Science, Required Technology, and Scope of a Probe-Class Far-Infrared Observatory

IR STIG Special Session

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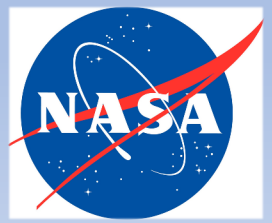
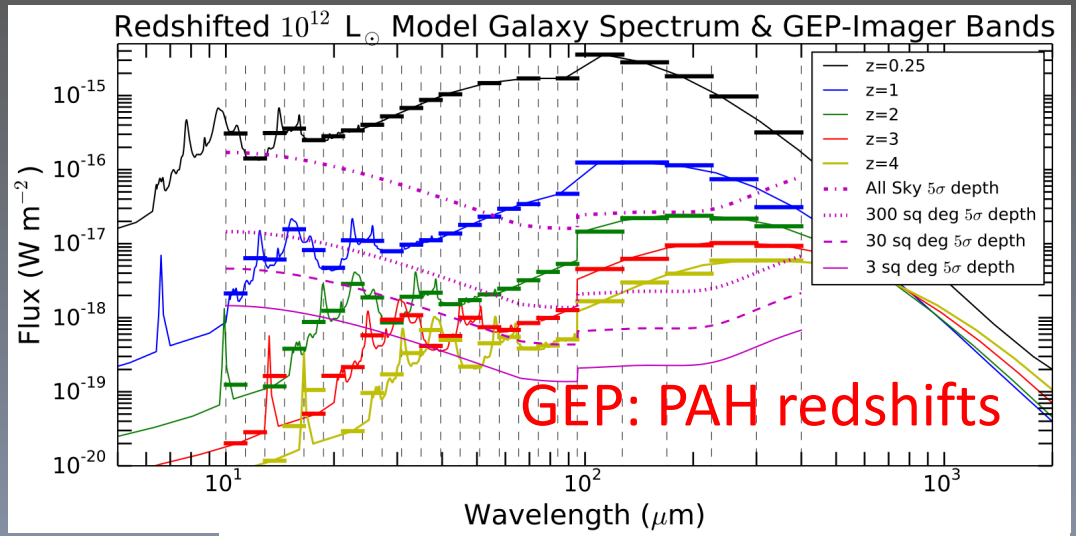
Jason Glenn, Goddard Space Flight Center

