Updates of the Next-Generation Infrared Astronomy Mission SPICA

Space Infrared Telescope for Cosmology and Astrophysics

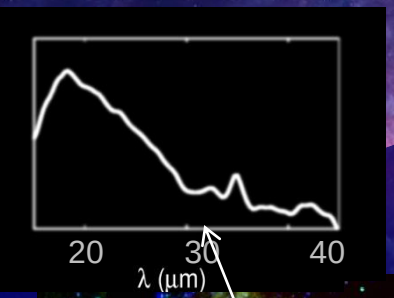
Hiroshi Shibai

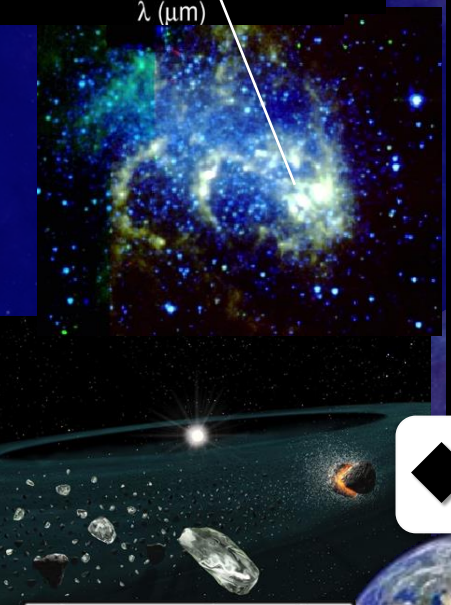
(Principal Investigator, *Osaka U & ISAS/JAXA)*
On behalf of *SPICA-J* Team

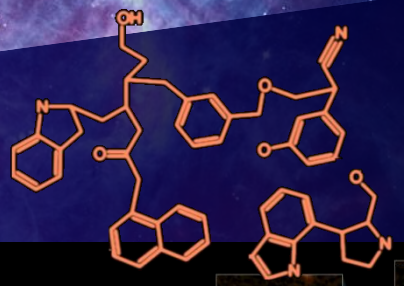
P6-19
SPICA Mid-Infrared Instrument (SMI): Results from Conceptual Design Study
Takehiko Wada *(ISAS/JAXA),* Hidehiro Kaneda *(Nagoya U)*, et al., SMI consortium

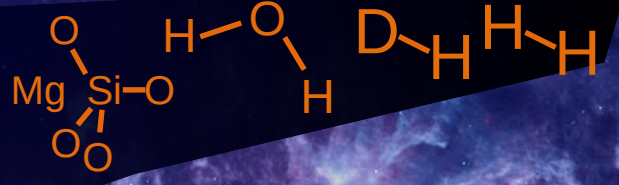
P6-20
The Taiwanese Contribution for SPICA mission
Shiang-Yu Wang, Min-Jye Wang, Ciska Kemper, Yen-Lu Huang *(ASIAA)*

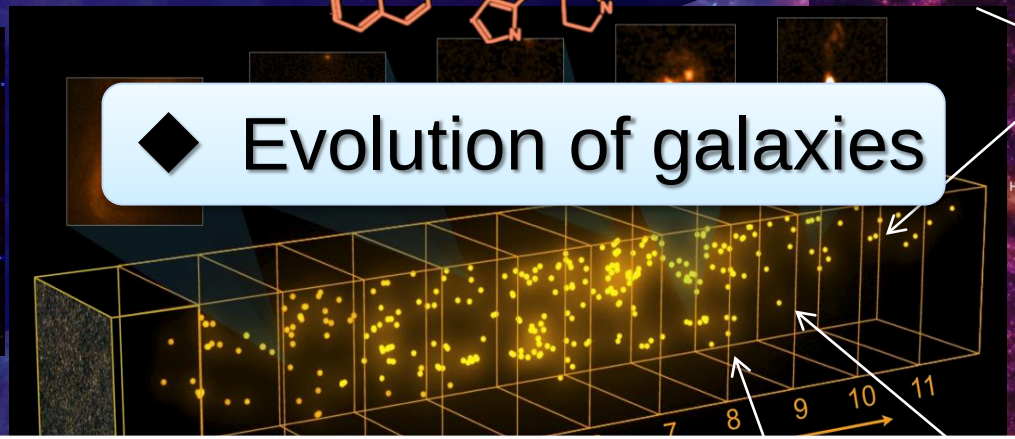
Enrichment of the Universe with metal and dust leading to the formation of habitable worlds



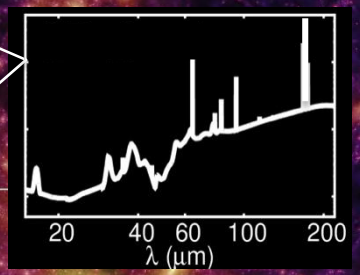




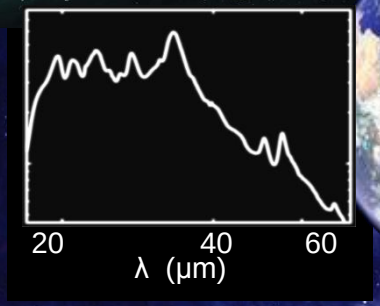


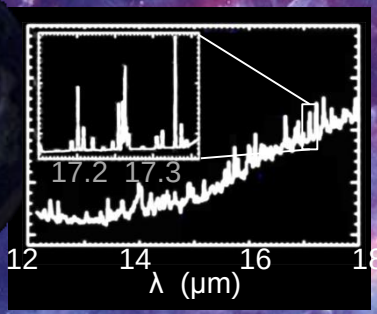


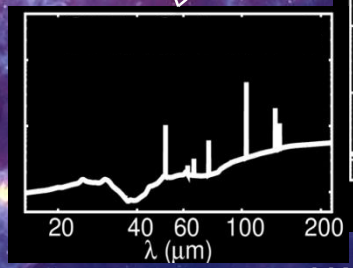
◆ Evolution of galaxies

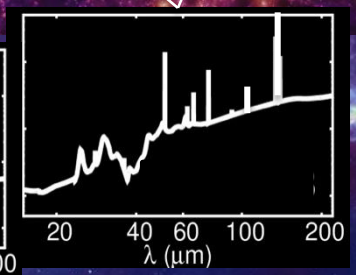


◆ Formation of planetary systems







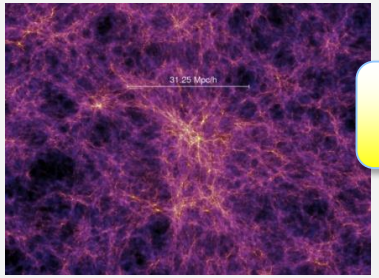


Science Goals of SPICA

Enrichment of the Universe with metal and dust, leading to the formation of habitable worlds

