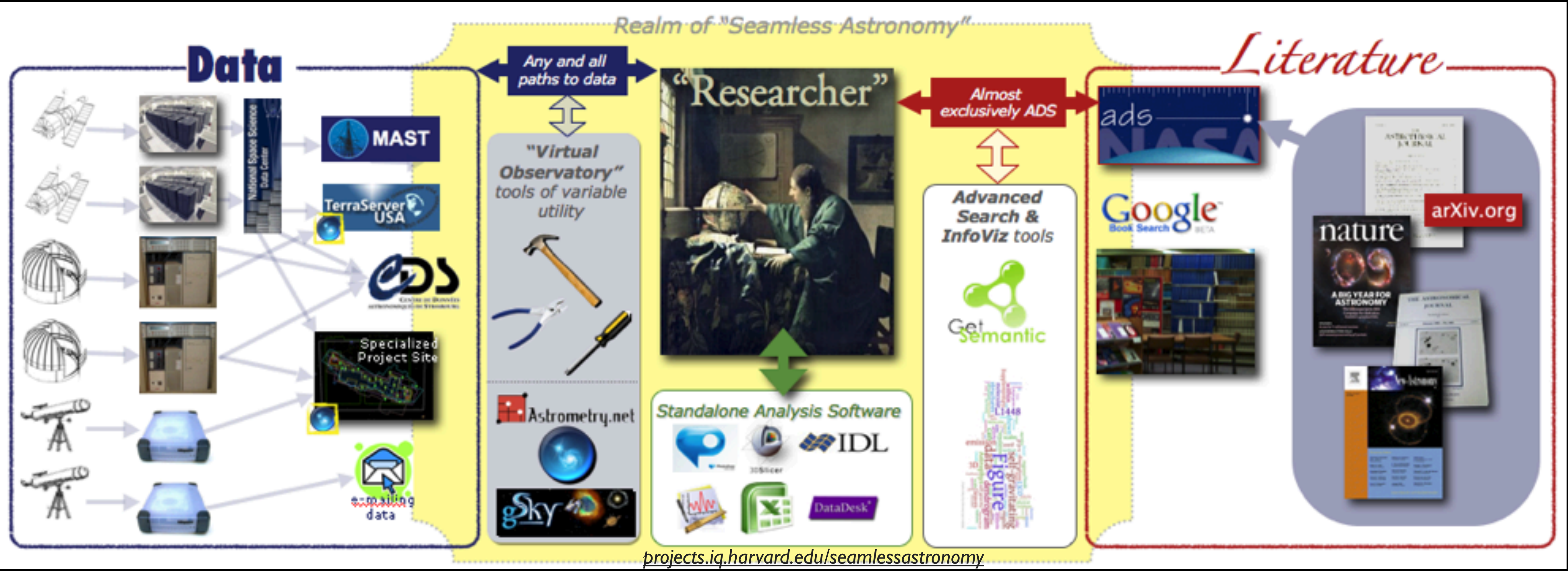
Seamless Astronomy

How astronomers share, explore & discover



projects.iq.harvard.edu/seamlessastronomy

Alyssa A. Goodman
Harvard-Smithsonian Center for Astrophysics

with
Alberto Accomazzi, Douglas Burke, Raffaele D'Abrusco, Rahul Davé, Christopher Erdmann, Pepi Fabbiano, 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)

The (US) Backstory

2001 ················· 2008 (2010)

NVO senior personnel:
Charles Alcock, University of Pennsylvania Kirk Borne, Astro
Tim Cornwell, NSF National Radio Astronomy Observatory
Optical Astronomy Observatory Giuseppina Fabbiano, Smit
Observatory Alyssa Goodman, Harvard University ***Jim Gray***
Hanisch, Space Telescope Science Institute George Helou, N
Analysis Center Stephen Kent, Fermilab Carl Kesselman, Uni
Miron Livny, University of Wisconsin, Madison Carol Lonsd
and Analysis Center Tom McGlynn, GSFC/HEASARC/USRA A
University Reagan Moore, San Diego Supercomputer Cente
Naval Observatory, Flagstaff Station Ray Plante, University
Thomas Prince, California Institute of Technology Ethan Sch
STScI Nicholas White, NASA Goddard Space Flight Center R
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How to Prepare Your Proposal
About Funding

Proposals and Awards

Proposal and Award Policies and Procedures Guide
Introduction
Proposal Preparation and

Management and Operation of the Virtual Astronomical Observatory

NSF
NASA

CONTACTS

Name	Email
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Eileen D. Friel	efriel@nsf.gov

PROGRAM GUIDELINES

Solicitation 08-537

Please be advised that the NSF Proposal & Award Policies & Procedure (PAPPG) includes revised guidelines to implement the mentoring pro the America COMPETES Act (ACA) (Pub. L. No. 110-69, Aug. 9, 2007.) specified in the ACA, each proposal that requests funding to support postdoctoral researchers must include a description of the mentoring that will be provided for such individuals. Proposals that do not com this requirement will be returned without review (see the PAPP Guide Grant Proposal Guide Chapter II for further information about the implementation of this new requirement).

2001 ················ 2008 (2010)

and meanwhile...

RVO

AstroGrid

Aus-VO

VObs.it

vo-i

CVO

SVO
Spanish Virtual Observatory

BRAVO

ArVO
Armenian Virtual Observatory

NVO
NATIONAL VIRTUAL OBSERVATORY

IVOA

China-VO

EURO VO

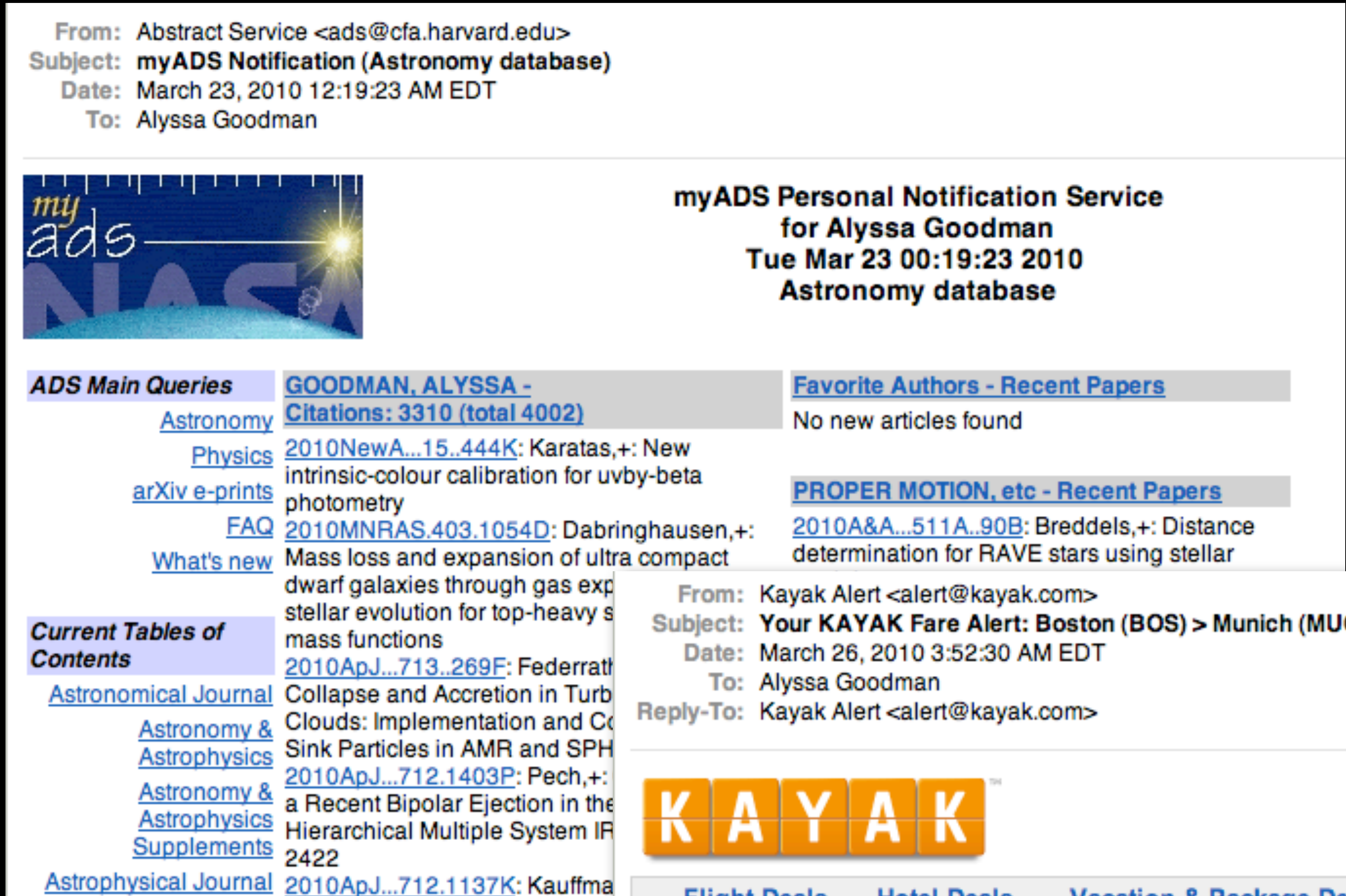
JVO

HVO
Hungarian Virtual Observatory

GERMAN ASTROPHYSICAL
GAVO
VIRTUAL OBSERVATORY

VO France

The VO



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

ADS Main Queries
Astronomy
Physics
arXiv e-prints
FAQ
What's new

Current Tables of Contents
Astronomical Journal
Astronomy & Astrophysics
Astronomy & Astrophysics Supplements
Astrophysical Journal

GOODMAN, ALYSSA - Citations: 3310 (total 4002)
2010NewA...15..444K: Karatas,+: New intrinsic-colour calibration for uvby-beta photometry
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 C
Sink Particles in AMR and SPH
2010ApJ...712.1403P: Pech,+:
a Recent Bipolar Ejection in the
Hierarchical Multiple System IR
2422
2010ApJ...712.1137K: Kauffma