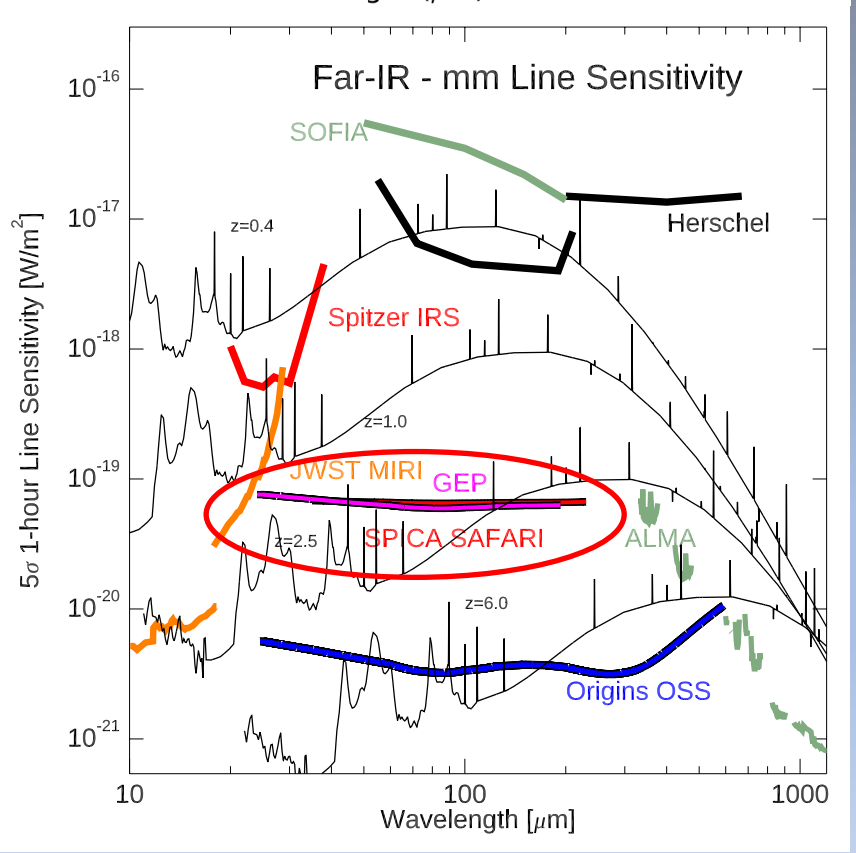
Matt Bradford, JPL



Far-IR Probe Science
The Obscured Universe

- Single ~2 m aperture
  - SPIRIT provides an alternative concept for a FIR interferometer: not described this presentation but similar wavebands and detector NEPs as GEP
- Potential observational capabilities (GEP)
  - Hyperspectral imaging 10 – 400 μm (mid-IR $\mathcal{R}$ ~20)
  - Spectroscopy 24 – 193 μm ($\mathcal{R}$ ~200)
- History of star formation and SMBH growth in galaxies
- The growth of metallicity in the hearts of galaxies
- Physical conditions of interstellar and protostellar disk gas for star and planet formation





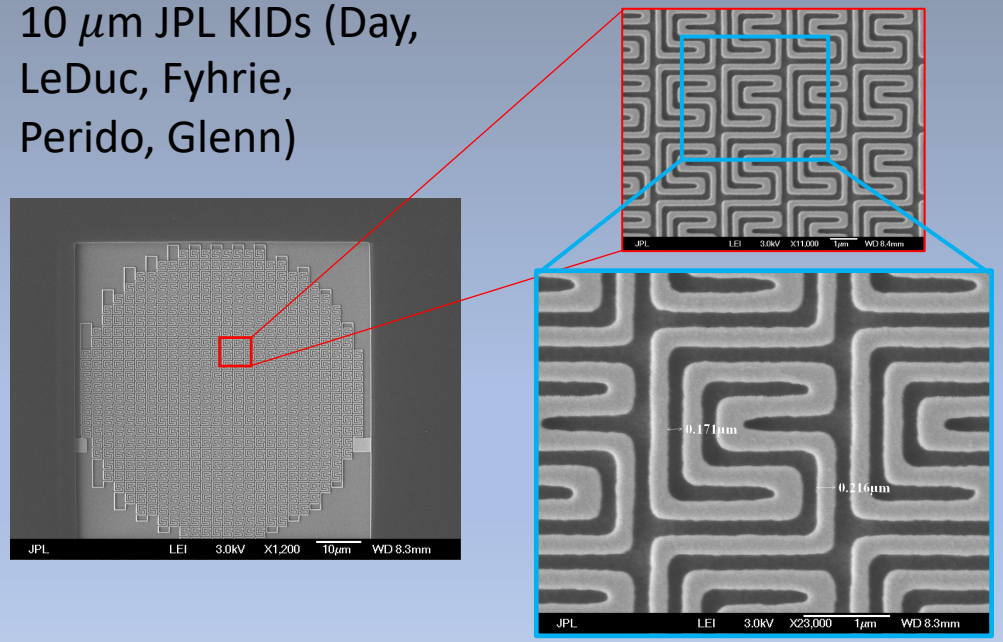
Far-IR Probe Required Technology

Arrays of several x10,000 low NEP detectors

The science is enabled by progress in array sizes and sensitivities. Key performance parameters must be demonstrated in the next 1 or 2 years.

Options: KIDs, TESs, QCDs.