Metal and dust enrichment through galaxy evolution

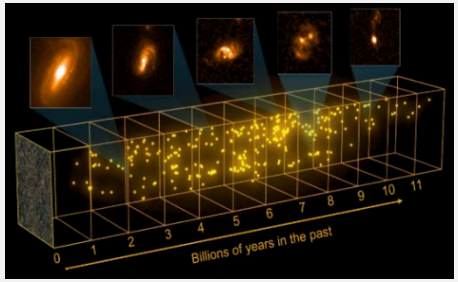
Star/Galaxy formation
First mineral, aromatics



Star formation in distant galaxies

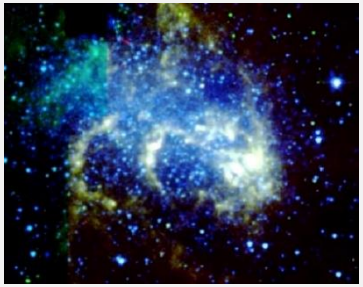
Dust-obscured AGNs and AGN outflow

Over the peak of the cosmic star-formation history



Star formation in nearby galaxies

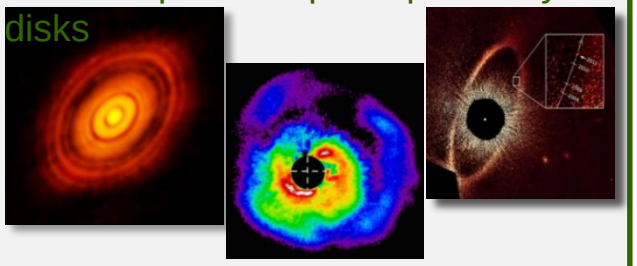
Spatially-resolved, high-z analogs or relics