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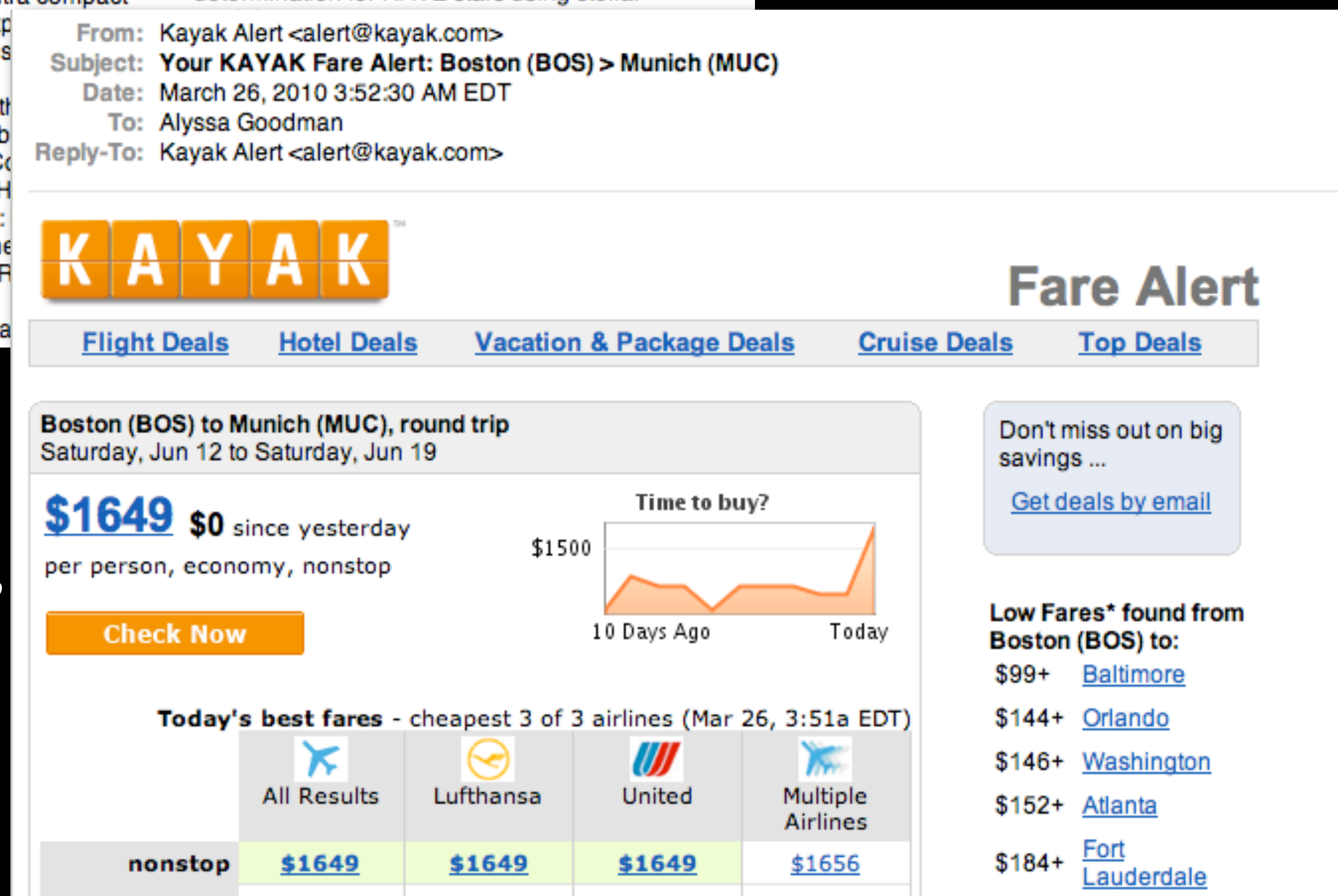
2010A&A...511A..90B: Breddels,+: Distance determination for RAVE stars using stellar



From: Kayak Alert <alert@kayak.com>
Subject: **Your KAYAK Fare Alert: Boston (BOS) > Munich (MUC)**
Date: March 26, 2010 3:52:30 AM EDT
To: Alyssa Goodman
Reply-To: Kayak Alert <alert@kayak.com>

KAYAK
Fare Alert

Flight Deals | Hotel Deals | Vacation & Package Deals | Cruise Deals | Top Deals

Boston (BOS) to Munich (MUC), round trip
Saturday, Jun 12 to Saturday, Jun 19

$1649 **$0** since yesterday
per person, economy, nonstop
Check Now

Today's best fares - cheapest 3 of 3 airlines (Mar 26, 3:51a EDT)

	All Results	Lufthansa	United	Multiple Airlines
nonstop	$1649	$1649	$1649	$1656

Don't miss out on big savings ...
Get deals by email

Low Fares* found from Boston (BOS) to:
$99+ Baltimore
$144+ Orlando
$146+ Washington
$152+ Atlanta
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Instead, we are building an integrated "seamless" virtual observatory


How?

Literature

WIKIPEDIA
The Free Encyclopedia

AstroBetter

Blogs, Wikis, etc.

Data

VizieR

SIMBAD

AstroGrid
VAO
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.*

Literature

"Seamless Astronomy" (Tools)

Data

ads labs

Astrometry.net

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Wikipedia The Free Encyclopedia

AstroBetter

Blogs, Wikis, etc.

ALADIN

WorldWide Telescope

TOPCAT

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SIMBAD

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

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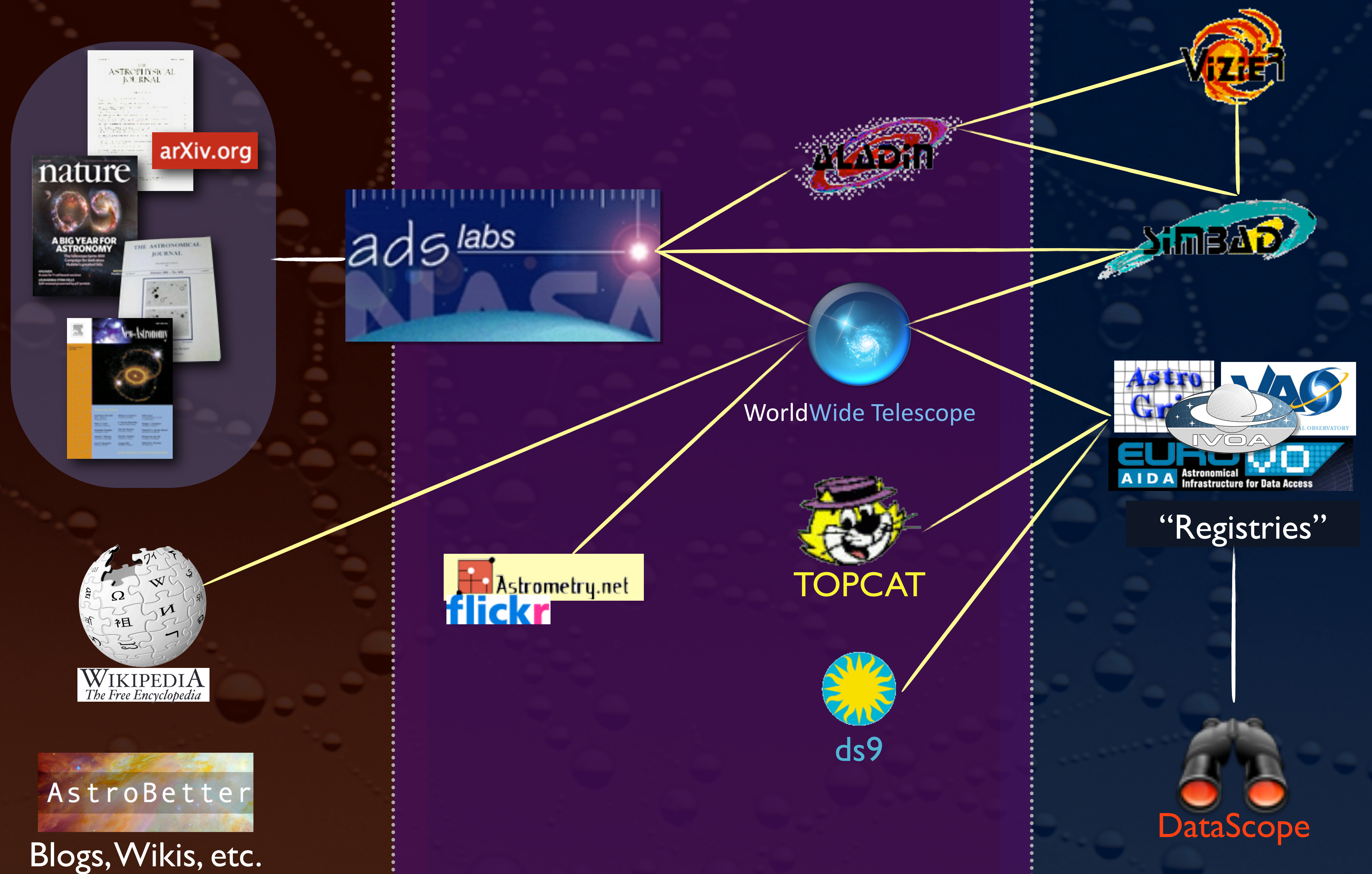

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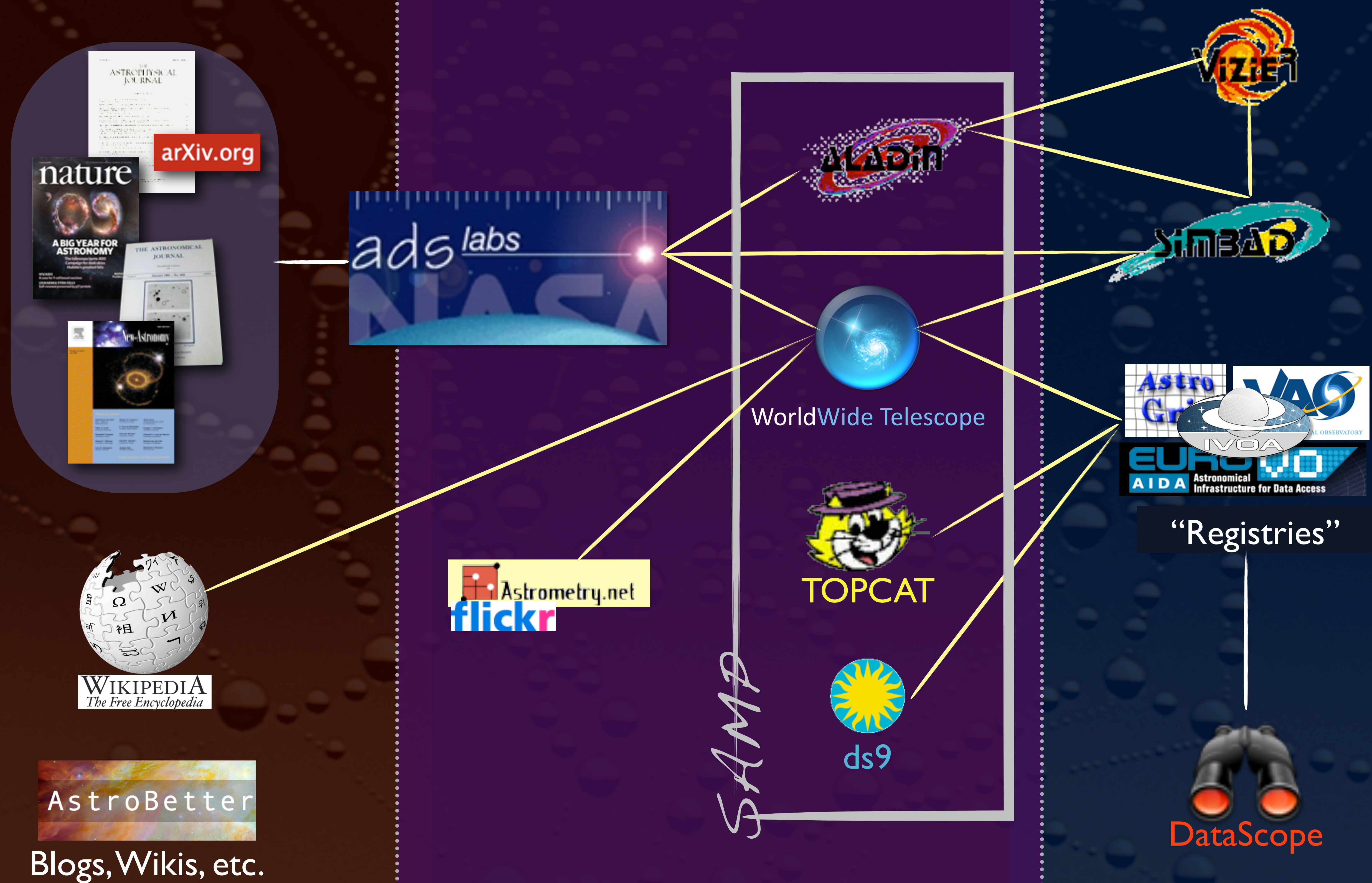

