Evermore
Seamless Astronomy

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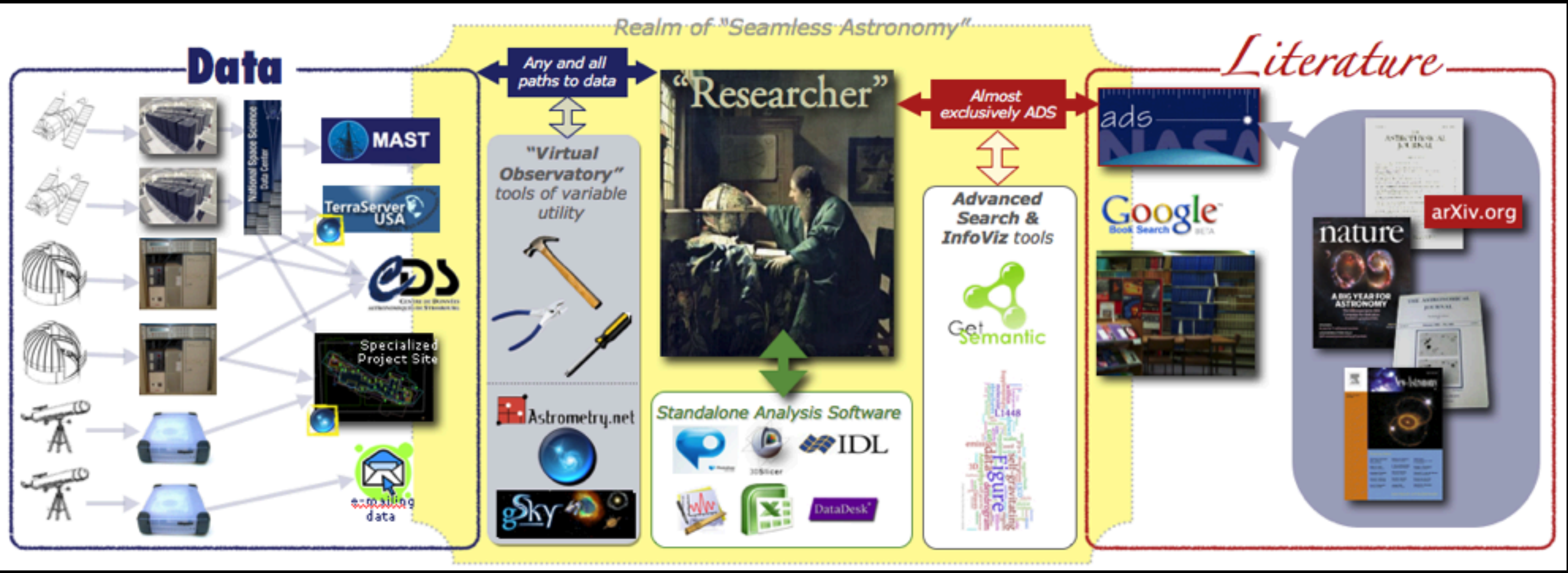
with Alberto Accomazzi, Douglas Burke, Gus Muench & Michael Kurtz (Harvard-Smithsonian CfA); Eli Bressert (U. Exeter); Tim Clark (Massachusetts General Hospital/Harvard Medical School); Chris Borgman (UCLA); Jonathan Fay & Curtis Wong (Microsoft Research)

Realm of Seamless Astronomy



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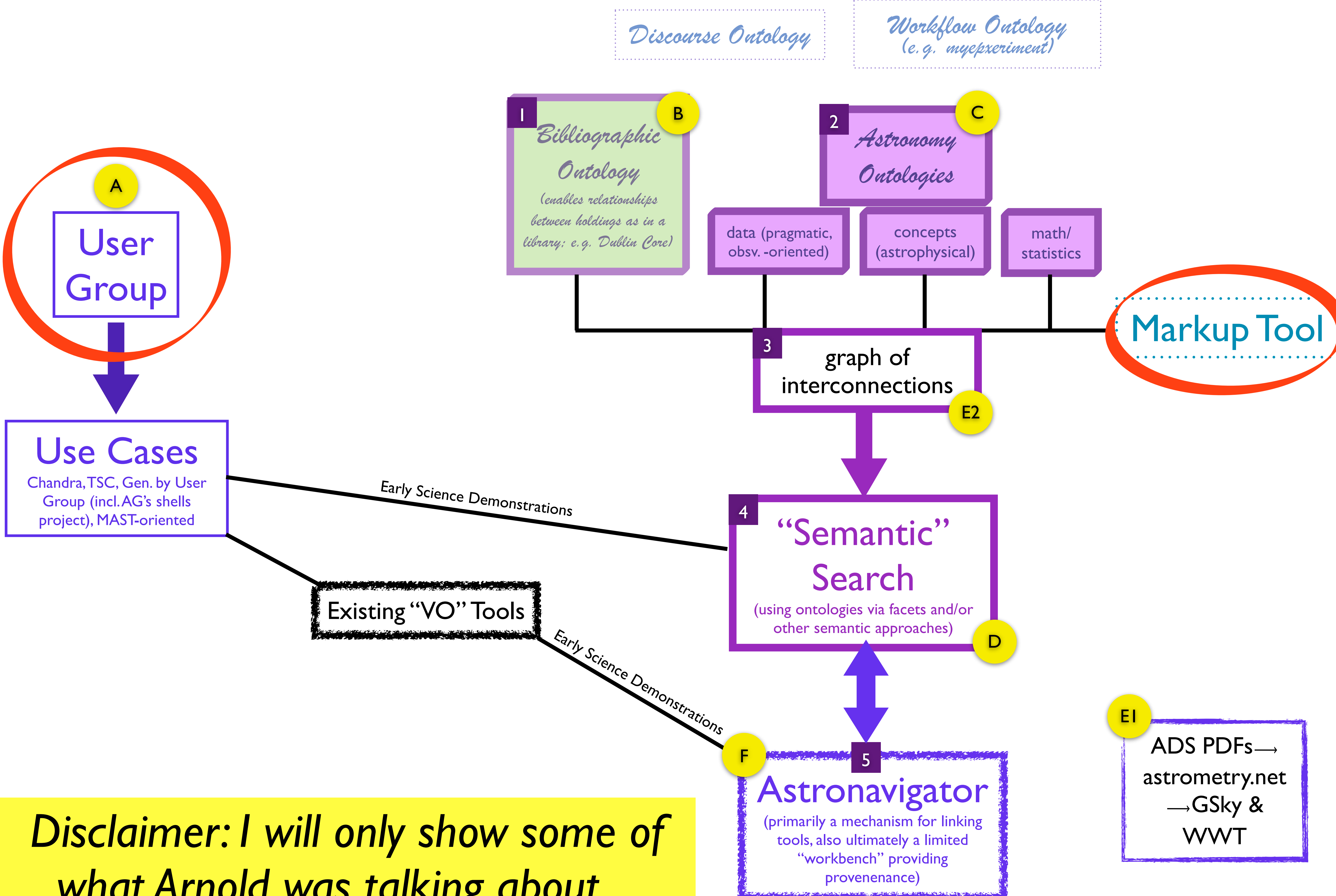


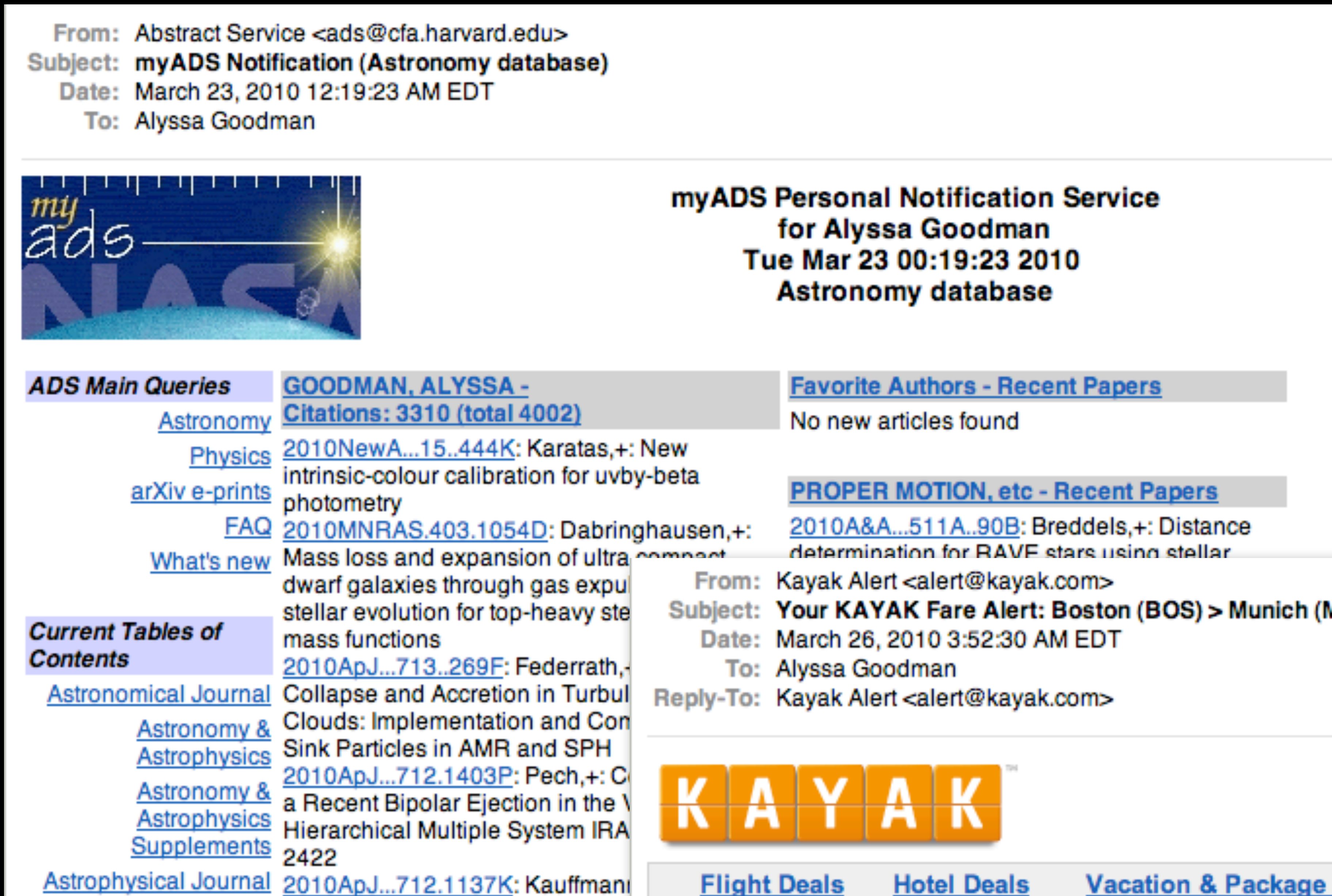
Disclaimer: I will only show some of what Arnold was talking about....

