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Alyssa A. Goodman
Harvard-Smithsonian Center for Astrophysics

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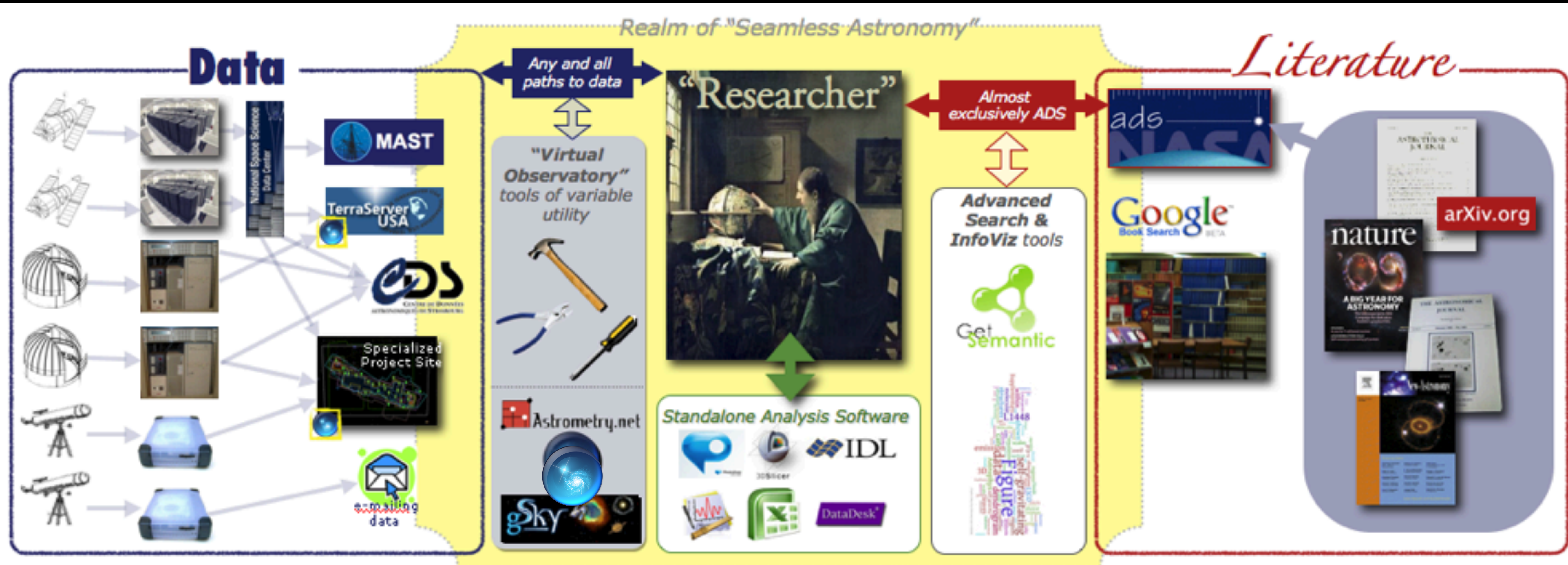

Collaborators:

Alberto Accomazzi, Douglas Burke, Raffaele D'Abrusco, Rahul Davé, Christopher Erdmann, Pepi Fabbiano, Alyssa Goodman, Jay Luker, Gus Muench, Michael Kurtz & Alberto Pepe (Harvard-Smithsonian CfA); Eli Bressert (U. Exeter); Tim Clark (Massachusetts General Hospital/Harvard Medical School); Mercé Crosas (Harvard Institute for Quantitative Social Science; Chris Borgman (UCLA); Jonathan Fay & Curtis Wong (Microsoft Research)

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Linking scientific data, publications, and communities

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The **Seamless Astronomy Group** at the **Harvard-Smithsonian Center for Astrophysics** brings together astronomers, computer scientists, information scientists, librarians and visualization experts involved in the development of tools and systems to study and enable the next generation of **online astronomical research.**

Current projects include research on the development of systems that seamlessly integrate scientific data and literature, the semantic interlinking and annotation of scientific resources, the study of the impact of social media and networking sites on scientific dissemination, and the analysis and visualization of astronomical research communities. Visit our project page to find out more.

Sponsors of Seamless Astronomy include NASA, NSF and Microsoft Research.

Contact us. For inquiries or questions, please email Sarah Block at sblock@cfa.harvard.edu.
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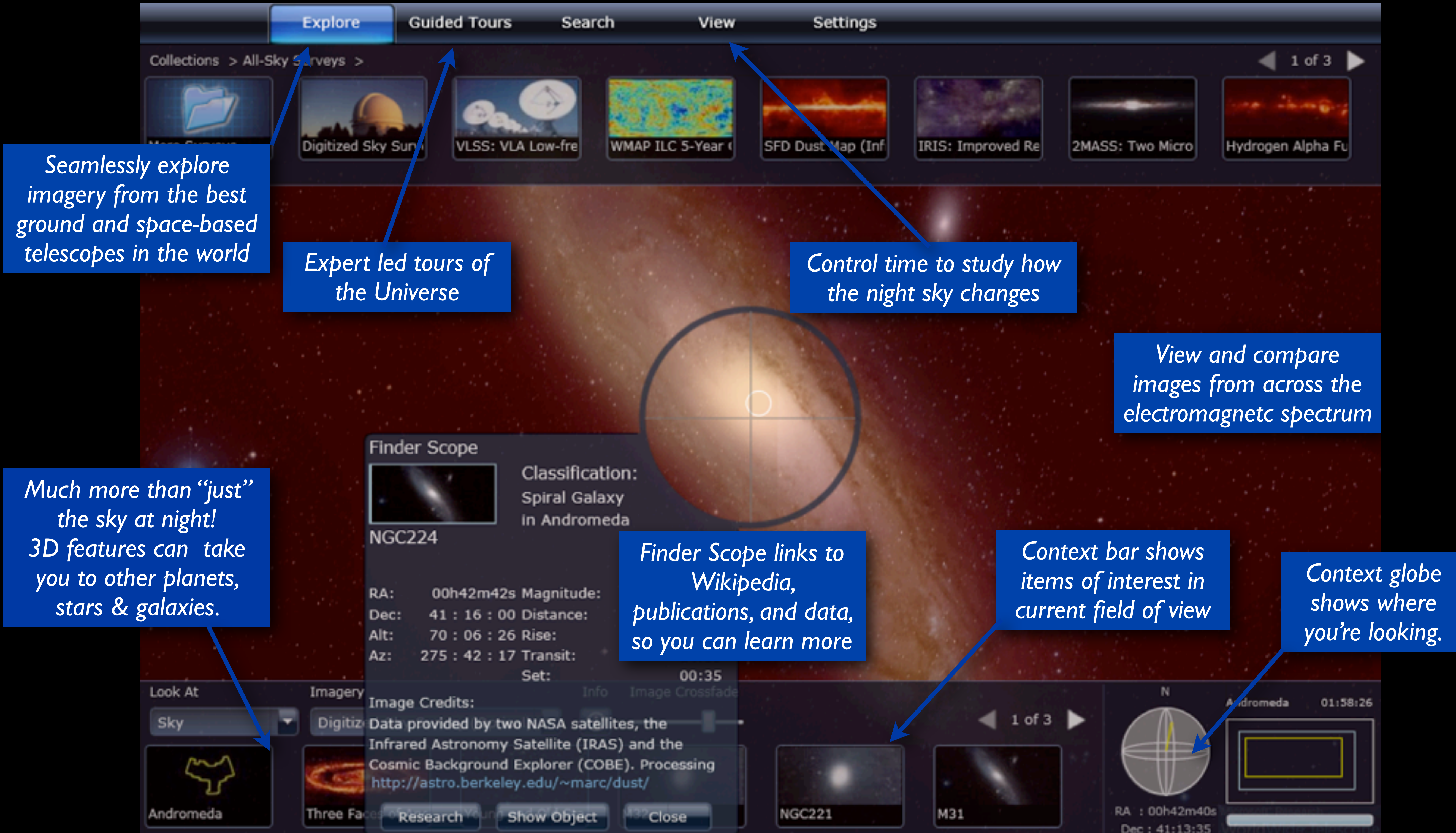

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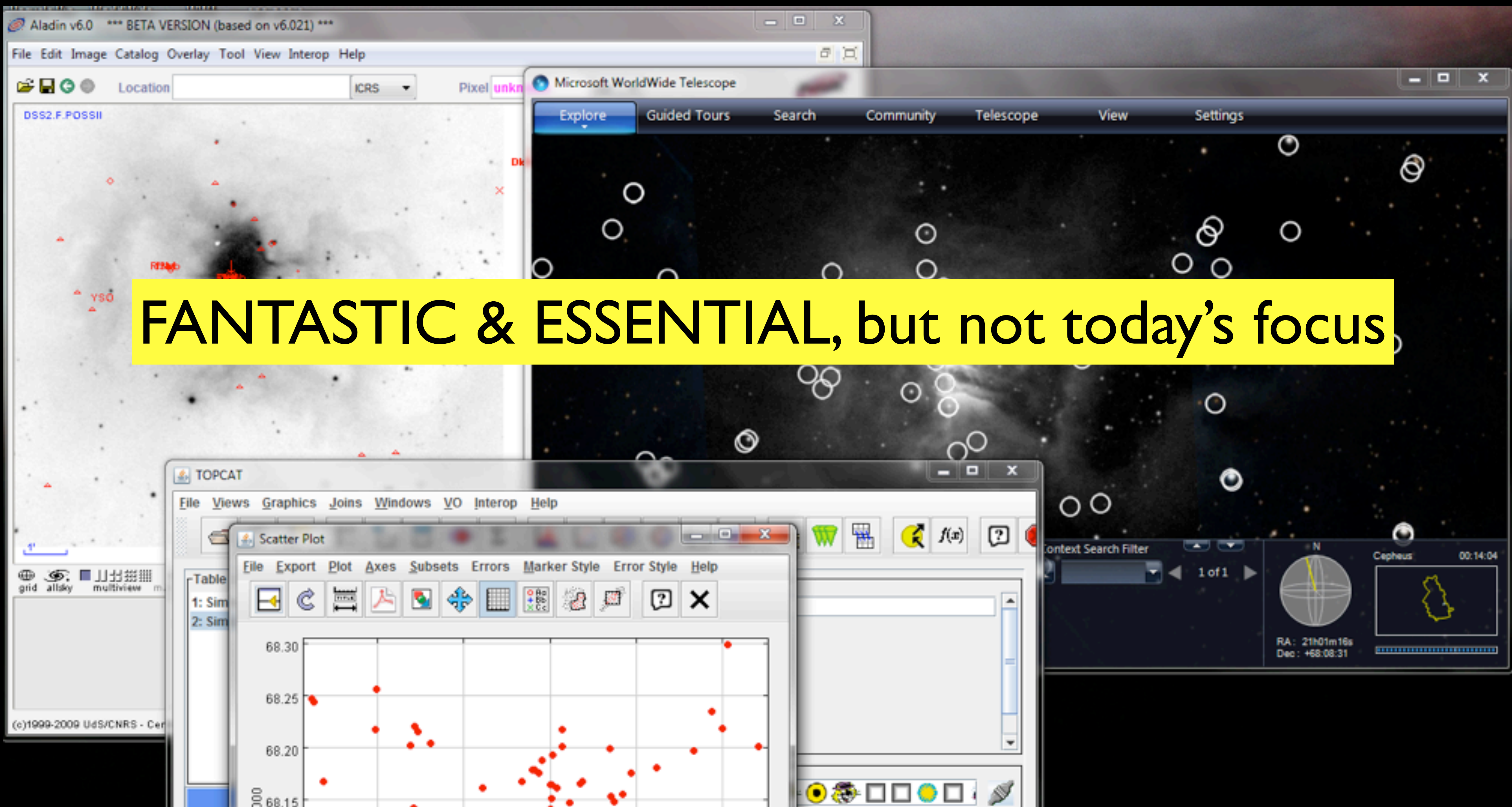

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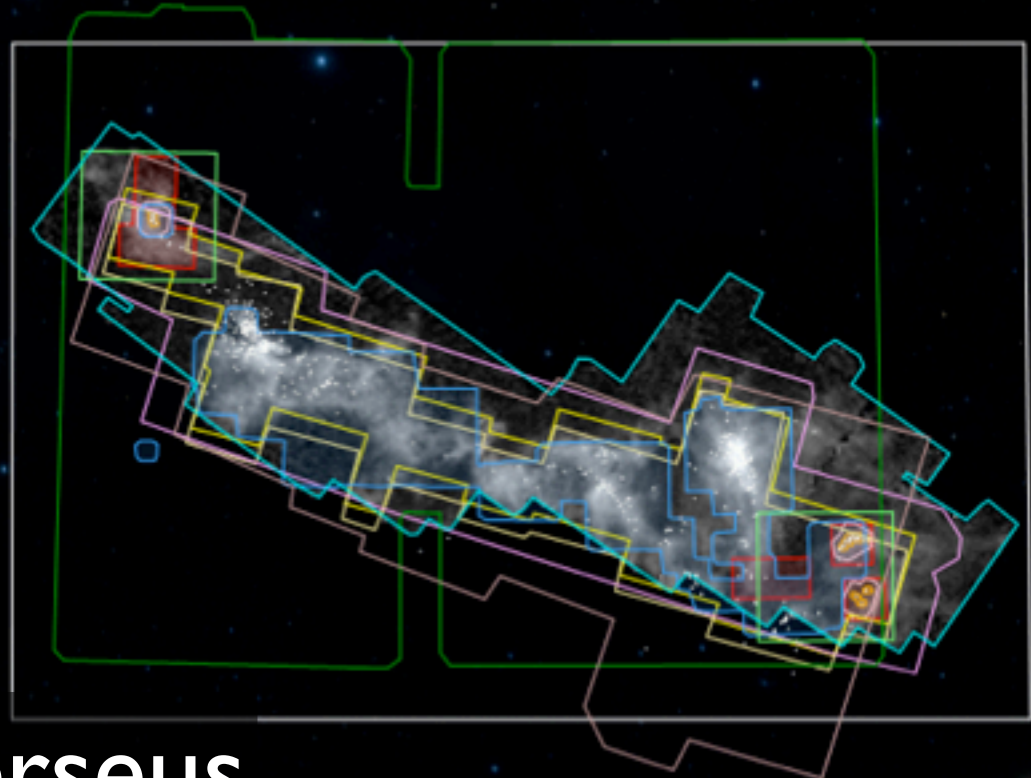

