

Seamless Astronomy & the WorldWide Telescope

Alyssa A. Goodman

*Harvard-Smithsonian Center for Astrophysics
Initiative in Innovative Computing @ Harvard*

Collaborators

*Harvard-Smithsonian Center for Astrophysics & SEAS: Alberto **Accomazzi**, Eli **Bressert**, Douglas **Burke**,
Rahul **Davé**, Pepi **Fabbiano**, Michael **Kurtz**, Gus **Muench**, Pavlos **Protopapas***

*Massachusetts General Hospital: Tim **Clark** & Sudeshna **Das***

*Microsoft Research: Jonathan **Fay**, Curtis **Wong***

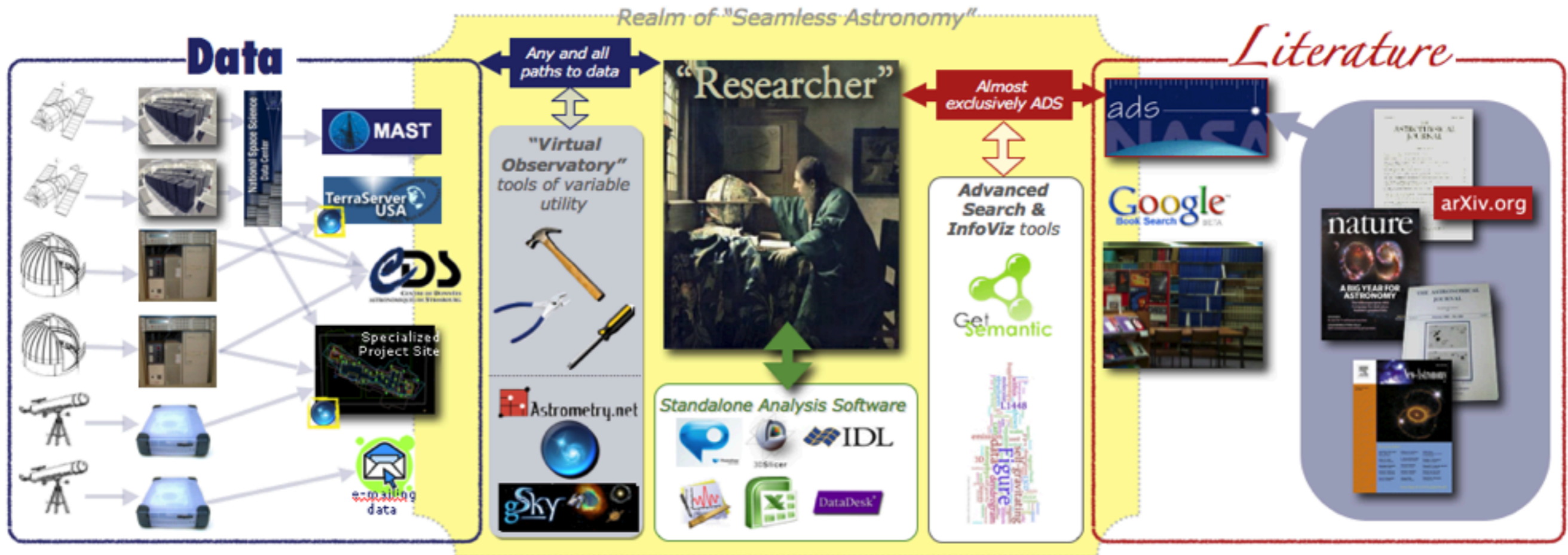
*RPI: Jim **Hendler** & Deborah **McGuinness***

*STScI: Alberto **Conti** & Carol **Christian***

*UCLA: Christine **Borgman***

Seamless Astronomy

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



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

Jim Gray & Alex Szalay

Typical Astronomers Today

Me

Astronomers who travel & use facebook...

Astronomers & the V.O. c. 2006





Monday, November 16, 2009

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

Email with Room Numbers
 (result of search)

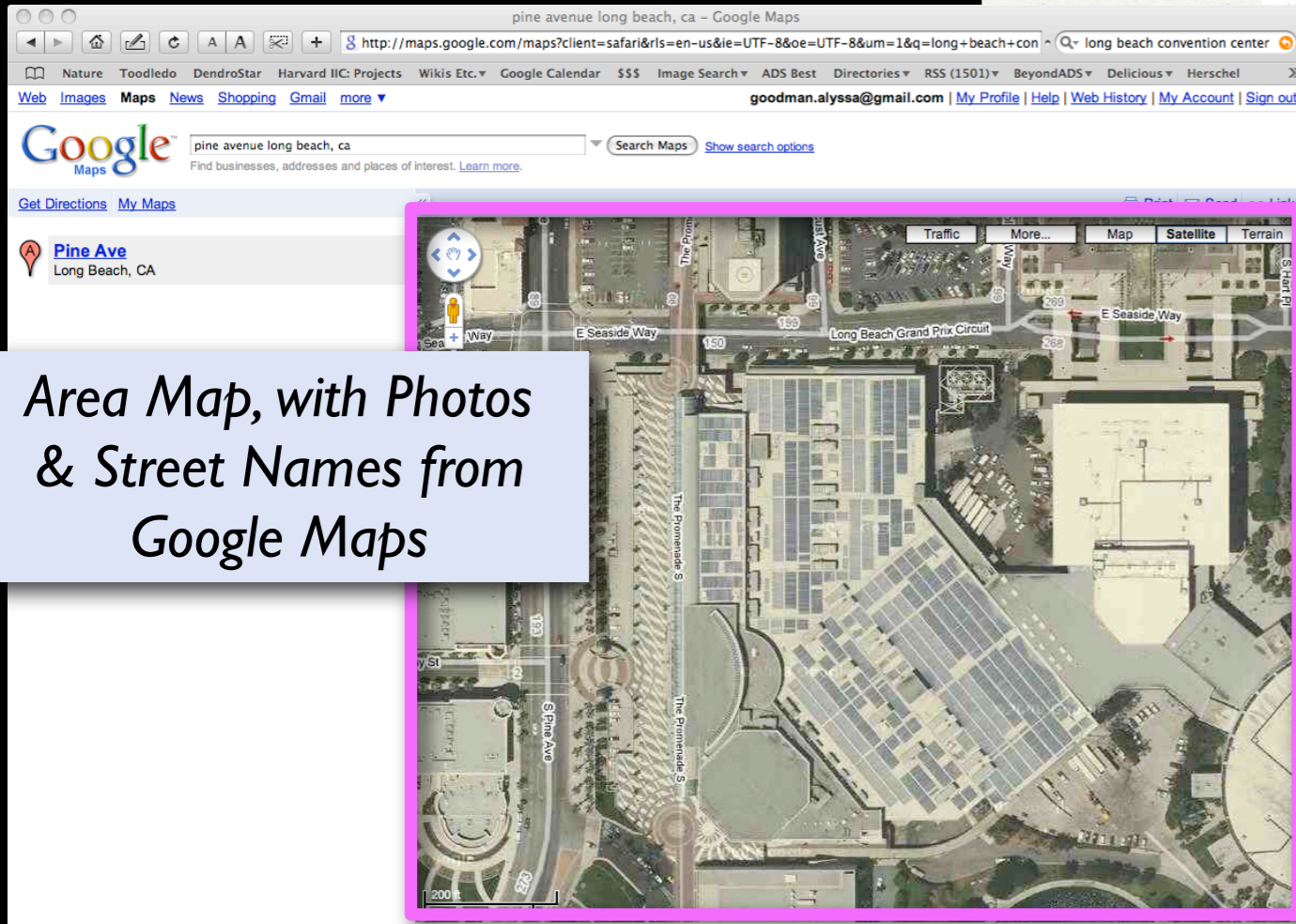
I just found Megan's earlier email, which mentioned that the press will be in room 204 of Convention Center. It is probably not too far from our room 308.
 Our setup and presentation will be in the same room: #308 (Exhibition Hall C).

Requires "Ontology"

Thanks,
 Yan

Interior Map on Long Beach CC Web Site

Requires "GIS/Layering"



Area Map, with Photos & Street Names from Google Maps

Ballroom & Meeting Room

http://www.longbeachcc.com/meeting.h

Nature Toodledo DendroStar Harvard IIC: Projects Wikis Etc. Google Calendar

SPECIAL SERVICES INCLUDED:

- House lighting, ventilation, heat or air conditioning as required during open times. Energy conservation is of prime concern to the Convention Center and minimal light and comfort levels will be maintained during move-in and move-out periods. Rehearsals and similar pre-event activities will be maintained accordingly.
- Housekeeping services during open hours in aisles, lobbies, lobby, open spaces and restrooms, plus one thorough cleaning of these same areas during non-openers. Meeting rooms will be cleaned between 12 AM and 11 PM nightly unless prior arrangements are made with the Event Manager.
- Water service will be supplied to head tables and podiums only. All other water service needs must be ordered through your Catering Sales Manager.
- The basic set up is included with the daily rental. Additional set ups are charged based upon half of the daily rental.
- Real-time basic room set per rented event day. Meeting rooms included with an Exhibit Hall rental include a one-day basic room set for the run of the event.
- Fully equipped first-aid facilities. Does not include a nurse. An Emergency Medical Technician will be scheduled through your Event Manager.
- Use of the outdoor marquee, as available. The marquee is subject to information directly related to Licensee's activities within the Convention Center. All messages must be pre-approved by Convention Center staff. (Please see Marketing Kit for all in-house Marketing and Public Relations details pertaining to your event).

SPECIAL SERVICES NOT INCLUDED:

- First aid staffing with Emergency Medical Technician will be provided at current rates.
- Licensee is responsible for removal of bulk trash, crates, pallets, packing materials, lumber, etc. prior to show opening and following move-out.
- Market sellers, ticket takers, ushers, security, stagehands, and event operations shall be provided by the Convention Center and billed to Licensee.
- Performance stages, exhibit tables and dance floors.

