Star Formation Taste Tests

COMPLETE

Alyssa Goodman
Jens Kauffman
Jaime Pineda
Scott Schnee
Erik Rosolowsky
Jonathan Foster
Rahul Shetty
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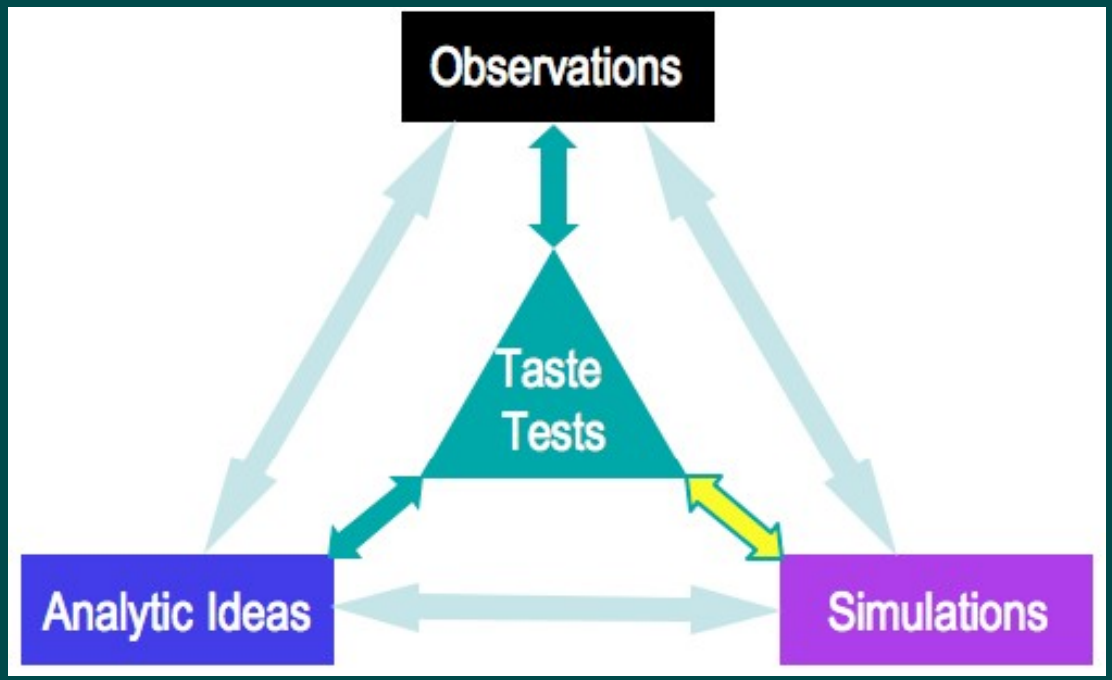
CfA

