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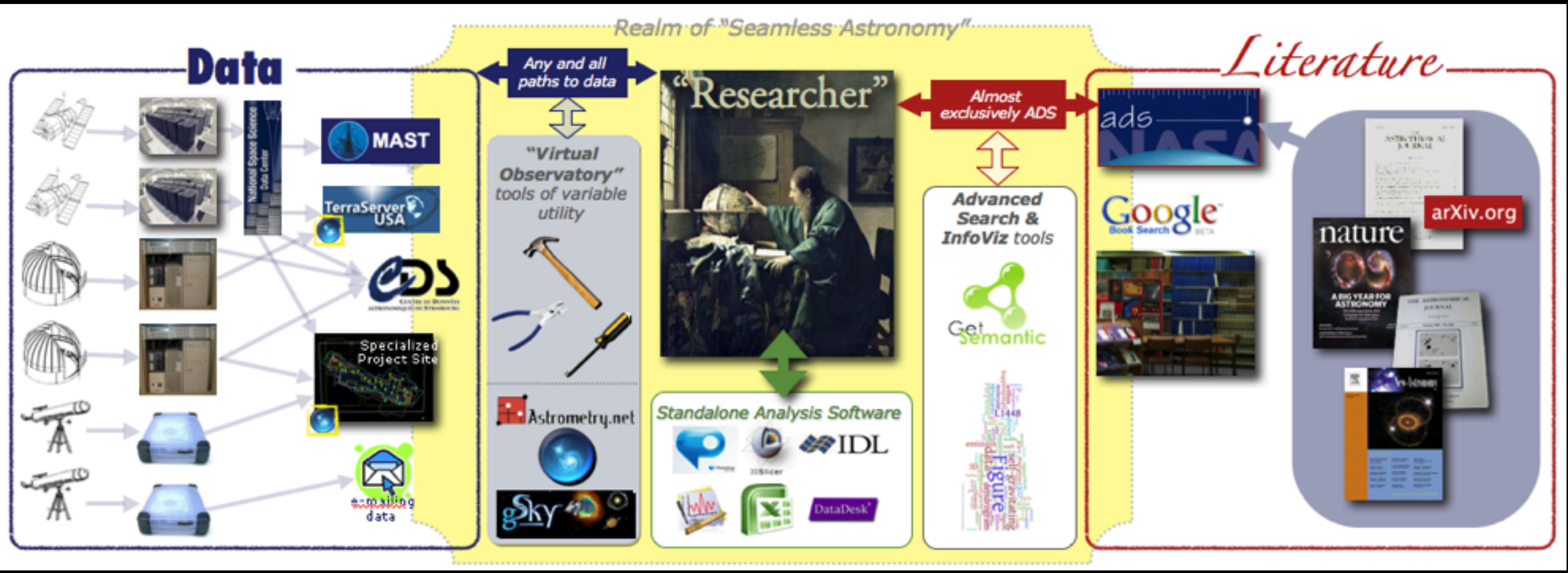
Alyssa A. Goodman
Harvard-Smithsonian Center for Astrophysics (CfA)
+ the Seamless Astronomy Team at CfA/Microsoft Research

slides online under "Research, Talks" at www.cfa.harvard.edu/~agoodman/

Seamless Astronomy



c. 2009

Seamless Astronomy

c. 2009

Literature

Blogs, Wikis, etc.

Data

"Registries"

DataScope

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Literature

"Seamless Astronomy" (Tools)

Data

WorldWide Telescope

TOPCAT

ds9

"Registries"

DataScope

Blogs, Wikis, etc.

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Literature

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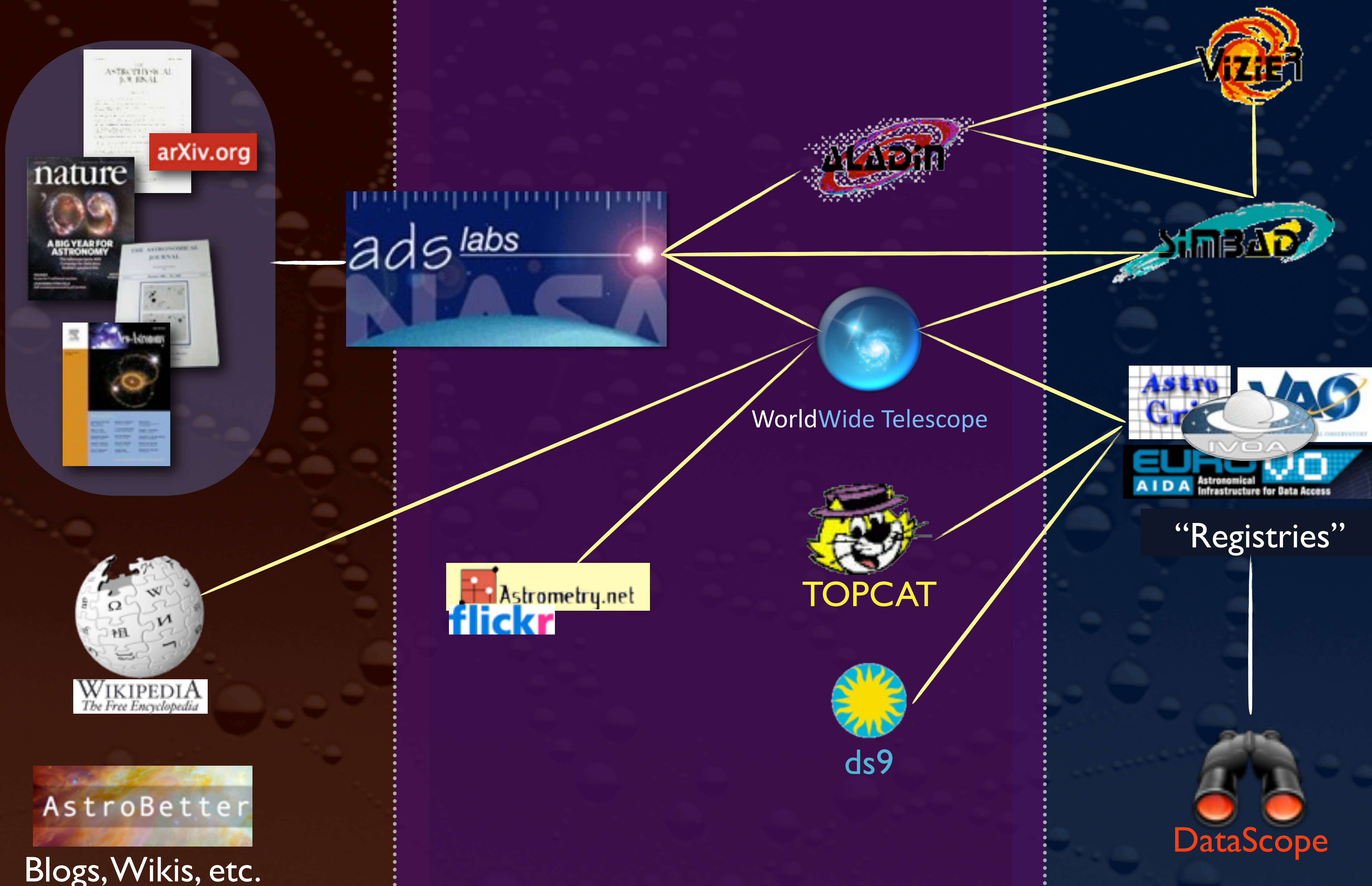

