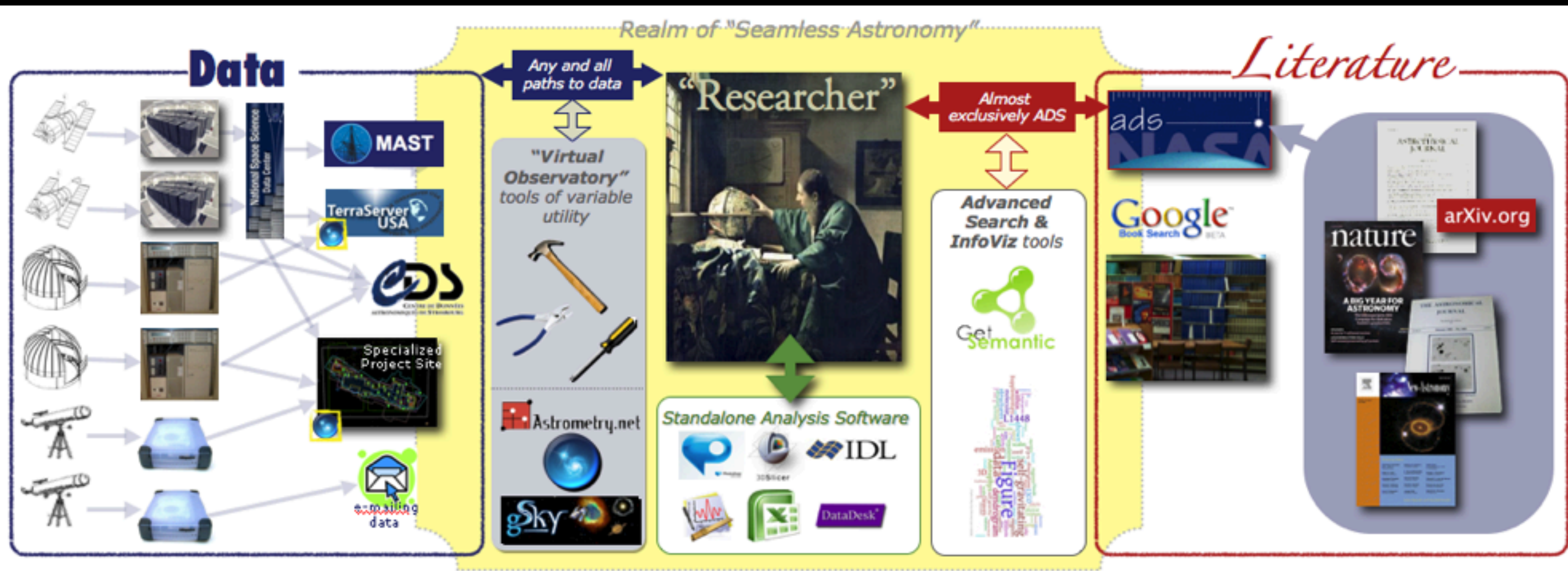
Part I
Seamless Astronomy

Alyssa A. Goodman

Harvard-Smithsonian Center for Astrophysics

with Alberto **Accomazzi**, Rahul **Davé**,
Gus **Muench** & Michael **Kurtz** (Harvard-Smithsonian CfA);
Tim **Clark** (Massachusetts General Hospital/Harvard Medical School);
Jonathan **Fay** & Curtis **Wong** (Microsoft Research)
+extended & upcoming collaboration with Chris Borgman & Alberto Pepe* (UCLA);
Doug Burke; Sarah Block, Pepi Fabbiano, et al. (CfA); E. Bressert (U. Exeter);
J. Hendler & D. McGuinness (RPI); A. Conti & C. Christian (STScI); A. Connolly et al. (U. Washington)

Realm of Seamless Astronomy



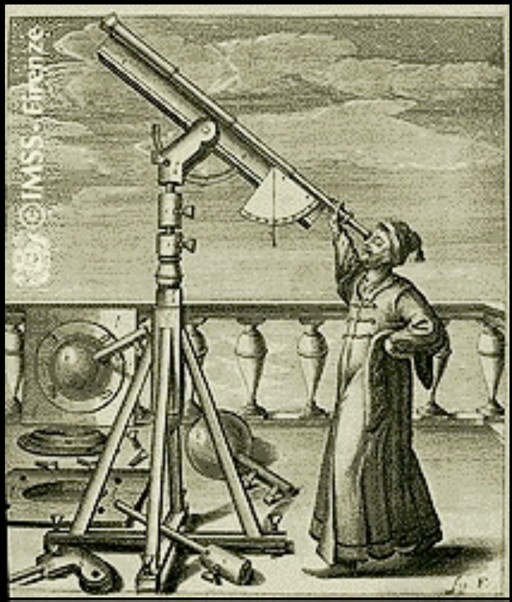
3500 years of Observing

Stonehenge, 1500 BC

Ptolemy in Alexandria, 100 AD

Observatory Tower, Lincolnshire, UK, c. 1300

Galileo, 1600



The "Scientific Revolution"

Reber's Radio Telescope, 1937

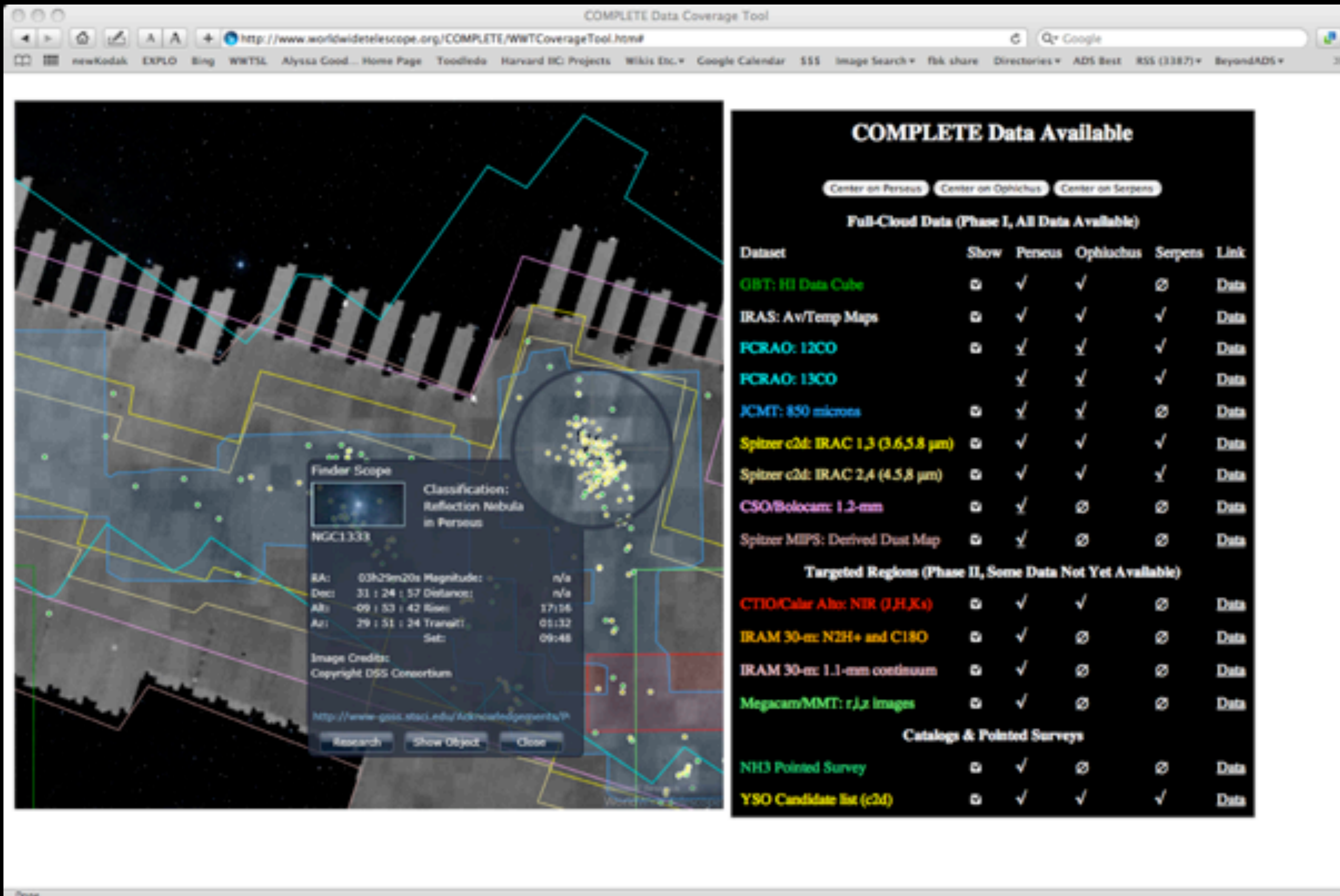
NASA/Explorer 7 (Space-based Observing) 1959

"The Internet"

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

"Virtual Observatories" 21st century

“Virtual” observing



What can today's Astronomer's "Research" look like?

http://www.cfa.harvard.edu/~agoodman/

Publishing

Data | Simulation

VIRTUAL ASTRONOMICAL OBSERVATORY

PDF 3D Adobe

WorldWide Telescope

e-Science Tools | Viz


WorldWide Telescope Ambassadors Program
http://www.cfa.harvard.edu/WWTAmbassadors/

Harvard University, WGBH & Microsoft Research
Alyssa Goodman, Patricia Udomprasert, Annie Valva & Curtis Wong

External Research

Microsoft Research

WorldWide Telescope: a UIS from Microsoft Research [UIS=Universe Information System]

Seamless *Data/Literature Connections* (e.g. ADS)

"*Modular Craftsmanship*" (e.g. flickr)

Collections, Communities & *Guided Tours*

The World Wide Telescope
an Archetype for Online-Science

Jim Gray (Microsoft)

Alex Szalay (Johns Hopkins University)

Microsoft Academic Days in Silicon Valley

http://research.microsoft.com/~gray/talks

Created by Curtis Wong and Jonathan Fay at MSR; AG is "Academic Partner" on the WWT Project

The (US) Backstory

2001 ················ 2008 (2010)

Science New

$10 Million N

ScienceDaily (Oc
its users the worl
research institutio
starting an ambiti
universe online.

See Also: (NVO), headed by astronomer Alex

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, Un
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
of Technology

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Upcoming Due Dates
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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

CONTACTS

Name	Email
Nigel Sharp	nsharp@nsf.gov
Eileen D. Friel	efriel@nsf.gov

PROGRAM GUIDELINES

Solicitation 08-537

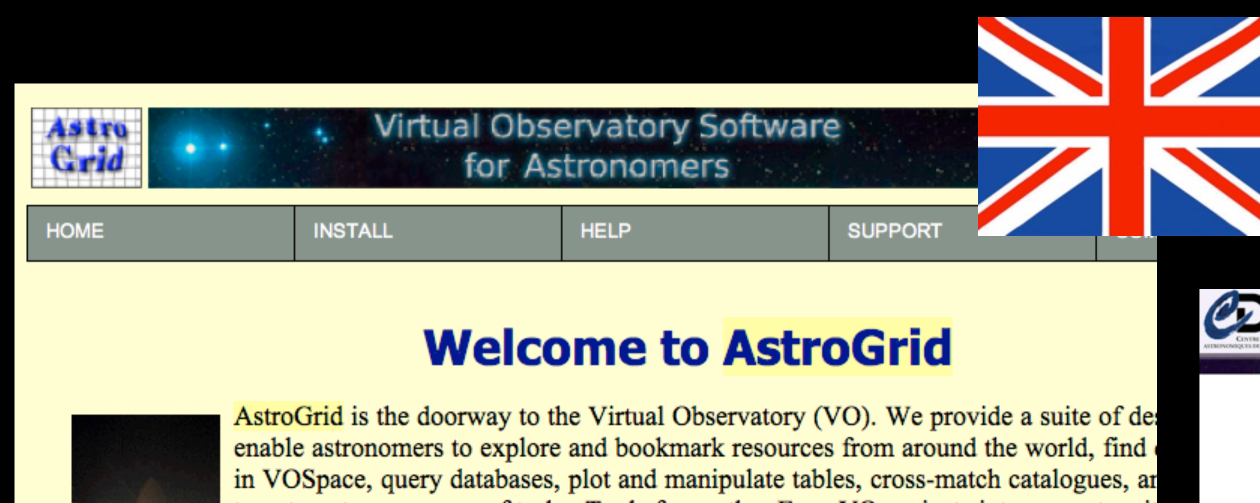
Please be advised that the NSF Proposal & Award Policies & Procedure (PAPPG) includes revised guidelines to implement the mentoring pro the America COMPETES Act (ACA) (Pub. L. No. 110-69, Aug. 9, 2007.) specified in the ACA, each proposal that requests funding to support postdoctoral researchers must include a description of the mentoring that will be provided for such individuals. Proposals that do not comp 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)

NVO
. . . the Universe at your fingertips

VAO
VIRTUAL ASTRONOMICAL OBSERVATORY

and meanwhile…



+ IVOA

IVOA

RVO

Astro Grid

Aus-VO

VObs.it

vo-i

CVO

SVO
Spanish Virtual Observatory

ArVO
Armenian Virtual Observatory

China-VO

EURO VO

France

GERMAN ASTROPHYSICAL
GAVO
VIRTUAL OBSERVATORY

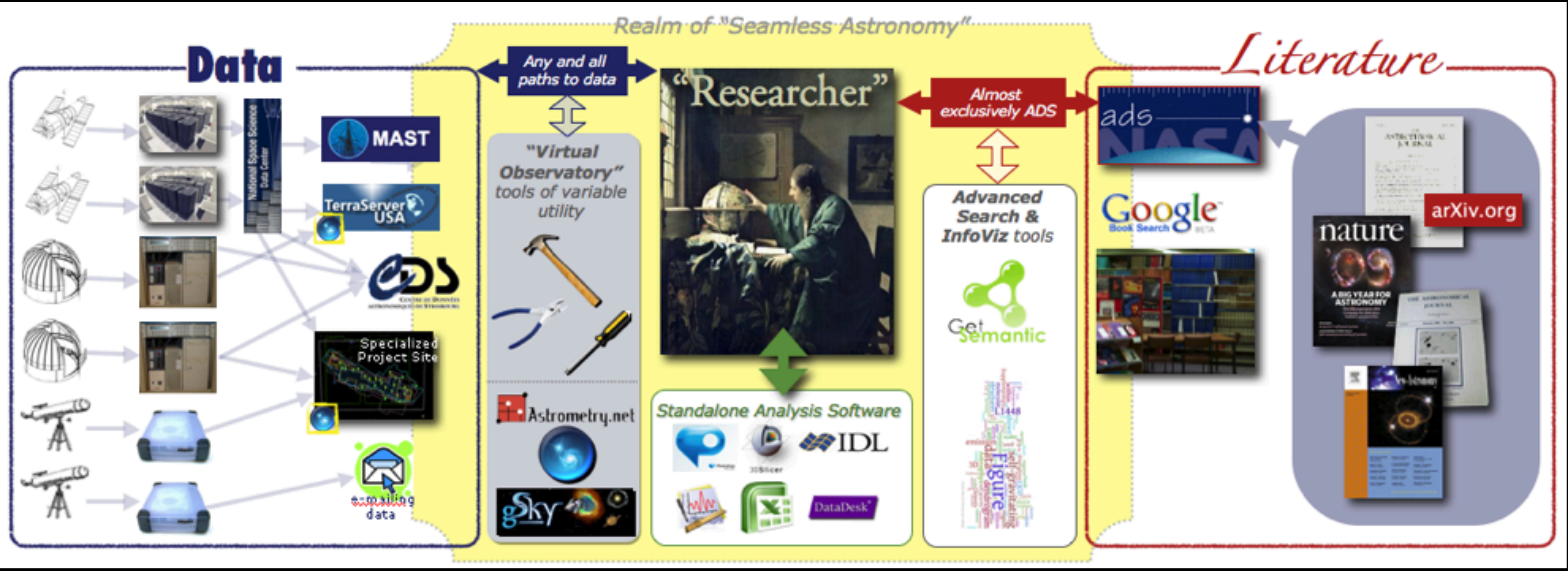
HVO
Hungarian Virtual Observatory

JVO

NVO
NATIONAL VIRTUAL OBSERVATORY

BRAVO

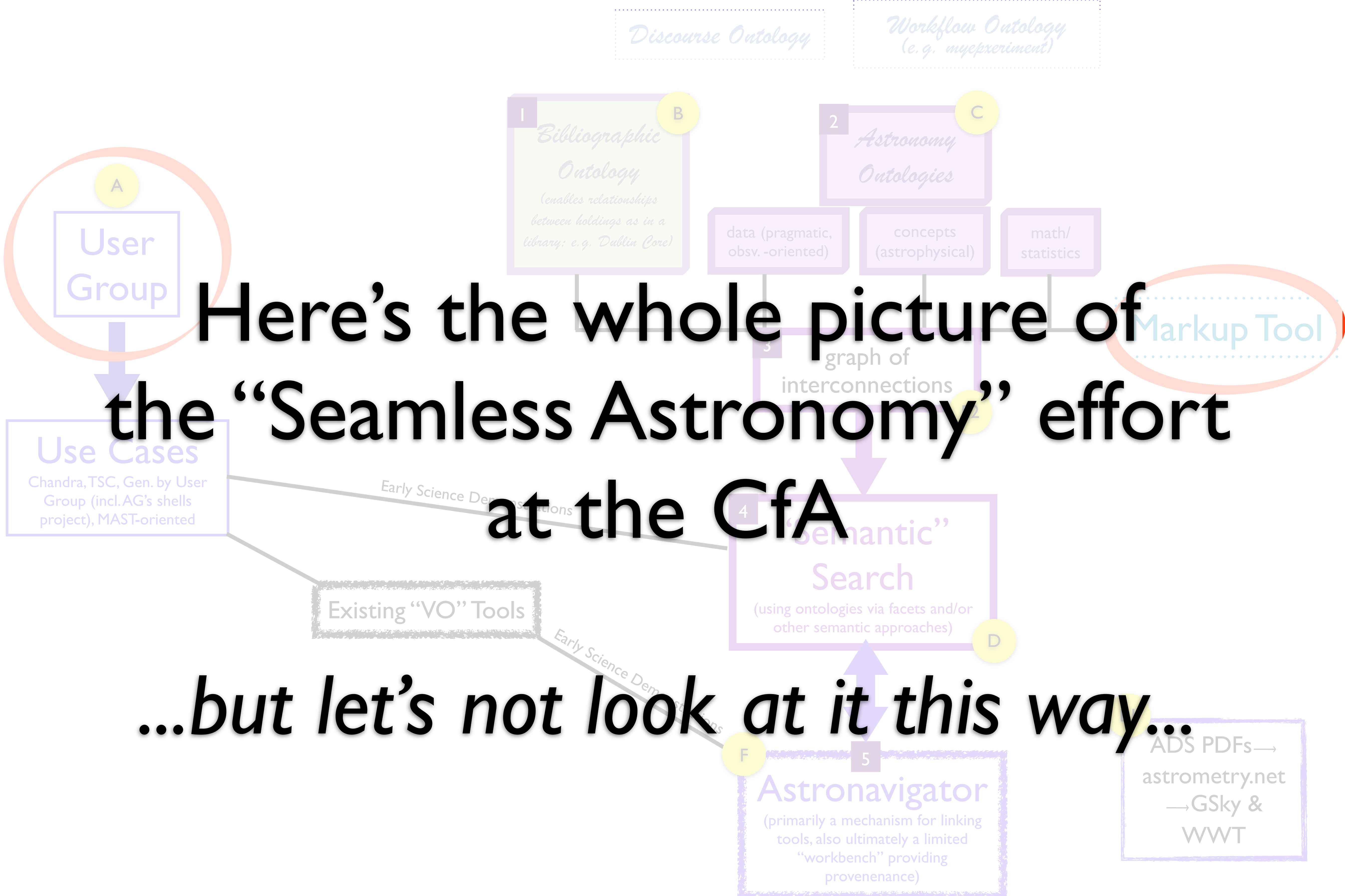
Seamless Astronomy



But, that was 2009...

Here's the whole picture of the "Seamless Astronomy" effort at the CfA

...but let's not look at it this way...




Realm of "Seamless Astronomy"
2010
Evermore
Seamless
Astronomy
Data
"Researcher"
Advanced Search & InfoViz tools
Get Semantic
arXiv.org
nature
A BIG YEAR FOR ASTRONOMY
THE ASTROPHYSICAL JOURNAL
THE ASTRONOMICAL JOURNAL
New Astronomy
Astrometry.net
gSky
Literature
Standalone Analysis Software
3DSlicer
IDL
DataDesk

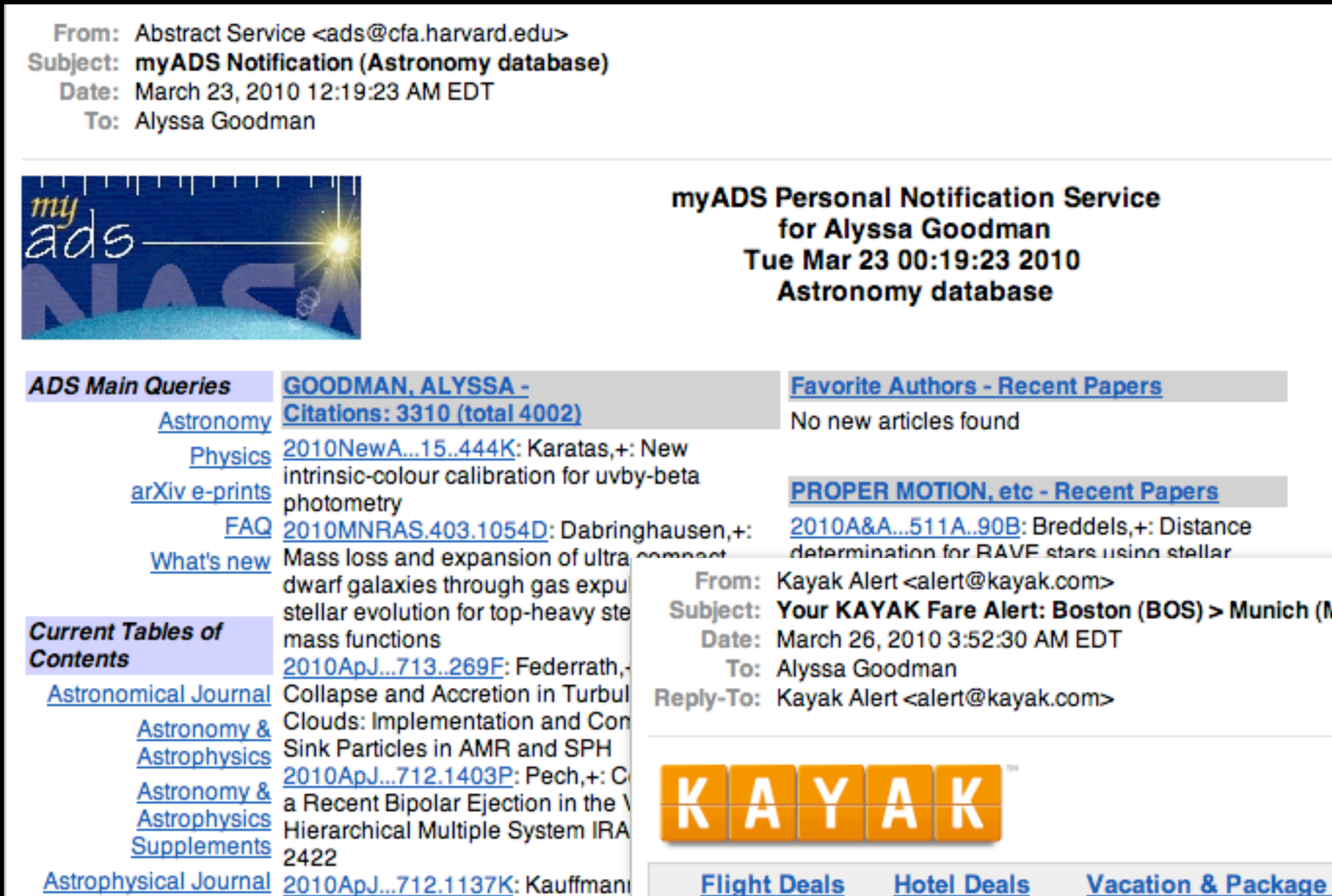
This simple argument, first made at the 2009 WWT session at AAS, seems to be working:

"Astronomy research tools should work as seamlessly as travel research tools."

