Seamless Astronomy

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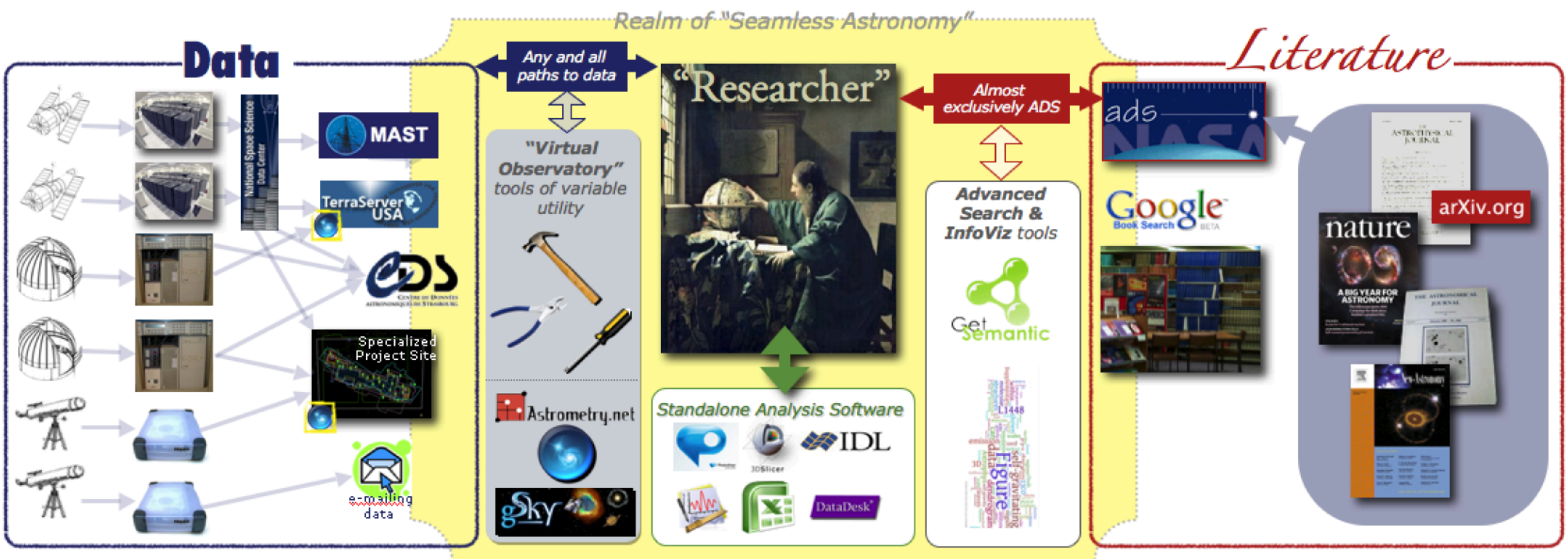
Initiative in Innovative Computing @ Harvard

Key Collaborators:
Curtis ***Wong*** *& Jonathan* ***Fay****, Microsoft Research/WWT*
Gus ***Muench****, Harvard*

Seamless Astronomy

www.cfa.harvard.edu/~agoodman and worldwidetelescope.org



Talk = overall philosophy

Poster = a bit more rigor

What (the) "Virtual Observatory" meant/means/should mean to...