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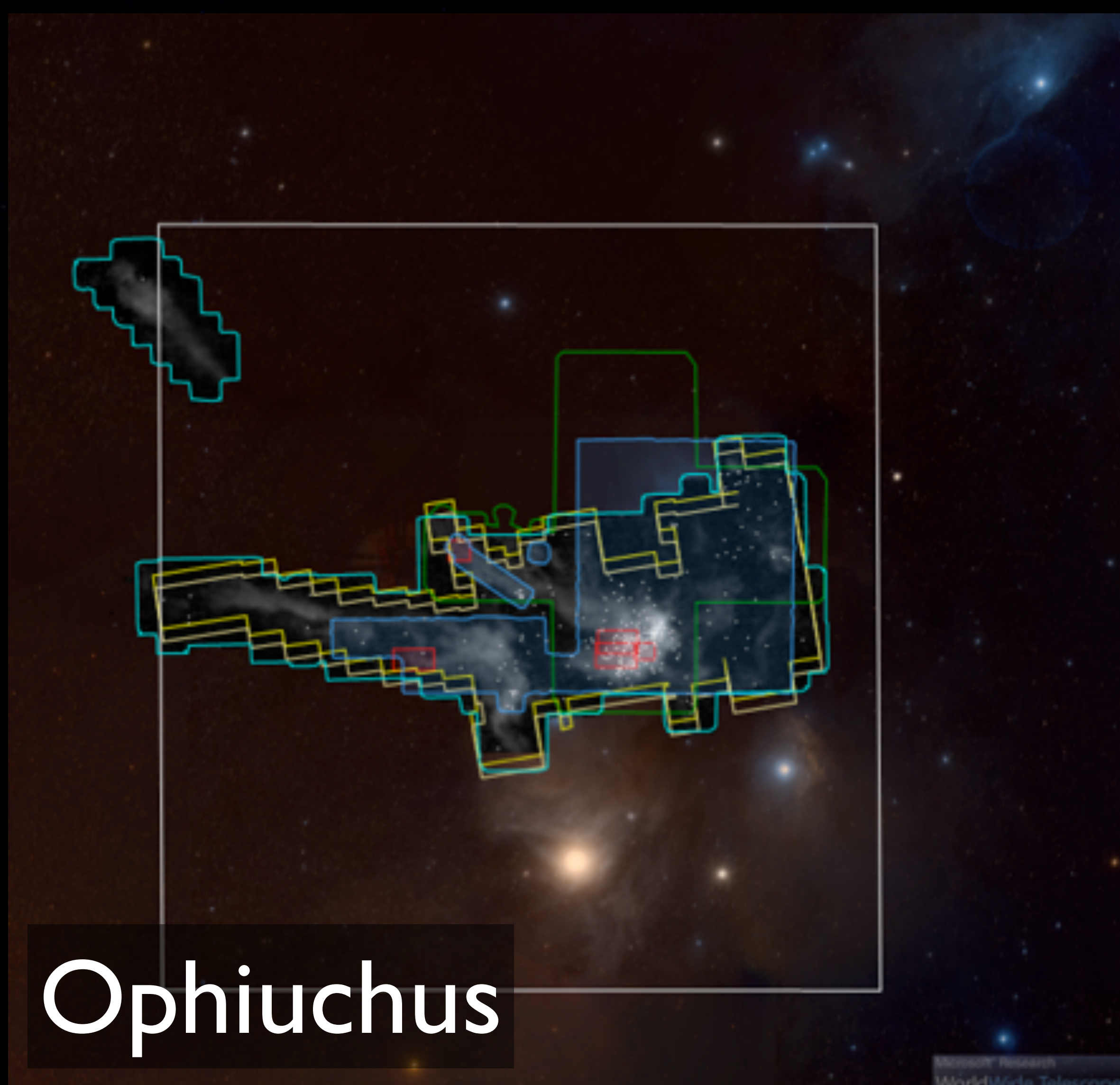

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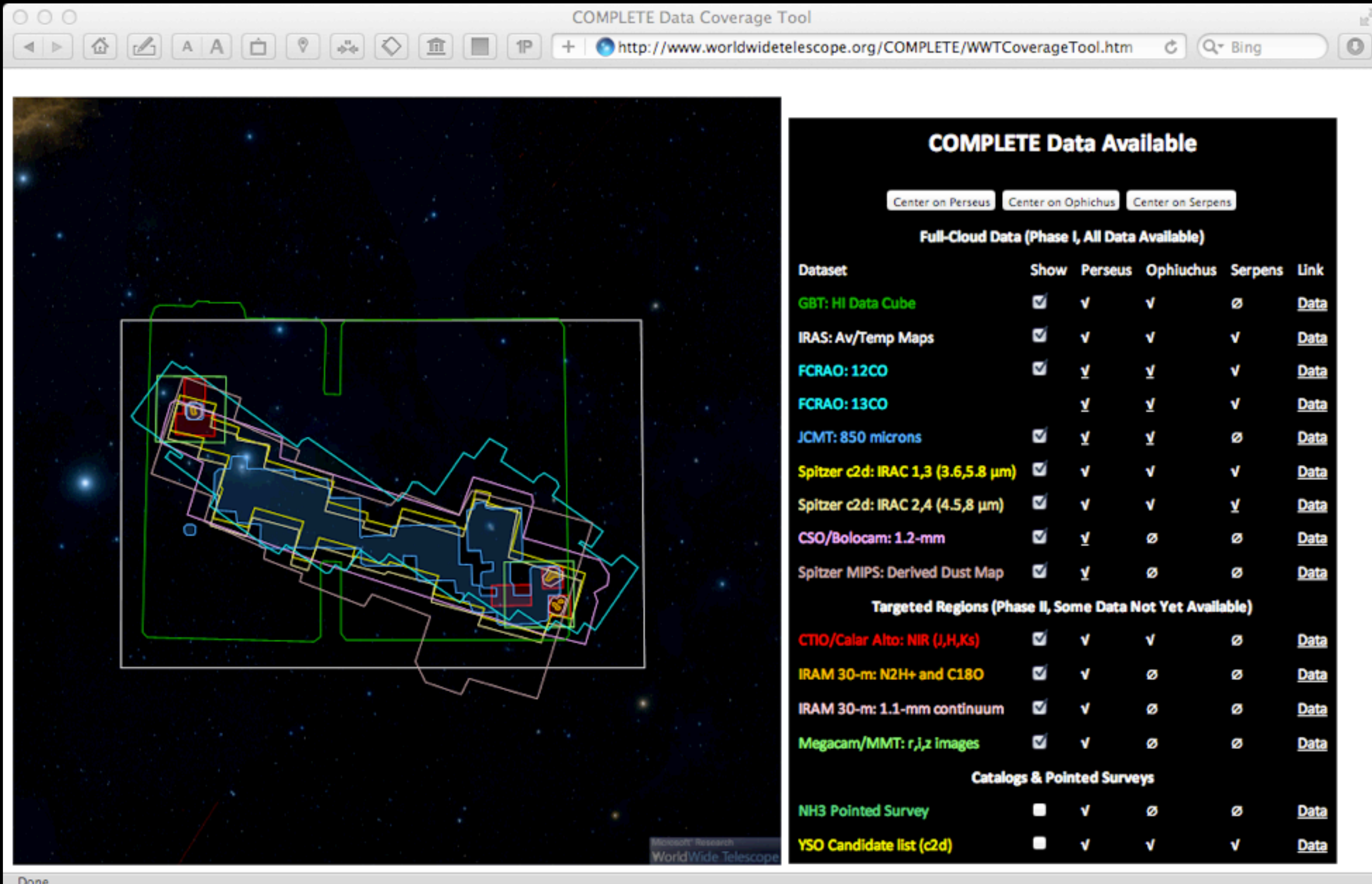

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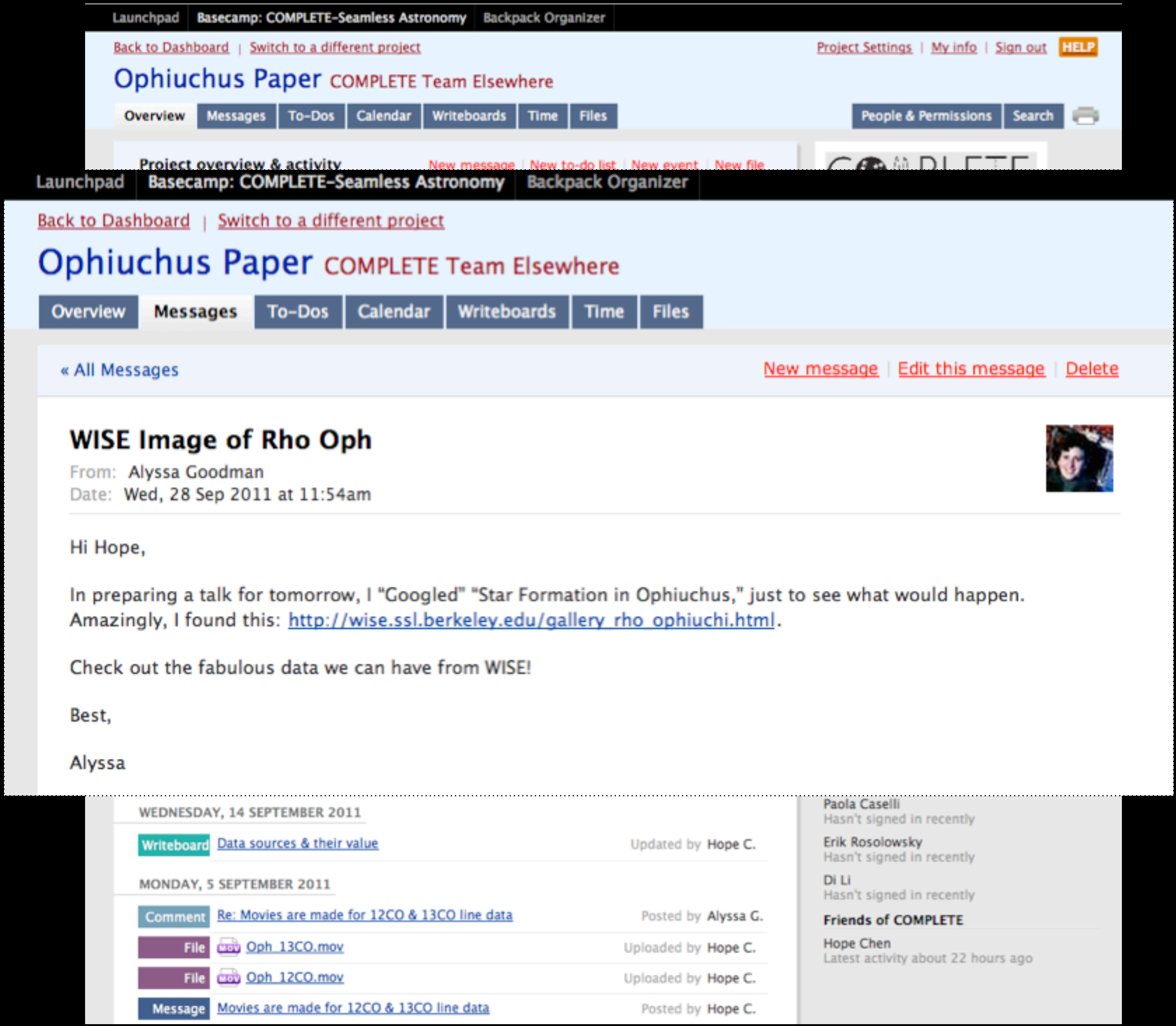
Brand-new Harvard Grad Student
Project: "COMPLETE" Ophiuchus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WISE Image of Rho Oph
From: Alyssa Goodman
Date: Wed, 28 Sep 2011 at 11:54am
Hi Hope,
In preparing a talk for tomorrow, I "Googled" "Star Formation in Ophiuchus," just to see what would happen. Amazingly, I found this: http://wise.ssl.berkeley.edu/gallery_rho_ophiuchi.html.
Check out the fabulous data we can have from WISE!
Best,
Alyssa
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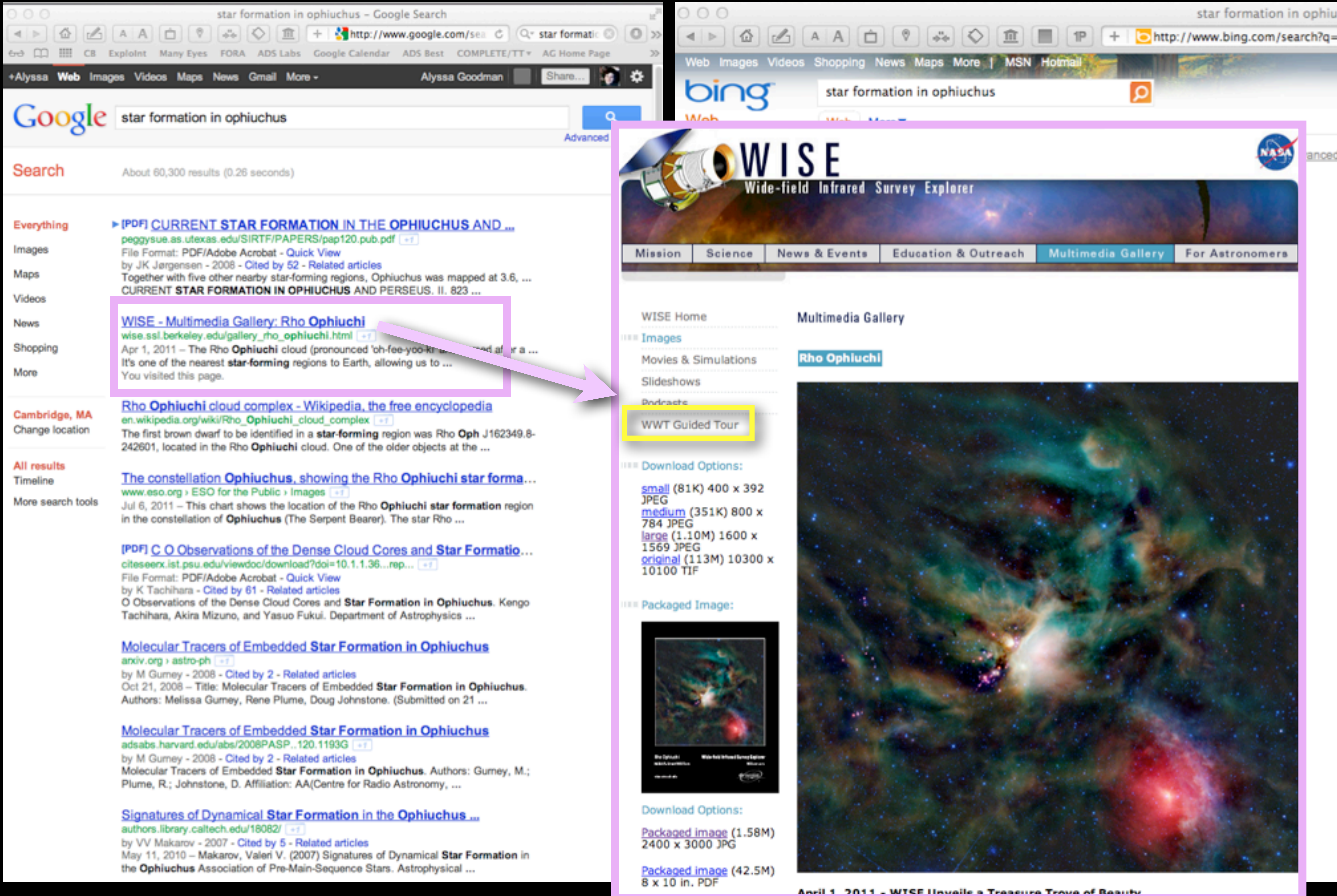