iiC Initiative in Innovative Computing at Harvard

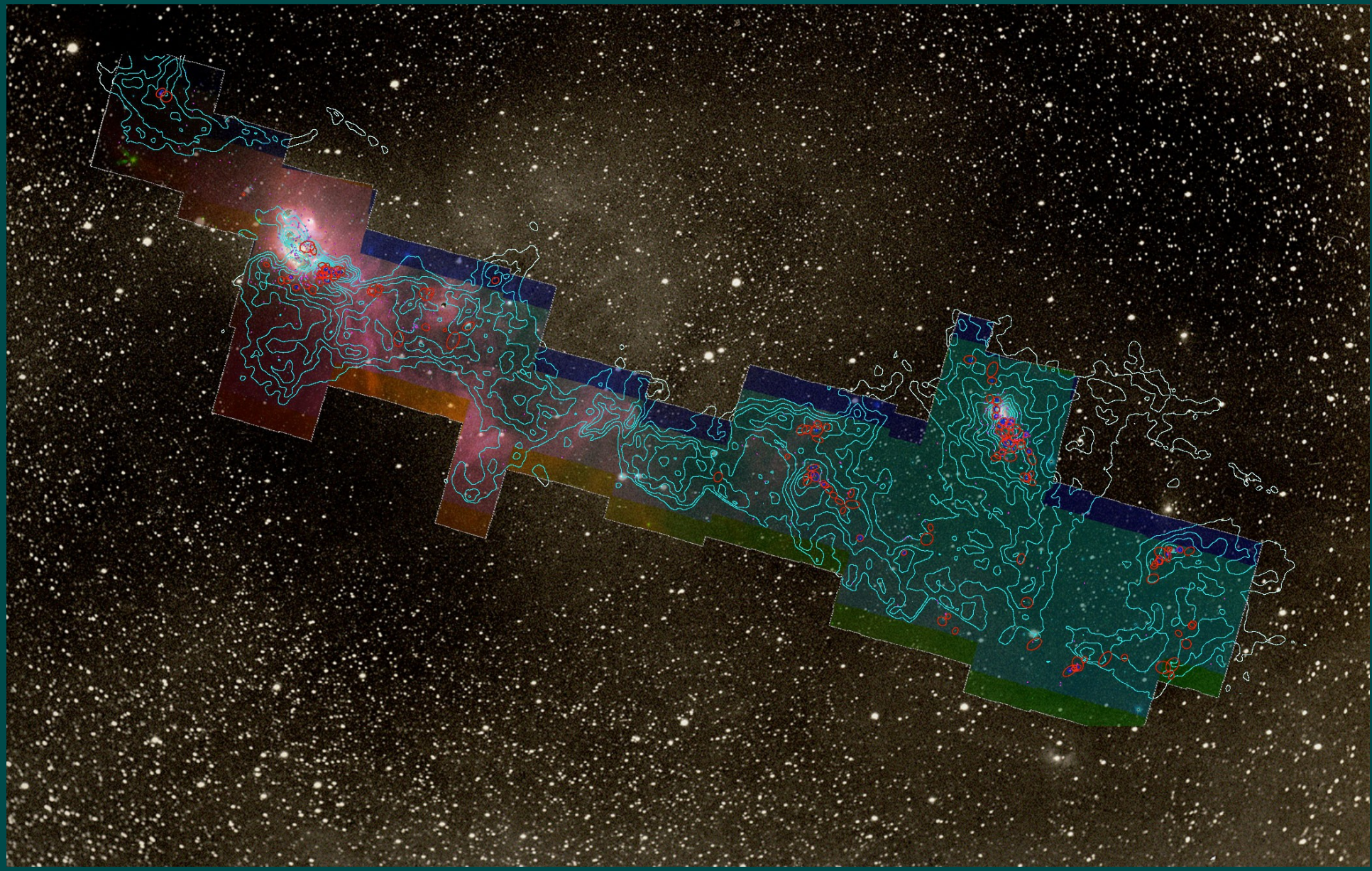
“Tasting” Star Formation



“Taste Tests”? We frame this project by analogy. How does a great chef, making a complicated dish, know if she has created what she originally intended when she is done cooking? She “tastes.” She informs her cooking with her extensive knowledge of food chemistry (analytic theory), uses all the cooking equipment (simulations) she has in the kitchen to try to make something edible and tasty (star forming, and realistic), and then she uses her senses (observations) to see if what she made tastes as intended. *“Tasting” in cooking actually encompasses the joint action of many senses: we propose here a combination of statistical techniques that we call “taste tests.”* The tests will allow us to discerningly decide if what we sense (observe) and what we can cook (simulate) might actually be tasty (form stars), and how (analytic theory) that happens.

from: Goodman & Rosolowsky, NSF Proposal Fall 2006

What's on the Menu?



- Isolated and Clustered Star Formation; Dead Zones

Recipes

- Collection of Simulations representing various conditions of star forming regions
- We will request/encourage simulators to share simulation data cubes
- We will make use of CADAC

Recipes

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http://cadac.sdsc.edu/

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CADAC

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The Computational Astrophysics Data Analysis Center

The Computational Astrophysics Data Analysis Center (CADAC) collects and stores results of large astrophysical simulations and provides data analysis resources to researchers worldwide. Because only a fraction of computational resources is typically available for data-analysis, early publication and sharing of large computational datasets are not commonplace in astrophysics.