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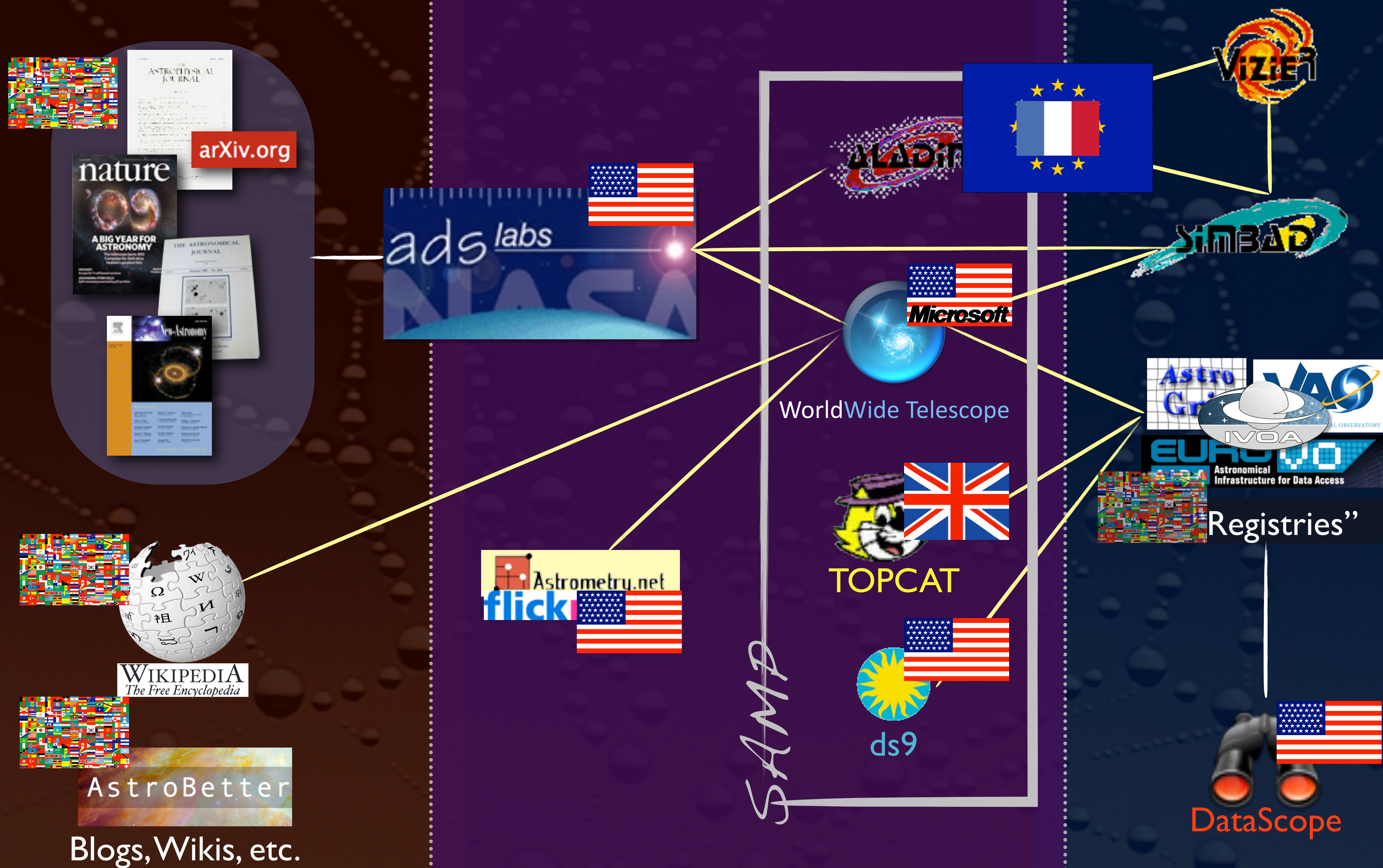
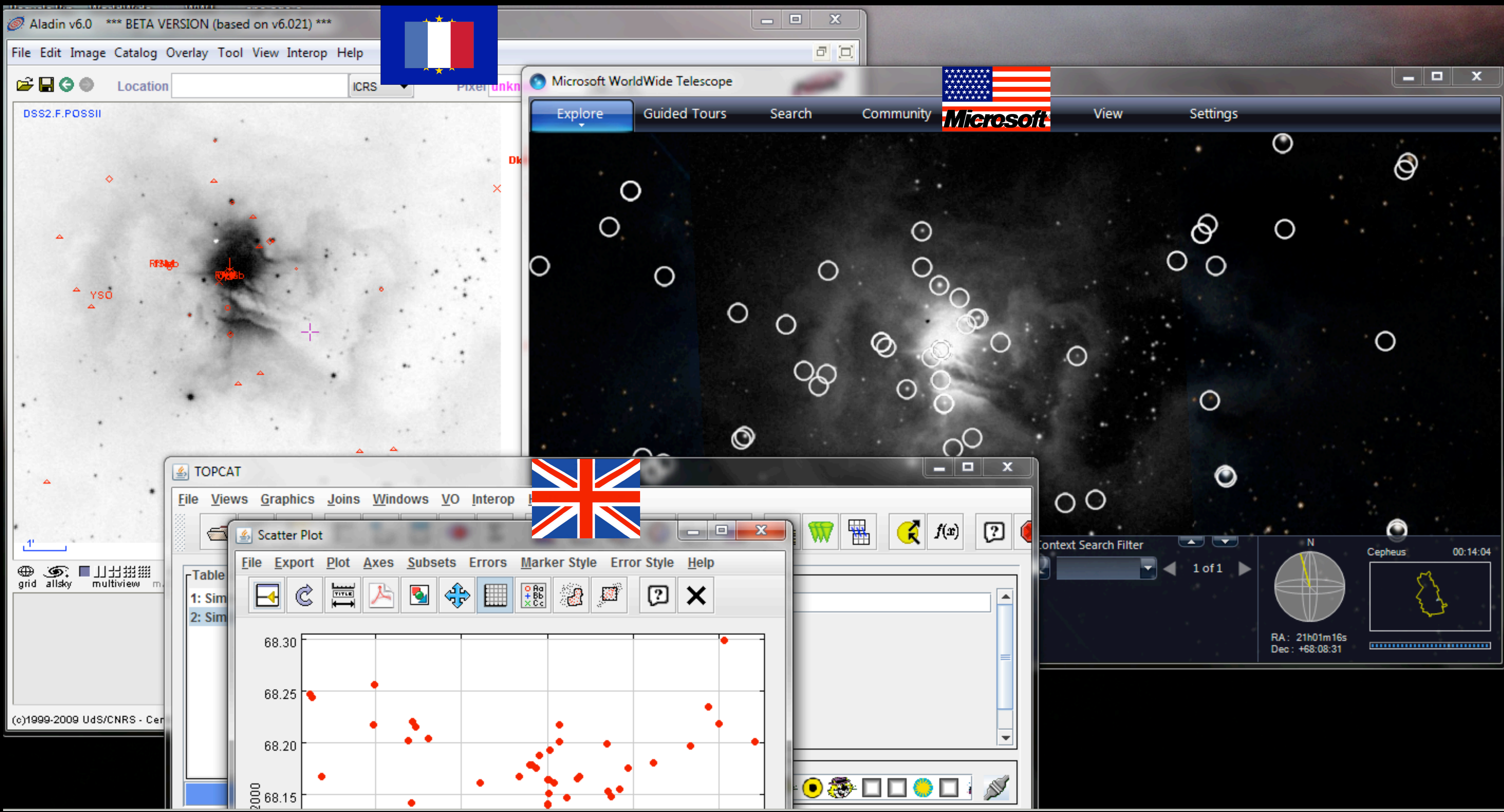


Disclaimer: *This slide shows key excerpts from within the astronomy community & excludes more general s/w that is used, such as Papers, Zotero, Mendeley, EndNote, graphing & statistics packages, data handling software, search engines, etc.*

SAMP
(Simple Application Messaging Protocol)

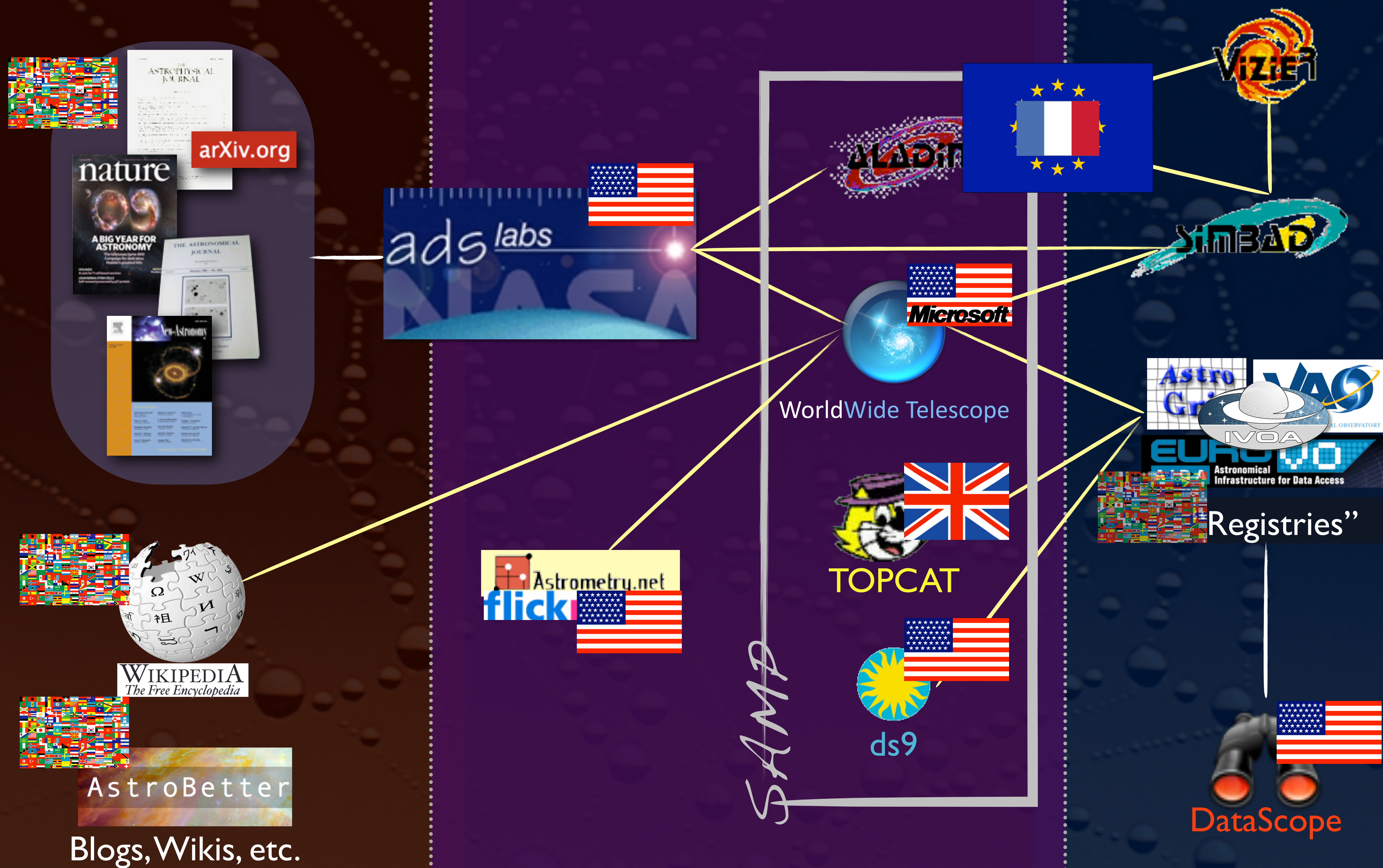


[link](#) to 12/2010 IVOA recommendation

Literature

"Seamless Astronomy" (Tools)