Interior Map on Long Beach CC Web Site

Ballroom Level: RM. 201, 202, 203, 204

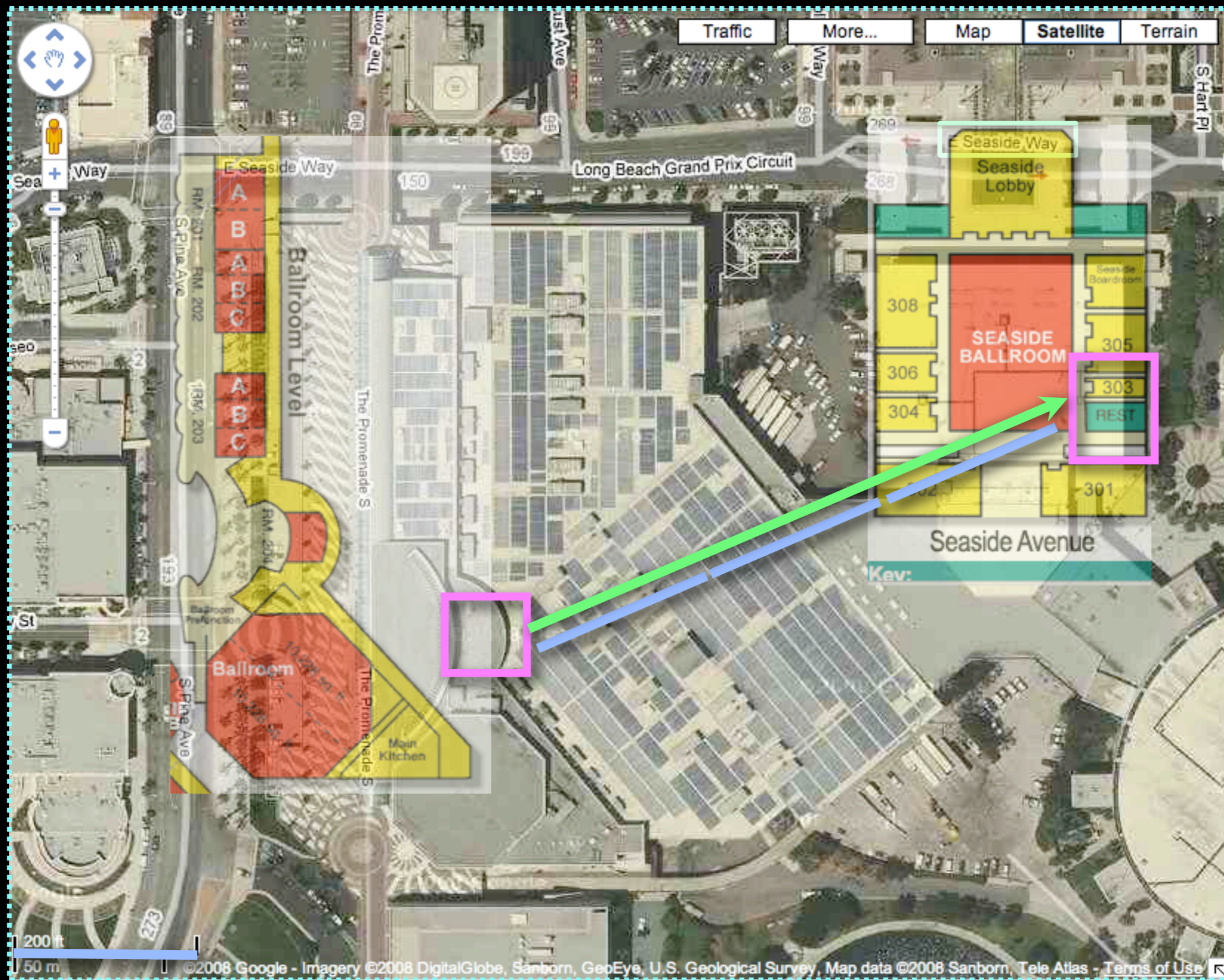
Concourse Level: RM. 101, 102, 103, 104

Ballroom: 10-228 sq. ft., 10-226 sq. ft.

Seaside Meeting Room Key: 308, 306, 304, 302, 305, 303, 301, REST

Seaside Avenue

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 Triplt site” I made to organize all this? What about the hotel & its location?

The screenshot shows a web browser with multiple overlapping windows. The top window is a Triplt page with the URL <http://www.tripit.com/trip/show/id/994306>. Below it, another window shows a similar Triplt page. The main window is an Expedia page for the Hyatt Regency Long Beach hotel. The page includes a navigation menu with options like Home, Flights, Hotels, Cars, Vacation Packages, Cruises, Activities, DEALS & OFFERS, Maps, and Business. The hotel listing features a star rating of 4.5 stars and a description: "Hotel near Long Beach Harbor overlooking lagoon". A map of the hotel's location is shown, with a callout for "Hyatt Regency Long Beach" and a scale bar indicating 40 yards. The map also shows nearby streets like Bay St and S Pine Ave. A sidebar on the left provides additional information about the hotel, including a location map, hotel details, traveler opinions, and room rates. The date "Mon, Jan 5" is displayed at the bottom of the sidebar.

Nearby Points of Interest



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



My TripAdvisor | Sign in

Register Now!

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

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

Search

Search input field with 'Go' button

- Long Beach Overview
- Long Beach Hotels
 - Hyatt Regency Long Beach
- Flights to Long Beach
- Long Beach Deals
- More On Long Beach
- Before You Go
- Things to Do
- Restaurants
- Map
- Traveler Photos
- Forum

- Long Beach Deals
- Discount Hotels
- Hotel & Air
- All Travel Offers

Free Newsletter

Interested in Hyatt Regency Long Beach and Long Beach?

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

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

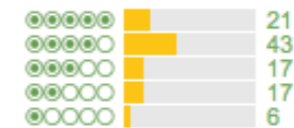
Check-in: 10/2/2009 Check-out: 10/9/2009 Adults: 1

- | | |
|---|--|
| <input checked="" type="checkbox"/> Expedia.com | <input checked="" type="checkbox"/> Orbitz.com |
| <input checked="" type="checkbox"/> LongBeach.Hyatt.com | <input checked="" type="checkbox"/> hotels.com |
| <input checked="" type="checkbox"/> Travelocity | <input type="checkbox"/> HotelClub.com |
| <input checked="" type="checkbox"/> Priceline.com | <input type="checkbox"/> Gtahotels.com |

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

TripAdvisor Traveler Rating: ?

104 Reviews



Write a review

TripAdvisor Popularity Index: ?

#14 of 38 hotels in Long Beach

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

Click here for best prices for Hyatt Regency Long Beach

- Hyatt Regency Long Beach: Great rooms from \$115 Smart Deal
Expedia.com Photos, Reviews and the Guaranteed Lowest Prices
- Hyatt Regency Long Beach: Save Up To 50% On Hotels Smart Deal
Orbitz.com View Hotel Photos, Reviews & More Compare & Save on Hotels at Orbitz
- Hyatt Regency Long Beach: Official Site Smart Deal
LongBeach.Hyatt.com Best Rates Guaranteed. Book Direct.
- Hyatt Regency Long Beach: Official Site, Smart Deal
Hyatt Regency Long Beach Best Rates

TripAdvisor Traveler Reviews

TripAdvisor Traveler Rating: ★★★★★

“Ontology”

“GIS/Layering”

“Search”

What's needed?

“Progressive Resolve”

“Registration”

“Selection”

**“Side-by-Side
Comparison”**

“Readable Labels”

“Highlighting”

“Zoom”

“Custom Site”

“Measurement”

“Off-the-Desktop”

“Inference”

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”

WorldWide Telescope

The screenshot shows the Microsoft WorldWide Telescope Web Client interface. The browser address bar displays the URL: <http://www.worldwidetelescope.org/webclient/default.aspx?wtml=http%3a%2f%2fwww.worldwidetel>. The navigation menu includes 'Explore', 'Guided Tours', 'Search', 'Community', 'View', and 'Settings'. The breadcrumb trail shows 'Collections > Open Collections > HH4647 >'. The main view is a star field with a central nebula. A control panel at the bottom left includes 'Look At' (Sky), 'Imagery' (Digitized Sky Survey (Optical)), and 'Image Crossfade'. A 'Done' button is at the bottom left. The bottom right shows a compass, coordinates (RA: 08h25m38s, Dec: -51:01:43), and a timer (00:07:32). A large, semi-transparent text overlay is present on the right side of the image.

“Side-by-Side Comparison”

“Readable Labels”

“Highlighting”

“Custom Site”

“Inference”

“Progressive Resolve”

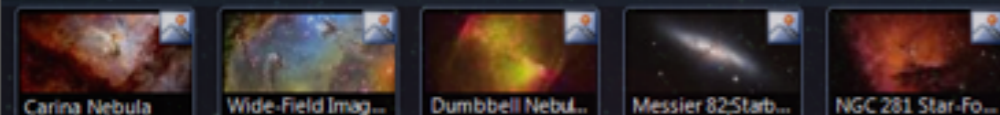
“Zoom”

“Search”

“Selection”

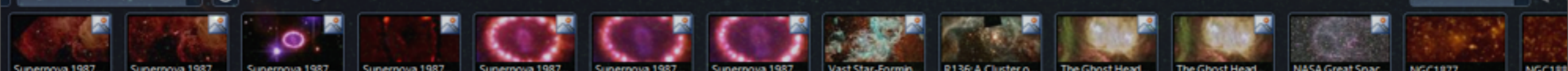
“GIS/Layering”

“Registration”



WWT Demos...

- ★ “Dust & Us” (Sample Interactive Tour)
- ★ Explore, Search, etc. (Basic Functionality)
- ★ ADS/Wikipedia/SIMBAD (Deep Links)



Galileo's Moons of Jupiter

Scop. Principe.
 Galileo Galilei, Familiari. Seruo della Ser. V. inuigilanti
 do amittuano, et lo ogni spirito se bene no solo sabisfuo
 aluano che non della stessa di Mathematico nelle sue
 Dio di Padova,
 Inuere diuere determinate di presentare al Scop. Principe
 l'occhio et a piacere di giuramento inestimabile se ogni
 negozio et in circa marittima o torrette stano di tenere per
 sto nuovo artificio nel maggior segreto et uolera a disposizione
 di di ser. L'occhio auato dalle piu se di te speculazioni di
 propri, bethua in l'uantaggi di scoprire Logici et Vole dell' inimis
 p'ue hore et pu di tempo prima di p'le se sopra noi et distinguend
 il numero et la qualita dei Vasselli guidare le sue forze
 p'allestirsi alla caccia et combattimento o alla fuga, o pure auer
 nella campagna aperta uidero et particolarly distinguere ogni suo
 moto et propriamente.
 Feb. 7. di Gennaio
 Giove si uide a 7
 Feb. 8. di
 Feb. 10. di
 Feb. 13. di
 Feb. 14. di
 Feb. 15. di
 Feb. 17. di

7	* . ○ *	17	* ○
8	○ . . *	18	* ○
10	* . * ○	19	* ○ . .
11	* . ○	19	* . ○ . .
12	* . ○ *	20	○ . . ○ ○ ○
13	* . ○ . .	21	. . ○
15	○	22	* . ○ . .
15	○ . . *	22	* ○ . . .
16	* ○ *	23	* . ○ *
16	* ○ *	23	○
17	* ○	24	* . ○
17	* ○	24	* ○

SIDERIUS NUNCIUS
 On the third, at the seventh hour, the stars were arranged in this
 quence. The eastern one was 1 minute, 30 seconds from Jupiter
 : closest western one 2 minutes; and the other western one wa
 ast * ○ * * West
 0 minutes removed from this one. They were absolutely on the
 ame straight line and of equal magnitude.
 On the fourth, at the second hour, there were four stars around
 upiter, two to the east and two to the west, and arranged precise
 East * * ○ * * West
 on a straight line, as in the adjoining figure. The easternmost wa
 listant 3 minutes from the next one, while this one was 40 second
 rom Jupiter; Jupiter was 4 minutes from the nearest western one
 d this one 6 minutes from the westernmost one. Their magnitude,
 ere nearly equal; the one closest to Jupiter appeared a little smaller
 an the rest. But at the seventh hour the eastern stars were only
 0 seconds apart. Jupiter was 2 minutes from the nearer eastern
 East ** ○ * * West
 one, while he was 4 minutes from the next western one, and this
 one was 3 minutes from the westernmost one. They were all equal
 and extended on the same straight line along the ecliptic.
 On the fifth, the sky was cloudy.
 On the sixth, only two stars appeared flanking Jupiter, as is seen
 East * ○ * West
 in the adjoining figure. The eastern one was 2 minutes and the
 western one 3 minutes from Jupiter. They were on the same straight
 line with Jupiter and equal in magnitude.
 On the seventh, two stars stood near Jupiter. both to the east.