The CADAC is a worldwide service that provides powerful data-storage and data-analysis resources to the astrophysical community, encouraging the early publication of complete numerical datasets. The CADAC will foster a new system and culture whereby data-analysis tools and computational data are shared. Its use will encourage scientific collaboration, increase the impact of numerical experiments, and facilitate the review process of journal papers based on computational simulations.

More Information

- Read more about the CADAC.
- Find out who is a member.
- Get some help joining.
- Visit the wiki pages for the KITP workshop Star Formation Through Cosmic Time.
- Read the CADAC announcement.

SDSC SAN DIEGO SUPERCOMPUTER CENTER UCSD lca Laboratory for Computational Astrophysics

Official web page of the University of California, San Diego.

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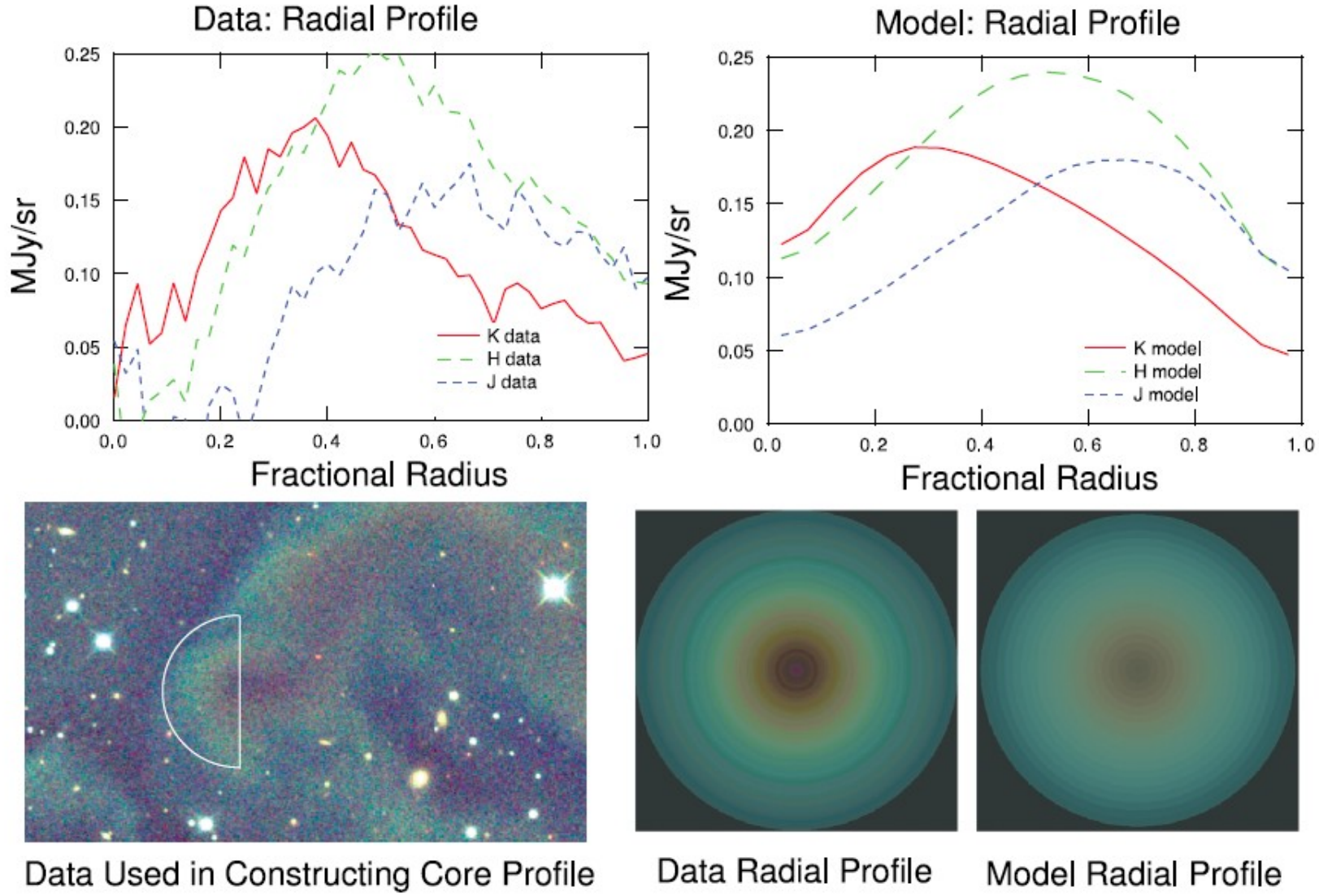
Tasting (key step)