Data



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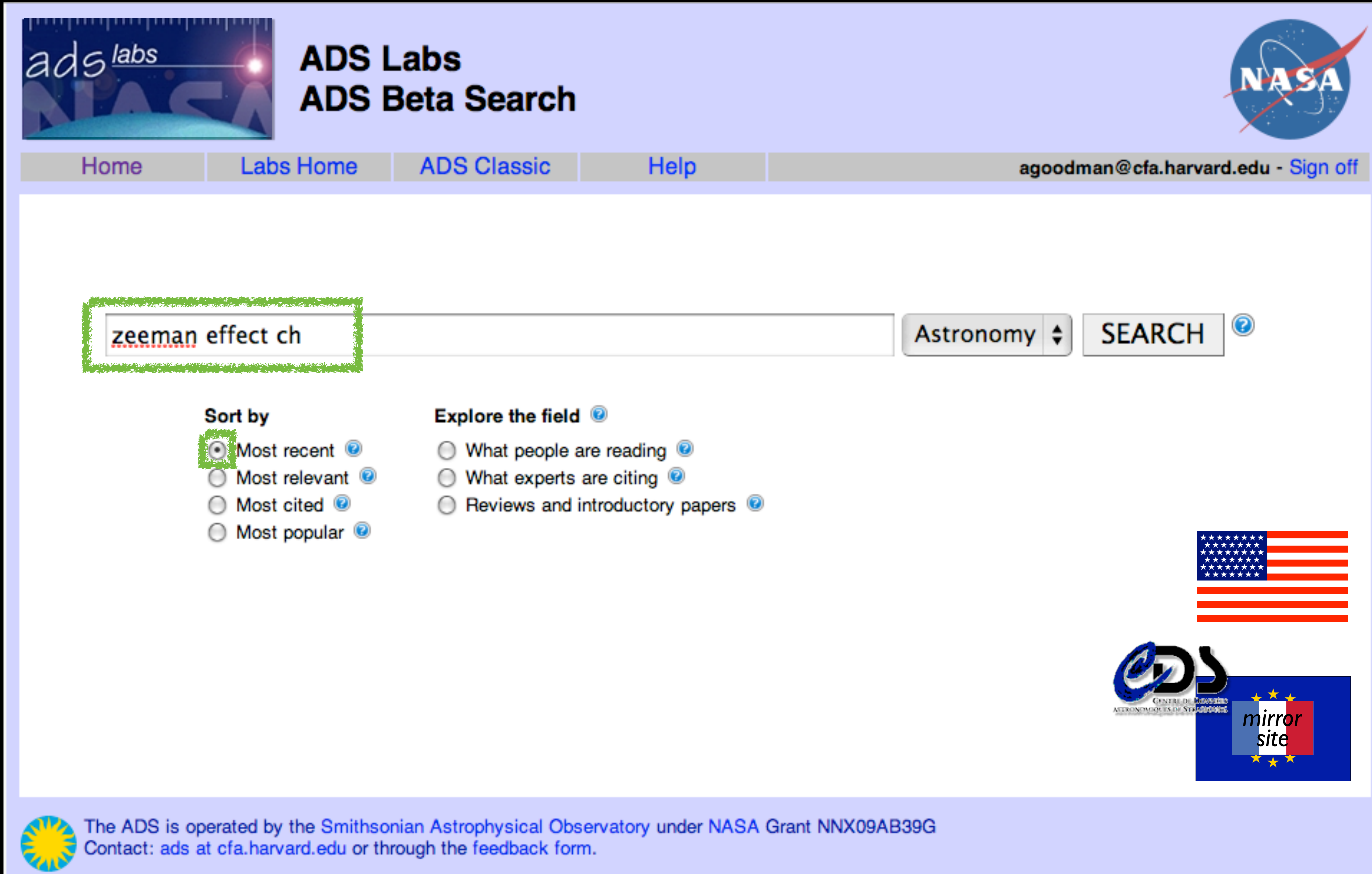

ADS Labs/Seamless Astronomy Core Collaboration

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

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Authors
- Uitenbroek, H (4)
- Amano, T (2)
- Angel, J (2)
- Asensio Ramos, A (2)
- Balasubramaniam, K (2)

Keywords

Archives

Missions

SIMBAD Objects
- ☑ Other object (3)
- ☐ Star (3)
- ☑ Nebula (1)

