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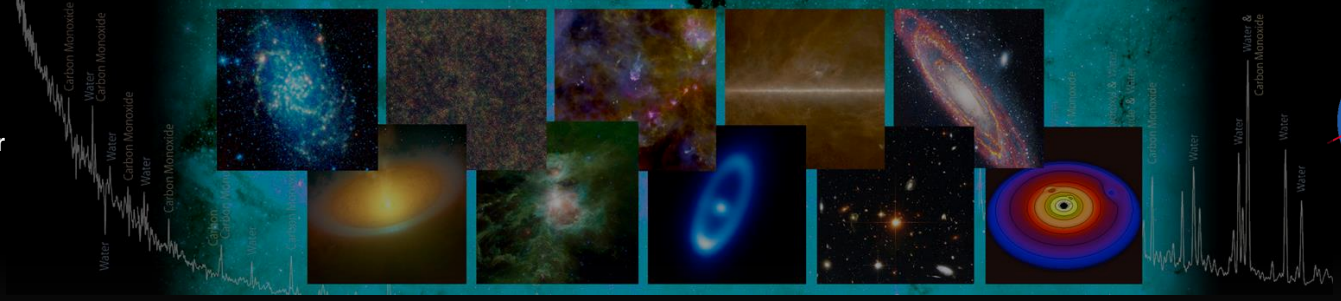


Far-IR Surveyor Planning Report

Presentation to the Astrophysics Subcommittee

16 March 2016

Dave Leisawitz, NASA Center Study Scientist,
Goddard Space Flight Center

Asantha Cooray, UC Irvine, STDT Community Chair

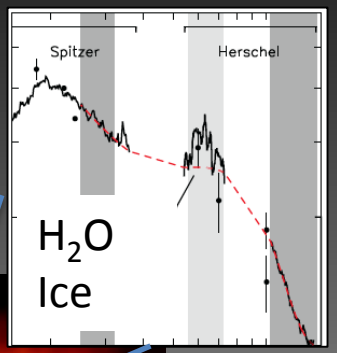
Margaret Meixner, STScI, STDT Community Chair

What is the Far-IR Surveyor?

- Comes from the NASA Astrophysics Roadmap, *Enduring Quests, Daring Visions*
- Roadmap envisages enhanced measurement capabilities relative to those of the *Herschel Space Observatory*:
  - large gain in sensitivity
  - angular resolution sufficient to overcome spatial confusion in deep cosmic surveys or to resolve protoplanetary disks
  - new spectroscopic capability
- Details will emerge from the study, but expect it will address some of the most compelling questions imaginable, such as “How did we get here?” (Cosmic Origins), and PCOS and ExEP themes
- “The far-infrared spectral region is home to most of the energy emitted by a broad range of astronomical phenomena, from stars and planets in formation to young galaxies building their stellar populations and feeding nuclear black holes.” – community report to the PAGs

Science opportunities

How do the conditions for habitability arise during the planet formation process?



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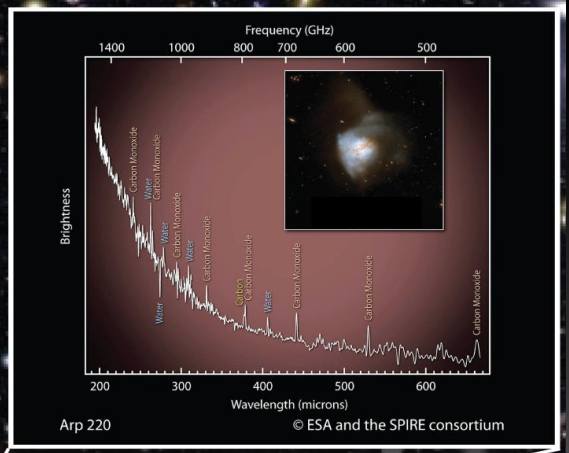