"Astronomy research tools should work as seamlessly as travel research tools."

When the concept of a **"Virtual Observatory" (VO)** was first discussed by future-looking astronomers in the mid-1990s, all thoughts were about **distributed data** and a **common system** to access it. But, information access on today's web primarily works in the **reverse**: **distributed tools** accessing **common data centers**. Capability and ease-of-use improvements to the web typically now come in the form of **nesting, aggregating or connecting tools.** Think **kayak.com**, iGoogle, or Bing Maps. In the "Seamless Astronomy" view to be discussed, today's "VO" should be thought of as the **ever-improving set** of **data archives, tools, interconnections,** and **standards** that strive to make astronomical research as "seamless" as travel research. The good news is that the cutting-edge of the astronomical research environment is moving rapidly in this seamless direction. The most savvy institutions are beginning to realize that the original VO model of data distributed on thousands of individual researchers' desktop hard drives is not a sustainable model, and that they need to offer **data hosting, archiving, and stewardship** services the way libraries offer such services for printed matter. **Software tools** are becoming much more **interoperable** thanks to protocols for message-passing such as "**SAMP**." And, the improved speed of **web applications** is to some extent removing platform-dependence as an obstacle to programmers and users alike. The bad news is that **most astronomers are largely unaware** of the tools that this new nirvana offers, and instead still conduct online research in the same way they did a decade ago. In this talk, I will focus in particular on how our recent work on connecting Microsoft's **WorldWide Telescope** program to other commonly-used astronomical research tools--most notably literature searching tools--has made the astronomical research environment more seamless. More generally, I will emphasize and demonstrate that an **ever-increasing diversity of tools** allow researchers to carry out a particular research task, so that the **important research** for the future lies in figuring out **how to make the tools, their interconnections, and their connections to data and literature resources useful and well-known to the astronomical community.**

(Abstract of the *Evermore Seamless Astronomy* presentation by A. Goodman at the Microsoft External Research Symposium, April 2010.)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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 expu[...] stellar evolution for top-heavy ste[...] mass functions
2010ApJ...713..269F: Federrath,-[...] Collapse and Accretion in Turbul[...] Clouds: Implementation and Con[...] Sink Particles in AMR and SPH
2010ApJ...712.1403P: Pech,+: C[...] a Recent Bipolar Ejection in the [...] Hierarchical Multiple System IRA[...] 2422
2010ApJ...712.1137K: Kauffman[...]

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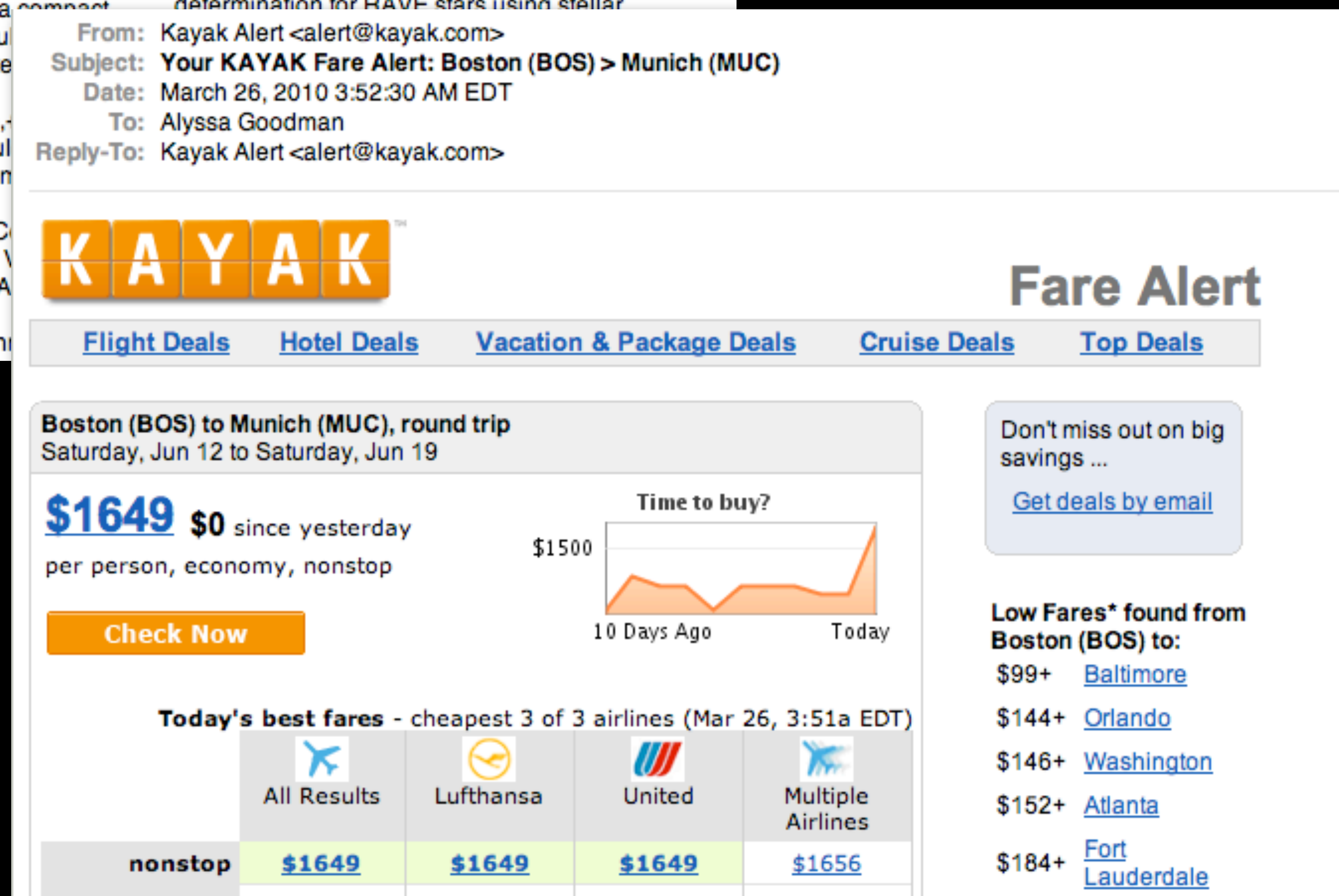
From: Kayak Alert <alert@kayak.com>
Subject: **Your KAYAK Fare Alert: Boston (BOS) > Munich (MUC)**
Date: March 26, 2010 3:52:30 AM EDT
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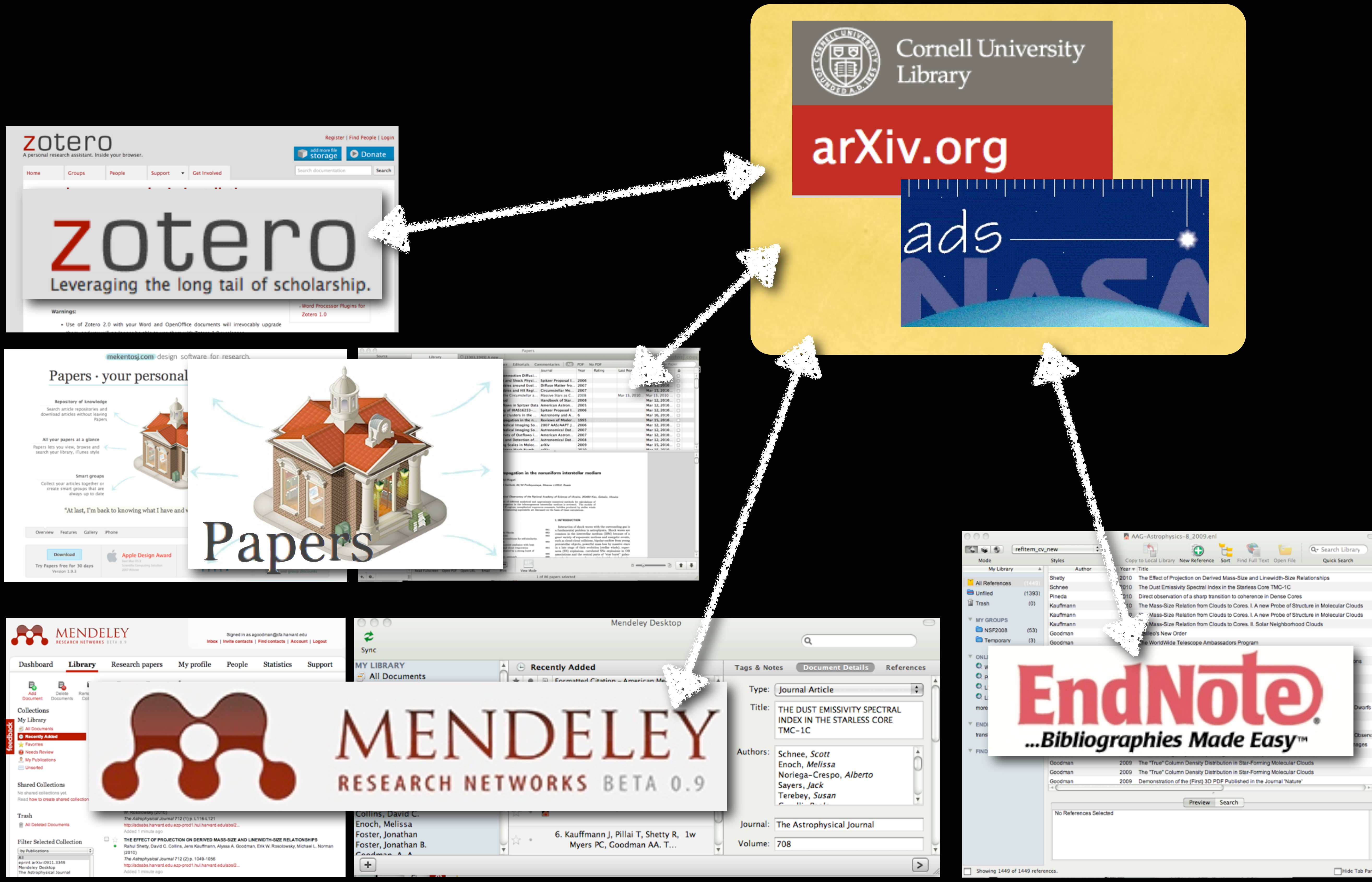
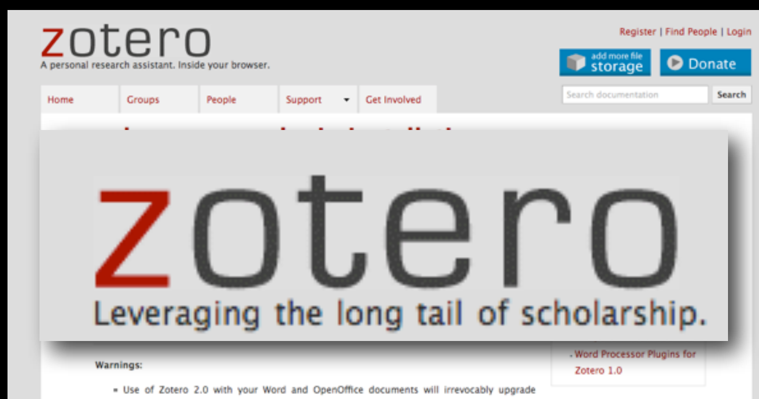
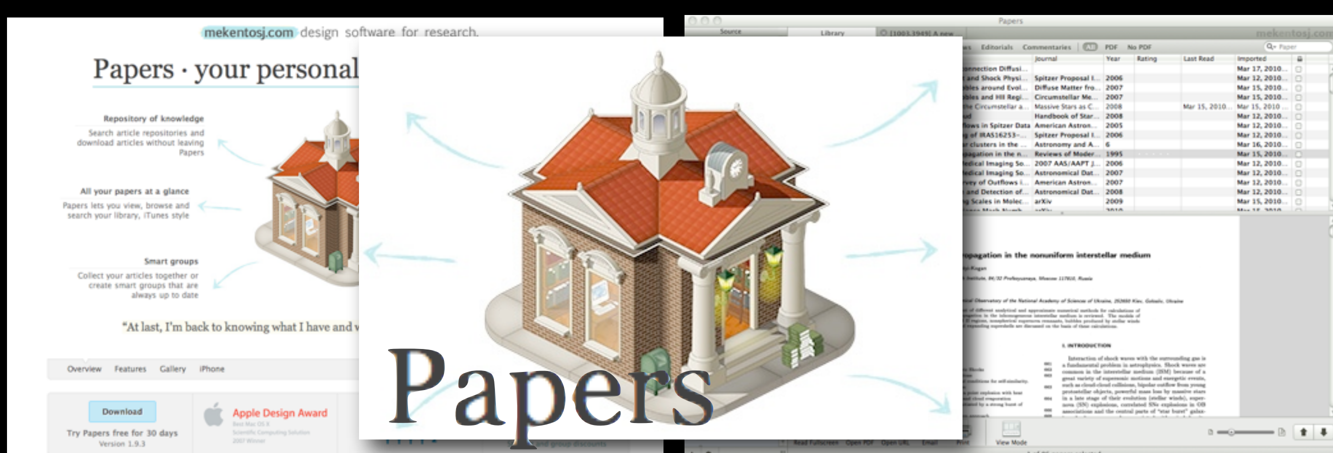
Astronomers can see parallels...

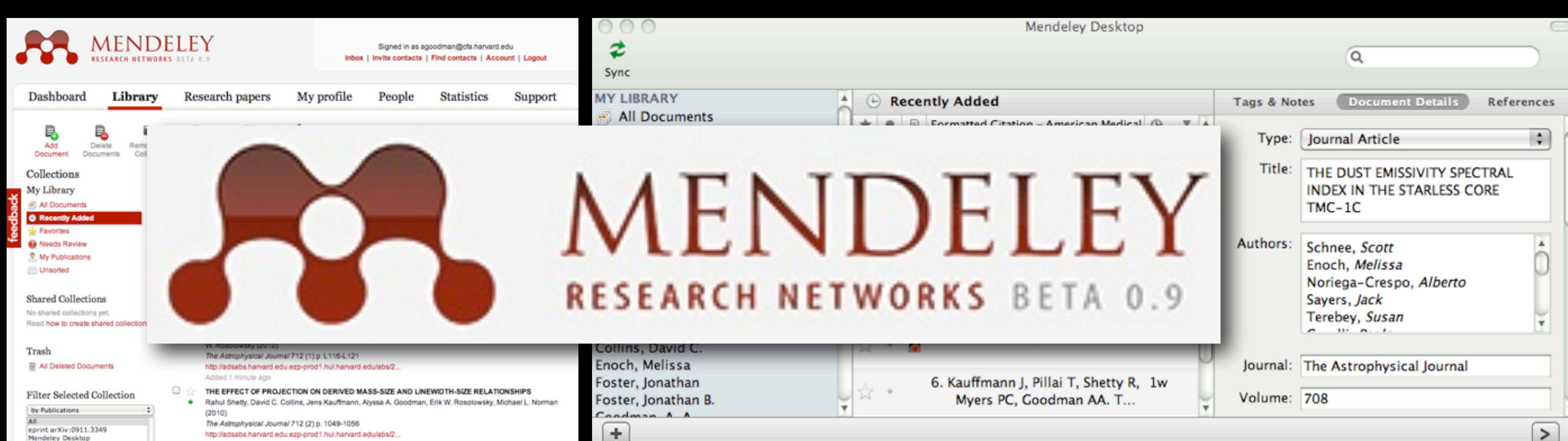
Literature Handling: *Diverse Apps, Common Data*

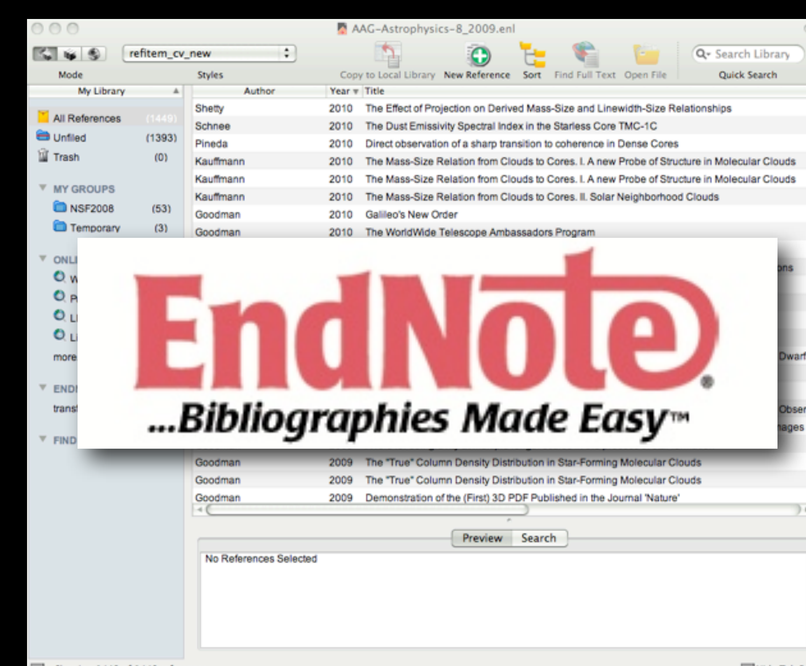


What fraction of astronomy researchers know about these tools?









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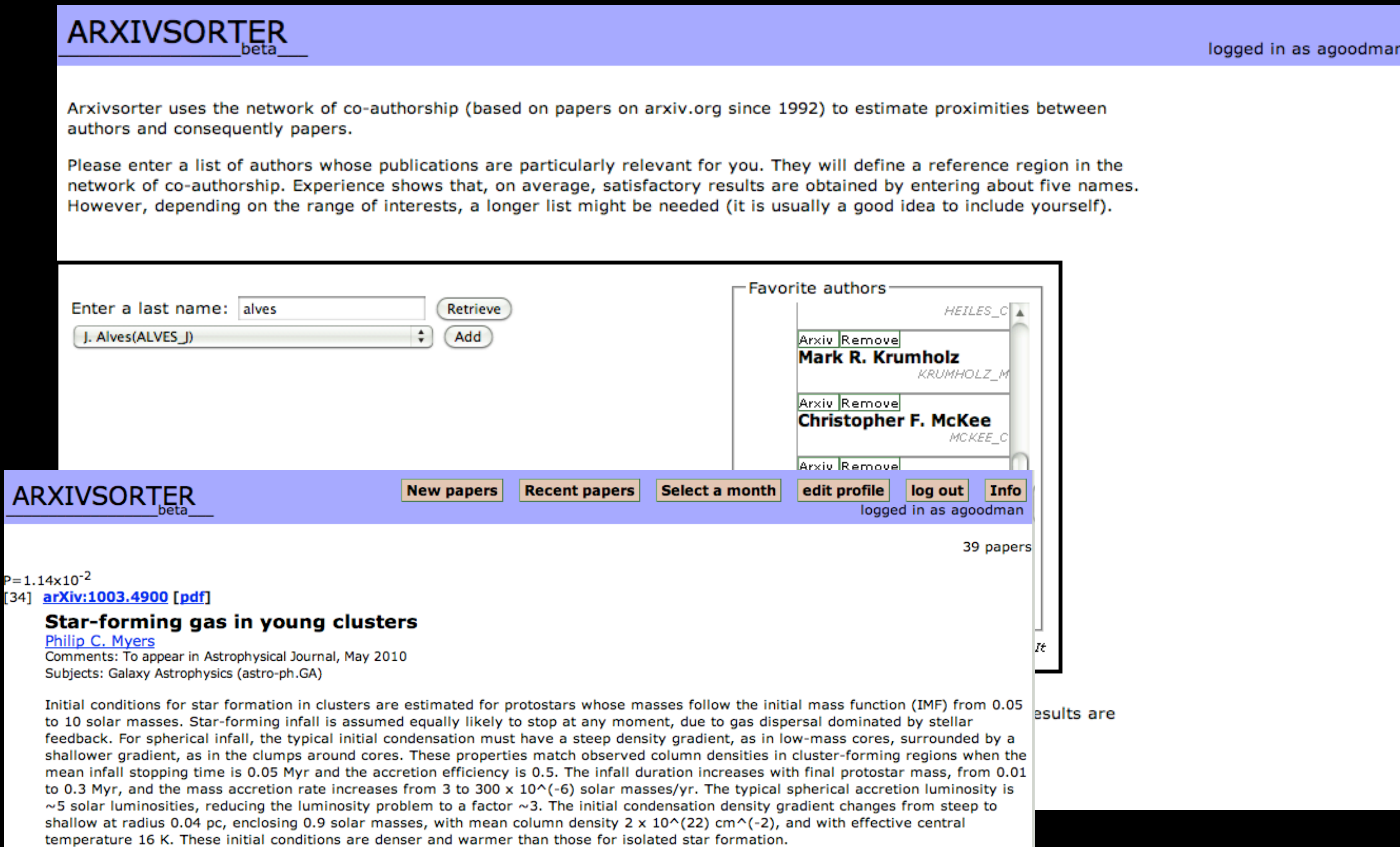
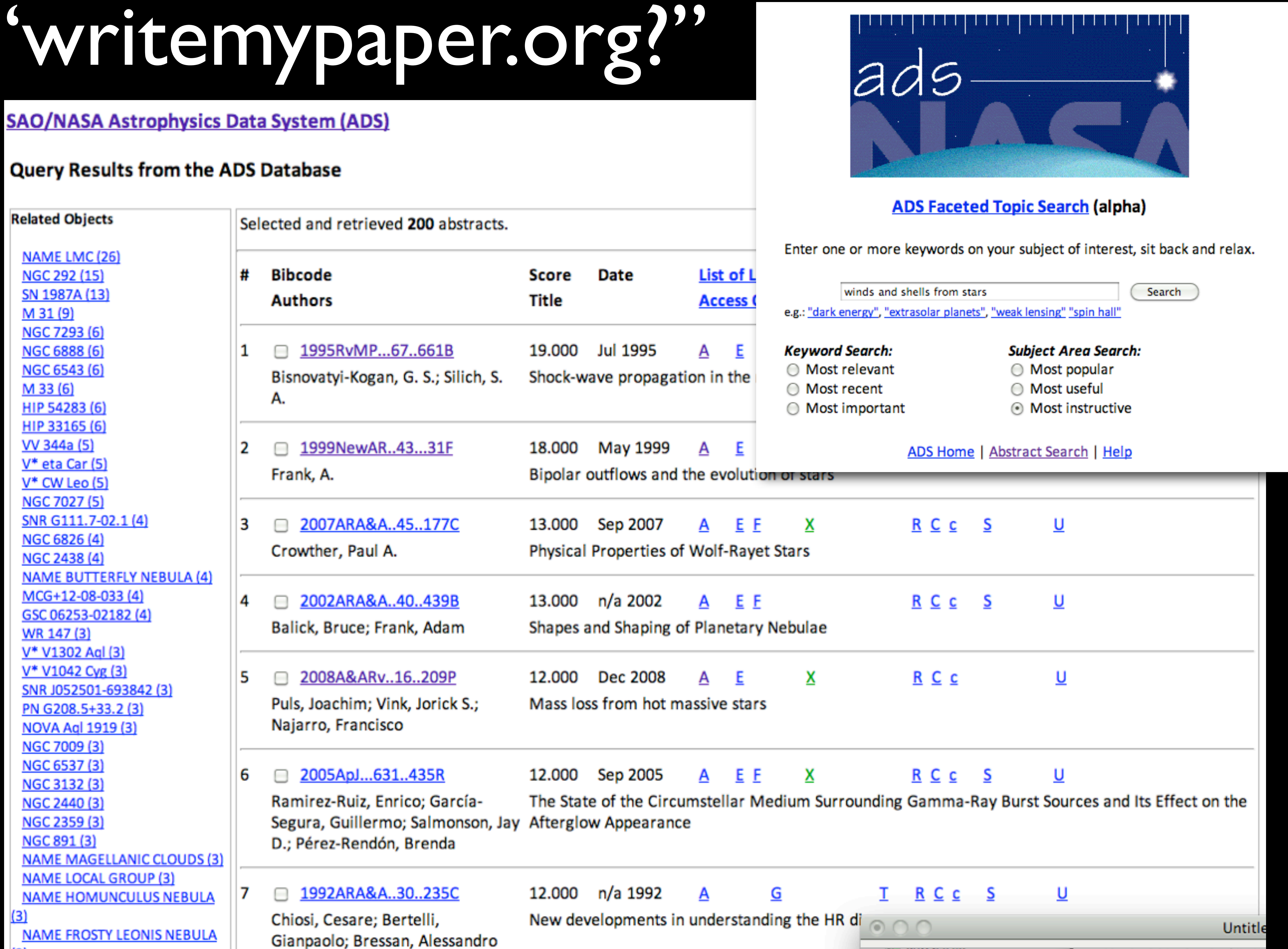


“writemypaper.org?”