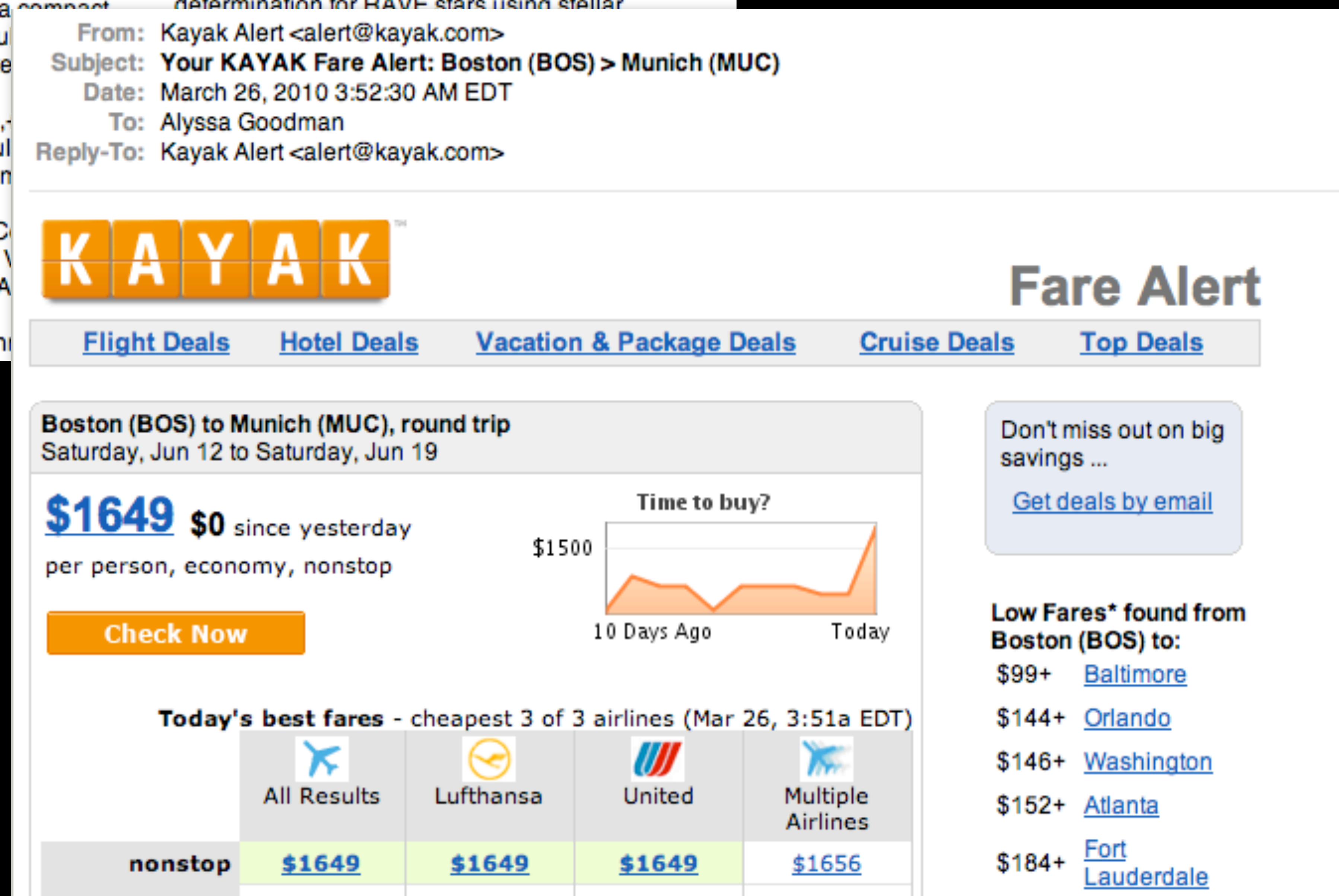
Astronomy research tools should work as seamlessly as travel research tools.

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.**

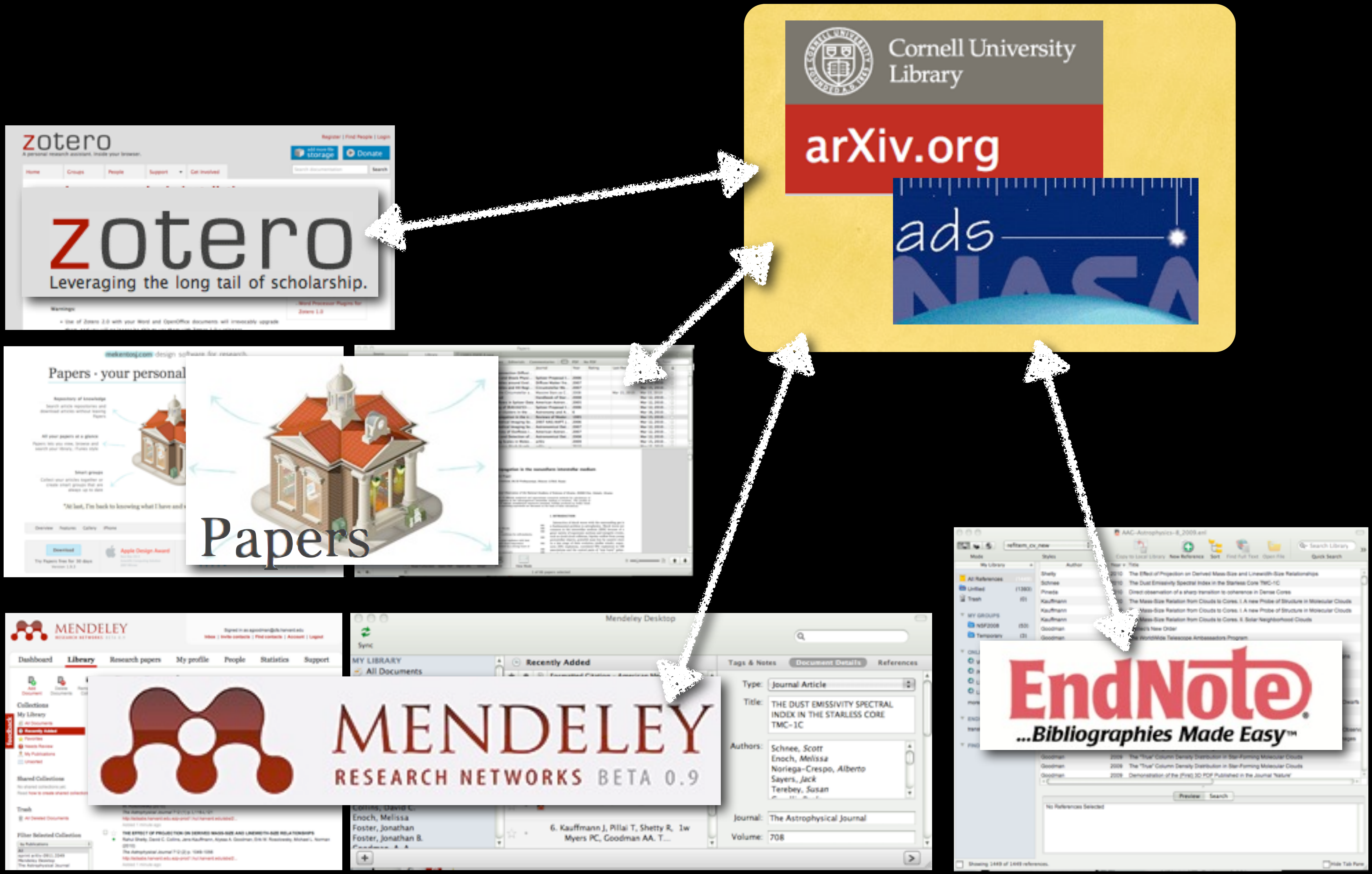
(Abstract of the *Evermore Seamless Astronomy* presentation by A. Goodman at the Microsoft External Research Symposium, April 2010.)



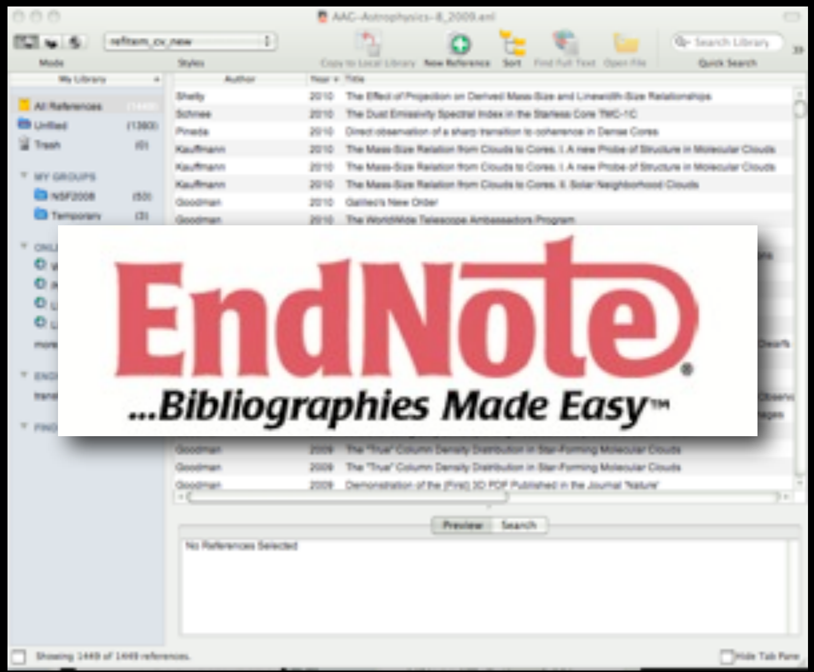


We're getting there...

Literature Handling: *Diverse Apps*, *Common Data*



What fraction of astronomy researchers know about these tools?