Planetary formation to habitable systems

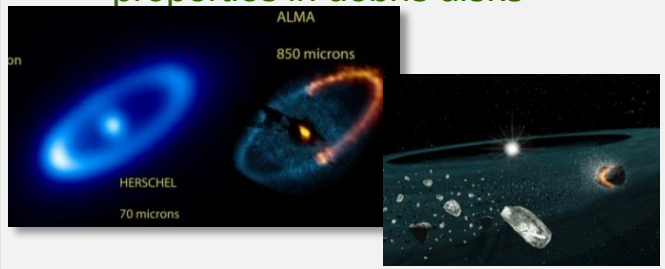
Gas dissipation in planet-forming disks

Gas dissipation in proto-planetary disks

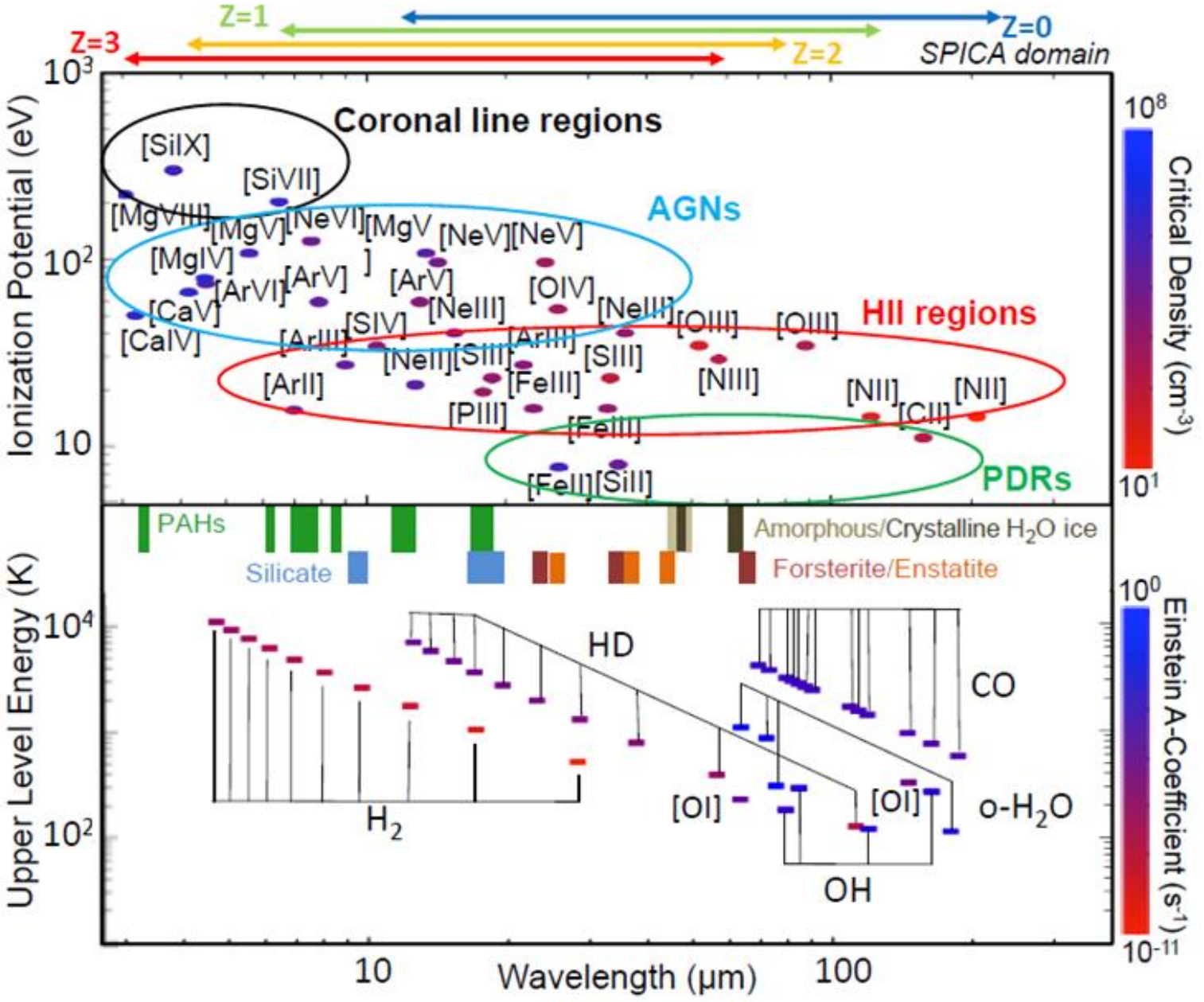


Dust evolution in planet-forming disks to solar system analogues

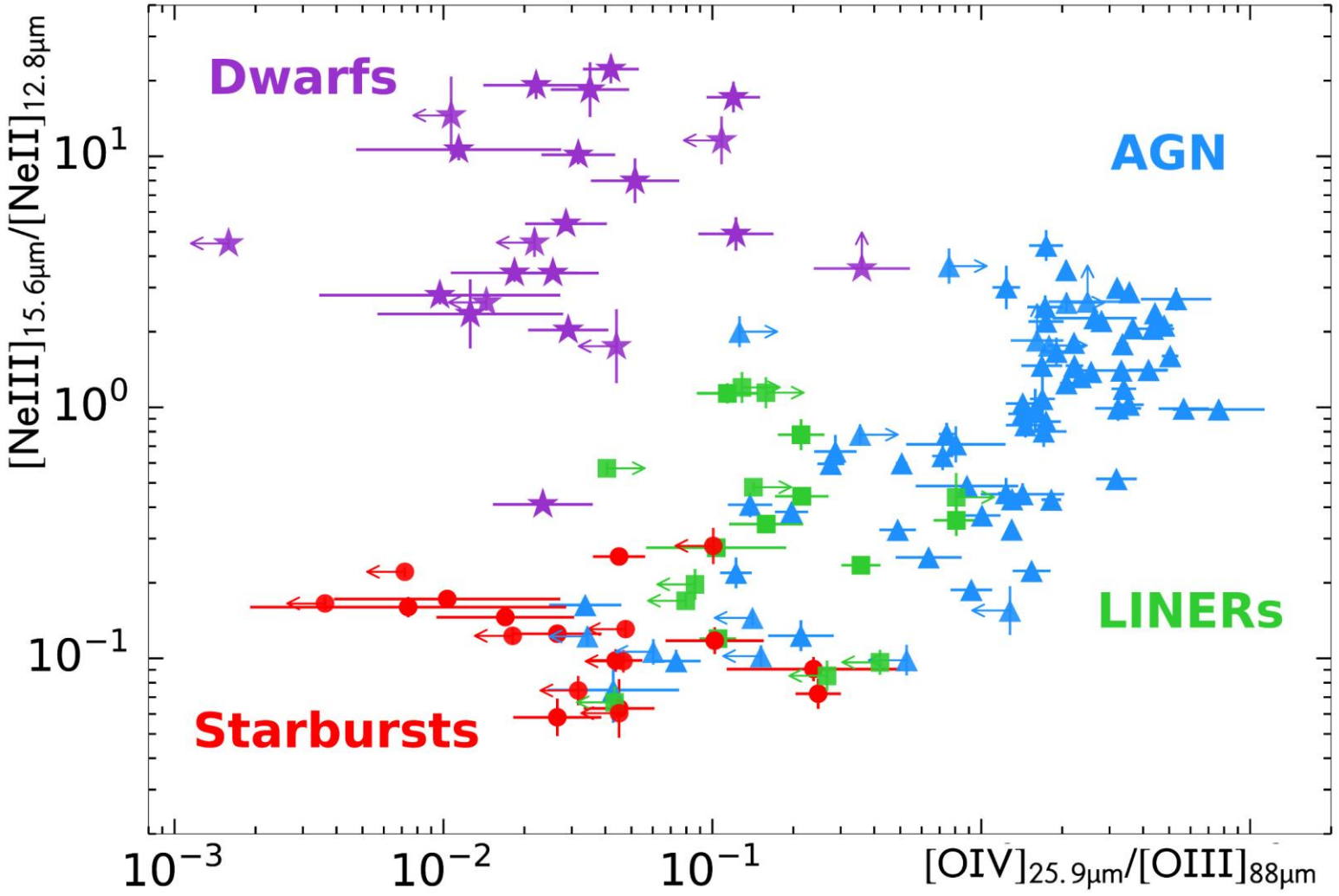
Changes of mineral and ice properties in debris disks



Diagnostic Spectral Lines and Bands



Example: Galaxies

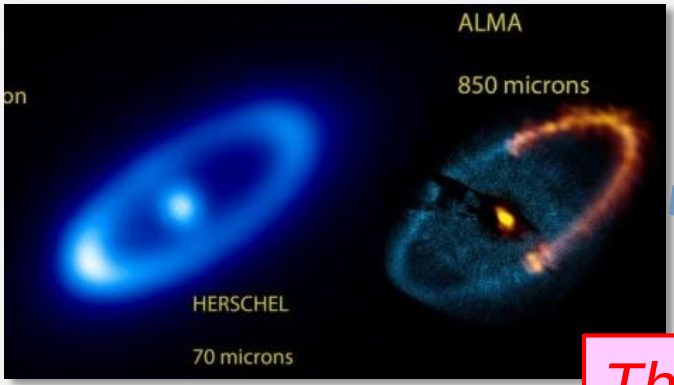


SPICA will characterize both obscured starbursts and AGN

across cosmic history since the Universe was only 1-2 billion years old.