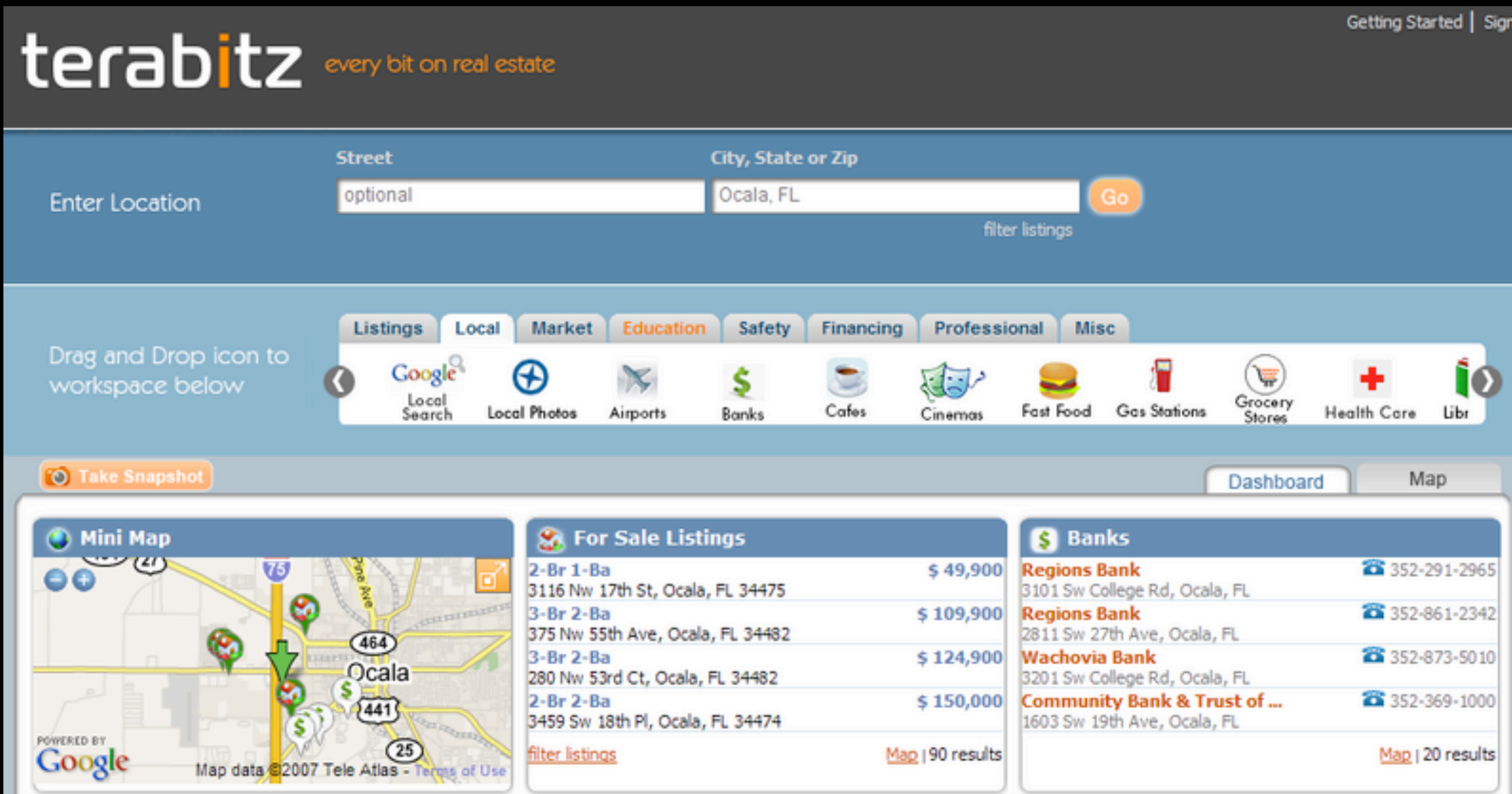
Jim Gray & Alex Szalay

Typical Astronomers Today

Me

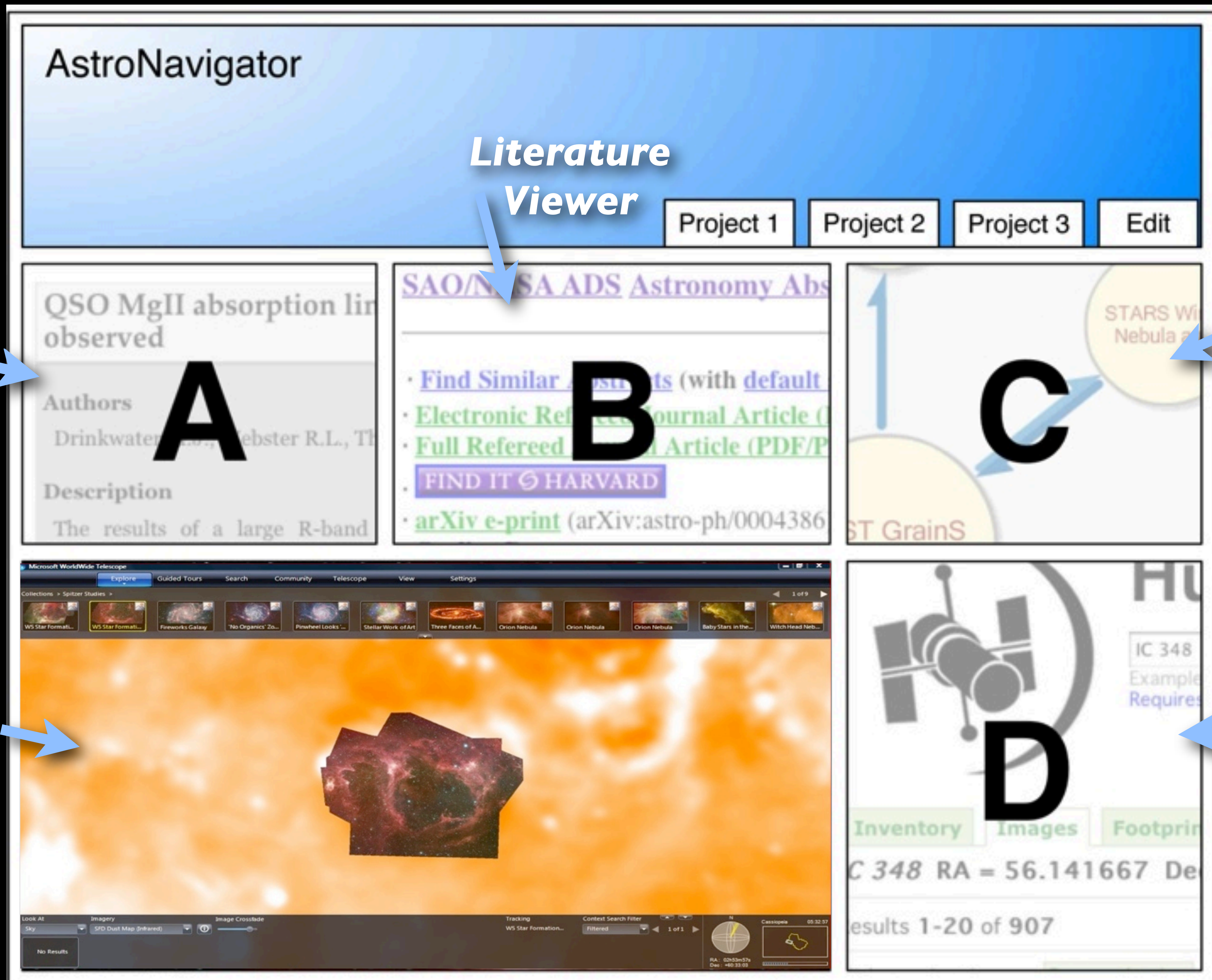
Astronomers who travel & use facebook...

astrobitz?


terabitz
every bit on real estate
Getting Started | Sign
Enter Location
Street
optional
City, State or Zip
Ocala, FL
Go
filter listings
Drag and Drop icon to workspace below
Listings
Local
Market
Education
Safety
Financing
Professional
Misc
Local Search
Local Photos
Airports
Banks
Cafes
Cinemas
Fast Food
Gas Stations
Grocery Stores
Health Care
Take Snapshot
Dashboard
Map
Mini Map
Ocala
Map data ©2007 Tele Atlas - Terms of Use
For Sale Listings
2-Br 1-Ba $ 49,900
3116 Nw 17th St, Ocala, FL 34475
3-Br 2-Ba $ 109,900
375 Nw 55th Ave, Ocala, FL 34482
3-Br 2-Ba $ 124,900
280 Nw 53rd Ct, Ocala, FL 34482
2-Br 2-Ba $ 150,000
3459 Sw 18th Pl, Ocala, FL 34474
filter listings
Map | 90 results
Banks
Regions Bank 352-291-2965
3101 Sw College Rd, Ocala, FL
Regions Bank 352-861-2342
2811 Sw 27th Ave, Ocala, FL
Wachovia Bank 352-873-5010
3201 Sw College Rd, Ocala, FL
Community Bank & Trust of ... 352-369-1000
1603 Sw 19th Ave, Ocala, FL
Map | 20 results

Seamless Astronomy

astrobitz?



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

“Ontology”

“GIS/Layering”

“Search”

What’s needed?

“Progressive Resolve”

“Registration”

“Selection”

“Side-by-Side Comparison”

“Readable Labels”

“Highlighting”

“Zoom”

“Custom Site”

“Measurement”

“Inference”

“Off-the-Desktop”

...and how to explain all that to the Astronomers?


LONG BEACH CONVENTIO CENTER

From: Yan Xu
Subject: RE: (non WWT) press conference attendance for AG or Tuesday AM
Date: December 31, 2008 2:56:23 AM EST
To: Yan Xu , Alyssa Goodman , Megan Watzke
Cc: Becki Culbert (Swift Group) , Curtis G. G. Wong <curtisgwong@msn.com> , Jens Kauffmann , Rosalind Reid

I just found Megan's earlier email, which mentioned that the press will be in room 204 of Convention Center. It is probably not too far from our room 308.

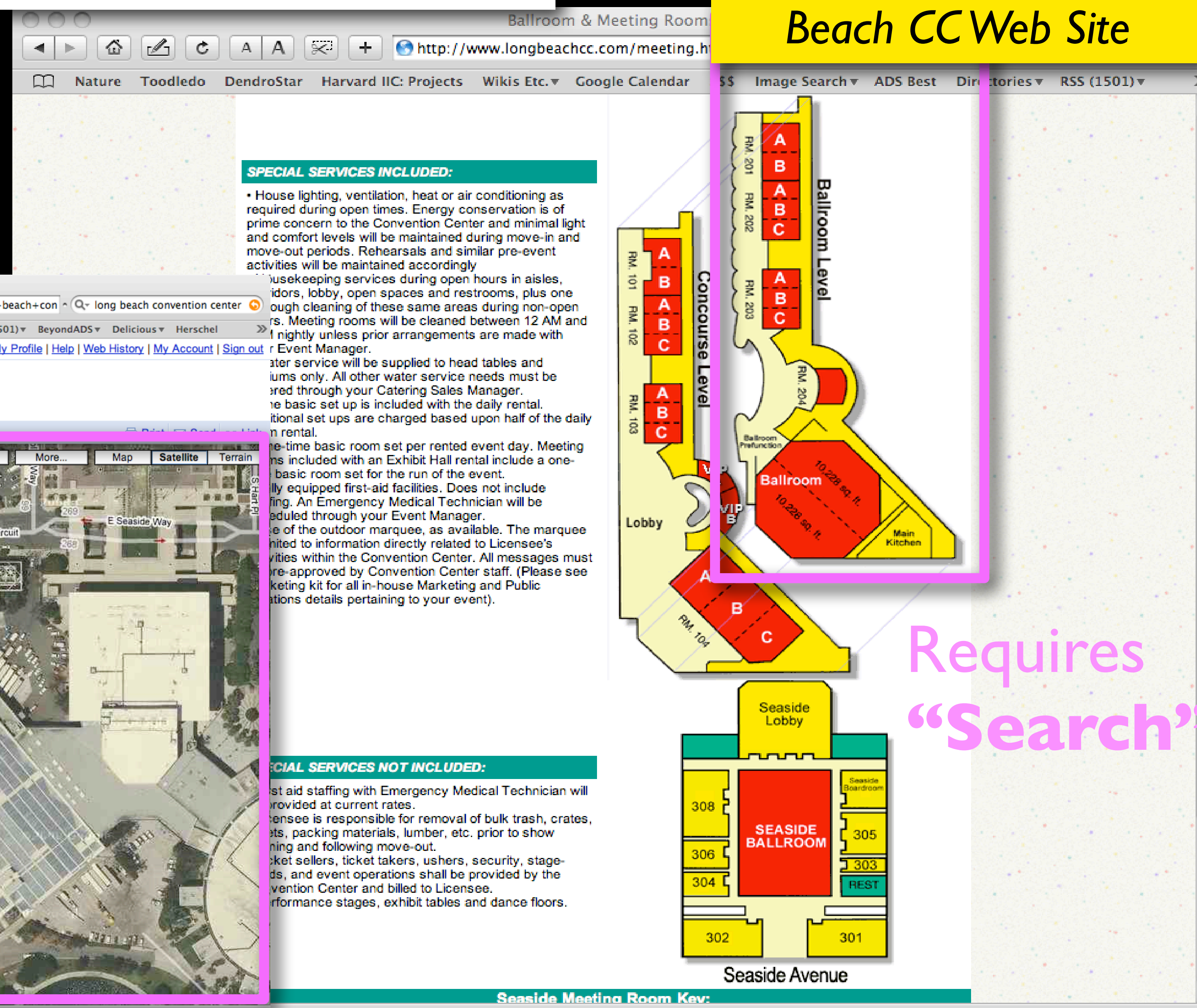
Our setup and presentation will be in the same room: #308 (Exhibition Hall C).