This page generated using ADS faceted Search, as developed by Michael Kurtz, Alberto Accomazzi & Jonathan Fay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Plot Results
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J2000
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1 of 2
NGC7023
Finder Scope
Classification:
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in Cepheus
NGC 7023
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Dec: 68 : 10 : 11
Alt: 30 : 55 : 38
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Magnitude: n/a
Distance: n/a
Rise: Circumpolar
Transit: Circumpolar
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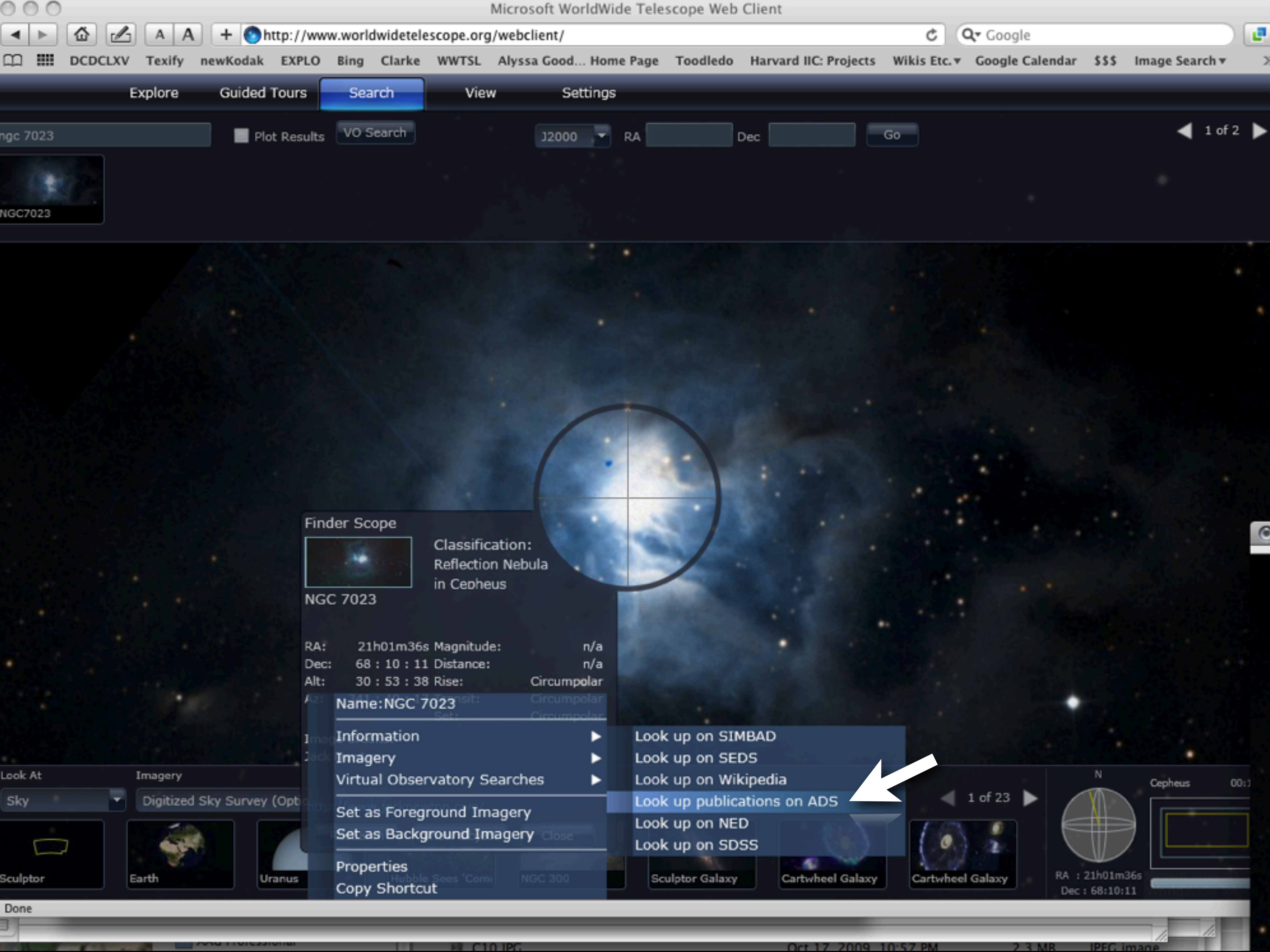
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Rise: Circumpolar
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Object Query Results

http://adsabs.harvard.edu/cgi-bin/abs_connect?db_key=AST&sim_query=YES&object=NGC%207

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SAO/NASA Astrophysics Data System (ADS)

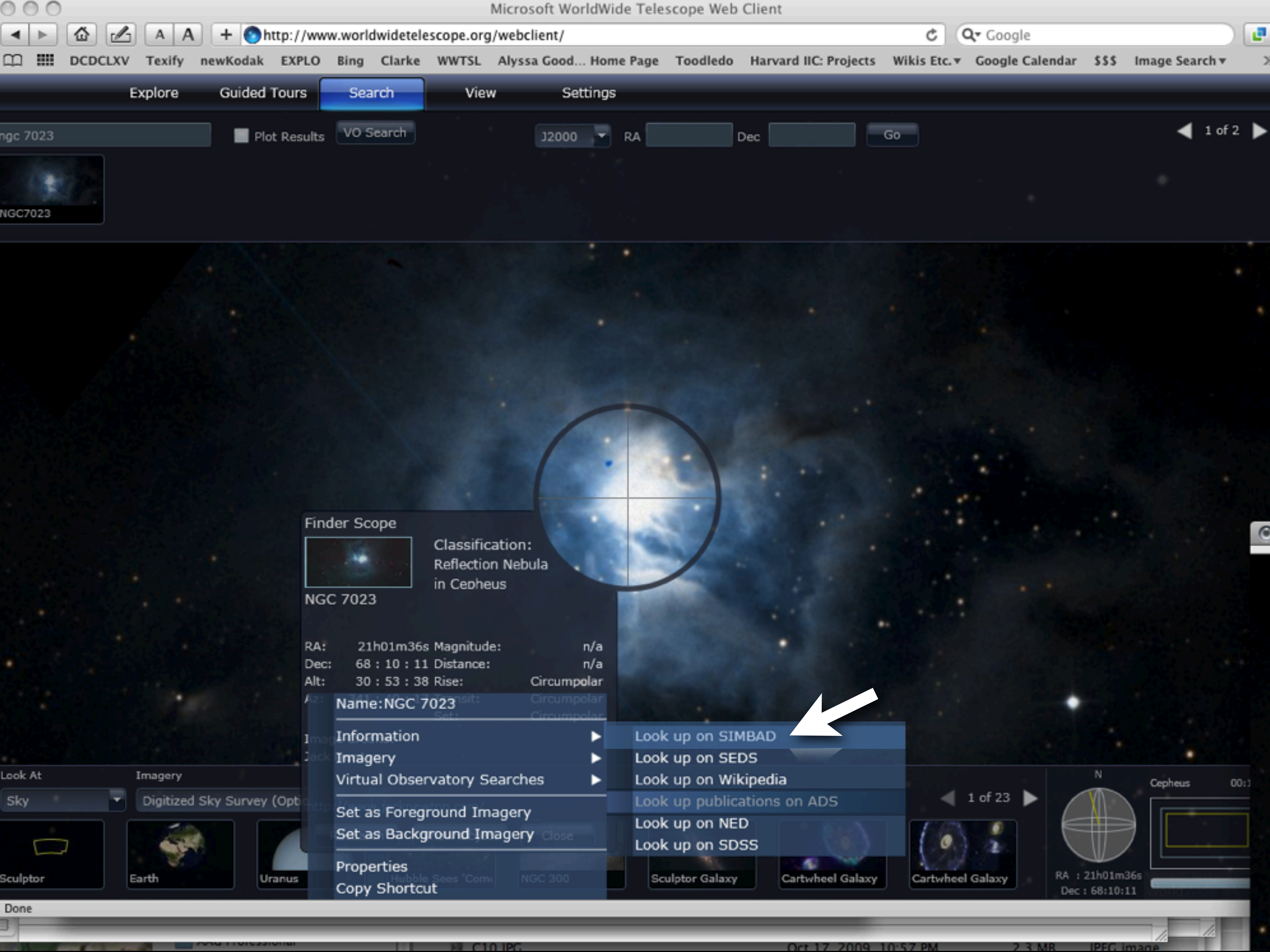
Query Results from the Astronomy Database

Go to bottom of page

Retrieved **200** abstracts, starting with number **1**. Total number selected: **393**.

Sort options

#	Bibcode / Authors	Score	Date / Title	List of Links / Access Control Help
1	2009ApJ...700.1609M Myers, Philip C.	1.000	08/2009 Filamentary Structure of Star-forming Complexes	A Z E F L X R C S U
2	2009ApJ...700.1190D Desai, Vandana; Soifer, B. T.; Dey, Arjun; LeFloc'h, Emeric; Armus, Lee; Brand, Kate; Brown, Michael J. I.; Brodwin, Mark; Jannuzi, Buell T.; Houck, James R.; and 8 coauthors	1.000	08/2009 Strong Polycyclic Aromatic Hydrocarbon Emission from z ≈ 2 ULIRGs	A Z E F L X R C S U
3	2009MNRAS.396.1851N Nutter, D.; Stamatellos, D.; Ward-Thompson, D.	1.000	07/2009 The initial conditions of isolated star formation - IX. Akari mapping of an externally heated pre-stellar core	A Z E F L X R S U
4	2009A&A...502..175B Boersma, C.; Peeters, E.; Martín-Hernández, N. L.; van der Wolk, G.; Verhoeff, A. P.; Tielens, A. G. G. M.; Waters, L. B. F. M.; Pel, J. W.	1.000	07/2009 A spatial study of the mid-IR emission features in four Herbig Ae/Be stars	A Z E F L R S U
5	2009MNRAS.395.1695H Hernán-Caballero, A.; Pérez-Fournon, I.; Hatziminaoglou, E.; Afonso-Luis, A.; Rowan-Robinson, M.; Rigopoulou, D.; Farrah, D.; Lonsdale, C. J.; Babbedge, T.;	1.000	05/2009 Mid-infrared spectroscopy of infrared-luminous galaxies at z ~ 0.5-3	A Z E F L X R C S U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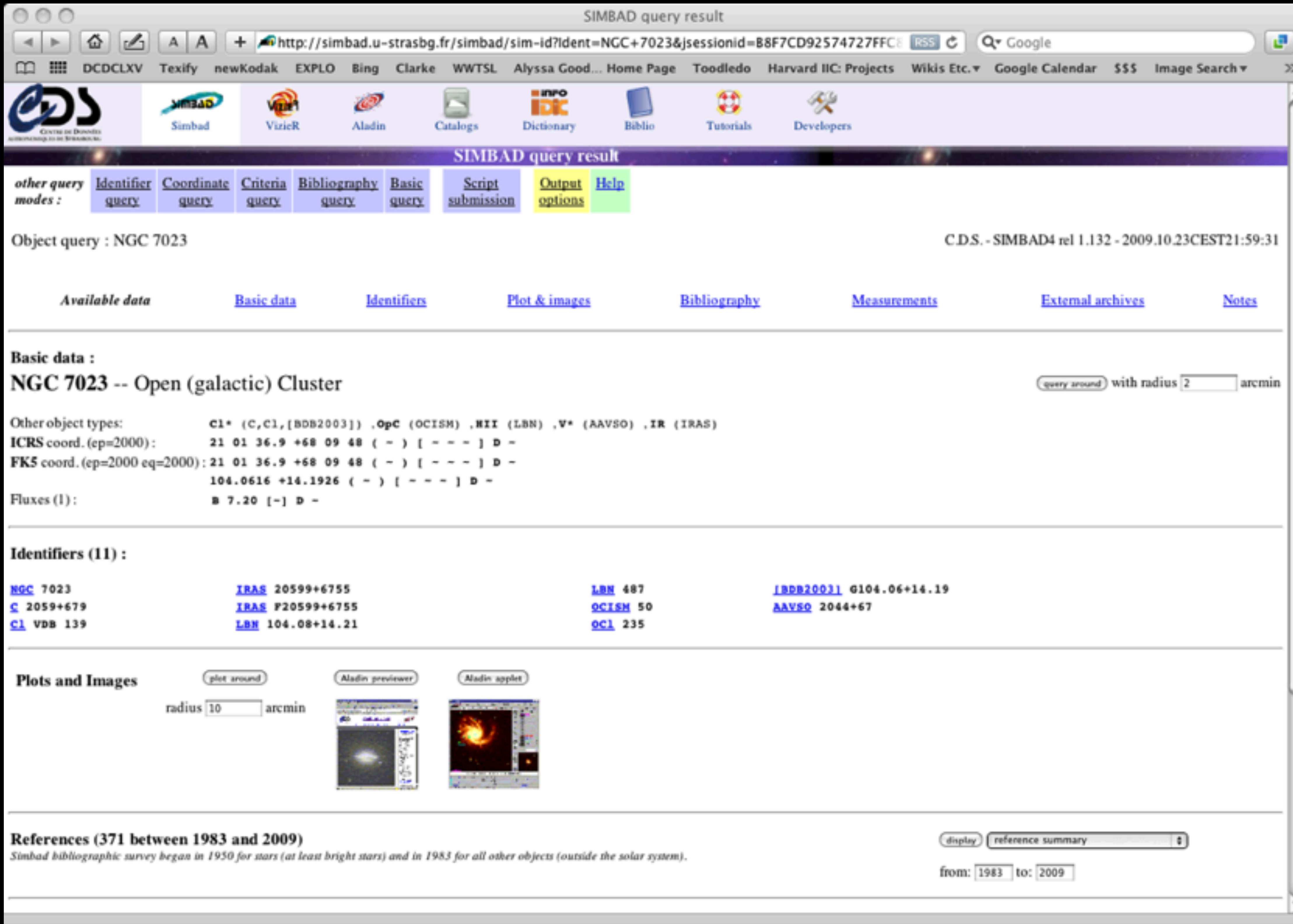
SIMBAD query result
http://simbad.u-strasbg.fr/simbad/sim-id?Ident=NGC+7023&jsessionid=B8F7CD92574727FFC
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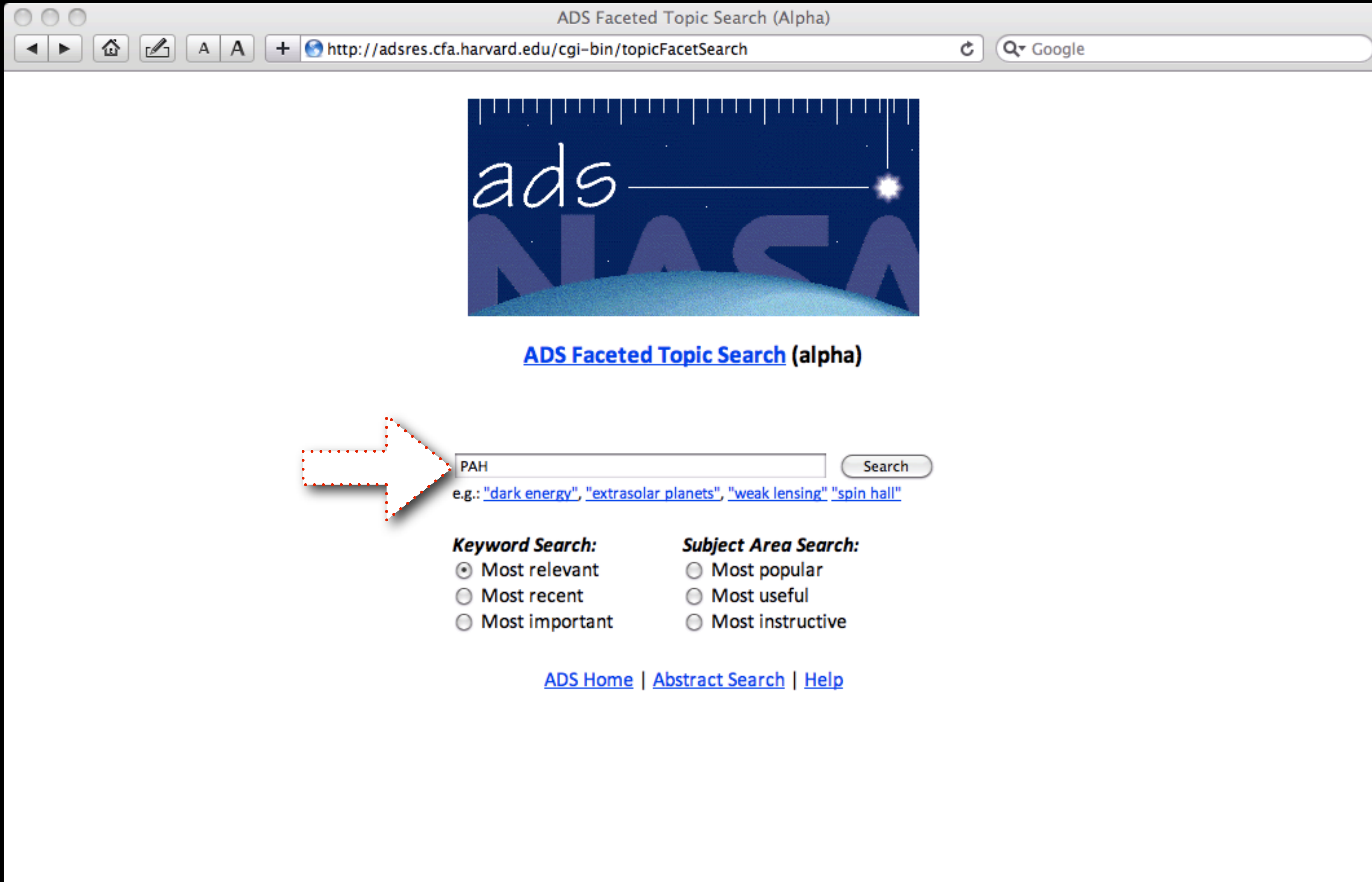
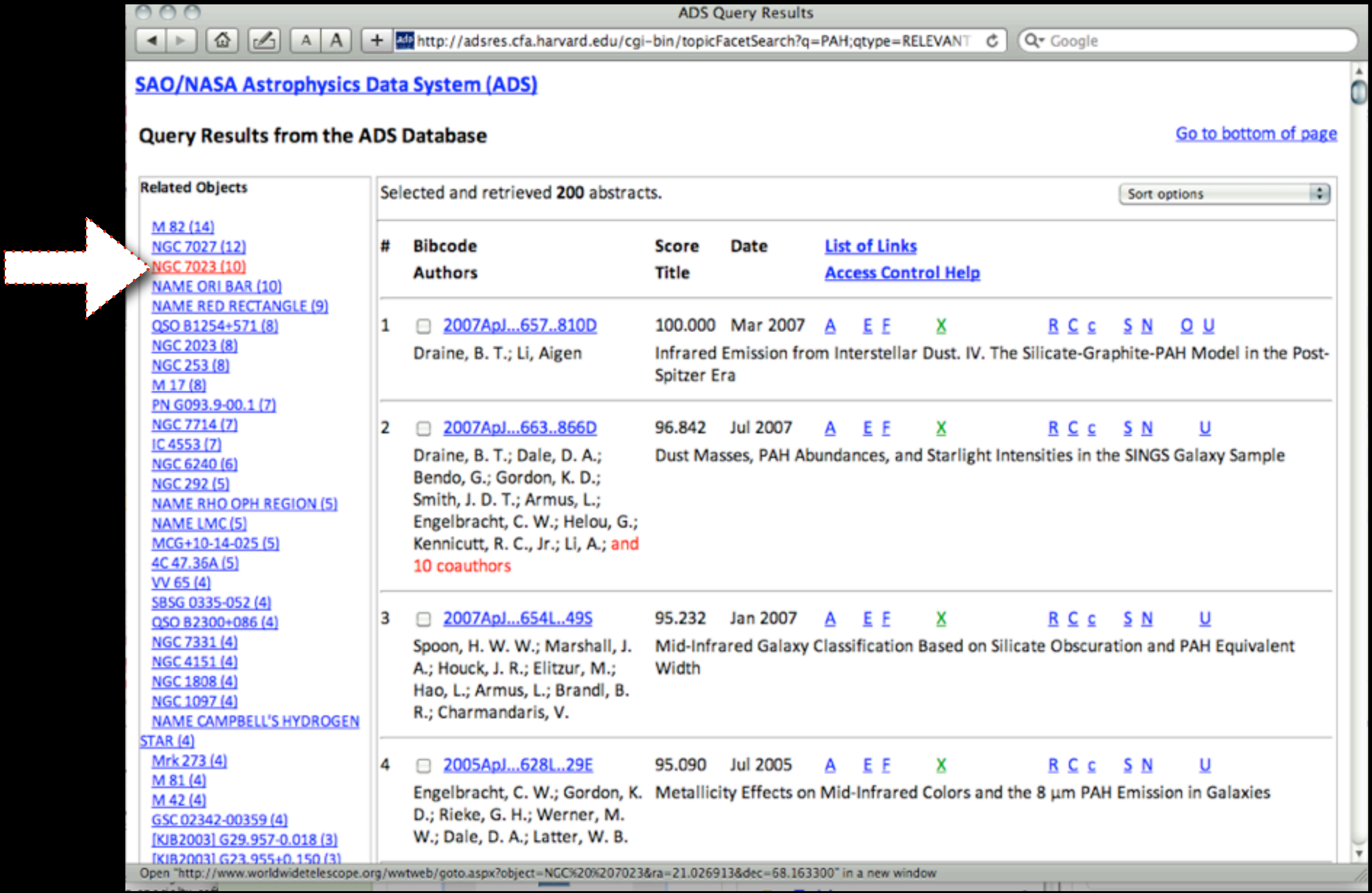
Simbad VizieR Aladin Catalogs Dictionary Biblio Tutorials Developers
SIMBAD query result
other query modes : Identifier query Coordinate query Criteria query Bibliography query Basic query Script submission Output options Help
Object query : NGC 7023
C.D.S. - SIMBAD4 rel 1.132 - 2009.10.23CEST21:59:31
Available data Basic data Identifiers Plot & images Bibliography Measurements External archives Notes
Basic data :
NGC 7023 -- Open (galactic) Cluster
query around with radius 2 arcmin
Other object types: Cl* (C,Cl,[BDB2003]) ,OpC (OCISM) ,HII (LBN) ,V* (AAVSO) ,IR (IRAS)
ICRS coord. (ep=2000) : 21 01 36.9 +68 09 48 (-) [- - -] D -
FK5 coord. (ep=2000 eq=2000) : 21 01 36.9 +68 09 48 (-) [- - -] D -
104.0616 +14.1926 (-) [- - -] D -
Fluxes (1) : B 7.20 [-] D -
Identifiers (11) :
NGC 7023
C 2059+679
Cl VDB 139
IRAS 20599+6755
IRAS F20599+6755
LBN 104.08+14.21
LBN 487
OCISM 50
OCl 235
[BDB2003] G104.06+14.19
AAVSO 2044+67
Plots and Images
plot around
radius 10 arcmin
Aladin previewer
Aladin applet
References (371 between 1983 and 2009)
Simbad bibliographic survey began in 1950 for stars (at least bright stars) and in 1983 for all other objects (outside the solar system).
display reference summary
from: 1983 to: 2009