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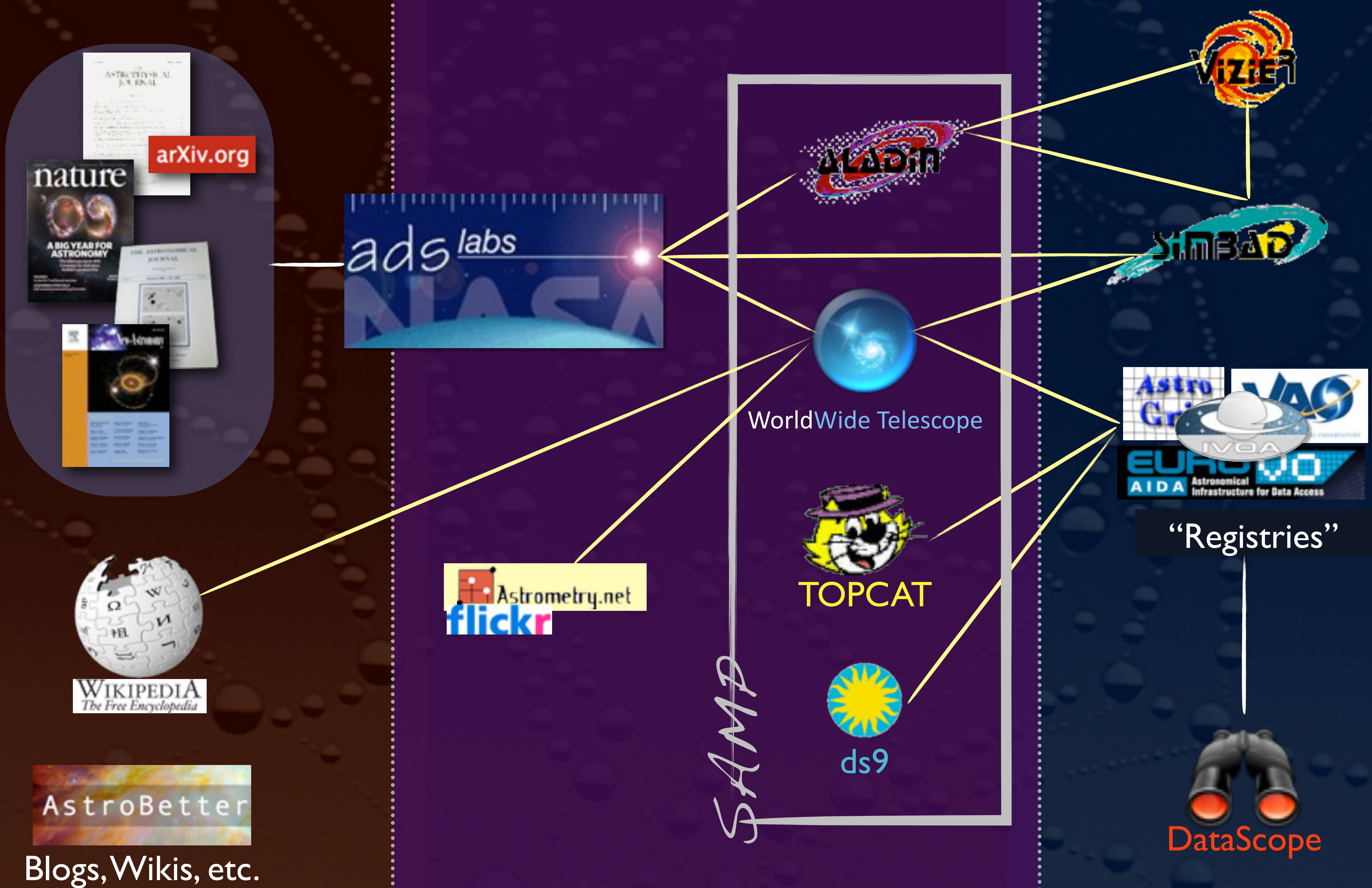

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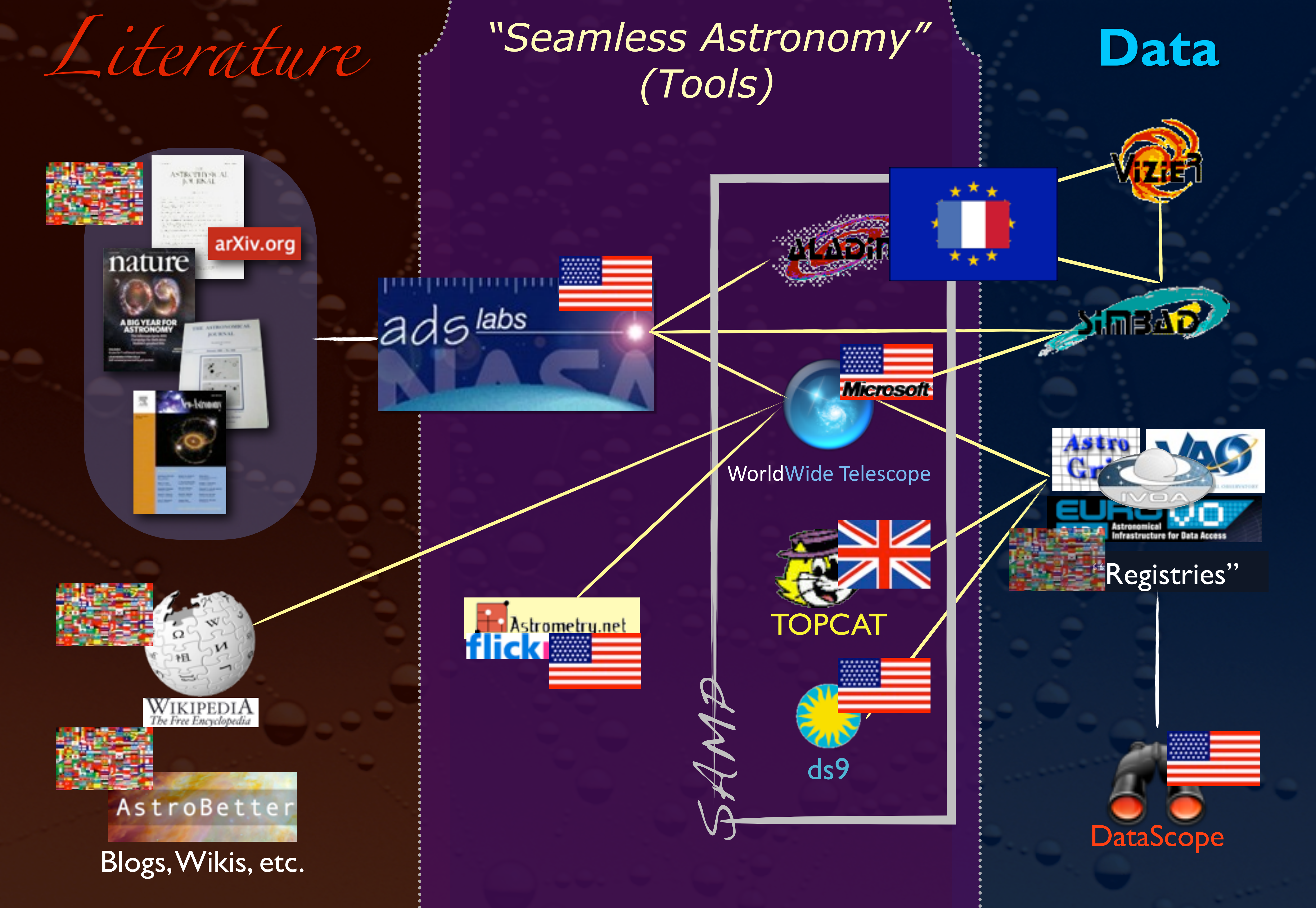

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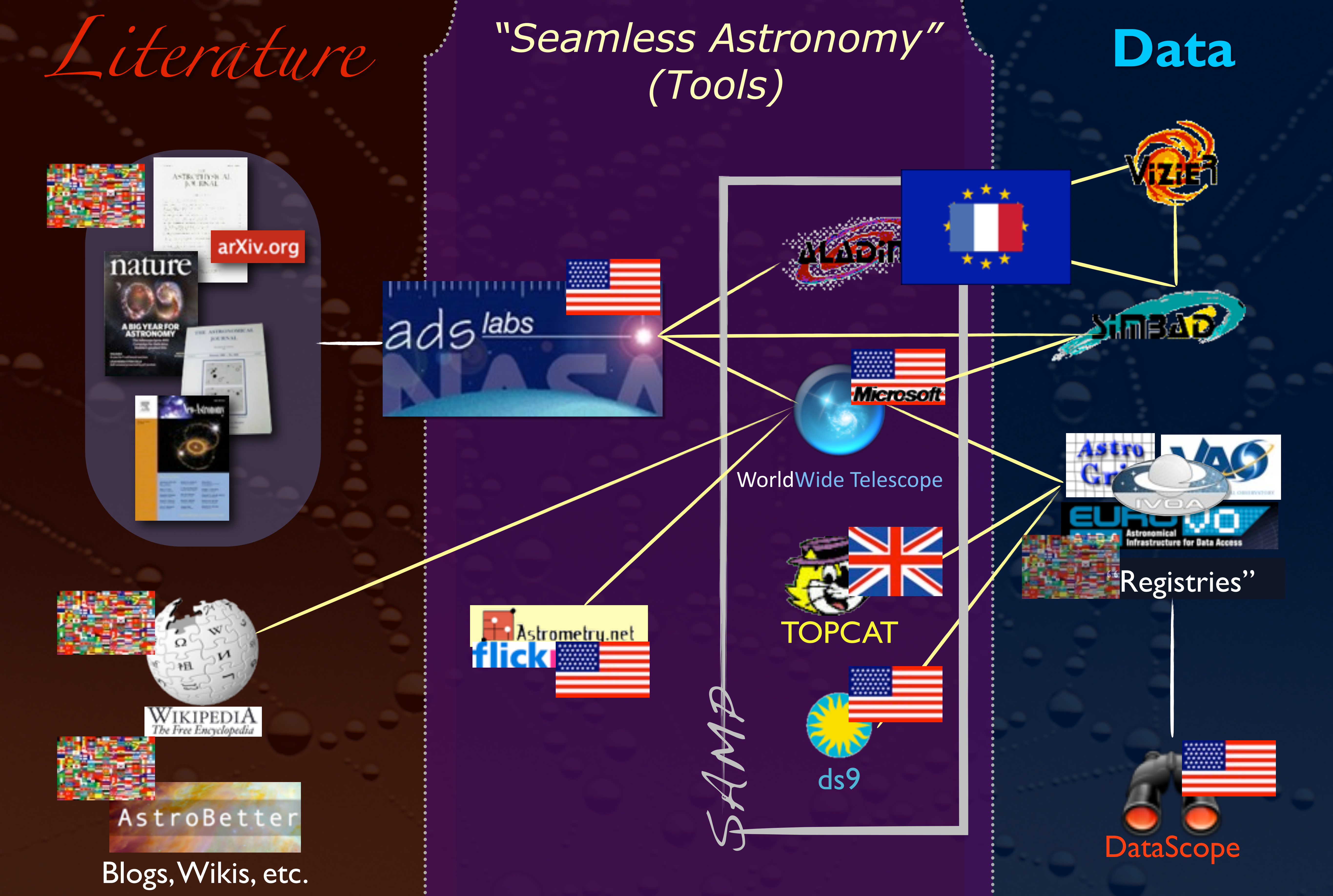