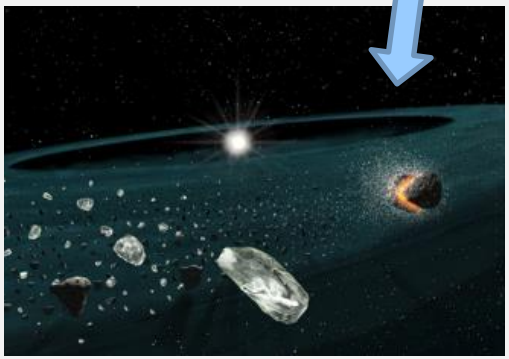
Example: Debris Disks

Changes of mineral and ice properties in debris disks



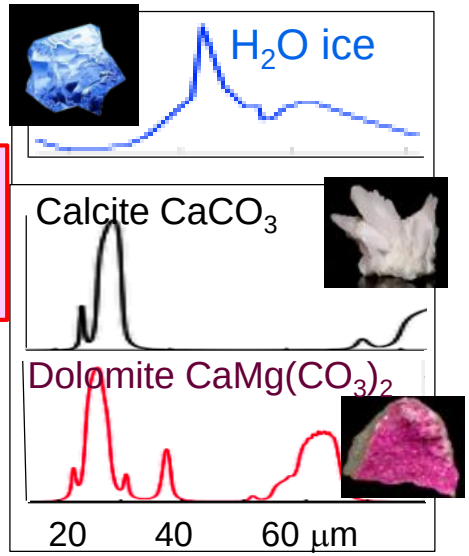
Debris Disks/Rings

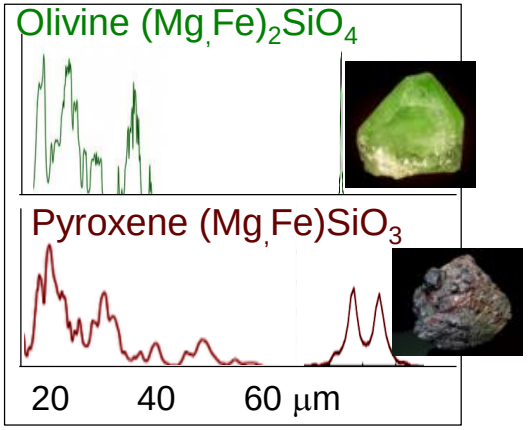
Thermal History?



Zodiacal Dust
Kuiper Belt Dust

SPICA will detect zodiacal disk analogues and their IR spectra which contain key information on their thermal histories reflecting formation of solar/planetary systems.