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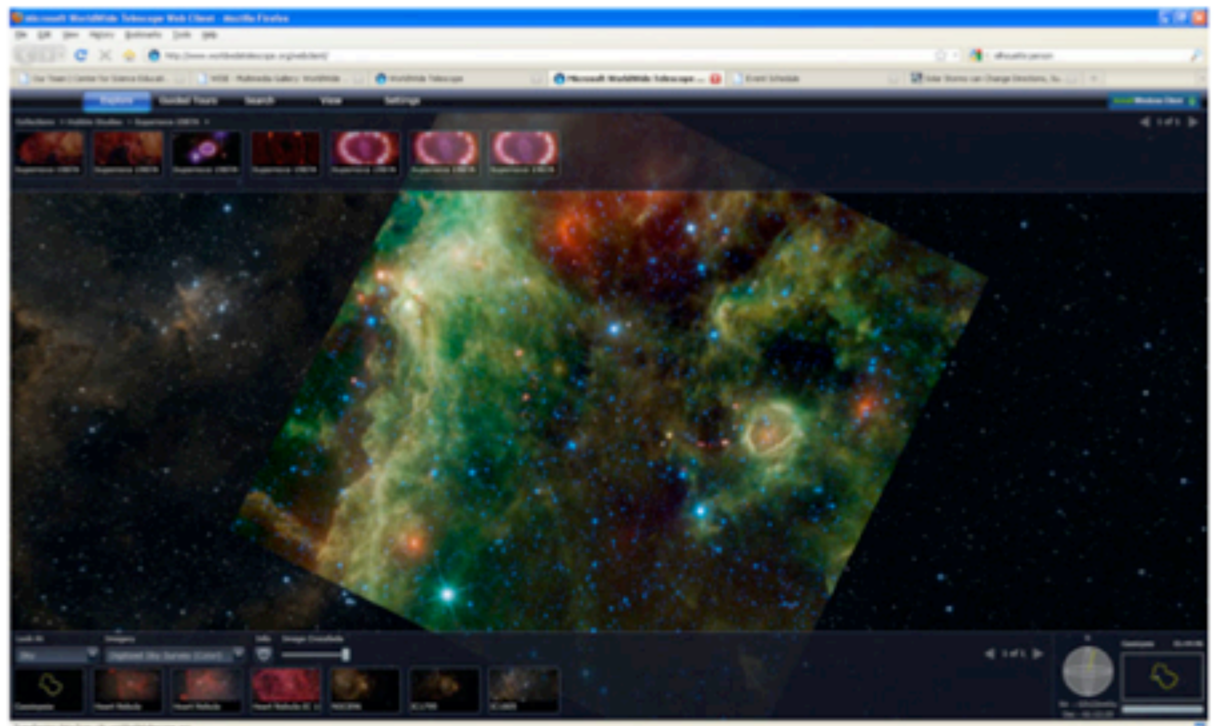

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The WorldWide Telescope (WWT) is a free Web 2.0 visualization software environment that enables your computer to function as a virtual telescope—bringing together imagery from the world's best ground- and space-based telescopes for the exploration of the universe.

The WorldWide Telescope can be downloaded or used online for free from www.worldwidetelescope.org.

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SAO184382; HD147933; DM
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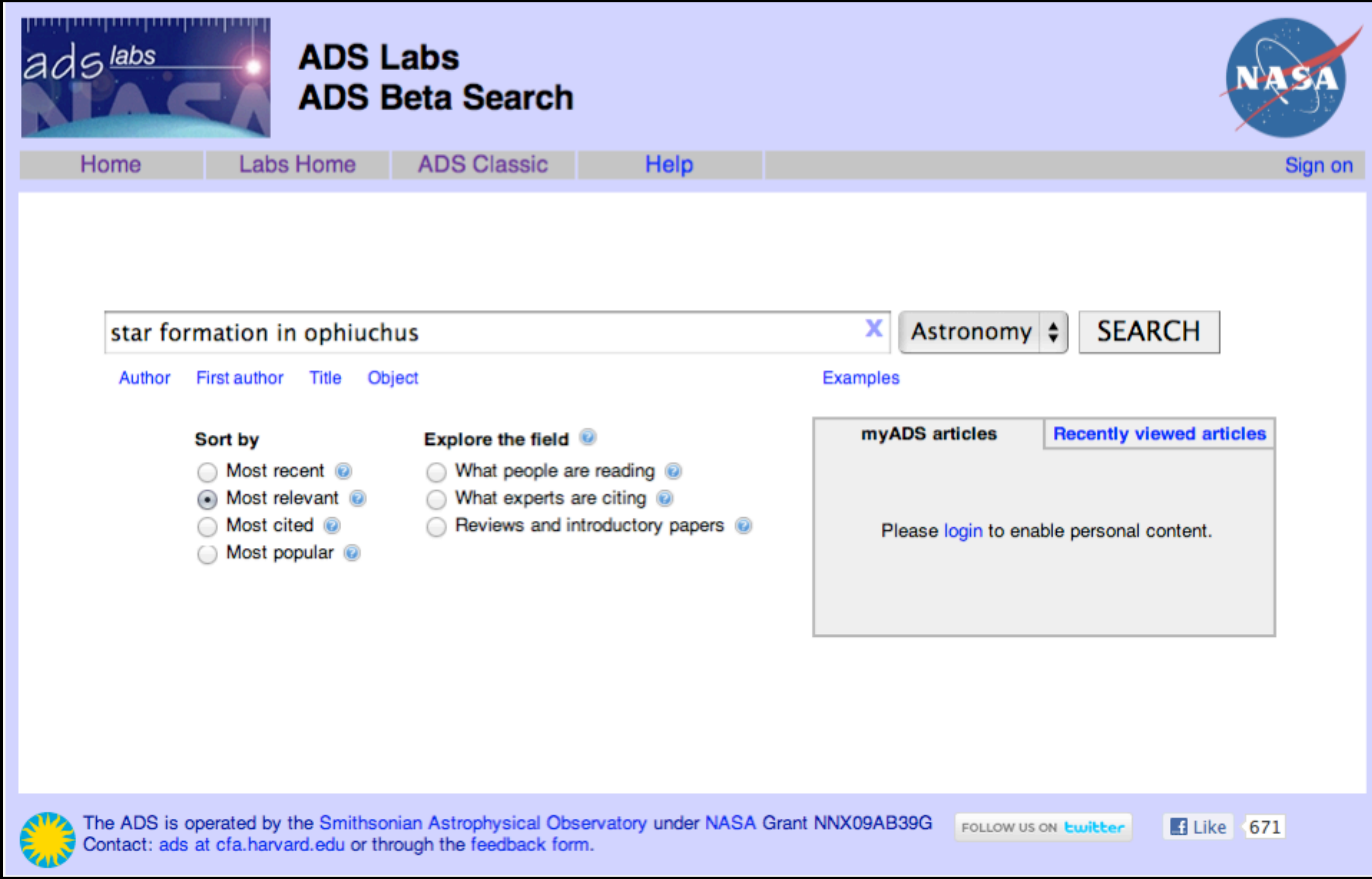

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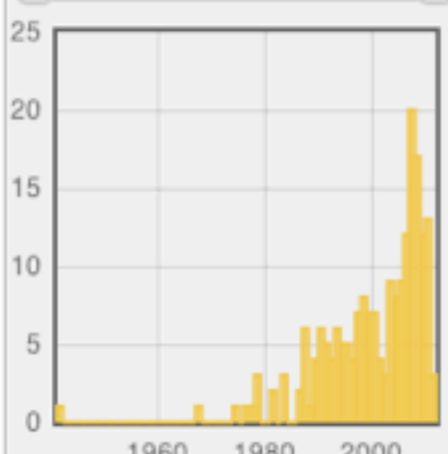

1. 2009ApJS..181..321E **The Spitzer c2d Legacy Results: Star-Formation Rates and Efficiencies; Evolution and Lifetimes**
Evans, Neal J., II; Dunham, Michael M.; Jørgensen, Jes K.; Enoch, Melissa L.; Merín, Bruno; van Dishoeck, Ewine F.; Alcalá, Juan M.; Myers, Philip C.; Stapelfeldt, Karl R.; Huard, Tracy L.; *and 8 coauthors*
The Astrophysical Journal Supplement, Volume 181, Issue 2, article id. 321-350 (2009). Apr 2009

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Motte, F.; Andre, P.; Neri, R.
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Lada, Charles J.
IN: Star forming regions; Proceedings of the Symposium, Tokyo, Japan, Nov. 11-15, 1985 (A87-45601 20-90). Dordrecht, D. Reidel Publishing Co., 1987, p. 1-17; Discussion, p. 17, 18. n/a 1987

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Ghez, A. M.; Neugebauer, G.; Matthews, K.
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Adams, Fred C.; Lada, Charles J.; Shu, Frank H.
Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 312, Jan. 15, 1987, p. 788-806. NASA-supported research. Jan 1987

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Simon, M.; Ghez, A. M.; Leinert, Ch.; Cassar, L.; Chen, W. P.; Howell, R. R.; Jameson, R. F.; Matthews, K.; Neugebauer, G.; Richichi, A.
Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 443, no. 2, p. 625-637 Apr 1995

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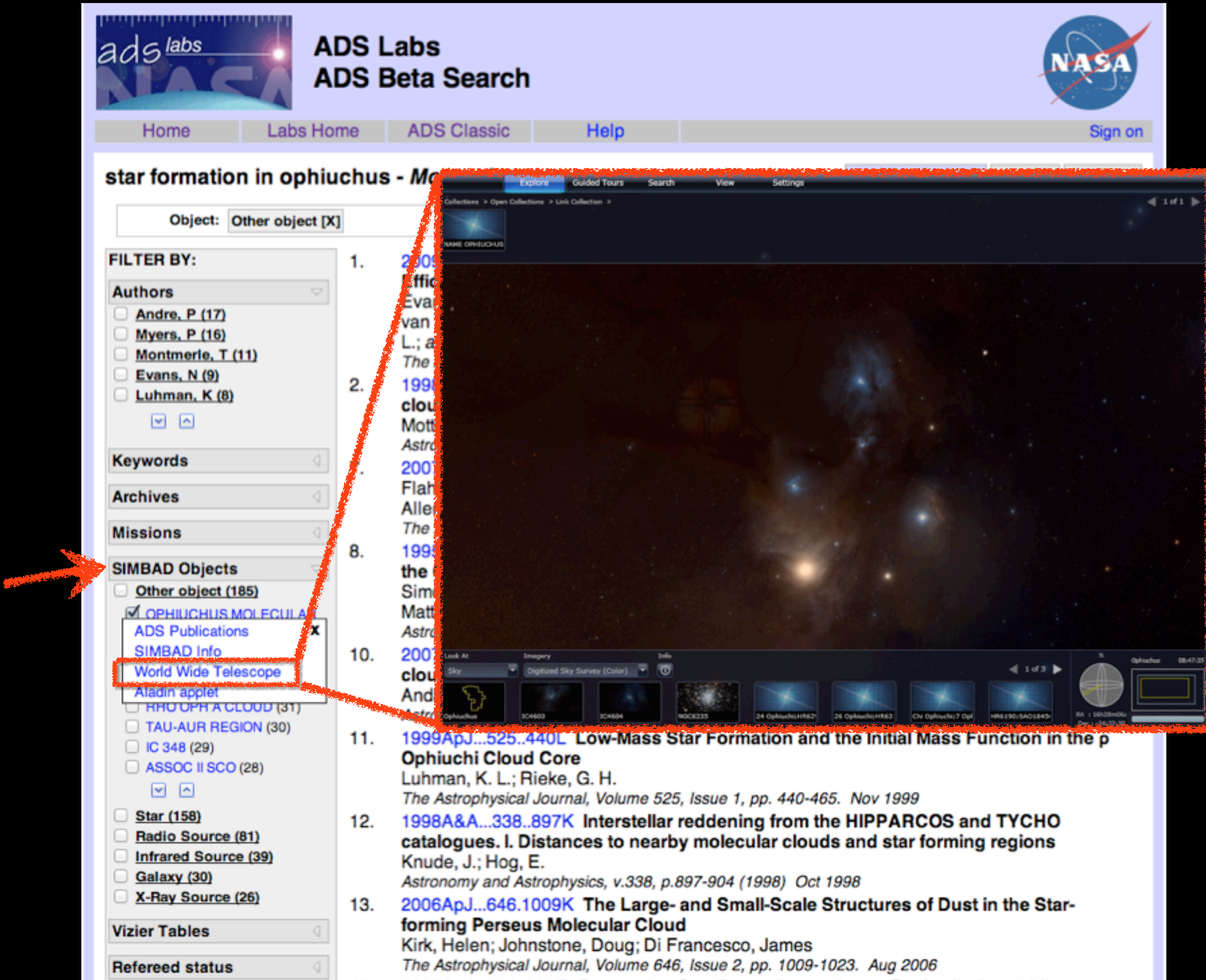
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11. 1999ApJ...525..440L Low-Mass Star Formation and the Initial Mass Function in the ρ Ophiuchi Cloud Core
Luhman, K. L.; Rieke, G. H.
The Astrophysical Journal, Volume 525, Issue 1, pp. 440-465. Nov 1999
12. 1998A&A...338..897K Interstellar reddening from the HIPPARCOS and TYCHO catalogues. I. Distances to nearby molecular clouds and star forming regions
Knude, J.; Hog, E.
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13. 2006ApJ...646.1009K The Large- and Small-Scale Structures of Dust in the Star-forming Perseus Molecular Cloud
Kirk, Helen; Johnstone, Doug; Di Francesco, James
The Astrophysical Journal, Volume 646, Issue 2, pp. 1009-1023. Aug 2006