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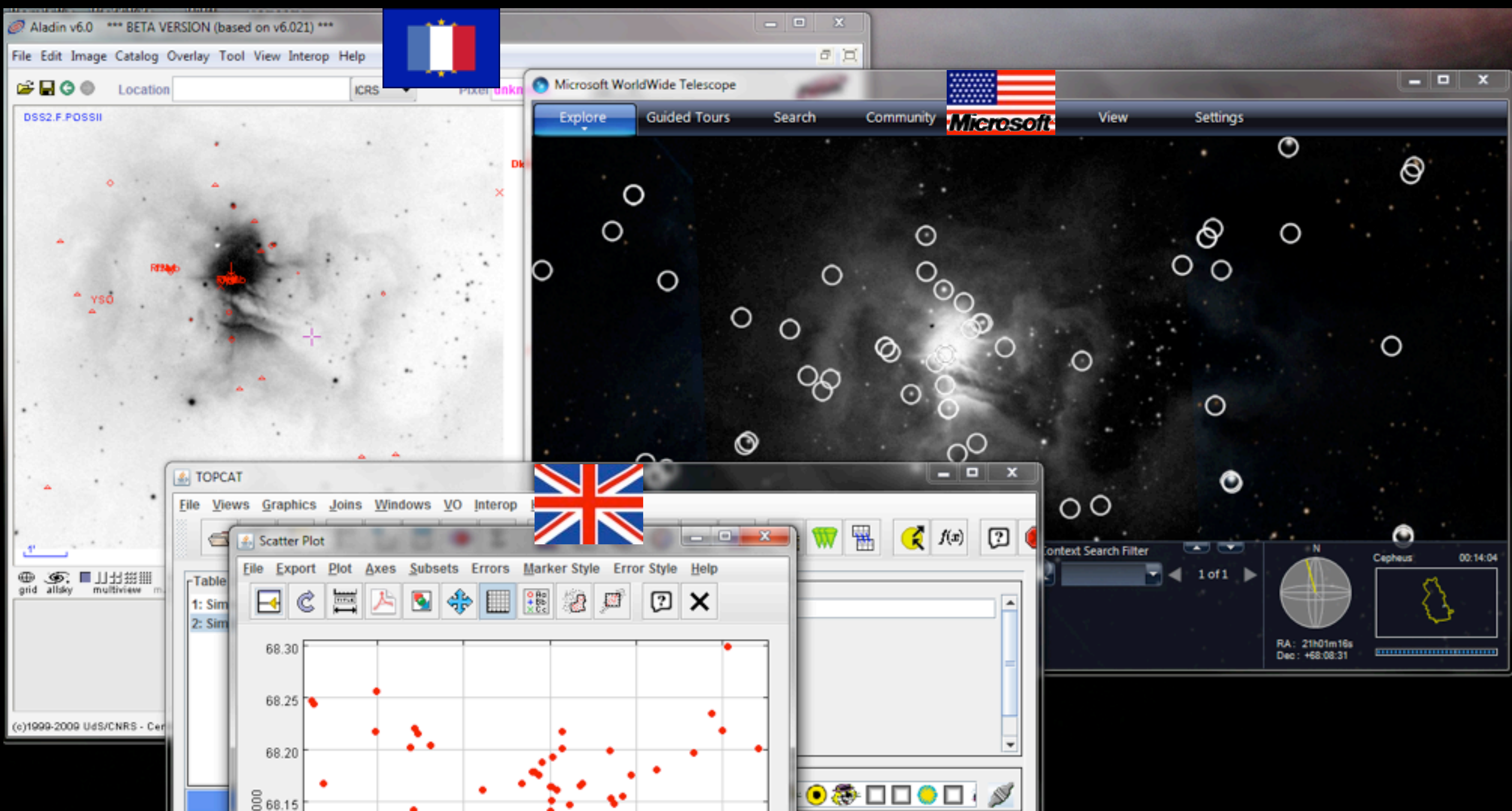
SAMP

(Simple Application Messaging Protocol)

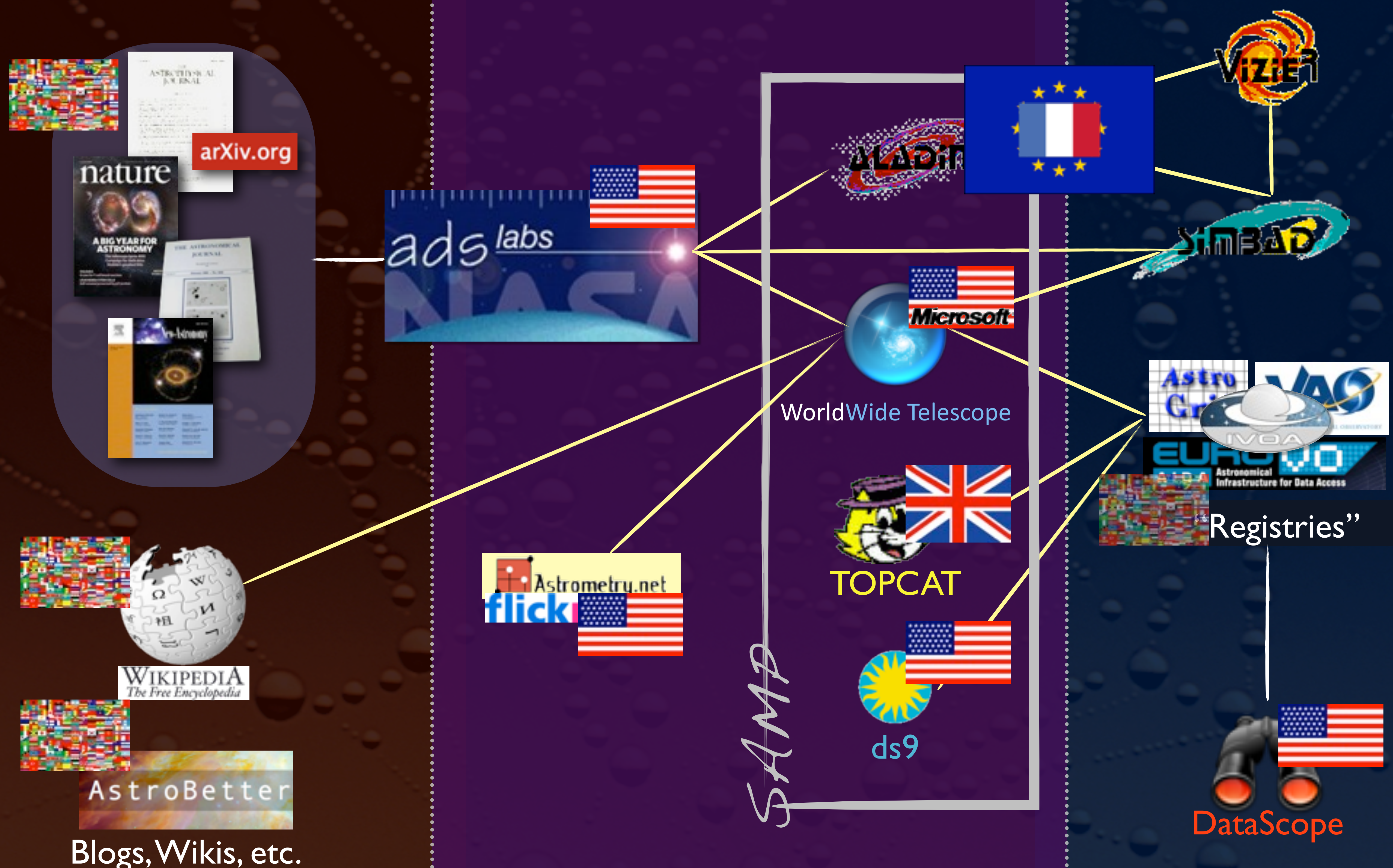


link to 12/2010 IVOA recommendation

Literature

"Seamless Astronomy" (Tools)

