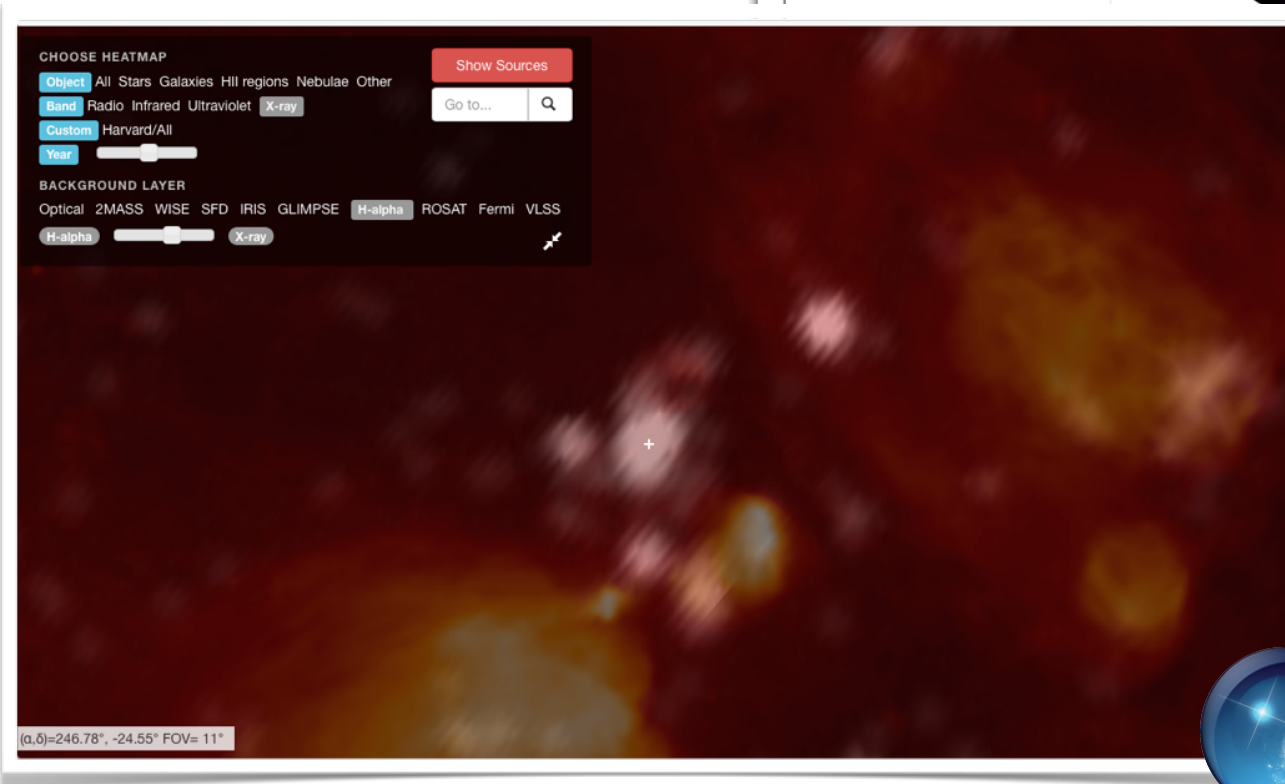