10 μm JPL KIDs (Day, LeDuc, Fyhrie, Perido, Glenn)



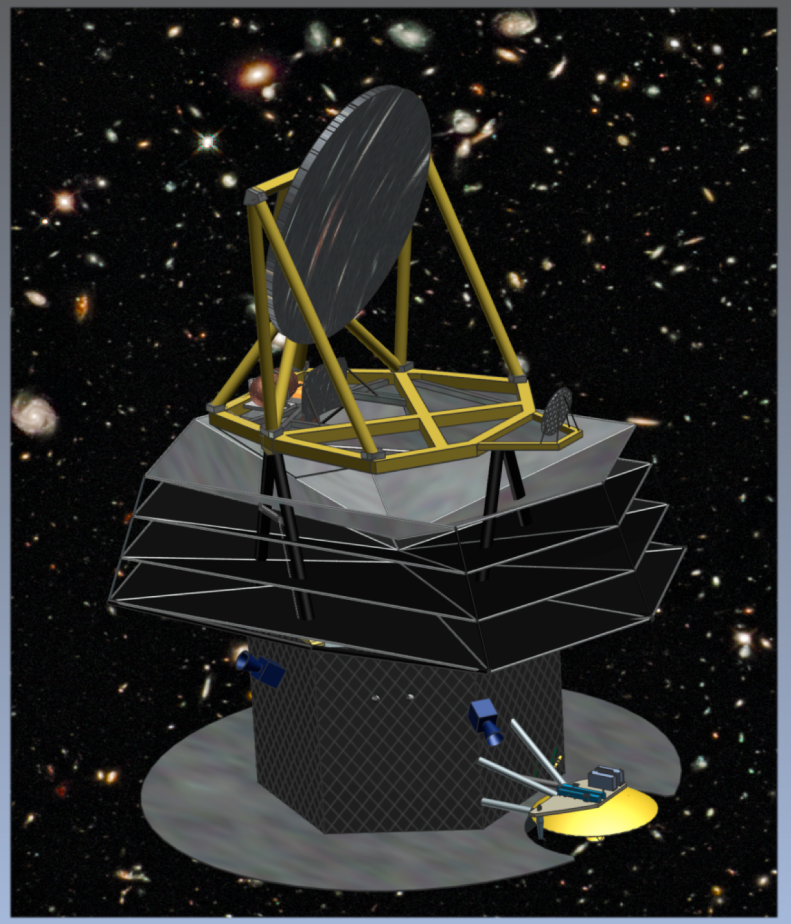
Key parameters:

- Imaging: NEPs $\leq 10^{-18}$ W Hz$^{-1/2}$
- Spectroscopy: NEPs $< 10^{-19}$ W Hz$^{-1/2}$
- Efficient optical coupling down to 10 and 25 μm (imaging and spectroscopy)
- Dynamic range
- Robustness to cosmic rays

Far-IR Probe Scope

Budget cap $1.0B - $1.5B: GEP concept demonstrates scope

- **Smaller aperture and/or more restricted instrumentation than afforded by Origins and SPICA:** not all their science will be obtainable.
- **Transformational astrophysics of galaxy evolution and star and planet formation will be possible** with a cold aperture ($\leq$ 6 K) and recent advances in detector sensitivity and array sizes.
- **A fast community-wide effort to adapt and refine the Galaxy Evolution Probe, SPICA, and Origins science cases and optimize the FIR-Probe design** needed to win the competition and ensure another 1 – 2 decades of exciting progress in our underexplored field.



GEP concept with a 2.0 m, 6 K, off-axis telescope.

Contact Jason and/or Matt to help shape this future!

jason.glenn@nasa.gov or matt.bradford@jpl.nasa.gov

Far-IR Probe Science Development Workshop

Monday March 21 - Wednesday March 23 (ending 1 PM)

Caltech Campus, Pasadena, CA

(With virtual component)

Objectives:

- Identify leading scientific questions for the Probe
- Outline measurement approaches and capabilities
- Chart final trades / decisions to guide formulation

https://www.ipac.caltech.edu/event/farirprobe

Questions: matt.bradford@jpl.nasa.gov, jason.glenn@nasa.gov

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