- “Observe” the Simulations: Apply Radiative Transfer to the simulations. (e.g. Padoan, Nordlund, Juvela)
- Codes: RADISH, MOCASSIN, and others (Chakrabarti et al., Ercolano et al., Keto et al.)
- Use statistical tests to compare true observations with “observed” simulations.
- Tests: PDFS, power spectra, auto-corr funcs, spectral correlation, VCA, PCA, CLOUDSHINE, DENDROGRAMS

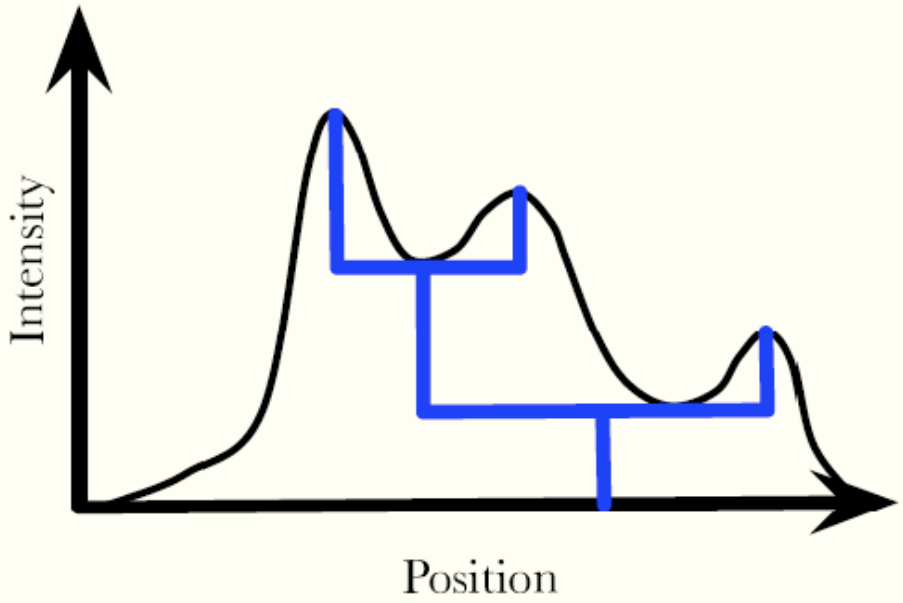
Column Density from Cloudshine?