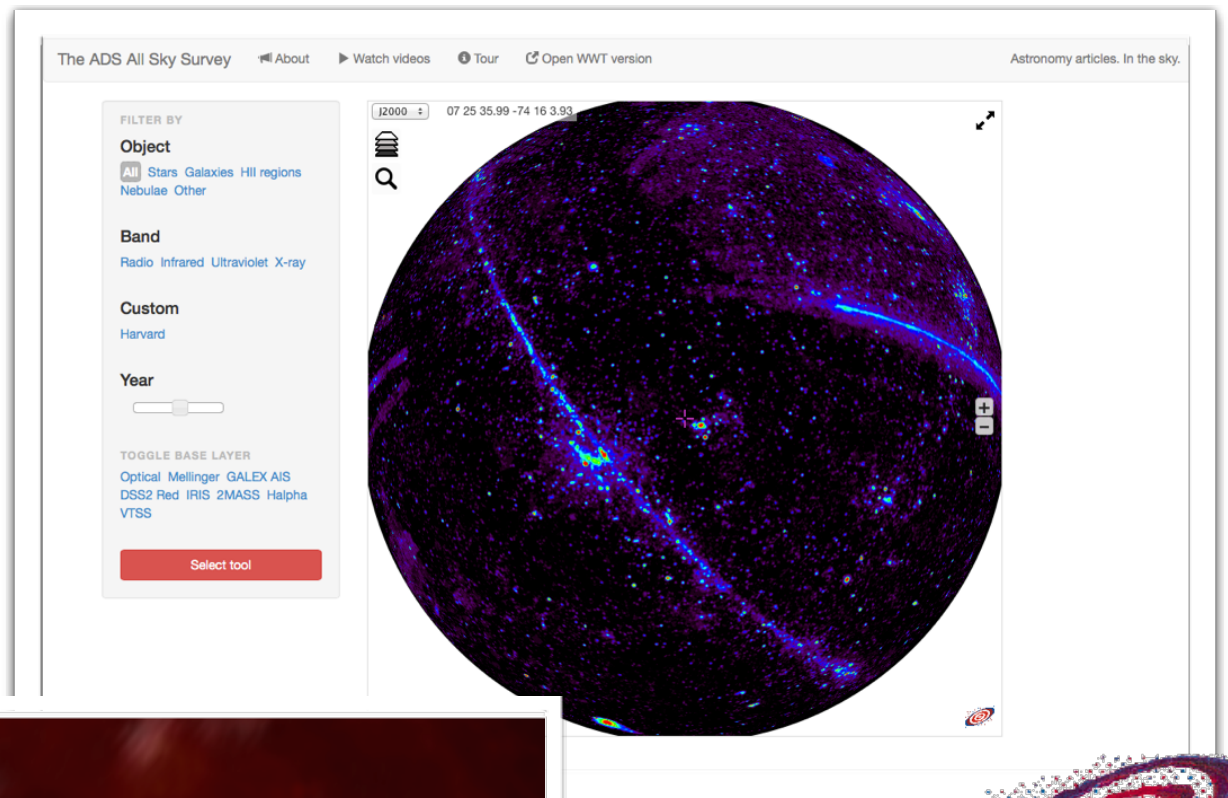
DATA VIEWERS