Data



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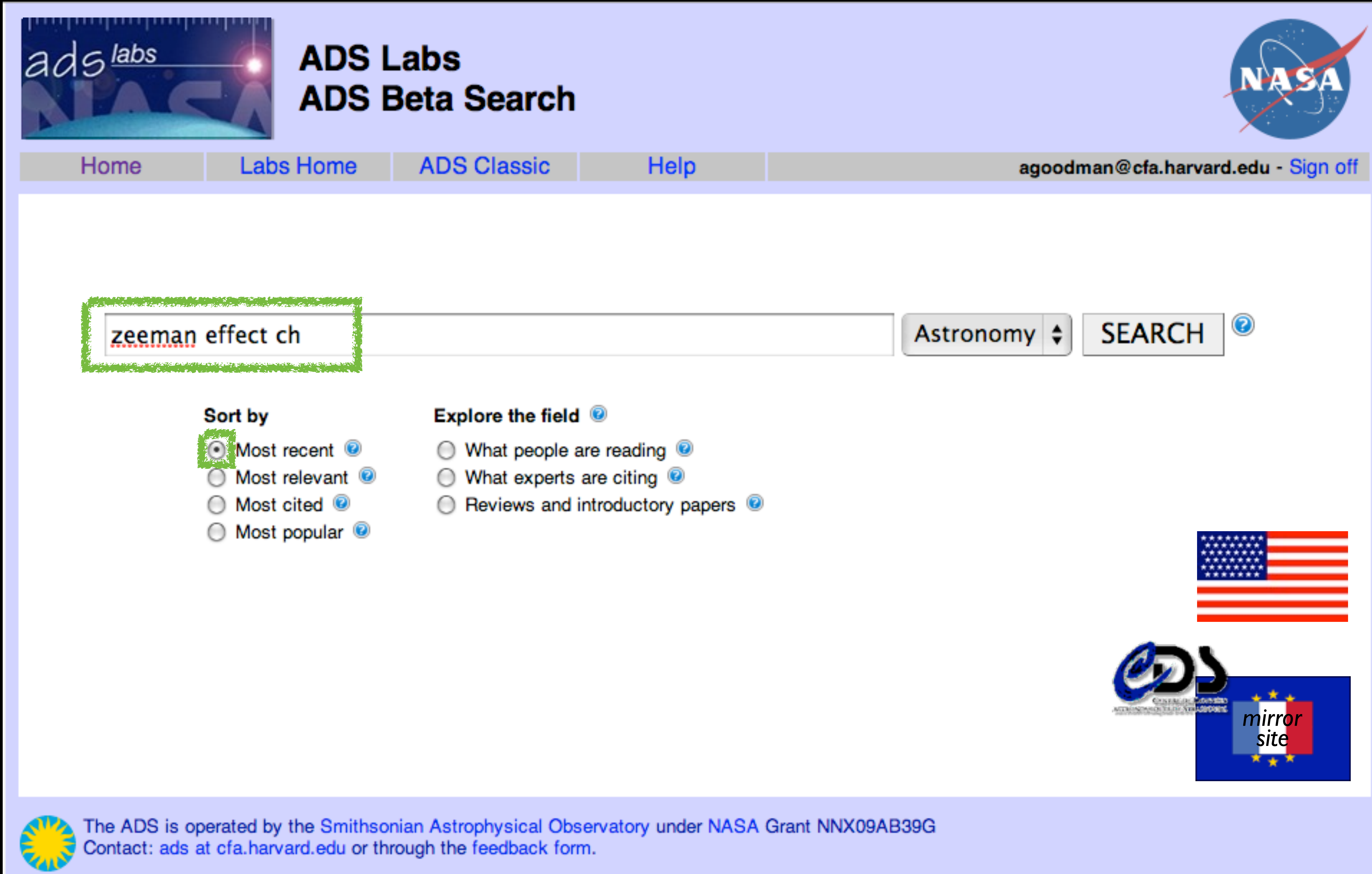

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*A. **Accomazzi**, A. Goodman, M. **Kurtz**, R. **Davé**, J. Luker, G. Muench, A. Pepe* ads labs

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Authors
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- [ ] Amano, T (2)
- [ ] Angel, J (2)
- [ ] Asensio Ramos, A (2)
- [ ] Balasubramaniam, K (2)

Keywords

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SIMBAD Objects
- [x] Other object (3)
- [ ] Star (3)
- [x] Nebula (1)

ADS Publications x
SIMBAD Info
World Wide Telescope
Aladin applet

Vizier Tables

Refereed status

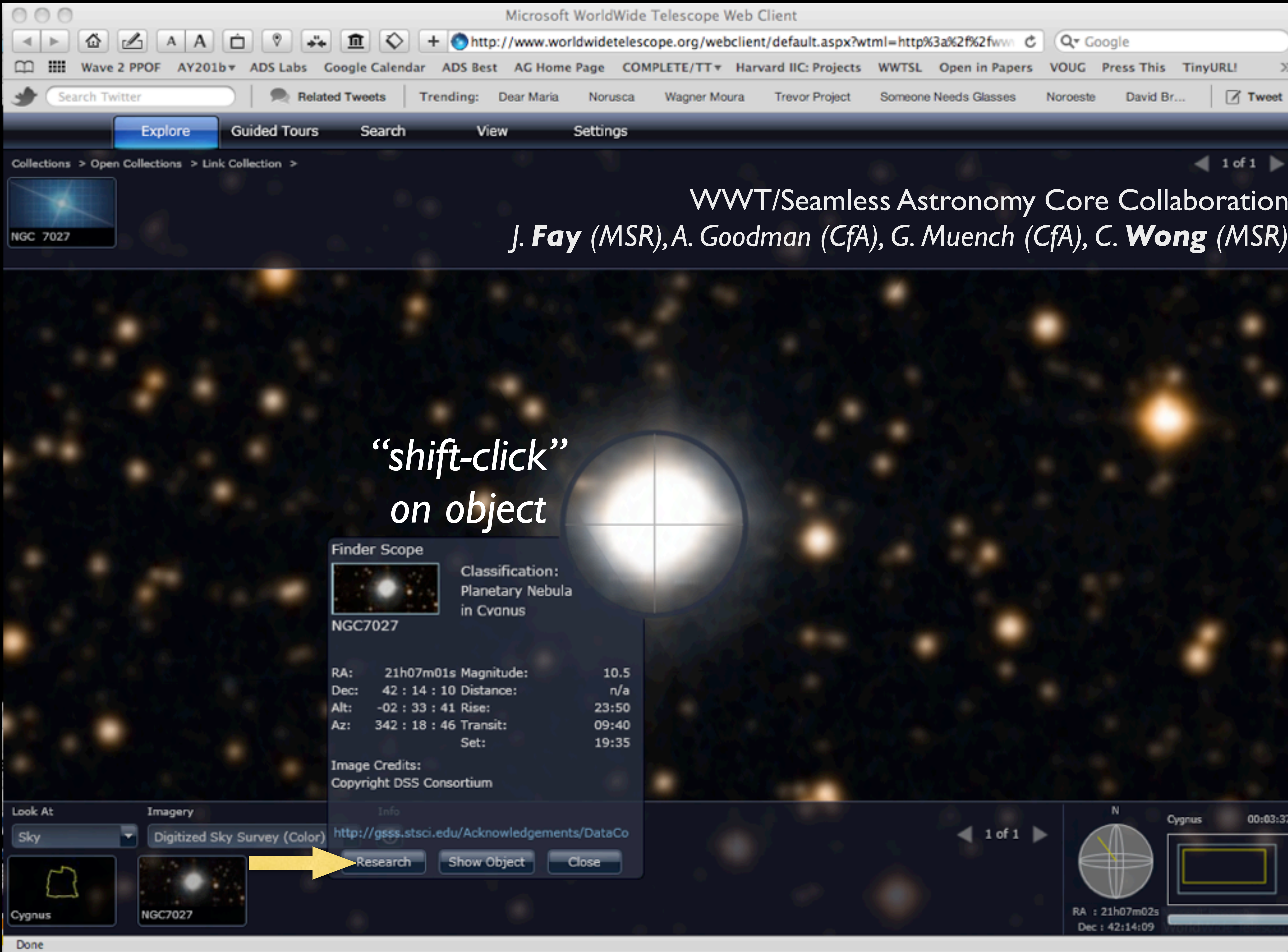
Dates

3. 2010ApJ...716L...1A **The J = 1-0 Transitions of 12CH+, 13CH+, and 12CD+**
Amano, T.
The Astrophysical Journal Letters, Volume 716, Issue 1, pp. L1-L3 (2010). Jun 2010

4. 2009ApJ...705L.176S **Detection of the Zeeman Effect in the 36 GHz Class I CH3OH Maser Line with the EVLA**
Sarma, A. P.; Momjian, E.
The Astrophysical Journal Letters, Volume 705, Issue 2, pp. L176-L179 (2009). Nov 2009

11. 2003A&A...412..513B **The molecular Zeeman effect and diagnostics of solar and stellar magnetic fields. II. Synthetic Stokes profiles in the Zeeman regime**
Berdyugina, S. V.; Solanki, S. K.; Frutiger, C.
Astronomy and Astrophysics, v.412, p.513-527 (2003) Dec 2003