ADS Publications
SIMBAD Info
World Wide Telescope
Aladin applet

Vizier Tables

Refereed status

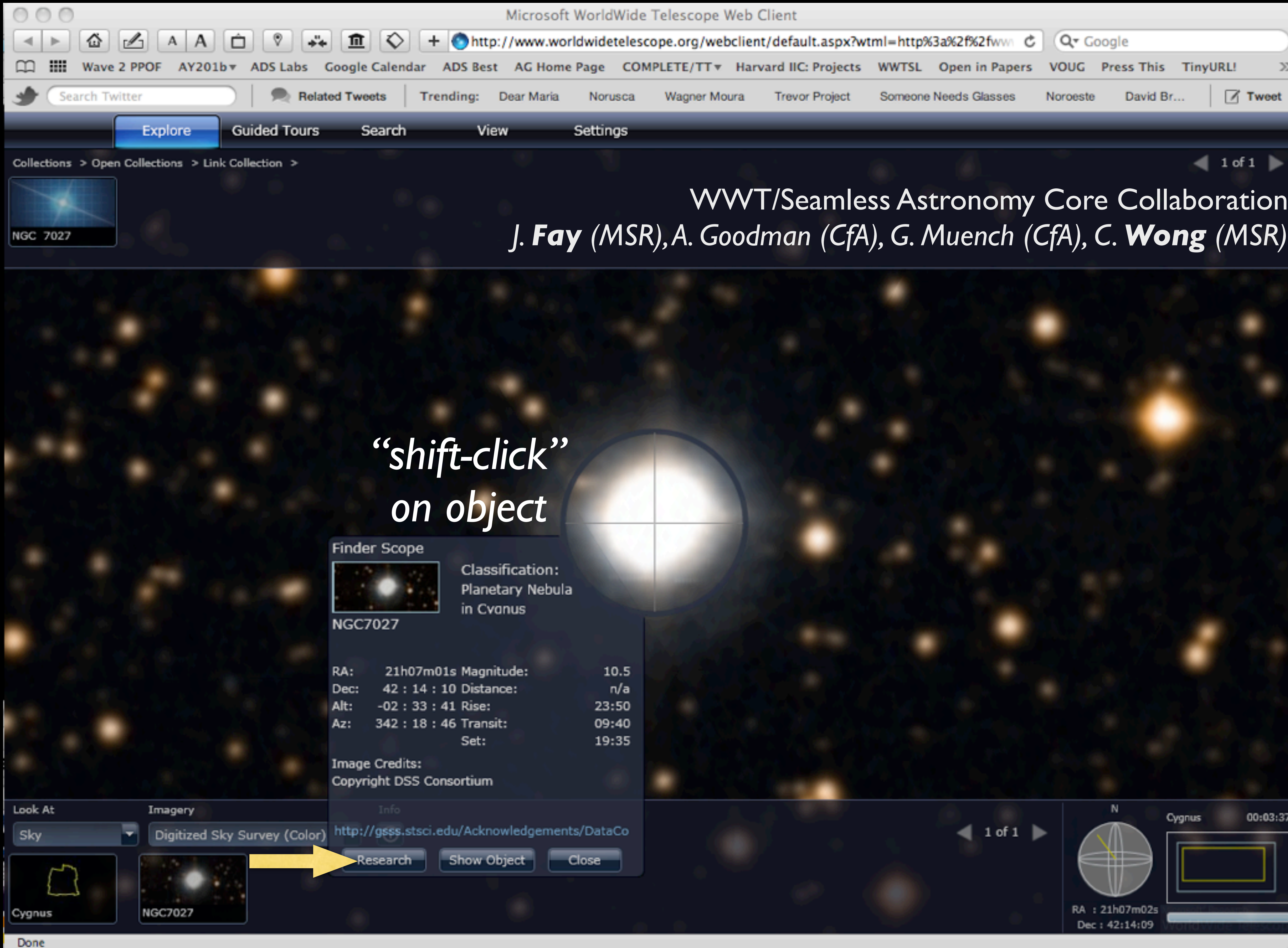
Dates

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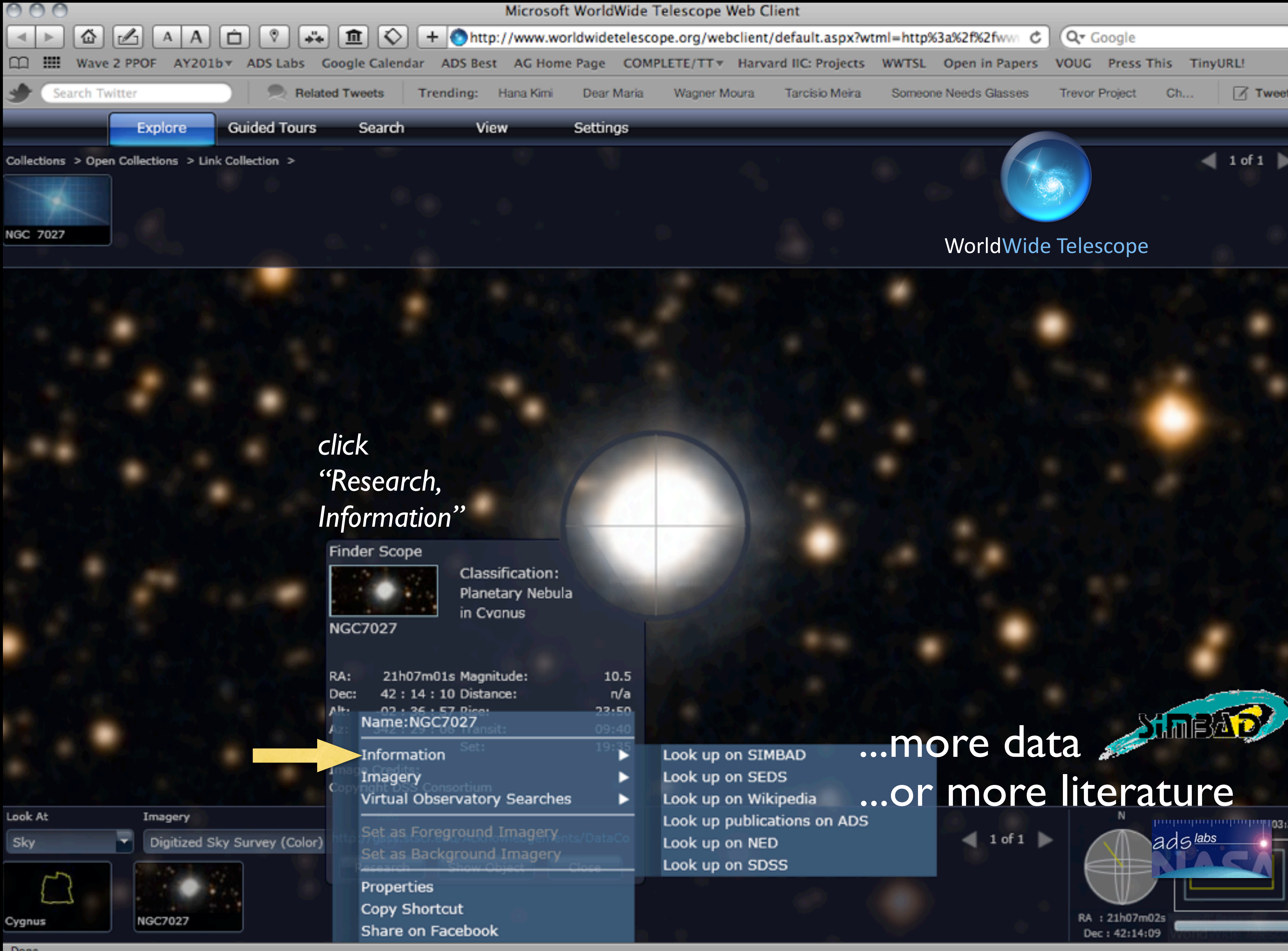
Microsoft WorldWide Telescope Web Client
http://www.worldwidetelescope.org/webclient/default.aspx?wtml=http%3a%2f%2fwww
Explore
Guided Tours
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NGC 7027
WorldWide Telescope
click
“Research,
Information”
Finder Scope
Classification:
Planetary Nebula
in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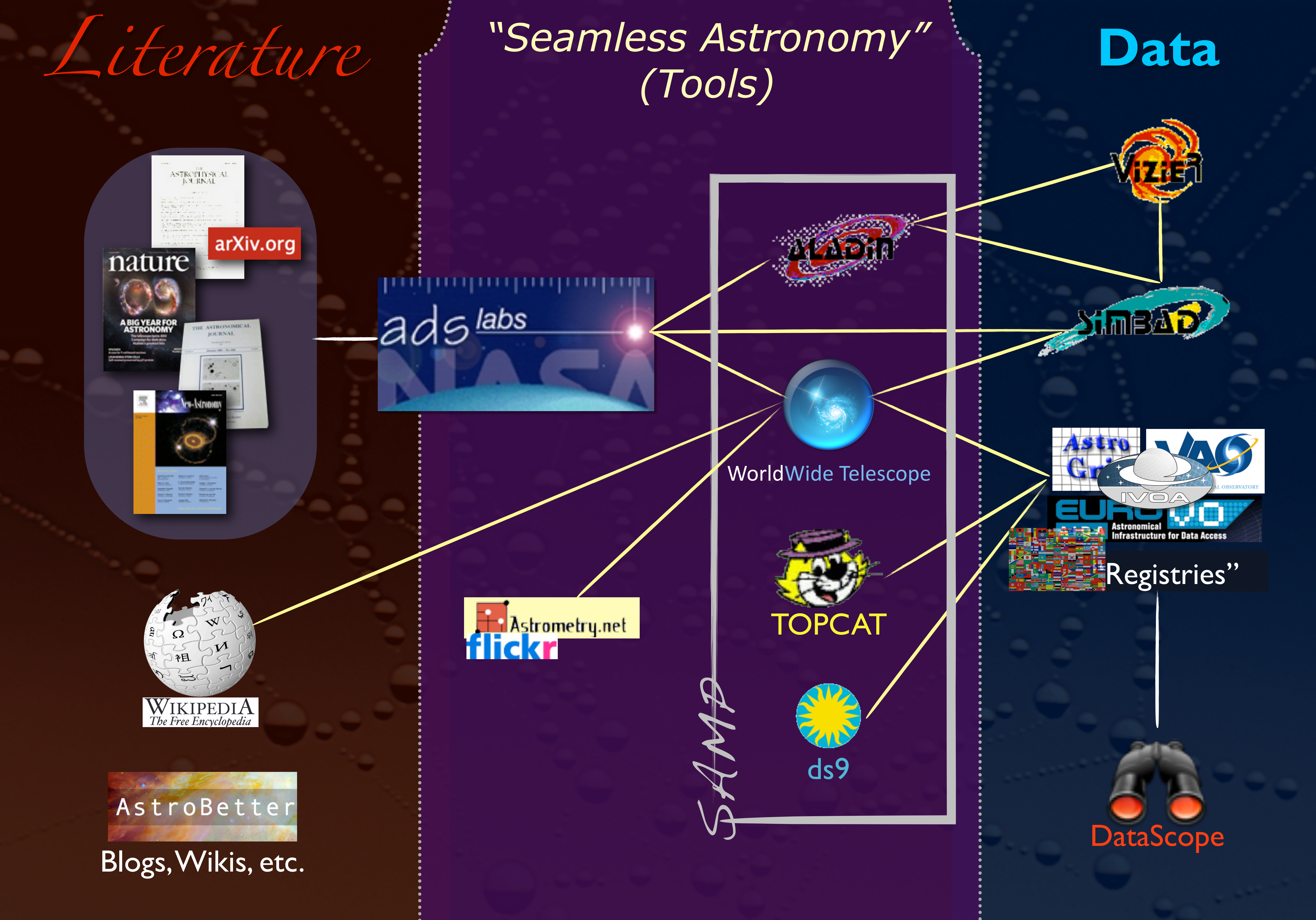