slide courtesy of Alberto Pepe



TRY IT AT  
ADSASS.ORG



*Aladin & WWT versions are  
both javascript.  
No plugins required, use any  
browser, any platform*



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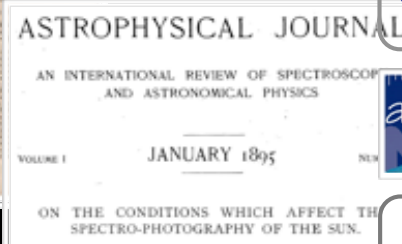
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1665



1895



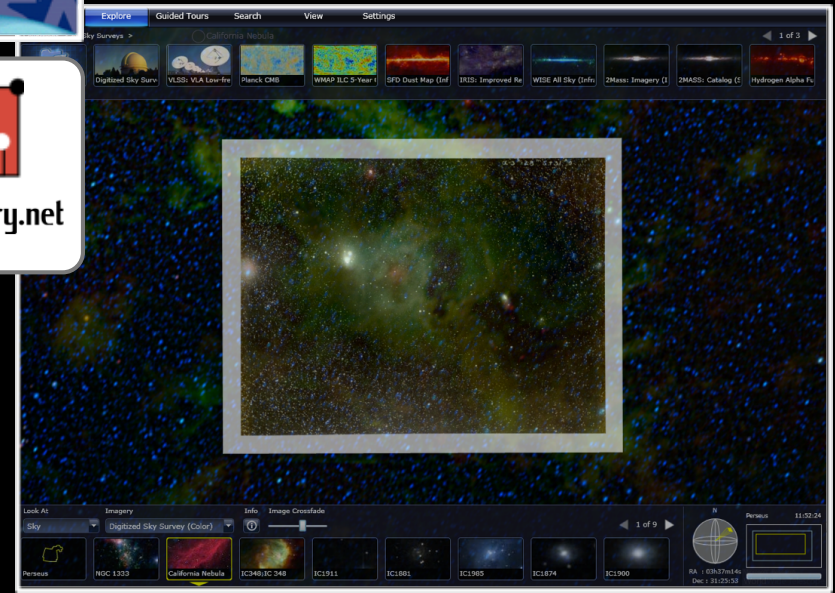
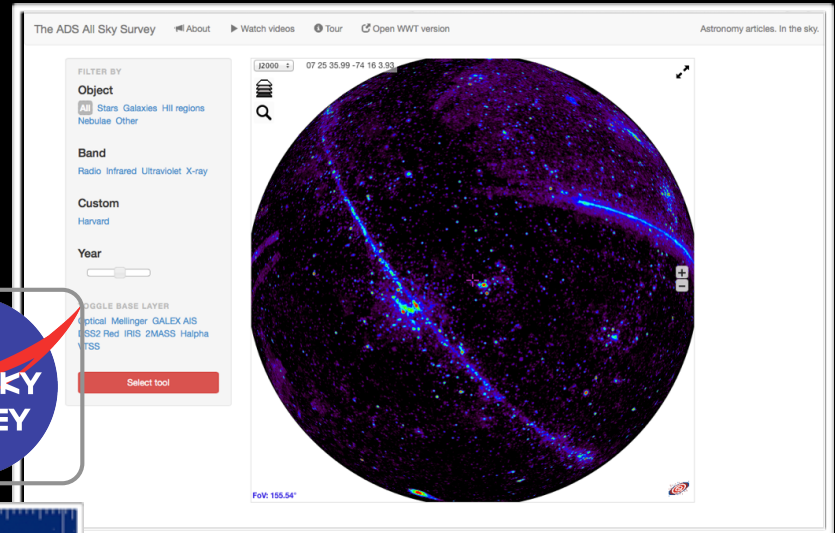
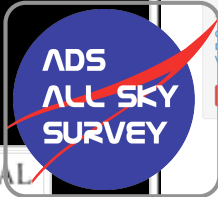
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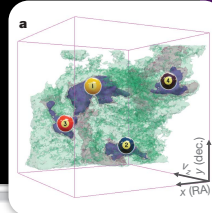
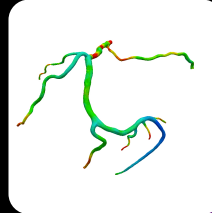
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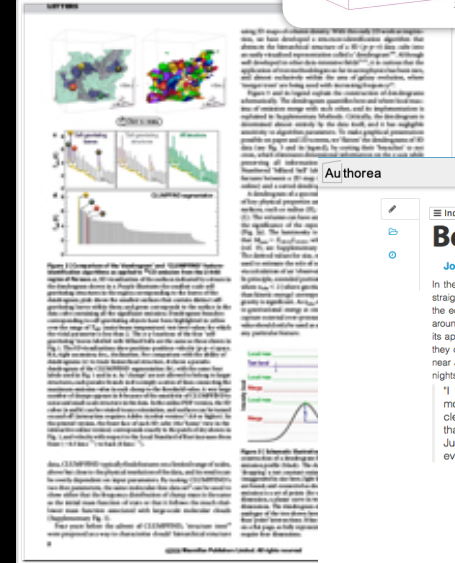