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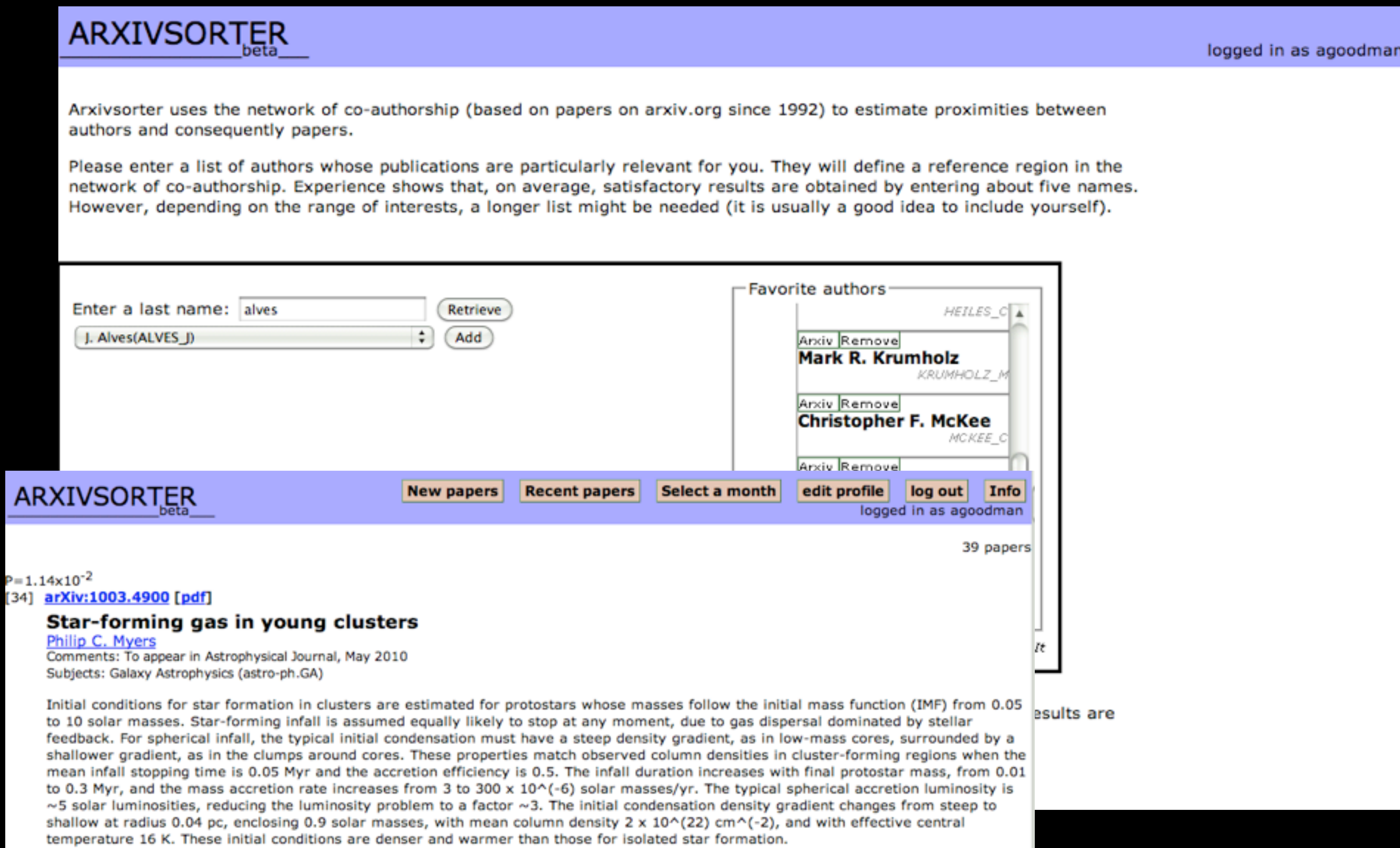

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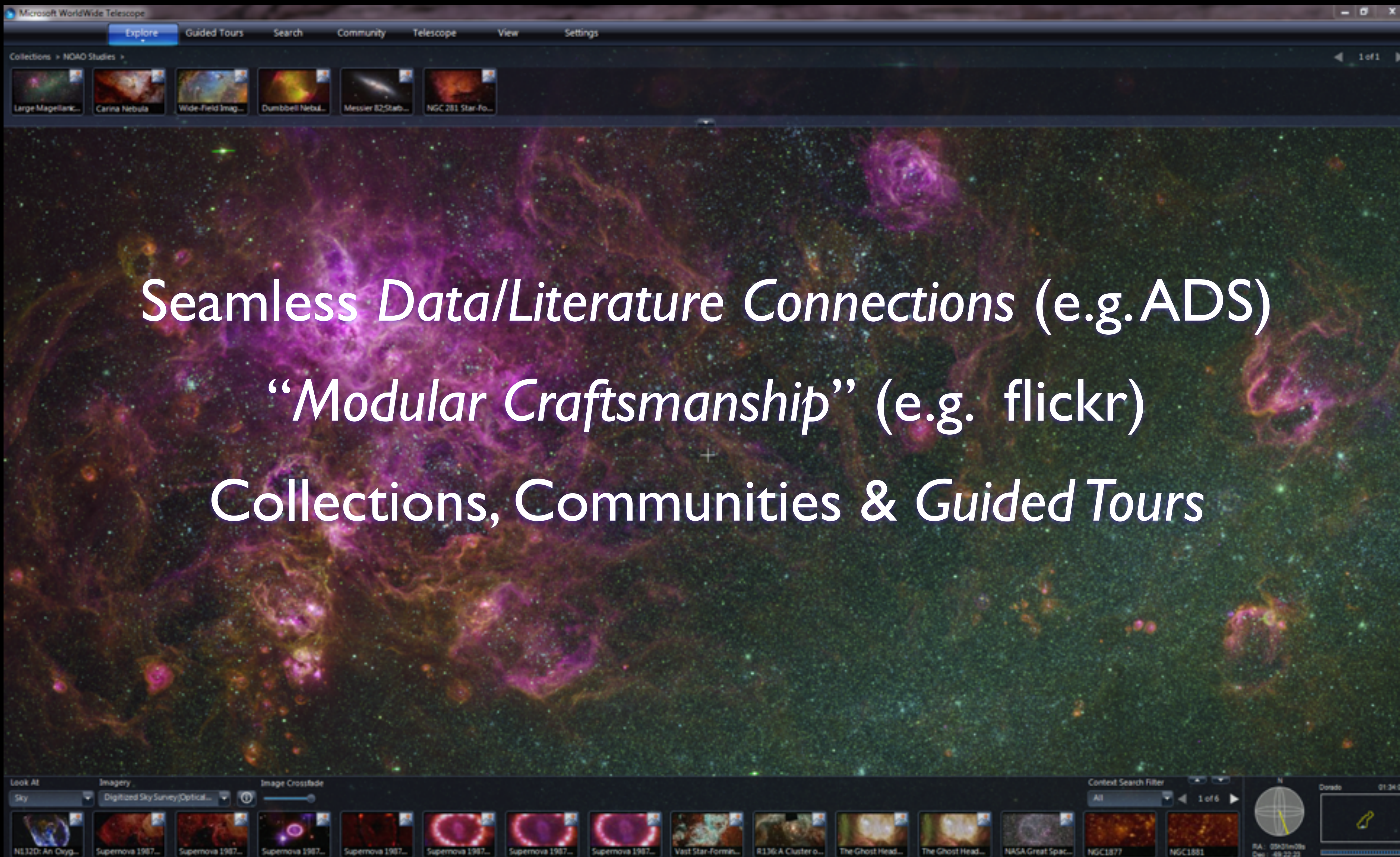
"WorldWide Telescope": a UIS from Microsoft Research
[UIS=Universe Information System]



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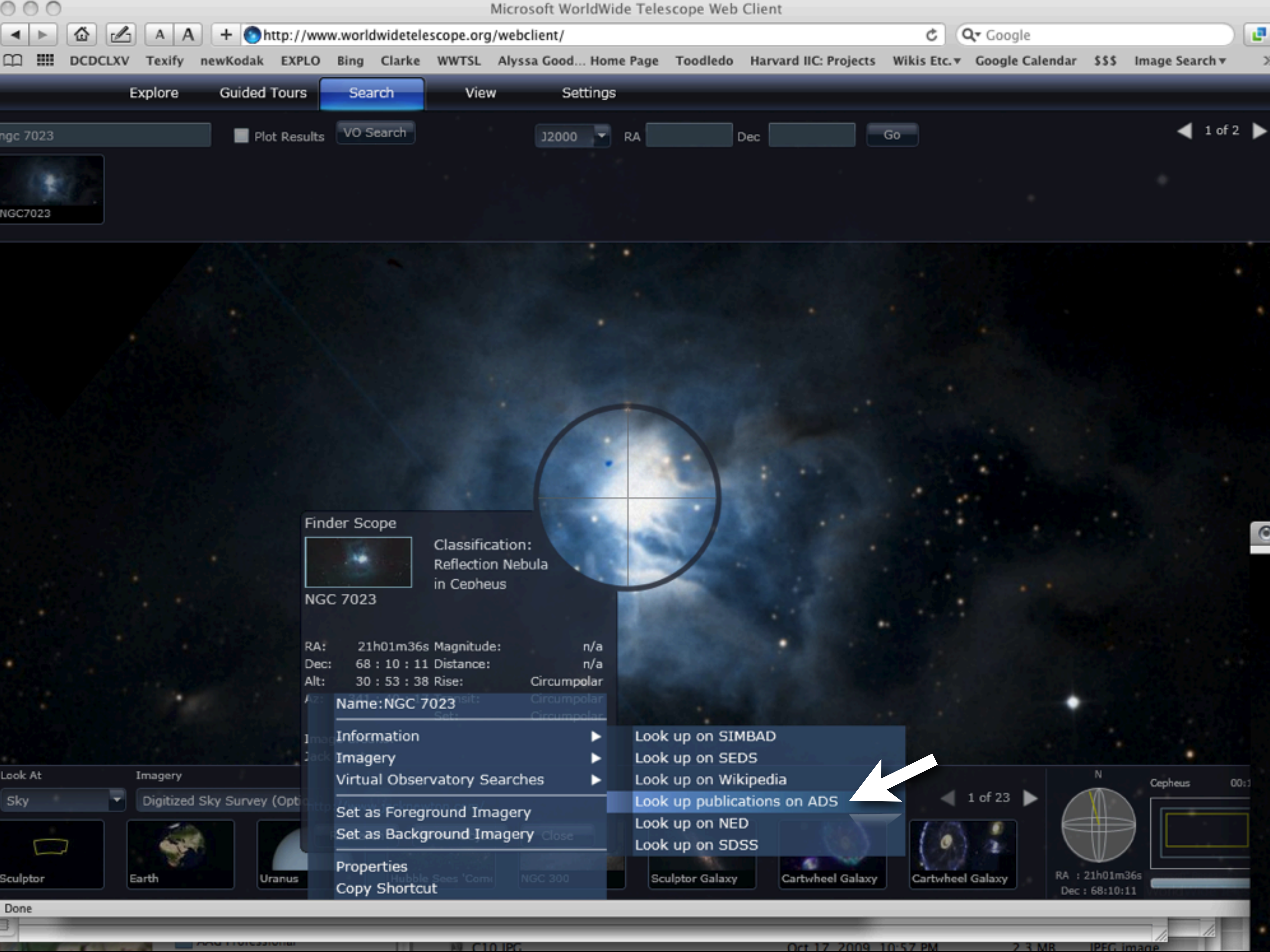