Notes for & re-productions of Siderius Nuncius (1610)



Spitzer Space Telescope

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

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[Features](#)
[About Spitzer](#)
[Search / Site Info](#)

NEWSROOM

Press Releases

- Chronological
- By Subject
- Outside Institutions

What's Happening Archive

Visuals

- Image Use Policy

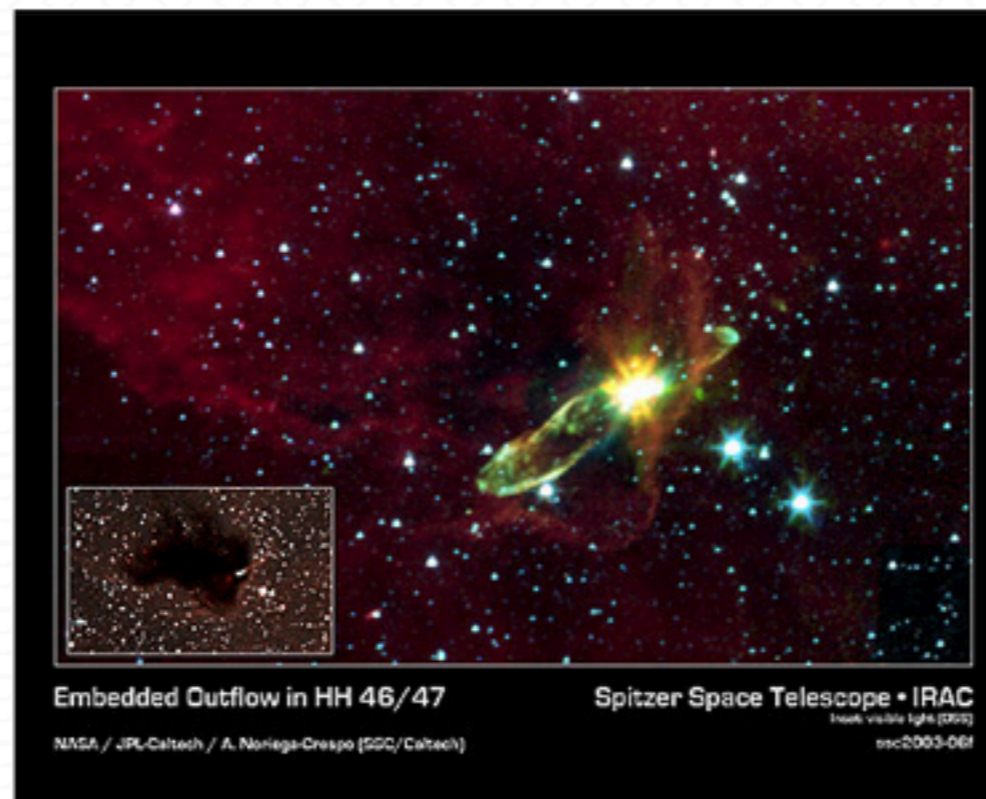
Update Notifications

- Mailing List
- RSS Feed (XML)

References

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

Media Contacts



Embedded Outflow in HH 46/47

Spitzer Space Telescope • IRAC

NASA / JPL-Caltech / A. Noriega-Crespo (SSC/Caltech)

IRAC visible light (003)
ssc2003-06f

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

HH4647

ADD NOTE SEND TO GROUP ADD TO SET BLOG THIS ALL SIZES ORDER PRINTS ROTATE EDIT PHOTO DELETE



Embedded Outflow in HH 46/47 Spitzer Space Telescope • IRAC
Inset: visible light (DSS)
NASA / JPL-Caltech / A. Noriega-Crespo (SSC/Caltech) SSC2003-06f

“Search”
“Custom Site”
“Registration”
“Readable Labels”

Uploaded on January 6, 2009 by Alyssa_Goodman

Alyssa_Goodman's photostream
16 uploads
browse

This photo also belongs to:

astrometry (Pool) x

Tags

- Astrometrydotnet:version=10145 x
- Astrometrydotnet:id=alpha-200901-20629873 x
- Astrometrydotnet:status=solved x

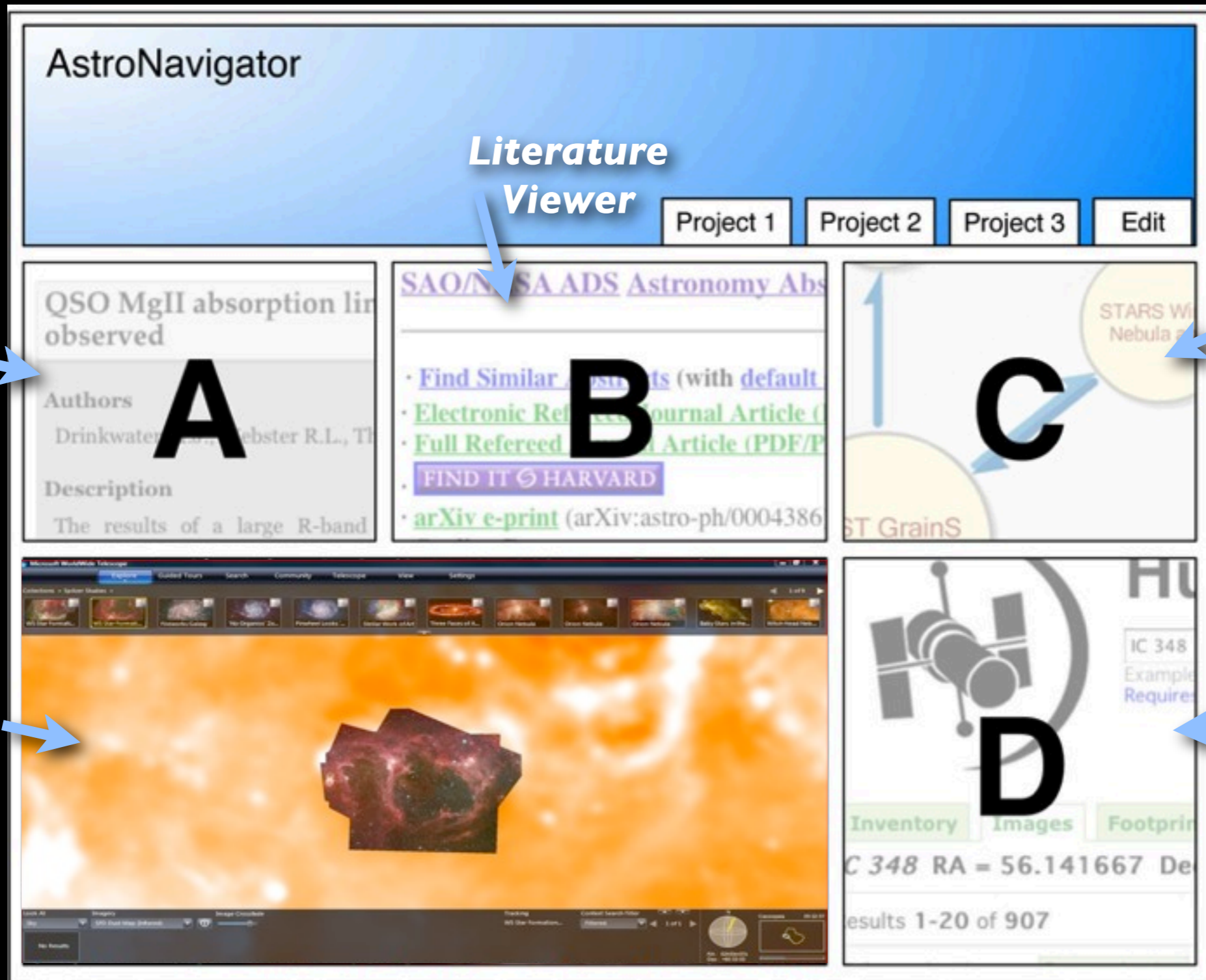
Add a tag

Additional Information

- All rights reserved (edit)
- Anyone can see this photo (edit)
- Add to your map
- Taken on December 12, 2003 (edit)
- Photo stats
- Viewed 7 times (Not including you)
- Edit title, description, and tags

Flag your photo

Seamless Astronomy



Semantic Search

Literature Viewer

Info Viz for Search Results

Data Viewer (e.g. WWT)

Archive Browser

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

astrobitz?

terabitz every bit on real estate

Getting Started | Sign I

Enter Location

Street optional City, State or Zip Ocala, FL

Go

filter listings

Drag and Drop icon to workspace below

Navigation menu: Listings, Local, Market, Education, Safety, Financing, Professional, Misc

Icons: Google Local Search, Local Photos, Airports, Banks, Cafes, Cinemas, Fast Food, Gas Stations, Grocery Stores, Health Care, Libr

Take Snapshot

Dashboard

Map

Mini Map

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

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”



More information: See the SEAS/IIC
“Scientists Discovery Room” [project pages](#)