# THE RIVETING SEQUEL

2009



2014



Authoria

BROWSE ABOUT CONTACT PLANS

Index ROUGH DRAFT OPEN SCIENCE

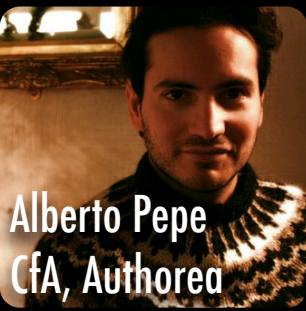
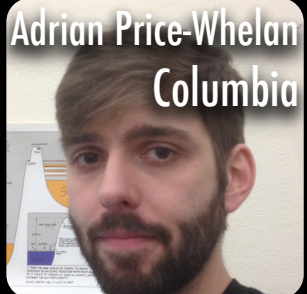
## Beyond Galileo

Josh Peek, Alberto Pepe, Adrian Price-Whelan, Chris Beaumont

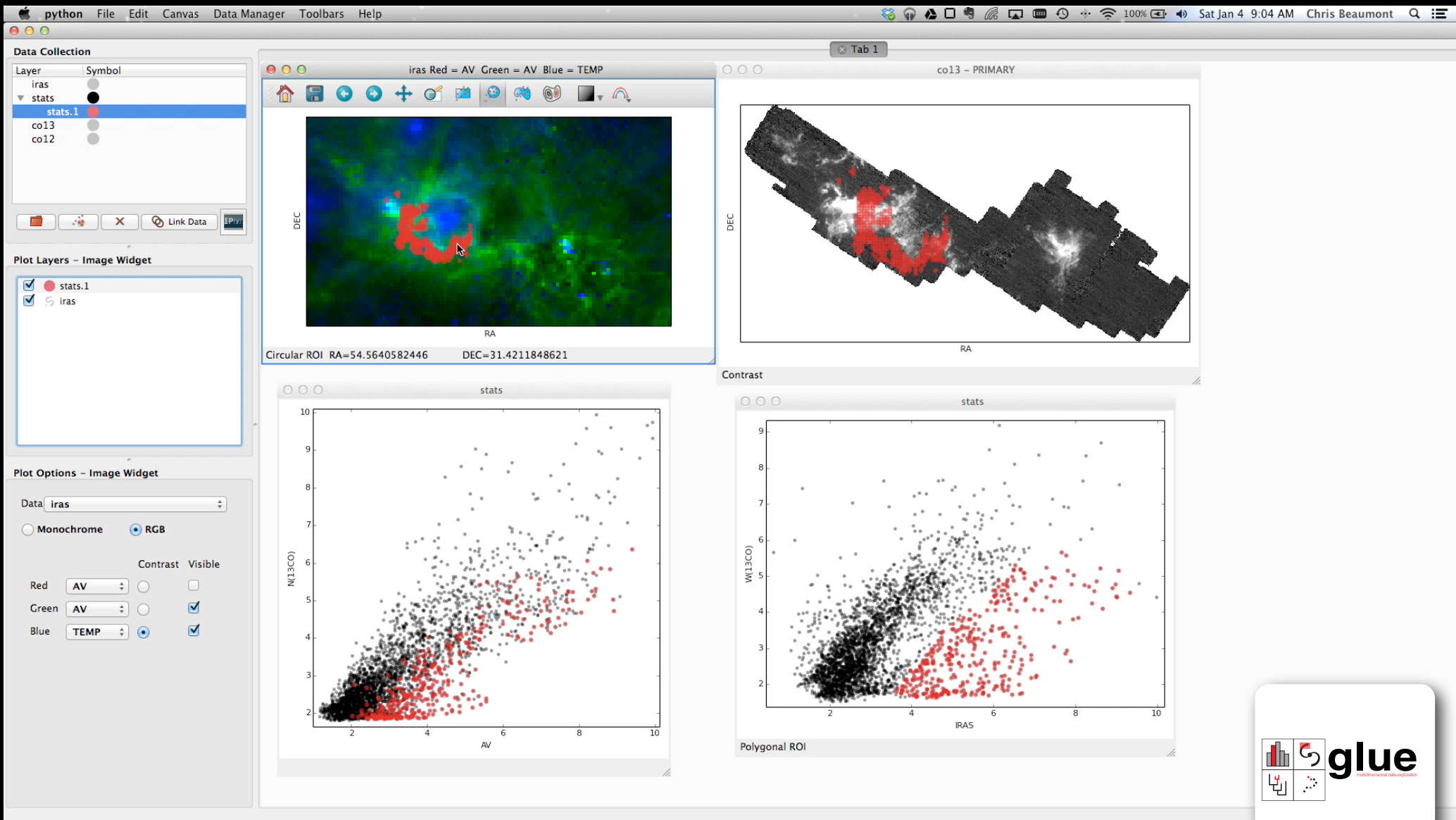
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Four Centuries of Discovery A Chasm in Mass Some are Similar... ..but Most are Different



