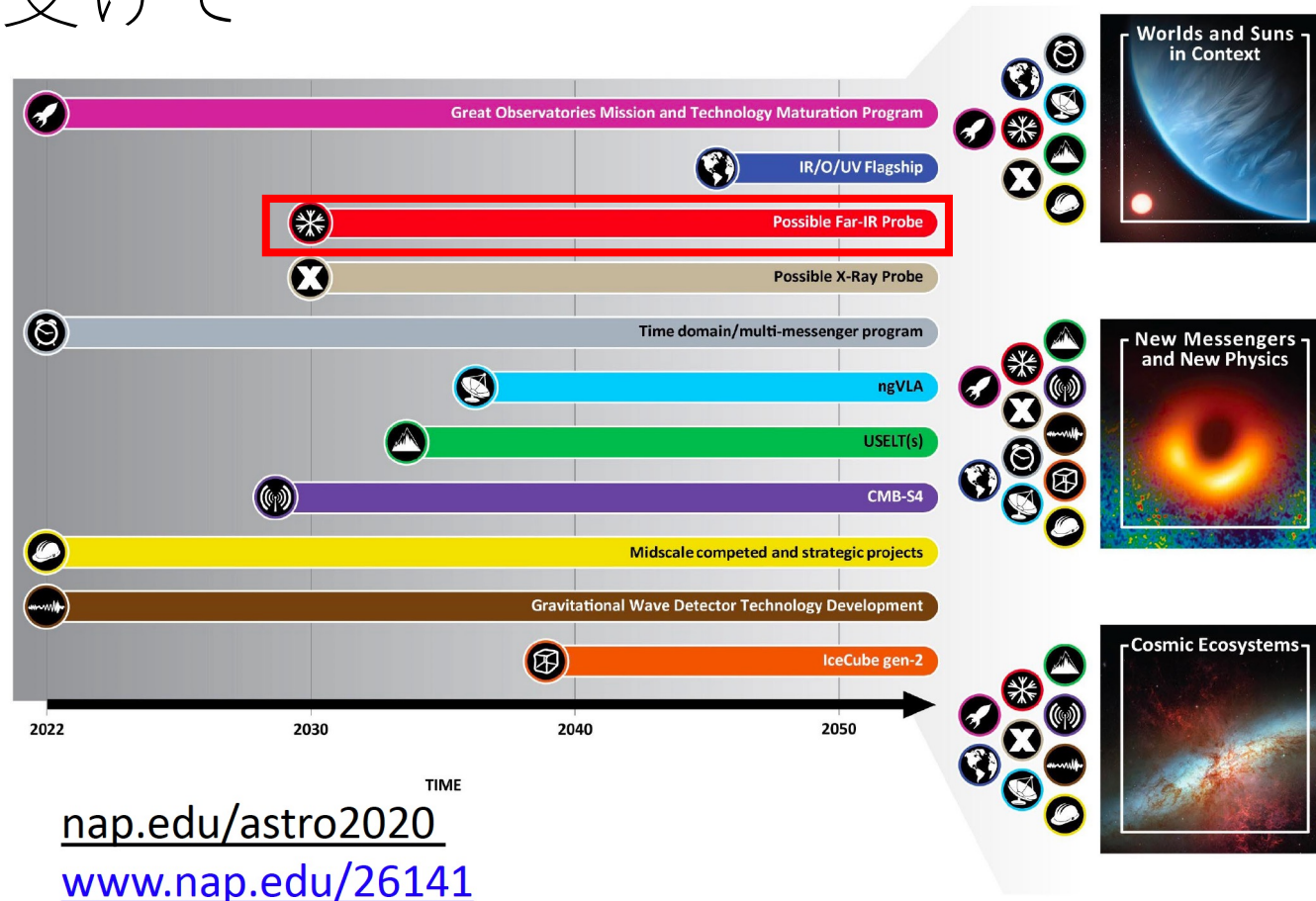


米国FIR probe ミッション候補 PRIMA(the PRobe Infrared Mission for Astrophysic)について

左近 樹 (東京大学)