Slideshow: Tabletop Computers *Continued* By Meredith Ringel Morris

First Published December 2008

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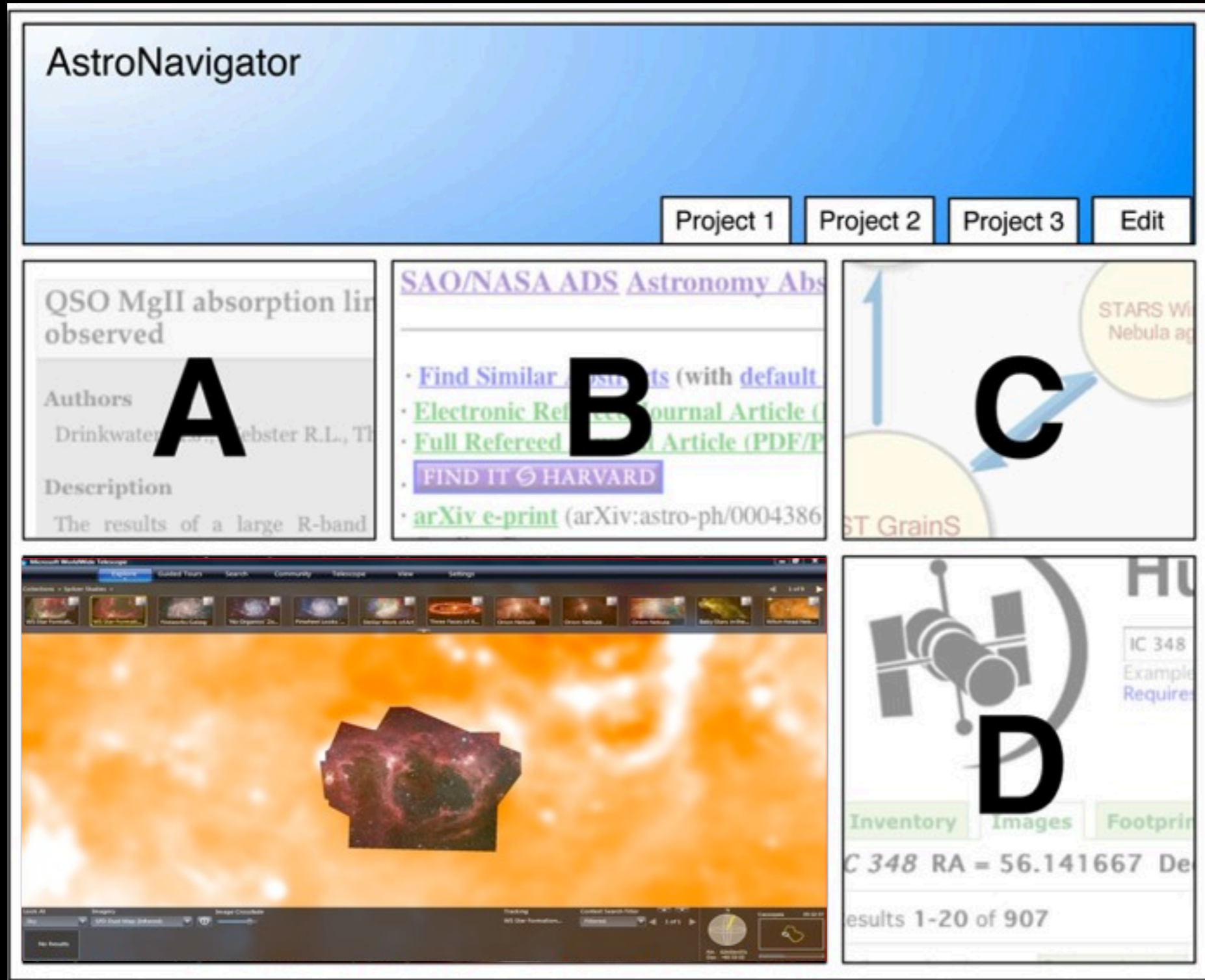


UBITABLE: Users can interact with surface computers through auxiliary devices, such as laptops, phones, and PDAs. The display on the auxiliary device can convey private or sensitive content to a single user, while group-appropriate content can appear on the tabletop display. Chia Shen and her colleagues 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.

“Ontology”

“Measurement”

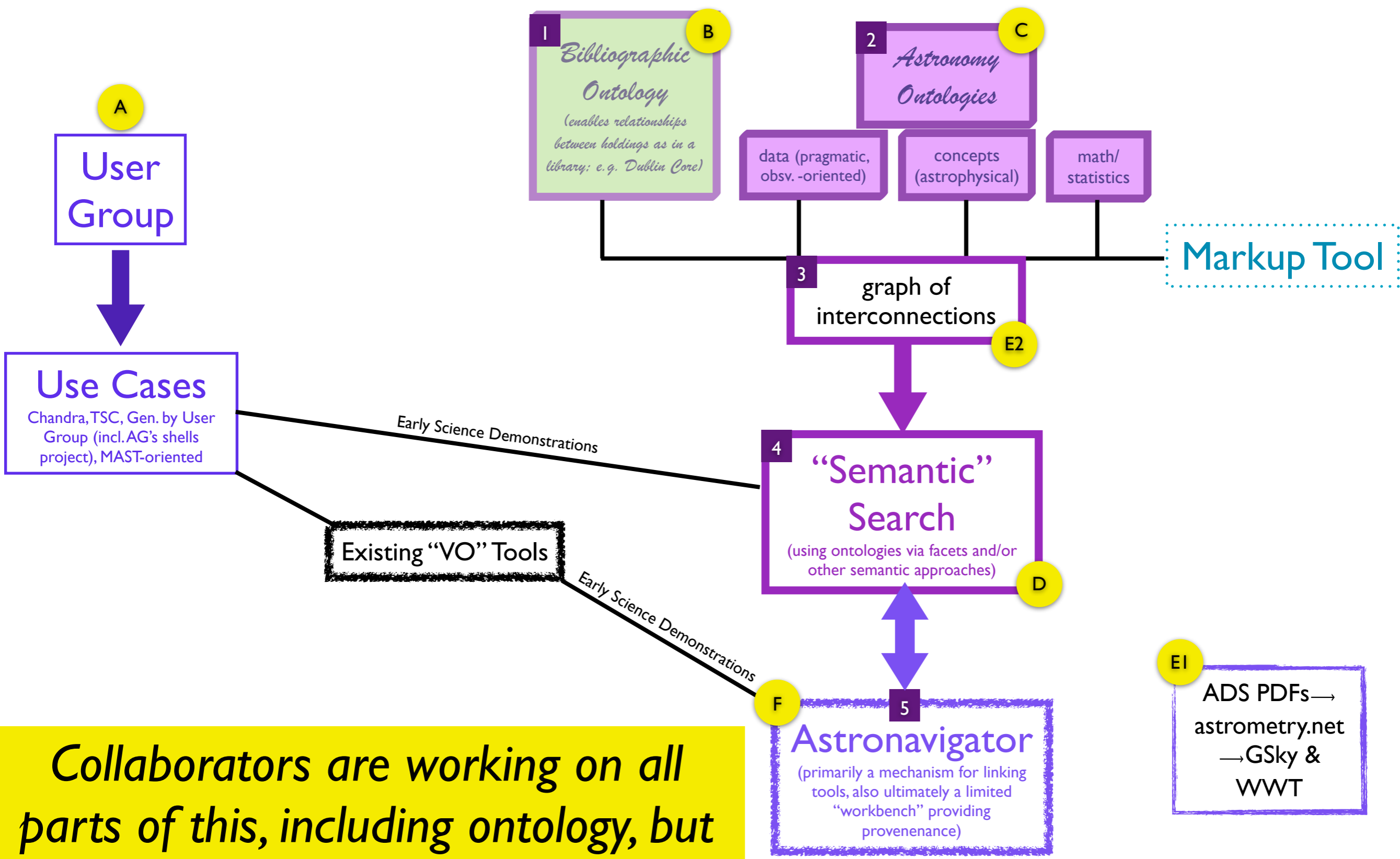
Seamless Astronomy



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

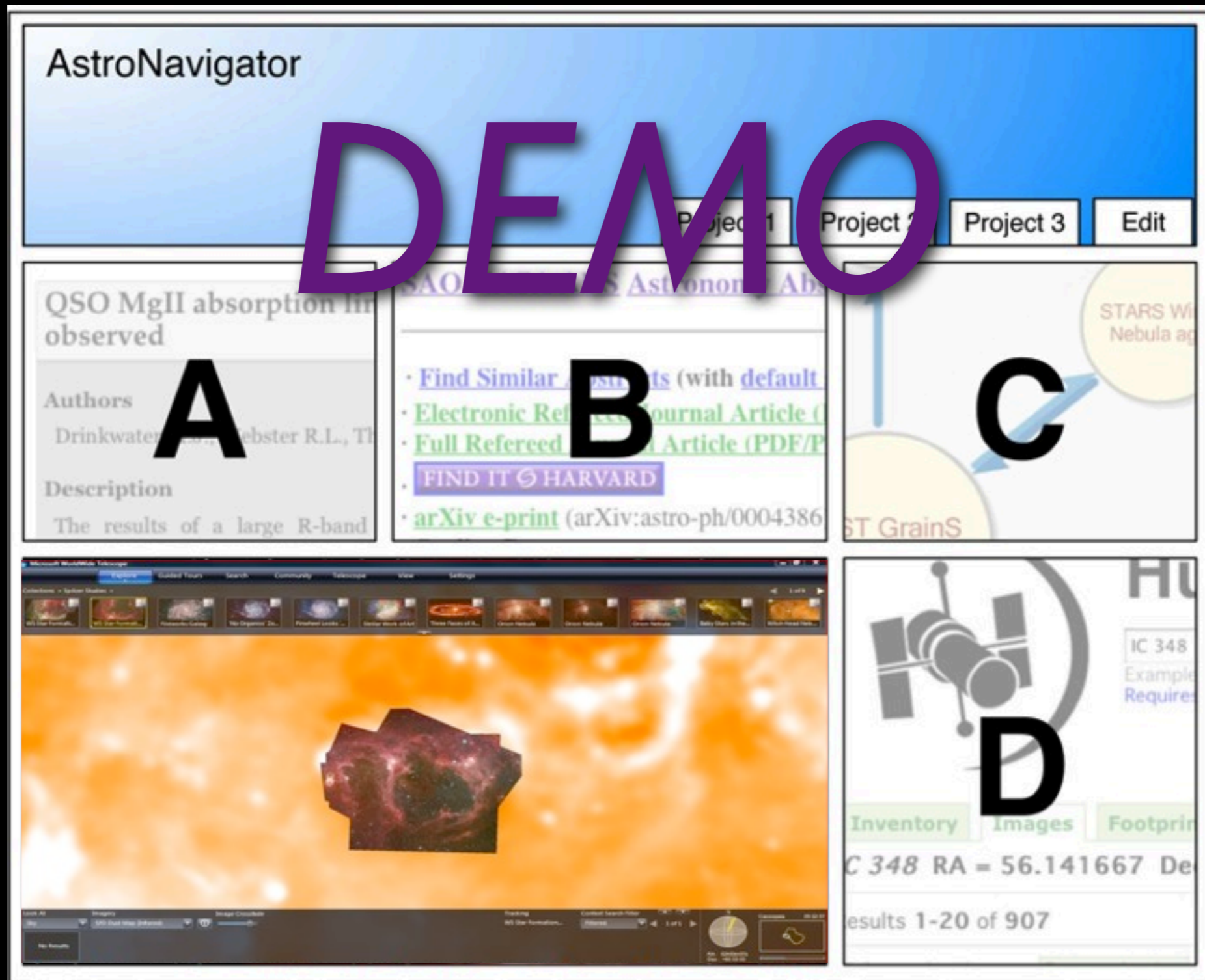
Discourse Ontology

Workflow Ontology
(e.g. myexperiment)



Collaborators are working on all parts of this, including ontology, but let's focus on measurement for now...