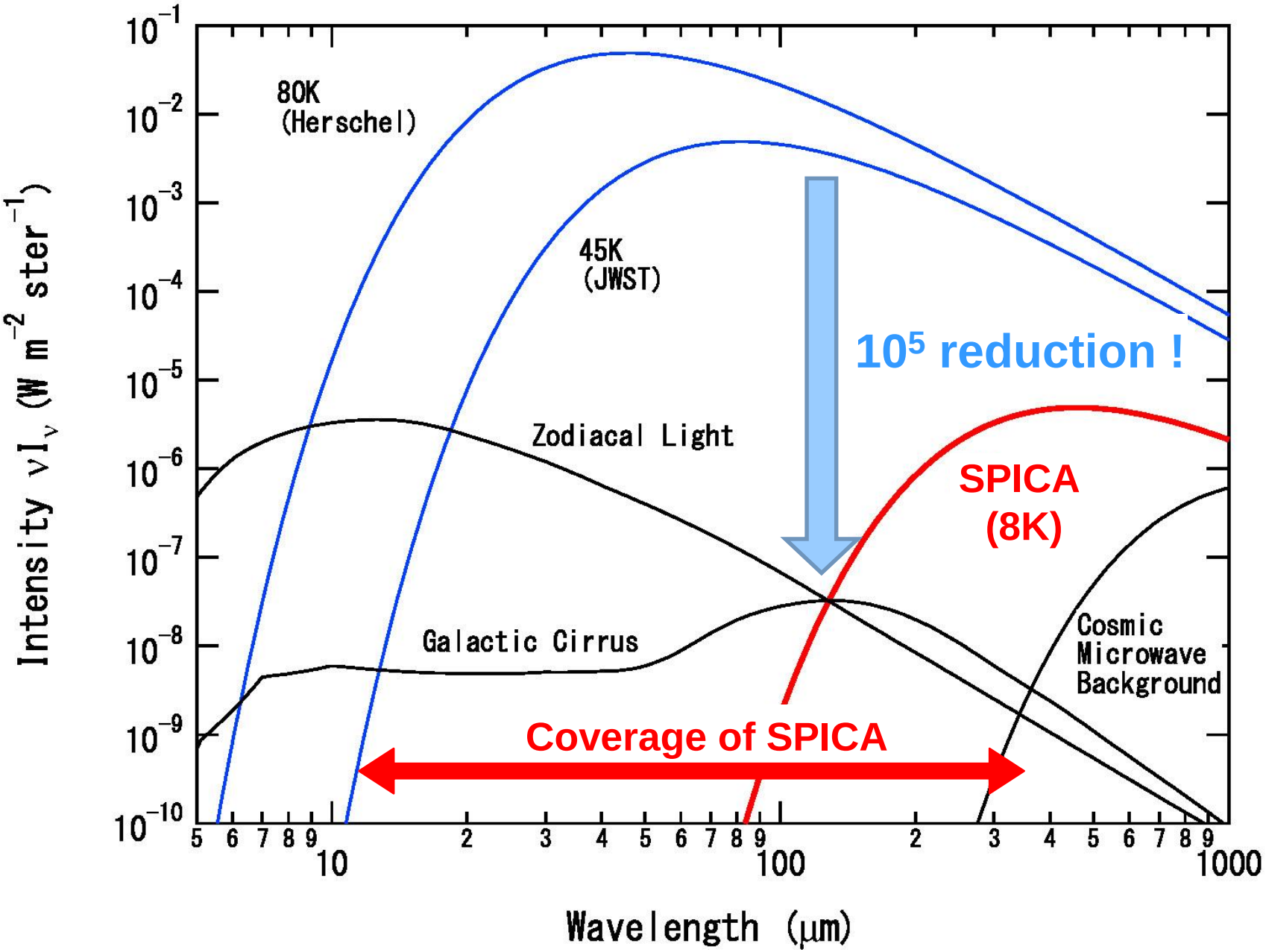




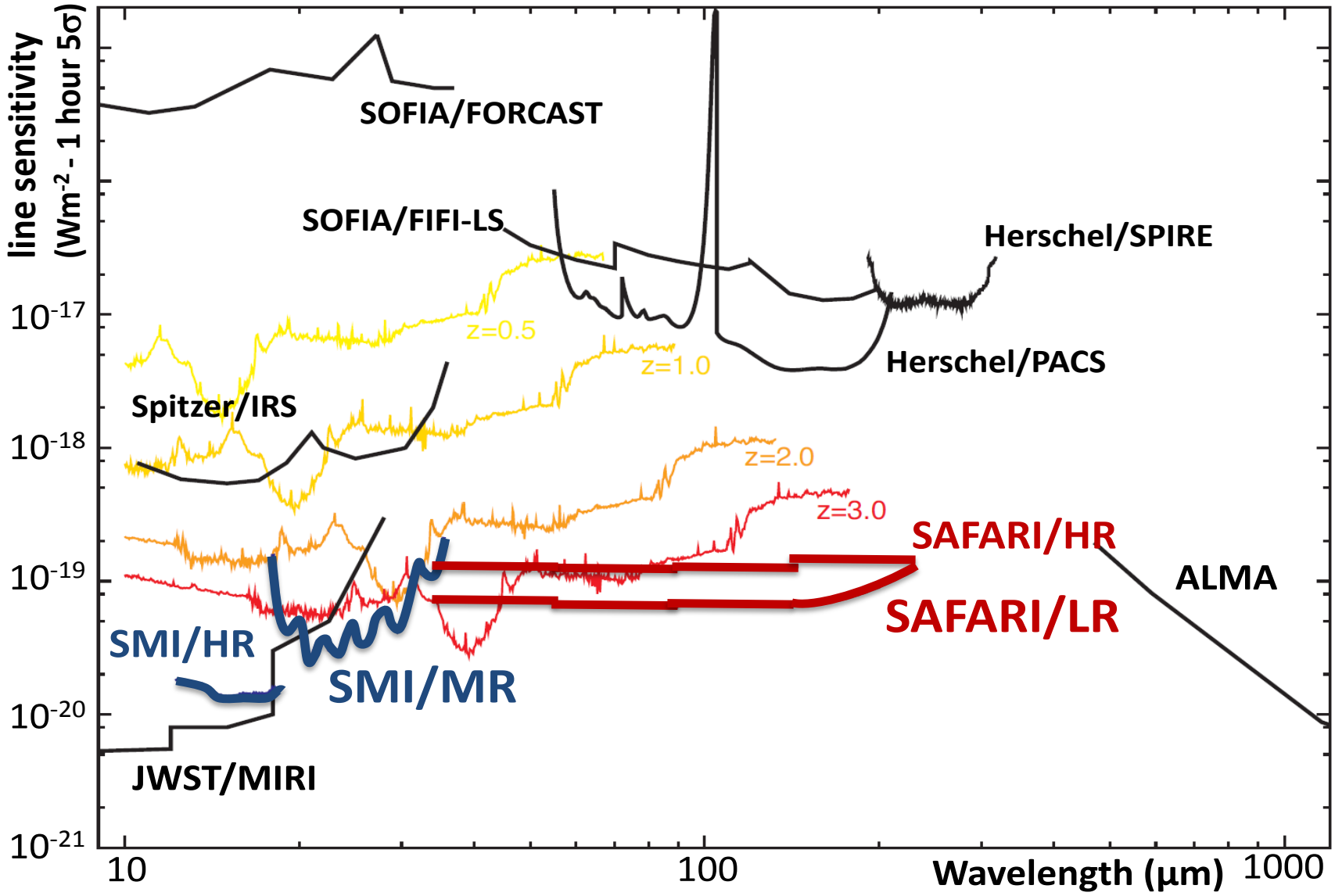
High-temperature minerals

Low-temperature minerals
formed by aqueous mineral alteration or alternate process

Ultra Low Background (a cryogenically-cooled telescope)