PRIMA team

Decadal Survey on Astronomy and Astrophysics 2020 (Astro2020) の結果を受けて



Decadal reportに FIR probe が SPICA recoveryとして明記

Astrophysics Probe Announcement of Opportunity Community Announcement

released by NASA Science Mission Directorate (SMD) on January 11, 2022 (notice ID NNH22ZDA008L)

The National Academies' 2020 Decadal Survey in Astronomy and Astrophysics, *Pathways to Discovery in Astronomy and Astrophysics for the 2020s*, recommends **probe missions to be competed in broad areas identified as important to accomplish the survey's scientific goals.**

For the coming decade, the Decadal Survey recommends

- **a far-infrared imaging and spectroscopy mission**
- **an X-ray mission designed to complement the European Space Agency (ESA's) Athena mission.**

Cost Cap: The PI-Managed Mission Cost (PIMMC) for an Astrophysics Probe mission is expected to be capped at **\$1 billion in fiscal year (FY) 2023 dollars**, not including any contributions, the cost of an AO-provided access to space, or any General Observer (GO)/Guest Investigator (GI) program costs. *NASA will provide standard launch services on a single launch vehicle outside the cost capped PIMMC.* PI-provided alternative access to space may not be proposed.

Science Investigations and Data: (1) A pointed observatory will have the bulk of its observing time made available to the community for General Observers (GO). *The NASA-managed GO program will be funded outside of the PIMMC.* The PI-led science team will conduct science investigation(s) with a limited amount of Guaranteed Time Observing (GTO); *the PI-led science investigations will be funded within the PIMMC.* (2) A survey observatory will have all of its survey data made available to the community for Guest Investigators (GI). The NASA-managed GI program will be funded outside of the PIMMC. The PI-led science team will conduct science investigation(s) with the survey data; the PI-led science investigations will be funded within the PIMMC. (3) All data will be made public as soon as practical through a NASA-managed astrophysics data archive. There is no limited data use period, even for pointed data.

The current Astrophysics Probe Program planning budget is sufficient to select and execute one Astrophysics Probe mission.

Astrophysics Probe Announcement of Opportunity Community Announcement

released by NASA Science Mission Directorate (SMD) on January 11, 2022 (notice ID NNH22ZDA008L)

Proposals in response to the forthcoming Announcement of Opportunity (AO) will be due not less than 90 days after its final release. Participation will be open to all categories of U.S. and non-U.S. organizations, including educational institutions, industry, not-for-profit organizations, Federally Funded Research and Development Centers, NASA Centers, and other Government agencies. Participation by NASA Centers must be consistent with NASA's Center Roles policies.

The schedule for the solicitation is intended to be:

Release of this special notice	January 2022
Release of draft AO:	June 2022 (target)
Release of final AO:	January 2023 (target)
Preproposal conference:	~ 3 weeks after final AO release
Proposals due:	90 days after AO release
Selection for competitive Phase A studies:	Early 2024 (target)
Concept study reports due:	Late 2024 (target)
Down-selection:	Mid 2025 (target)

→ August 16, 2022

2023 Astrophysics Probe Explorer (APEX)

DRAFT Announcement of Opportunity Released for Community Comment

Released Date: August 16, 2022, Comments Due: September 29, 2022 (notice ID NNH22ZDA015J)

NASA Strategic Goals:

The NASA Science Mission Directorate (SMD) is addressing this strategic goal through broad objectives, one of which is “to understand the Sun, Earth, Solar System, and Universe.” SMD addresses this objective by conducting astrophysics investigations to address the following science goals:

- ***How does the Universe work?*** Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity;
- ***How did we get here?*** Explore the origin and evolution of the galaxies, stars, and planets that make up our universe;
- ***Are we alone?*** Discover and study planets around other stars, and explore whether they could harbor life.