Seamless “Measurement” via SAMP?



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

Our "Real" Work...

COMPLETE, Astronomical Medicine & Taste-Testing

COMPLETE Data Coverage Tool

http://www.worldwidetelescope.org/COMPLETE/WWTCoverageTool.htm#

newKodak EXPLO Bing WWTSL Alyssa Good... Home Page Toodledo Harvard IIC: Projects Wikis Etc. Google Calendar \$\$\$ Image Search fbk share Directories ADS Best RSS (3387) BeyondADS

Finder Scope

Classification:
Reflection Nebula in Perseus

NGC1333

RA: 03h29m20s Magnitude: n/a
 Dec: 31 : 24 : 57 Distance: n/a
 Alt: -09 : 53 : 42 Rise: 17:16
 Az: 29 : 51 : 24 Transit: 01:32
 Set: 09:48

Image Credits:
Copyright DSS Consortium

<http://www-gsss.stsci.edu/Acknowledgements/P>

Research Show Object Close

COMPLETE Data Available

Center on Perseus Center on Ophiuchus Center on Serpens

Full-Cloud Data (Phase I, All Data Available)

Dataset	Show	Perseus	Ophiuchus	Serpens	Link
GBT: HI Data Cube	<input checked="" type="checkbox"/>	✓	✓	∅	Data
IRAS: Av/Temp Maps	<input checked="" type="checkbox"/>	✓	✓	✓	Data
FCRAO: 12CO	<input checked="" type="checkbox"/>	✓	✓	✓	Data
FCRAO: 13CO	<input checked="" type="checkbox"/>	✓	✓	✓	Data
JCMT: 850 microns	<input checked="" type="checkbox"/>	✓	✓	∅	Data
Spitzer c2d: IRAC 1,3 (3.6,5.8 μm)	<input checked="" type="checkbox"/>	✓	✓	✓	Data
Spitzer c2d: IRAC 2,4 (4.5,8 μm)	<input checked="" type="checkbox"/>	✓	✓	✓	Data
CSO/Bolocam: 1.2-mm	<input checked="" type="checkbox"/>	✓	∅	∅	Data
Spitzer MIPS: Derived Dust Map	<input checked="" type="checkbox"/>	✓	∅	∅	Data

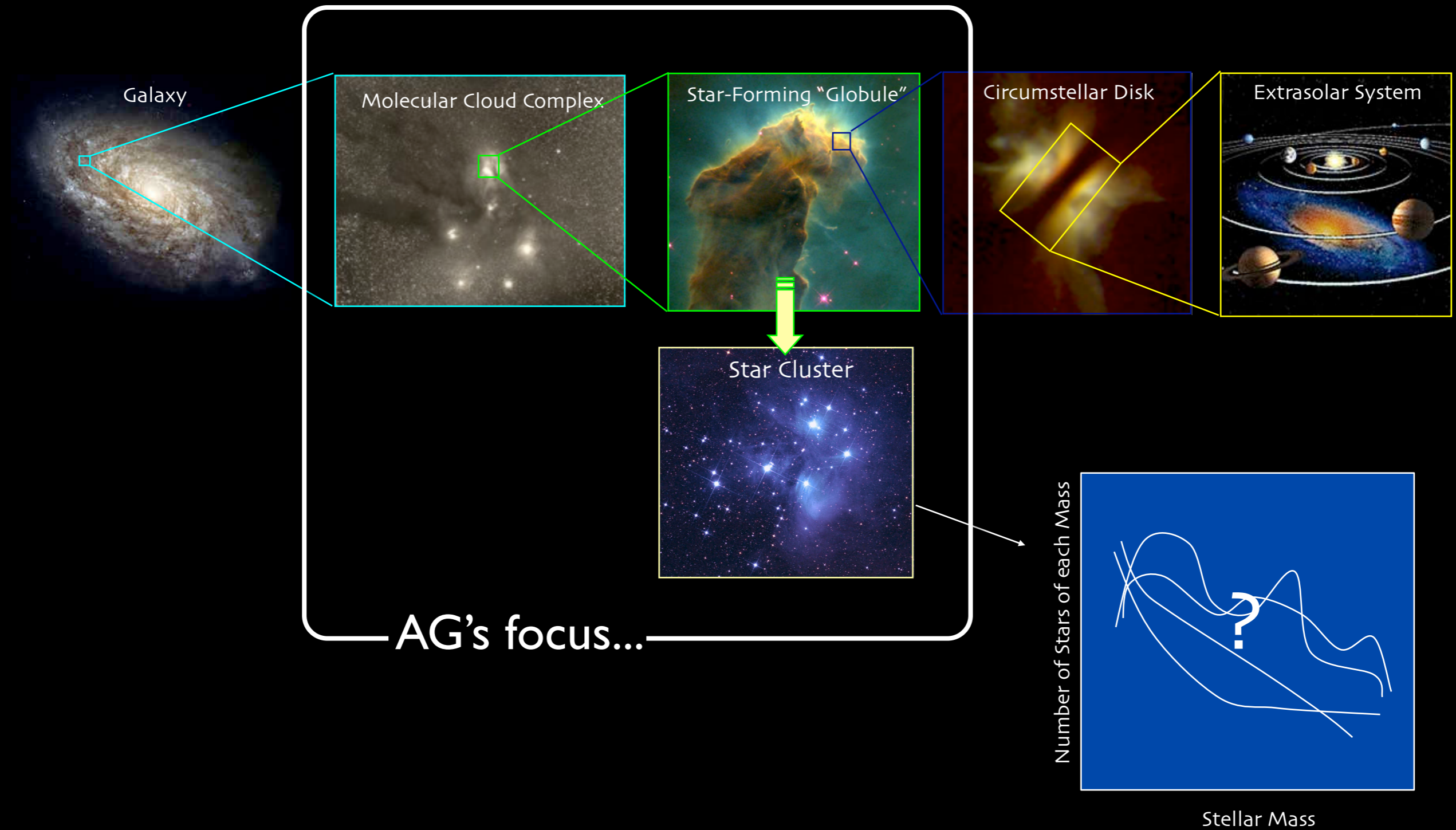
Targeted Regions (Phase II, Some Data Not Yet Available)

CTIO/Calar Alto: NIR (J,H,Ks)	<input checked="" type="checkbox"/>	✓	✓	∅	Data
IRAM 30-m: N2H+ and C18O	<input checked="" type="checkbox"/>	✓	∅	∅	Data
IRAM 30-m: 1.1-mm continuum	<input checked="" type="checkbox"/>	✓	∅	∅	Data
Megacam/MMT: r,i,z images	<input checked="" type="checkbox"/>	✓	∅	∅	Data

Catalogs & Pointed Surveys

NH3 Pointed Survey	<input checked="" type="checkbox"/>	✓	∅	∅	Data
YSO Candidate list (c2d)	<input checked="" type="checkbox"/>	✓	✓	✓	Data

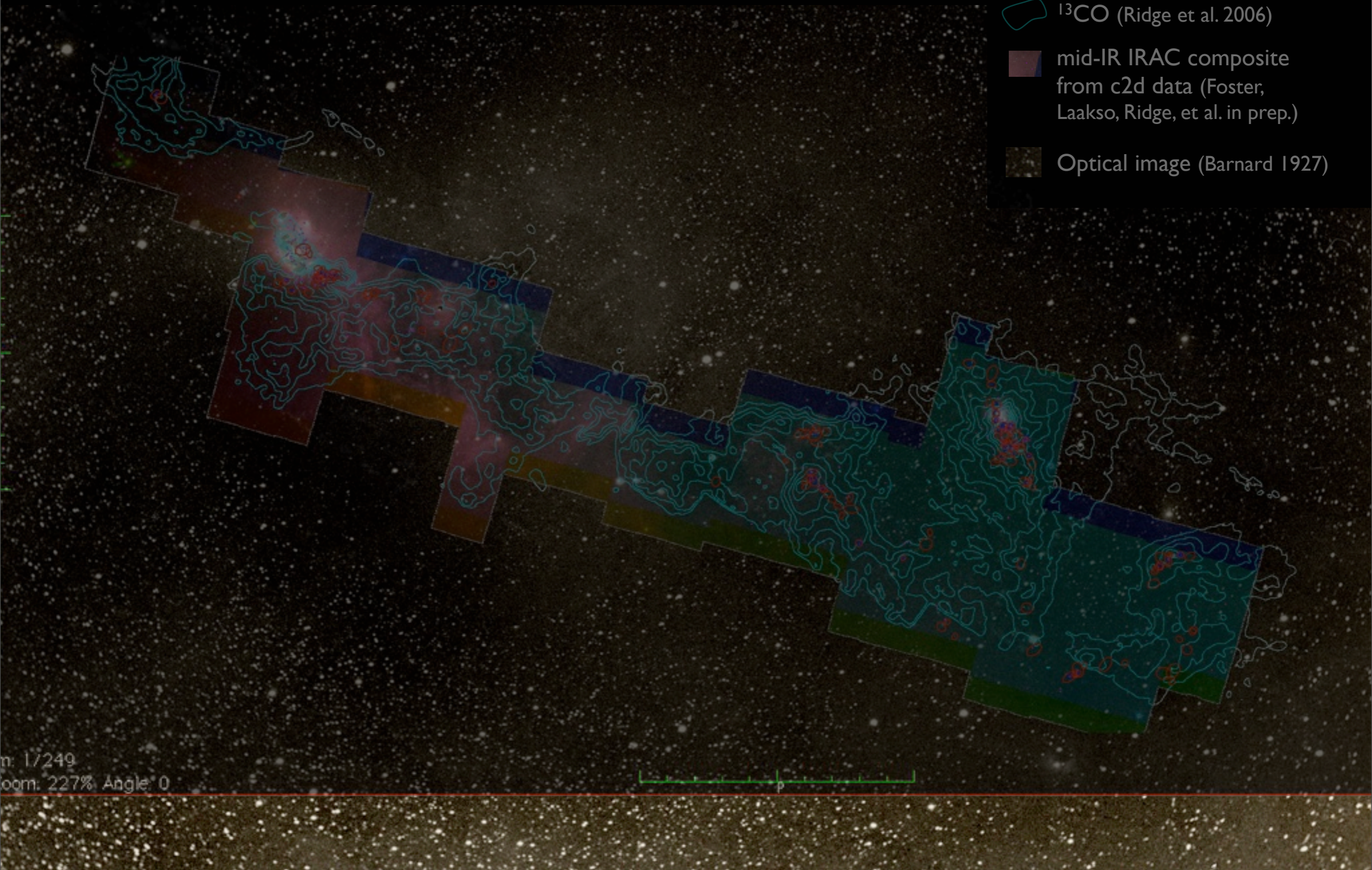
Star (and Planet, and Moon) Formation 101