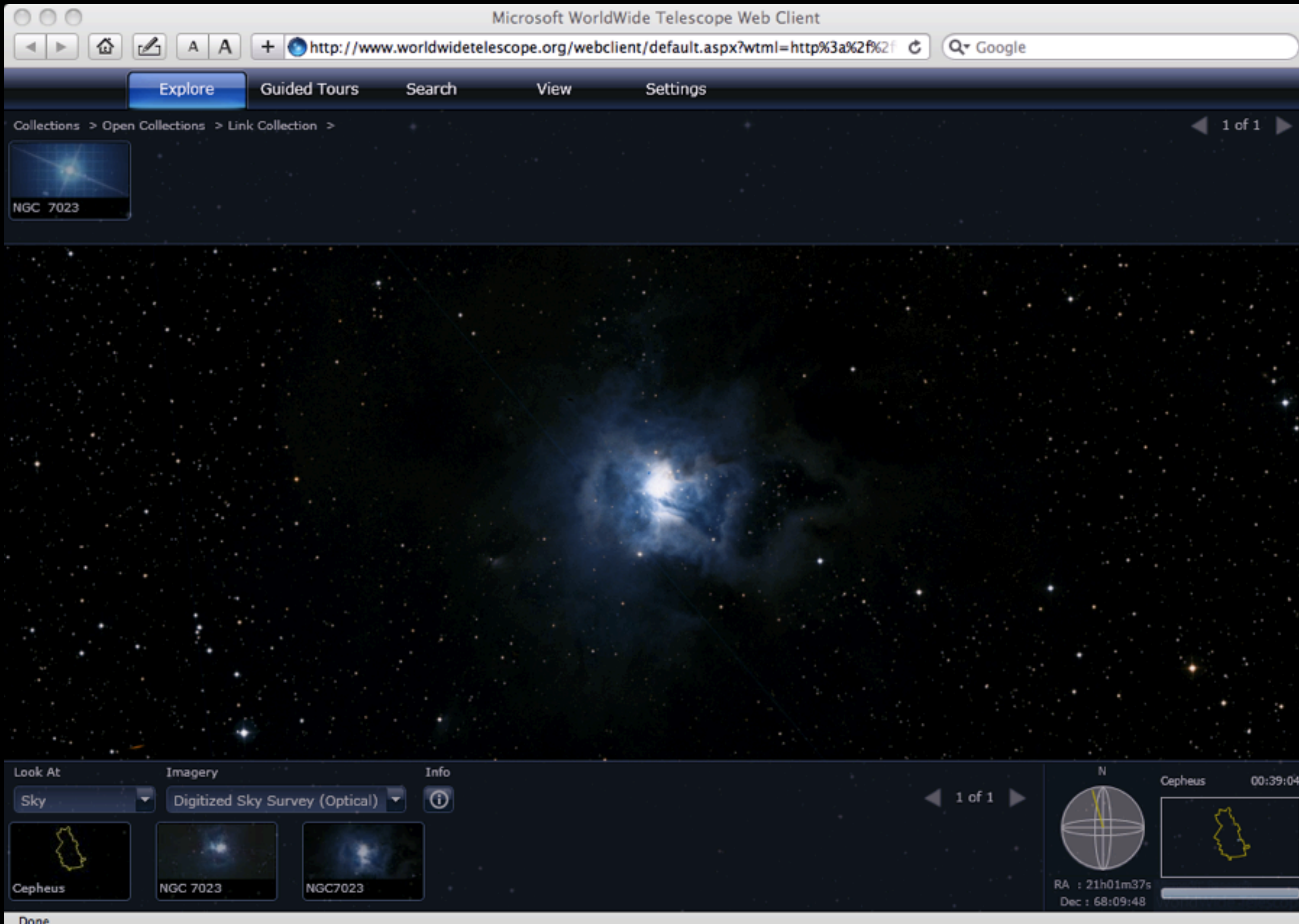


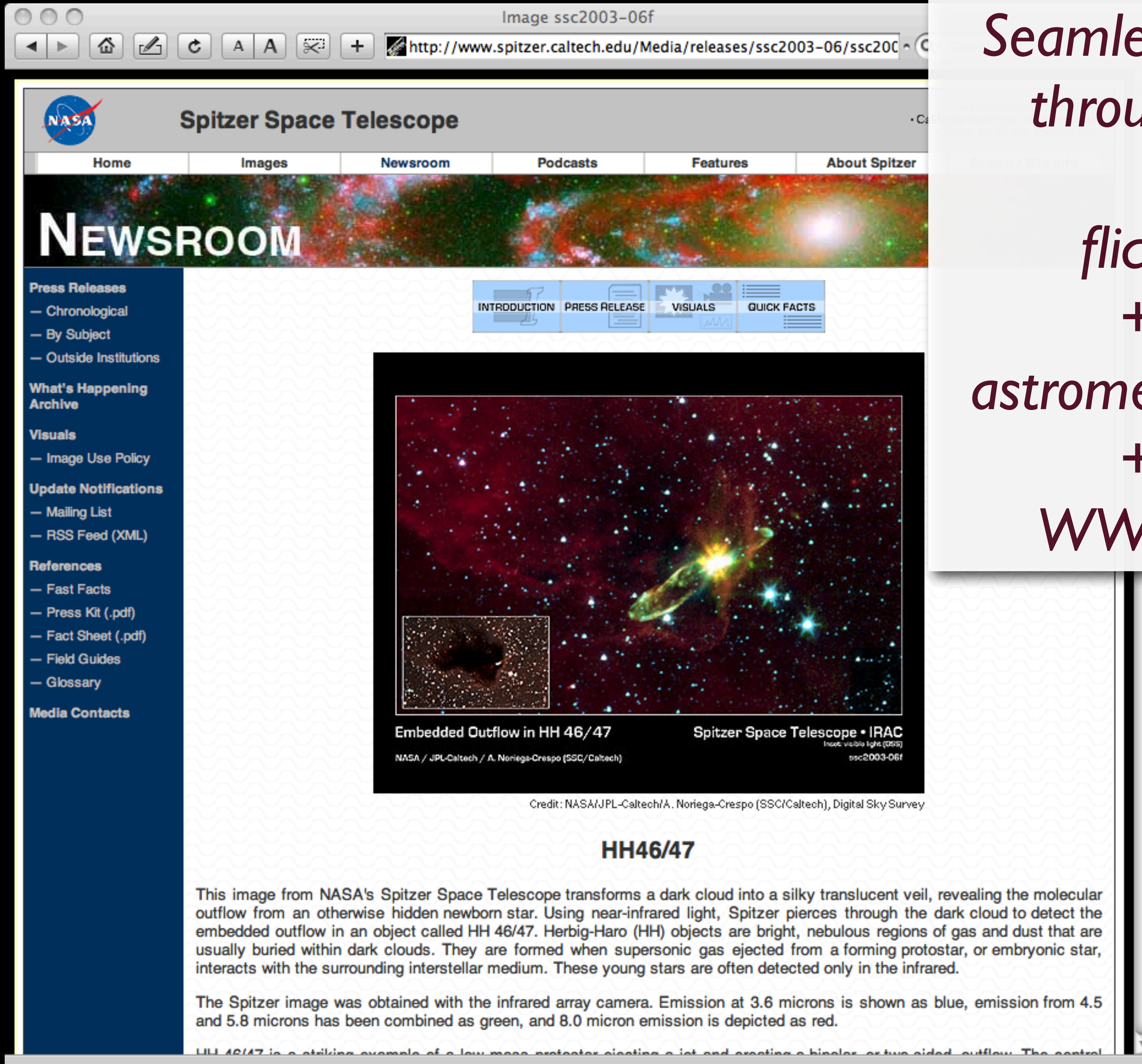
"alpha" Faceted Topic Search in ADS
(courtesy of Michael Kurtz & Alberto Accomazzi)



list of objects with links to WWT browser
(thanks to ADS team & Jonathan Fay)

And now we got to NGC 7023 by using the literature as a filter.





Seamlessness through...

flickr

+

astrometry.net

+

WWT !?

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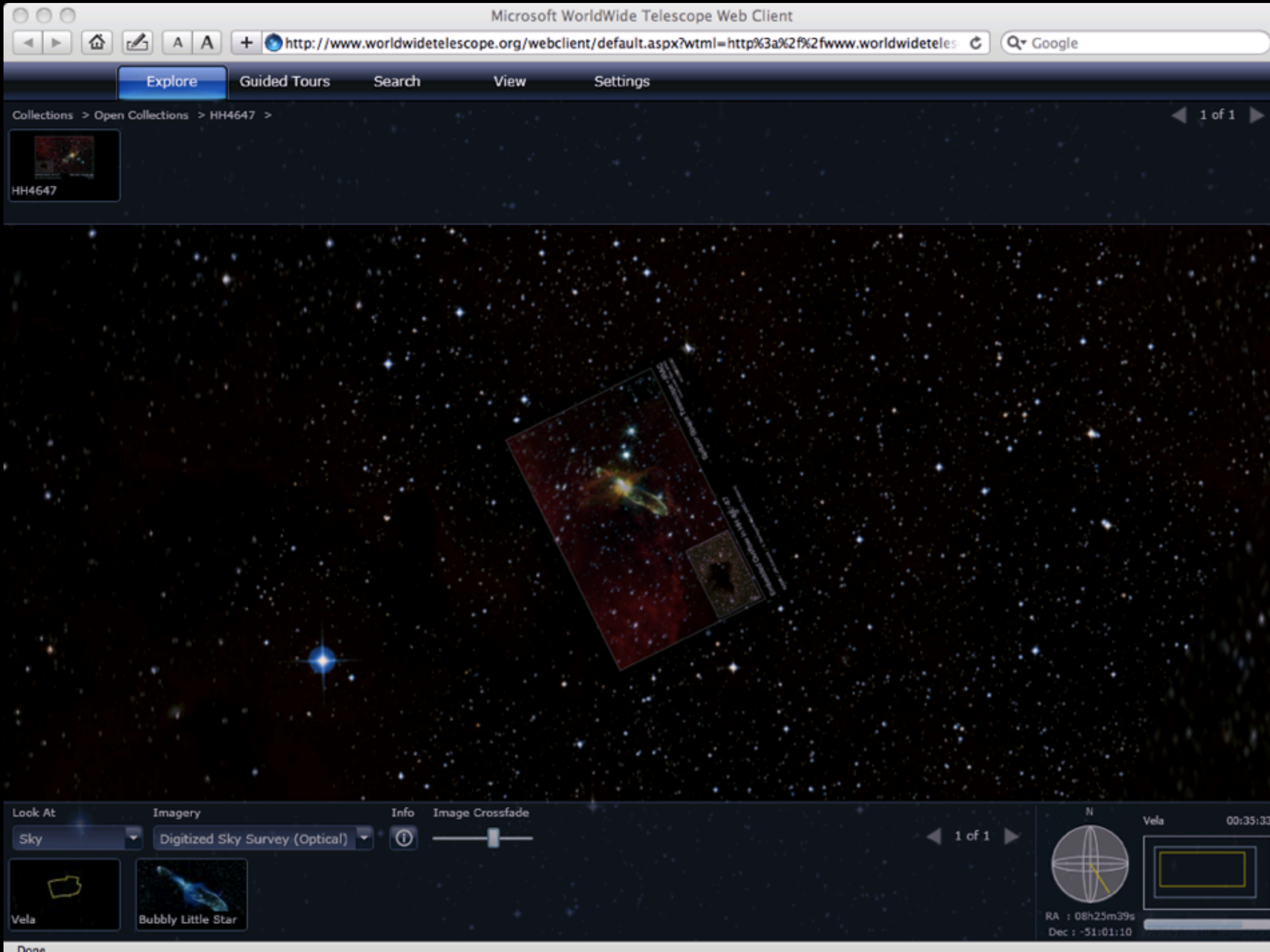
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HH4647
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Bubbly Little Star
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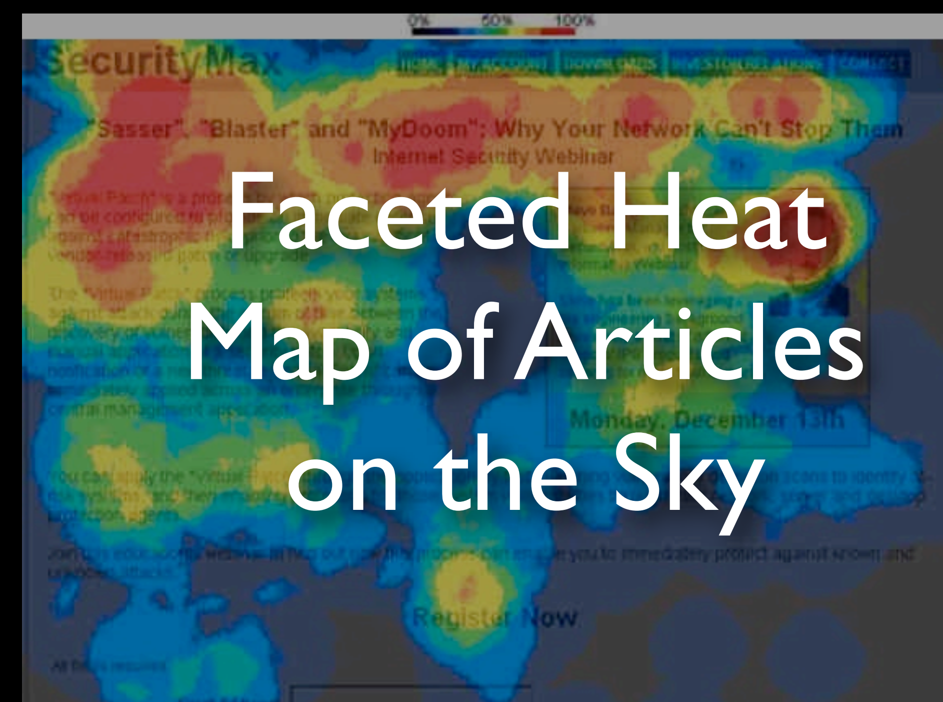
Done

Coming (Very) Soon...

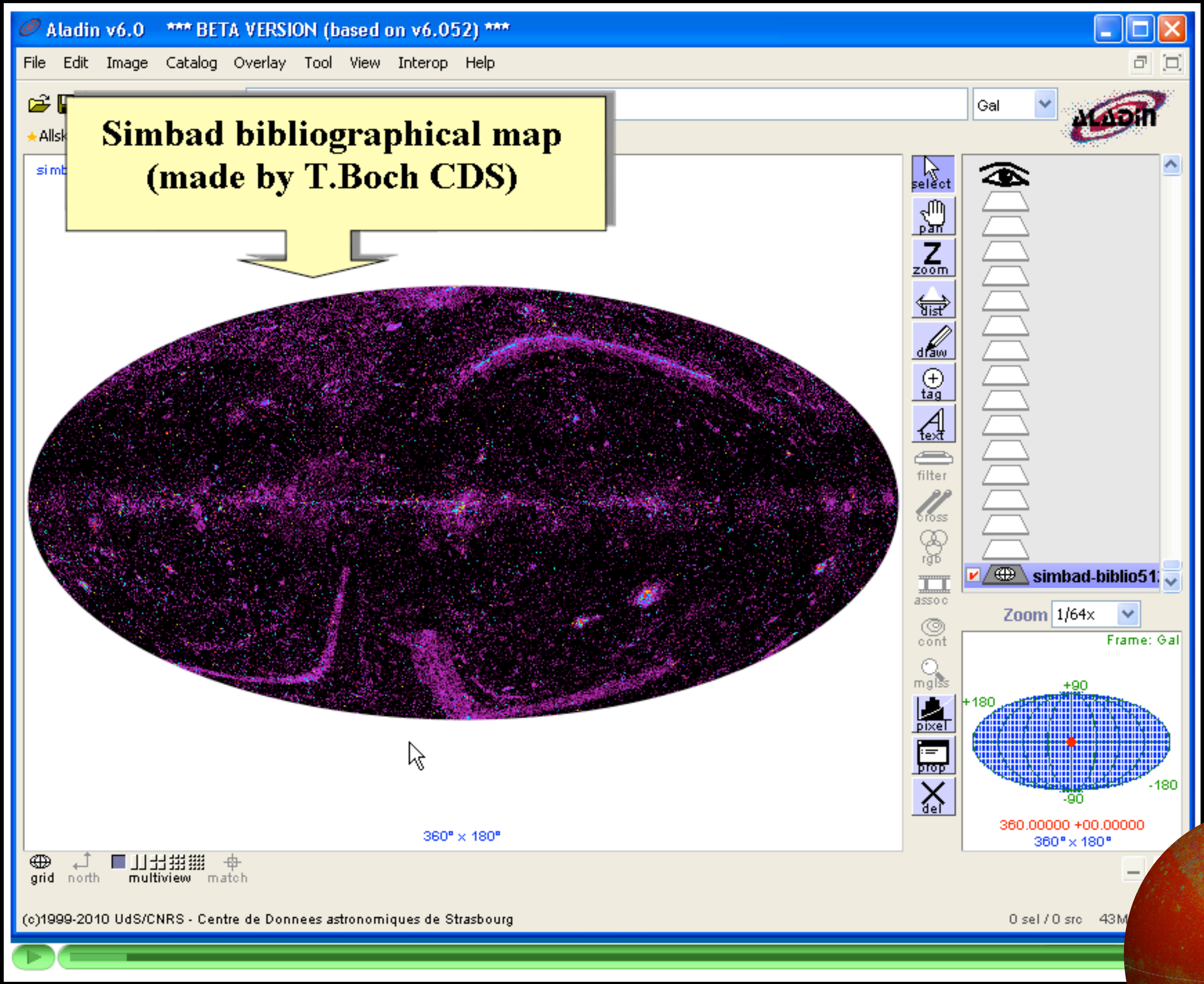
Historical Image Layer Extracted from ALL ADS holdings (using astrometry.net)

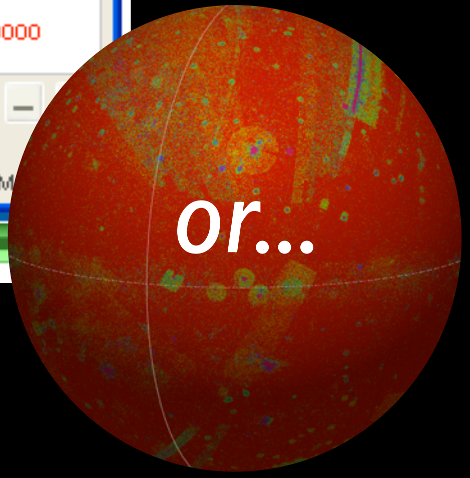


Faceted Heat Map of Articles on the Sky

[e.g. ADS-CDS-WWT]

Prototype of Articles on the Sky (April 2010)





with thanks to CDS/Pierre Fernique

The future is here... data *IN* articles

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

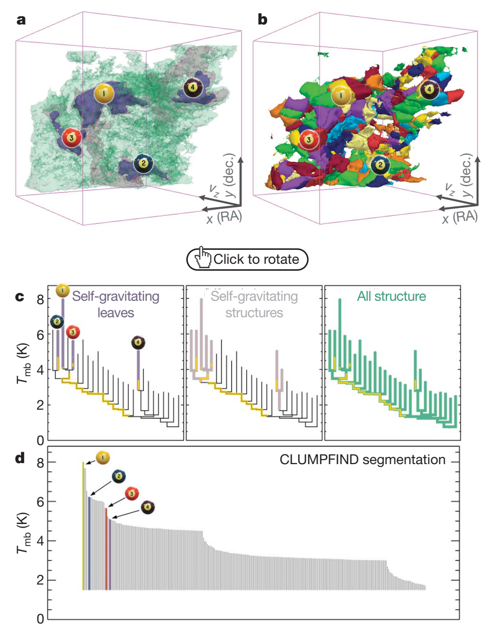


Figure 2 | Comparison of the 'dendrogram' and 'CLUMPFIND' feature-identification algorithms as applied to ^{13}CO emission from the L1448 region of Perseus. a, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating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

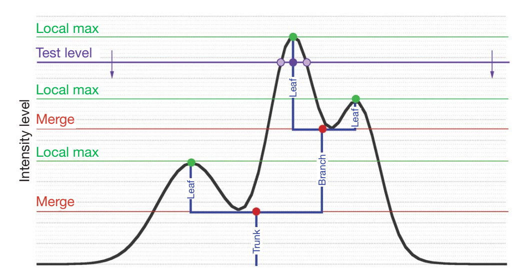


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in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