Astrophysics Probe Explorer Goals and Objectives:

In 2021, the National Academies’ 2020 Decadal Survey in Astronomy and Astrophysics, Pathways to Discovery in Astronomy and Astrophysics for the 2020s (<https://www.nap.edu/catalog/26141/pathways-to-discovery-in-astronomy-and-astrophysics-for-the-2020s>) (2020 Decadal Survey), recommended probe missions to be competed in broad areas identified as important to accomplish the 2020 Decadal Survey’s scientific goals and objectives. Thus, the Probe class of mission was added to the Explorers Program portfolio. For the coming decade, the 2020 Decadal Survey recommends a far-infrared mission or an X-ray mission as a Probe-class mission.

Responses to the APEX AO will be limited to one of those two mission themes: recommended by the Decadal Survey. These areas are

- **A far-infrared imaging or spectroscopy mission**
- **An X-ray probe.**

Proposals must be responsive to the preponderance of the mission theme's objectives as provided in Sections 7.5.3.2 through 7.5.3.4 of the Decadal Survey.

Participation is open to all categories of organizations or institutions, U.S. or non-U.S., including educational, industrial, and not-for-profit institutions, Federally Funded Research and Development Centers (FFRDCs) including the Jet Propulsion Laboratory (JPL), University Affiliated Research Centers (UARCs), NASA Centers, and other Government agencies.

2023 Astrophysics Probe Explorer (APEX)

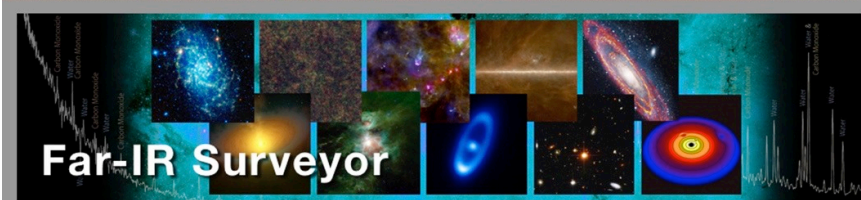
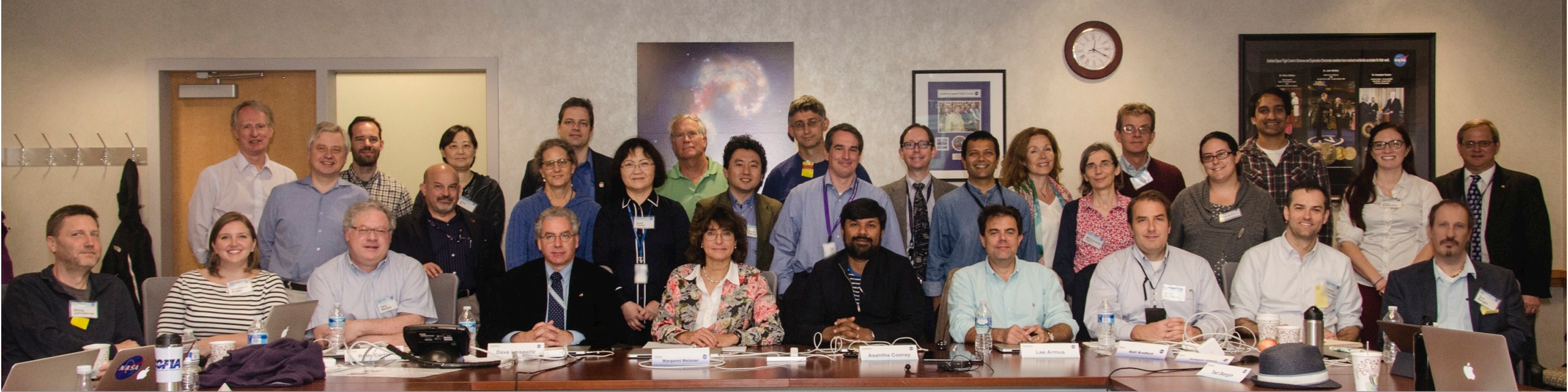
DRAFT Announcement of Opportunity Released for Community Comment

Released Date: August 16, 2022, Comments Due: September 29, 2022 (notice ID NNH22ZDA015J)