COMPLETE = COordinated Molecular Probe Line Exinction Thermal Emission

image size: 520 x 274
view size: 1305 x 733
VL: 63 WWT 07

-  mm peak (Enoch et al. 2006)
-  sub-mm peak (Hatchell et al. 2005, Kirk et al. 2006)
-  ^{13}CO (Ridge et al. 2006)
-  mid-IR IRAC composite from c2d data (Foster, Laakso, Ridge, et al. in prep.)
-  Optical image (Barnard 1927)



m: 1/249
zoom: 227% Angle: 0



Astronomical Medicine

Alyssa Goodman (IIC/CfA/FAS)

Michael Halle (IIC/SPL/HMS)

Ron Kikinis (SPL/HMS)

Douglas Alan (IIC)

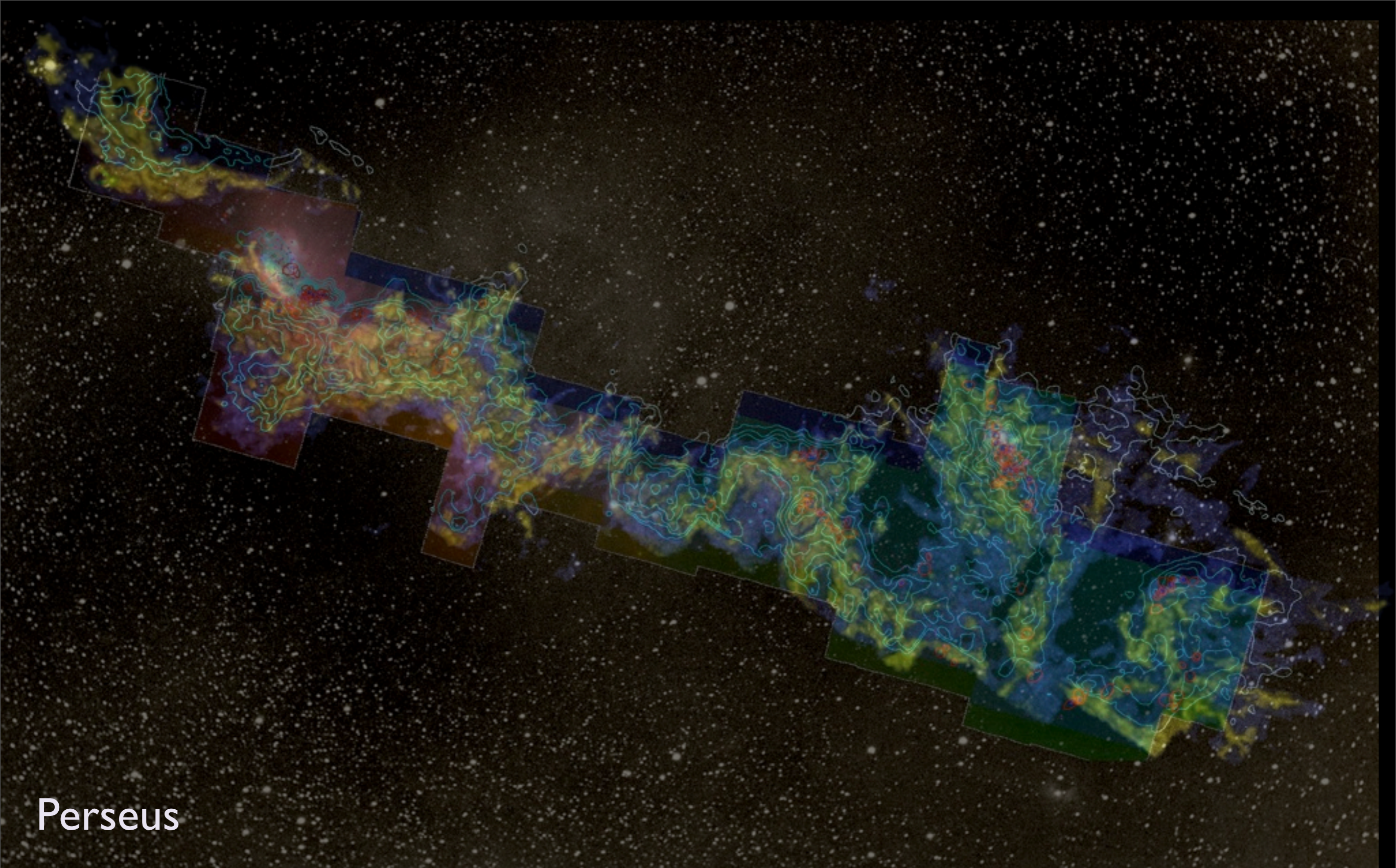
Michelle Borkin (FAS/IIC)

Jens Kauffmann (CfA/IIC)

Erik Rosolowsky (CfA/UBC Okanagan)

Nick Holliman (U. Durham)





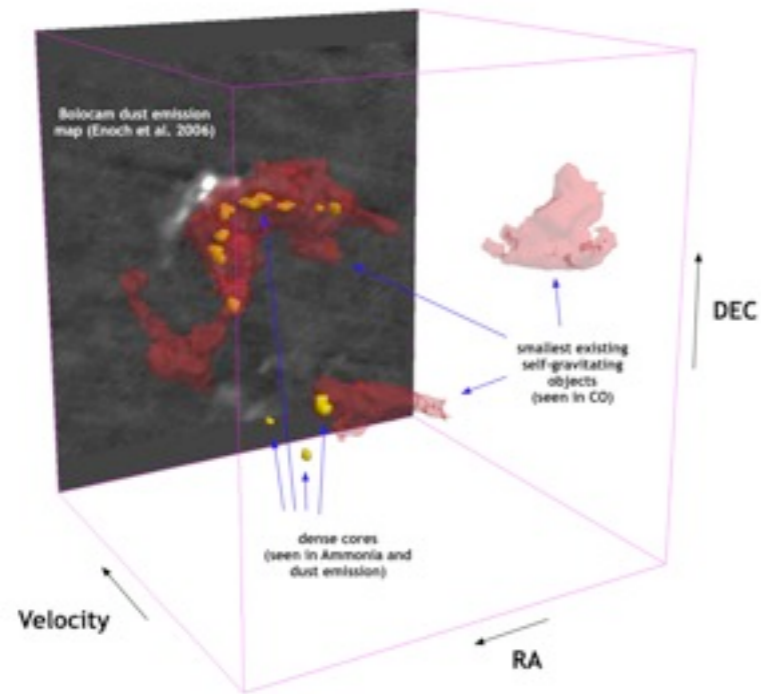
Perseus

3D Viz made with VolView

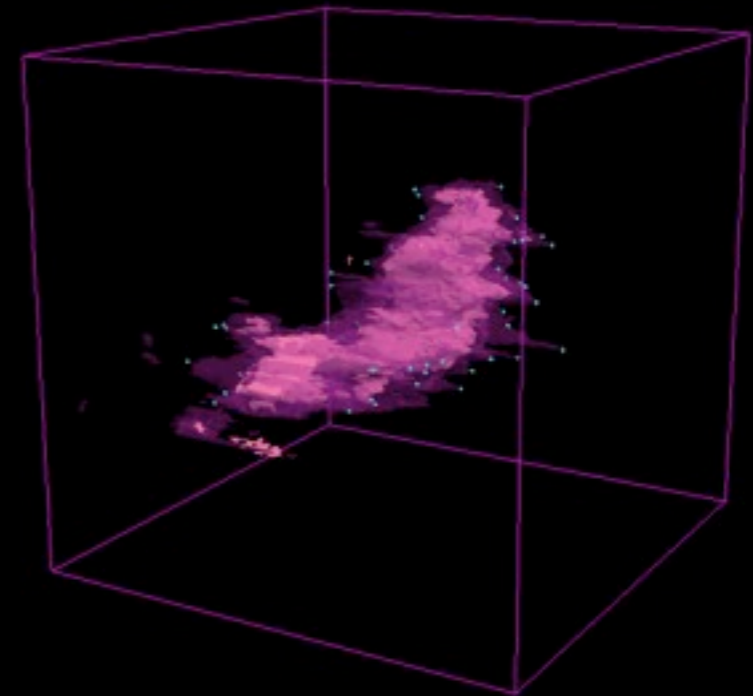
AstronomicalMedicine@iig

COMPLETE

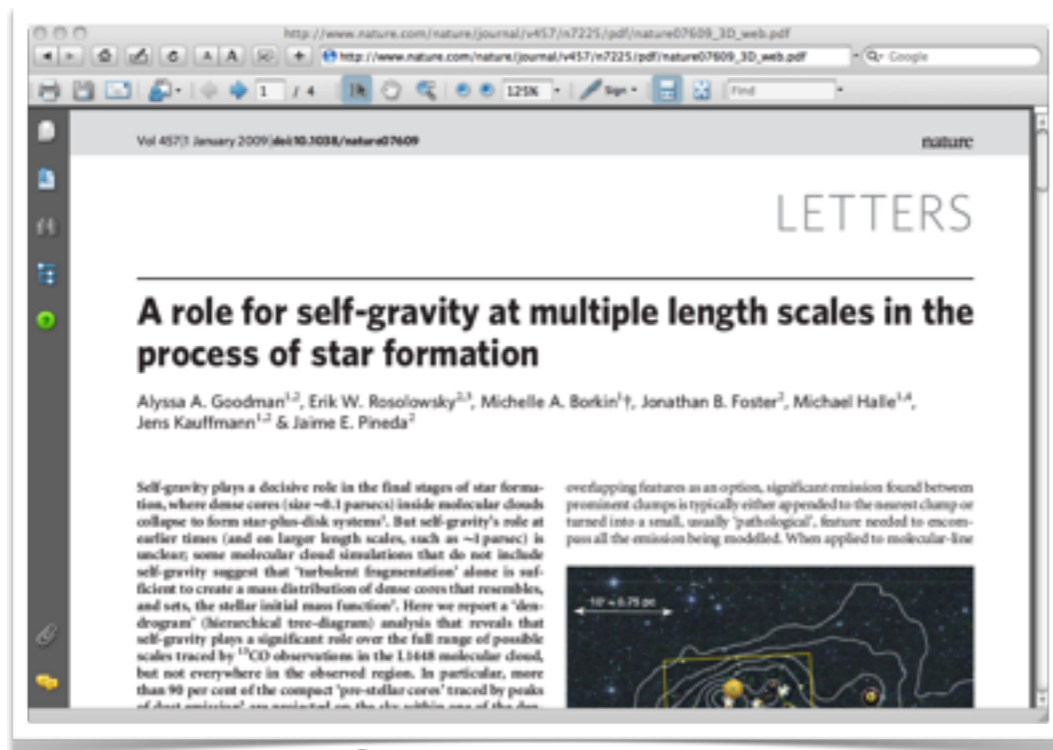
Some of What We're Learning...