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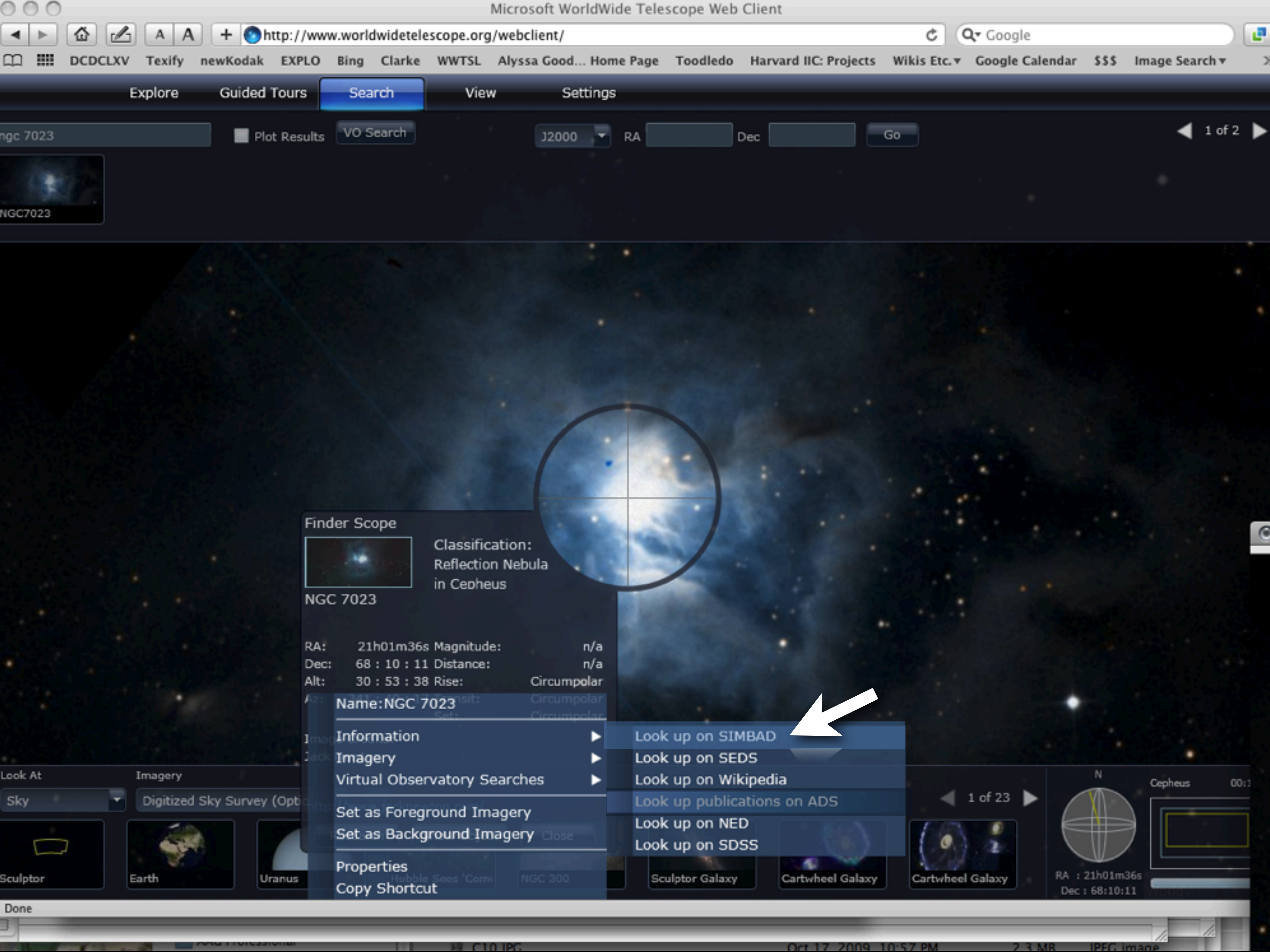
2	2009ApJ...700.1190D Desai, Vandana; Soifer, B. T.; Dey, Arjun; LeFloc'h, Emeric; Armus, Lee; Brand, Kate; Brown, Michael J. I.; Brodwin, Mark; Jannuzi, Buell T.; Houck, James R.; and 8 coauthors	1.000	08/2009 Strong Polycyclic Aromatic Hydrocarbon Emission from z ≈ 2 ULIRGs	A Z E F L X R C S U
3	2009MNRAS.396.1851N 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

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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)
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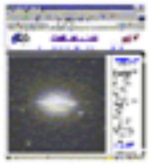
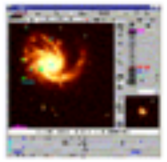
Identifiers (11) :

NGC 7023	IRAS 20599+6755	LBN 487	[BDB2003] G104.06+14.19
C 2059+679	IRAS F20599+6755	OCISM 50	AAVSO 2044+67
Cl VDB 139	LBN 104.08+14.21	OCl 235	

Plots and Images

plot around radius 10 arcmin — Aladin previewer — Aladin applet



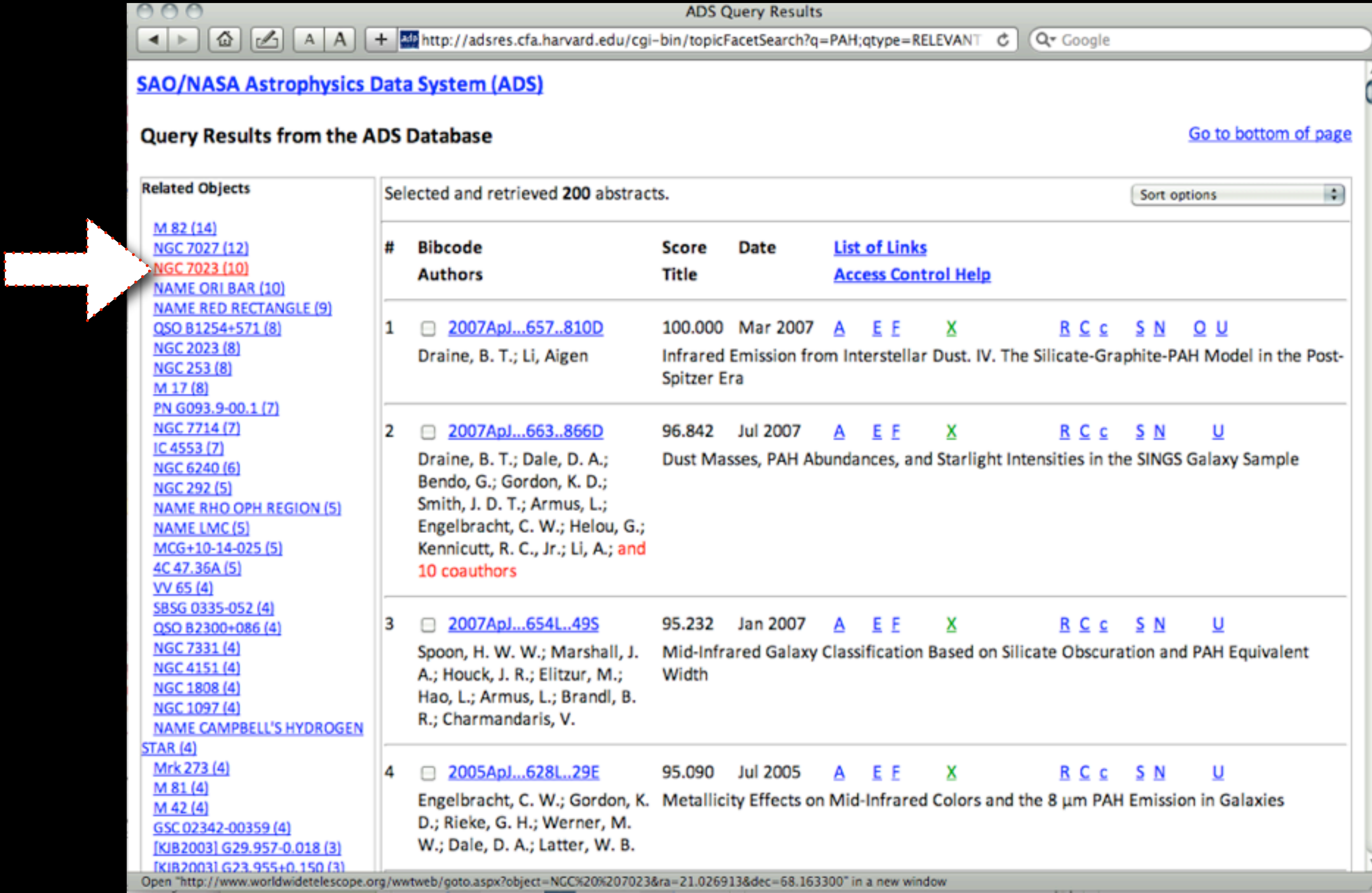


References (371 between 1983 and 2009)

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)