Proposed Opportunity Period and Schedule

AO Release Date	July 2023 target
Preproposal Conference	AO Release + 3 weeks
Mandatory Notice of Intent to Propose Deadline at 11:59 p.m. Eastern Time	AO Release + 6 weeks
Electronic Proposal Submittal Deadline at 11:59 p.m. Eastern Time	AO Release + 3 months
Letters of Commitment Due (with Proposal).....	AO Release + 3 months
Deadline for Augmented Submission via the NASA Box service at 4:30 p.m. Eastern Time	AO Release + 3 months + 1 week
Step-1 Selections Announced (target)	AO Release + 8 months
Initiate Phase A Concept Studies (target)	AO Release + 9 months
Phase A Concept Study Reports Due (target)	Early 2025
Down-selection of Investigation(s) for Flight (target)	Late 2025
AO-Required Launch Readiness Date	NLT January 2032 (TBR)

Please address comments or questions on the draft AO only via email to the APEX Lead Program Scientist: Dr. Patricia M. Knezek (subject line to read "APEX DRAFT AO") at: patricia.m.knezek@nasa.gov. Responses to individual comments may be given by email or posted in the Q&As (Questions and Answers) section of the Astrophysics Explorers Program Acquisition website: <https://explorers.larc.nasa.gov/2023APPROBE/>. Anonymity of persons or institutions submitting questions will be preserved. The comment period for the draft AO ends on **September 29, 2022**.



Far-IR Surveyor STDT Meeting
NASA's Goddard Space Flight Center
May 12 - 13, 2016

FIR probe candidates (information based on IRSTIG IR Astrophysics Workshop 2022 on 31 March 2022):

- **PRIMA: a Far-Infrared Astrophysics Probe** [Jason Glenn (NASA Goddard), Charles M. Bradford (JPL)]
- **FIRSST: Far-Infrared Spectroscopy Space Telescope** [Asantha Cooray (University of California, Irvine)]
- **SPIRIT: The Space Infrared Interferometric Telescope** [David Leisawitz (NASA Goddard)]
(→ SPICE: Space Interferometer for Cosmic Evolution)
- **SALTUS: Single Aperture Large Telescope for Universe Studies** [Chris Walker (University of Arizona)]

PRIMA (The PRobe far-Infrared Mission for Astrophysics)

(<https://prima.ipac.caltech.edu/>)

PRIMA is a **cryogenically-cooled, far-infrared** observatory for the community for the next decade.

The **PRIMA** team is studying both a **sensitive wideband spectrometer** and a **multi-band spectrophotometric imager / polarimeter**. Key areas of study for the spectrometer include the trade between resolving power, wavelength coverage, and mapping speed for low-resolution spectroscopy ($R \sim 200$), as well as the approach to medium-resolving-power spectroscopy ($R \sim 5000$). For the imager, the number and wavelengths of the bands, the spectrophotometric channel width, and the approach to polarimetry are key trades under consideration. Performance estimates for the two **PRIMA** instruments will be updated as the concept is further developed.

Newsletter #1

A **survey to solicit ideas from the community on both the science and instrumentation for research in far-IR astronomy** was conducted prior to the Community Workshop on March 22, 2022

- 121 response

- Strong demand for (1) $R \sim 200$ spectroscopy, (2) $R \sim 10^3$ - 10^4 spectroscopy, (3) broadband imaging, (4) polarimetry, (5) 25-200 μm wave coverage

Newsletter – Summer 2022

<https://prima.ipac.caltech.edu/page/newsletter>



PRIMA (The PProbe far-Infrared Mission for Astrophysics)

(<https://prima.ipac.caltech.edu/>)

Newsletter – Summer 2022

PRIMA Science Team

PI: Jason Glenn (NASA GSFC)

Acting Deputy PI/Project Scientist: Matt Bradford (NASA JPL / Caltech)

Science Lead: Alexandra Pope (UMass Amherst)

GO Science Lead: Margaret Meixner (USRA)

Science Steering Committee:

Lee Armus (IPAC)

Cara Battersby (U. Connecticut)

Alberto Bolatto (U. Maryland)

Brandon Hensley (Princeton)

Tiffany Kataria (NASA JPL)

Elisabeth Mills (U. Kansas)

Arielle Moullet (SOFIA USRA)