Thanks,
Yan

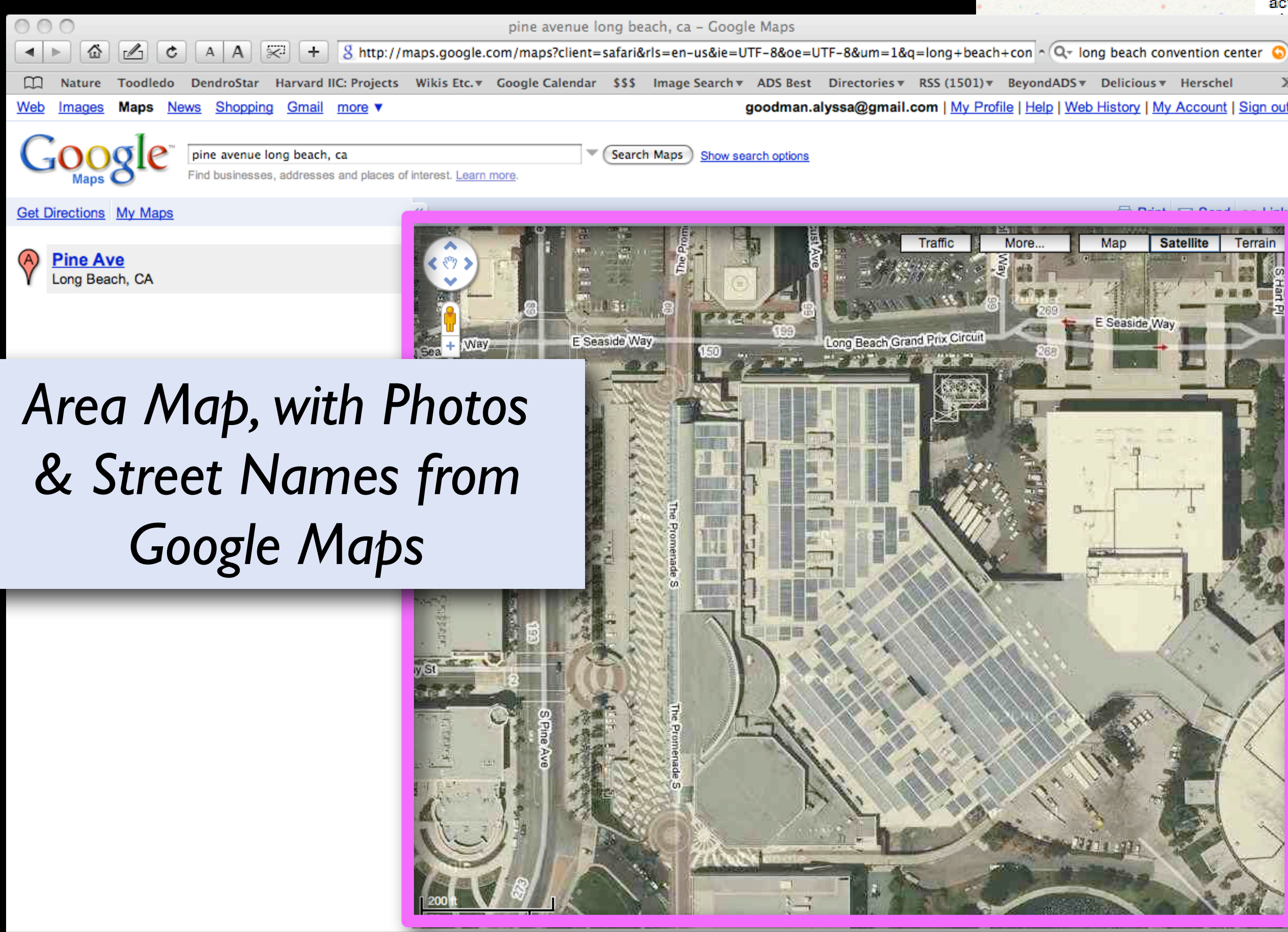
Email with Room Numbers (result of search)

Requires "**Ontology**"

Interior Map on Long Beach CC Web Site

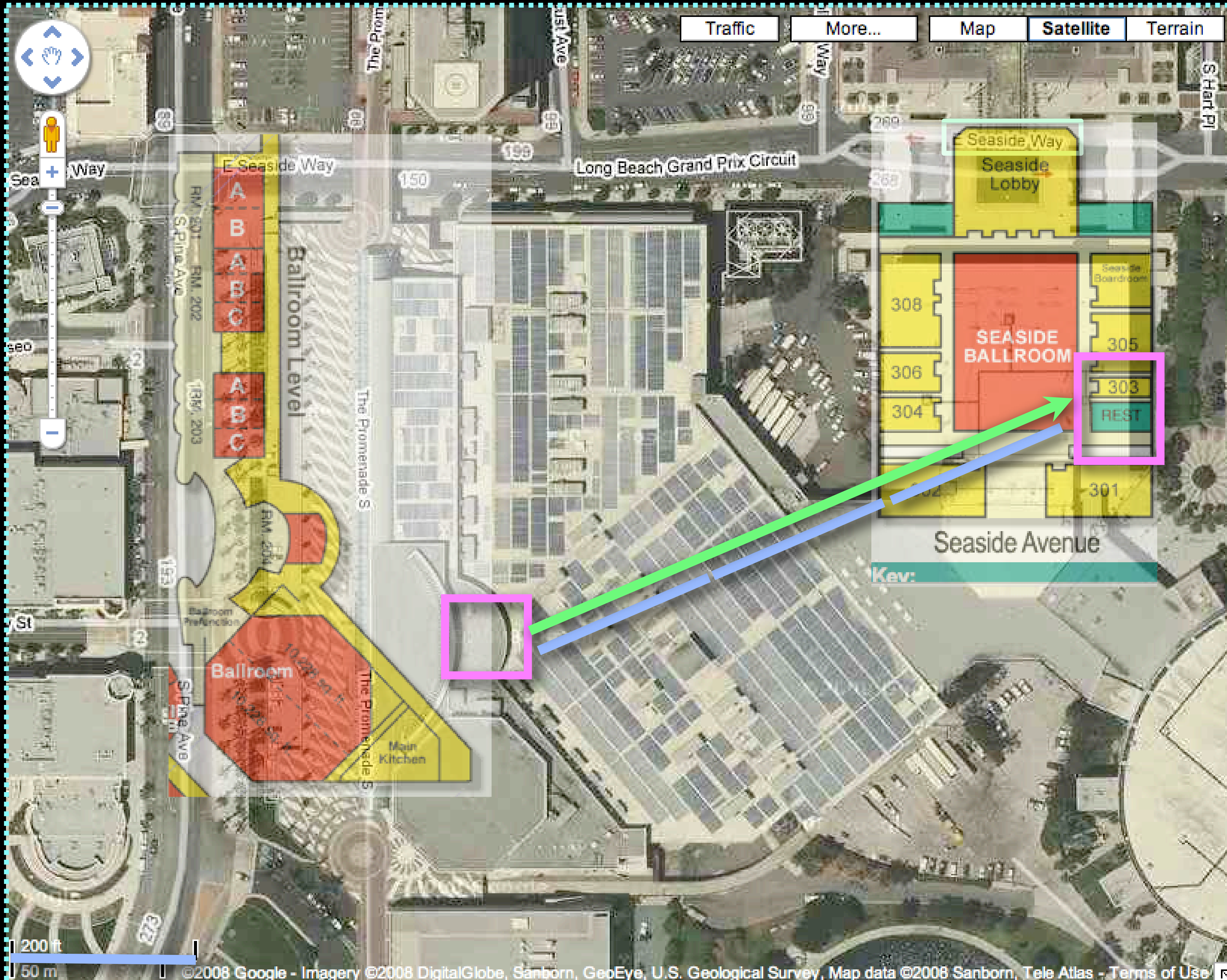


Requires "**GIS/Layering**"