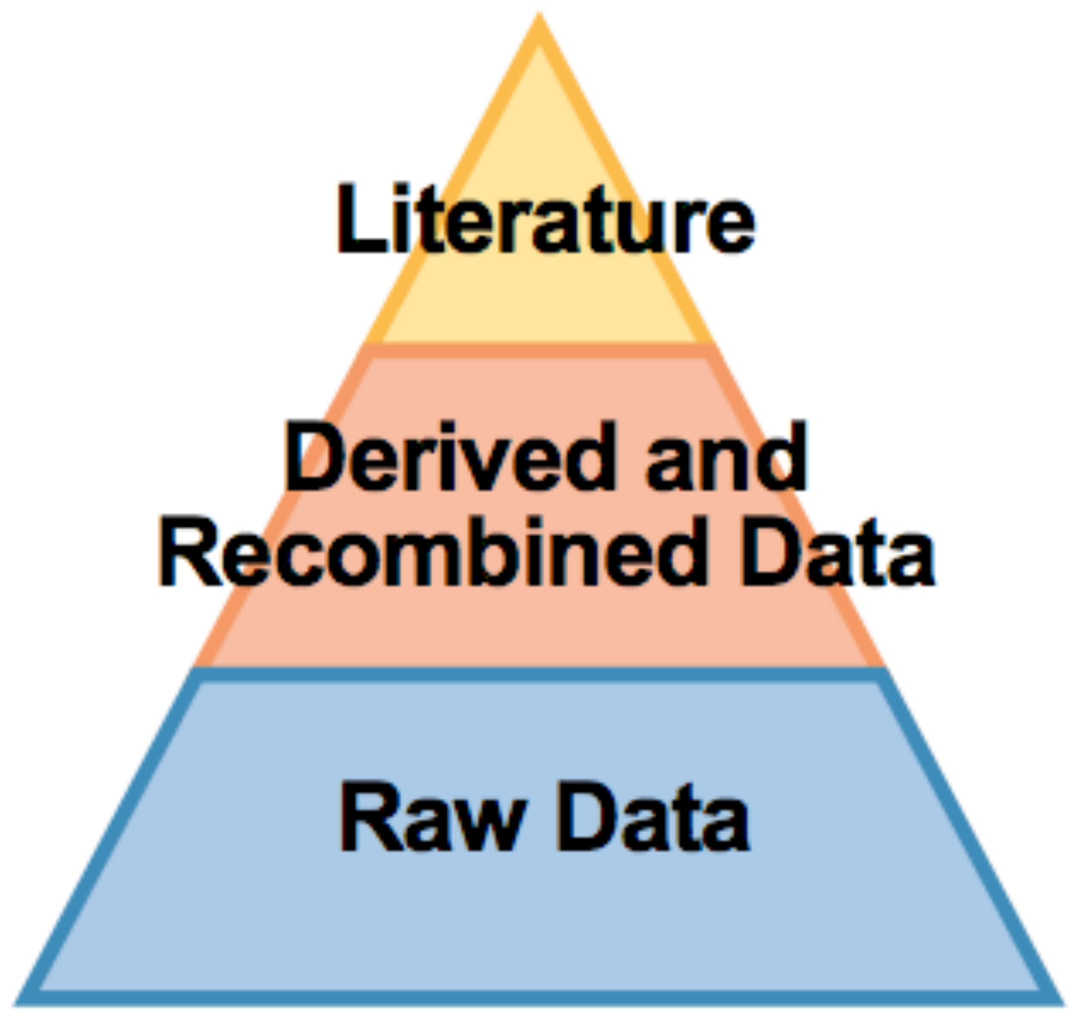
Goodman et al. *Nature*, 2009


Explore
Guided Tours
Search
Community
Telescope
View
Settings
Studies >
Carina Nebula
Wide-Field Imag...
Dumbbell Nebul...
NGC 281 Star-Fo...
"Old Data"
astrometry.net/flickr/WWT
"New Data"
WWT/ADS/SIMBAD/VAO
WWT as API
"Your Data"
"My Data"
3D PDF
Imagery
Image Crossfade
Digitized Sky Survey (Optical...
Context Search Filter
All

Jim Gray (& Alex Szalay) had it right (in 2004)

All Scientific Data Online

- Many disciplines overlap and use data from other sciences
- Internet can unify all literature and data
- Go from literature to computation to data back to literature
- Information at your fingertips for everyone-everywhere



- Increase Scientific Information Velocity
- Huge increase in Science Productivity

Jim Gray (& Alex Szalay) had it right (in 2004)

The World Wide Telescope an Archetype for Online-Science

Jim Gray (Microsoft)

Alex Szalay (Johns Hopkins University)

Microsoft Academic Days in Silicon Valley

http://research.microsoft.com/~gray/talks

All Scientific Data Online

- Many disciplines overlap and use data from other sciences
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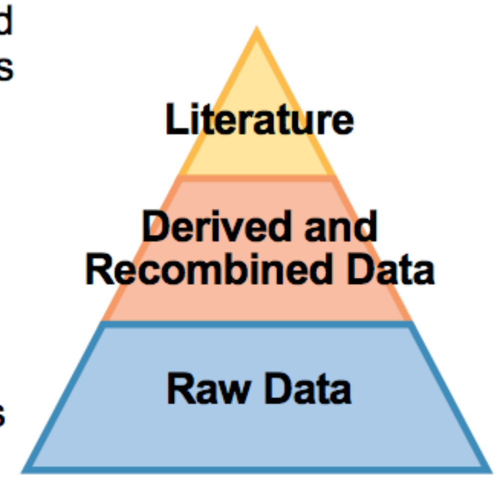
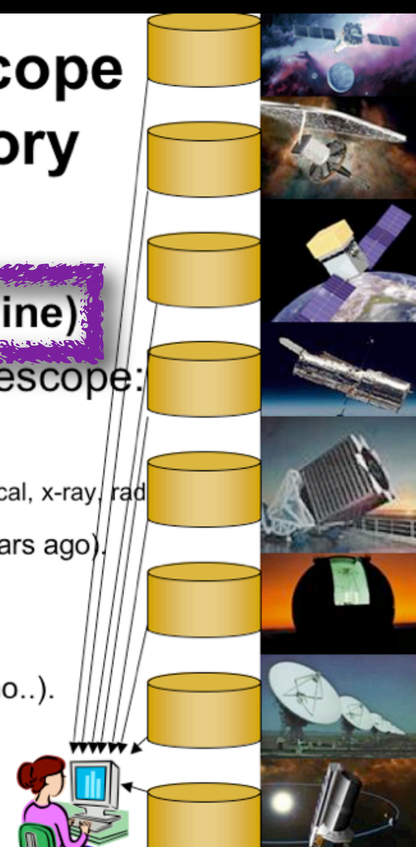


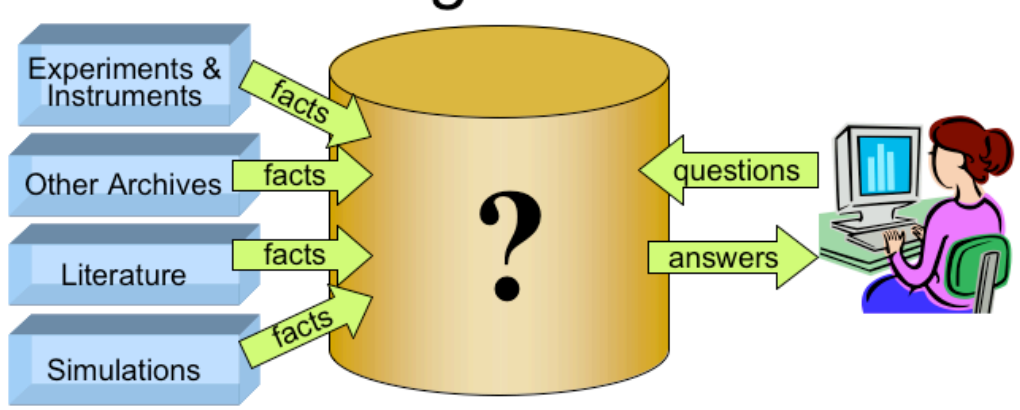
World Wide Telescope Virtual Observatory

http://www.ivoa.net/

- Premise:
  - **Most data is (or could be online)**
- The Internet is the world's best telescope:
  - It has data on every part of the sky
  - In every measured spectral band: optical, x-ray, rad
  - As deep as the best instruments (2 years ago).
  - It is up when you are up. The "seeing" is always great (no working at night, no clouds no moons no..).
  - It's a smart telescope: links objects and data to literature on them.



The Big Picture



The Big Problems

- Data ingest
- Managing a petabyte
- Common schema
- How to organize it?
- How to *reorganize* it
- How to coexist with others
- Query and Vis tools
- Support/training
- Performance
  - Execute queries in a minute
  - Batch query scheduling

8

How do we increase the fraction of astronomy researchers who know about these tools?

WIKIBOOKS
Open books for an open world

User Groups
(CfA now has one)

YouTube

+Suggestions?!

User Groups (CfA now has one)

WIKIBOOKS
Open books for an open world

ASTROBETTER
Tips and Tricks for Professional Astronomers

.astronomy

YouTube

myexperiment

CfA Virtual Observatory Users Group

Search this site

Want to hear more? Please see Gus Muench!

- **Home**
- Blog
- Calendar
- Contributors
- Description
- Files
- Glossary
- Planning
- Presentations
- Resources
- Surveys
- Workflows
- Sitemap

Home

VIRTUAL ASTRONOMICAL OBSERVATORY

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

By Virtual Observatory (VO), we mean all forms of network tools, databases and websites that are utilized for astronomical research.

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

Messages

More on NSF data management... Since the ScienceInsider article, NSF has since issued a press release about requiring data management plans as part of all NSF funding proposals starting in October 2010:"*This is the* ...
Posted May 12, 2010 12:23 PM by August Muench

May 2010 Meeting reminder. This is a reminder that the next VO users group meeting is: Tomorrow, May 7th 10-11am Pratt Conference Room. Data "publishing" is the subject for our meeting and I ...
Posted May 6, 2010 1:41 PM by August Muench

NSF Guidelines on Data Access ScienceInsider reports that NSF is moving towards requiring that a data management plan to be submitted as part of future NSF grant applications. To quote:*NSF's current policy requires* ...
Posted May 6, 2010 1:23 PM by August Muench

May 2010 Meeting date/time Our next meeting will be 10-11am Friday May 7th in the Pratt Conference room (60 Garden Street). Our inaugural meeting touched on many topics from software to data archiving ...
Posted Apr 28, 2010 1:14 PM by August Muench

Discussion (Google Group)

Join the Discussion

Friends

- Astrobetter
- Astropython
- IVOA
- VAO

My recent activity

There are no recent activities.

6
days since
User Group Meeting

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

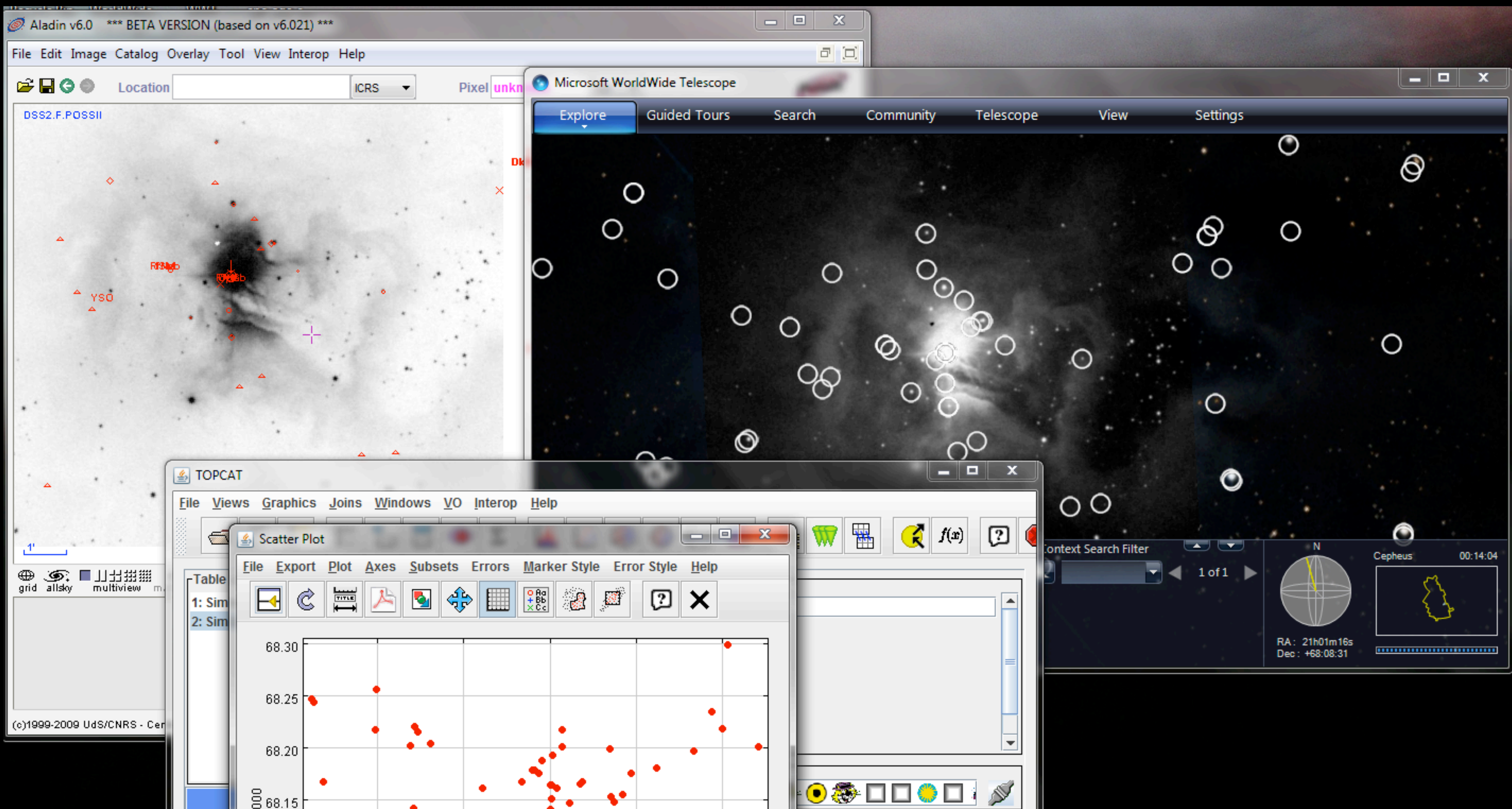
Kiva model proposed at MSR in semi-jest in 2009...

Now being implemented through VAO "Associates" and WWT Partners.

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

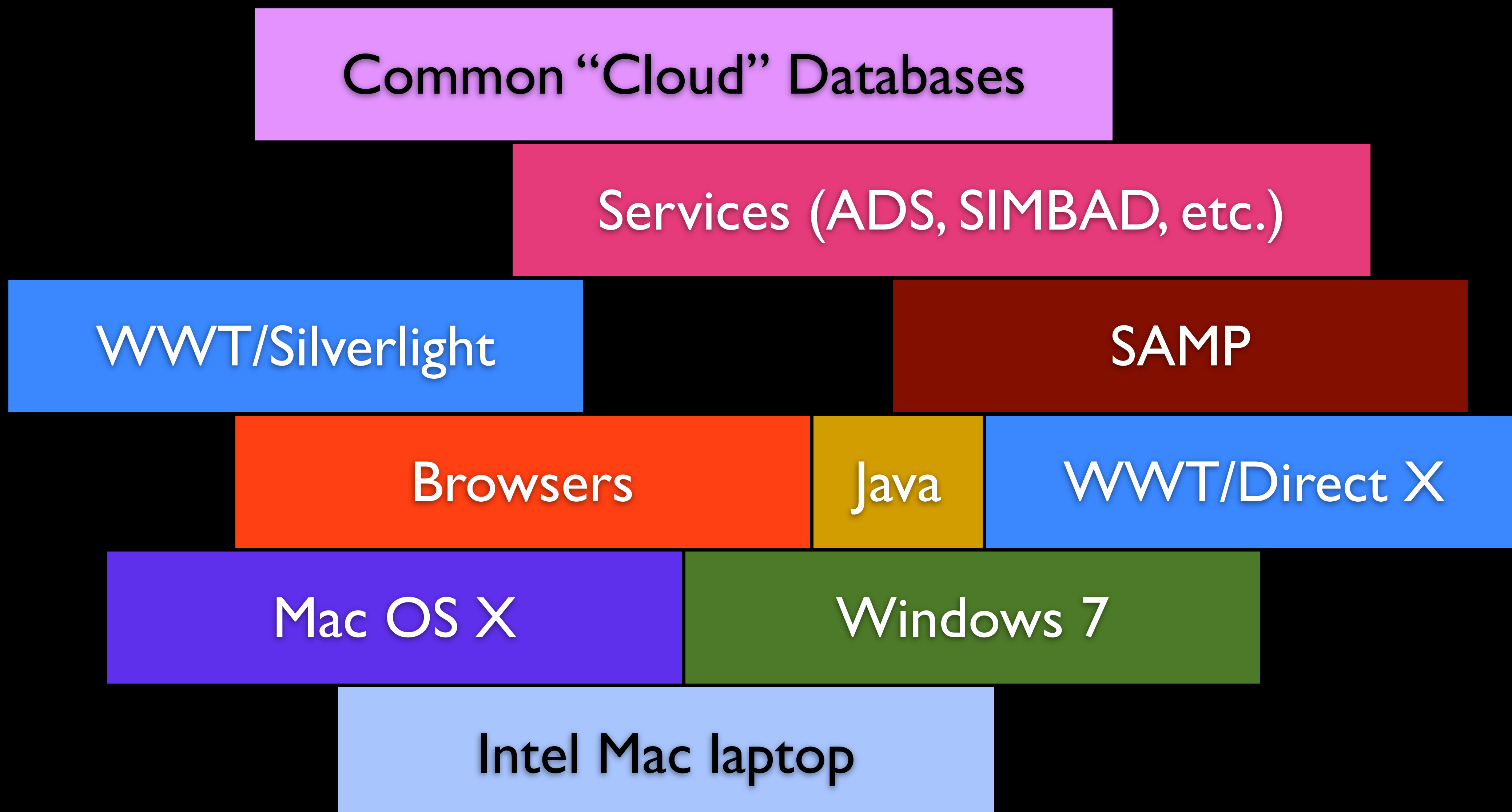
"SAMP" is a great technical start, but offers a very significant user interface challenge.

SAMP

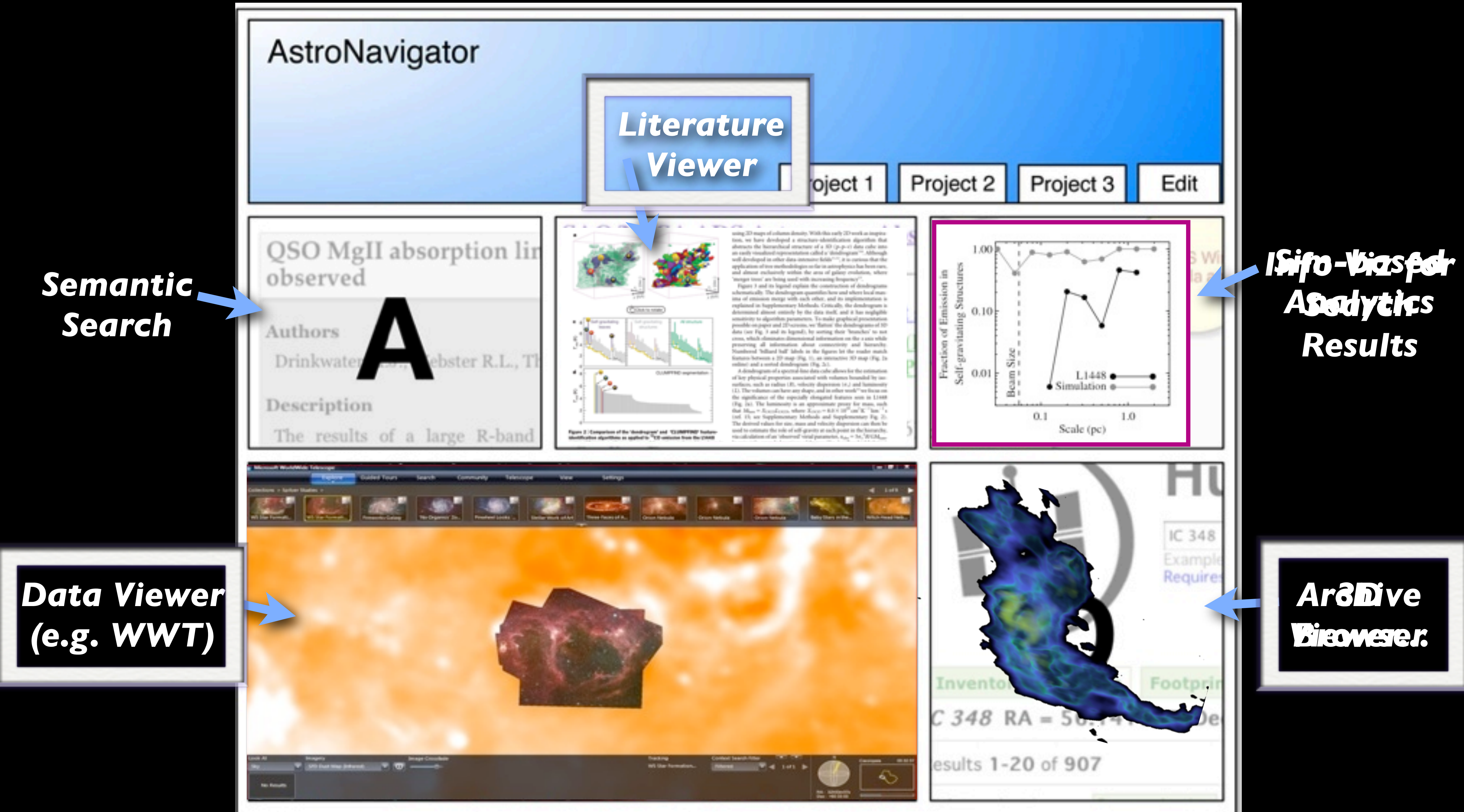


Aladin v6.0 *** BETA VERSION (based on v6.021) ***
File Edit Image Catalog Overlay Tool View Interop Help
Location
ICRS
Pixel
DSS2.F.POSSII
YSO
grid
allsky
multiview
(c)1999-2009 UdS/CNRS - Cer
Microsoft WorldWide Telescope
Explore
Guided Tours
Search
Community
Telescope
View
Settings
Context Search Filter
1 of 1
Cepheus
00:14:04
RA : 21h01m16s
Dec : +68:08:31
TOPCAT
File Views Graphics Joins Windows VO Interop Help
Table
1: Sim
2: Sim
Scatter Plot
File Export Plot Axes Subsets Errors Marker Style Error Style Help
68.30
68.25
68.20
68.15

Think about the "modules" needed to make this work...but do the details matter, to your research, if the system works seamlessly?