Klaus Pontoppidan (Space Telescope)

JD Smith (U. Toledo)

Rachel Somerville (Rutgers / Flatiron)

Johannes Staguhn (JHU / GSFC)

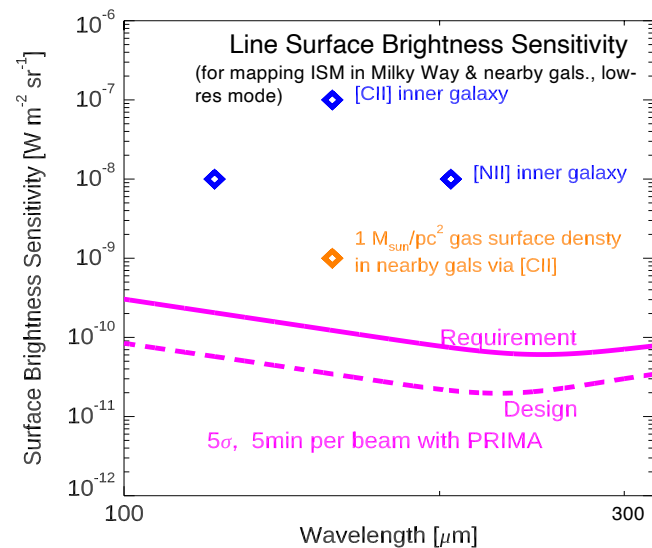
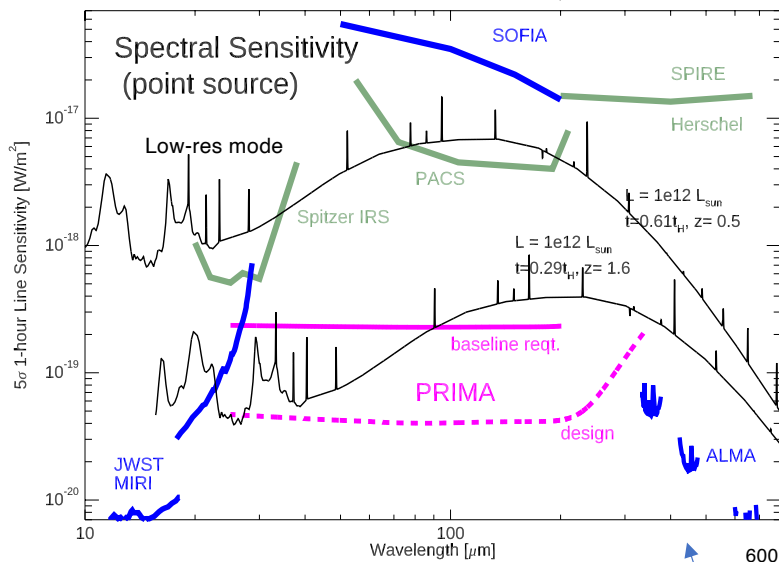


Far-IR Surveyor STDT Meeting
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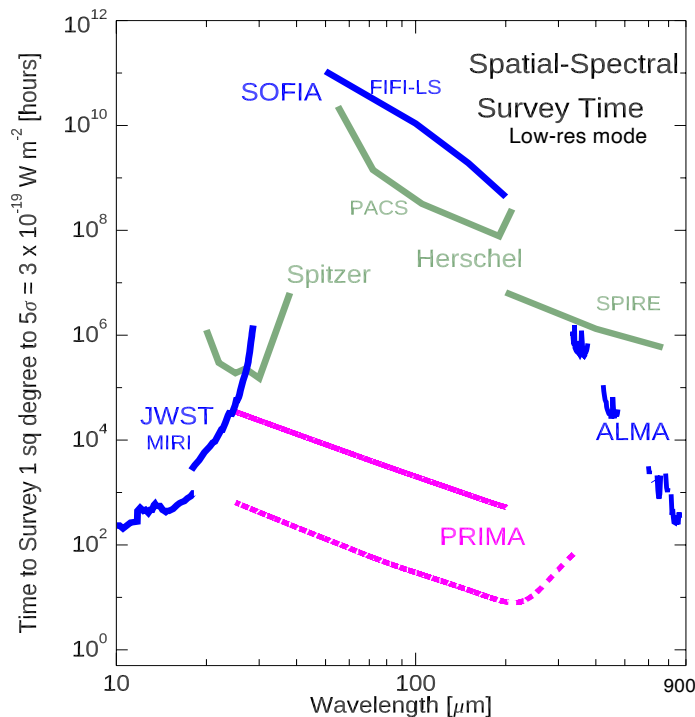
- 125 individual science cases are received from our community input survey in February
- The PRIMA team is currently crafting the key scientific narratives and the instrument suite that will put PRIMA in a strong competitive position for mission selection.