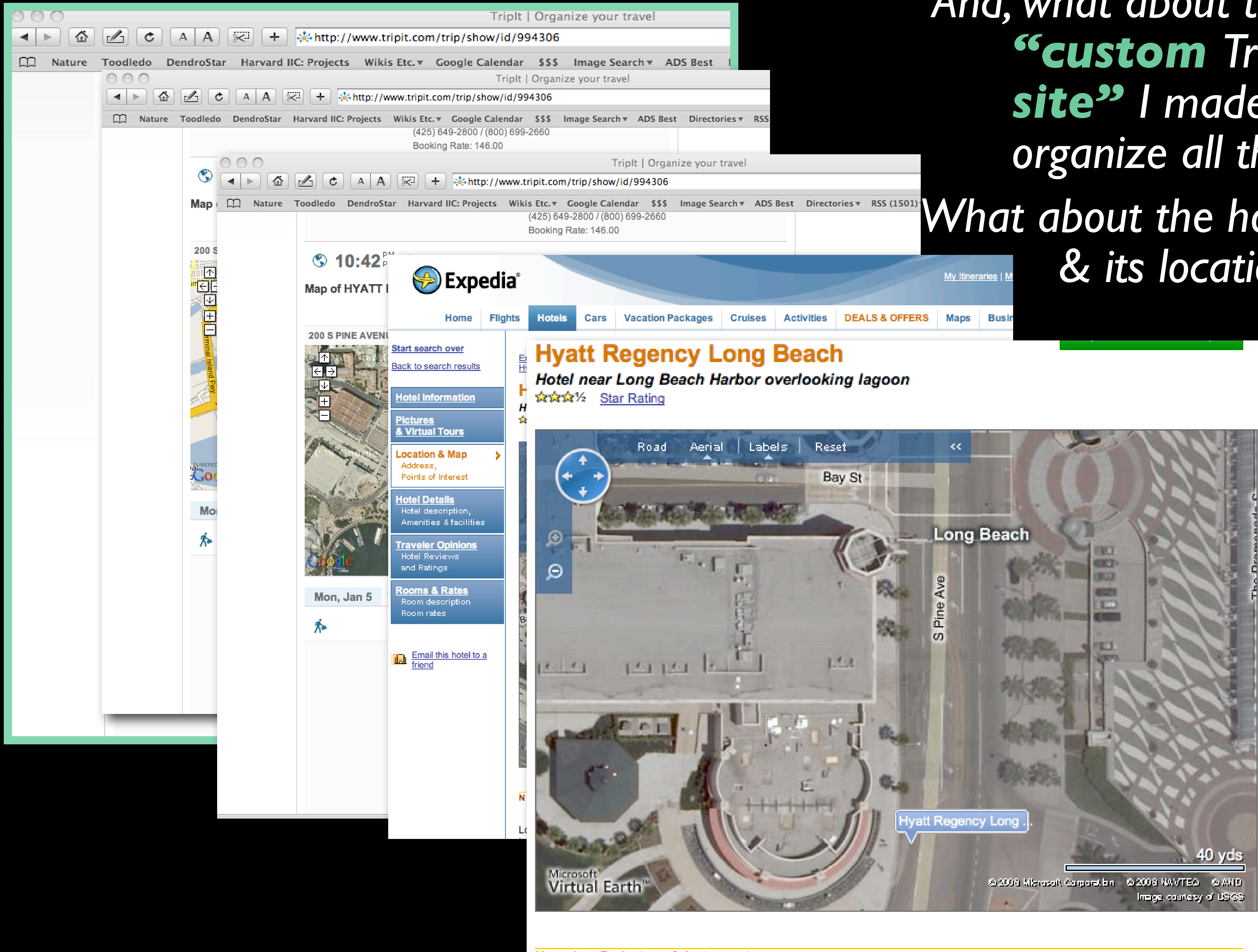
Area Map, with Photos & Street Names from Google Maps

Requires "**Search**"



...*requires:* **"Selection"** ; **"Registration"**;
"Readable Labels" ; **"Highlighting"** ; & **"Measurement"**

in order to yield: **"Inference"**: *...Wow, that's about 600 feet, hope we can change the room!*



And, what about that “custom TripIt site” I made to organize all this?

What about the hotel & its location?

“Inference”: *...Oh, that building with the funky paths outside is the Hyatt... what if I...*

Hyatt Regency Long Beach (Long Beach, CA) - Hotel Reviews - TripAdvisor

http://www.tripadvisor.com/Hotel_Review-g32648-d77605-Reviews-Hyatt_Regency_Long_Beach-Lor RSS Google

Nature Toodledo DendroStar Harvard IIC: Projects Wikis Etc. Google Calendar $$$ Image Search ADS Best Directories RSS (1501) BeyondADS Delicious Herschel

tripadvisor® get the truth. then go.®

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Over 20 million traveler reviews & opinions of hotels, vacations & more

Hyatt Regency Long Beach Hotel

Home | Destinations | Fun & Games | Free Travel Guides | Vacation Ideas | International Sites

Search

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Interested in **Hyatt Regency Long Beach** and **Long Beach?**

We'll send you updates with **the latest deals, reviews and articles for Hyatt**

Home → United States → California (CA) → Long Beach → Long Beach Hotels

Hyatt Regency Long Beach

Hotel class: ★★★★

Rooms: 510

COMPARE PRICES

- Hotel photos
- Map this hotel
- Hotel amenities
- Virtual tour

200 South Pine Avenue, Long Beach, CA 90802

Property Type: Hotel ?

Full service hotel with water views from rooms. Walking distance to 100 shops and restaurants, Aquarium of the Pacific. Centrally located for easy...

more »

Check Rates and Availability: $236 Avg. Price

Check-in:	Check-out:	Adults:
10/2/2009 (mm/dd/yyyy)	10/9/2009 (mm/dd/yyyy)	1

- [x] Expedia.com
- [x] Orbitz.com
- [x] LongBeach.Hyatt.com
- [x] hotels.com
- [x] Travelocity
- [ ] HotelClub.com
- [x] Priceline.com
- [ ] Gtahotels.com

CHECK RATES!

Opens one window for each offer. Please disable pop-up blockers.

TripAdvisor Traveler Reviews

TripAdvisor Traveler Rating:

TripAdvisor Traveler Rating: ?

104 Reviews

5	21
4	43
3	17
2	17
1	6

Write a review

TripAdvisor Popularity Index: ?

#14 of 38 hotels in Long Beach

Call now to book: 1-800-45-HOTEL
from hotels.com

What's possible now?

"Progressive Resolve"

"Zoom"

"Search"

"Selection"

"GIS/Layering"

"Registration"

"Side-by-Side Comparison"

"Readable Labels"

"Highlighting"

"Custom Site"

"Inference"

"Off-the-Desktop"

"Ontology" **"Measurement"**

Image ssc2003-06f

http://www.spitzer.caltech.edu/Media/releases/ssc2003-06/ssc200

Google

Spitzer Space Telescope

• Jet Propulsion Laboratory
• California Institute of Technology
• Vision for Space Exploration

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Newsroom

Press Releases
- Chronological
- By Subject
- Outside Institutions

What's Happening Archive

Visuals
- Image Use Policy

Update Notifications
- Mailing List
- RSS Feed (XML)

References
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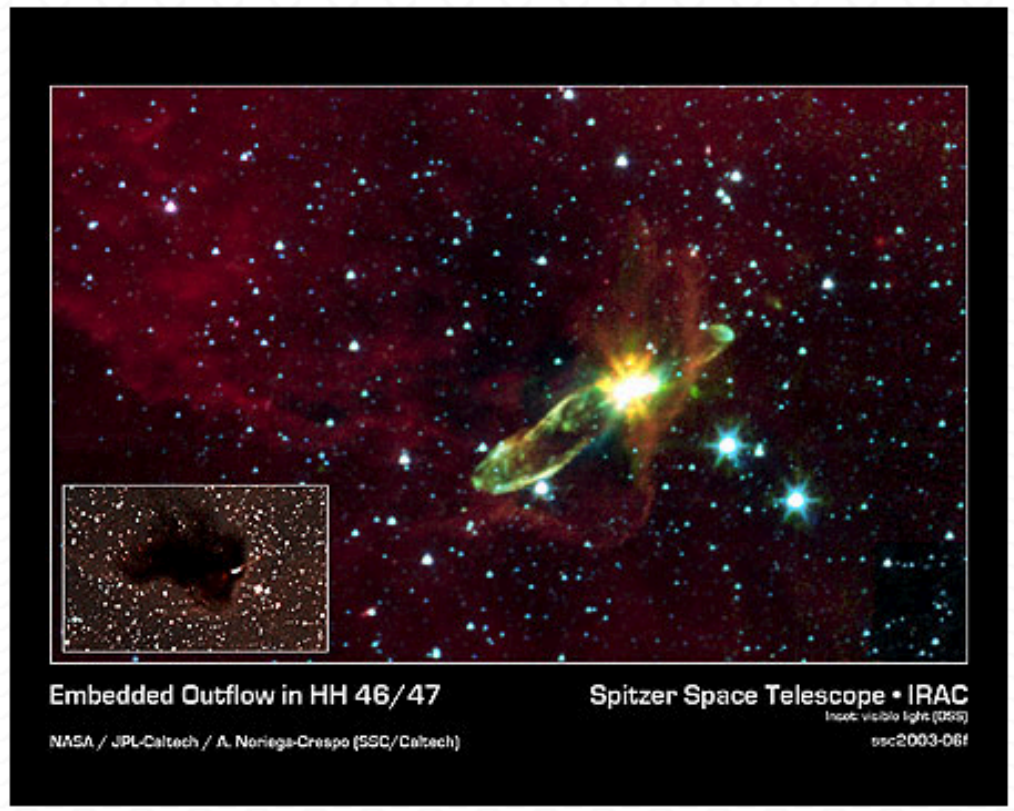
- Press Kit (.pdf)
- Fact Sheet (.pdf)
- Field Guides
- Glossary