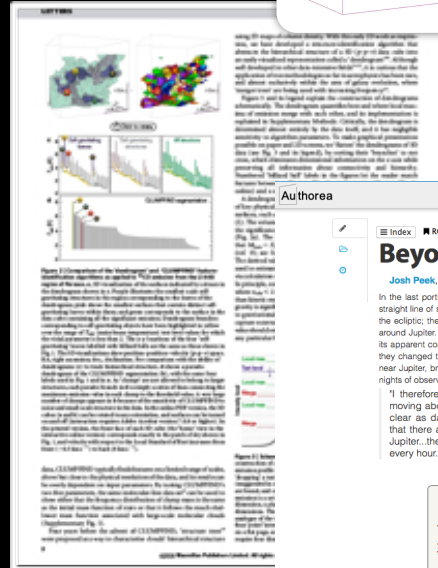
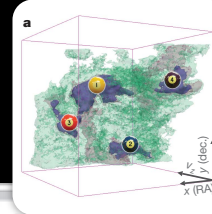
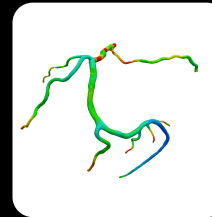
# LINKED VIEWS OF HIGH-DIMENSIONAL DATA GLUE



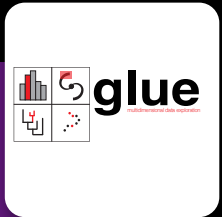


# THE RIVETING SEQUEL

2009



2014



Authorea

BROWSE ABOUT CONTACT PLANS FEEDBACK HEL

Index ROUGH DRAFT OPEN SCIENCE

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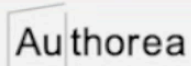
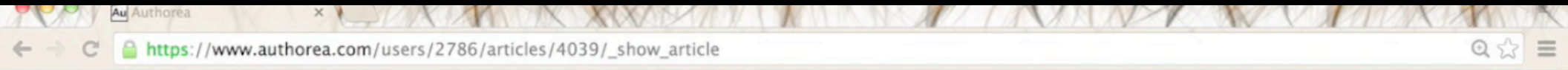
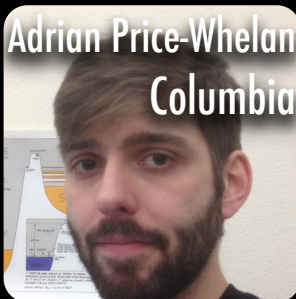
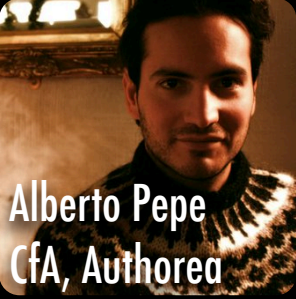
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"I therefore concluded and decided unhesitatingly, that there are three stars in the heavens moving about Jupiter, as Venus and Mercury round the Sun, which at length was established as clear as daylight by numerous subsequent observations. These observations 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)

Four Centuries of Discovery A Charm in Mass Some are Similar...but Most are Different