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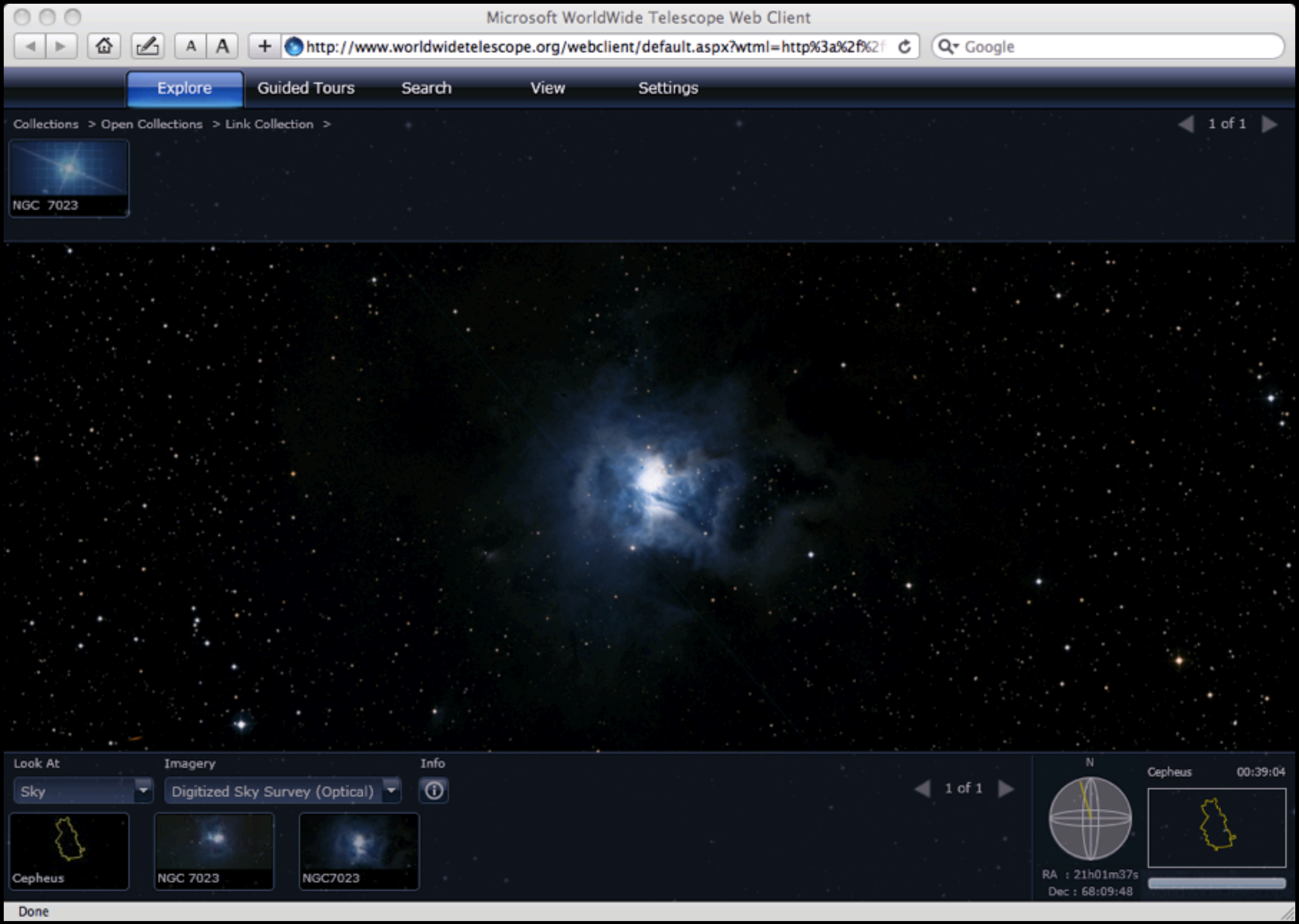

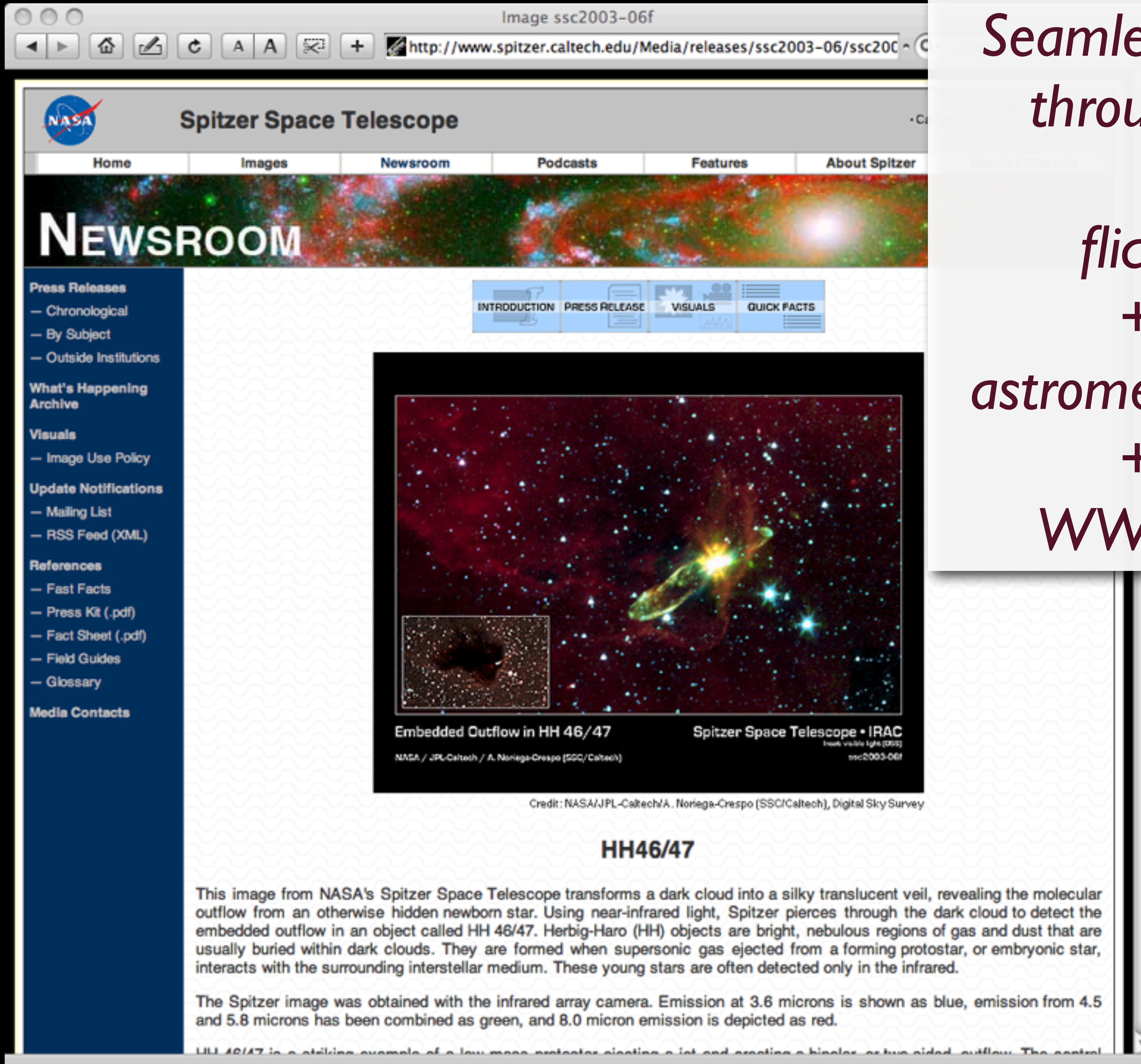

Seamlessness through...

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WWT !?

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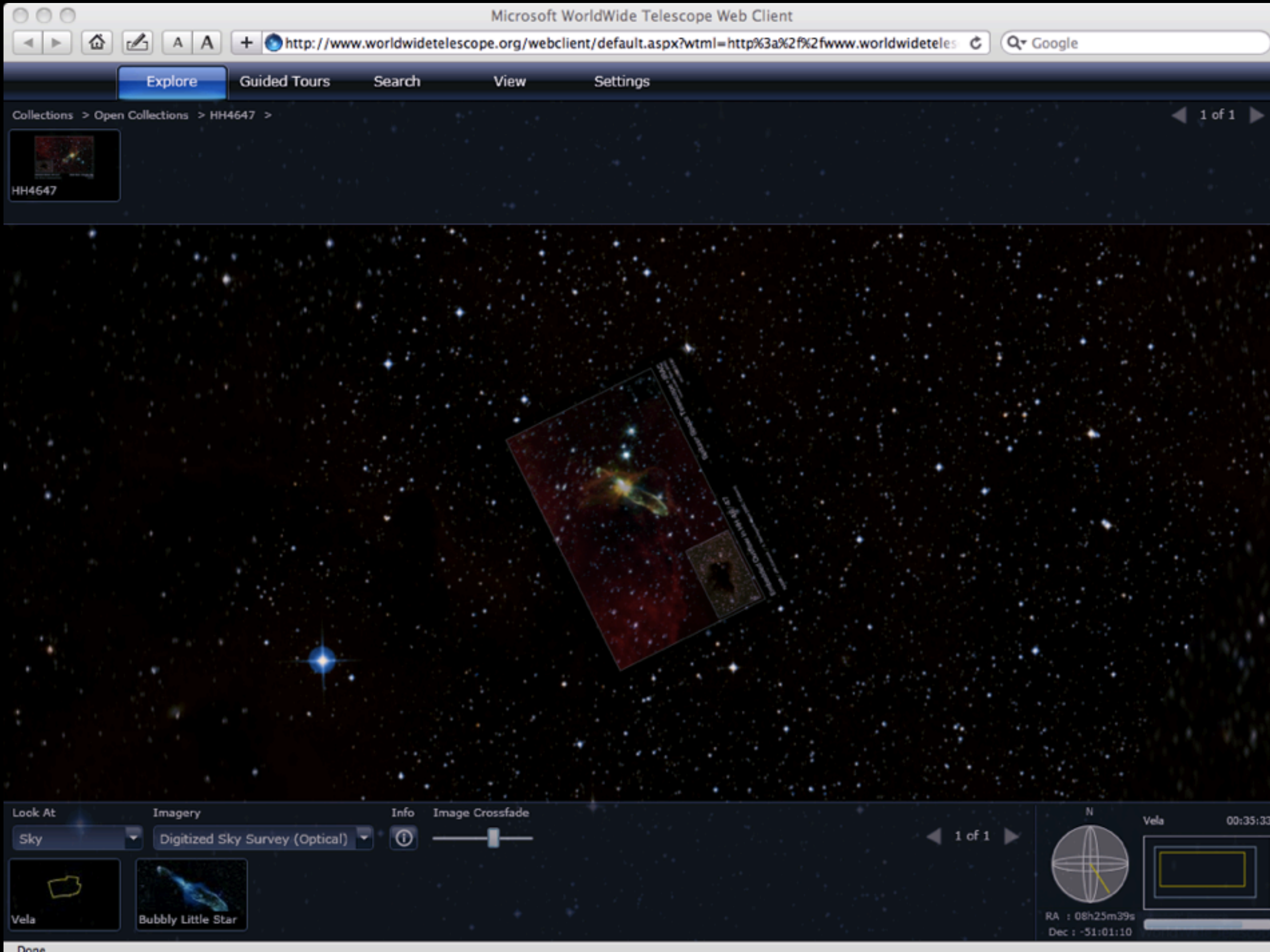

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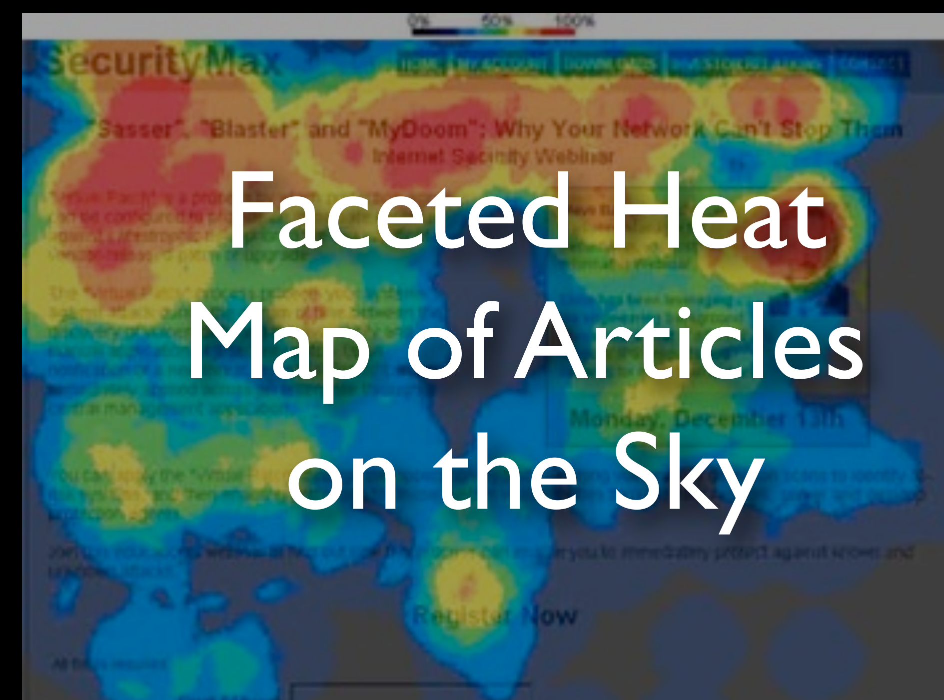
Coming Soon from ADS
(I hope!)