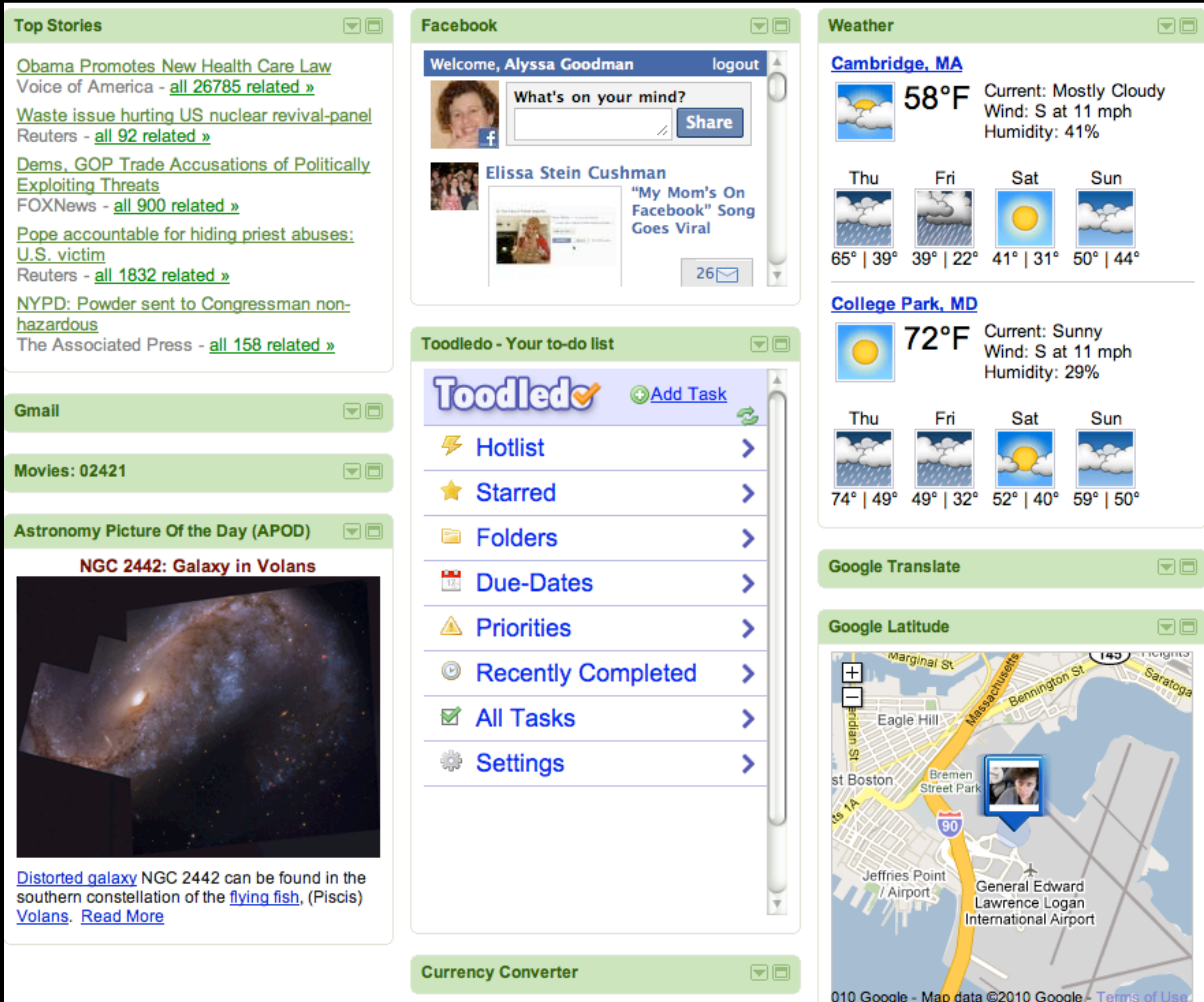


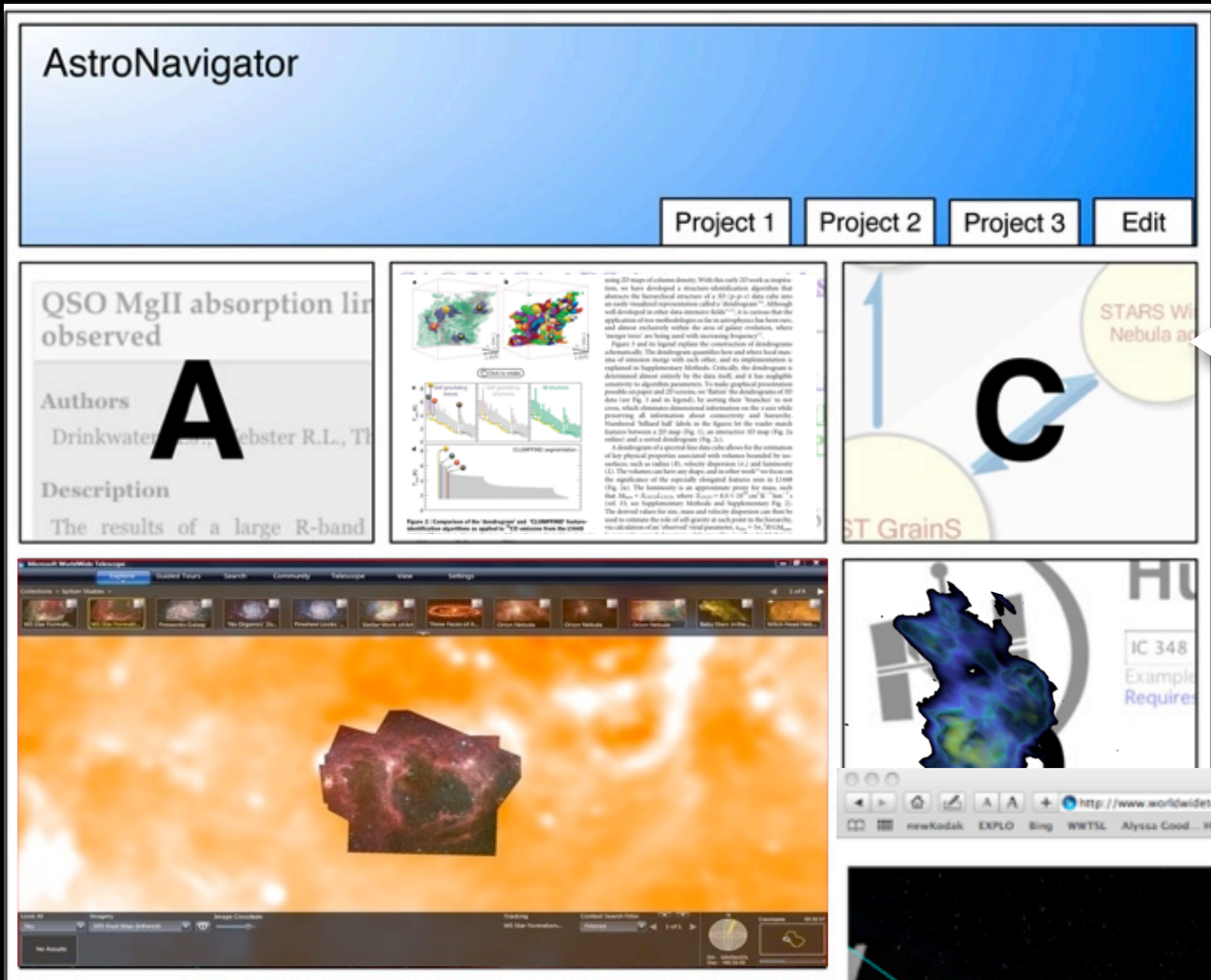
Seamless Astronomy



Mockup based on work of Eli Bressert, excerpted from NASA AISRP proposal by Goodman, Muench, Christian, Conti, Kurtz, Burke, Accomazzi, McGuinness, Hendler & Wong, 2008

iGoogle: "A Diversity of Tools"



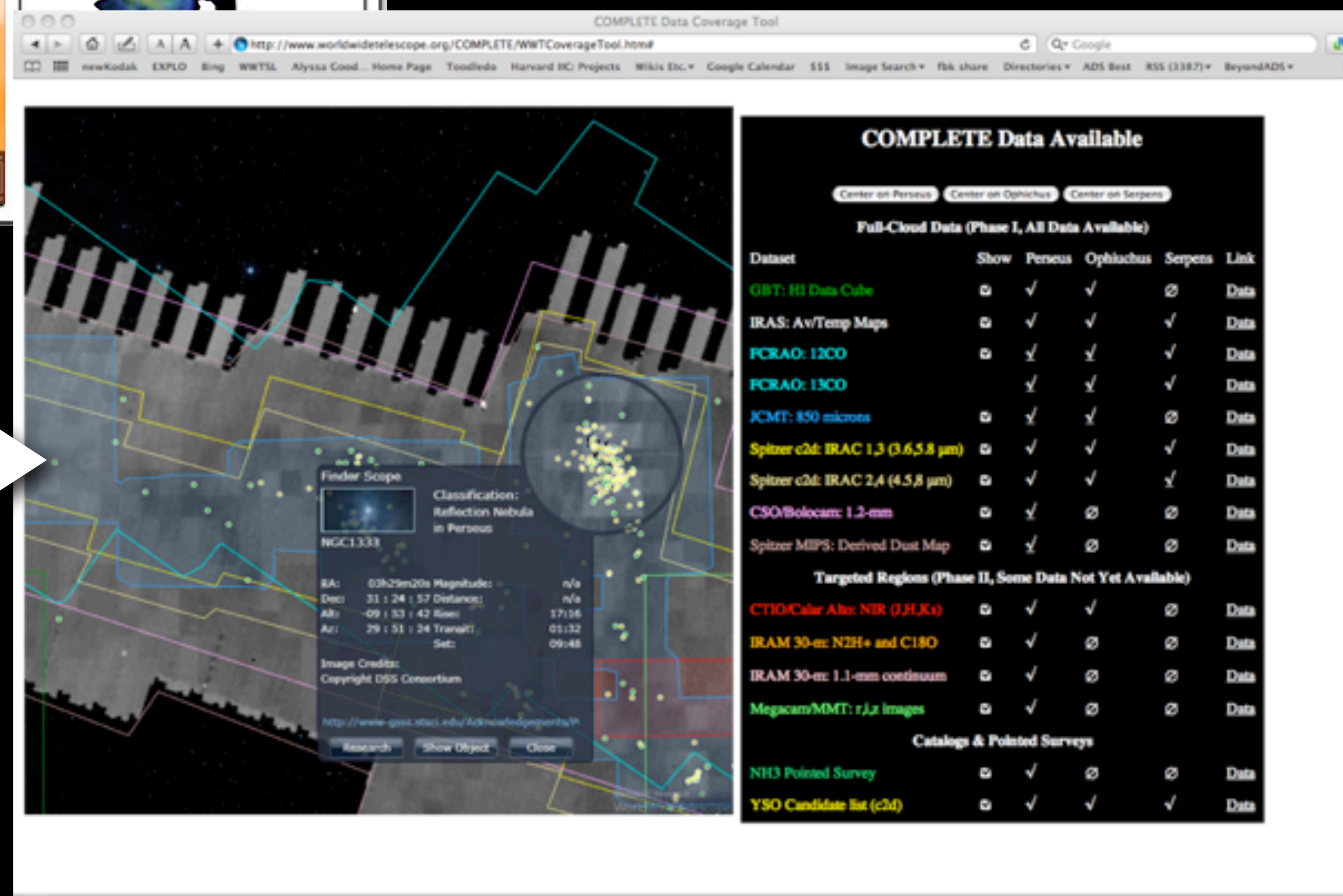


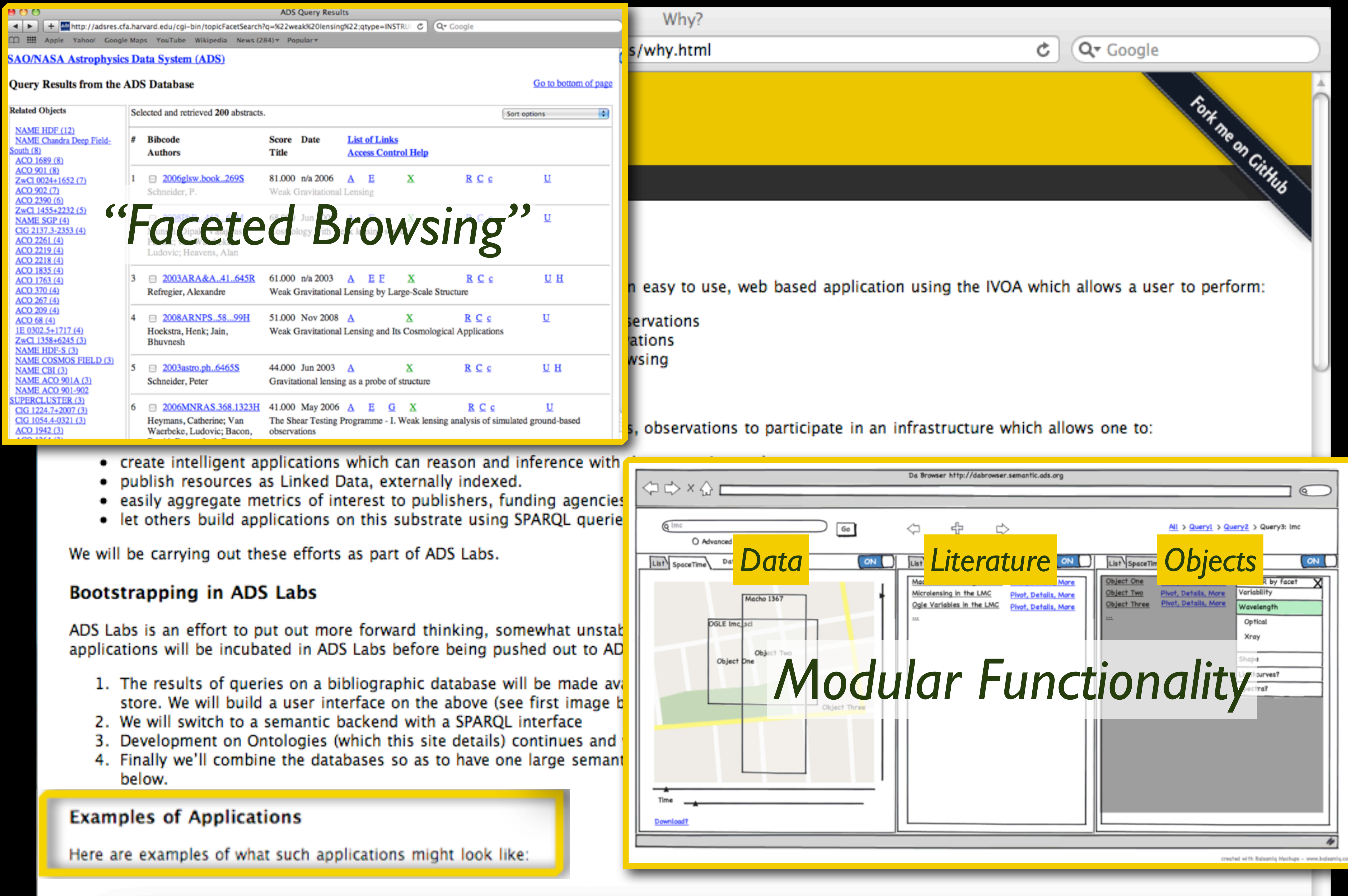
Fiction

(but soon fact!)

Fact

(right now)

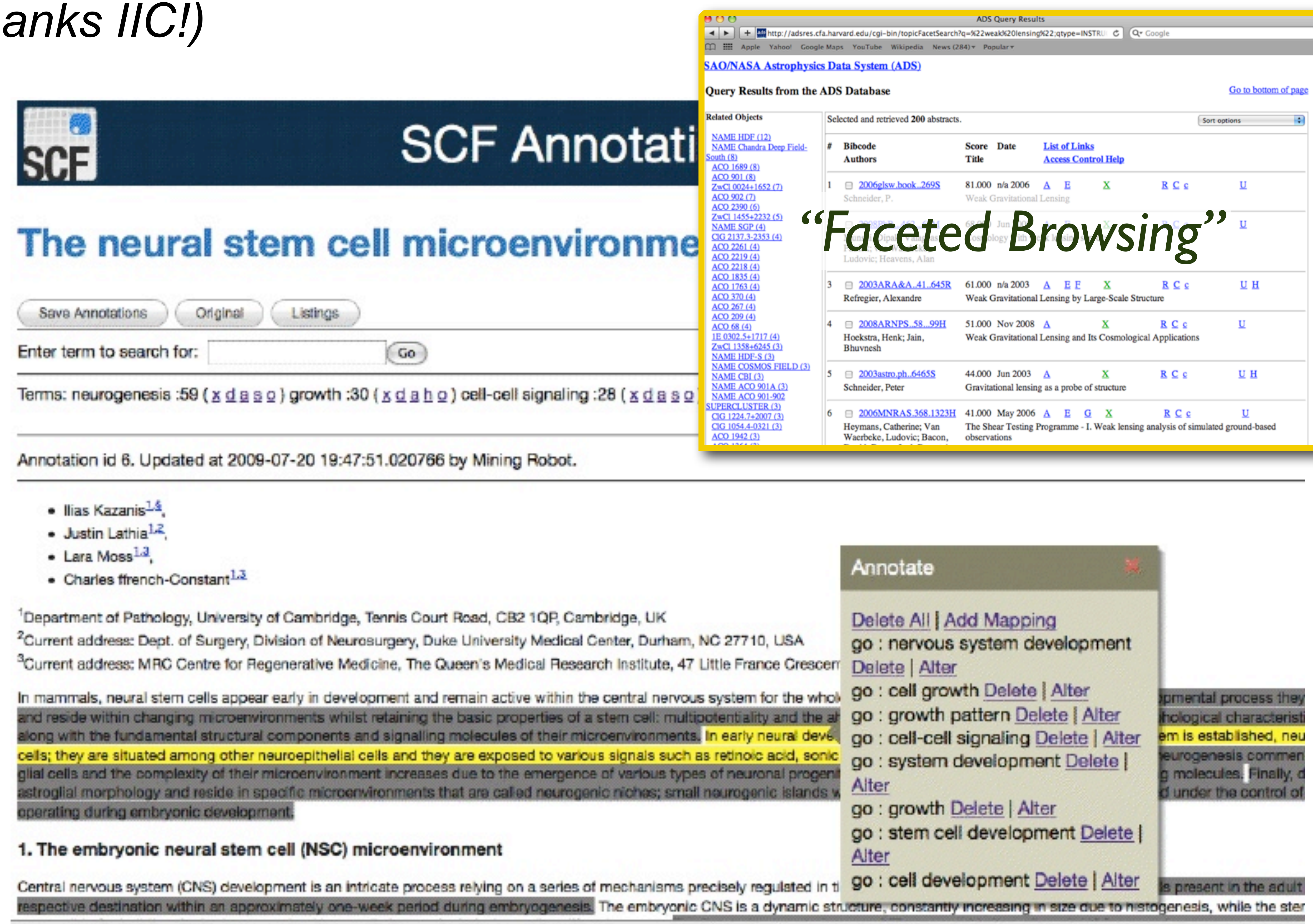




Ongoing "ADS Labs" Work: Rahul Davé, Alberto Accomazzi, Michael Kurtz, AG

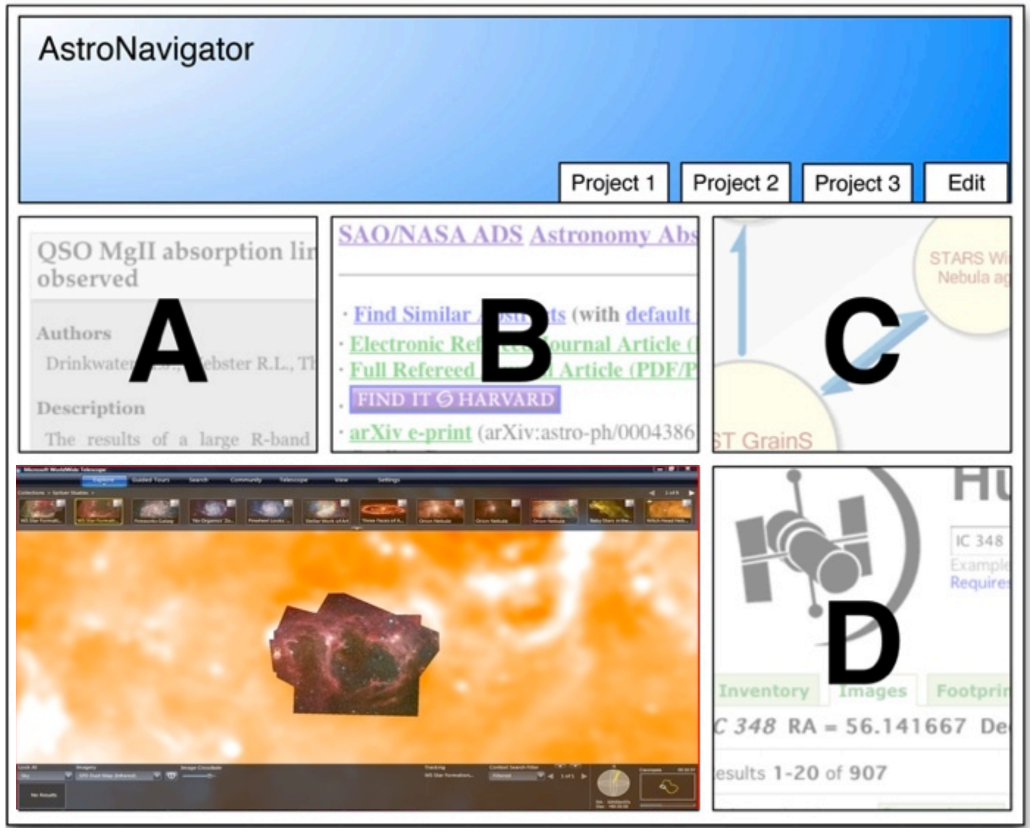
Thanks to ADS (NASA)/VAO(NASA+NSF)/MSFT funding.

Article Markup via ADS will be similar to working Life Sciences Tool (thanks IIC!)