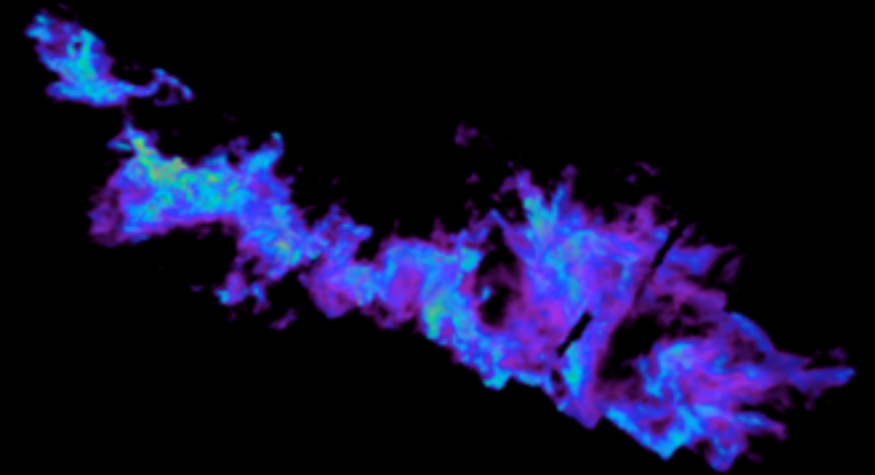
*Cores nest in cocoons
(Kauffmann et al. 2009)*



*Tripled Outflows
(Borkin et al. 2008,9)*



*Gravity Matters
(Goodman et al. 2009)*



*Shells Rule
(Arce et al. 2009)*

Tasting Star Formation



Star Formation Taste Tests > Overview

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Star Formation Taste Tests CFA

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Welcome to the Tasting Room



This is the collaborative space for those who do simulations of star forming regions, and those who observe them. It was inspired, in the Fall of 2006, by the NSF proposal entitled "Star Formation Taste Tests," by A. Goodman & E. Rosolowsky. Today, it is used to host conversations about and short descriptions of simulations, along with links to longer descriptions (e.g. Journal articles & web sites). In the future, we are planning to connect more enhanced descriptions of those simulations directly to online code bases and sample outputs, via the new [CADAC](#) site. So, stay tuned.

MONDAY, 13 APRIL 2009

Message [Relevant References relating to Bayesian Methods](#) Posted by Rahul S.

TUESDAY, 7 APRIL 2009

File [dustfit_slides.pdf](#) Uploaded by Rahul S.

WEDNESDAY, 18 FEBRUARY 2009

Writeboard [Taste Tests we Plan \(COMPLETE Group\)](#) Updated by Alyssa G.

To-do [Compare PPP and PPV dendrograms to determine the correct "paradigm" for mapping between the two: \(Dendrograms and Simulations\)](#) Completed by Alyssa G.

To-do [Taste-Testing delivery to CADAC prior to Ringberg Meeting \(Dendrograms and Simulations\)](#) Completed by Alyssa G.

To-do [link to http://www1.astrophysik.uni-kiel.de/asd/ \(Dendrograms and Simulations\)](#) Assigned to Sarah B.

Writeboard [Re: Heitsch et al: Colliding Flows](#) Comment by Alyssa G.


WEDNESDAY, 21 JANUARY 2009

Message [Decadal Survey](#) Posted by Alyssa G.

THURSDAY, 20 NOVEMBER 2008

Comment [Re: "Toward a Prescriptive Understanding of Kennicutt-Schmidt Relations"](#) Posted by Alex L.

Comment [Re: "Toward a Prescriptive Understanding of Kennicutt-Schmidt Relations"](#) Posted by Alex L.



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People on this project

HCO

Alyssa Goodman
You are logged in right now

Sarah Block
Latest activity 25 days ago

Rahul Shetty
Latest activity 28 days ago

August Muench
Latest activity 28 days ago

Douglas Alan
Latest activity 28 days ago

Jens Kauffmann
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Tim Clark
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American Museum of Natural History

Mordecai-Mark Mac Low
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Héctor Arce
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Cal State Stanislaus

Christopher De Vries
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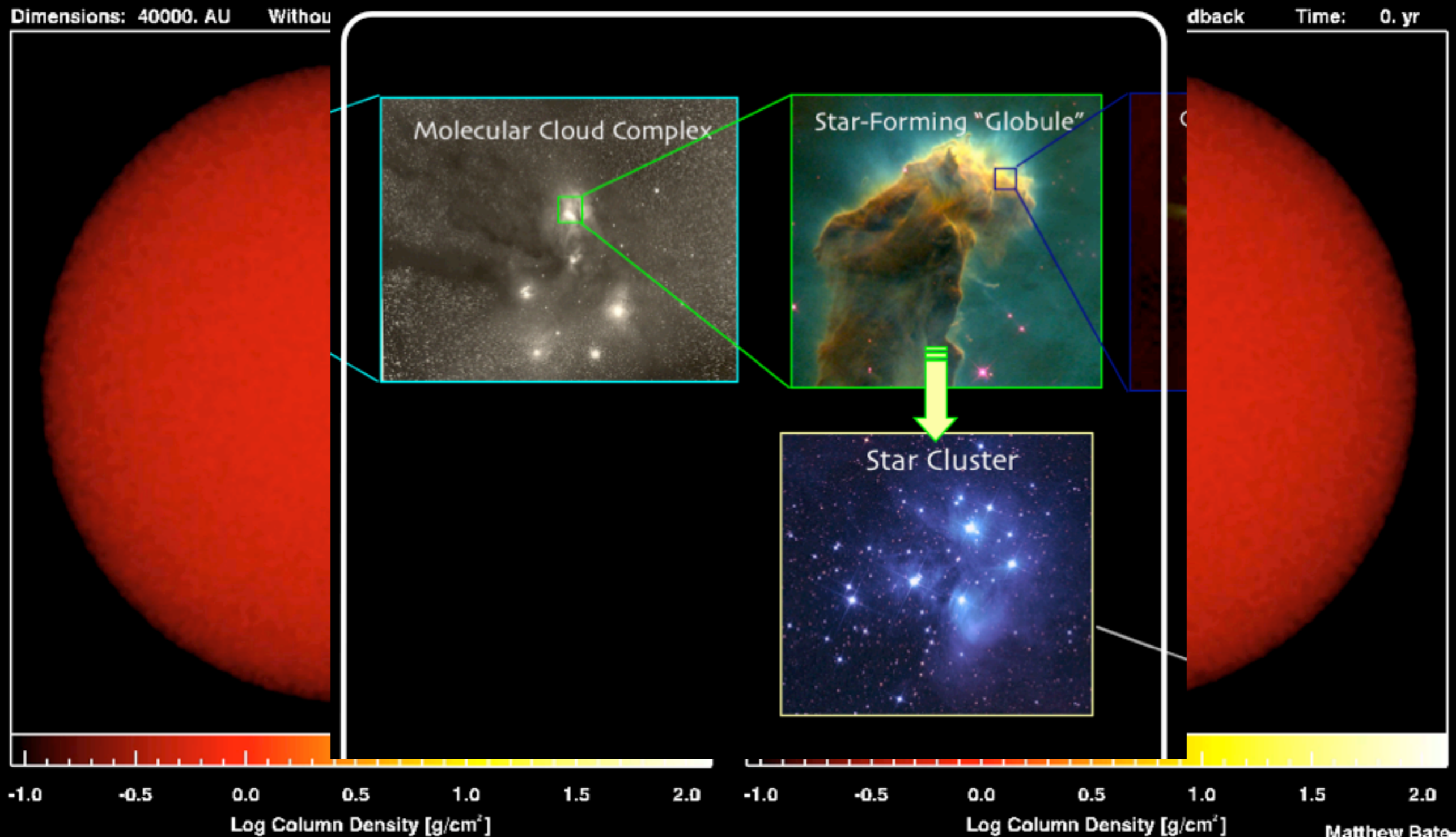
Calar Alto/MPI

Joao Alves
Hasn't logged in recently

Caltech

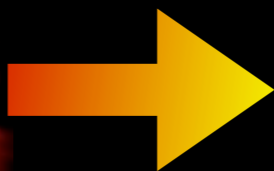
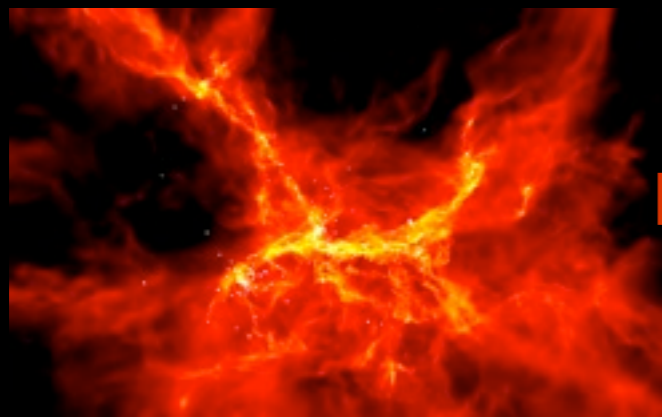
Scott Schnee
Hasn't logged in recently