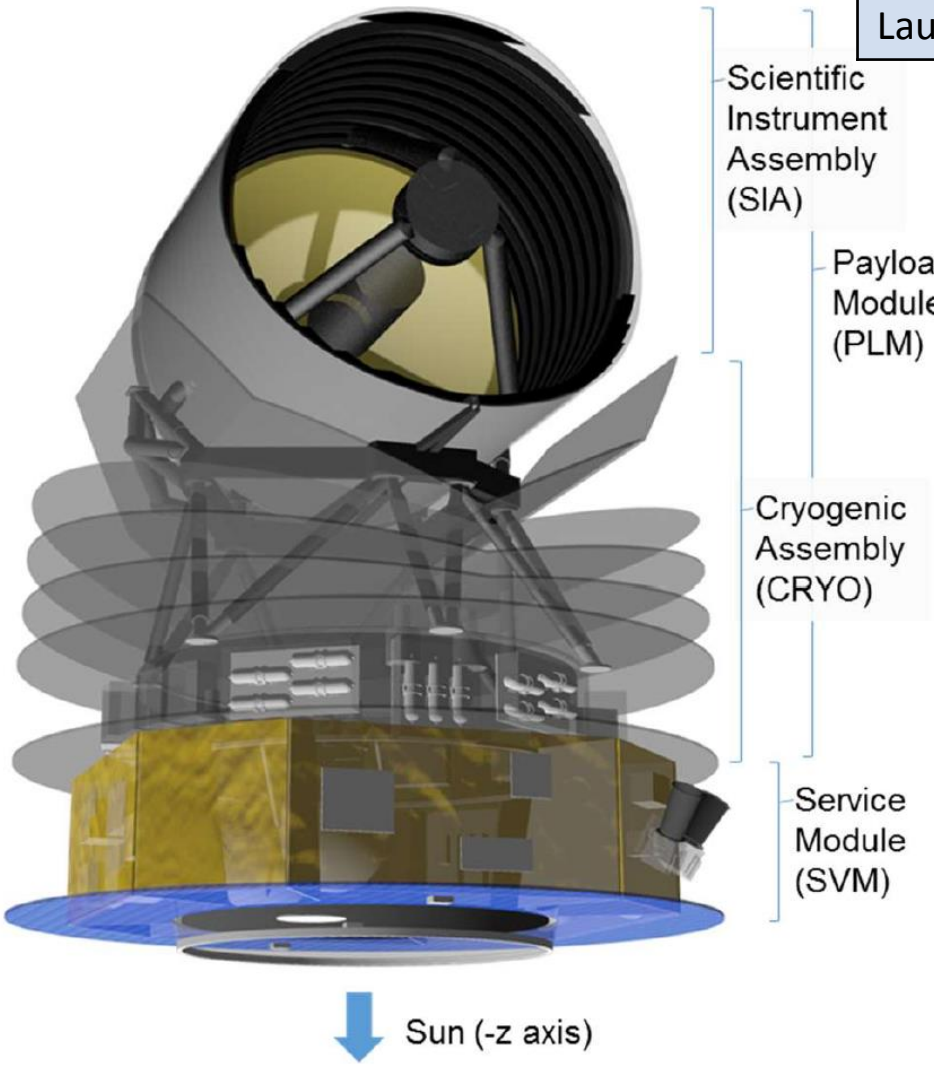
Expected Line Sensitivity of SPICA

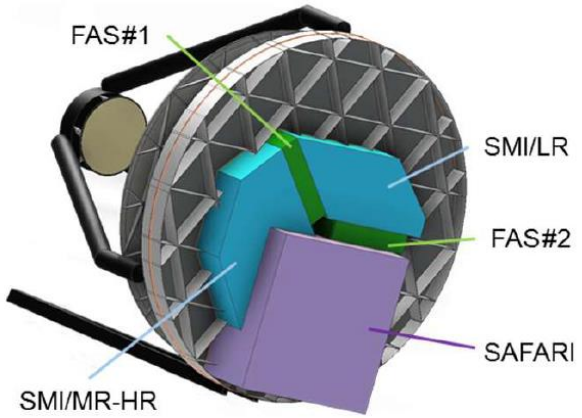


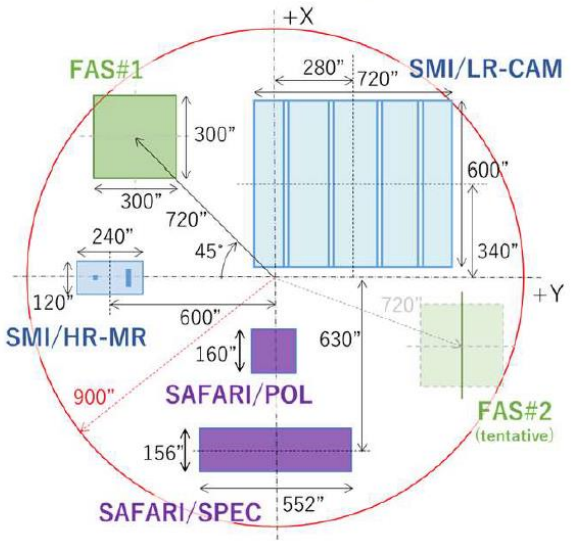
SPICA is expected to achieve the unprecedented sensitivity

Spacecraft Design

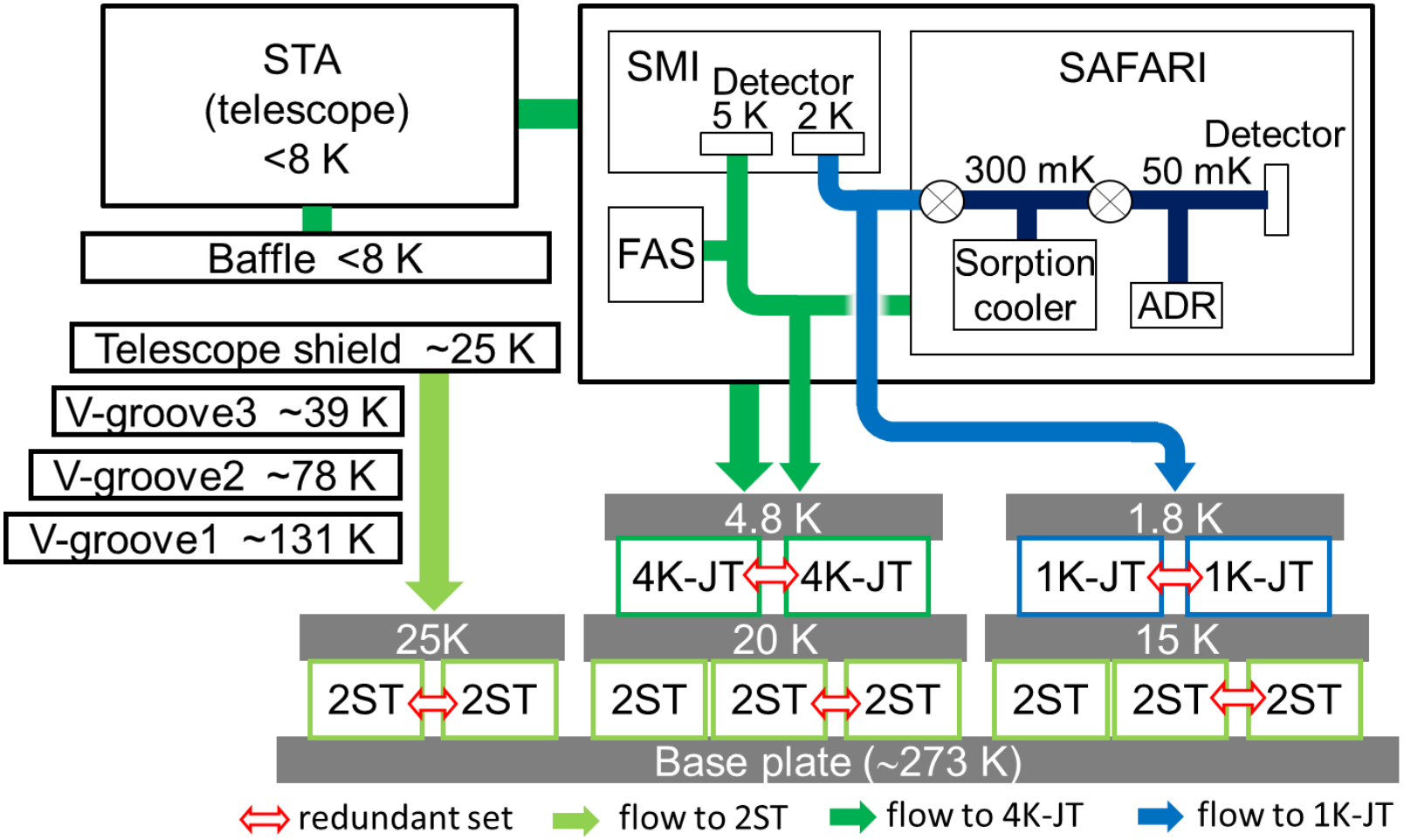
Parameter	Description
Telescope	2.5 m aperture, cooled below 8 K
Wavelength	12 – 350 µm
Orbit	Orbit around S-E L2
Launcher	JAXA H3
Launch Year	2027-2028