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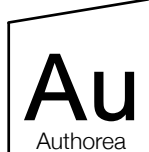
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## Beyond Galileo

Josh Peek, Alberto Pepe + Add author

In the last portion of *Sidereus Nuncius*, Galileo reported his discovery of **four objects** that appeared to form a straight line of stars near **Jupiter**. The first night, he witnessed a line of three little stars close to Jupiter parallel to the ecliptic; the following nights brought different arrangements and another star into his view, totaling four stars around Jupiter. (Galilei 1618) Throughout the text, Galileo gave illustrations of the relative positions of Jupiter and its apparent companion stars as they appeared nightly from late January through early March 1610. The fact that they changed their positions relative to Jupiter from night to night, but always appeared in the same straight line near Jupiter, brought Galileo to deduce that they were four bodies in orbit around Jupiter. On January 11 after 4 nights of observation he wrote:

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## 10 Simple Rules for the Care and Feeding of Scientific Data

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Alyssa Goodman, Alberto Pepe, Alexander W. Blocker, Christine L. Borgman, Kyle Cranmer, Merce Crosas, Rosanne Di Stefano, Yolanda Gil, Paul Groth, Margaret Hedstrom, David W. Hogg, Vinay Kashyap, Ashish Mahabal, Aneta Siemiginowska, Aleksandra Slavkovic

### Introduction

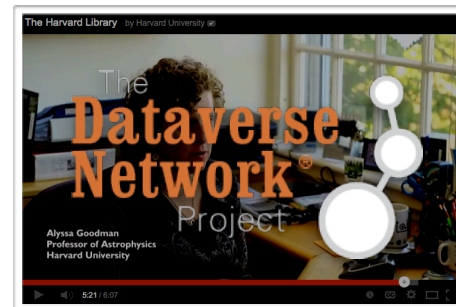
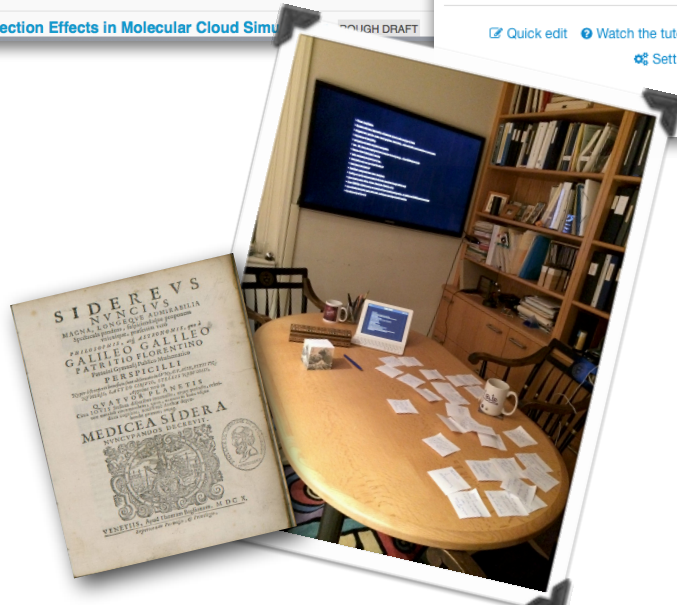
In the early 1600s, Galileo Galilei turned a telescope toward Jupiter. In his log book each night, he drew to-scale schematic diagrams of Jupiter and some oddly-moving points of light near it. Galileo labeled each drawing with the date. Eventually he used his observations to conclude that the Earth orbits the Sun, just as the four Galilean moons orbit Jupiter. History shows Galileo to be much more than an astronomical hero, though. His clear and careful record keeping and publication style not only let Galileo understand the Solar System, it continues to let anyone understand how Galileo did it. Galileo's notes directly integrated his **data** (drawings of Jupiter and its moons), key **metadata** (timing of each observation, weather, telescope properties), and **text** (descriptions of methods, analysis, and conclusions). Critically, when Galileo included the information from those notes in *Siderius Nuncius* (Galilei 1610), this integration of text, data and metadata was preserved, as shown in Figure 1. Galileo's work advanced the "Scientific Revolution," and his approach to observation and analysis contributed significantly to the shaping of today's modern "Scientific Method" (Galilei 1618, Drake 1957).