Media Contacts

INTRODUCTION | PRESS RELEASE | VISUALS | QUICK FACTS



Credit: NASA/JPL-Caltech/A. Noriega-Crespo (SSC/Caltech), Digital Sky Survey

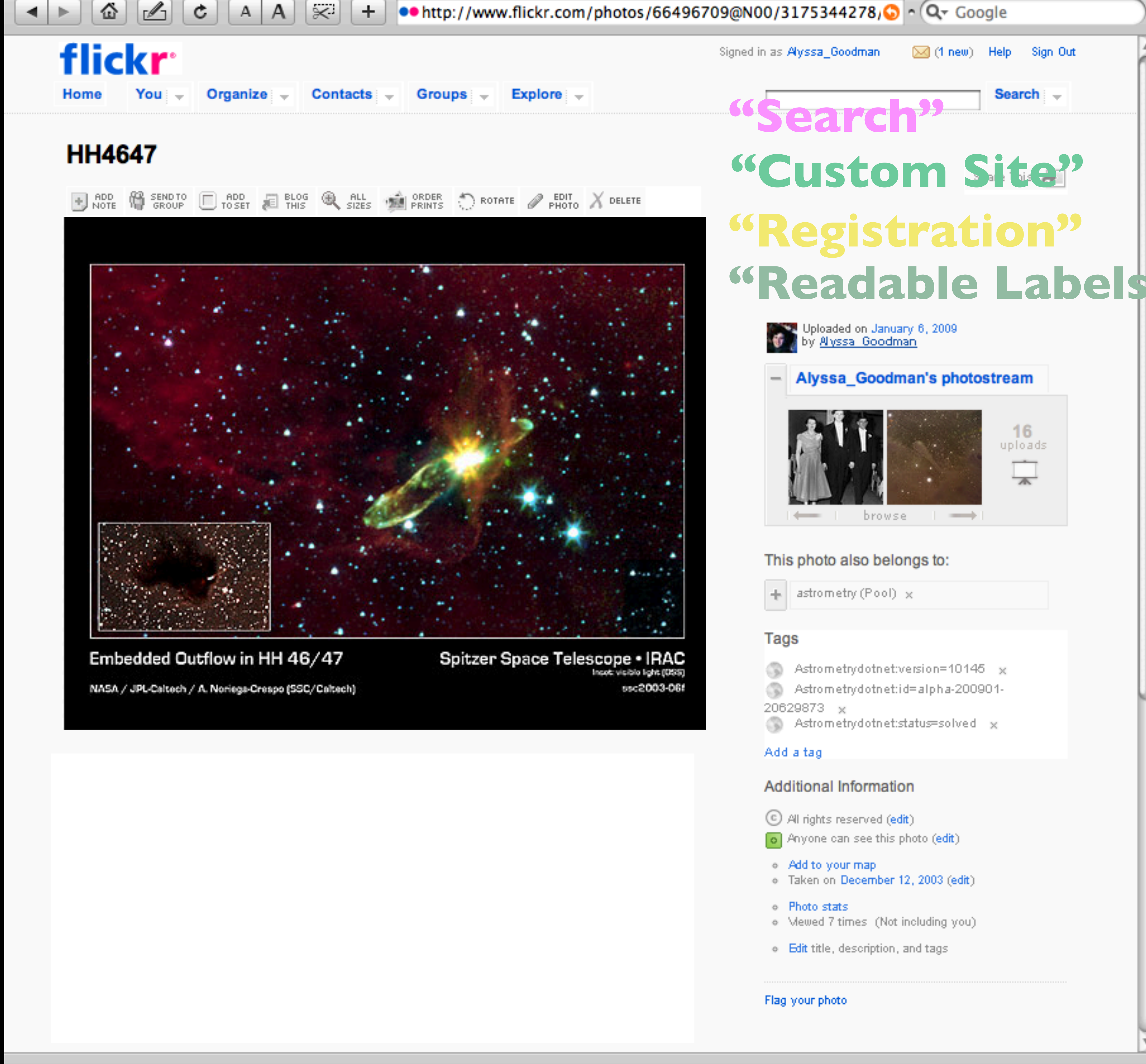
HH46/47

This image from NASA's Spitzer Space Telescope transforms a dark cloud into a silky translucent veil, revealing the molecular outflow from an otherwise hidden newborn star. Using near-infrared light, Spitzer pierces through the dark cloud to detect the embedded outflow in an object called HH 46/47. Herbig-Haro (HH) objects are bright, nebulous regions of gas and dust that are usually buried within dark clouds. They are formed when supersonic gas ejected from a forming protostar, or embryonic star, interacts with the surrounding interstellar medium. These young stars are often detected only in the infrared.

The Spitzer image was obtained with the infrared array camera. Emission at 3.6 microns is shown as blue, emission from 4.5 and 5.8 microns has been combined as green, and 8.0 micron emission is depicted as red.

HH 46/47 is a striking example of a low-mass protostar ejecting a jet and creating a bipolar, or two-sided, outflow. The central

Thursday, April 30, 2009



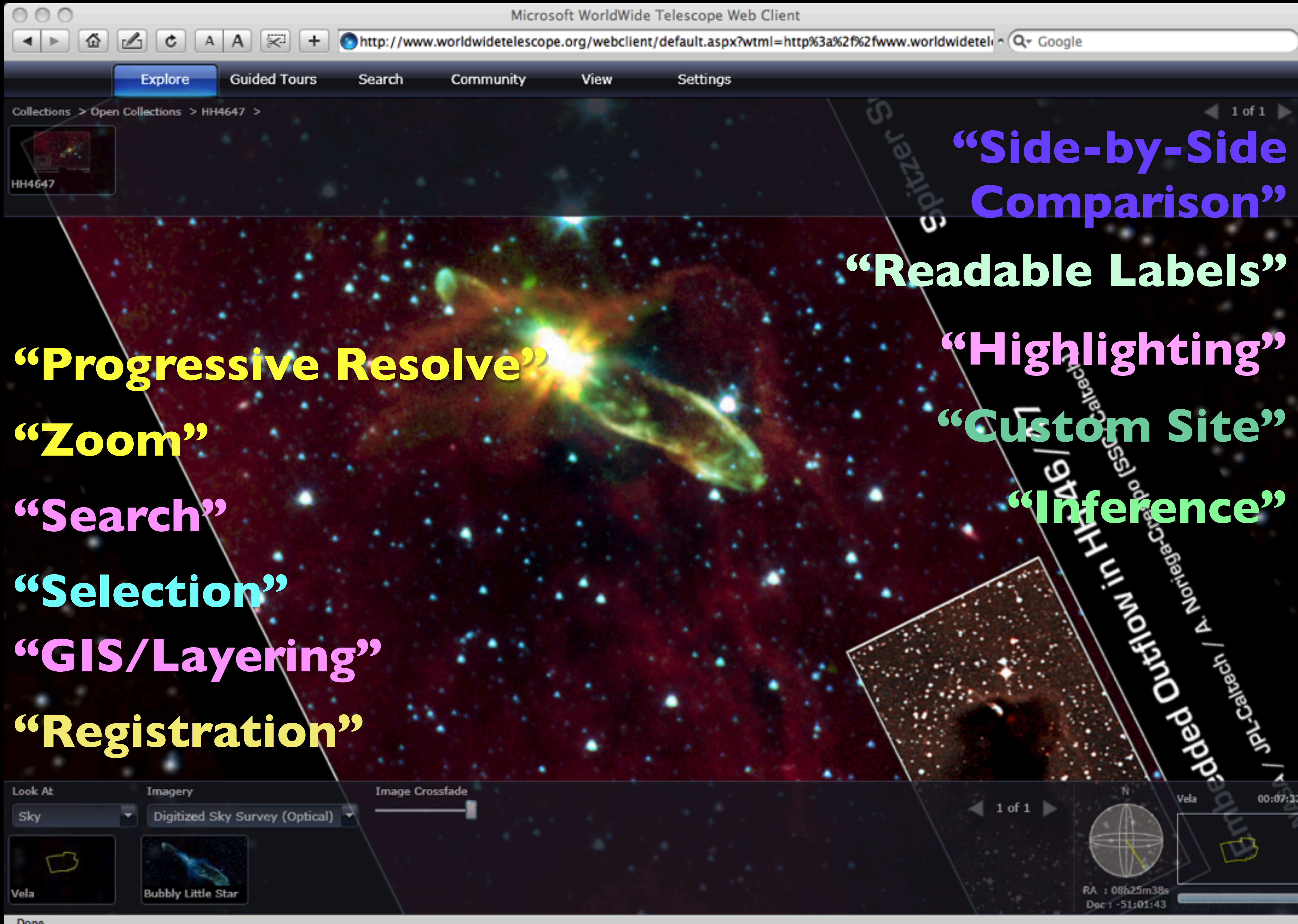
"Search"

"Custom Site"

"Registration"

"Readable Labels"

WWT Silverlight “Alpha”



And to go fully “seamless”?