Cooling System (Cryogen-Free System)

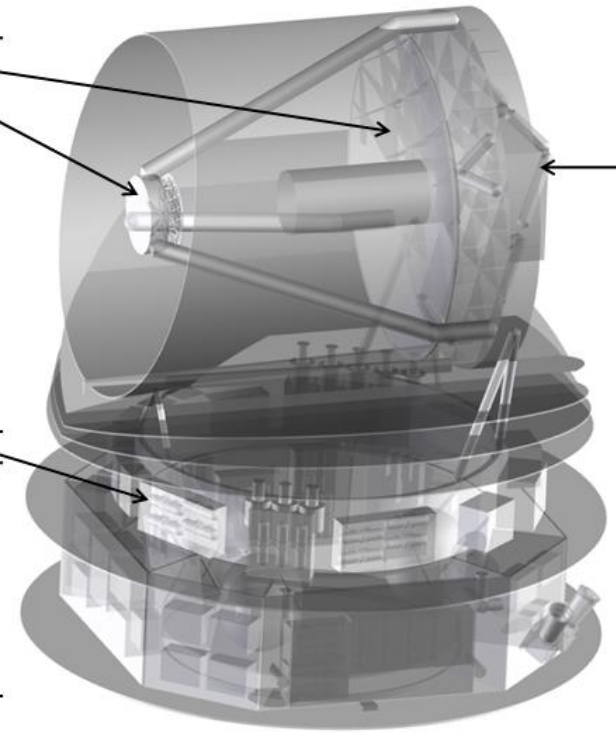


- Heritage of previous missions: AKARI, SMILES, Hitomi
- End-to-end demonstration of the cooling chain is underway (JAXA-CEA-CNES).

International Workshare Plan

ESA leads the project

JAXA leads the Japan-part



Telescope — ESA

Payload Module — JAXA

Cooler — JAXA

Service Module — ESA

Focal Plane Instruments

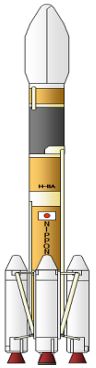
Far-Infrared Instrument (SAFARI)

Netherlands
Spain France
Italy Belgium
Switzerland UK
Germany
Sweden Austria
Ireland Denmark
USA Canada
Taiwan Japan

Mid-Infrared Instrument (SMI)

