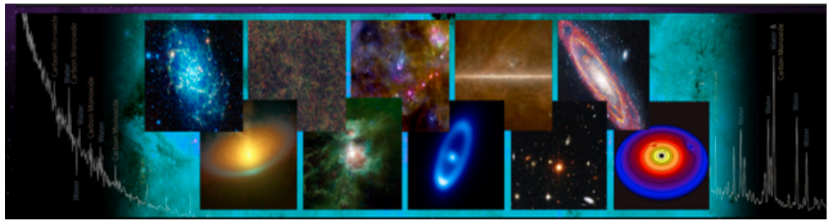
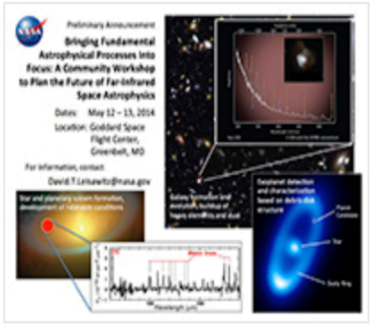
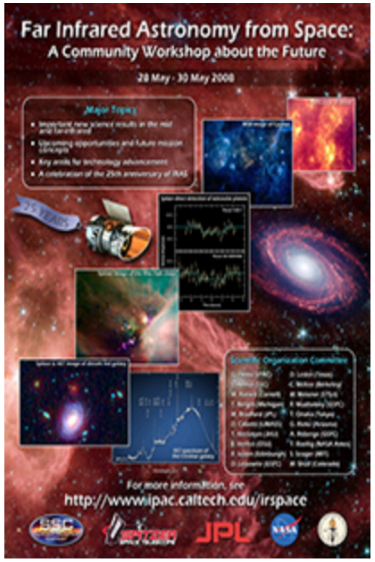
Far IR Surveyor Workshop

June 3rd - 5th 2015
Caltech's Beckman Institute
Pasadena, CA





NASA is seeking input from the science community that will culminate in a decision to support studies of three or four large missions to prepare for the next Decadal Survey in Astrophysics. A white paper released by NASA's Astrophysics Division lists four candidate missions, including a Far-Infrared Surveyor mission. This mission is listed because it was recommended in the Astrophysics Roadmap, *Enduring Quests, Daring Visions,* which you can find on the same web site. The community now has an opportunity to comment on the candidate missions and to recommend additions to or deletions from the initial candidate list.



Community input will be provided to NASA's Astrophysics Subcommittee through its three Program Analysis Groups (PAGs). The Far-IR Science Interest Group comprises all interested members of the community and reports to the Cosmic Origins PAG (COPAG). Recently, the COPAG issued an RFI for short 1-2 page whitepapers addressing the candidate missions. The listing of recent meetings as well as the submitted whitepapers can be found on the COPAG community input page. This call for whitepapers, along with other aspects of the large mission study schedule and NASA's charge to the PAGs was discussed during the most recent COPAG town hall meeting on 10 March 2015.

Preparing for the 2020 Decadal Survey

- One of the tasks of the 2020 Decadal Survey is to prioritize large missions to follow JWST and WFIRST.
- The NASA whitepaper "Planning for the 2020 Decadal Survey" outlines the plan for providing information to the committee on a small set of large mission concepts.

The process and timeline:

- Identify a small set of missions. One of these: "FIR Surveyor"
- NASA Program Analysis Groups (PAGs; COPAG, ExoPAG, PhysPAG) will solicit community input (Jan – Summer 2015) on which missions should be studied.
- PAGs report to NAC Astrophysics Subcommittee (Fall 2015)

Preparing for the 2020 Decadal Survey

The process and timeline (continued):

- NAC reports to NASA on concepts which should be studied (Fall 2015)
- Decision by Astrophysics Division Director (Fall 2015). (Tech. needs proposals could be submitted to the Spring 2016 ROSES call).
- Science and Technology Definition Teams (STDT) will be appointed for each mission concept study. An open call will solicit applications for membership. STDT define science objectives, strawman payload and identifies technology needs for each concept.
- Each study is assigned to a NASA center with oversight from program office at GSFC or JPL. Center study teams produce a DRM (with STDT) and conduct a cost assessment.
- Each STDT produces one or more reports to be used as Decadal committee input (science case, payload, DRM, tech. dev. needed).