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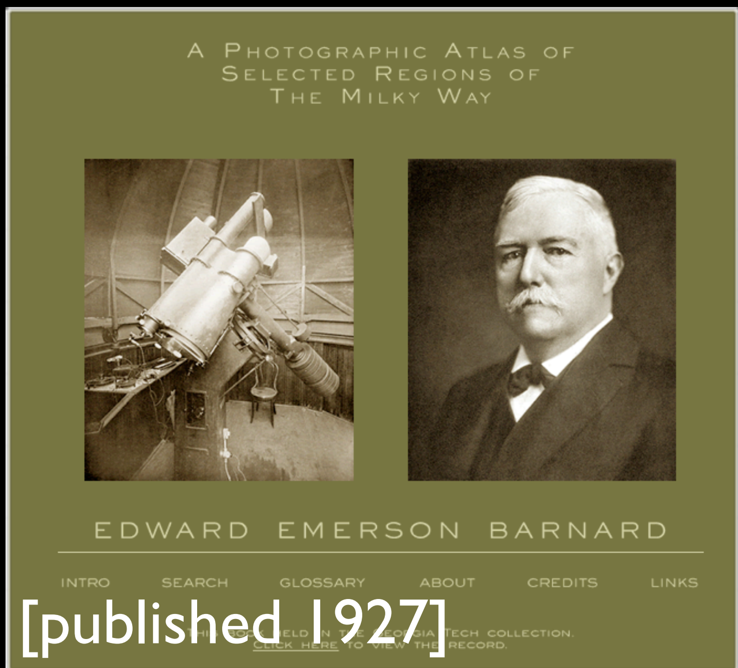
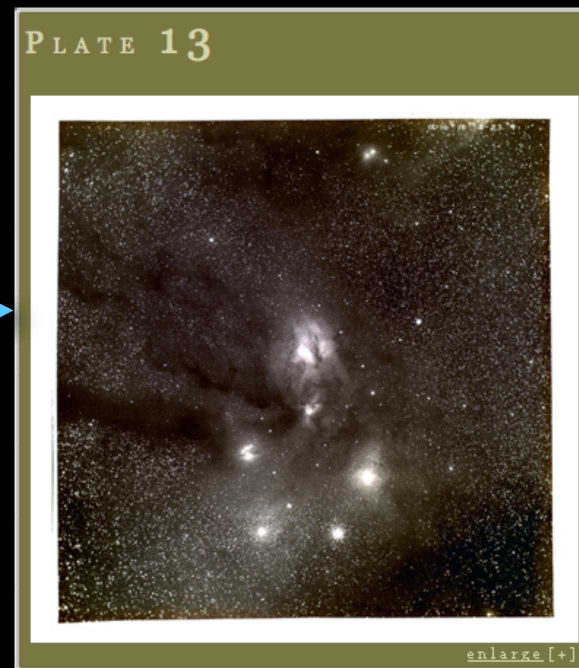
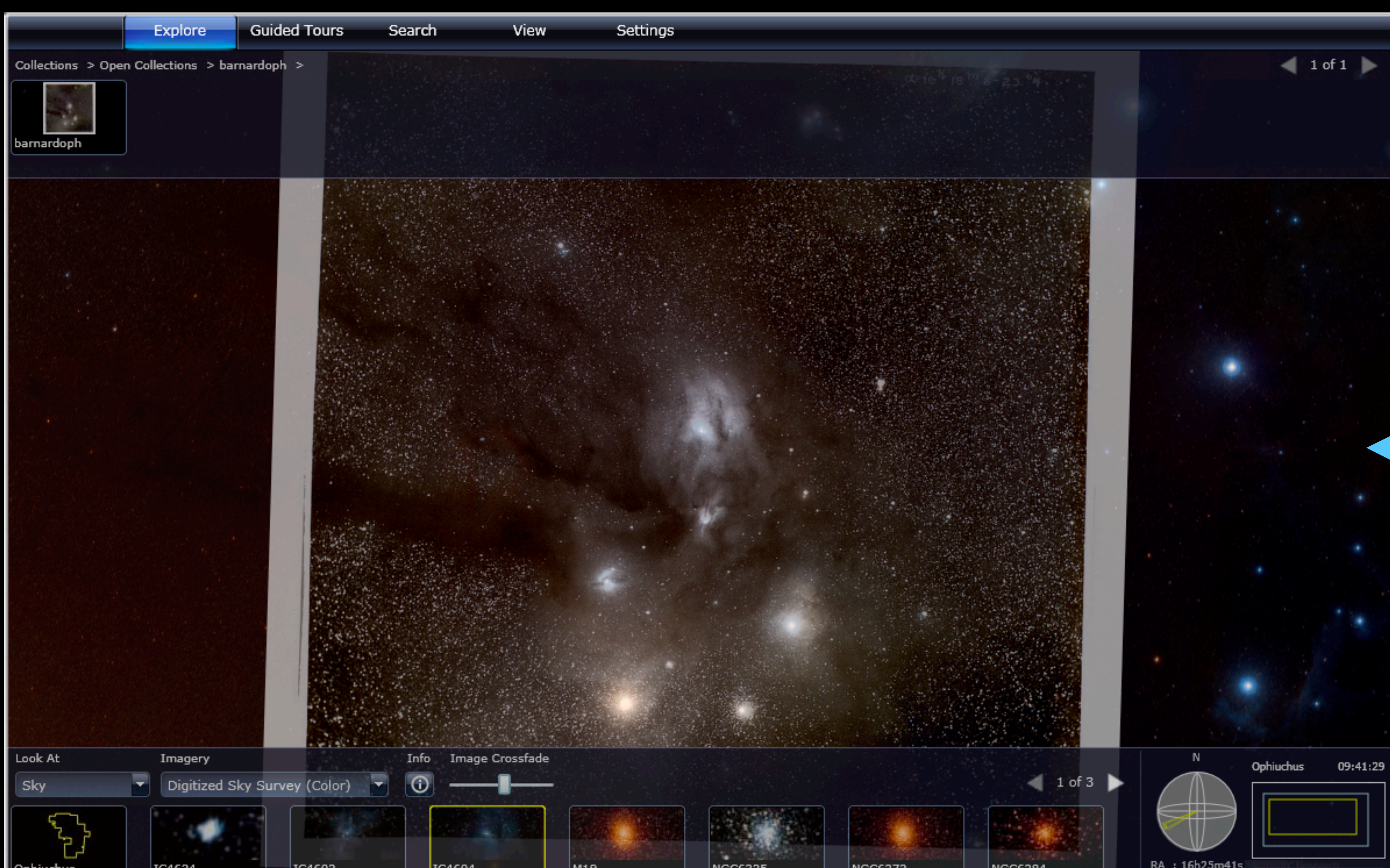
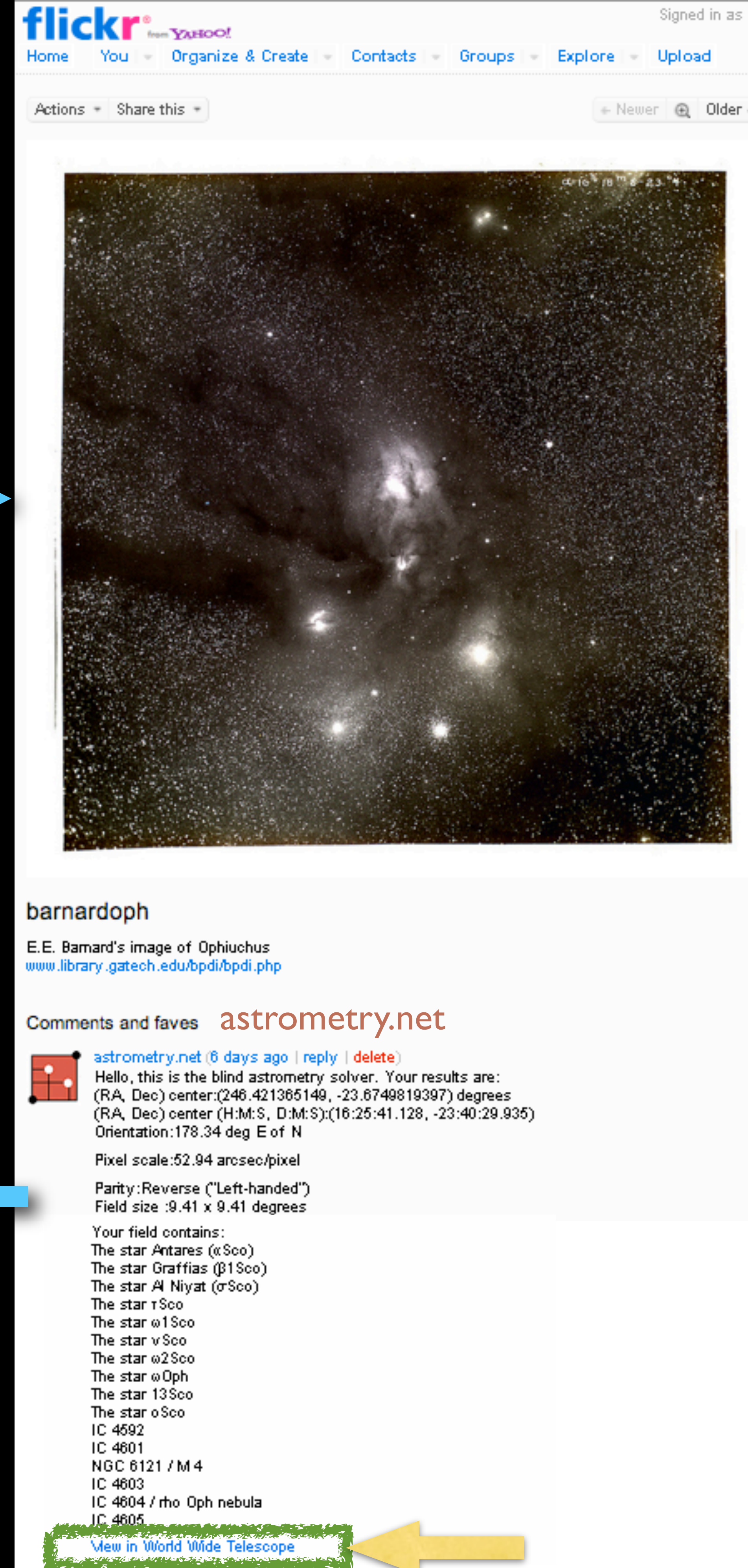
“Seamless Astronomy”... astrometry.net + flickr + WWT

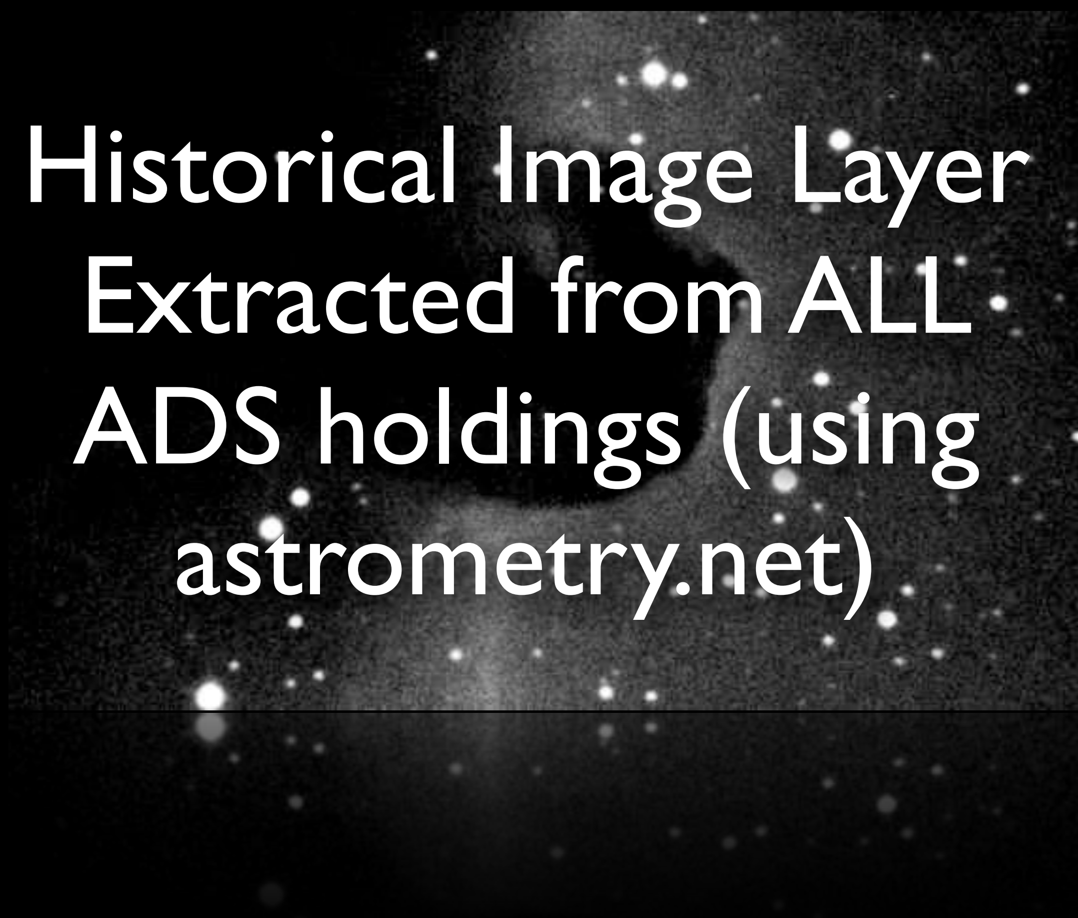


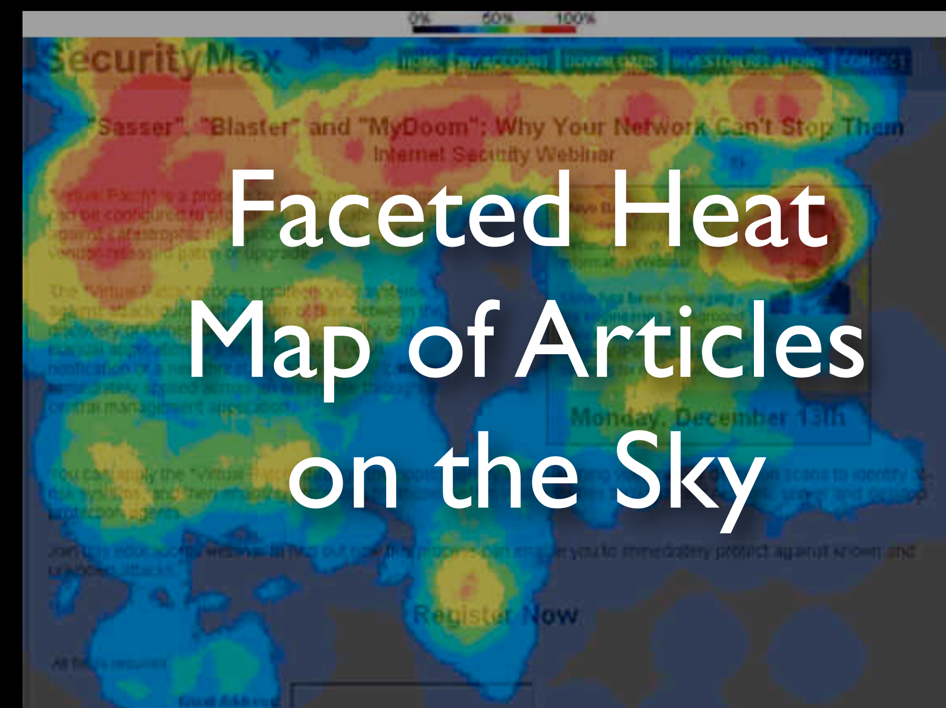






Coming (using astrometry.net++)in 2011...