12. 2000PASP..112..873W **Magnetism in Isolated and Binary White Dwarfs**
Wickramasinghe, D. T.; Ferrario, Lilia
The Publications of the Astronomical Society of the Pacific, Volume 112, Issue 773, pp. 873-924. Jul 2000



WWT/Seamless Astronomy Core Collaboration
J. **Fay** (MSR), A. Goodman (CfA), G. Muench (CfA), C. **Wong** (MSR)
"shift-click" on object
Microsoft WorldWide Telescope Web Client
http://www.worldwidetelescope.org/webclient/default.aspx?wtml=http%3a%2f%2fww
Explore
Guided Tours
Search
View
Settings
Collections > Open Collections > Link Collection >
1 of 1
NGC 7027
Finder Scope
Classification: Planetary Nebula in Cygnus
NGC7027
RA: 21h07m01s
Dec: 42 : 14 : 10
Alt: -02 : 33 : 41
Az: 342 : 18 : 46
Magnitude: 10.5
Distance: n/a
Rise: 23:50
Transit: 09:40
Set: 19:35
Image Credits:
Copyright DSS Consortium
http://gsss.stsci.edu/Acknowledgements/DataCo
Research
Show Object
Close
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Cygnus
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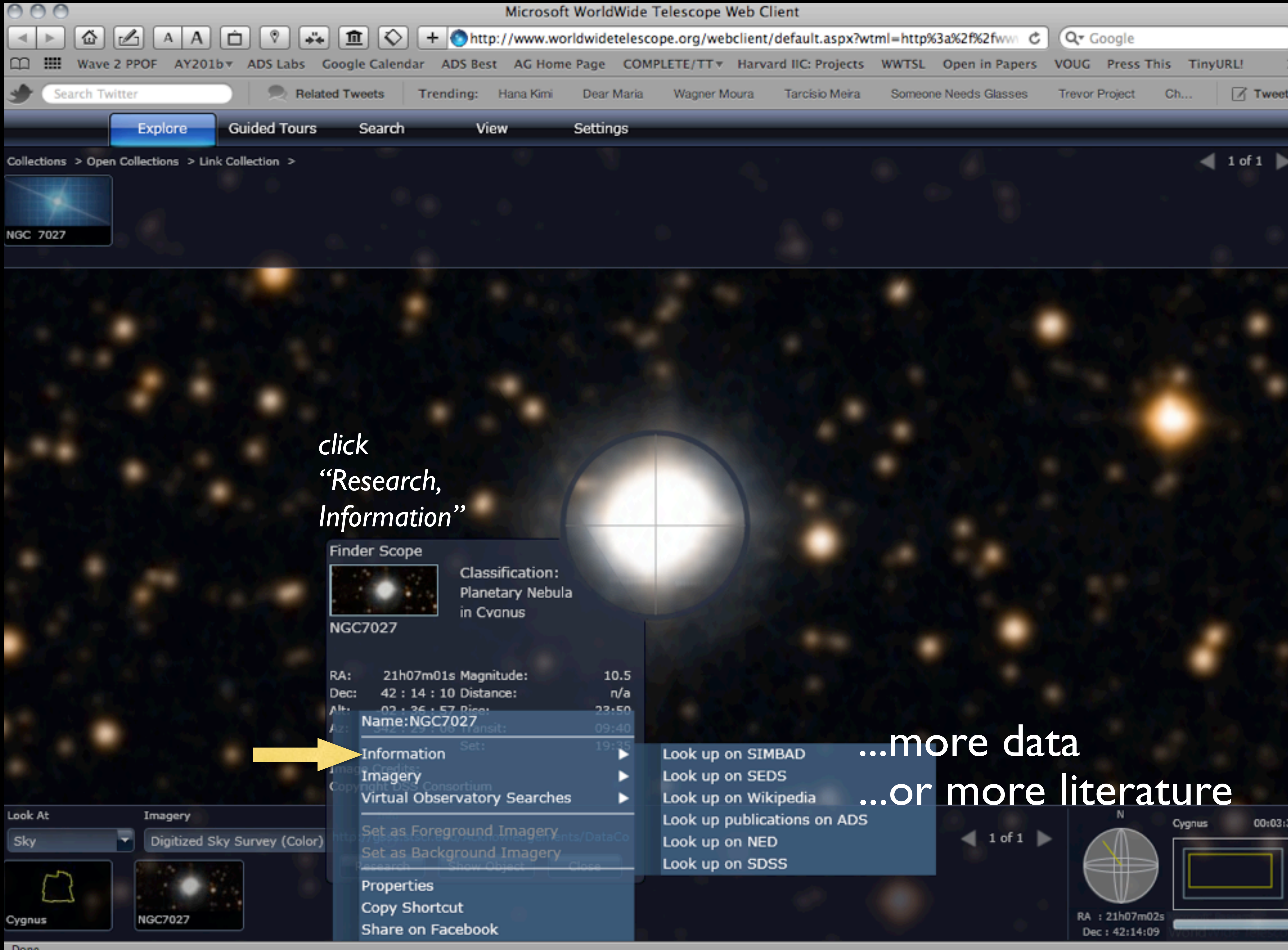
Microsoft WorldWide Telescope Web Client
Explore
Guided Tours
Search
View
Settings
Collections > Open Collections > Link Collection >
1 of 1
NGC 7027
click
“Research,
Information”
Finder Scope
Classification:
Planetary Nebula
in Cygnus
NGC7027
RA: 21h07m01s Magnitude: 10.5
Dec: 42 : 14 : 10 Distance: n/a
Name:NGC7027
Information
Imagery
Virtual Observatory Searches
Set as Foreground Imagery
Set as Background Imagery
Properties
Copy Shortcut
Share on Facebook
Look up on SIMBAD
Look up on SEDS
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- ☑ Nebula (1)
  - ☑ NGC 7027 (1)
  - ☑
- X

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Vizier Tables

Refereed status

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from 1933 to 2011

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The Publications of the Astronomical Society of the Pacific, Volume 112, Issue 773, pp. 873-924. Jul 2000

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zeeman effect in molecular clouds - *Most relevant*

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FILTER BY:

Authors

- Crutcher, R (35)
- Troland, T (31)
- Heiles, C (20)
- Brogan, C (10)
- Goss, W (10)
- Roberts, D (10)
- Goodman, A (9)
- Myers, P (9)
- Kazes, I (8)
- Wielebinski, R (5)