Goals of the workshop

- Four candidate large (>$1B) missions were listed in the whitepaper:
  - FIR Surveyor
  - Habitable-Exoplanet Imaging Mission
  - UV/Optical/IR Surveyor
  - X-ray Surveyor

What we need to do:

- Develop and articulate the best science case for a FIR Surveyor

What are the key science questions likely to be relevant in the 2020's which are uniquely addressable with a FIR mission?

Goals of the workshop

What we need to do (continued):

- Reach consensus on which mission architecture provides the essential measurement capabilities (sensitivity, spatial and spectral resolving power, mapping speed, etc.) at an affordable cost.

  Architectures under consideration for the FIR Surveyor:

  - Single, large FIR telescope (CALISTO – Matt Bradford)
  - FIR Interferometer (SPIRIT – Dave Leisawitz)

- Write a workshop summary / whitepaper for delivery to the PAGs (goal 19 June). The whitepaper should make a convincing scientific case for one architecture.

Organizing committee plus science breakout chairs responsible for drafting the whitepaper based on the presentations/discussions at this workshop. *See note from Neal Evans.*

Goals of the workshop

Our workshop is different than a typical science meeting:

- invited talks + submitted key science questions
- science breakouts and reports (Weds & Thurs.)
- lots of discussion time (>4hrs)
- straw poll for US scientists on Thursday
- committee breakout and summary (Friday)

Science breakouts:

- *High-z / Cosmology (N. Wright, J. Glenn)*
- *Nearby Galaxies (K. Sheth, K. Sandstrom)*
- *Milky Way SF and ISM (P. Goldsmith, D. Lis)*
- *Planetary Systems / Solar System (C. Chen, J. Bauer)*

Far IR Surveyor Workshop

Submitted Key Science Questions

1. An accurate census of Compton-thick AGN at z>2 from the 14/24um NeV lines (Duncan Farrah).
2. A definitive answer to the origin of dust at low redshift: supernovae and/or AGB stars? (Duncan Farrah)
3. Are galactic winds responsible for shutting down SF at z < 2 in LIRGs? Is this feedback primarily AGN or SB driven? (L. Armus)
4. Do planetary systems form around every star? Why or why not? (H. Yorke)
5. Image protoplanetary disks and measure the distributions of H2, HD, water vapor and ice, and dust to learn how the conditions for habitability arise during the planet formation process. (D. Leisawitz)
6. Image structures in a large number of debris disks to find and characterize exoplanets through their interactions with the disks. (D. Leisawitz)
7. Mid-infrared spectral diagnostics of star formation and AGN activity in main-sequence galaxies out to z=5 (Duncan Farrah).
8. Molecular hydrogen lines as diagnostics of the formation of the first stars at z>>6 (Duncan Farrah).
9. The clustering of IR-faint AGN & starbursts on spatial scales ranging from voids/filaments to intrahalo, at 1<z<6. Redshift-space distortions, bias cf to passively evolving systems, etc (Duncan Farrah).
10. The faint end of the far-IR luminosity function up to z~6. Hierarchical modes of galaxy assembly, contribution from faint galaxies to the CIB, etc (Duncan Farrah).
11. The pre-stellar core mass function across the Local Group. Does the stellar IMF vary significantly, depend on environment, etc? (Duncan Farrah)
12. The radial dust distribution around nearby stars at 100-300K as diagnostics of Earth-like planet formation in the habitable zone (Duncan Farrah).
13. Understand the formation, merger history, and star formation history of galaxies, and the role of AGN in galaxy evolution. (D. Leisawitz)
14. Warm-gas water lines as diagnostics of early-stage planetary formation - terrestrial oceans, snow lines, etc. Also, OH and far-infrared fine structure lines as a diagnostic of cooling and gas infall (Duncan Farrah).
15. What are the size distributions of outer solar system object populations down to ~10km scales and out to distances ~ 50AU or greater? (J. Bauer)
16. What is the prevalence of water in protoplanetary disks? (D. Benford)
17. Why is star formation so much more efficient at z~1-4 .. is the chemistry in the ISM different? (A. Pope)

other stuff

- All science breakout groups meet on both Weds. and Thurs. Will have Google docs for notes and phone lines.