[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)

Literature

“Seamless Astronomy” (Tools)

Data

WIKIPEDIA
The Free Encyclopedia

AstroBetter

Blogs, Wikis, etc.

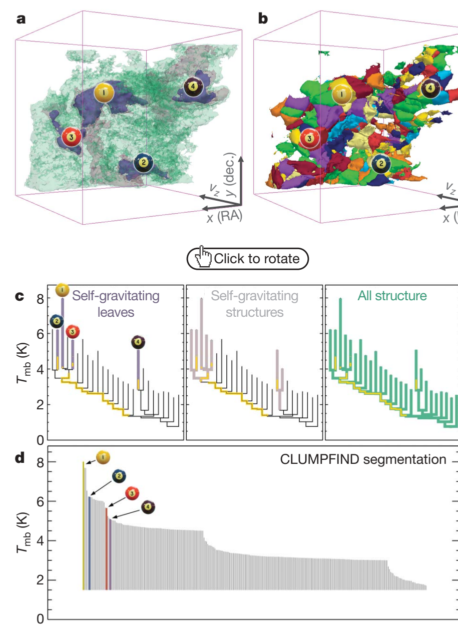


Figure 2 | Comparison of the ‘dendrogram’ and ‘CLUMPFIND’ feature-identification algorithms as applied to ^{13}CO emission from the L1448 region of Perseus. a, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating 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.

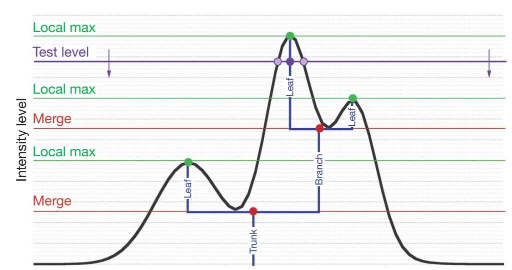


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by ‘dropping’ a test constant emission level (purple) from above in tiny steps (exaggerated in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

“Registries”

DataScope

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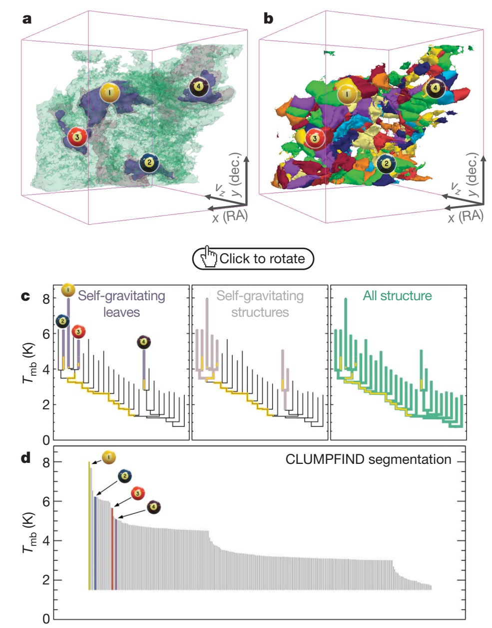
Data in *Literature*

Note: This work came from the "'AstroMed" project am.iic.harvard.edu



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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.

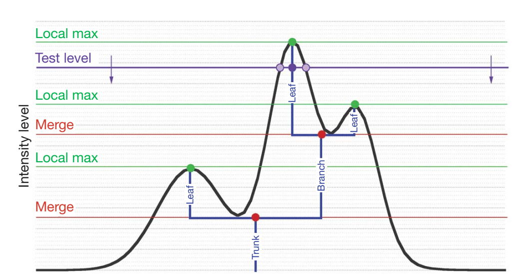
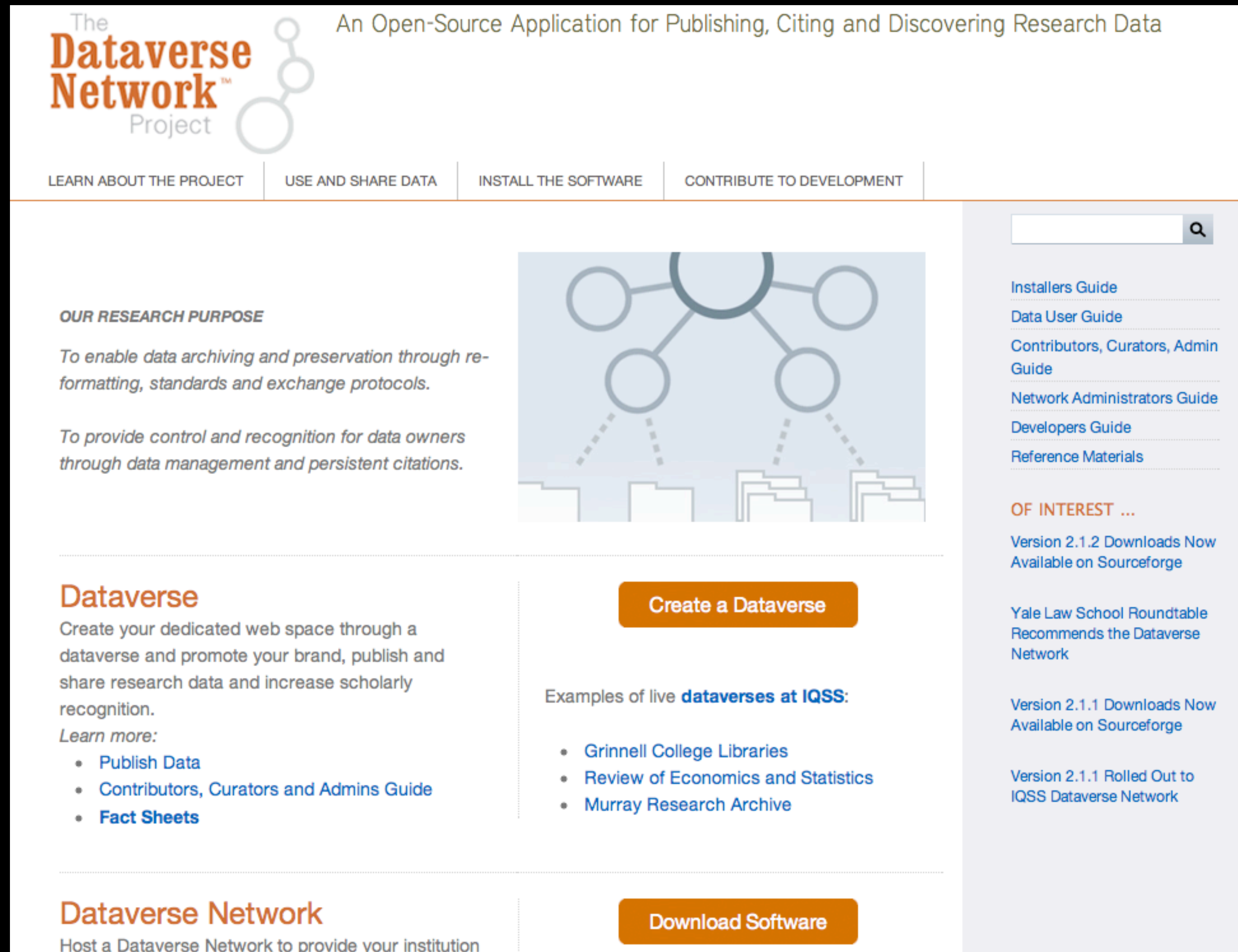


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in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

Goodman et al. *Nature*, 2009

More Data in/from Literature 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.)

But awareness is not high enough
...and skepticism is not hard to find.

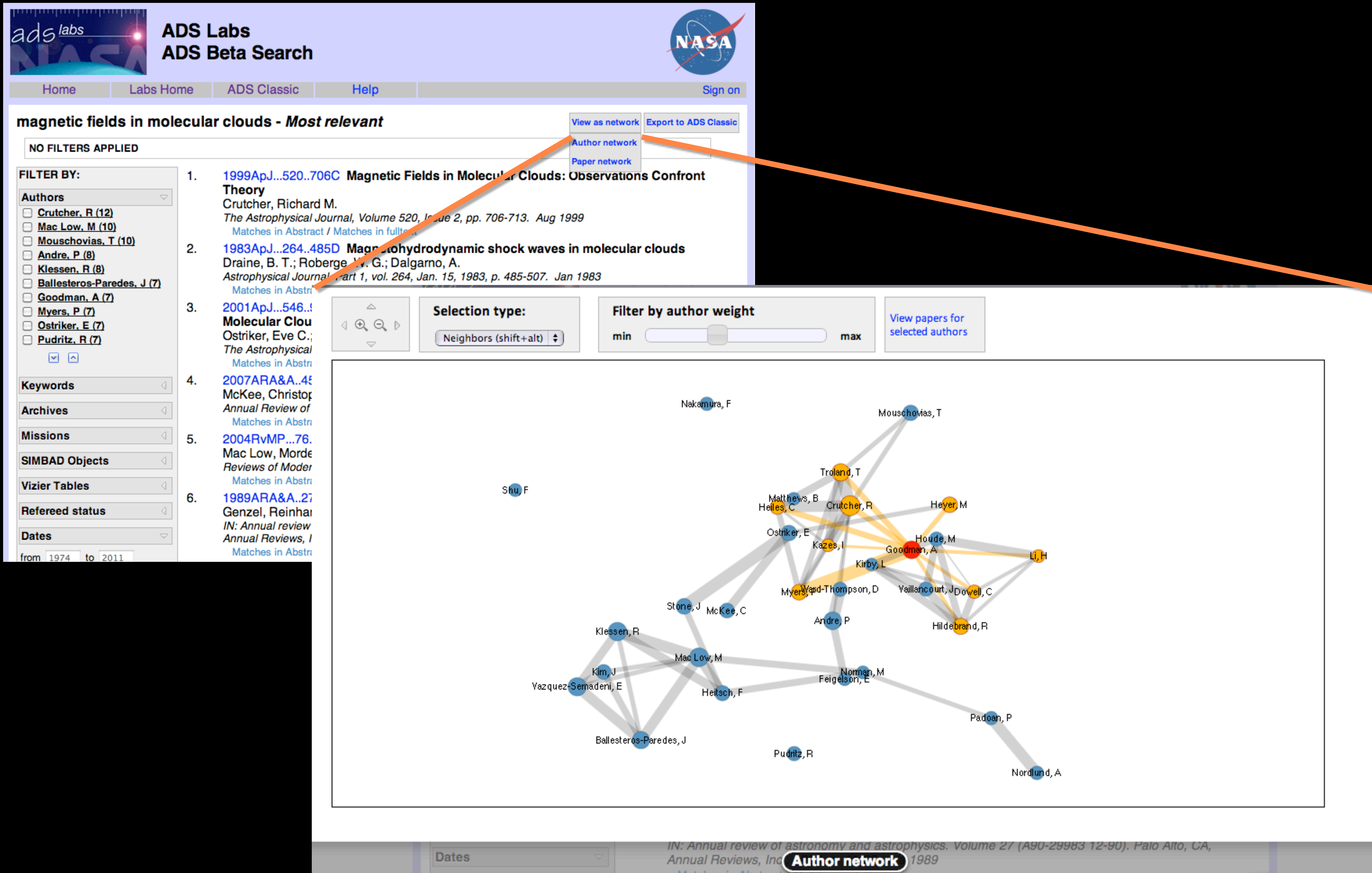
Good news is that the young & young at heart are headed in the right direction.