Nagoya U
JAXA
Osaka U
Tokyo U
Tohoku U
Kyoto U
ASIAA

Focal Plane Attitude Sensor — ESA



Launcher — JAXA

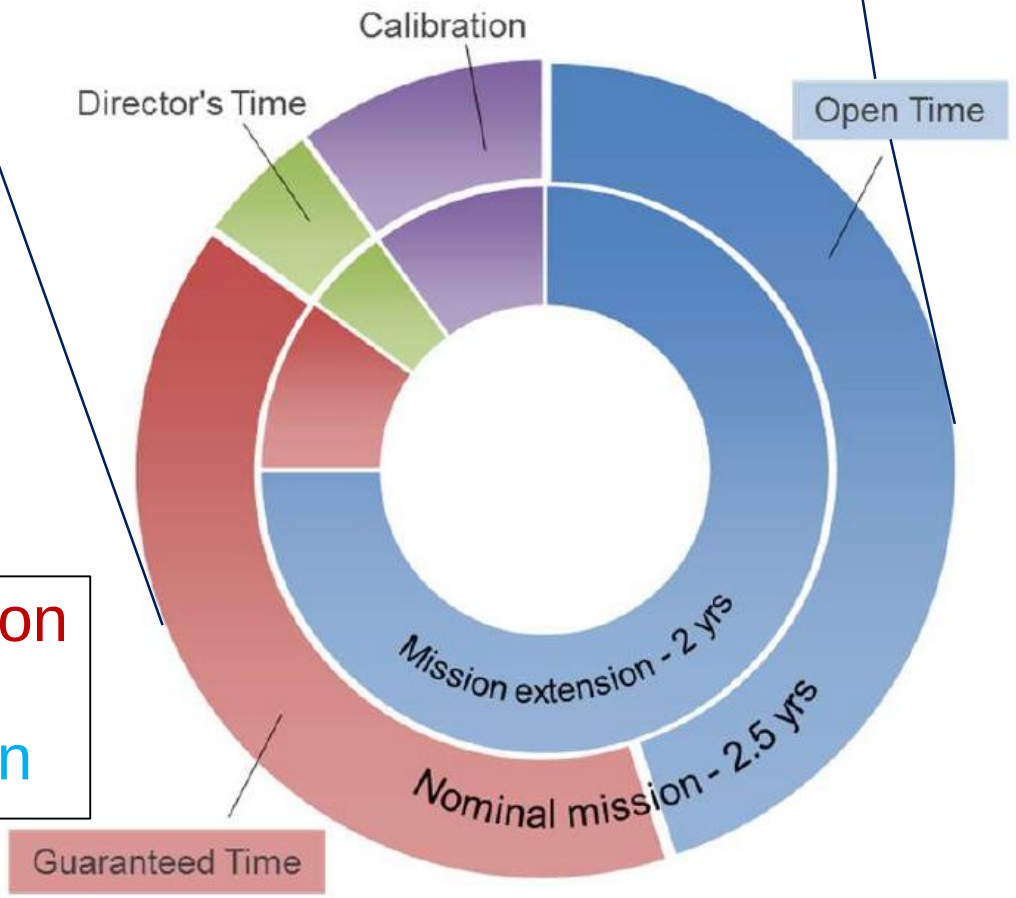
Data Center — JAXA NAOJ — ESA

Science Community

Japan, Europe, USA, Canada, Taiwan, South Korea,,,,,

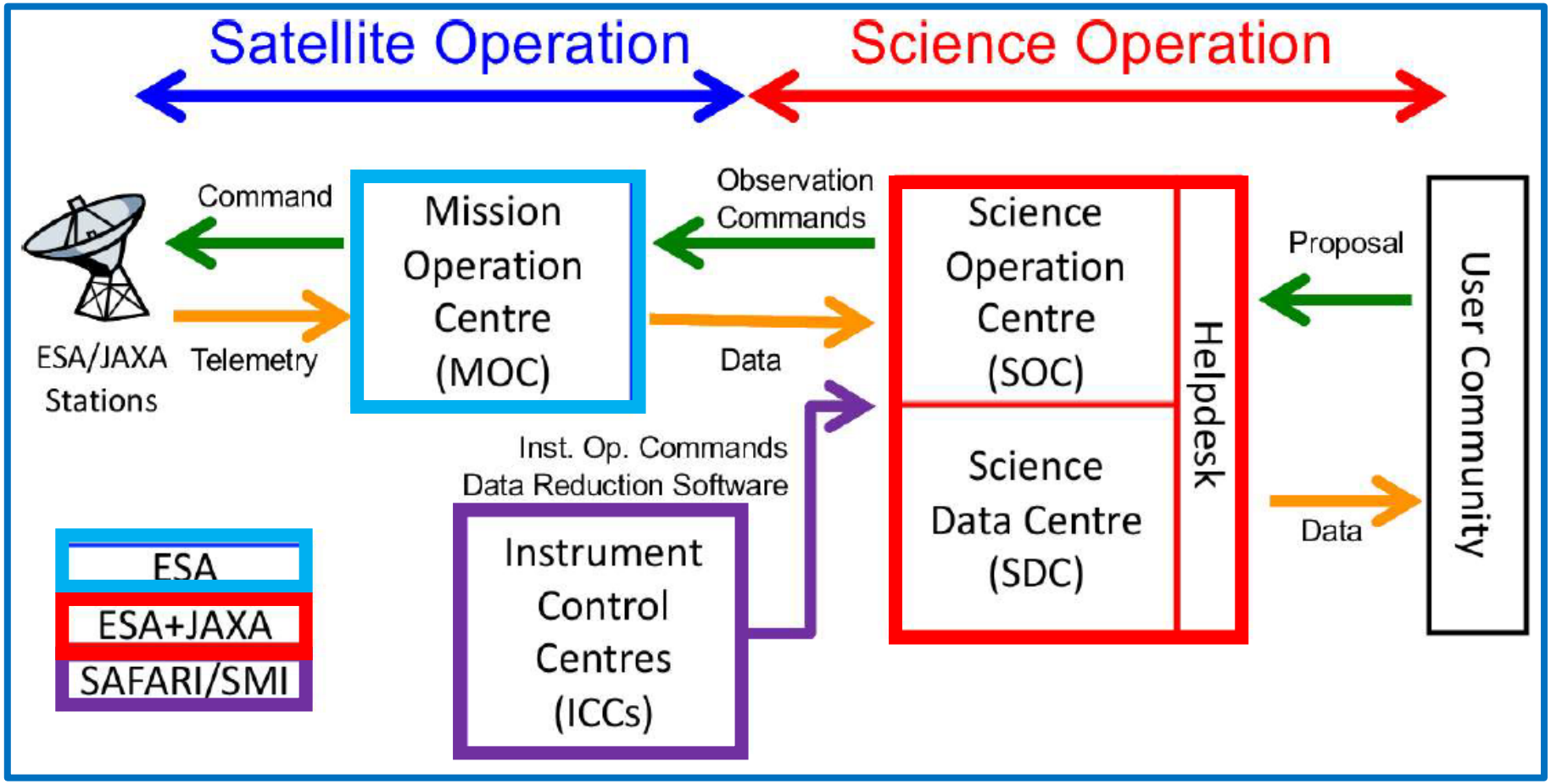
Observational Operation Plan

Observation Period:
2.5 years (Nominal)
+2 years (Extended)



Programmed Observation
+
Open-time Observation

Ground System for Operation



(Co-operation by ESA and JAXA)

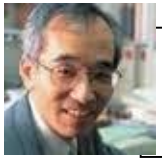
Management Structure (Nation-Wide Organization)

ISAS (JAXA)
Director General
S. Tsuneta

Japanese SPICA Team

Science Core Team

SPICA Science T/F Chief
S. Yamamoto (U Tokyo)



SPICA PI & Chief
H. Shibai (Osaka U)

Project Scientist
T. Onaka (U Tokyo)

Assistant SPICA PI & SMI PI
H. Kaneda (Nagoya U)

Deputy Chief
T. Nakagawa (ISAS)

Assistant PS
T. Yamada (ISAS)

Deputy Chief
H. Ogawa (ISAS)

Assistant PS
K. Kohno (U Tokyo)

Payload Module (JP)
H. Matsuhara (ISAS)

External Advisor
S. Iguchi (NAOJ)

Staff
in ISAS, JAXA,
Universities
NAOJ

SAFARI (JP)
Y. Doi (U Tokyo)

SPICA Data Center
Issei Yamamura (ISAS)

SPICA Data Center of Japan with NAOJ

Current Status in Japan and Europe

■ Japan

- SPICA is in Phase A1 (First half of Phase A), waiting for selection of ESA's M5 candidates.
- Science Council of Japan selected SPICA as one of highest-priority projects (28 in total).
- MEXT is reviewing SPICA as a nation-wide project in their science roadmap.

■ Europe

- ESA conducted a preliminary study for Cryogenic IR Telescope Mission (CDF Study, 2015-2016), and under reviewing process of M5 (until the end of 2017).
- SRON and other member institutions of SAFARI sent their LoIs to ESA in order to present their intention.

Summary

- Re-definition of the SPICA Mission ⇒ ***New SPICA***
  - Technically Feasible and Financially Affordable (for JAXA + ESA)
  - Telescope Aperture is 3.2m -> ***2.5m***, cooled below 6K -> ***8K***
  - AKARI-type Configuration to ***Planck-type*** Configuration
  - Progress of Science Study ⇒ ***Optimization*** of Instruments
  - Nation-Wide Organization

The old SPICA project stopped in 2013/2014, mainly due to the new governmental policy of the space development.
(The largest class of space science mission ≅ 300 MUSD)

Then, JAXA decided to stop the SPICA project once, and to reform SPICA to a realistic mission plan under the new financial condition in Japan.
Here, I presented the result of this re-definition of SPICA.