- **Need to avoid front (East) patio area on Weds. (today) after 3:30pm. Can use West (left) and North-East auditorium exits for breakouts and adjournment. (Memorial service for Prof. Jack Richards)*

- Wireless: either Caltech Guest, Caltech registered, or Eduroam

- Webex information has been posted to the website for remote participants. Phone lines for breakouts will be added later today.

other stuff

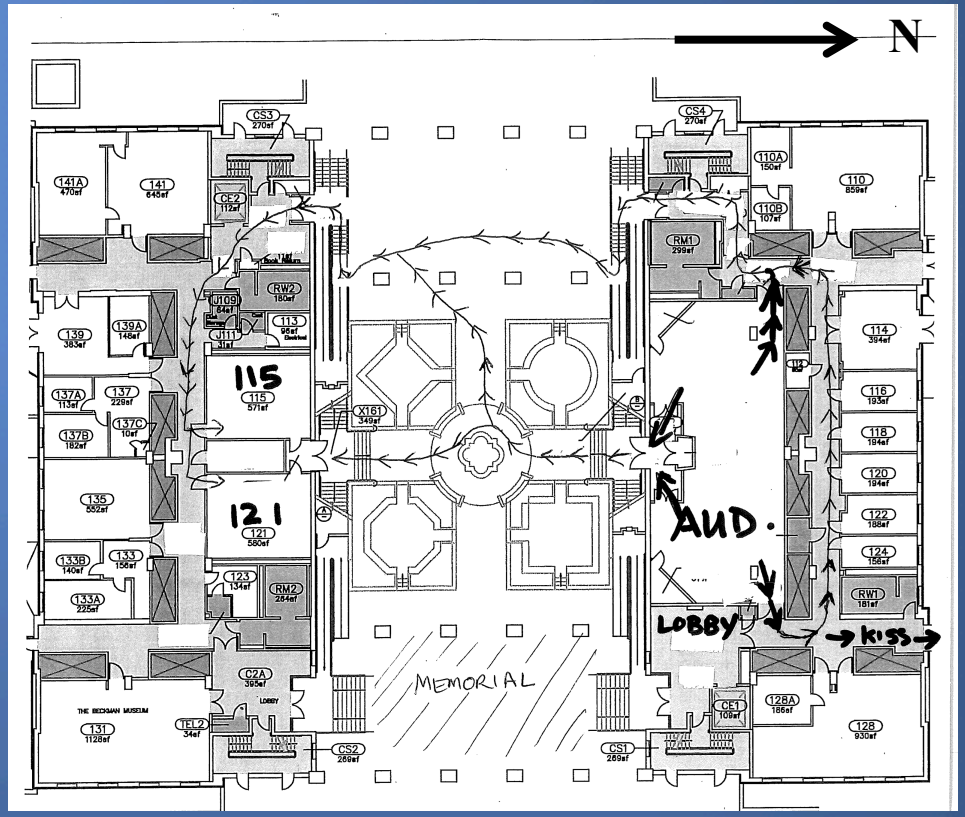
- You're on your own for lunch and dinner. There are two cafeterias on campus (Chandler, Broad) and other options within easy walking distance. See maps on reg. table.

- We are working on a group dinner for Thursday. Details TBD.

- Wannetta Lockhart (SSC) is outside all day Weds., then Thurs. and Fri. morning. She can help you with maps, airport shuttles, etc.

Beckman – Weds. afternoon

- Route to use for breakouts and adjournment on Weds. afternooon
- We'll use one breakout room in Beckman, two at the Keck Institute, plus the auditorium
- Room assignments will be made later today based on estimated group sizes