Collaborative Astronomy at University of Washington

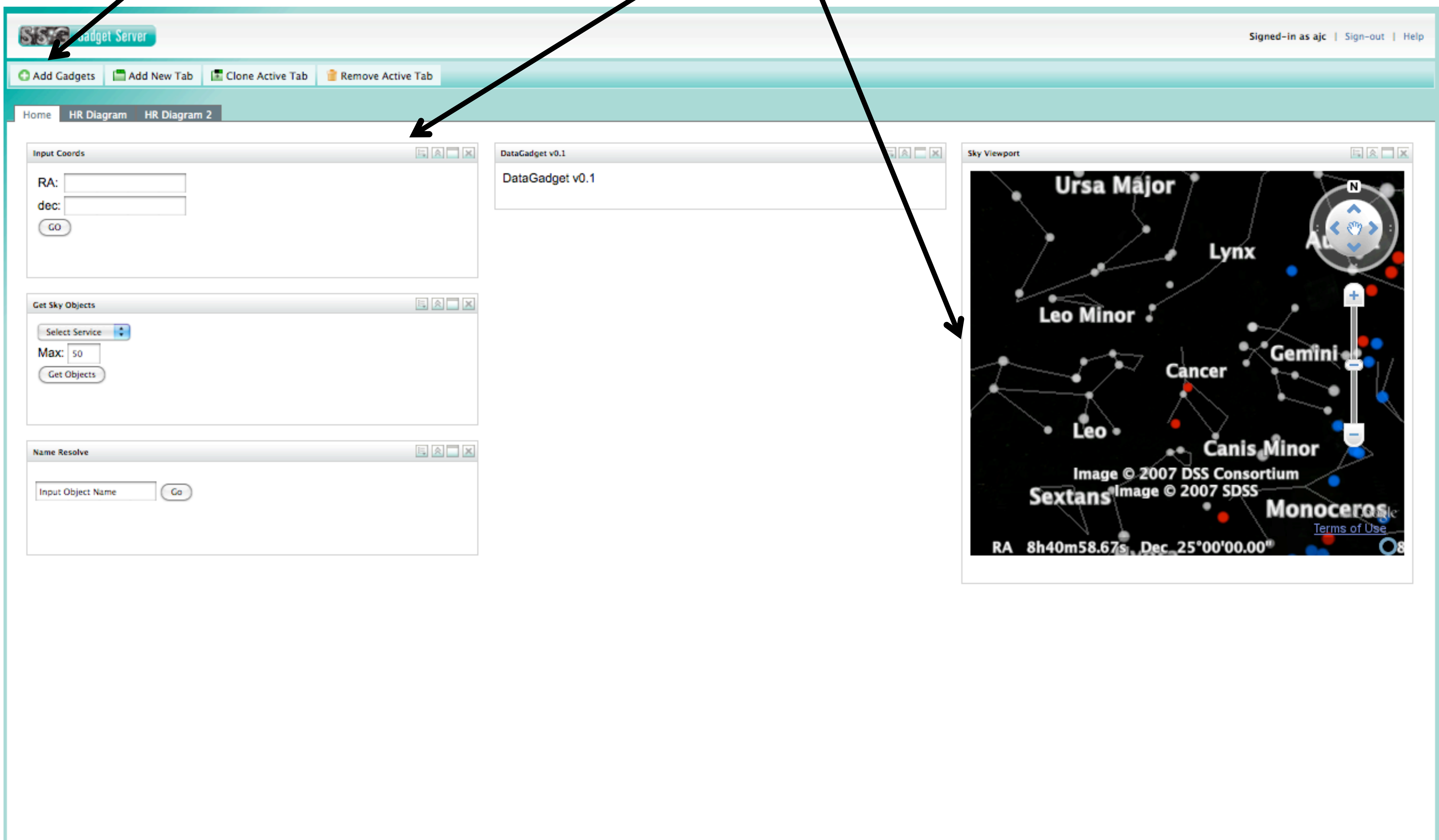
- **Research in a Browser**
  - **"iGoogle" for Astronomy**
    - Collections of simple atomic applications (gadgets)
    - Users choose the view they want
    - All gadgets can communicate with each other
  - **Customizable and sharable**
    - Users can build and share "mashups"
    - Widgets are simple to create
    - Widgets call virtual observatory resources
  - **Efficient**
    - Communication is within the browser (fast)
    - Built from javascript (standard)



Collaborative Astronomy (Connolly, Gibson, Krughoff, Sayers, Smith 2010)

Select Gadgets

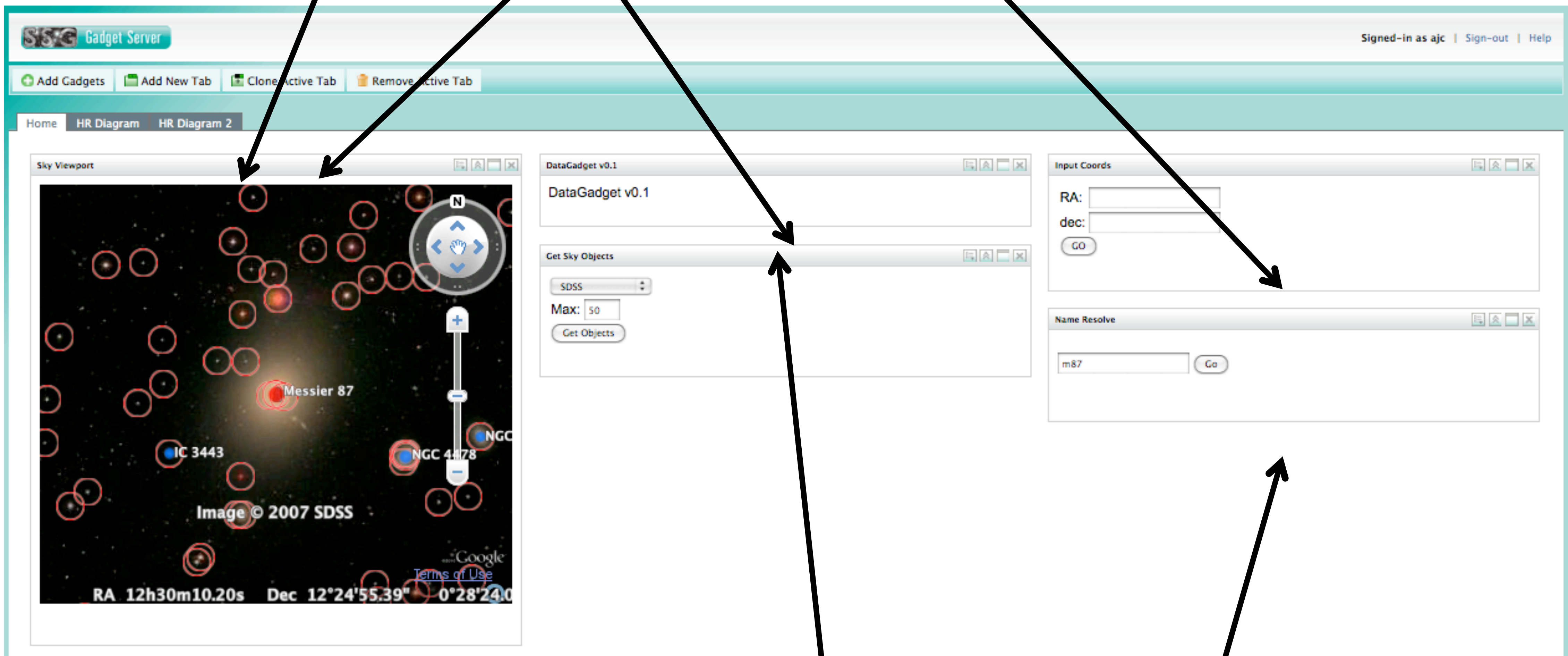
Rearrange based on your preference



Collaborative Astronomy (Connolly, Gibson, Krughoff, Sayers, Smith 2010)

Query the SDSS based on viewport
and return the source overlaid on images

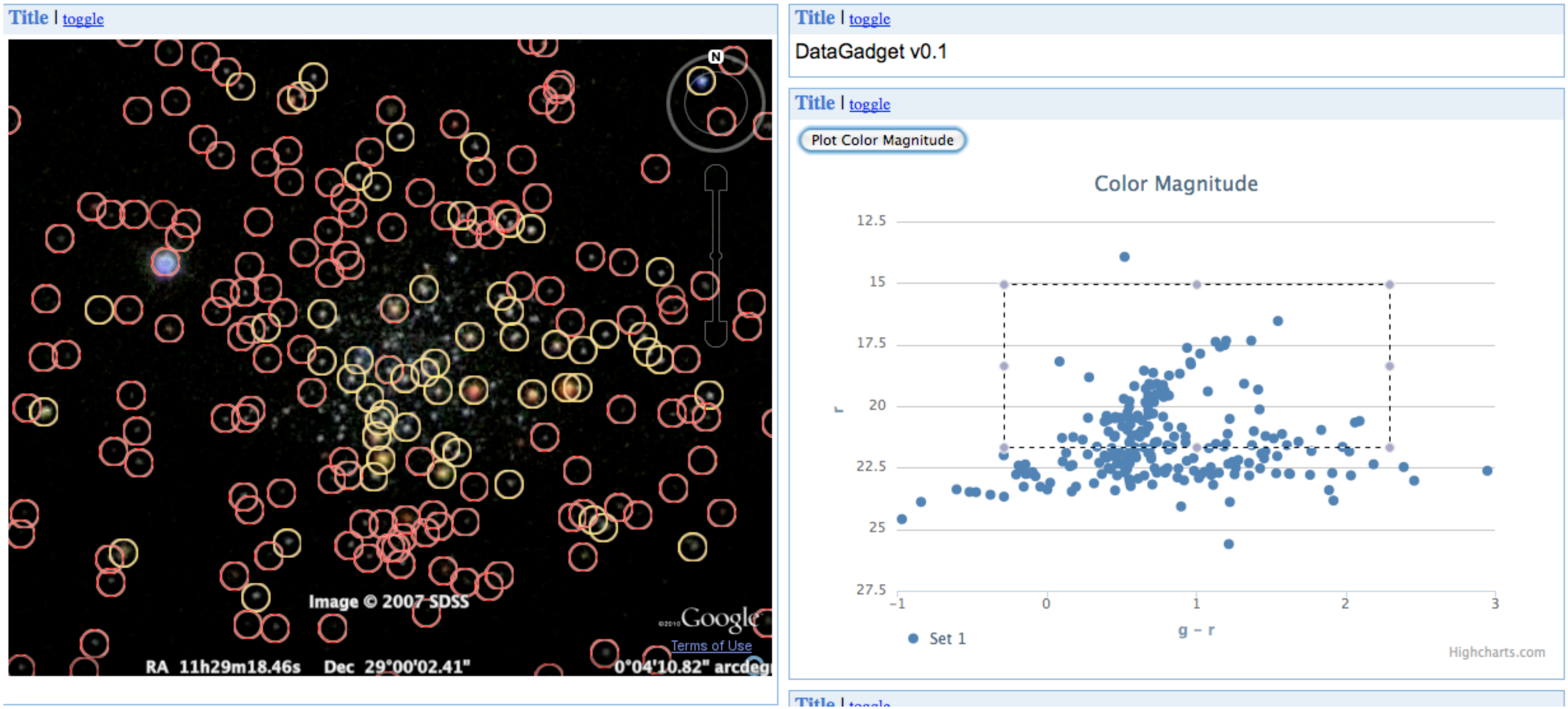
Name resolver and zoom to field



All gadgets communicate through the data gadget

Collaborative Astronomy (Connolly, Gibson, Krughoff, Sayers, Smith 2010)

Create, store and share multiple views of gadgets



Interaction allows selections to be shown on the viewport

Collaborative Astronomy (Connolly, Gibson, Krughoff, Sayers, Smith 2010)

Part 2
WorldWide Telescope Ambassadors Program

Alyssa Goodman
Harvard University Professor of Astronomy,
WGBH Scholar-in-Residence, Microsoft Academic Partner

Annie Valva
WGBH Interactive, Director of Research & Development

Pat Udomprasert
WWT Program Coordinator

WWT Ambassadors

Who?

Harvard/CfA, WGBH and Microsoft Research staff in collaboration with Volunteer Ambassadors

What?

Future-leaning way to teach and learn STEM concepts

How?

Use new WWT platform to give experts and learners access to the Universe

Where?

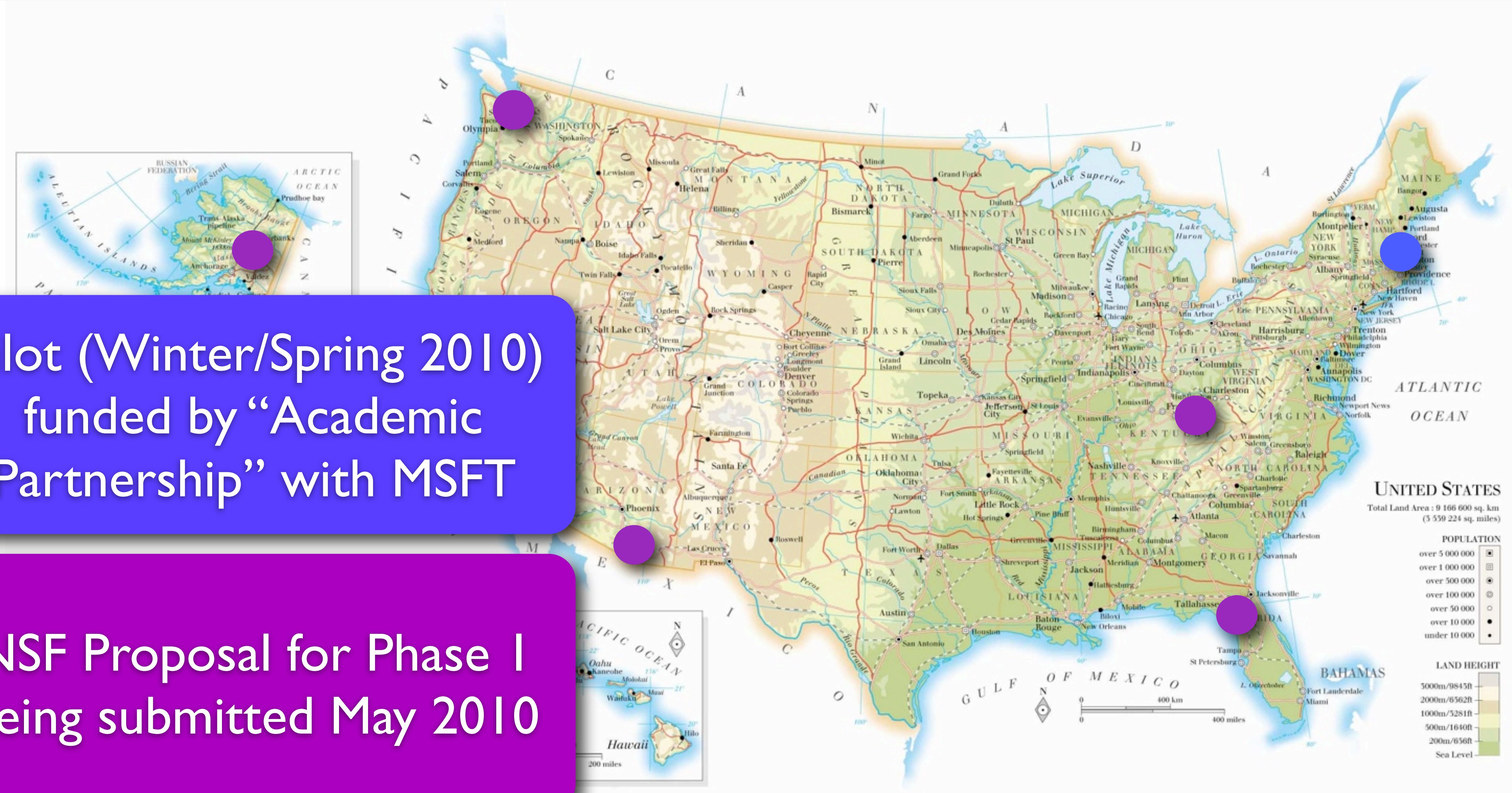
Public spaces and schools in a variety of regions

Where? ... and When?

Public spaces and schools in a variety of regions

Pilot ● *Boston Area*

Phase 1 candidates ● *Tucson, AZ; Seattle, WA; Appalachia; Gainesville, FL; Fairbanks, AK*



Pilot (Winter/Spring 2010) funded by "Academic Partnership" with MSFT

NSF Proposal for Phase 1 being submitted May 2010

Phase II: US-wide; Phase III: International

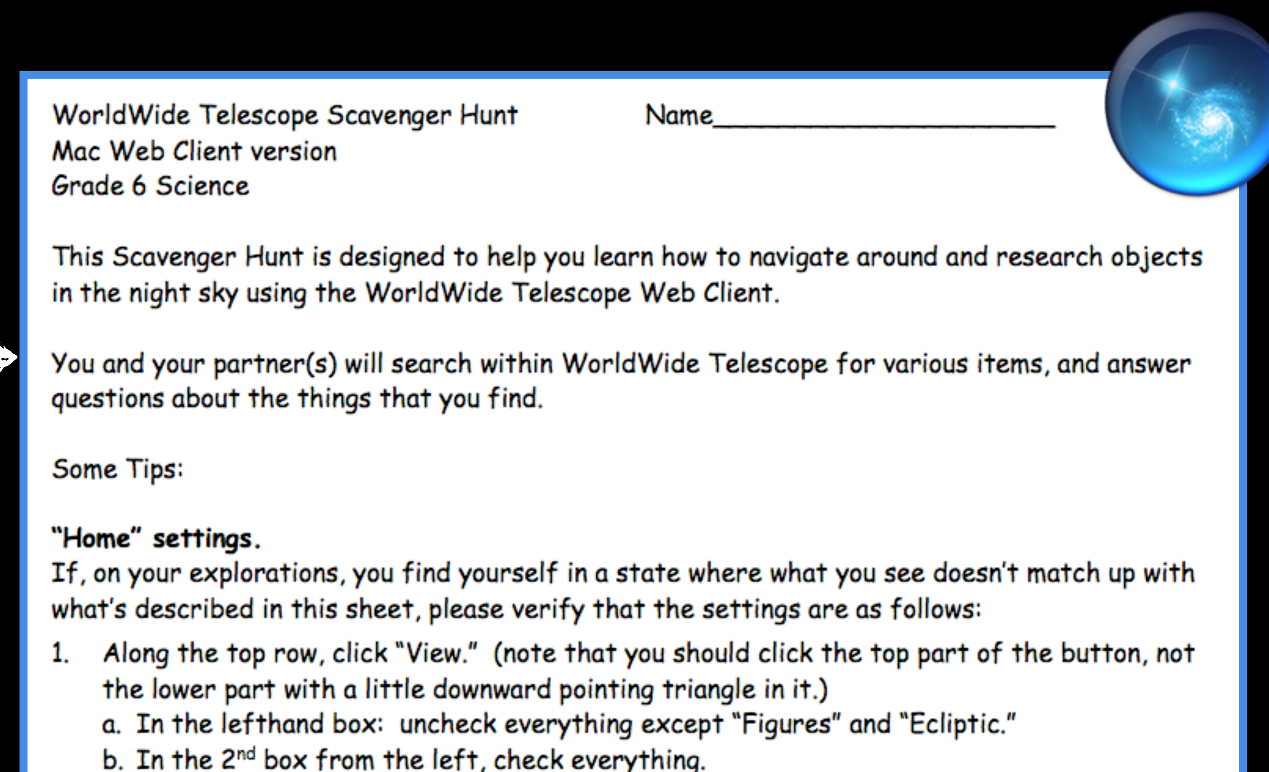
To find out more...

Please see Pat Udomprasert, Sarah Block, Jeremy Cushman, Sana Sharma, me and the web and the wall outside this room...

www.cfa.harvard.edu/WWTAmbassadors/

What?

Future-leaning way to teach and learn STEM concepts



WorldWide Telescope Scavenger Hunt Name_______________________
Mac Web Client version
Grade 6 Science

This Scavenger Hunt is designed to help you learn how to navigate around and research objects in the night sky using the WorldWide Telescope Web Client.

You and your partner(s) will search within WorldWide Telescope for various items, and answer questions about the things that you find.

Some Tips:

"Home" settings.
If, on your explorations, you find yourself in a state where what you see doesn't match up with what's described in this sheet, please verify that the settings are as follows:

1. Along the top row, click "View." (note that you should click the top part of the button, not the lower part with a little downward pointing triangle in it.)
   a. In the lefthand box: uncheck everything except "Figures" and "Ecliptic."
   b. In the 2nd box from the left, check everything.

WWT Tours,
including creation by Ambassadors & learners + hosting

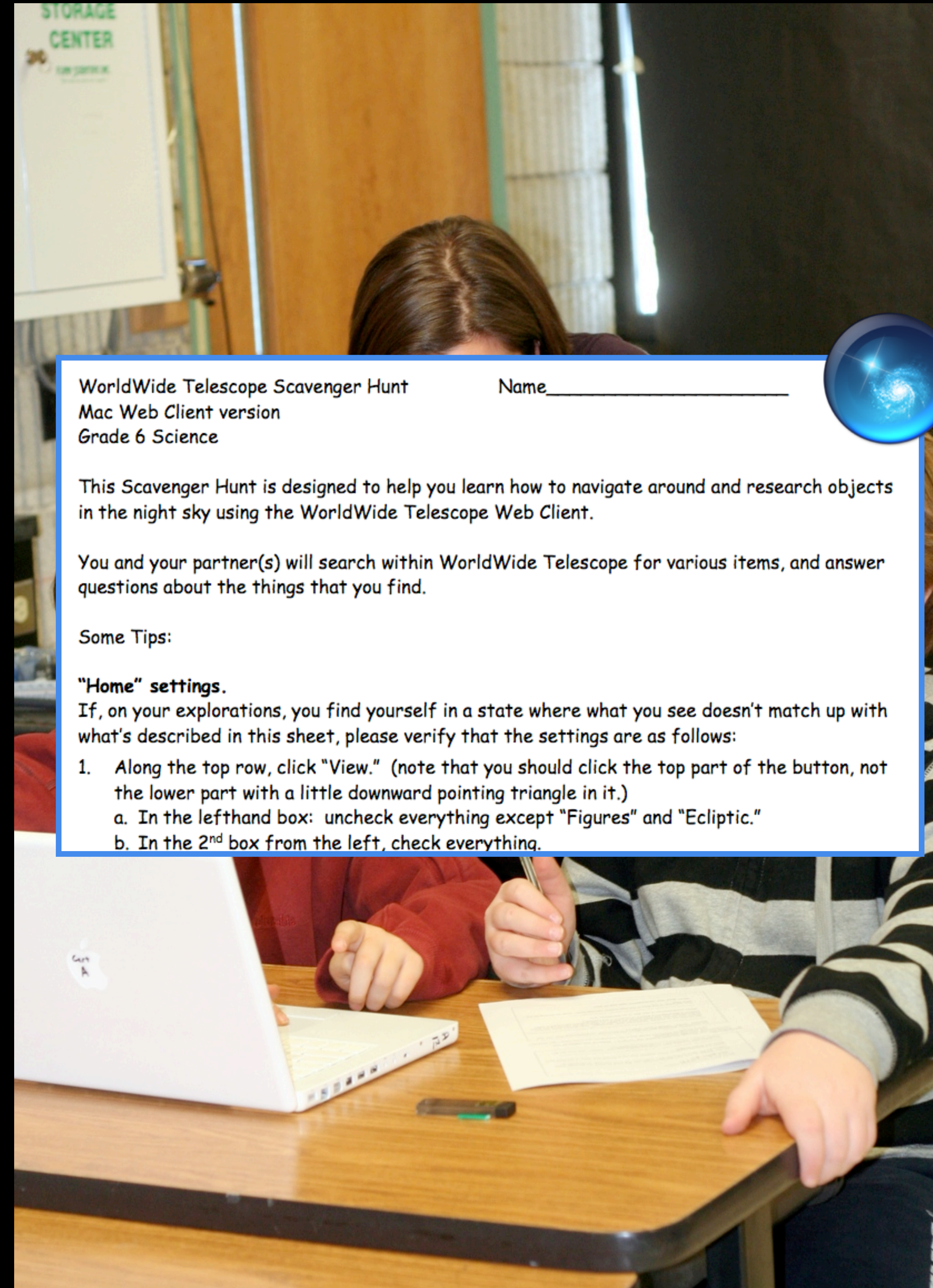
Guided WWT Exploration
activities created by program staff & Ambassadors/teachers

How?