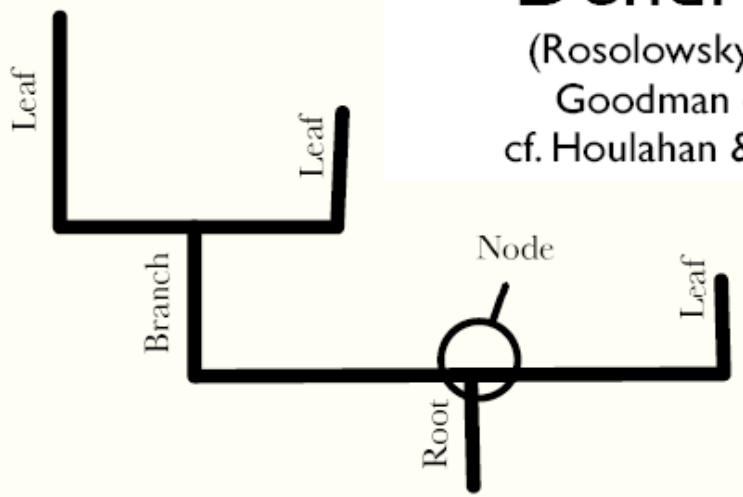


Foster & Goodman 2006

FIG. 3.—Model of cloudshine in one core as reflected interstellar radiation. The lower left panel shows the roughly circular feature we chose to model as a sphere. Due to the surrounding structure, only the left half of the circle was used to derive an angle-averaged radial profile. The comparison between this radial profile and our best-fit model (an r^{-2} density profile and a total optical depth of 120 mag of visual extinction) is shown in two ways: above as radial flux profiles in individual bands and in the lower right as a synthetic color-composite image that allows for an overall comparison. Although the fit is good, the central region of the core is darker than predicted by the model. Some of this may be due to self-sky subtraction in the image (which causes dark edges around bright features) and a nonspherical, nonisotropically illuminated core, and some may be due to a failure to adequately model the density structure at the center of the core.

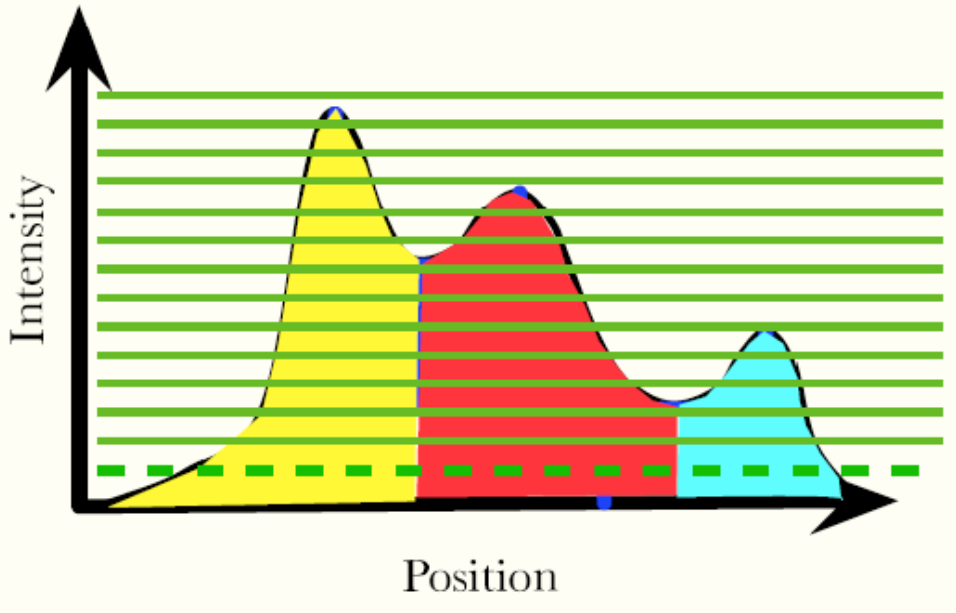
Dendrograms (Hierarchical) vs. CLUMPFIND (Non-hierarchical)





Dendrogram

(Rosolowsky et al. 2007;
Goodman et al. 2007
cf. Houlahan & Scalo 1992)