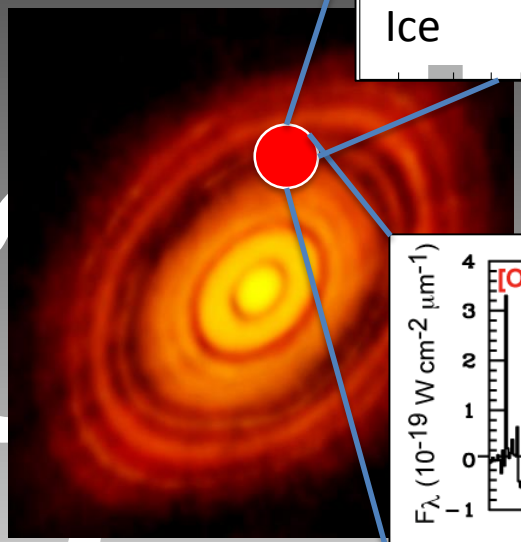

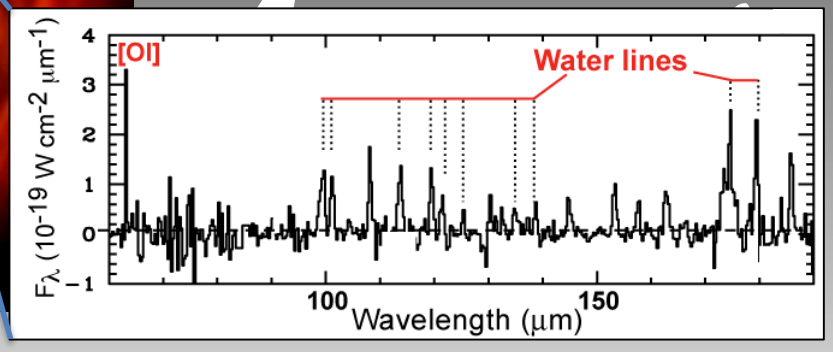

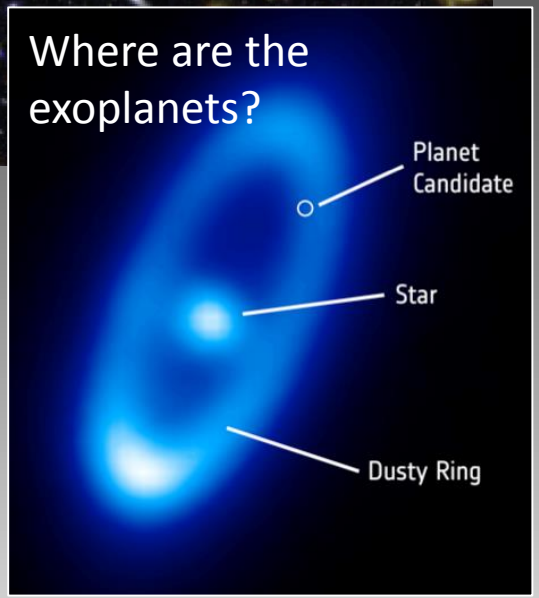

Synergy and Uniqueness

- ALMA, JWST, and new ground-based facilities will change the landscape by the time the FIR Surveyor flies
- The Far-IR Surveyor will bring complementary and unique capabilities to the community
  - Access to water in gaseous and solid states
  - Observing many objects where they are brightest, giving access to objects too faint to see at other wavelengths
  - Access to the dominant interstellar gas cooling lines, and lines that can be used to diagnose physical conditions
- Examples: need far-IR in space to observe protoplanetary disks and non-stellar emission from z < 3 galaxies at the emission peak; high-z galaxies covered by ALMA and JWST

Study flow

Identify visionary, robust, and compelling science questions

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Derive from those questions a set of high-priority measurement requirements for the FIR Surveyor

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Decide what "executable" means in terms of practical parameters, such as technology readiness

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Choose a mission architecture

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Determine technology needs

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Evaluate trades and iterate engineering design with STDT

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Estimate cost

↓

Present to Decadal Survey

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Technology

- Current best understanding of technology needs summarized in the Cosmic Origins Program Annual Technology Report at http://cor.gsfc.nasa.gov/technology/
- Key technologies common to all architectures
  - Low-noise far-IR detector arrays
  - Cryocoolers
- New technology requirements will emerge from the study
  - Examples: large, high-thermal-conductance mirrors for the far-IR; interferometry

Study team

- Great turnout! Received 90 applications and a good deal of international interest (Canada, Chile, France, Germany, Greece, The Netherlands, UK)
- Community Chairs:
  - Dr. Asantha Cooray, University of California, Irvine
  - Dr. Margaret Meixner, Space Telescope Science Institute
- NASA Center Study Scientist
  - Dr. David Leisawitz, NASA GSFC

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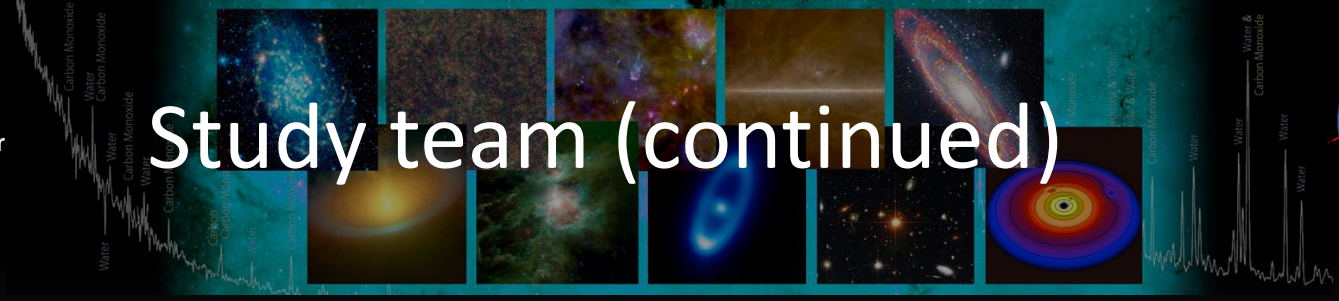
Study team (continued)