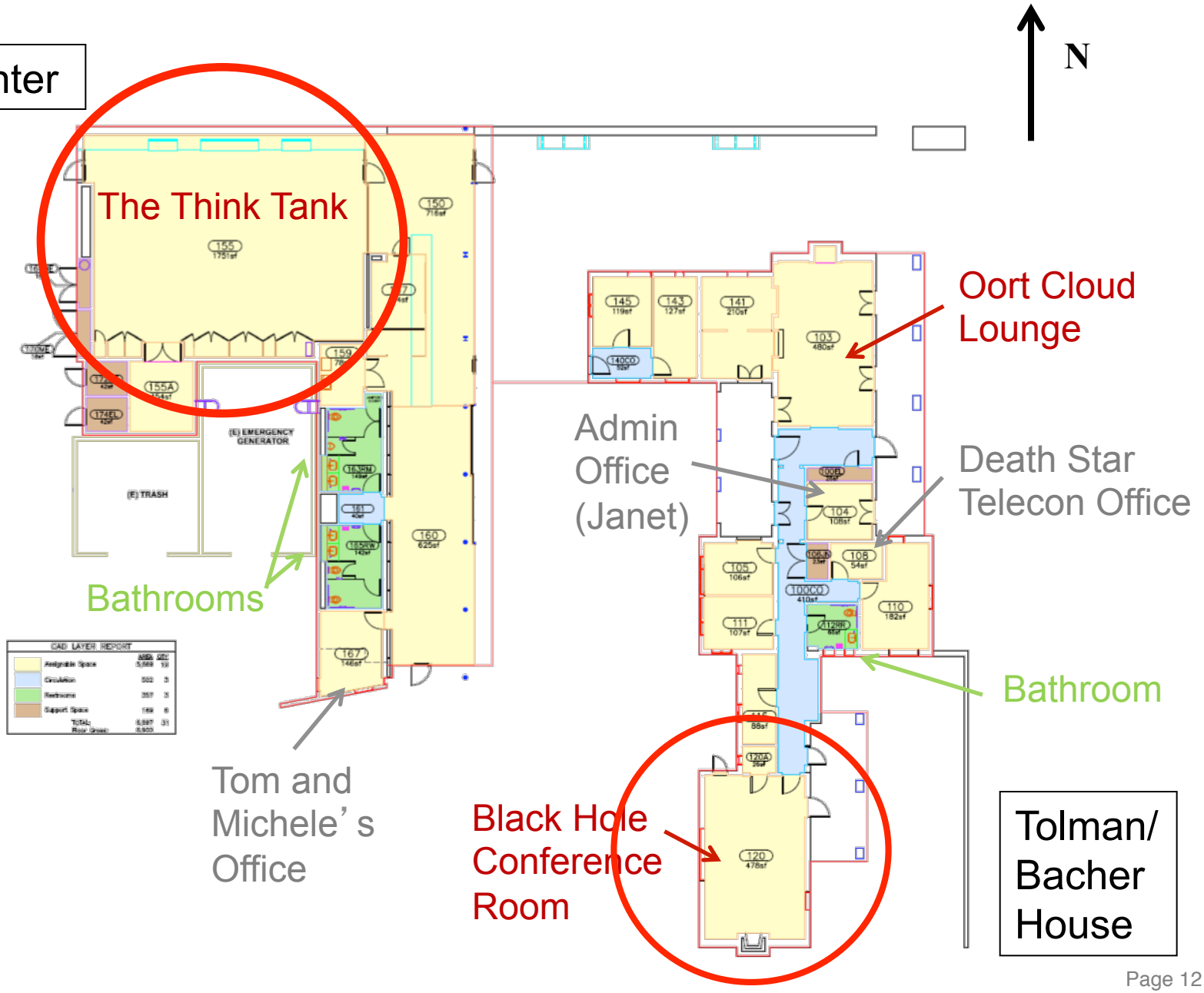
final thoughts

- We have been given a unique opportunity by NASA and the 2013 Astrophysics Roadmap committee to articulate the best science case for the FIR Surveyor, and to help decide what it should be.

- In the next 3 days (and coming weeks) we should work hard to identify the most compelling science, and the most pressing questions that the FIR Surveyor will help us answer.

- thank you for coming to Pasadena and being part of this effort

Keck Center


N
The Think Tank
Oort Cloud Lounge
Admin Office (Janet)
Death Star Telecon Office
Bathrooms
Bathroom
Tom and Michele's Office
Black Hole Conference Room
Tolman/ Bacher House
(E) EMERGENCY GENERATOR
(E) TRASH
CAD LAYER REPORT