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

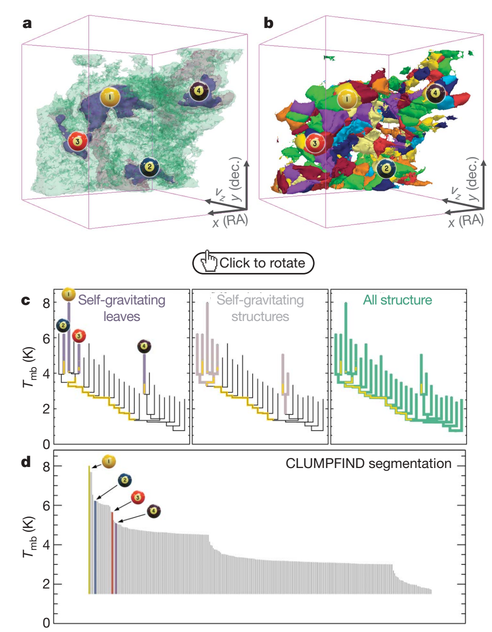


Figure 2 | Comparison of the 'dendrogram' and 'CLUMPFIND' feature-identification algorithms as applied to ^{13}CO emission from the L1448 region of Perseus. a, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating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

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 $X_{13CO} = 8.0 \times 10^{20}\ \mathrm{cm^2\,K^{-1}\,km^{-1}\,s}$ (ref. 15; see Supplementary Methods and Supplementary Fig. 2). The derived values for size, mass and velocity dispersion can then be used to estimate the role of self-gravity at each point in the hierarchy, via calculation of an 'observed' virial parameter, $\alpha_{obs} = 5\sigma_v^2 R/GM_{lum}$. In principle, extended portions of the tree (Fig. 2, yellow highlighting) where $\alpha_{obs} < 2$ (where gravitational energy is comparable to or larger than kinetic energy) correspond to regions of p–p–v space where self-gravity is significant. As α_{obs} only represents the ratio of kinetic energy to gravitational energy at one point in time, and does not explicitly capture external over-pressure and/or magnetic fields[16], its measured value should only be used as a guide to the longevity (boundedness) of any particular feature.

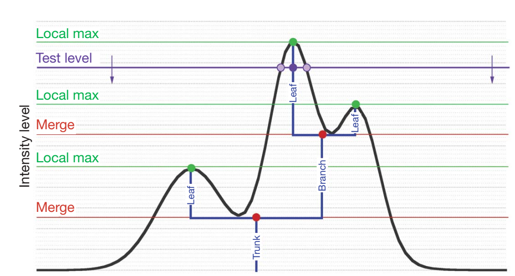


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in size here, light lines) until all the local maxima and mergers are found, and connected as shown. The intersection of a test level with the emission is a set of points (for example the light purple dots) in one dimension, a planar curve in two dimensions, and an isosurface in three dimensions. The dendrogram of 3D data shown in Fig. 2c is the direct analogue of the tree shown here, only constructed from 'isosurface' rather than 'point' intersections. It has been sorted and flattened for representation on a flat page, as fully representing dendrograms for 3D data cubes would require four dimensions.

FYI... as per Eric's comments, this came from our "'AstroMed" project am.iic.harvard.edu

Goodman et al. *Nature*, 2009

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

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User Groups
(CfA now has one)

YouTube

+Suggestions?!

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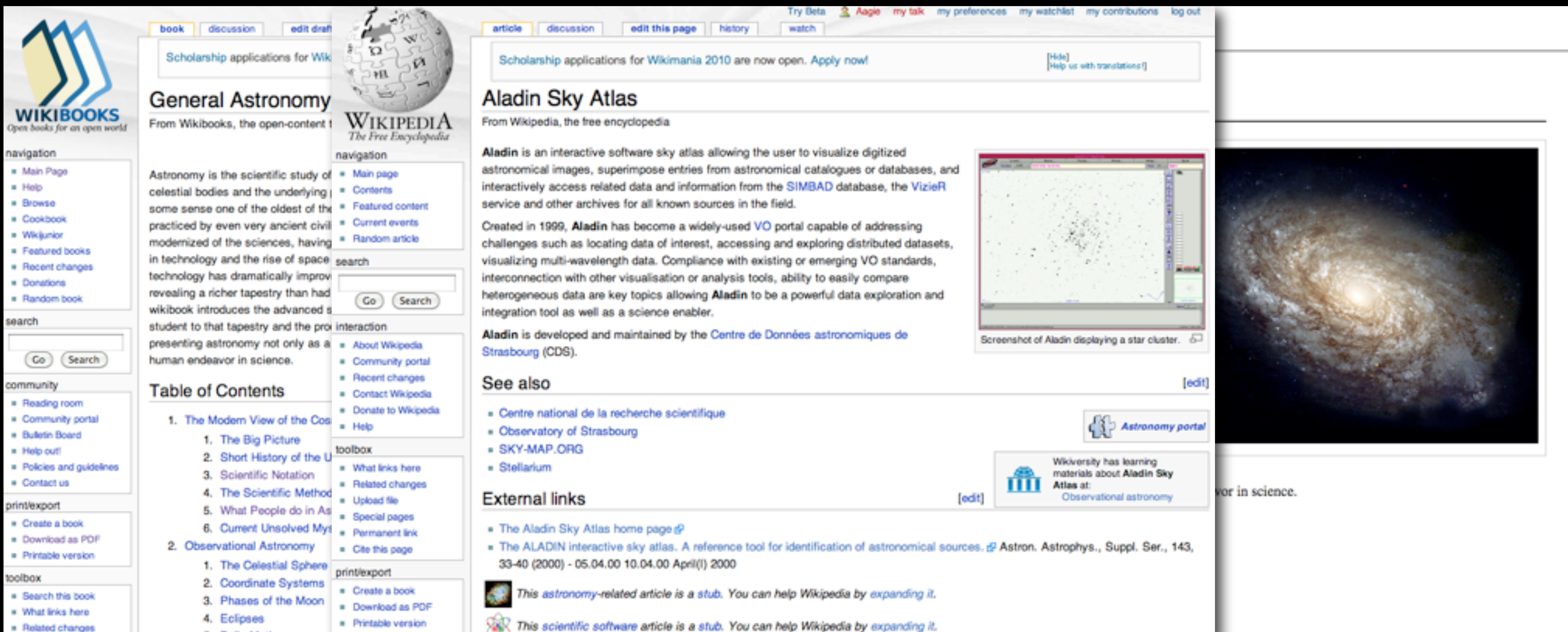

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Astronomy is the scientific study of
celestial bodies and the underlying
some sense one of the oldest of the
practiced by even very ancient civil
modernized of the sciences, having
in technology and the rise of space
technology has dramatically improv
revealing a richer tapestry than had
wikibook introduces the advanced s
student to that tapestry and the pro
presenting astronomy not only as a
human endeavor in science.
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Aladin Sky Atlas
From Wikipedia, the free encyclopedia
Aladin is an interactive software sky atlas allowing the user to visualize digitized astronomical images, superimpose entries from astronomical catalogues or databases, and interactively access related data and information from the SIMBAD database, the VizieR service and other archives for all known sources in the field.
Created in 1999, Aladin has become a widely-used VO portal capable of addressing challenges such as locating data of interest, accessing and exploring distributed datasets, visualizing multi-wavelength data. Compliance with existing or emerging VO standards, interconnection with other visualisation or analysis tools, ability to easily compare heterogeneous data are key topics allowing Aladin to be a powerful data exploration and integration tool as well as a science enabler.
Aladin is developed and maintained by the Centre de Données astronomiques de Strasbourg (CDS).
Screenshot of Aladin displaying a star cluster.
See also
[edit]
Centre national de la recherche scientifique
Observatory of Strasbourg
SKY-MAP.ORG
Stellarium
Astronomy portal
Wikiversity has learning materials about Aladin Sky Atlas at:
Observational astronomy
External links
[edit]
The Aladin Sky Atlas home page
The ALADIN interactive sky atlas. A reference tool for identification of astronomical sources. Astron. Astrophys., Suppl. Ser., 143, 33-40 (2000) - 05.04.00 10.04.00 April(I) 2000
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vor in science.