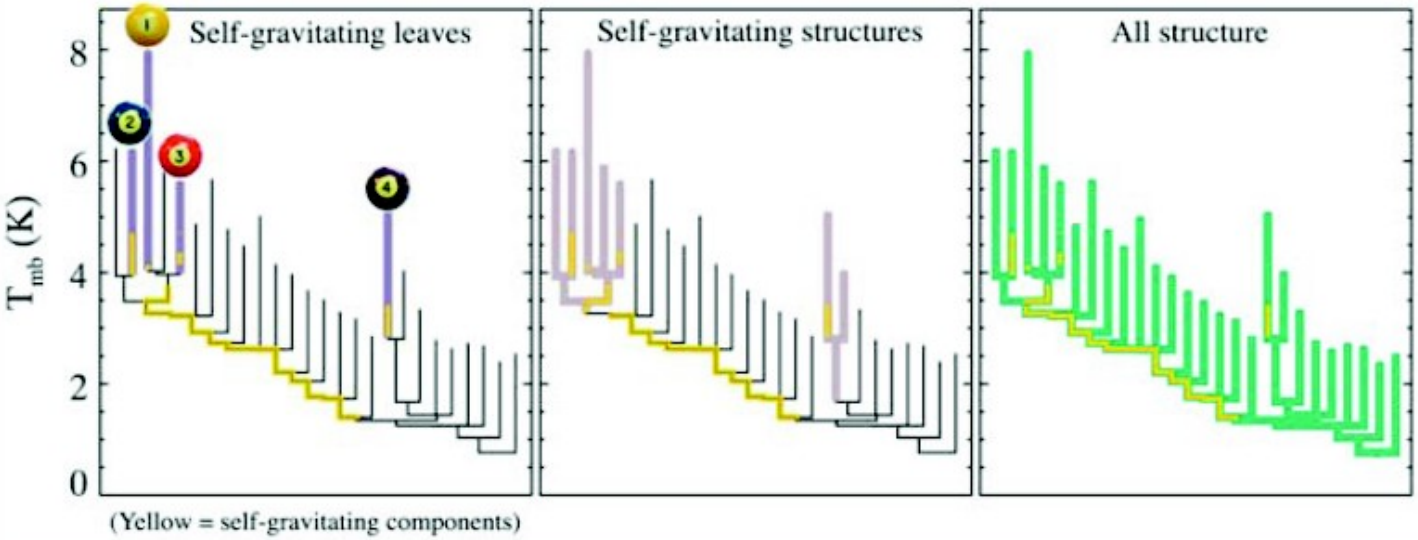


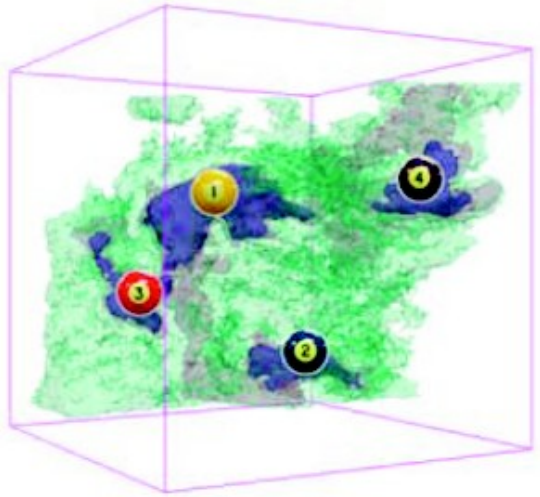
CLUMPFIND

(Williams et al. 1994)