Using new WWT platform to give experts and learners access to the Universe

WWT Ambassadors Program

Recruiting, Vetting, Coordination



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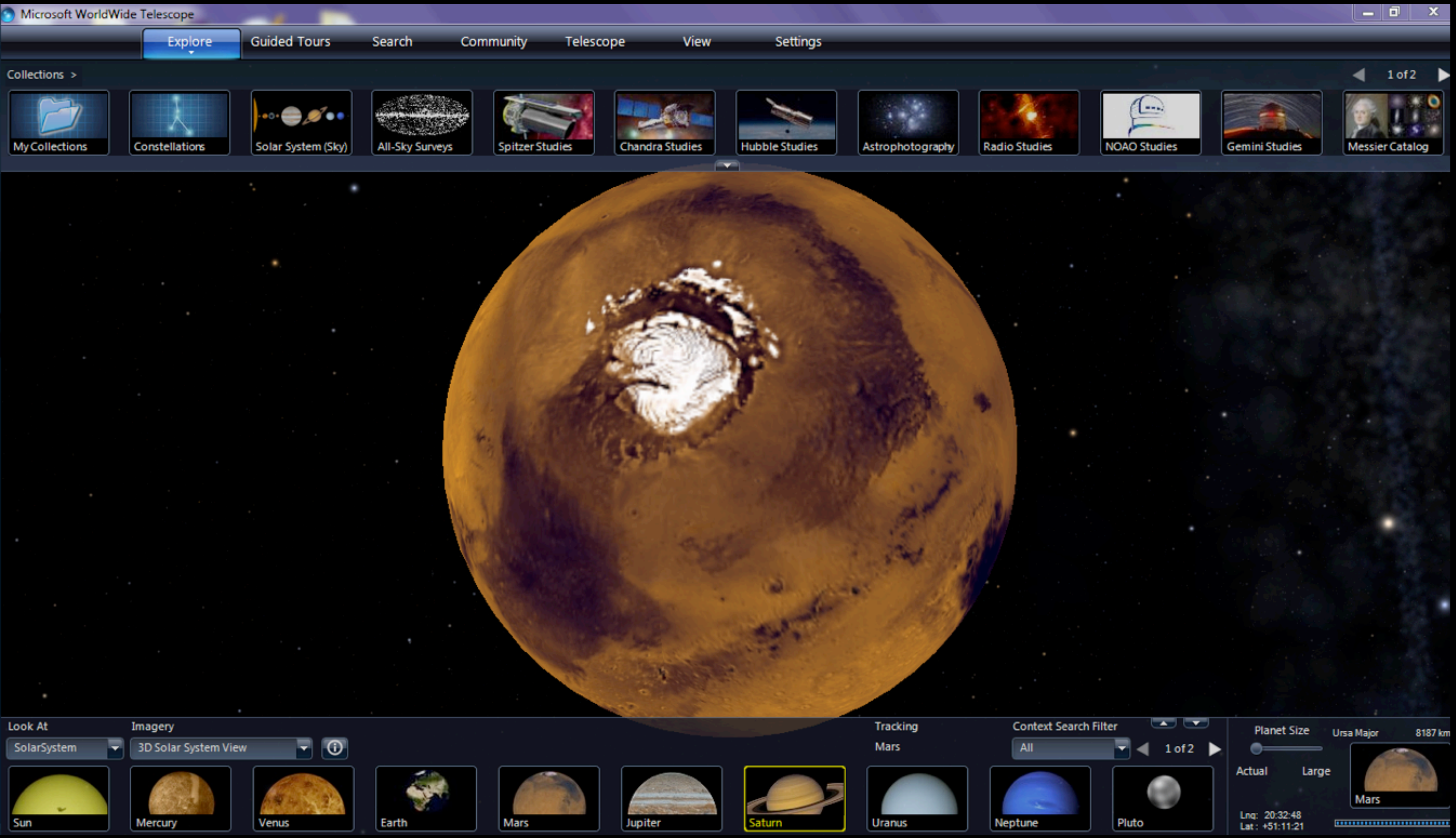
*Clarke Middle School, Lexington, MA (WWT Ambassadors **Pilot** School)*

“Why is one polar ice cap on Mars bigger than the other?”

– Clarke Middle School 6th Grader



Michelle Bartley interviews her 6th-grade science class about WWT

December 19, 2009

“I never knew programs like this could even exist. It’s just amazing.”

–Clarke Middle School 6th grade student

More quotes from Clarke 6th Graders

“Learning about our Universe by actually seeing and exploring it makes it easier to contemplate and more fun.”

“You can explore the Universe yourself and you don't always have to only learn from the teacher.”

“It gave me a better mental map of the universe.”

(And of the 72 surveys we’ve collected, 71 are positive toward WWT Ambassadors.)

Spring 2010 Pilot Results

15 WWT Tours Created by groups of 4 to 5 students in 4 sixth-grade Science Classes (of M. Bartley, Clarke MS)

Facilitated by 4 WWT **Ambassadors**: 1 Ph.D. Astrophysicist (Udomprasert); 1 Harvard Undergrad Physicist (Cushman); 1 retired Ph.D. Physicist (Post); 1 planetarium-show writer (Becker)

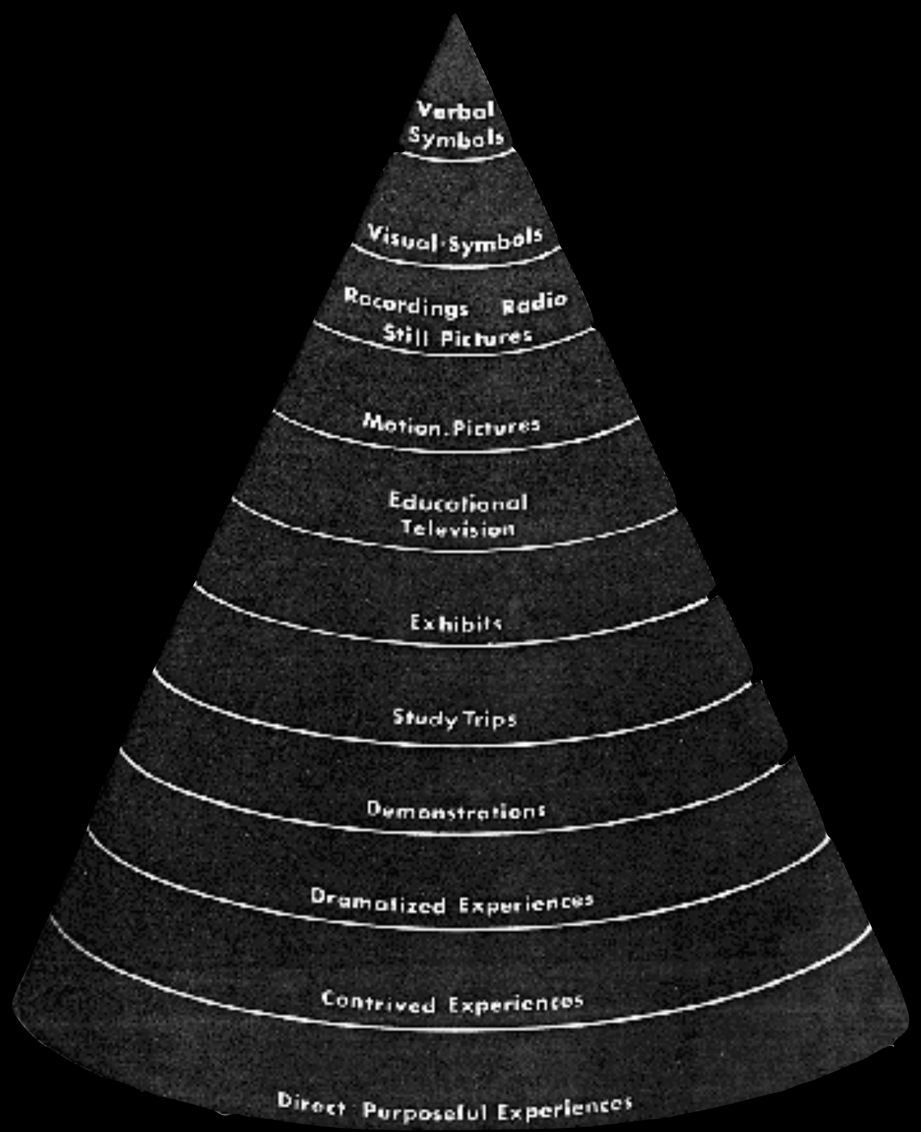
Students, parents & teachers report creating WWT Tours is a better vehicle for learning than PPT presentations, papers

Unexpected finding: Tour creation is a non-threatening way to reveal students' understanding/mis-understanding of concepts

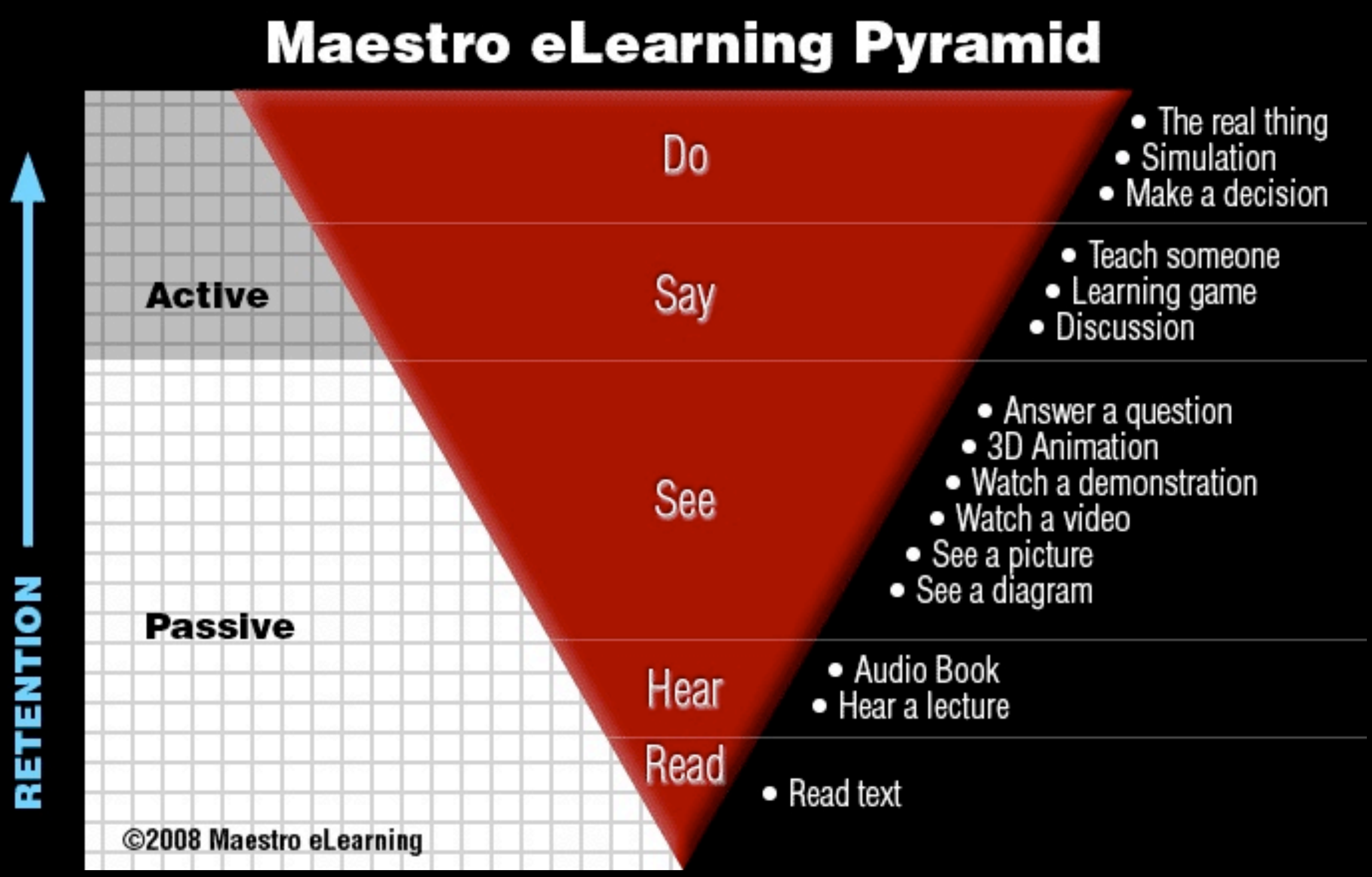
Why?

Increase STEM literacy in US now.

Demonstrate cyberlearning's value to the "Cone of Experience"



Edgar Dale, "Audio Visual Methods in Teaching", 1946-69



Tour: Dust & Us

Temperature

Planets

Stars

Galaxies

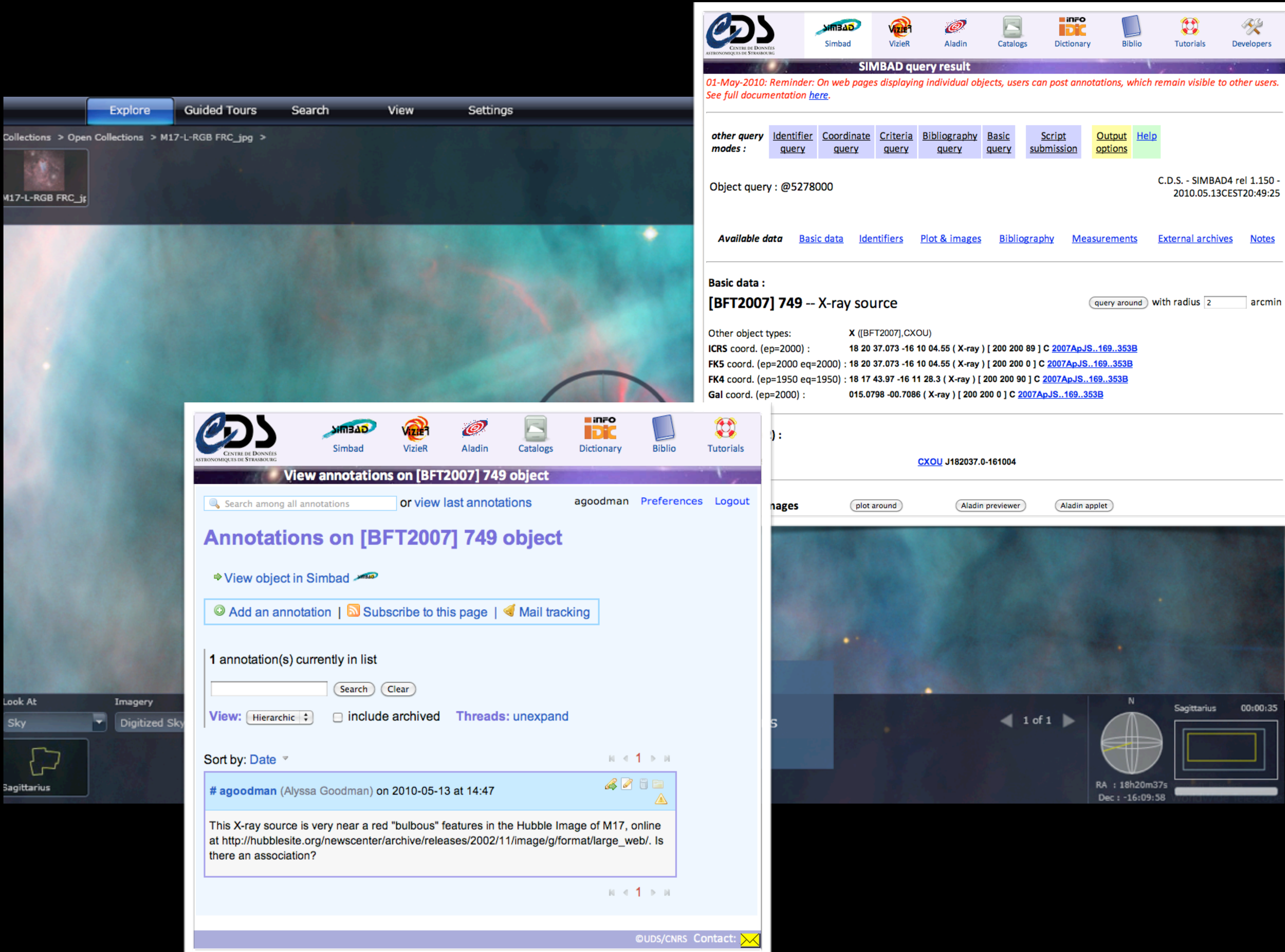
Gas

Exotica (Black Holes, etc.)

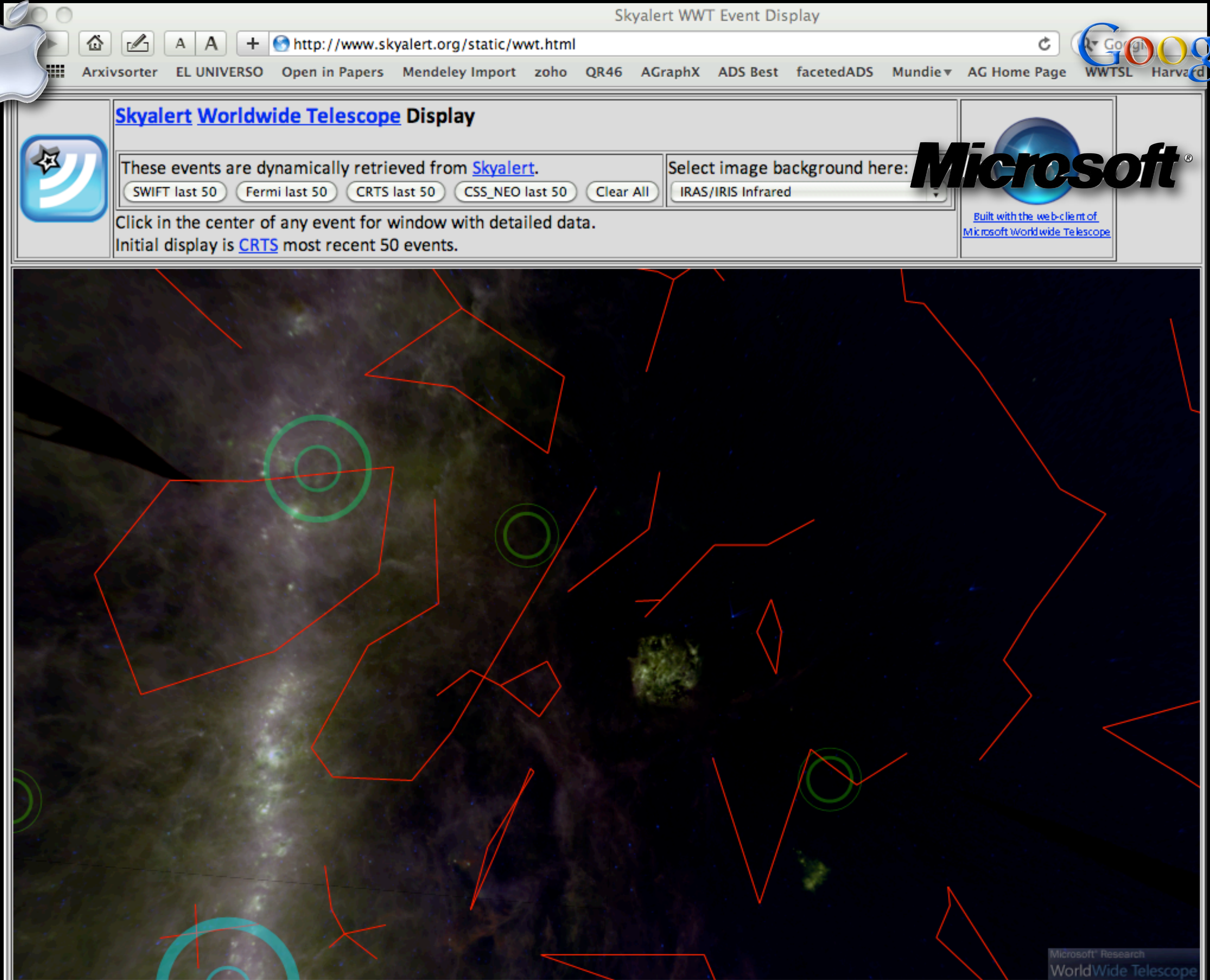
- **Proposed Index & Search Scheme for WWT Ambassadors**
- WWT Tips and Tricks
- Popular Interests
  - Beauty in the Night Sky
  - Space Exploration
  - Exotic Objects and Events
  - Collisions and Explosions
  - For and By Kids
- Night Sky Observing
  - Beauty in the Night Sky
  - Constellations
  - Finding Objects in the Sky
  - Brightness and Magnitudes
  - Telescopes and Technology
- Objects in the Sky
  - Solar System - Ours and Beyond
  - Stars and Their Evolution
  - Between the Stars - Gas and Dust
  - Galaxies
  - Cosmology
  - Exotic Objects
- Astrophysical Concepts
  - Light
  - Scales in the Universe
  - Physical Properties of Matter
  - Changes with Time
  - Big Theories in Physics
- Scientific Processes and Skills
  - How We Know
  - Limitations to What We Can Know
- Science and Society
  - Current Research
  - History of Science
  - Cultural Influences and Perspectives
  - Space Exploration

We'd ***need*** more ***astrophysicists*** as WWT Ambassadors to create STEM-oriented Tours (hint, hint... and we'll help you!)

1:30



Explore
Guided Tours
Search
View
Settings
Collections > Open Collections > M17-L-RGB FRC_jpg >
SIMBAD query result
01-May-2010: Reminder: On web pages displaying individual objects, users can post annotations, which remain visible to other users.
See full documentation here.
other query modes :
Identifier query
Coordinate query
Criteria query
Bibliography query
Basic query
Script submission
Output options
Help
Object query : @5278000
C.D.S. - SIMBAD4 rel 1.150 - 2010.05.13CEST20:49:25
Available data
Basic data
Identifiers
Plot & images
Bibliography
Measurements
External archives
Notes
Basic data :
[BFT2007] 749 -- X-ray source
query around
with radius 2 arcmin
Other object types: X ([BFT2007],CXOU)
ICRS coord. (ep=2000) : 18 20 37.073 -16 10 04.55 (X-ray) [200 200 89] C 2007ApJS..169..353B
FK5 coord. (ep=2000 eq=2000) : 18 20 37.073 -16 10 04.55 (X-ray) [200 200 0] C 2007ApJS..169..353B
FK4 coord. (ep=1950 eq=1950) : 18 17 43.97 -16 11 28.3 (X-ray) [200 200 90] C 2007ApJS..169..353B
Gal coord. (ep=2000) : 015.0798 -00.7086 (X-ray) [200 200 0] C 2007ApJS..169..353B
CXOU J182037.0-161004
plot around
Aladin previewer
Aladin applet
Simbad
VizieR
Aladin
Catalogs
Dictionary
Biblio
Tutorials
Developers
View annotations on [BFT2007] 749 object
Search among all annotations
or view last annotations
agoodman
Preferences
Logout
Annotations on [BFT2007] 749 object
View object in Simbad
Add an annotation | Subscribe to this page | Mail tracking
1 annotation(s) currently in list
Search
Clear
View: Hierarchic
include archived
Threads: unexpand
Sort by: Date
agoodman (Alyssa Goodman) on 2010-05-13 at 14:47
This X-ray source is very near a red "bulbous" features in the Hubble Image of M17, online at http://hubblesite.org/newscenter/archive/releases/2002/11/image/g/format/large_web/. Is there an association?
©UDS/CNRS Contact:
Look At
Imagery
Sky
Digitized Sky
Sagittarius
1 of 1
RA : 18h20m37s
Dec : -16:09:58
00:00:35



http://www.skyalert.org/static/wwt.html

How best to work with NSF OCI, MPS/AST, EHR & CISE simultaneously?

Proposals/Phases

- RAPID/EAGER?
- Unsolicited?
- Cyberlearning?
- Other?

We are ready-to-go in 2010 on Phase I. Phase II possible in 2011-12.