Keywords

Archives

Missions

SIMBAD Objects

Vizier Tables

Refereed status

Dates

from 1967 to 2011

1. 1988ApJ...329..392M **Magnetic molecular clouds - Indirect evidence for magnetic support and ambipolar diffusion**
   Myers, P. C.; Goodman, A. A.
   Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 329, June 1, 1988, p. 392-405. Jun 1988
2. 2001ApJ...554..916B **New OH Zeeman Measurements of Magnetic Field Strengths in Molecular Clouds**
   Bourke, Tyler L.; Myers, Philip C.; Robinson, Garry; Hyland, A. R.
   The Astrophysical Journal, Volume 554, Issue 2, pp. 916-932. Jun 2001
3. 1999ApJ...514L.121C **Detection of the CN Zeeman Effect in Molecular Clouds**
   Crutcher, Richard M.; Troland, Thomas H.; Lazareff, Bernard; Paubert, Gabriel; Kazès, Ilya
   The Astrophysica
4. 2009ApJ...692.
   Crutcher, Richa
   The Astrophysic
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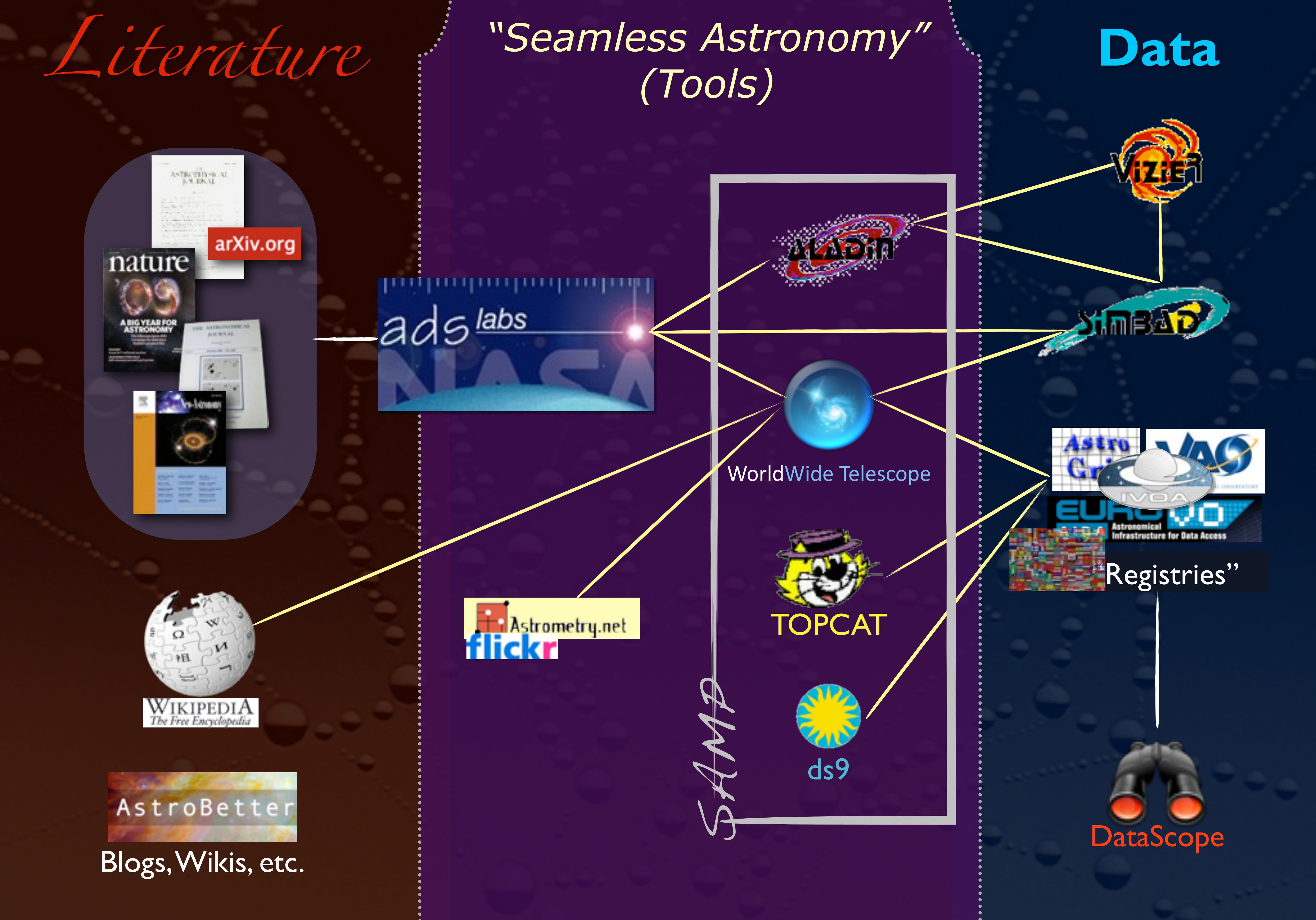
   Observations: Inference of
   Crutcher, Richard M.; Wandelt, Benjamin; Heiles, Carl;
   Thomas H.
   The Astrophysical Journal, Volume 725, Issue 1, pp. 466-479 (2010). Dec 2010
6. 1976ARA&A..14....1H **The interstellar magnetic field**
   Heiles, C.
   In: Annual review of astronomy and astrophysics. Volume 14. (A76-46826 24-90) Palo Alto, Calif., Annual Reviews, Inc., 1976, p. 1-22. Research supported by the Alfred P. Sloan Foundation and NSF. n/a 1976
7. 1986A&A...164..328K **Measurement of magnetic-field strengths in molecular clouds Detection of OH-line Zeeman splitting**
   Kazes, I.; Crutcher, R. M.
   Astronomy and Astrophysics (ISSN 0004-6361), vol. 164, no. 2, Aug. 1986, p. 328-336. Aug 1986
8. 1983A&A...125L..23C **The magnetic field of the NGC 2024 molecular cloud -**

"Semantic Knowledge Discovery"
... is this list right? (not quite yet)



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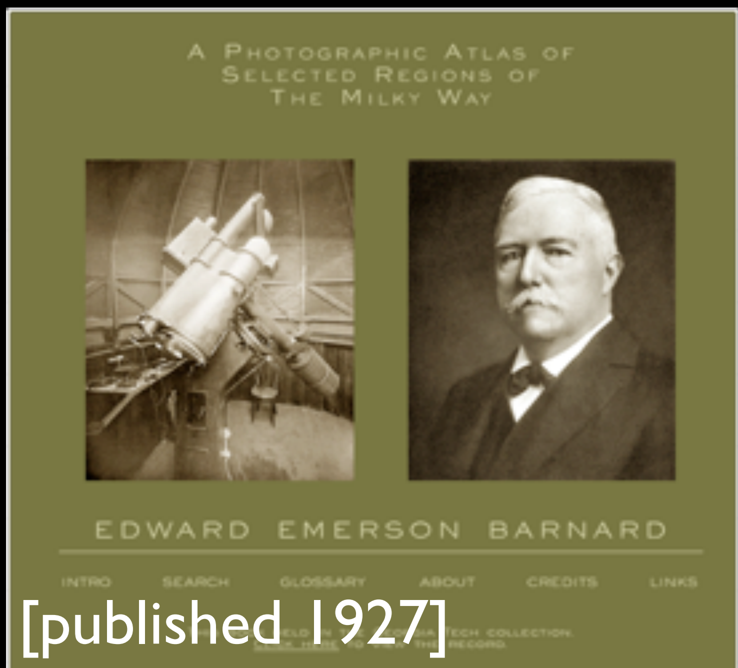
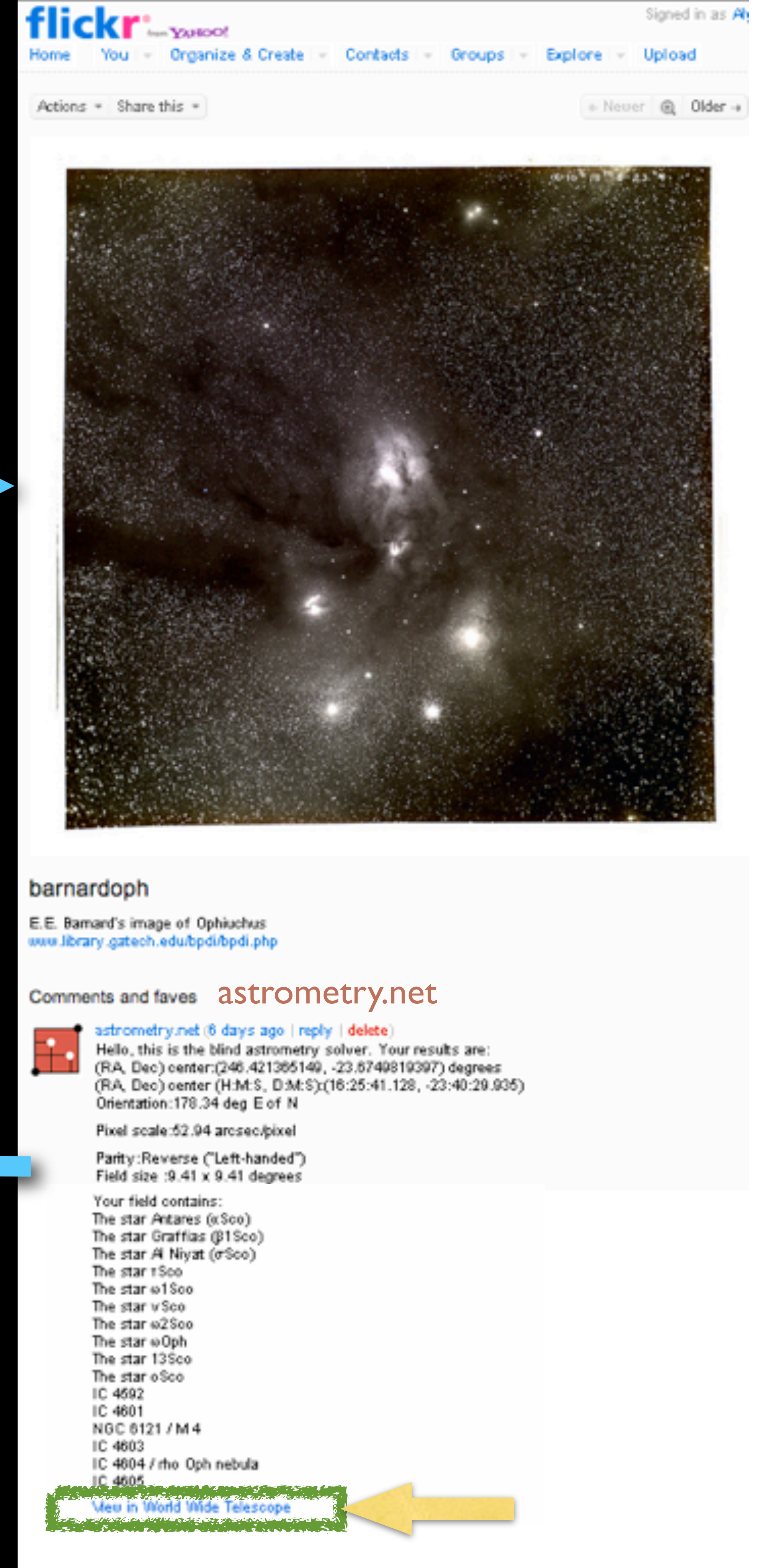
"Seamless Astronomy"...