Magnetohydrodynamic Simulations

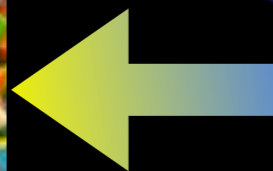


Simulations of Bate 2009

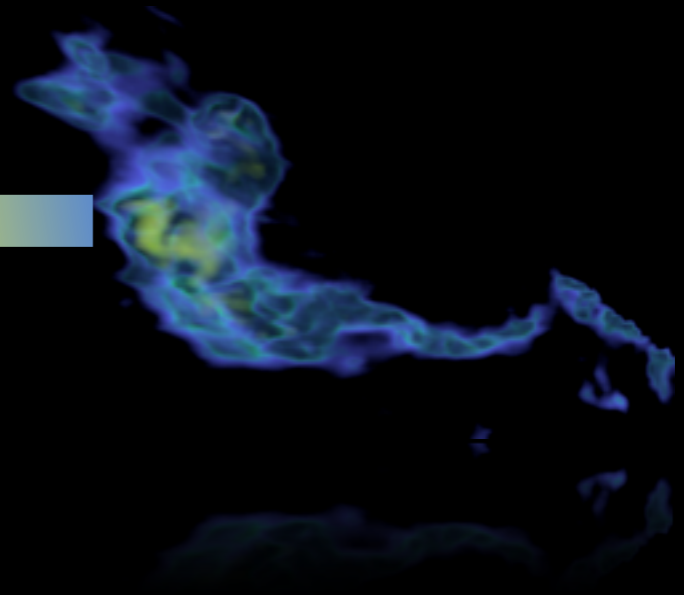
simulations



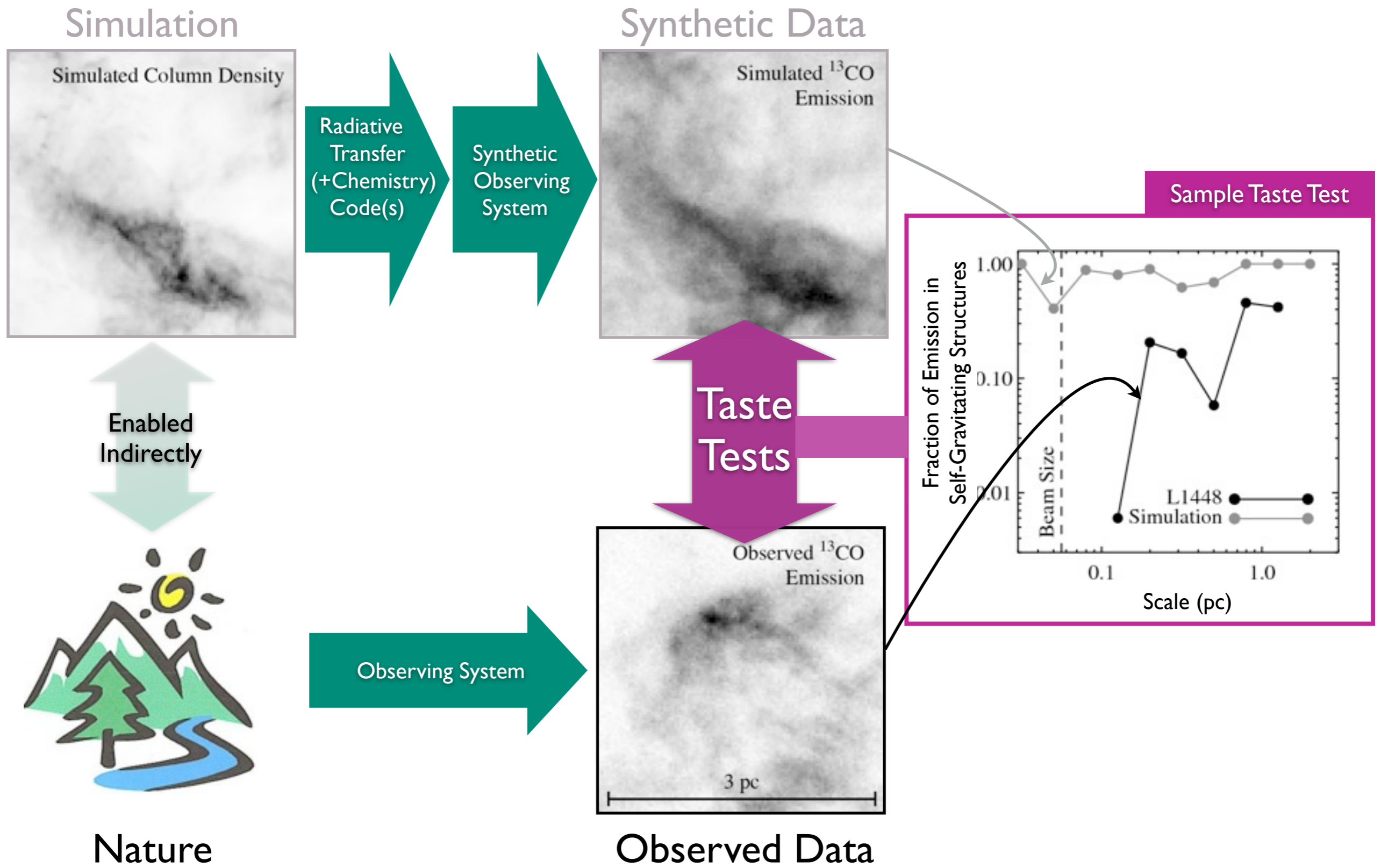
Tasting



>2D
observations



The Taste-Testing Process



(Tasting)

The Role Self-Gravity in Star Formation

LETTERS

NATURE | Vol 457 | 1 January 2009

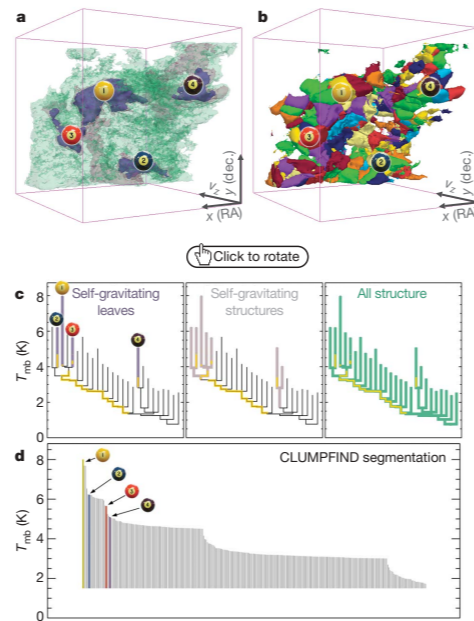


Figure 2 | Comparison of the 'dendrogram' and 'CLUMPFIND' feature-identification algorithms as applied to ^{13}CO emission from the L1448 region of Perseus. **a**, 3D visualization of the surfaces indicated by colours in the dendrogram shown in **c**. Purple illustrates the smallest scale self-gravitating structures in the region corresponding to the leaves of the dendrogram; pink shows the smallest surfaces that contain distinct self-gravitating leaves within them; and green corresponds to the surface in the data cube containing all the significant emission. Dendrogram branches corresponding to self-gravitating objects have been highlighted in yellow over the range of T_{mb} (main-beam temperature) test-level values for which the virial parameter is less than 2. The x - y locations of the four 'self-gravitating' leaves labelled with billiard balls are the same as those shown in Fig. 1. The 3D visualizations show position-position-velocity (p - p - v) space. RA, right ascension; dec., declination. For comparison with the ability of dendrograms (**c**) to track hierarchical structure, **d** shows a pseudo-dendrogram of the CLUMPFIND segmentation (**b**), with the same four labels used in Fig. 1 and in **a**. As 'clumps' are not allowed to belong to larger structures, each pseudo-branch in **d** is simply a series of lines connecting the maximum emission value in each clump to the threshold value. A very large number of clumps appears in **b** because of the sensitivity of CLUMPFIND to noise and small-scale structure in the data. In the online PDF version, the 3D cubes (**a** and **b**) can be rotated to any orientation, and surfaces can be turned on and off (interaction requires Adobe Acrobat version 7.0.8 or higher). In the printed version, the front face of each 3D cube (the 'home' view in the interactive online version) corresponds exactly to the patch of sky shown in Fig. 1, and velocity with respect to the Local Standard of Rest increases from front (-0.5 km s^{-1}) to back (8 km s^{-1}).

data, CLUMPFIND typically finds features on a limited range of scales, above but close to the physical resolution of the data, and its results can be overly dependent on input parameters. By tuning CLUMPFIND's two free parameters, the same molecular-line data set⁸ 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 frequency¹³.

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 work¹⁴ 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 $M_{\text{lum}} = X_{13\text{CO}} L_{13\text{CO}}$, where $X_{13\text{CO}} = 8.0 \times 10^{20} \text{ cm}^{-2} \text{ K}^{-1} \text{ km}^{-1} \text{ s}$ (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, $\alpha_{\text{obs}} = 5\sigma_v^2 R / GM_{\text{lum}}$. In principle, extended portions of the tree (Fig. 2, yellow highlighting) where $\alpha_{\text{obs}} < 2$ (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 fields¹⁶, its measured value should only be used as a guide to the longevity (boundedness) of any particular feature.

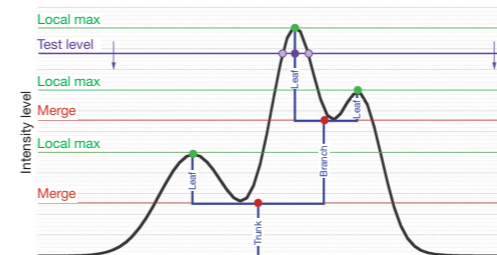


Figure 3 | Schematic illustration of the dendrogram process. Shown is the construction of a dendrogram from a hypothetical one-dimensional emission profile (black). The dendrogram (blue) can be constructed by 'dropping' a test constant emission level (purple) from above in tiny steps (exaggerated in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

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Goodman et al. Nature, 2009

Seamless Astronomy

AstroNavigator

Literature Viewer

Project 1 Project 2 Project 3 Edit

QSO MgII absorption lines observed

Authors: Drinkwater, Webster R.L., et al.

Description: The results of a large R-band

Fraction of Emission in Self-gravitating Structures

Beam Size

Scale (pc)

L1448 Simulation

IC 348 Example Requires

Footprint

C 348 RA = 56.14

results 1-20 of 907

Semantic Search

Info Viewer for Analysis Results

Data Viewer (e.g. WWT)

Archive Browser

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

BONUS DEMO

Ongoing(!) “Real” Work...
COMPLETE, Astronomical Medicine & Taste-Testing

The Role of B-Stars in Molecular Cloud Evolution

(special thanks to Sanjana Sharma & Gus Muench!)