“Progressive Resolve”

“Zoom”

“Search”

“Selection”

“GIS/Layering”

“Registration”

“Side-by-Side Comparison”

“Readable Labels”

“Highlighting”

“Custom Site”

“Inference”

“Off-the-Desktop”

“Ontology” **“Measurement”**

Going
“Off-the-Desktop”

Slideshow: Tabletop Computers *Continued*
By Meredith Ringel Morris

First Published December 2008

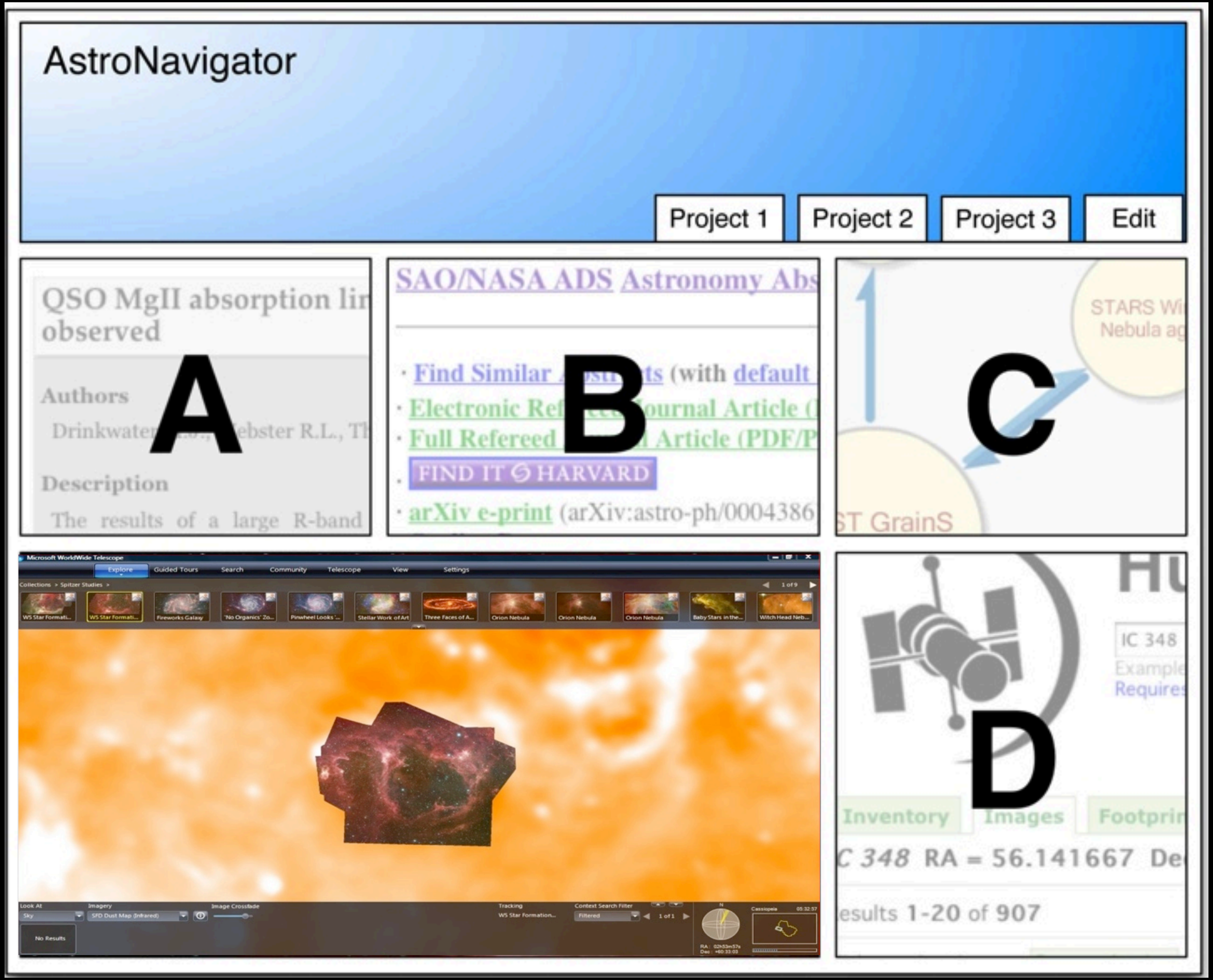
Email Print Comments (1) Reprints Newsletters

UBITABLE: Users can interact with surface computers through auxiliary devices, such as laptops, phones, and PDAs. The display on the auxiliary device can convey private or sensitive content to a single user, while group-appropriate content can appear on the tabletop display. Chia Shen and her colleagues at Mitsubishi Electric Research Laboratories, in Cambridge, Mass., have explored auxiliary interactions with surface computers in their UbiTable project, in which two people with laptops collaborate over a tabletop display. Recently, Shen expanded the UbiTable into an interactive room called the WeSpace. People can share data on their laptops with other people in the room, using both a table and a large display wall. Here, three Harvard University astrophysicists discuss radio and IR spectrum images using the WeSpace.

More information: See the IIC’s “Scientists Discovery Room” project pages

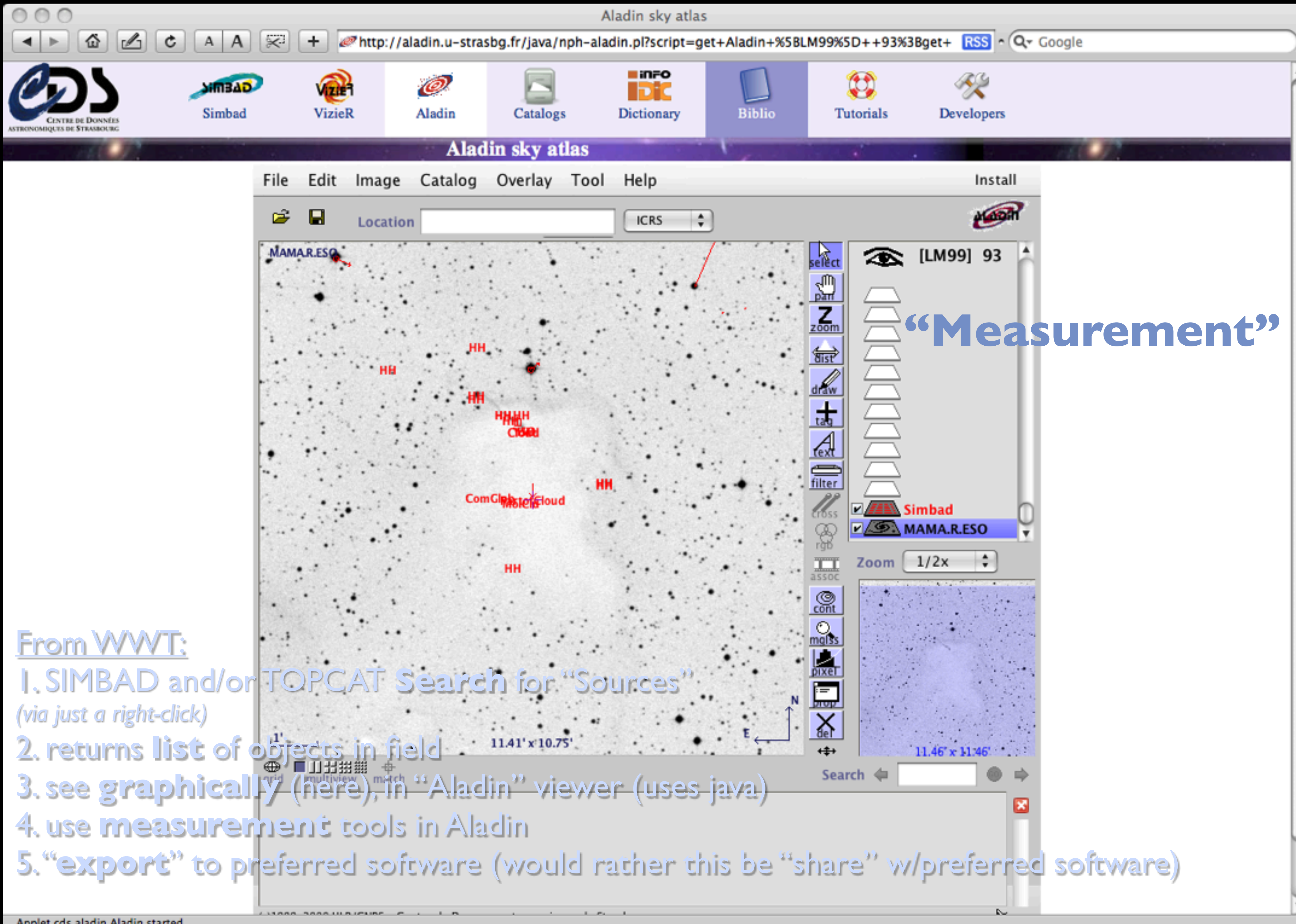
“Ontology” “Measurement”