astrometry.net + flickr + WWT

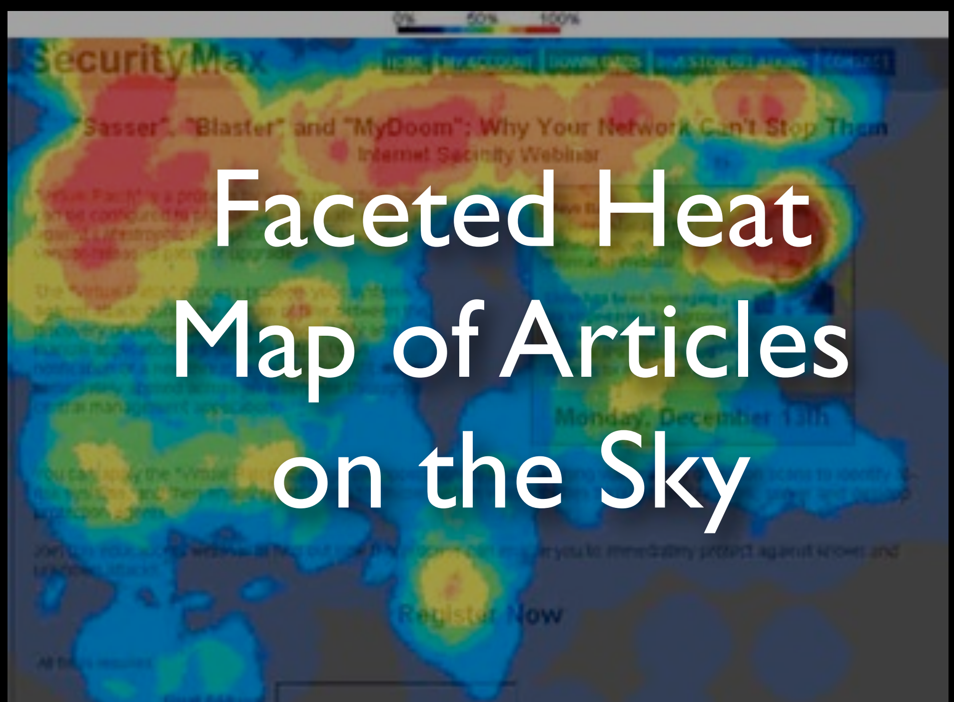


[published 1927]



Coming (using astrometry.net++)in 2011...

Historical Image Layer Extracted from ALL ADS holdings (using astrometry.net)

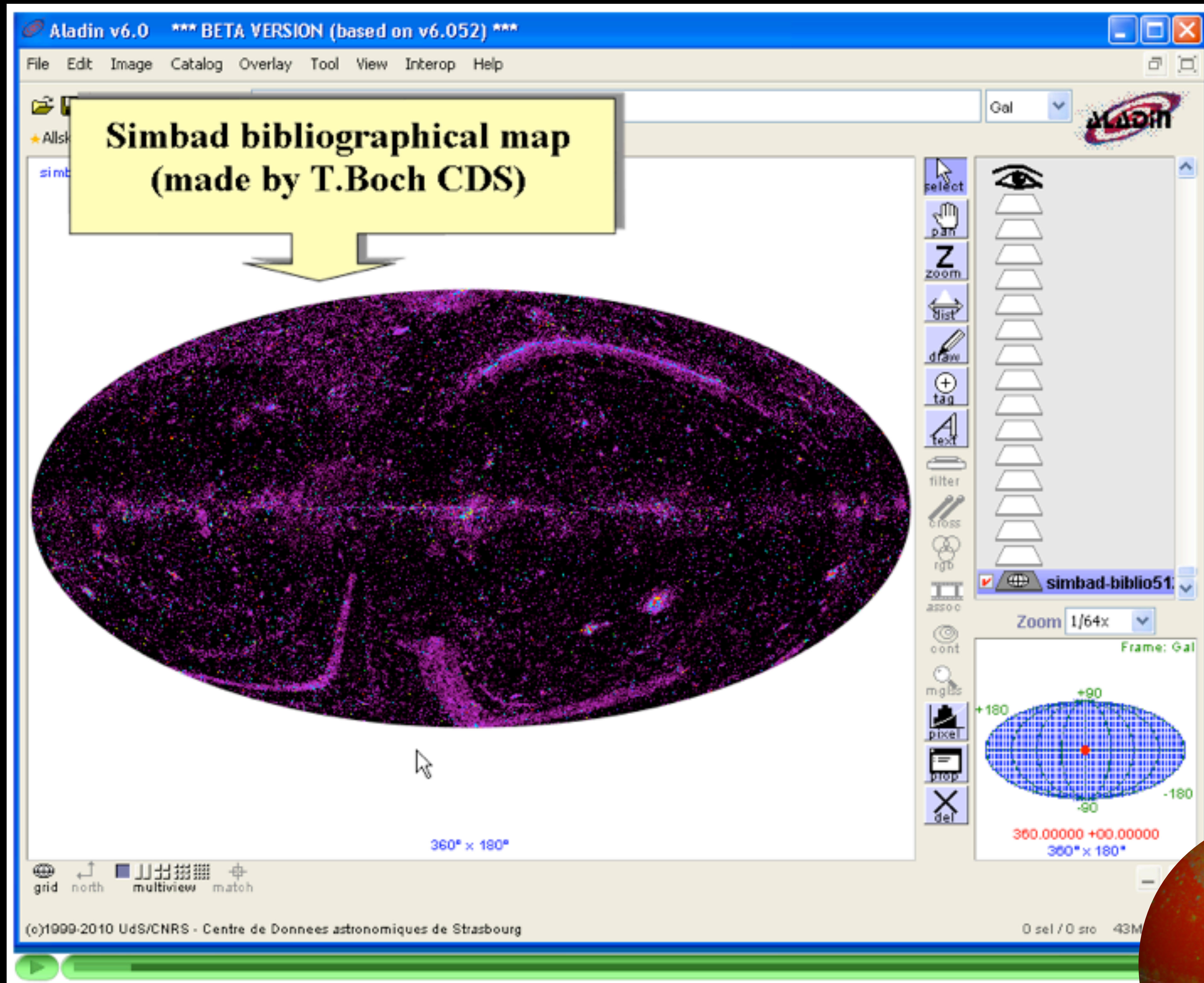


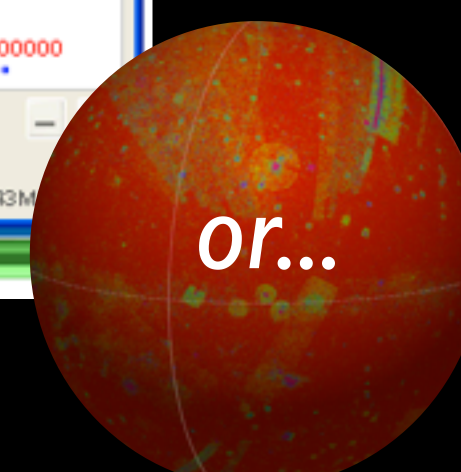
Faceted Heat Map of Articles on the Sky

[e.g. ADS-CDS-WWT]

Collaborators: Alberto Accomazzi (CfA); Jonathan Fay (MSR); Alyssa Goodman (CfA); David Hogg (NYU); Gus Muench (CfA); Alberto Pepe (CfA)+advice from Pierre Fernique (CDS) & Thomas Bock (CDS)

Prototype of Articles on the Sky (2010)