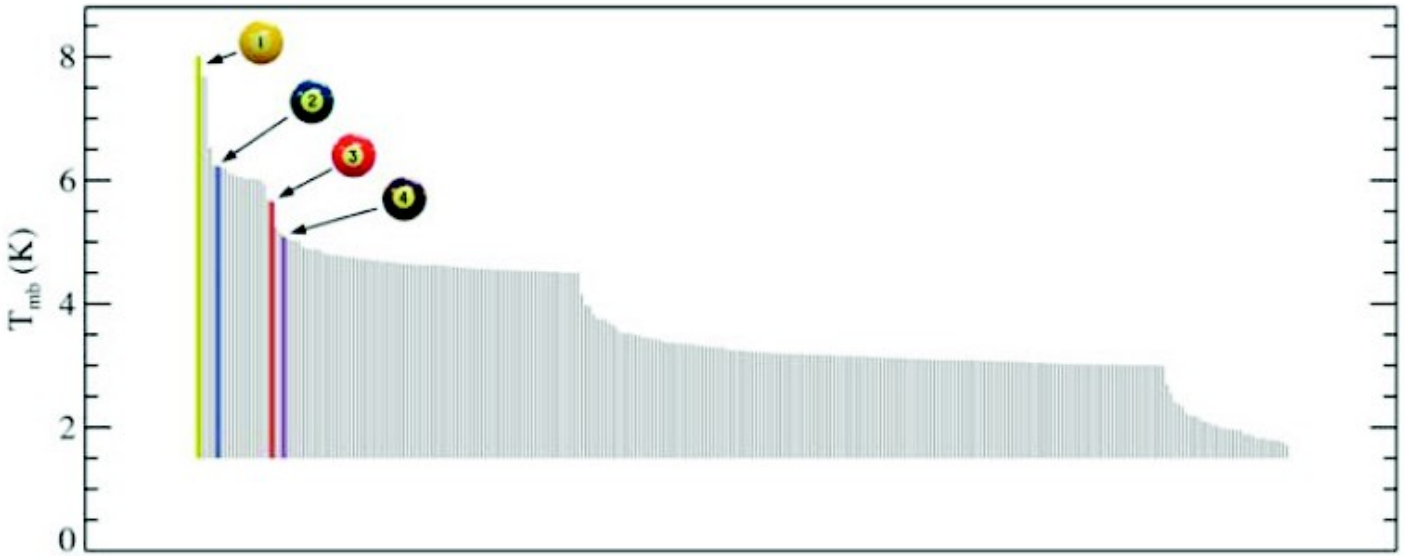
Dendrograms (Hierarchical) vs. CLUMPFIND (Non-hierarchical)