Today most research projects are considered complete when a journal article based on the analysis has been written and published. Trouble is, unlike Galileo's report in *Siderius Nuncius*, the amount of real data and data description in modern publications is almost never sufficient to repeat or even statistically verify a study being presented. Worse, researchers wishing to build upon and extend work presented in the literature often have trouble recovering data associated with an article after it has been published. More often than scientists would like to admit, they cannot even recover the data associated with their own published works.

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# Ten Simple Rules for the Care and Feeding of Scientific Data

Alyssa Goodman, Alberto Pepe , Alexander W. Blocker, Christine L. Borgman, Kyle Cranmer, Merce Crosas, Rosanne Di Stefano, Yolanda Gil, Paul Groth, Margaret Hedstrom, David W. Hogg, Vinay Kashyap, Ashish Mahabal, [ ... ], Aleksandra Slavkovic, [ [view all](#) ]

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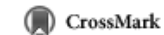
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# "10 SIMPLE RULES"

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# LINKS TO USEFUL RESOURCES FROM "10 SIMPLE RULES" PAPER...

## A: General Data Repositories

- **Dataverse** (<http://thedata.org>): A repository for research data that takes care of long-term preservation and good archival practices, while researchers can share, keep control of, and get recognition for their data.
- **FigShare** (<http://figshare.com>): A repository where users can make all of their research outputs available in a citable, shareable, and discoverable manner.
- **Zenodo** (<http://zenodo.org>): A repository service that enables researchers, scientists, projects, and institutions to share and showcase multidisciplinary research results (data and publications) that are not part of existing institutional or subject-based repositories.
- **Dryad** (<http://datadryad.org>): A repository that aims to make data archiving as simple and as rewarding as possible through a suite of services not necessarily provided by publishers or institutional websites.

## B: Directories of Research Data Repositories

- **DataBib** (<http://databib.org>): Databib is a tool for helping people identify and locate online repositories of research data. Users and bibliographers create and curate records that describe data repositories that users can search.
- **Re3data.org** (<http://www.re3data.org>): Re3data is a global registry of research data repositories from different academic disciplines for researchers, funding bodies, publishers, and scholarly institutions.
- **Open Access Directory** ([http://oad.simmons.edu/oadwiki/Data\\_repositories](http://oad.simmons.edu/oadwiki/Data_repositories)): A list of repositories and databases for open data.
- **Force 11 Catalog** (<http://www.force11.org/catalog>): A dynamic inventory of web-based scholarly resources, a collection of alternative publication systems, databases, organizations and groups, software, services, standards, formats, and training tools.

## C: Workflow Management Systems

- **Taverna** (<http://www.taverna.org.uk>): An open-source and domain-independent workflow management system—a suite of tools used to design and execute scientific workflows and aid in silico experimentation.
- **Kepler** (<https://kepler-project.org>): Software designed to help scientists, analysts, and computer programmers create, execute, and share models and analyses across a broad range of scientific and engineering disciplines.
- **Wings** (<http://www.wings-workflows.org>): A semantic workflow system that assists scientists with the design of computational experiments.
- **VisTrails** (<http://www.vistrails.org>): An open-source scientific workflow and provenance management system that supports data exploration and visualization.
- **Knime** (<http://www.knime.org>): A graphical workbench for the entire analysis process: data access, data transformation, initial investigation, powerful predictive analytics, visualization, and reporting.