- Members of the STDT
  - Dr. Lee Armus, NASA Infrared Processing and Analysis Center
  - Dr. Cara Battersby, Harvard-Smithsonian Center for Astrophysics
  - Dr. Edwin Bergin, University of Michigan
  - Dr. Matthew Bradford, NASA Jet Propulsion Laboratory
  - Dr. Kim Ennico-Smith, NASA Ames Research Center
  - Dr. Gary Melnick, Harvard-Smithsonian Center for Astrophysics
  - Dr. Stefanie Milam, NASA Goddard Space Flight Center
  - Dr. Desika Narayanan, Haverford College
  - Dr. Klaus Pontopiddan, Space Telescope Science Institute
  - Dr. Alexandra Pope, University of Massachusetts
  - Dr. Thomas Roellig, NASA Ames Research Center
  - Dr. Karin Sandstrom, University of California, San Diego
  - Dr. Kate Y. L. Su, University of Arizona
  - Dr. Joaquin Vieira, University of Illinois, Urbana Champaign
  - Dr. Edward Wright, University of California, Los Angeles
  - Dr. Jonas Zmuidzinas, California Institute of Technology

Study team (continued)

- Ex officio non-voting members of the STDT
  - Dr. Dominic Benford, NASA Headquarters, Far-IR Surveyor Deputy Program Scientist
  - Dr. Sean Carey, NASA Infrared Processing and Analysis Center liaison
  - Dr. Maryvonne Gerin, Ecole Normale Superieure, CNES liaison
  - Dr. Frank Helmich, SRON liaison
  - Dr. Karl Menten, Max Planck Institut fuer Radioastronomie, DLR liaison
  - Dr. Susan Neff, NASA GSFC, Cosmic Origins Program Chief Scientist
  - Dr. Deborah Padgett, NASA GSFC, Cosmic Origins Program Deputy Chief Scientist
  - Dr. Douglas Scott, University of British Columbia, CAS liaison
  - Dr. Kartik Sheth, NASA Headquarters, Far-IR Surveyor Program Scientist

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STDT balance

- The STDT is diverse and inclusive
- Wide variety of science areas: planet formation, Galactic and extragalactic astrophysics, solar system
- Demographically diverse
  - 12 men, 7 women
  - 4 persons of color
  - 6 early career (≤ 10 years since PhD), 4 mid-career, 9 senior (>20 years since PhD)
  - 8 from the west, 4 mid-west, 7 east

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Recent progress

- Goddard chosen as lead Center for the study, December 2015
  - D. Leisawitz, NASA Center Study Scientist
  - K. Hartman, Interim Study Manager
- Reached out to other Centers, industry, more outreach and discussion planned
- Chairs selected in February, STDT members in March
- Study Scientist and Study Manager met by phone with the Co-Chairs on March 8
  - Agreed on near-term STDT priorities
  - Discussed a one-page draft study team document on Principles and Guidelines
  - Will defer architecture decision until about 1 year into the study (science first)
- STDT to hold opening kickoff telecon before end of March
- Study Scientist and Manager to meet with GSFC engineering management on March 16 to explain engineering requirements
- IPAC to provide liaison and communication infrastructure for the study, including public website

Guiding principles

- Team will value opinions and contributions from all members equally, and will approach all study topics with an open mind
- STDT and Center Study Office are mutually supporting and comprise an integrated Study Team
- STDT members represent the broader astronomical community
- Document and presentation release policy – must have team agreement to release
- Postdocs and students will be acknowledged for their contributions
- STDT meetings and telecons will be open to the public
- Far-IR Science Interest Group (SIG) provides conduit for information flow with the general community
- May have science and technology working groups
- Will share information with other study teams

Summary

- The Far-IR Surveyor will offer many exciting science opportunities, as befitting a large NASA mission
- The Far-IR Surveyor Study Team will deliver a scientifically compelling, executable mission concept to the Decadal Survey Committee
- STDT meetings will be open, and the Far-IR SIG will be a second channel for two-way communication with the community
- Announcement of the first STDT meeting will be posted on the Cosmic Origins web site, http://cor.gsfc.nasa.gov