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

Sharing Amongst Applications



“Measurement”

From WWT:

1. SIMBAD and/or TOPCAT **Search** for “Sources”

(via just a right-click)

2. returns **list** of objects in field

3. see **graphically** (here), in “Aladin” viewer (uses java)

4. use **measurement** tools in Aladin

5. “**export**” to preferred software (would rather this be “share” w/preferred software)

SIMBAD query result

http://simbad.u-strasbg.fr/simbad/sim-coo?CooE

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 : coord 3.44989898784776h+30.3468458710566d (FK5, 2000, 2000), radius: 10 arcmin

C.D.S. - SIMBAD4 rel 1.114 -

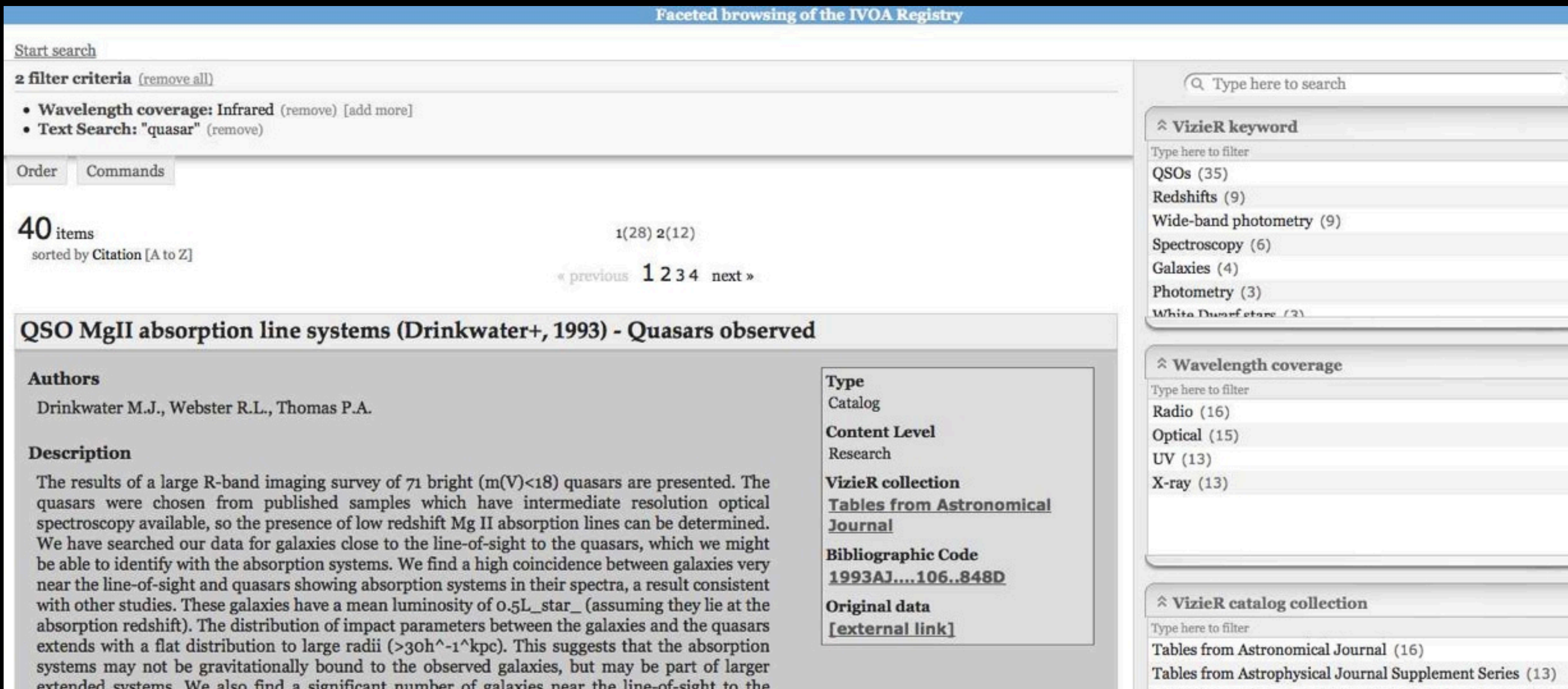
in either Aladin (default...ugly...but quantitative) or WWT (via SAMP)

Number of objects : 29 plot this list of objects ⦿ Equat. ○ Gal ○ SGal ○ Ecl

N	Identifier	dist(asec)	Otype	ICRS (2000) coord.	Sp type	#ref 1850 - 2009	#notes
1	HH 279A	82.46	HH	03 26 57.1 +30 19 33	~	1	0
2	HH 279B	127.83	HH	03 26 59.1 +30 18 41	~	1	0
3	HH 278C	289.57	HH	03 27 02.4 +30 25 36	~	1	0
4	HH 278	309.37	HH	03 26 59.4 +30 25 58	~	5	0
5	HH 278A	309.37	HH	03 26 59.4 +30 25 58	~	1	0
6	HH 278B	314.55	HH	03 27 00.5 +30 26 03	~	1	0
7	HH 279	324.83	HH	03 27 18.6 +30 17 16	~	4	0
8	HH 279C	325.81	HH	03 27 18.7 +30 17 16	~	1	0
9	[EYG2006] Bolo 19	342.02	mm	03 27 02.0 +30 15 08	~	2	0
10	HH 493	378.13	HH	03 26 49.3 +30 14 55	~	4	0
11	[JHE2006] J032649+301454	380.46	IR	03 26 49.0 +30 14 54	~	1	0
12	HH 317D	400.22	HH	03 26 56.9 +30 14 10	~	1	0
13	TXS 0323+301	405.25	Rad	03 26 32.9 +30 17 18	~	0	0