User Groups (CfA now has one)

WIKIBOOKS
Open books for an open world

ASTROBETTER
Tips and Tricks for Professional Astronomers

.astronomy

YouTube

myexperiment

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

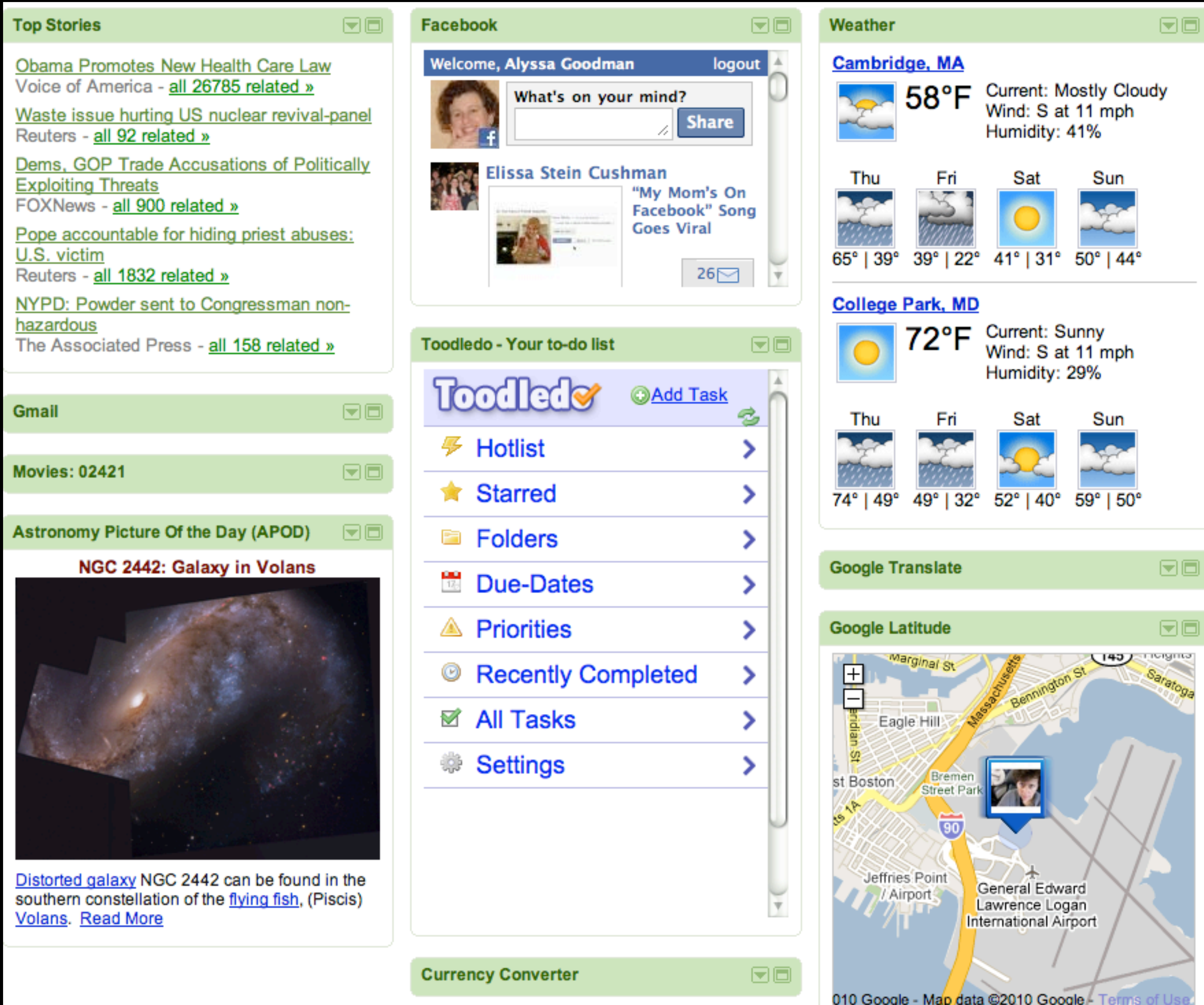
Kiva model.. with VAO funding?

“Associates”?

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

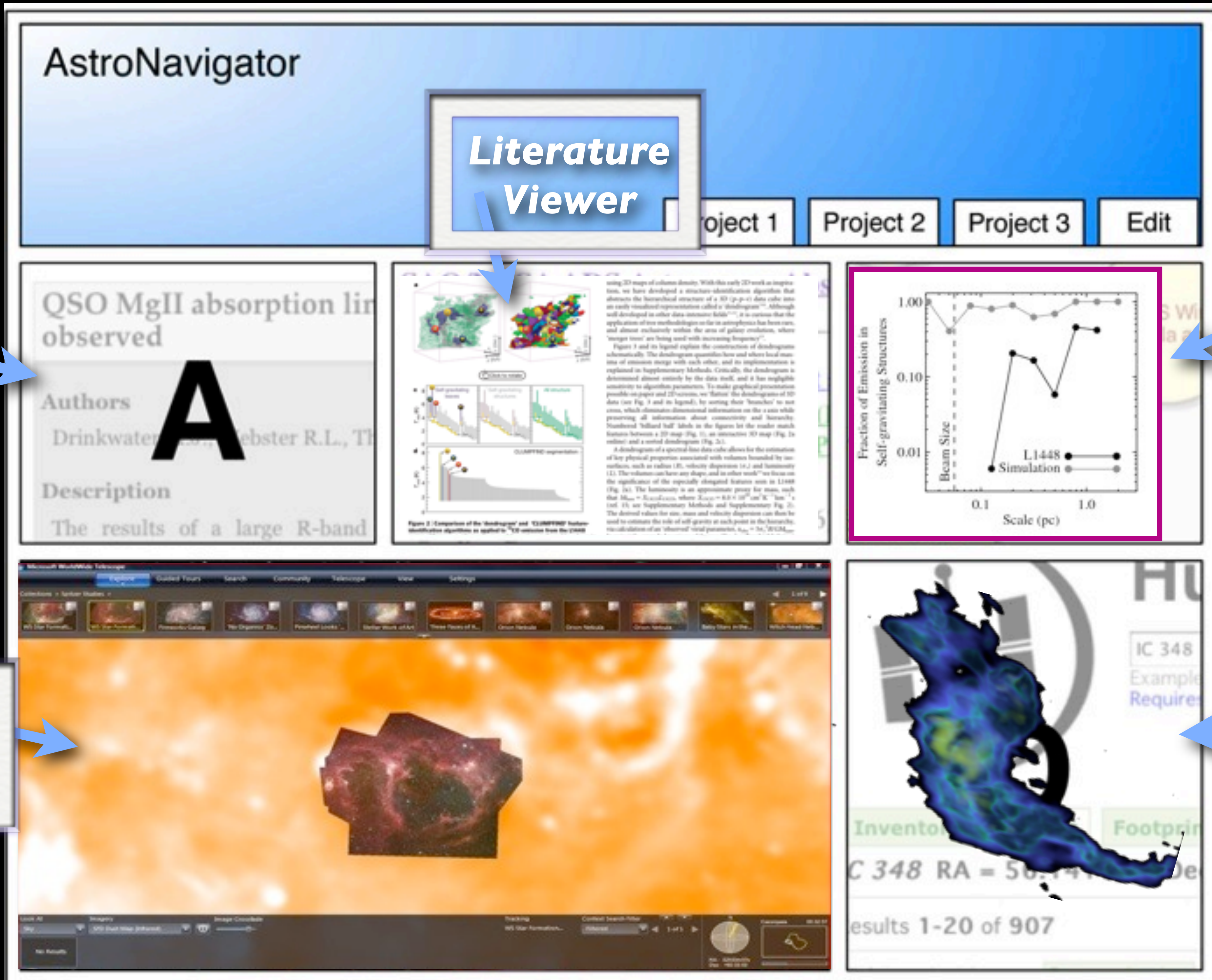
“SAMP” is a great technical start, but offers a very significant user interface challenge.

iGoogle: "A Diversity of Tools"



Seamless Astronomy

Semantic Search



Info-Vis for Analytics

Sift-based Search Results

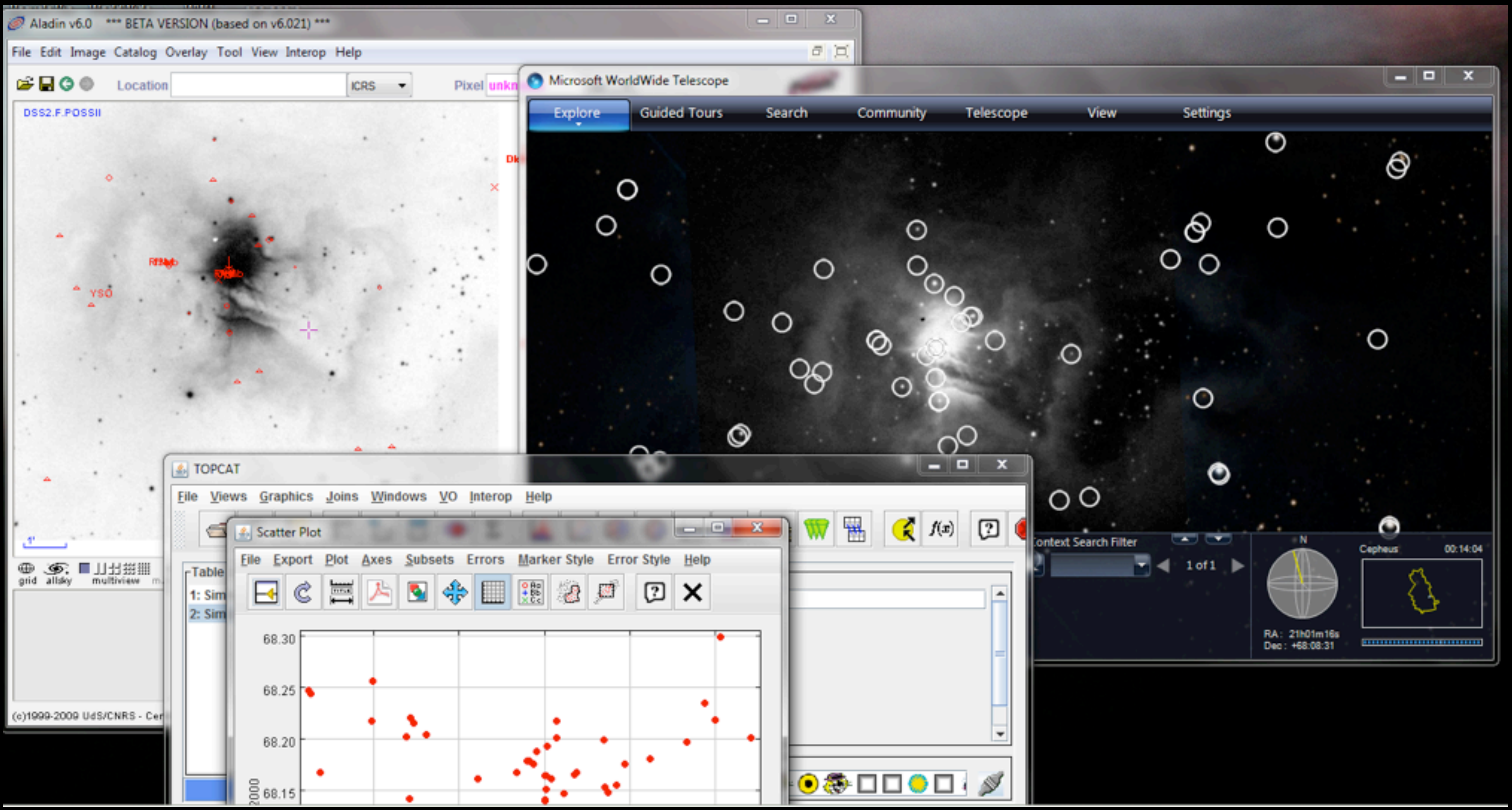
Data Viewer (e.g. WWT)