Funding agencies have been slow to come along
...industrial collaboration is a better bet at present
(e.g. Microsoft Research/WorldWide Telescope).

Sage BIONETWORKS

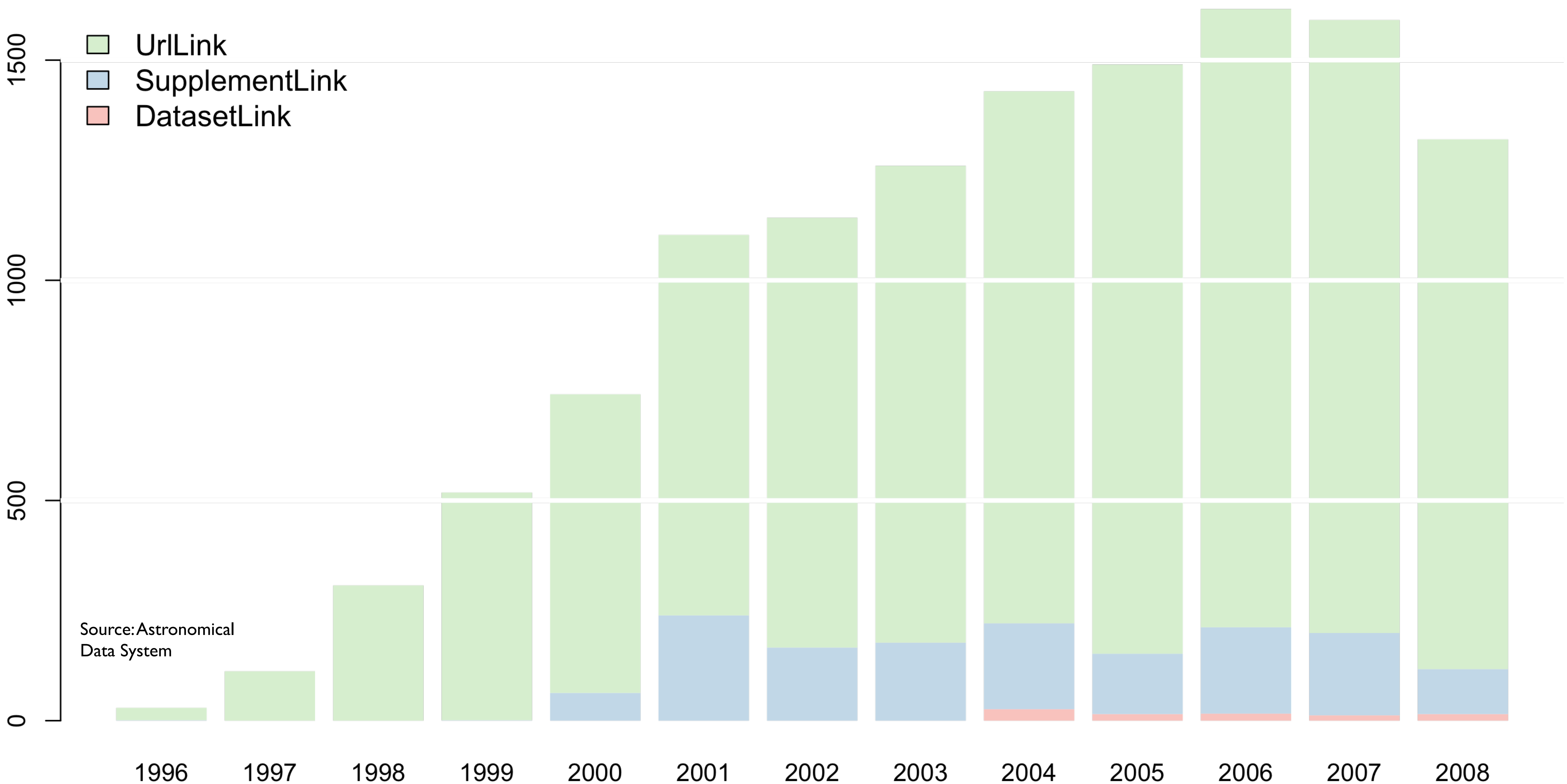
data links

ADS may be our "way in" via killer apps



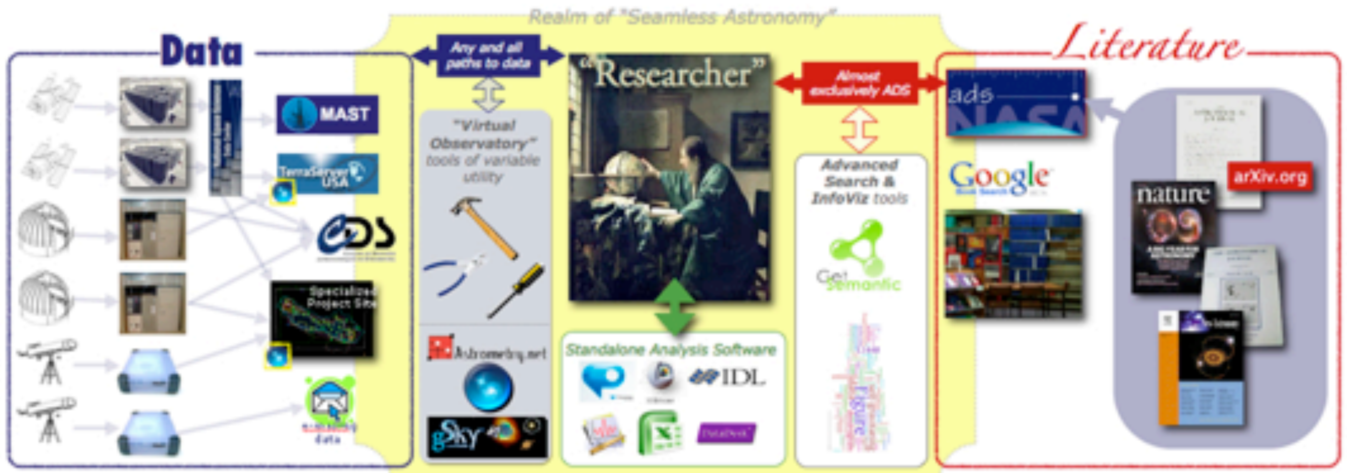
DATA IN "LITERATURE"

NUMBER OF ASTRONOMY PUBLICATIONS WITH LINKS, BY YEAR (ADS)



online astronomy user group

Search this site



Welcome! This website provides a platform for sharing resources, workflows, and basic organizational information about networked tools, websites and databases in astronomy. Its intended audience is any scientist performing astronomical research online. It originated from the activities of scientists at the Harvard Smithsonian Center for Astrophysics in Cambridge, MA.

By online astronomy, we mean all forms of networked tools, databases and websites that are utilized for astronomical research, including scholarly discourse and social interactions through blogs, forums and other web media.

By *user group*, we mean a group of individuals who meet approximately monthly to discuss their solutions and problems with doing their research online.

Blog

Research Blogs, Forums and Q&A websites Our January 25, 2011 meeting topic will be "Research Blogs, Forums and Q&A websites." We will hold an open discussion on how everyone uses these tools in their everyday ...

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

Expo of Online Astronomy tools (aka, a VO expo)
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

ADASS Day 1: A new portal, new Aladin features
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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15
days since
January 2011 Mtg

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

How do we increase the number of people who create and interlink new tools?

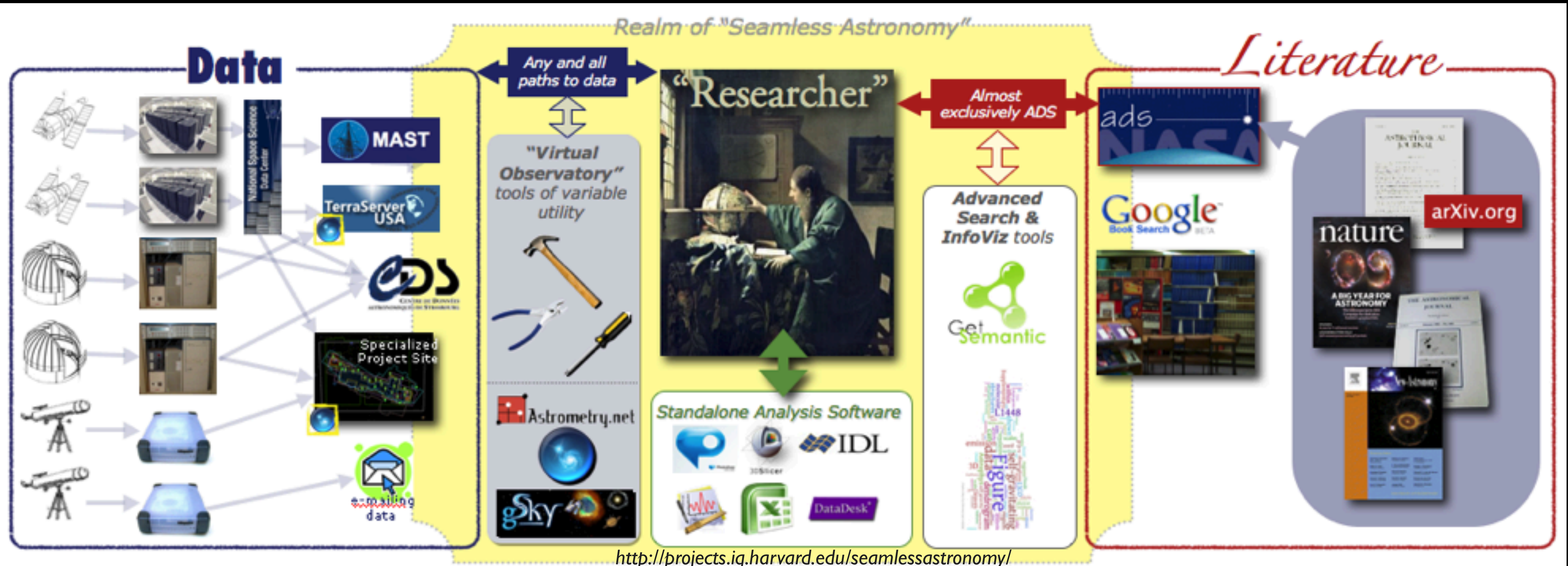
Kiva model: WWT Partners & “VAO Associates”

How do we organize such diverse tools, so as to make them interoperably useful?....

"SAMP" is a great technical start, but offers a very significant user interface challenge.

Seamless Astronomy

projects.iq.harvard.edu/seamlessastronomy



Alyssa A. Goodman

Harvard-Smithsonian Center for Astrophysics

Smithsonian Microsoft Research NASA NSF

with

Alberto Accomazzi, Douglas Burke, Raffaele D'Abrusco, Rahul Davé, Christopher Erdmann, Pepi Fabbiano, 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)

“Citizen Science”