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Hildebrand, R. H.; Davidson, J. A.; Dotson, J. L.; Dowell, C. D.; Novak, G.; Vaillancourt, J. E.
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6. 2010ApJS..186..406D **350 μm Polarimetry from the Caltech Submillimeter Observatory**
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Houde, Martin; Bastien, Pierre; Dotson, Jessie L.; Dowell, C. Darren; Hildebrand, Roger H.; Peng, Ruisheng; Phillips, Thomas G.; Vaillancourt, John E.; Yoshida, Hiroshige
The Astrophysical Journal, Volume 569, Issue 2, pp. 803-814. Apr 2002
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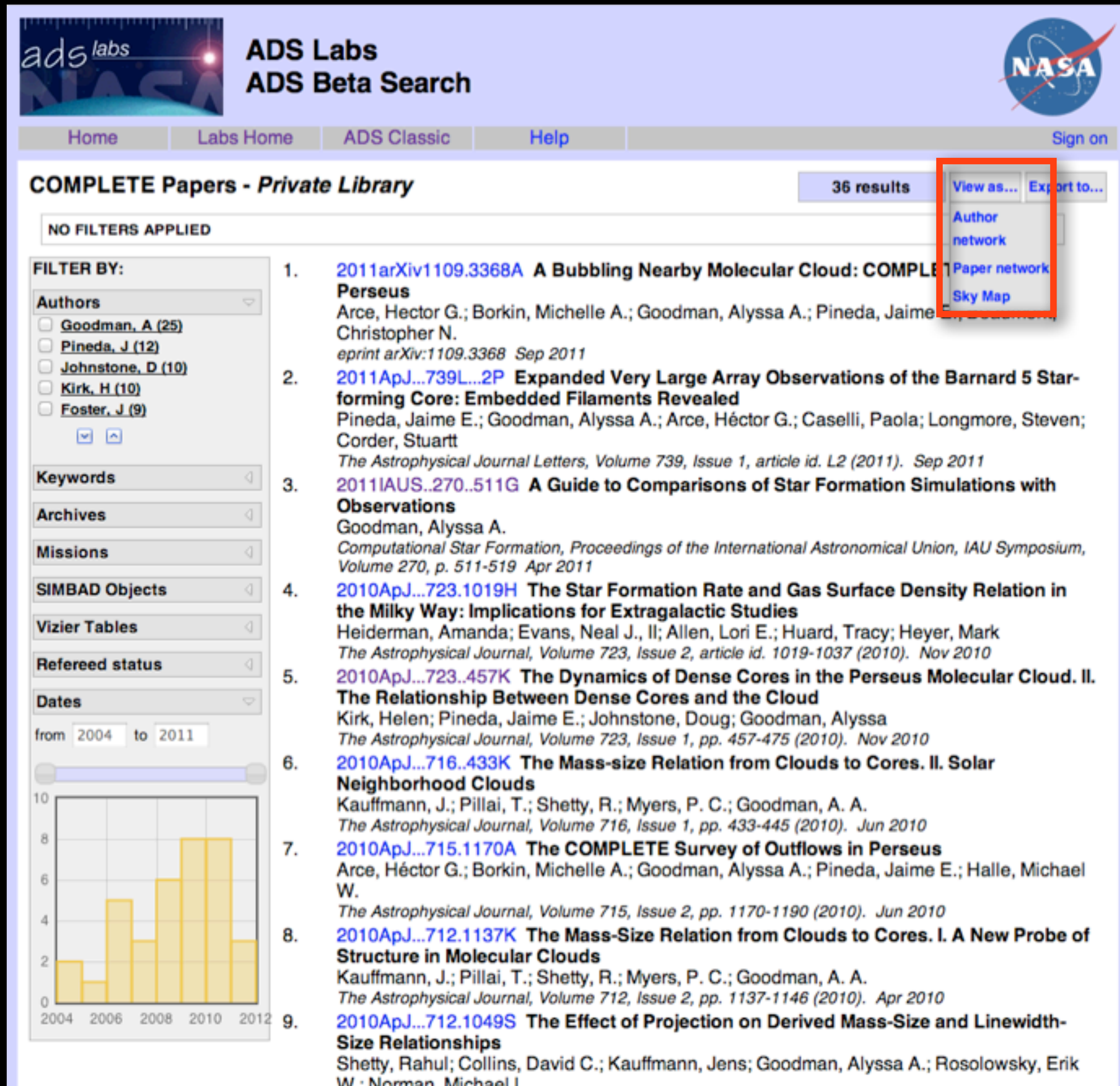
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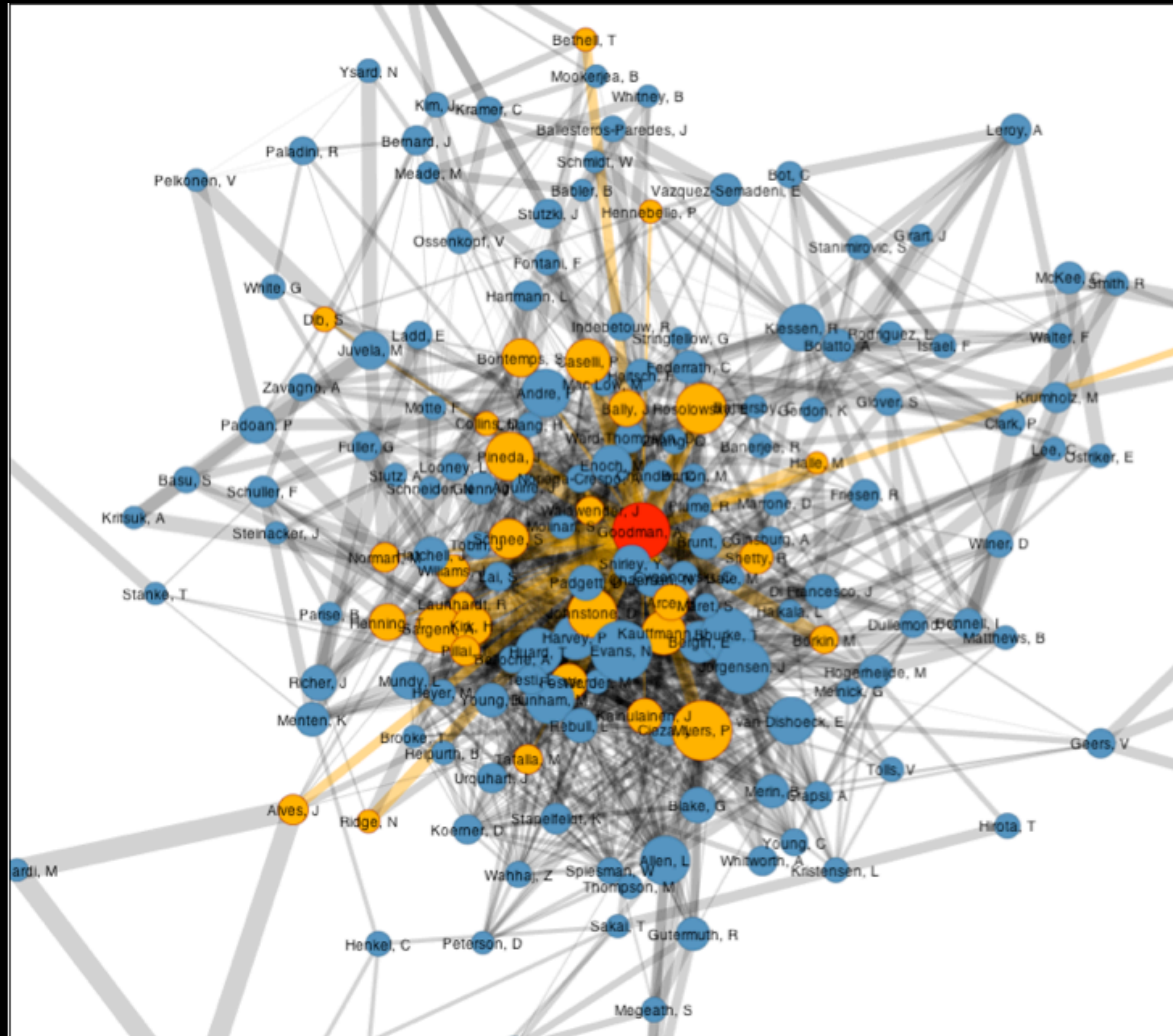
2004 2006 2008 2010 2012
1. 2011arXiv1109.3368A A Bubbling Nearby Molecular Cloud: COMPLE… Perseus
Arce, Hector G.; Borkin, Michelle A.; Goodman, Alyssa A.; Pineda, Jaime … Christopher N.
eprint arXiv:1109.3368 Sep 2011
2. 2011ApJ...739L...2P Expanded Very Large Array Observations of the Barnard 5 Star-forming Core: Embedded Filaments Revealed
Pineda, Jaime E.; Goodman, Alyssa A.; Arce, Héctor G.; Caselli, Paola; Longmore, Steven; Corder, Stuartt
The Astrophysical Journal Letters, Volume 739, Issue 1, article id. L2 (2011). Sep 2011
3. 2011IAUS..270..511G A Guide to Comparisons of Star Formation Simulations with Observations
Goodman, Alyssa A.
Computational Star Formation, Proceedings of the International Astronomical Union, IAU Symposium, Volume 270, p. 511-519 Apr 2011
4. 2010ApJ...723.1019H The Star Formation Rate and Gas Surface Density Relation in the Milky Way: Implications for Extragalactic Studies
Heiderman, Amanda; Evans, Neal J., II; Allen, Lori E.; Huard, Tracy; Heyer, Mark
The Astrophysical Journal, Volume 723, Issue 2, article id. 1019-1037 (2010). Nov 2010
5. 2010ApJ...723..457K The Dynamics of Dense Cores in the Perseus Molecular Cloud. II. The Relationship Between Dense Cores and the Cloud
Kirk, Helen; Pineda, Jaime E.; Johnstone, Doug; Goodman, Alyssa
The Astrophysical Journal, Volume 723, Issue 1, pp. 457-475 (2010). Nov 2010
6. 2010ApJ...716..433K The Mass-size Relation from Clouds to Cores. II. Solar Neighborhood Clouds
Kauffmann, J.; Pillai, T.; Shetty, R.; Myers, P. C.; Goodman, A. A.
The Astrophysical Journal, Volume 716, Issue 1, pp. 433-445 (2010). Jun 2010
7. 2010ApJ...715.1170A The COMPLETE Survey of Outflows in Perseus
Arce, Héctor G.; Borkin, Michelle A.; Goodman, Alyssa A.; Pineda, Jaime E.; Halle, Michael W.
The Astrophysical Journal, Volume 715, Issue 2, pp. 1170-1190 (2010). Jun 2010
8. 2010ApJ...712.1137K The Mass-Size Relation from Clouds to Cores. I. A New Probe of Structure in Molecular Clouds
Kauffmann, J.; Pillai, T.; Shetty, R.; Myers, P. C.; Goodman, A. A.
The Astrophysical Journal, Volume 712, Issue 2, pp. 1137-1146 (2010). Apr 2010
9. 2010ApJ...712.1049S The Effect of Projection on Derived Mass-Size and Linewidth-Size Relationships
Shetty, Rahul; Collins, David C.; Kauffmann, Jens; Goodman, Alyssa A.; Rosolowsky, Erik W.; Norman, Michael L.

COMPLETE

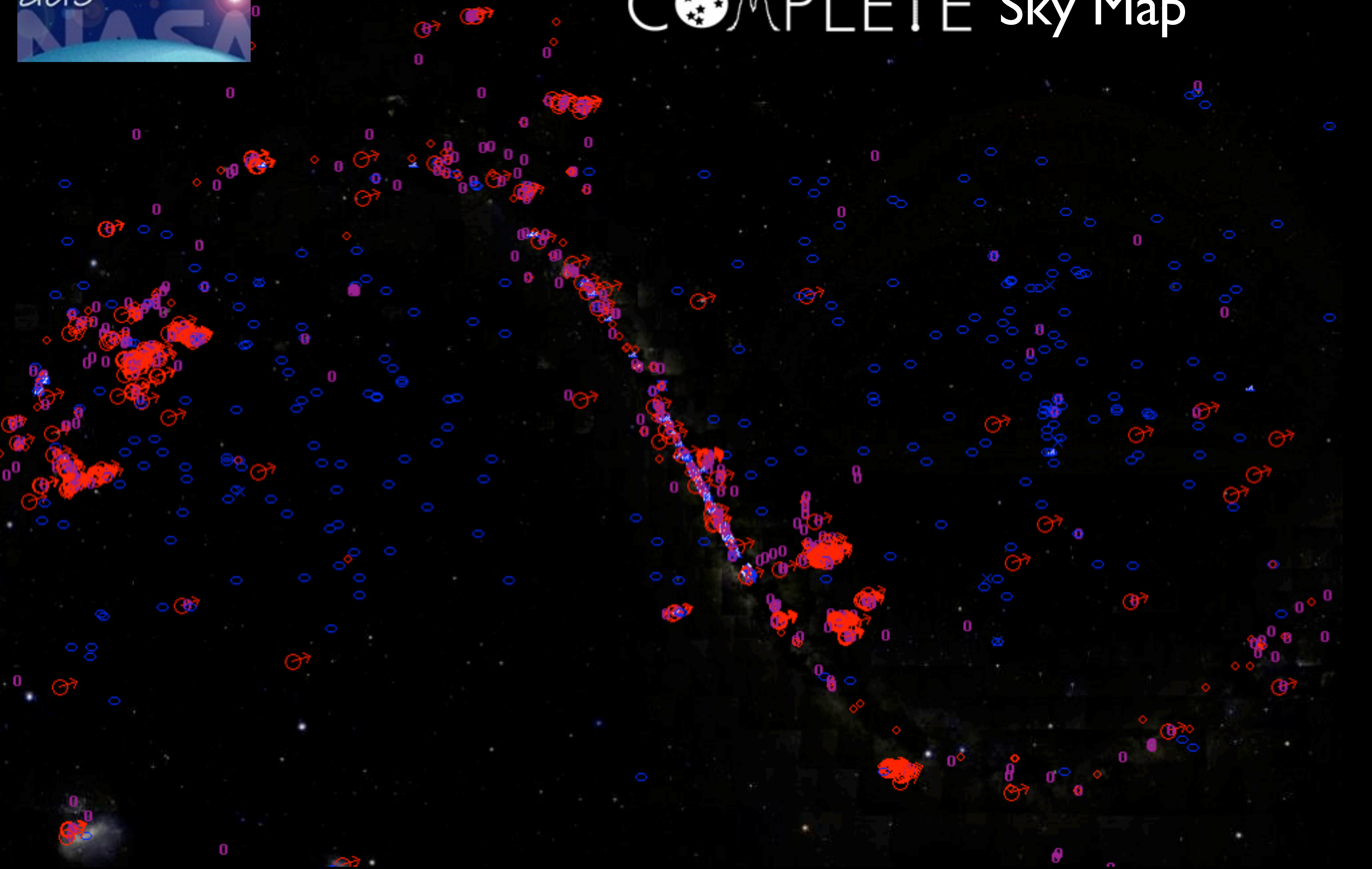
Citation Network

(from ADS Labs)