Archive Browser

3D Viewer

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

SAMP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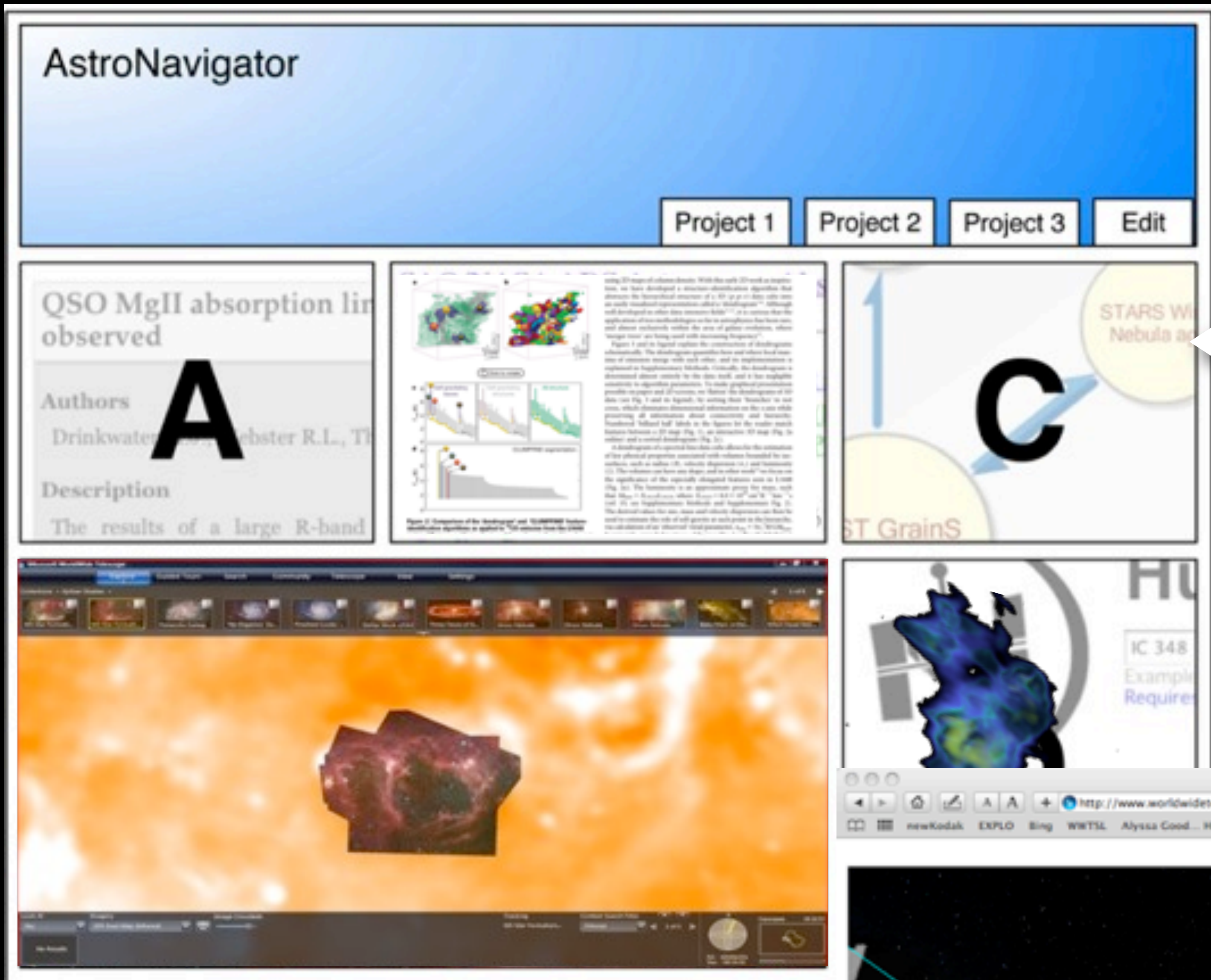
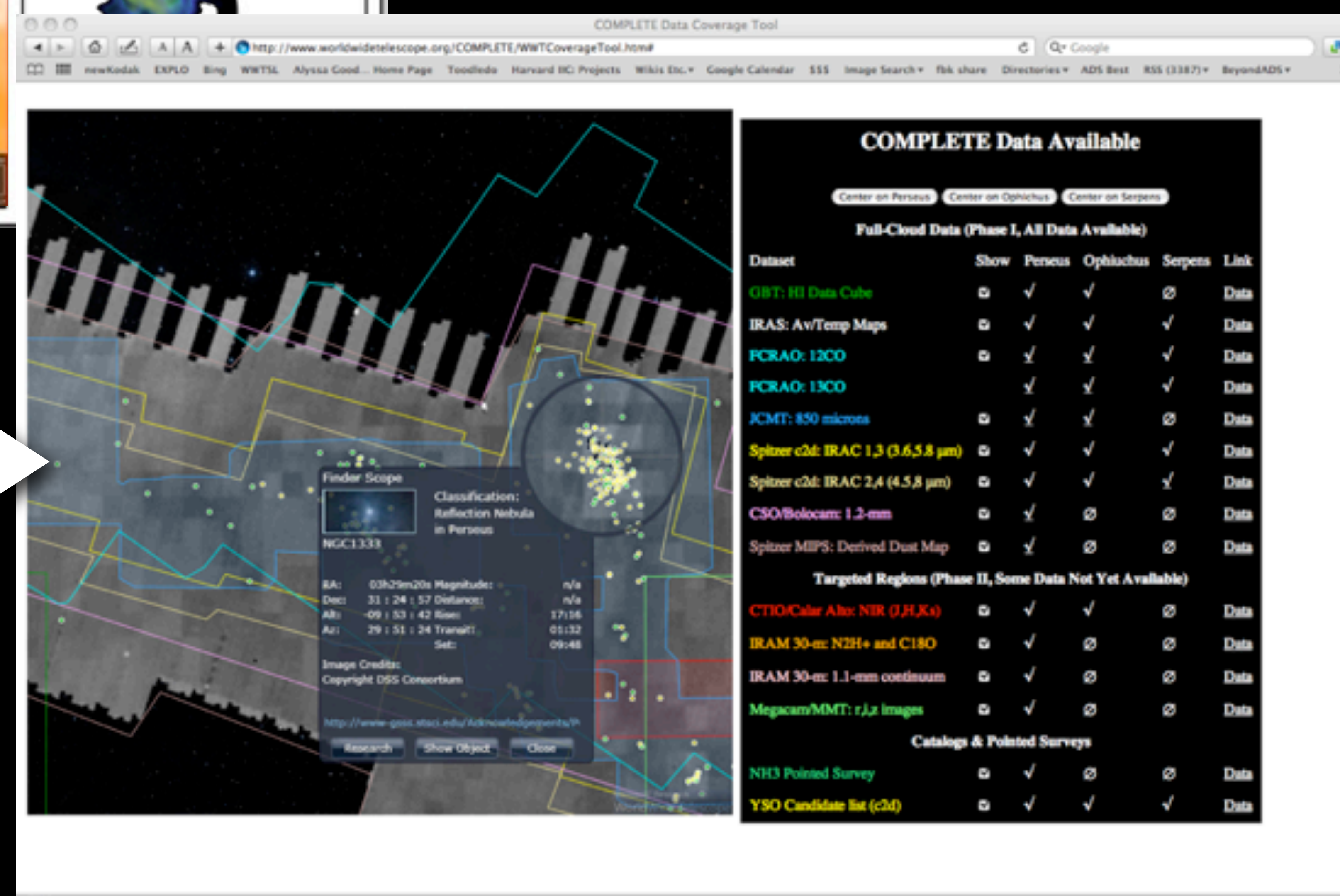


Fiction
(for now)

Fact
(right now)



Evermore Seamless Astronomy

Alyssa A. Goodman

Harvard-Smithsonian Center for Astrophysics

with Alberto Accomazzi, Douglas Burke, Gus Muench & Michael Kurtz (Harvard-Smithsonian CfA); Eli Bressert (U. Exeter); Tim Clark (Massachusetts General Hospital/Harvard Medical School); Chris Borgman (UCLA); Jonathan Fay & Curtis Wong (Microsoft Research)

Extra Slides

Wikipedia

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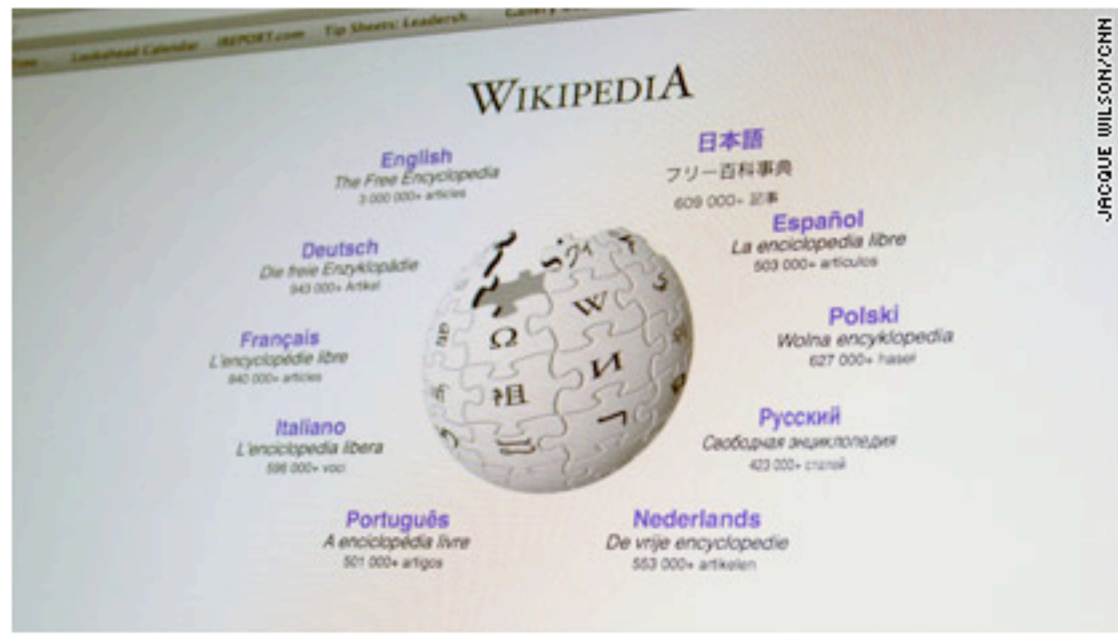
March 24, 2010

Wikipedia down after server meltdown

Posted: 03:07 PM ET



Wikipedia was offline Wednesday afternoon after an overheating problem at the online encyclopedia's European data center.

Wikipedia's **technical blog** said the site's servers shut themselves down to avoid damage from the heat.

Administrators tried to shift traffic to a cluster of servers in Florida, but "it turned out that this failover mechanism was now broken, causing the DNS resolution of Wikimedia sites to stop working globally," according to the blog.

"This problem was quickly resolved, but unfortunately it may take up to an hour before access is restored for everyone, due to caching effects," the blog said.

Trying to access wikipedia.com and wikipedia.org at about 2:45 p.m. ET produced a navigation error