Instrumentation Optimizes Sensitivity (=speed) & Spectral Coverage

PRIMA-S WIDEBAND MULTI-MODE SPECTROMETER



Preliminary Performance Estimates



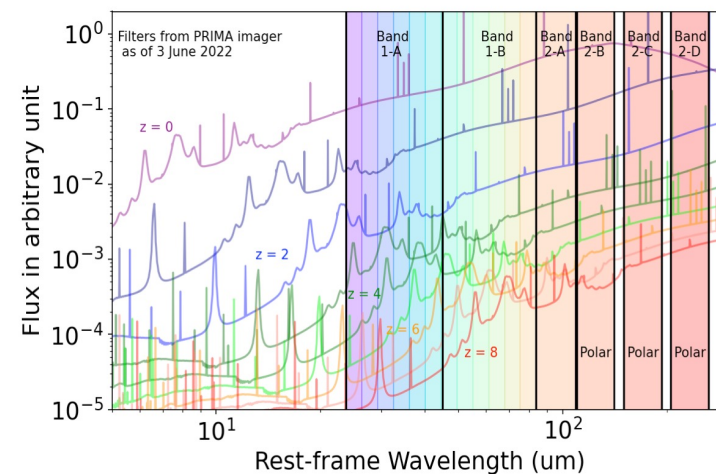
High-Res mode will have **comparable sensitivity and full spectral coverage** with $R \sim 3000-5000$ at 100 microns

PRIMAGER: MULTIBAND SPECTRO-PHOTOMETRIC IMAGING AND POLARIMETRY

Imager provided by European consortium led by CNES and SRON.
D. Burgarella, L. Ciesla, W. Jellema leads

Preliminary Specifications

- $R \sim 10$ at 25 to 80 microns in two 2×2 arcmin arrays. (12 filter bands)
- $R \sim 4$ in four longer wavelength bands (each 2×2 arcmin), 3 w/ polarimetry.



PRIMA Science Working Groups

Science steering committee

Margaret Meixner (GO Science Coordinator), Johannes Staguhn, Rachel Somerville, etc.

WG1 Cosmic History of Star and Black Hole Formation Through Cosmic Time

Alexandra Pope, Lee Armus

WG2 Heavy Elements and Dust through Cosmic Time

JD Smith, Brandon Hensley

WG3 Star and Planetary System Formation

Klaus Pontoppidan, Cara Battersby

WG4 Feedback and ISM Physics in Galaxies

Alberto Bolatto, Betsy Mills

WG5 Evolved Planetary Systems and Solar System

Tiffany Kataria, Arielle Moullet

*Working group members, anyone is free to join, say up to 2 groups.
Possibility of being promoted to co-I if someone does a lot of work. (Jason Glenn)*

結語

FIR probeは、Decadal ReportでもSPICA recoceryと明記されている通り、我が国のIRTS、あかり、SPICAの科学および技術へリテージを生かすことができる大変貴重な機会である。

PRIMAのPI: Jason Glenn氏およびActing deputy PI: Matt Bradford氏らとの対話に基づいて、Science Working Groupへの参加の自薦を募り、日本人研究者がプロポーザルにおける科学策定活動に関わる道筋を探っている。

興味のある方の参加をとりまとめますので、
左近 (isakon@astron.s.u-tokyo.ac.jp) までお知らせ下さい。
(GOPIRAメーリングリスト宛案内[gopira:01673]を参照してください)