*many thanks to A. Accomazzi, R. Davé, M. Kurtz, G. Di Milia, A. **Pepe***

COMPLETE Sky Map

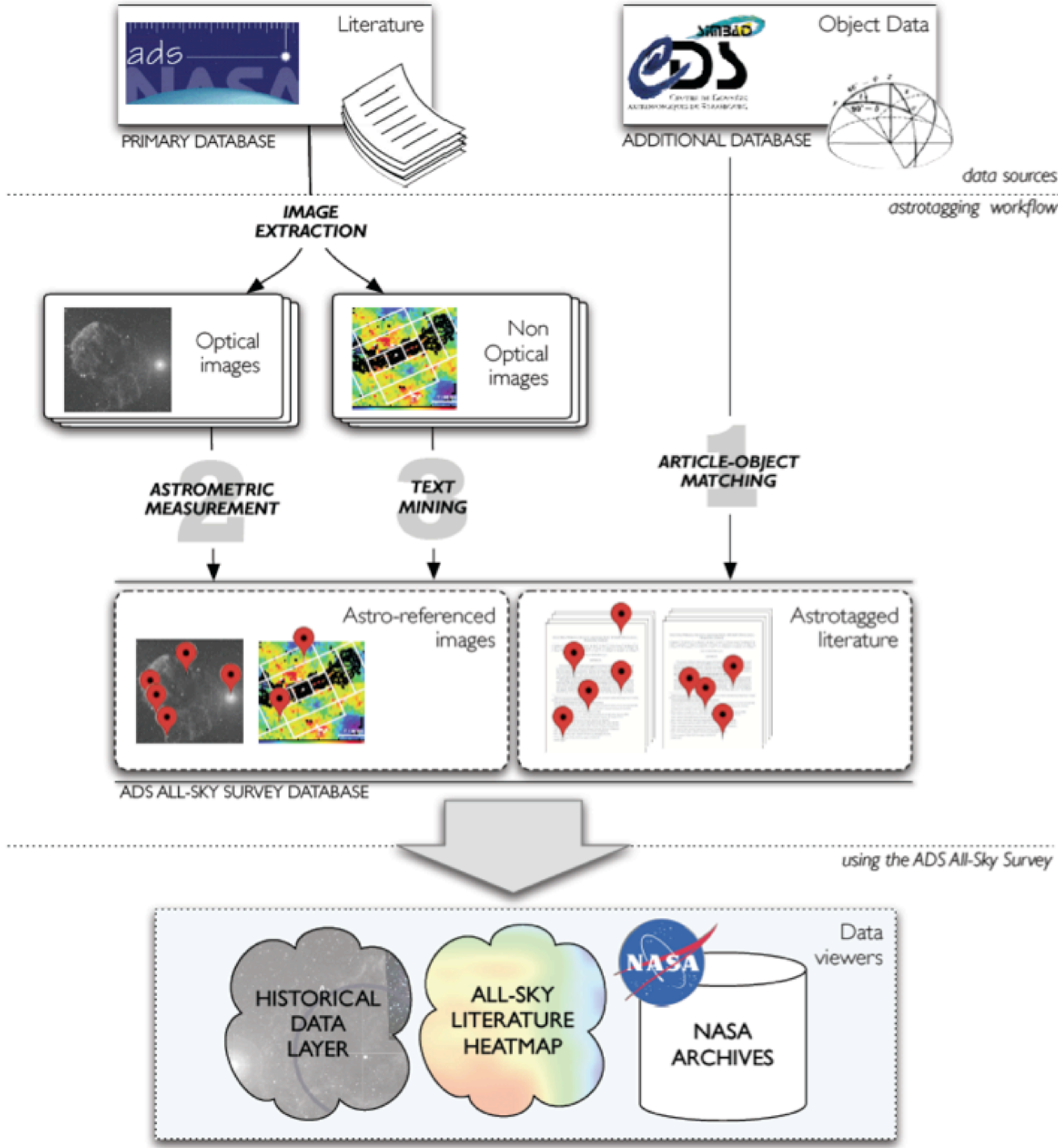


Yes, this is Google Sky...WWT version coming soon!

c.2012

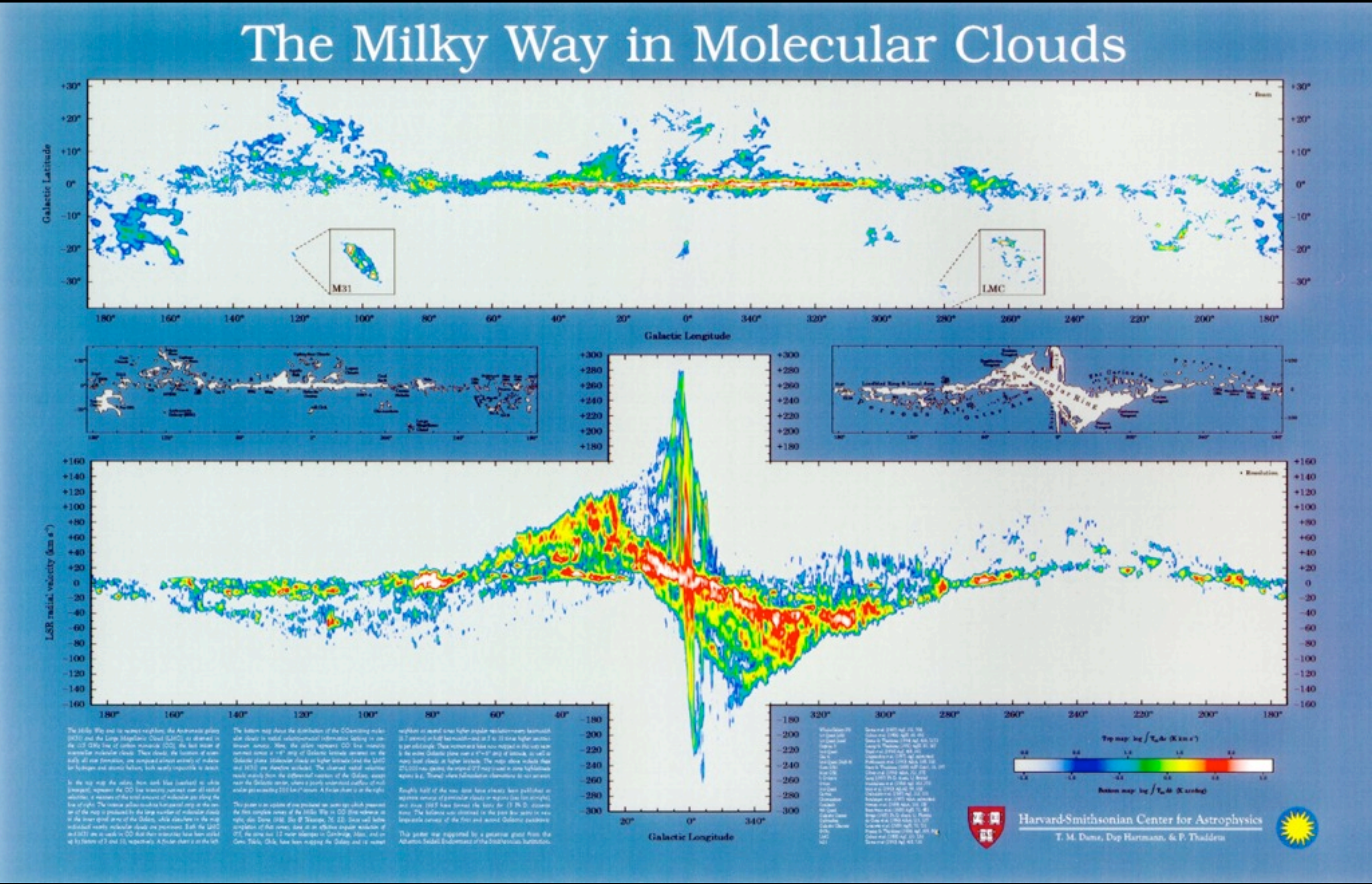
The ADS All-Sky Survey

*A. Goodman (**CfA**)*
A. Muench (CfA)
A. Pepe (CfA)
with A. Accomazzi (CfA),
*A. Conti (**STScI**),*
R. Davé (CfA)
*T. Boch (**CDS**),*
*J. Fay (**MSR**),*
*D. Hogg (**NYU**)*

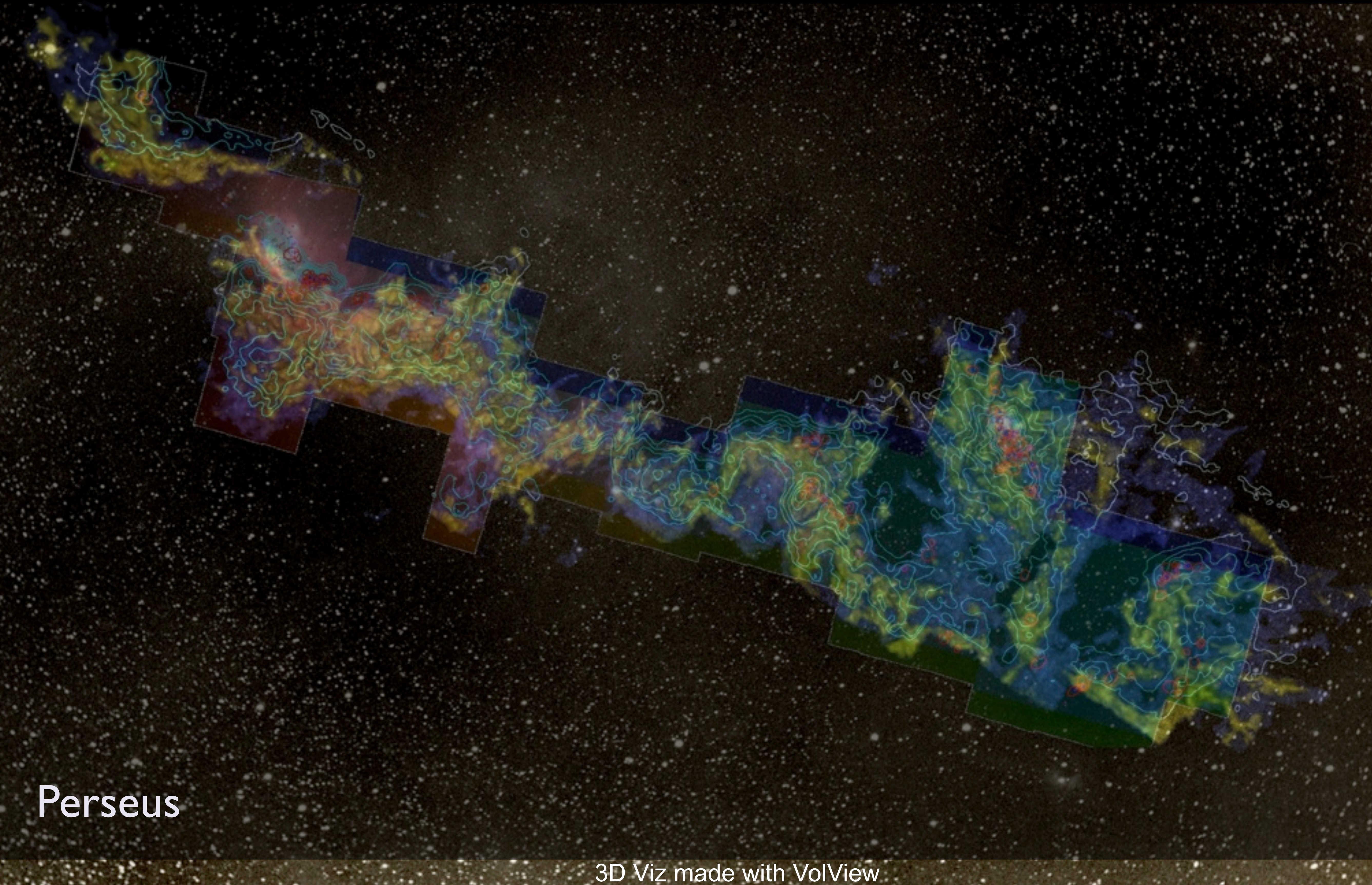


The Future

universe3d.org



Dame, Hartman & Thaddeus 1997

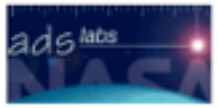

Perseus
3D Viz made with VolView

SEAMLESS ASTRONOMY

Linking scientific data, publications, and communities

ABOUT PEOPLE PROJECTS PUBLICATIONS PRESENTATIONS SOFTWARE CFA DATA (BETA)

Projects



Seamless integration of scientific data and literature
Astronomical data artifacts and publications exist in disjointed repositories. The conceptual relationship that links data and publications is rarely made explicit. In collaboration with ADS and ADSlabs, and through our work in conjunction with the Institute for Quantitative Social Science (IQSS), we are working on developing a platform that allows data and literature to be seamlessly integrated, interlinked, mutually discoverable.

Astronomy Dataverse
Astronomers use, peruse and produce vast amounts of scientific data. Making these data publicly available is important because it supports the reproducibility of results, and ensures their long term preservation and reuse. While raw astronomical data are normally stored and made public available via large-scale archives, reduced data are often left out entirely from both astronomical archives and related publications.

In a pilot study in 2011, we are evaluating the Dataverse, an open data archive hosted by Harvard University and managed by the Institute for Quantitative Social Science (IQSS), as a project-based repository for the storage, access, and citation of reduced astronomical data. We have interviewed a set of 10 astronomers about their needs, and the prototype CfA Dataverse is now online.

WorldWide Telescope (WWT)
WorldWide Telescope provides a rich contextual visualization environment for astronomical data. Our group collaborates with the WWT Team at Microsoft Research both to enrich WWT for use in research as well as in teaching. On the research end, we seek to integrate WWT "Seamlessly" with VAO-sponsored projects, as well as with ADS Labs. On the teaching end, we founded and now run the WorldWide Telescope Ambassadors outreach effort.