## D: Source Code Repositories

- **GitHub** (<http://github.com>): A web-based hosting service for software development projects that use the Git revision control system, including many open-source projects.
- **Git** (<http://git-scm.com>): A free and open-source distributed version control system designed to handle everything from small to very large projects with speed and efficiency.
- **Mercurial** (<http://mercurial.selenic.com>): A free, distributed source control management tool. It efficiently handles projects of any size and offers an easy and intuitive interface.
- **BitBucket** (<https://bitbucket.org>): A web-based hosting service for projects that use either the Mercurial or Git revision control systems.

## E: Systems to Package, Access, and Execute Data and Code

- **IPython Notebook** (<http://ipython.org/notebook.html>): A web-based interactive computational environment where you can combine code execution, text, mathematics, plots, and rich media into a single document.
- **ROpenSci** (<http://ropensci.org>): A suite of packages that allow access to data repositories through the R statistical programming environment.
- **Authorea** (<https://authorea.com>): A collaborative online word processor for scholarly papers that allows the writing of web-native, living, dynamic, “executable” articles that include text, mathematical notation, images, and data. It currently supports inclusion and rendering of d3.js plots and IPython notebooks.
- **Dexy** (<http://dexy.it>): A multipurpose project automation tool for working with documents via a command-line interface.

## F: Software Tools to Run Your Own Document Repository

- **Invenio** (<http://invenio-software.org>): Invenio is a free software suite enabling you to run your own digital library or document repository on the web. Invenio is an ideal solution for running document repositories of moderate to large sizes (several millions of records). Invenio is codeveloped by CERN, DESY, EPFL, FNAL, and SLAC.
- **Eprints** (<http://www.eprints.org/software>): Eprints is one of the easiest and fastest ways to set up small to medium-sized repositories of open-access research literature, scientific data, theses, reports, and multimedia. Developed at the University of Southampton, UK.
- **DSpace** (<http://www.dspace.org>): DSpace is a turnkey institutional repository application developed by the Duraspace organization.

## G: Licensing and Privacy

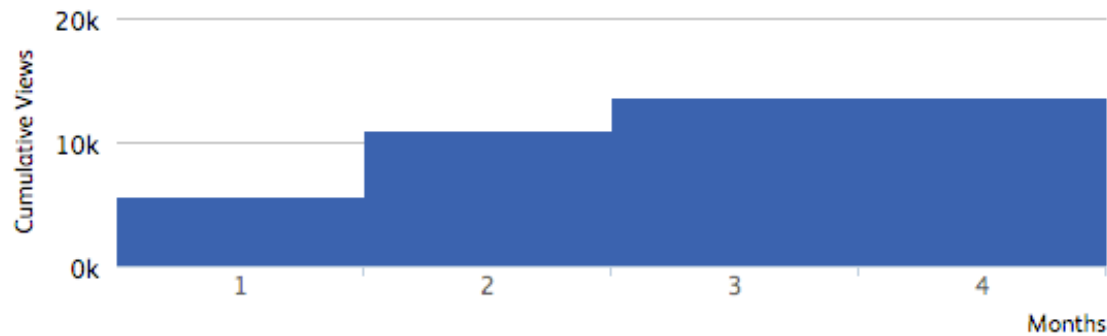
- **Open Source Initiative** (<http://opensource.org/licenses>): Open-source licenses are licenses that comply with the Open Source Definition: they allow software to be freely used, modified, and shared. These include Apache, BSD, GNU (GPL), MIT, and the Mozilla Public License.
- **Privacy Tools for Sharing Research Data** (<http://privacytools.seas.harvard.edu>): A Harvard-based collaborative and multidisciplinary effort to help enable the collection, analysis, and sharing of personal data for research in social science and other fields while providing privacy for individual subjects.

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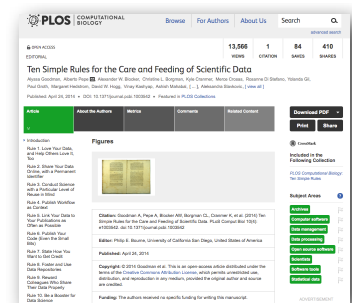
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