with thanks to CDS/Pierre Fernique

Literature

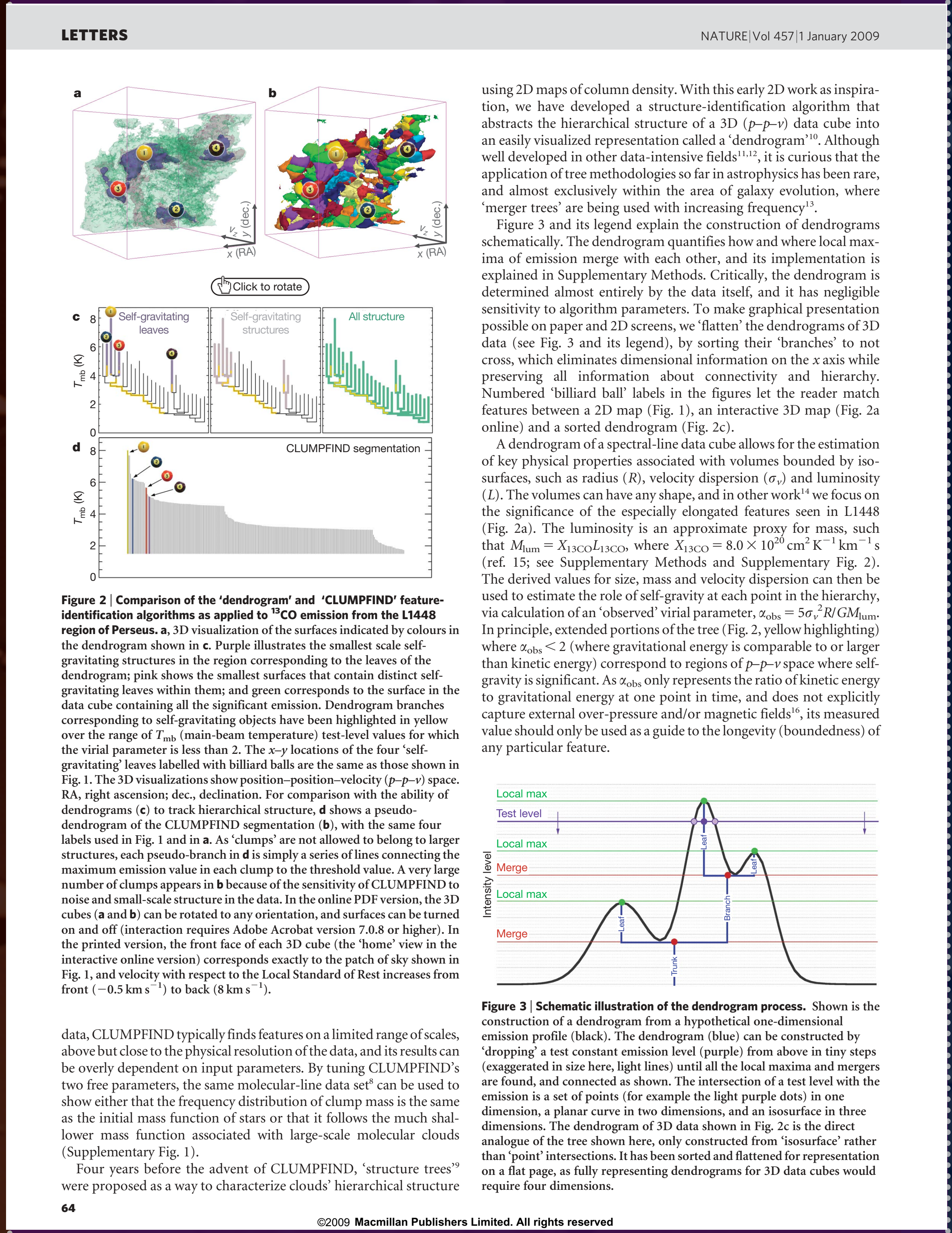
"Seamless Astronomy" (Tools)

Data

WIKIPEDIA
The Free Encyclopedia

AstroBetter

Blogs, Wikis, etc.



LETTERS

NATURE | Vol 457 | 1 January 2009

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.

64

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VizieR

SIMBAD

AstroGrid
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"Registries"

DataScope

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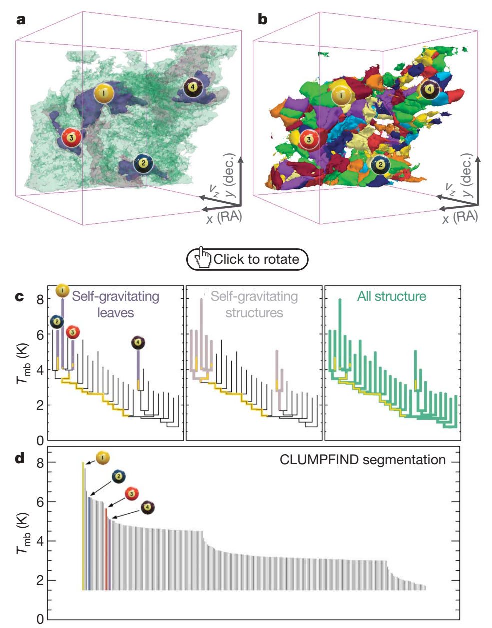
“Data” in “Literature”



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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.

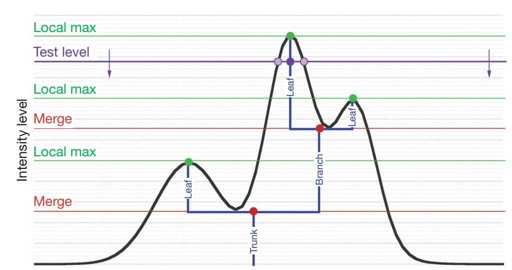

Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by ‘dropping’ a test constant emission level (purple) from above in tiny steps (exaggerated in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

Note: This work came from the “AstroMed” project am.iic.harvard.edu

Goodman et al. *Nature*, 2009

More Data in(/from) Literature (SKD!) coming in 2011

Astronomy Dataverse, *β*

Harvard Institute for Quantitative Social Science (Gary King, Mercé Crosas)
+ Seamless Astronomy Group, (Chris Erdmann, Alberto Pepe, Gus Muench et al.)

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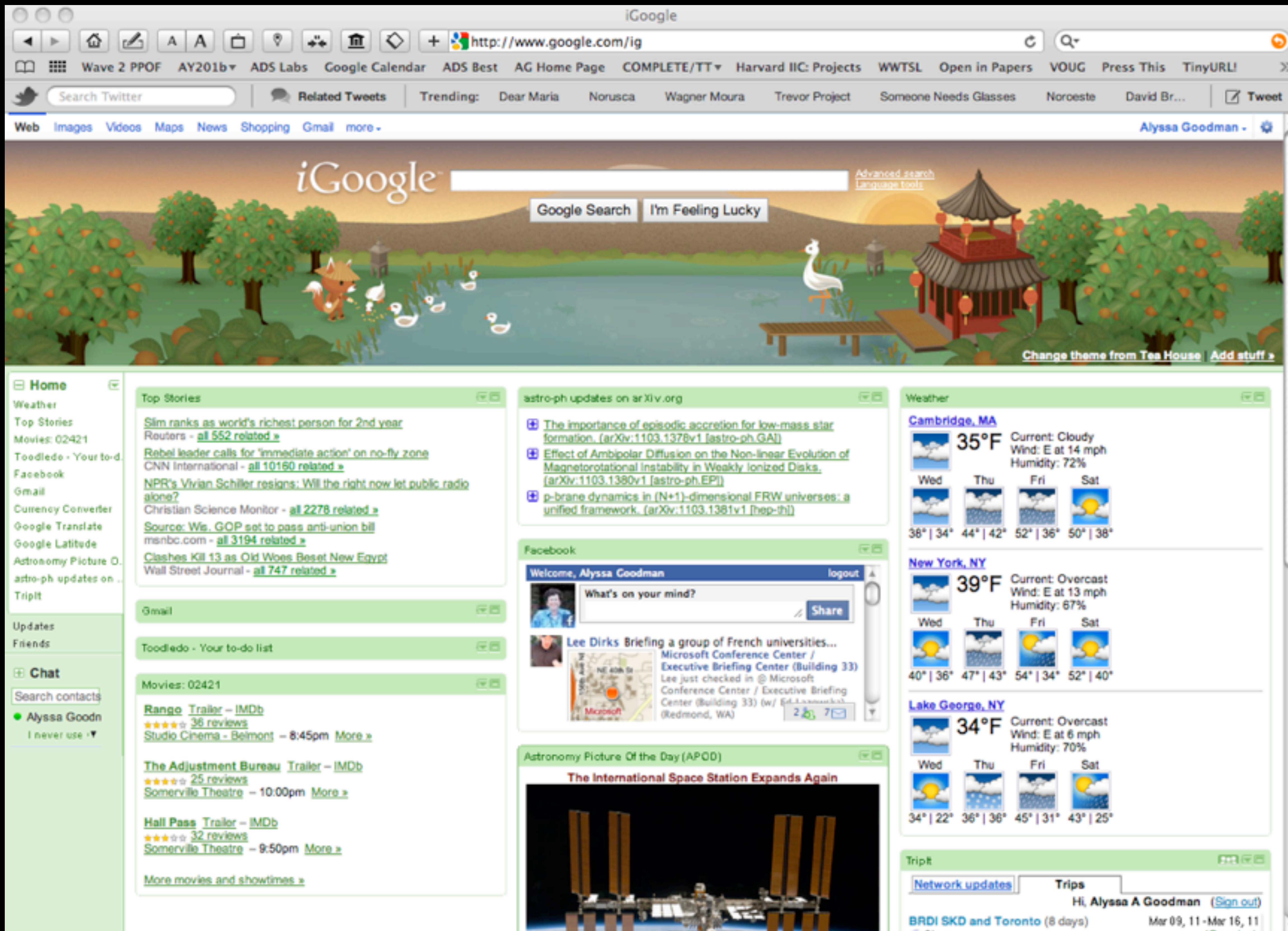

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online astronomy user group

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Posted Jan 23, 2011 9:11 PM by August Muench

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We are holding our "VO Expo" tomorrow morning (1 Dec, 9am-noon) in Phillips Auditorium. We will be covering the role of the CfA VO User group for scientists (and ...
Posted Dec 15, 2010 9:34 AM by August Muench

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Monday was the first full day of the Astronomical Data Analysis Software and Systems 2010 meeting. As there are new tools being presented and demo'd, I'm going to ...
Posted Nov 9, 2010 7:09 PM by August Muench

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The figure (above) diagrams the relationship between astronomical research and the data and literature sources that the research draws upon. The researcher stands between the literature and data, taking information from each, integrating their

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