Events
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Links

Latest news

augustmuench: Farmers' Almanac foresees a rough winter ahead & dowser finds huge body of dirty water under the Longfellow bridge http://t.co/DwL2mMT

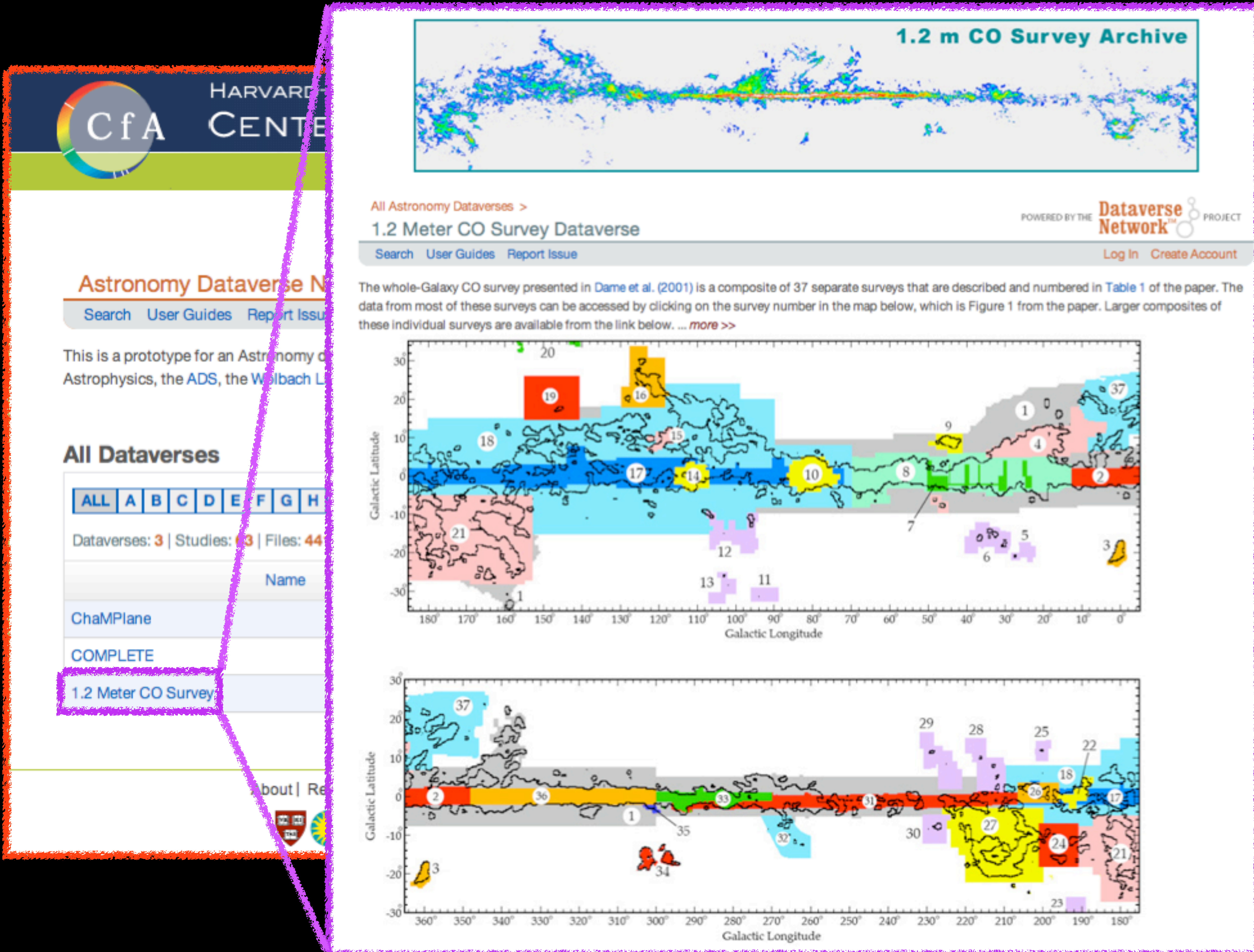
albertoconti: RT @james_s_bullock: Why doesn't the History Channel just change its name to the Bigfoot Lover's Pseudoscience Channel?http://j.mp/rlKp4C

albertoconti: RT @johnmaeda: "Not everything knowable can be articulated in propositional form." http://t.co/ZYD43ER

albertoconti: RT @sarahkendrew: looks awesome! >>; @astrobetter: New Post: iObserve: The Astronomical Observing App We've Been Waiting For http:/ ...

augustmuench: my post `on open science and anonymous peer review`

projects.iq.harvard.edu/seamlessastronomy/pages/projects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Dataverses: 3 | Studies: 63 | Files: 44
Name
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All Astronomy Dataverses >
1.2 Meter CO Survey Dataverse
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The whole-Galaxy CO survey presented in Dame et al. (2001) is a composite of 37 separate surveys that are described and numbered in Table 1 of the paper. The data from most of these surveys can be accessed by clicking on the survey number in the map below, which is Figure 1 from the paper. Larger composites of these individual surveys are available from the link below. ... more >>
Galactic Latitude
Galactic Longitude
Galactic Latitude
Galactic Longitude

aagie Alyssa Goodman

If you know of "viewers" for maps of the Galaxy or Universe online, add them here: tinyurl.com/universe3d, and pass on this link too.

27 Sep

Pinky: *"Gee, Brain, what do you want to do tonight?"*
The Brain: *"The same thing we do every night, Pinky—try to take over the world!"*

Online Maps of the Galaxy & the Universe

This form is being used to collect information about online resources that offer data-driven views of the Milky Way or the Universe beyond. Ultimately, the information here will be used to populate a new "aggregator" service at universe3d.org.

* Required

Name of Site/Page/Service *

URL: *
enter the main URL for the site

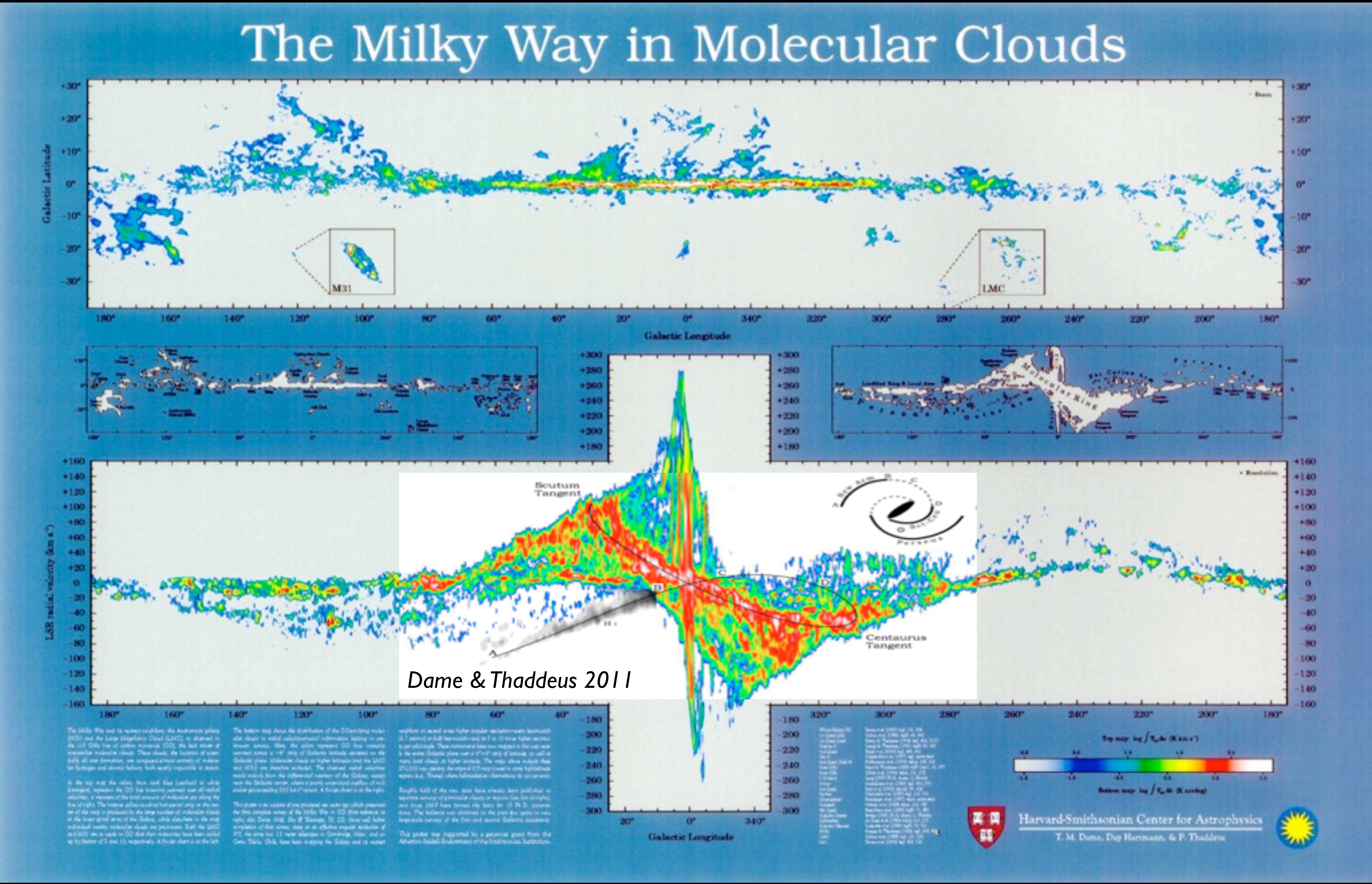
Alternate URL:
if there is more than 1 URL associated with the service, enter it, or a note about it, here

Contact email or URL for site creator/maintainer, if known:

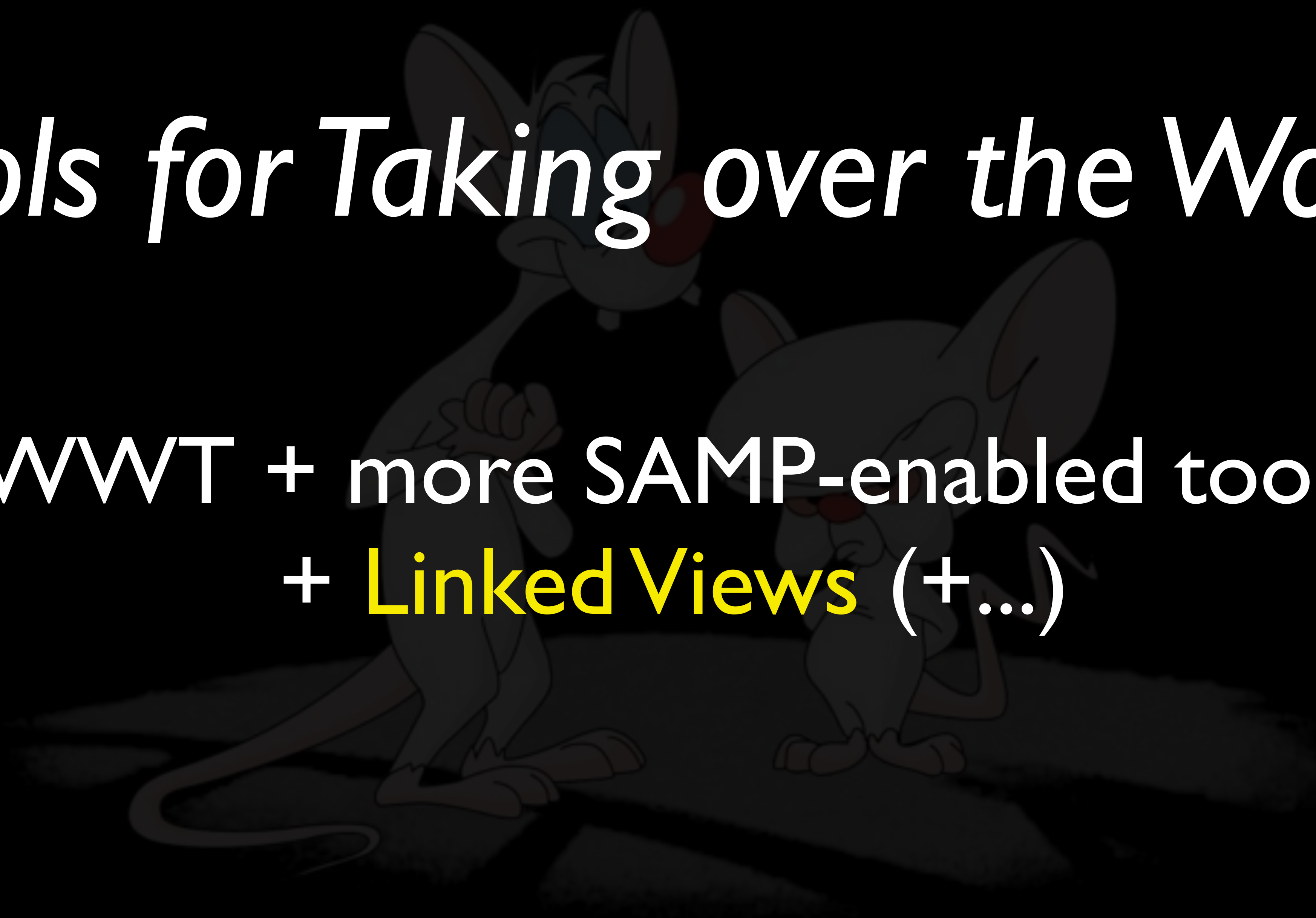
Your email address if you're willing to elaborate on your answers here, should we have questions..
(Optional, but helpful to us!)

If you'd like to, please describe what you think this site is useful for as it stands...

Software tools used
Please describe, in free text format, anything you know about how the site works, from a software point of view.