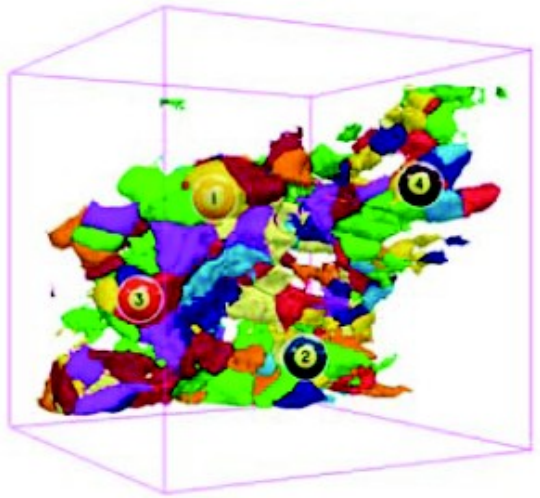
L1448 region of Perseus





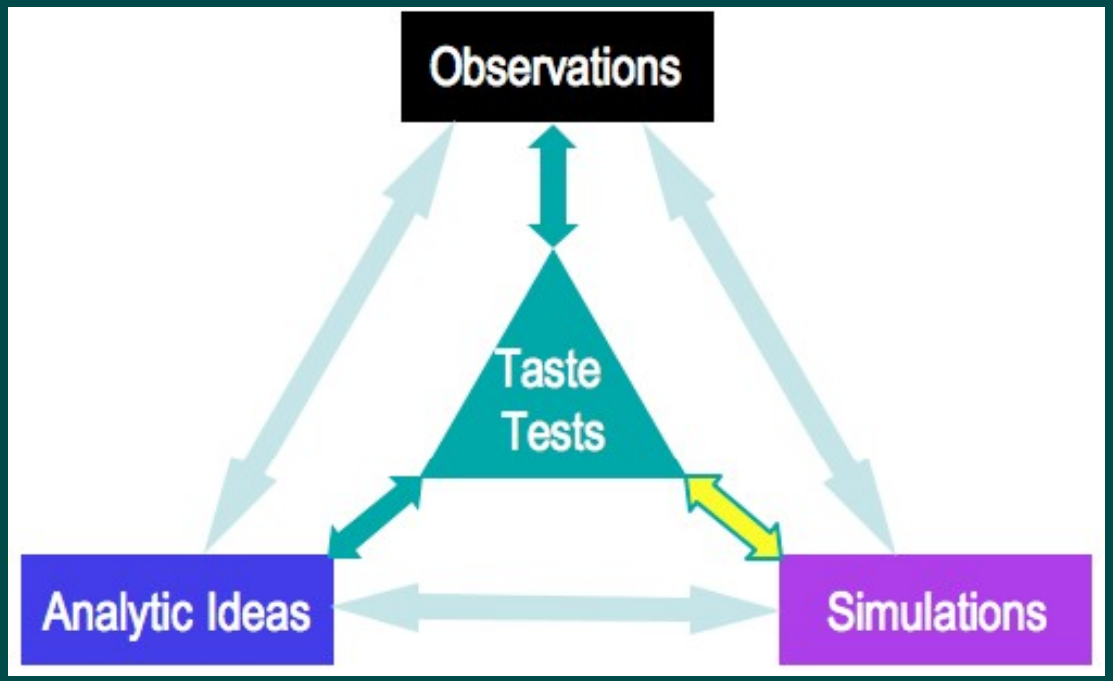
The online PDFs of these insets are interactive, and can be rotated and manipulated by the viewer.





Cooks and Tasters Wanted

- Similar to observations, simulations will be available to everyone through CADAC
- We envision a collaborative effort



Cooks and Tasters Wanted

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Project overview & activity

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 simulatons, 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 (likely with help from our friends at NCSA and SDSC). So, stay tuned.

MONDAY, 15 OCTOBER

Message Gathering Simulation Data Cubes — Posted by Rahul S.

Writeboard Thoughts on CfA R.T. Project — Updated by Rahul S.

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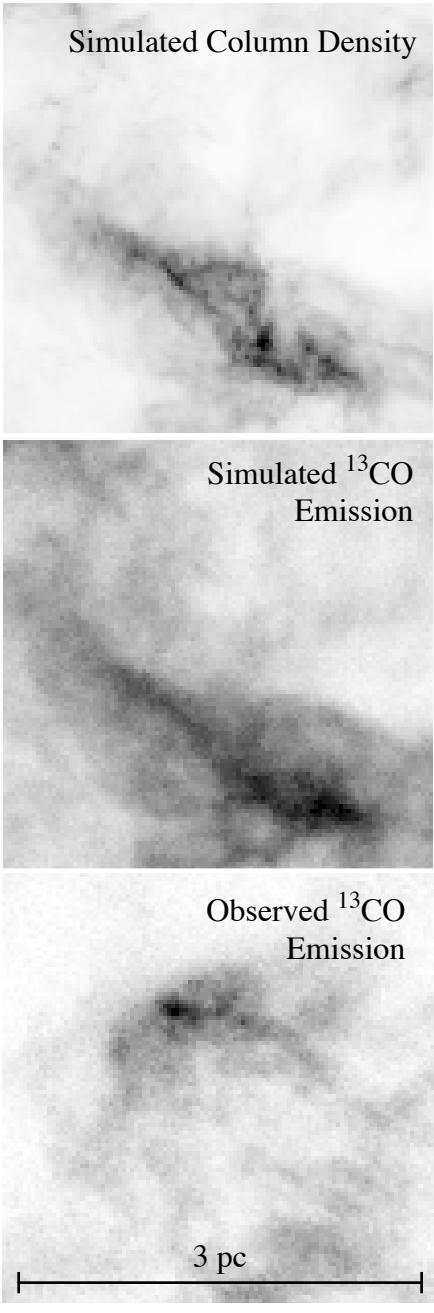
Simulated Column Density
Simulated ^{13}CO Emission
Observed ^{13}CO Emission
3 pc