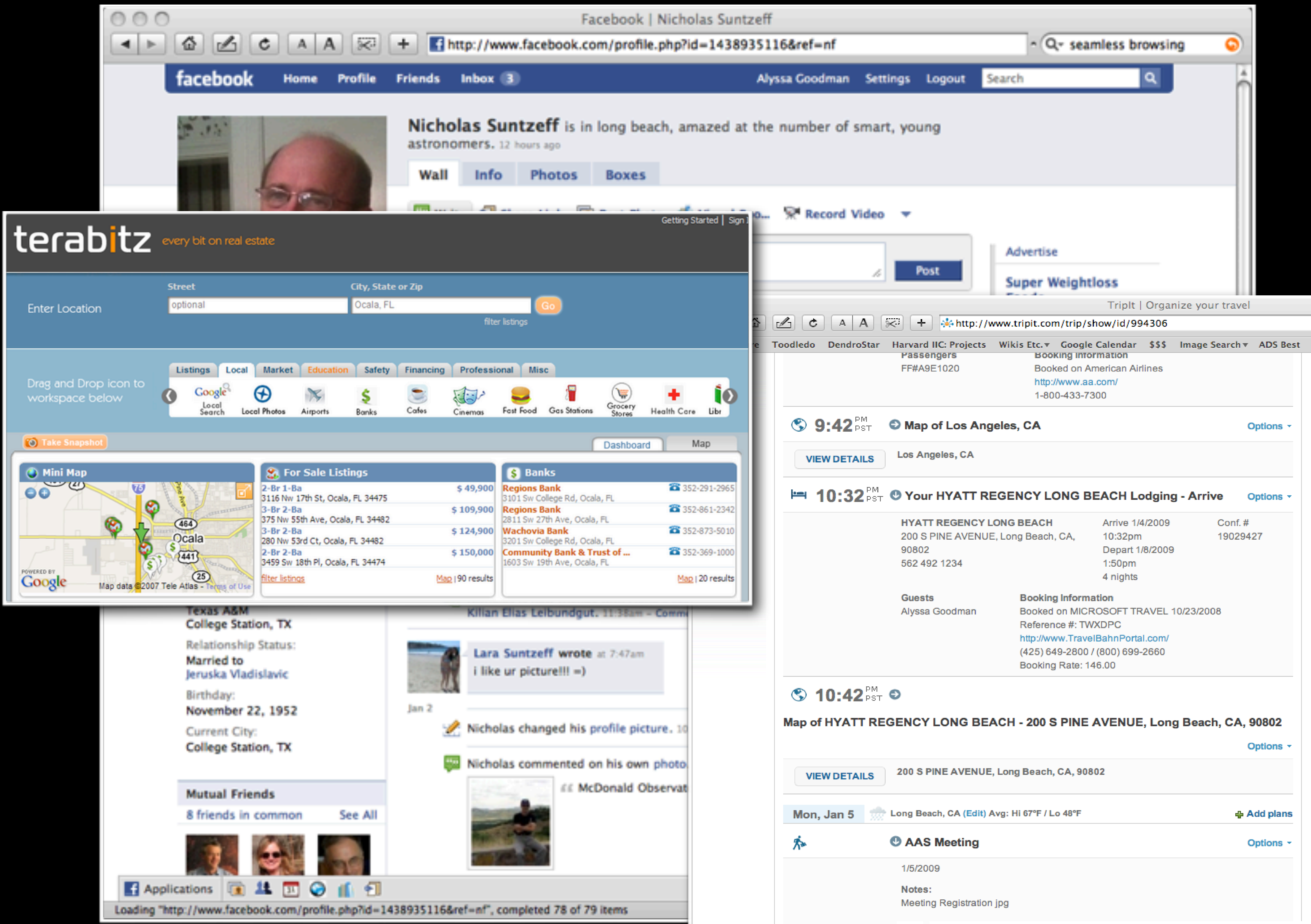
Prototype “Faceted” Browsing

(using very lightweight **“Ontology”***)*



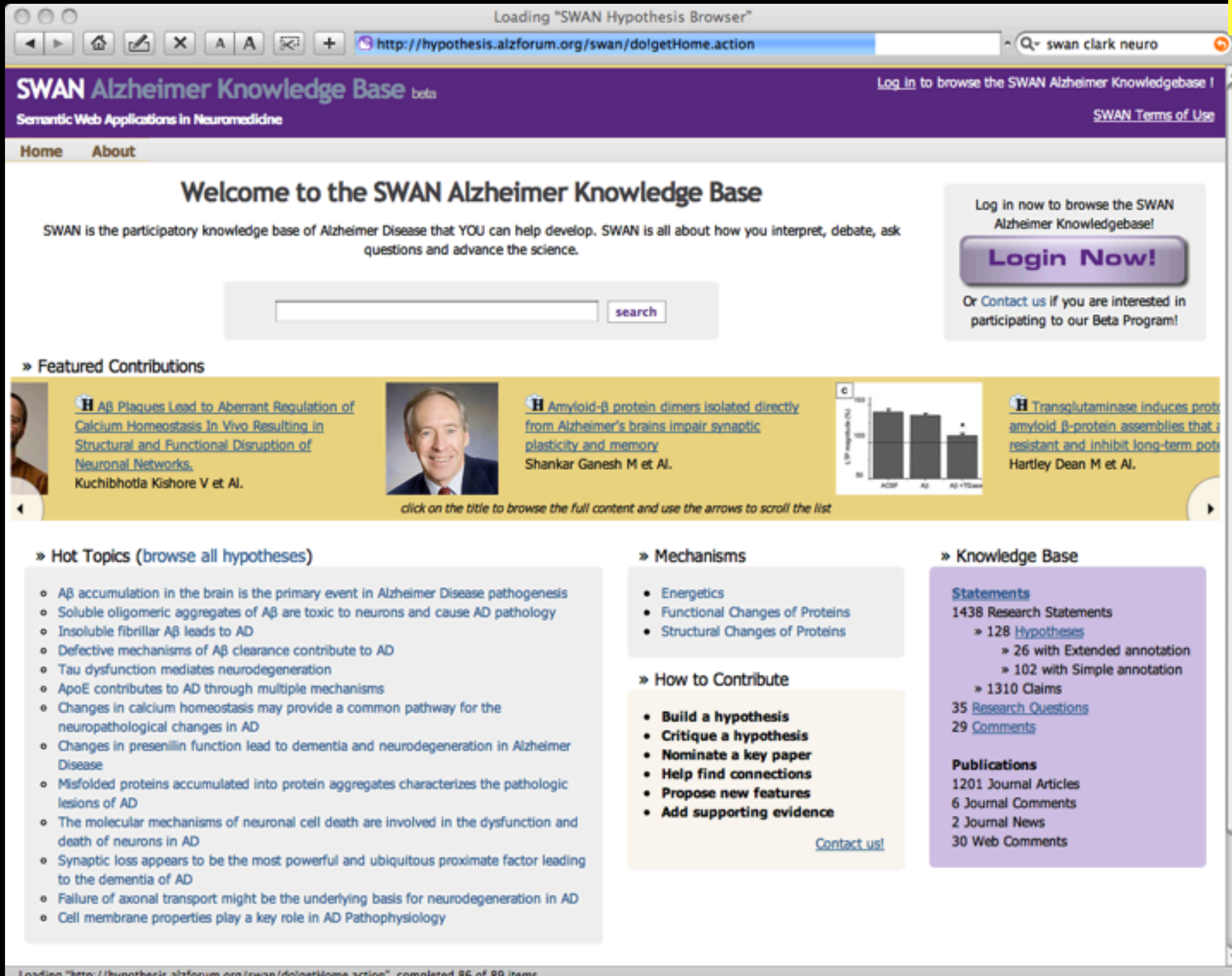
courtesy Douglas Burke, CfA/IIC

We need to catch up to this & go beyond...



Opportunities for Progress: Generalizing “Semantic” (Life) Science

“SCF”:



Progress (on the "beyond" bit)!

3D PDF

Goodman et al. *Nature*, 1/1/09

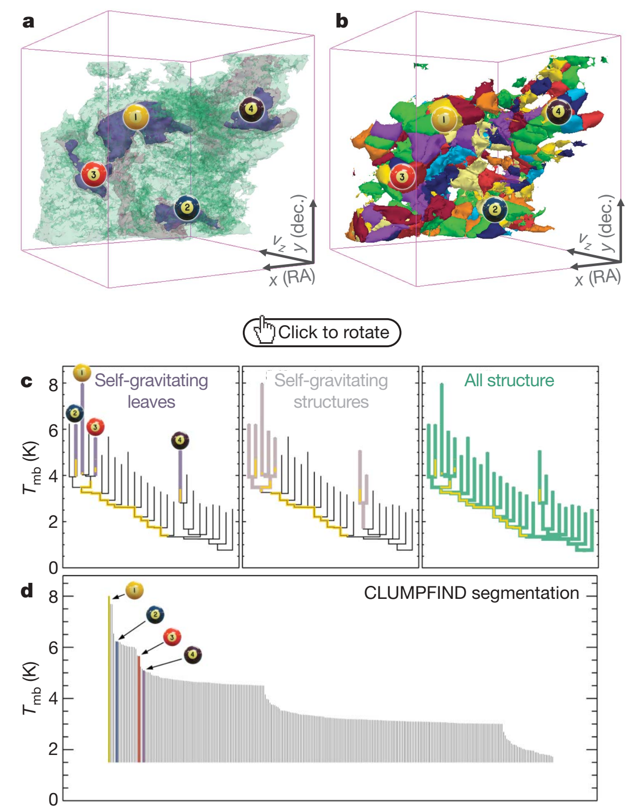


Figure 2 | Comparison of the 'dendrogram' and 'CLUMPFIND' feature-identification algorithms as applied to ^{13}CO emission from the L1448 region of Perseus. a, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating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

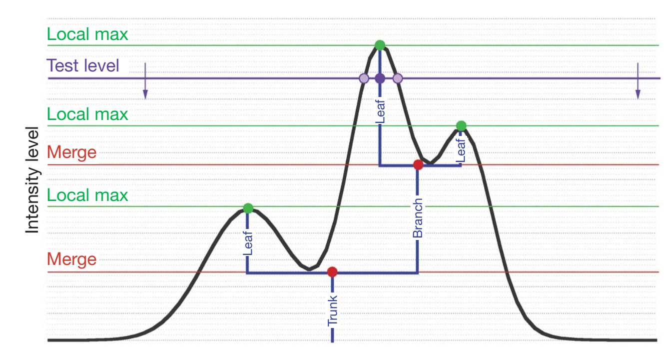


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in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

A very radical proposal for how to get this all done...