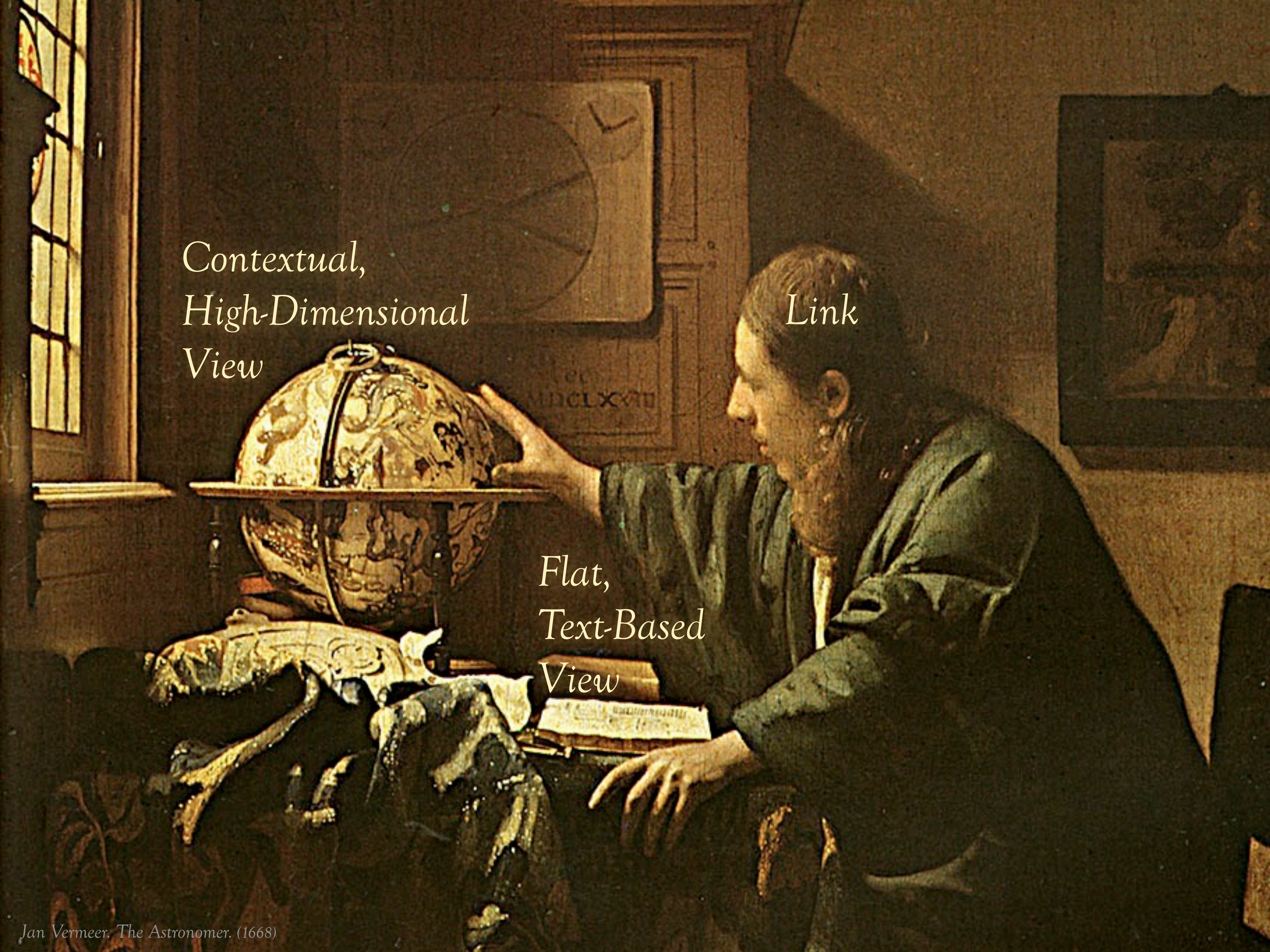


Dame, Hartman & Thaddeus 1997

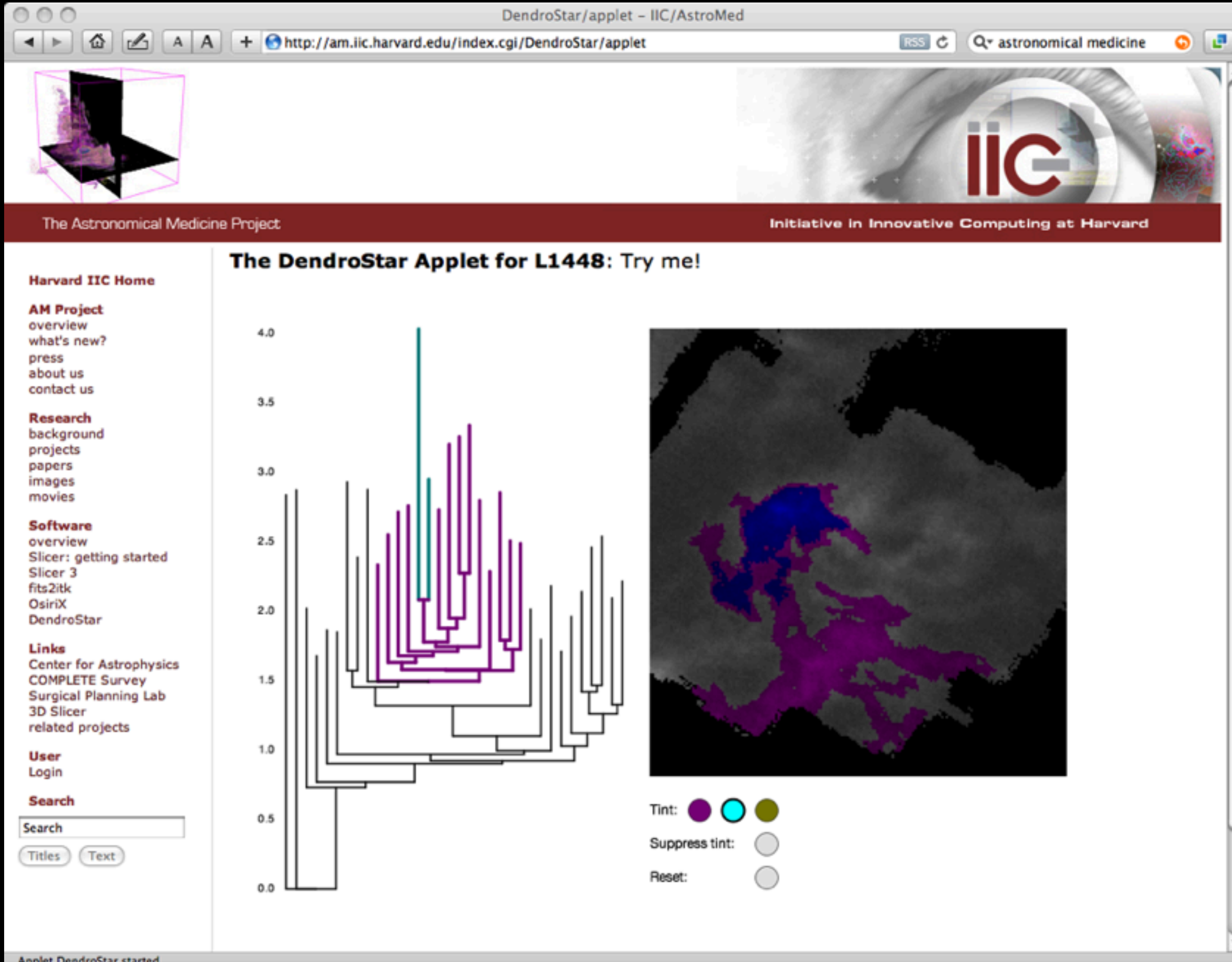


Tools for Taking over the World:

WWT + more SAMP-enabled tools
+ Linked Views (+...)



Jan Vermeer. The Astronomer. (1668)

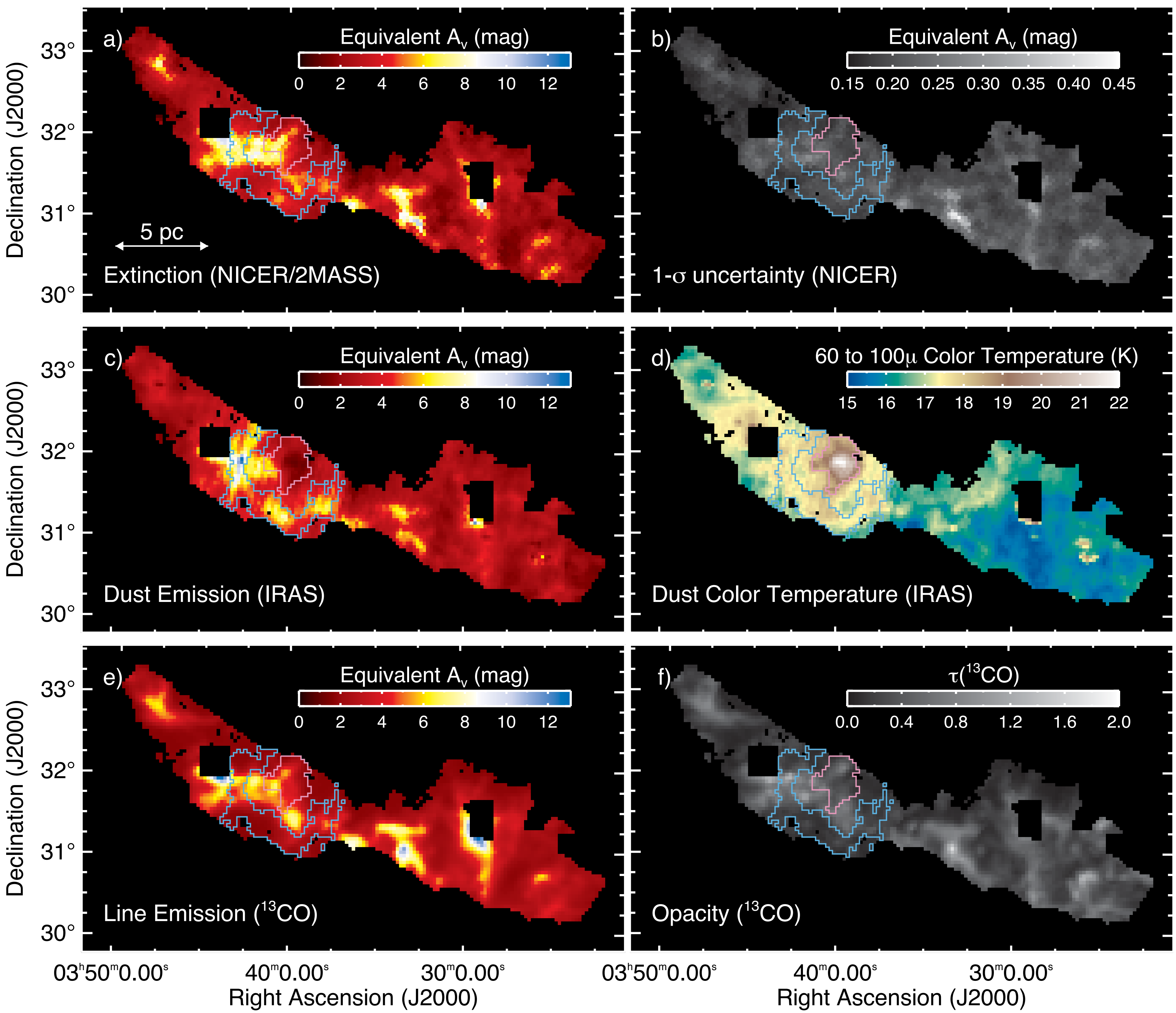


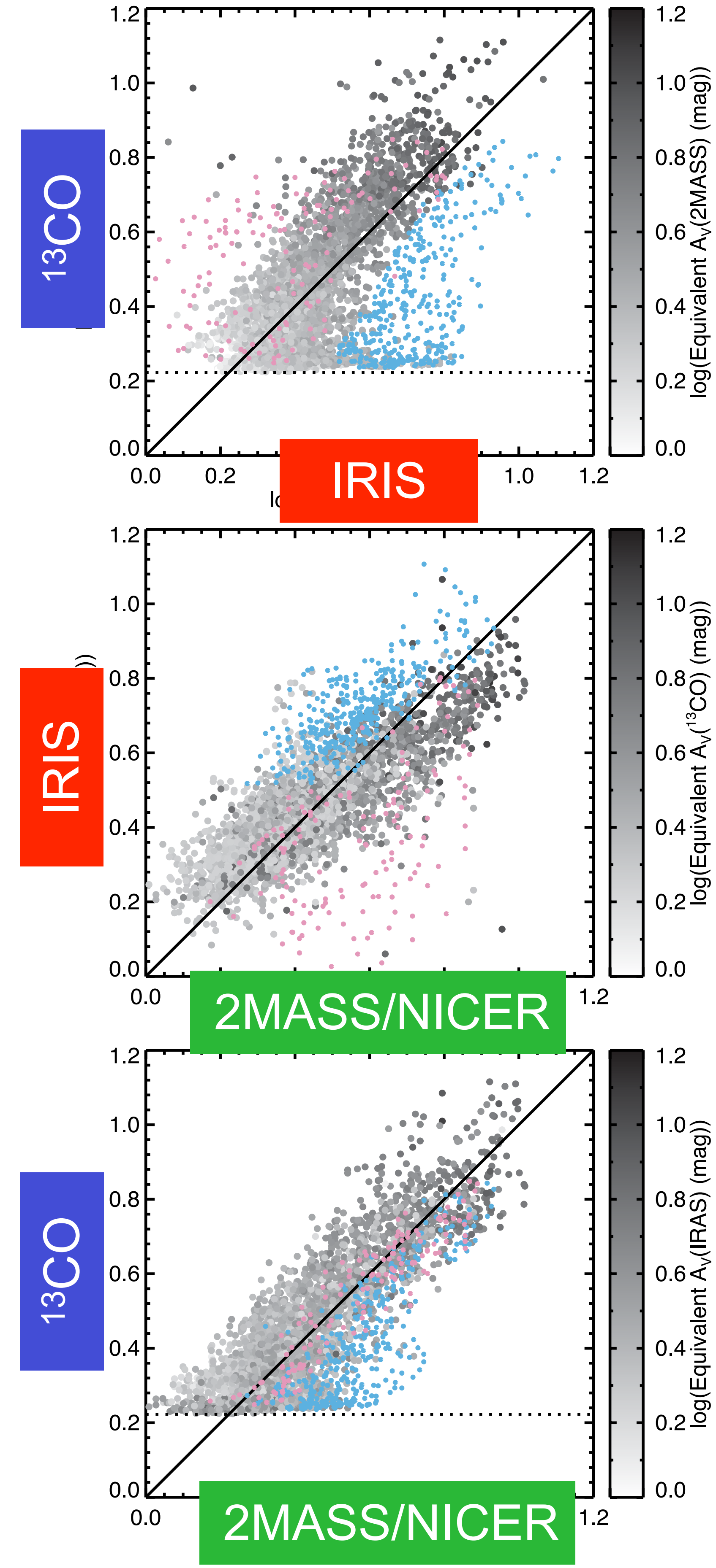
http://am.iic.harvard.edu/index.cgi/DendroStar/applet

Dendrogram Algorithm by Erik Rosolwosky; Applet by Douglas Alan

COMPLETE Perseus Column Density

(Dust Emission, Extinction & Gas Emission)

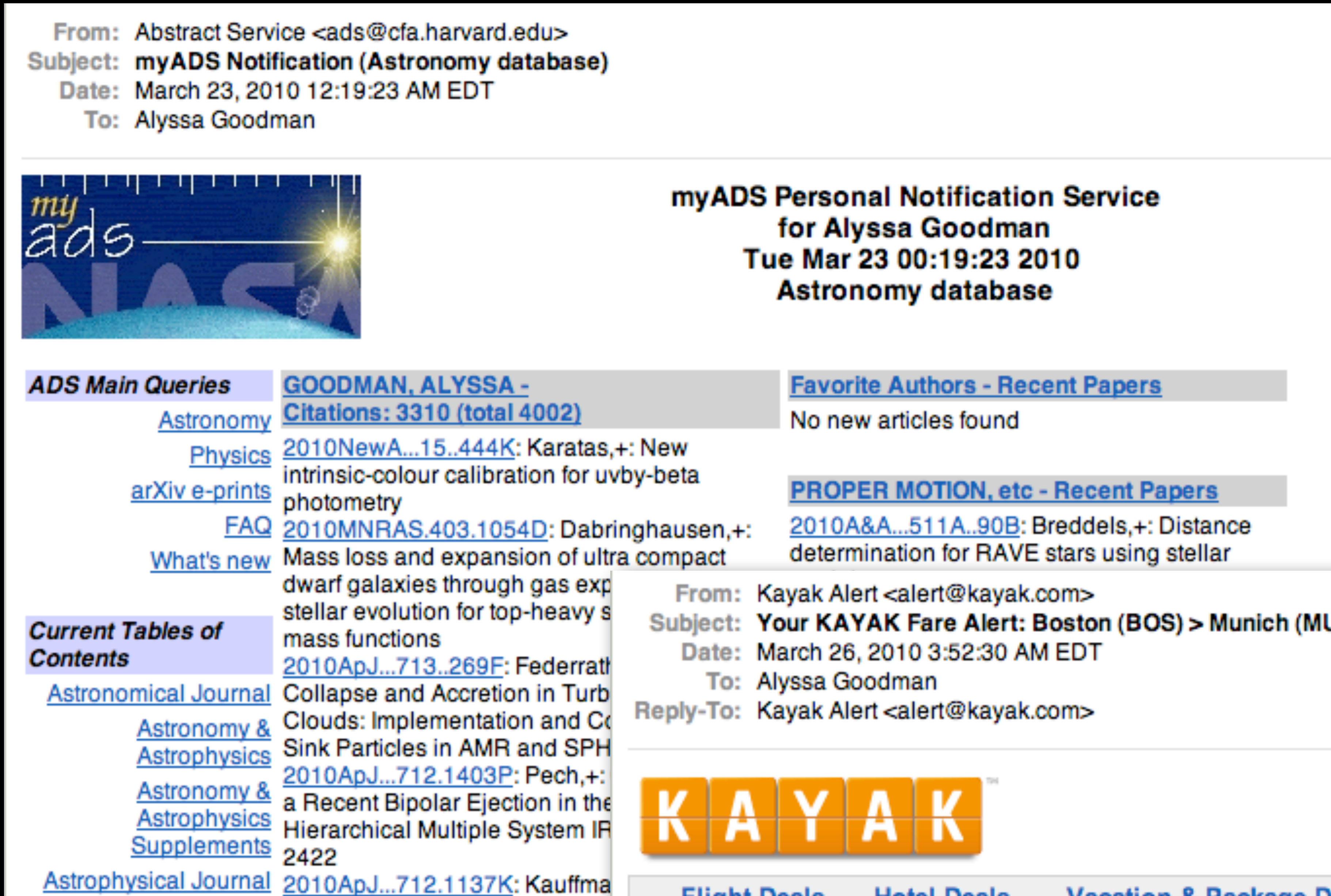




figures: Goodman, Pineda & Schnee 2009 cf. Schnee et al. 2005, 2006, 2008; Pineda et al. 2008

Seamless Astronomy Enabled by WWT

Alyssa A. Goodman
Harvard-Smithsonian Center for Astrophysics


From: Abstract Service <ads@cfa.harvard.edu>
Subject: **myADS Notification (Astronomy database)**
Date: March 23, 2010 12:19:23 AM EDT
To: Alyssa Goodman

myADS Personal Notification Service
for Alyssa Goodman
Tue Mar 23 00:19:23 2010
Astronomy database

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2010MNRAS.403.1054D: Dabringhausen,+: Mass loss and expansion of ultra compact dwarf galaxies through gas exp stellar evolution for top-heavy s mass functions
2010ApJ...713..269F: Federrat Collapse and Accretion in Turb Clouds: Implementation and Co Sink Particles in AMR and SPH
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2010ApJ...712.1137K: Kauffma

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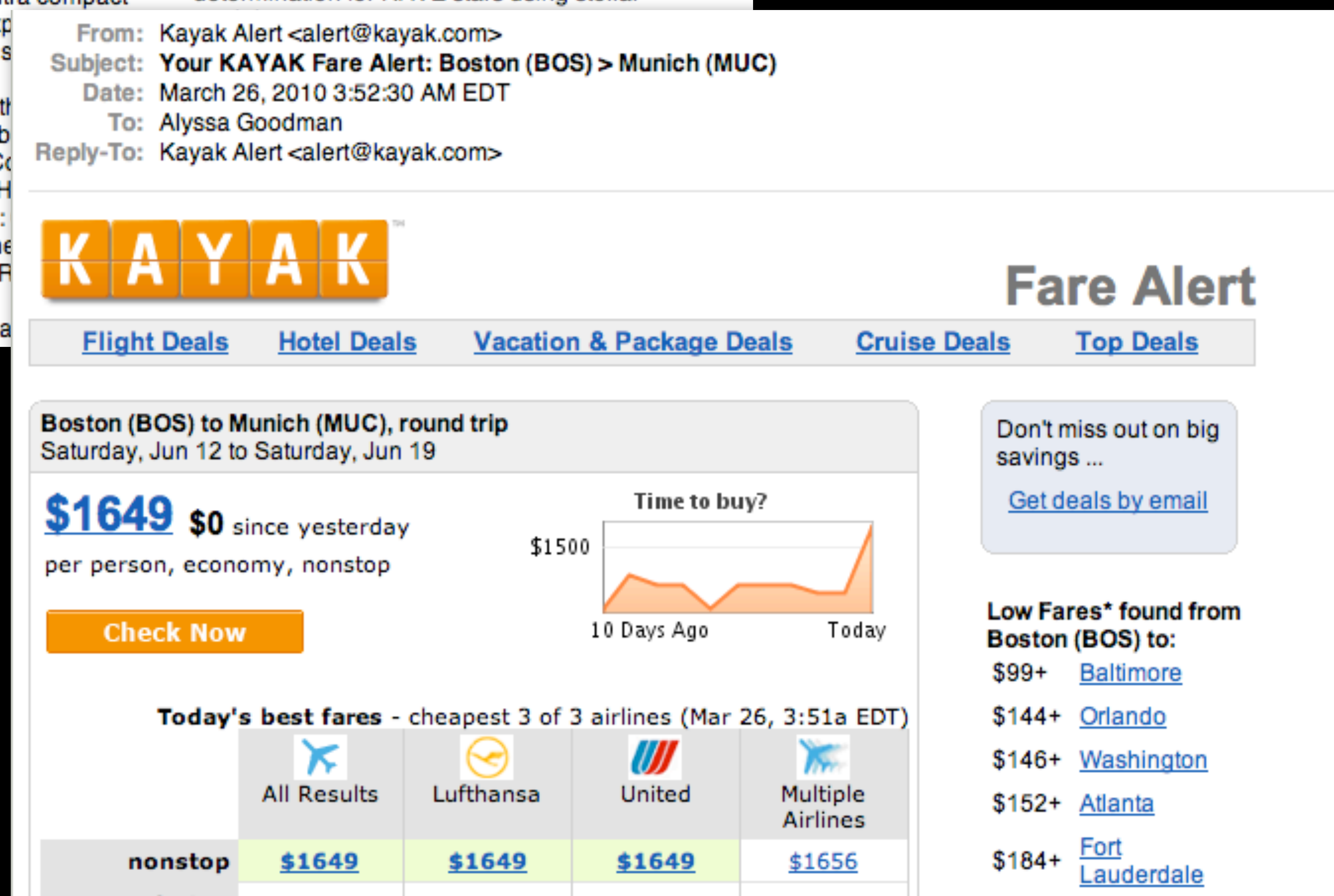
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Subject: **Your KAYAK Fare Alert: Boston (BOS) > Munich (MUC)**
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The "travel" analogy seems to resonate best...

Literature

"Seamless Astronomy" (Tools)

Data

WIKIPEDIA
The Free Encyclopedia

AstroBetter

Blogs, Wikis, etc.

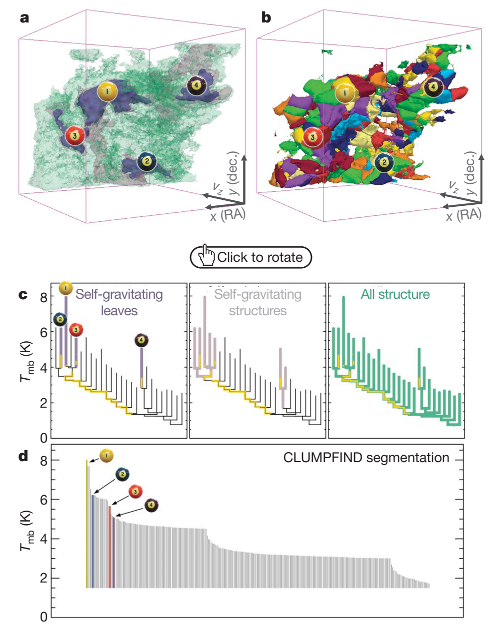


Figure 2 | Comparison of the 'dendrogram' and 'CLUMPFIND' feature-identification algorithms as applied to ^{13}CO emission from the L1448 region of Perseus. a, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating 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_{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 ($-0.5\ km\ s^{-1}$) to back ($8\ km\ s^{-1}$).

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[8] 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'[9] were proposed as a way to characterize clouds' hierarchical structure using 2D maps of column density. With this early 2D work as inspiration, we have developed a structure-identification algorithm that abstracts the hierarchical structure of a 3D (*p*–*p*–*v*) data cube into an easily visualized representation called a 'dendrogram'[10]. Although well developed in other data-intensive fields[11,12], it is curious that the application of tree methodologies so far in astrophysics has been rare, and almost exclusively within the area of galaxy evolution, where 'merger trees' are being used with increasing frequency[13].

Figure 3 and its legend explain the construction of dendrograms schematically. The dendrogram quantifies how and where local maxima of emission merge with each other, and its implementation is explained in Supplementary Methods. Critically, the dendrogram is determined almost entirely by the data itself, and it has negligible sensitivity to algorithm parameters. To make graphical presentation possible on paper and 2D screens, we 'flatten' the dendrograms of 3D data (see Fig. 3 and its legend), by sorting their 'branches' to not cross, which eliminates dimensional information on the *x* axis while preserving all information about connectivity and hierarchy. Numbered 'billiard ball' labels in the figures let the reader match features between a 2D map (Fig. 1), an interactive 3D map (Fig. 2a online) and a sorted dendrogram (Fig. 2c).

A dendrogram of a spectral-line data cube allows for the estimation of key physical properties associated with volumes bounded by isosurfaces, such as radius (R), velocity dispersion (σ_v) and luminosity (L). The volumes can have any shape, and in other work[14] we focus on the significance of the especially elongated features seen in L1448 (Fig. 2a). The luminosity is an approximate proxy for mass, such that $M_{lum} = X_{13CO} L_{13CO}$, where $X_{13CO} = 8.0 \times 10^{20}\ cm^2\ K^{-1}\ km^{-1}\ s$ (ref. 15; see Supplementary Methods and Supplementary Fig. 2). 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, $\alpha_{obs} = 5\sigma_v^2 R/GM_{lum}$. In principle, extended portions of the tree (Fig. 2, yellow highlighting) where $\alpha_{obs} < 2$ (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 α_{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[16], its measured value should only be used as a guide to the longevity (boundedness) of any particular feature.

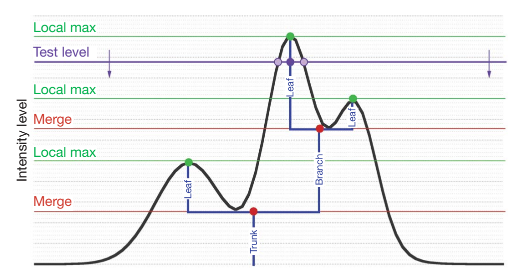


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in 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.

VizieR

SIMBAD

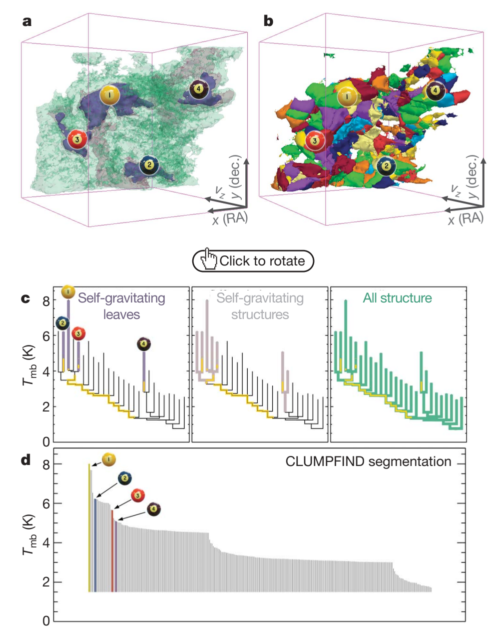
AstroGrid NVO IVOA EURO-VO AIDA Astronomical Infrastructure for Data Access

"Registries"

DataScope

***Disclaimer**: This slide shows key excerpts from within the astronomy community & excludes more general s/w that is used, such as Papers, Zotero, Mendeley, EndNote, graphing & statistics packages, data handling software, search engines, etc.*

Data in *Literature*



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A dendrogram of a spectral-line data cube allows for the estimation of key physical properties associated with volumes bounded by isosurfaces, such as radius (R), velocity dispersion (σ_v) and luminosity (L). The volumes can have any shape, and in other work[14] we focus on the significance of the especially elongated features seen in L1448 (Fig. 2a). The luminosity is an approximate proxy for mass, such that $M_{lum} = X_{13CO} L_{13CO}$, where $X_{13CO} = 8.0 \times 10^{20}\,\mathrm{cm^2\,K^{-1}\,km^{-1}\,s}$ (ref. 15; see Supplementary Methods and Supplementary Fig. 2). 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, $\alpha_{obs} = 5\sigma_v^2 R/GM_{lum}$. In principle, extended portions of the tree (Fig. 2, yellow highlighting) where $\alpha_{obs} < 2$ (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 α_{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[16], its measured value should only be used as a guide to the longevity (boundedness) of any particular feature.

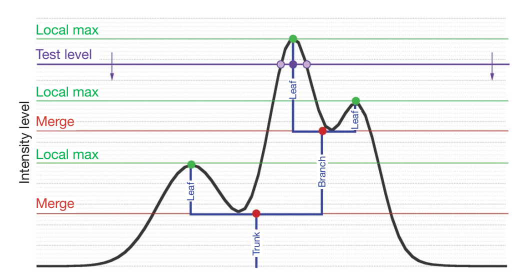

Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in 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.

Goodman et al. *Nature*, 2009