The next-generation space infrared astronomy mission

SPICA

Space Infrared Telescope for Cosmology and Astrophysics

9th East Asian Meeting on Astronomy
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Institute of Space & Astronautical Science, Japan Aerospace Exploration Agency

Outline of my Talk

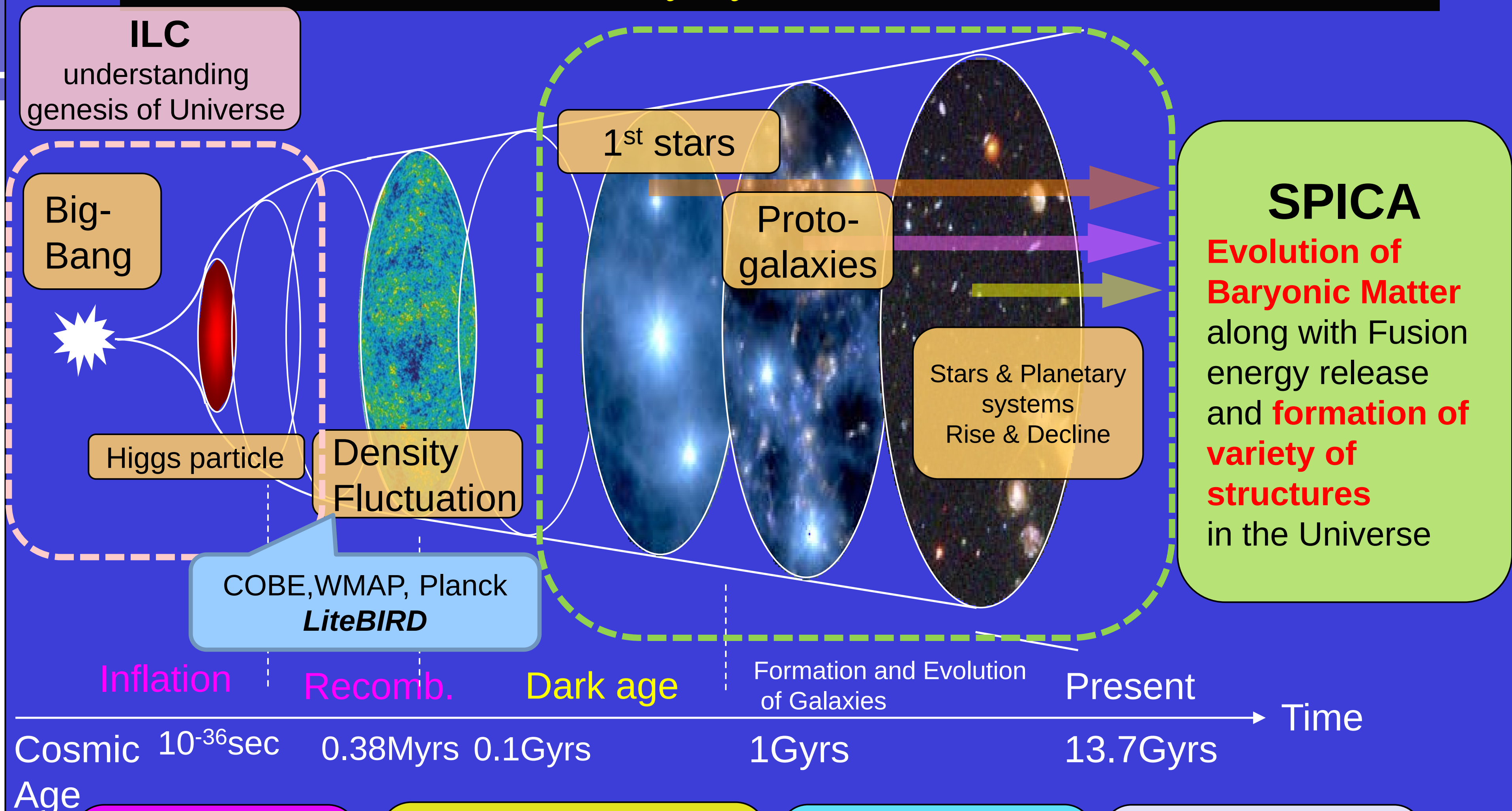
- Unique Scientific Goals of SPICA
- Mission Overview
- Programmatic Status

SPICA Science Goals

Unveil the evolution of Baryoni
Matter in the Universe

Life cycle of interstellar &
Intergalatic matter
Planetary Systems Formation
Birth and Evolution of Galaxies

Cosmic History from Genesis of the Universe to Stars & Planetary systems Formation



Density Fluctuation in early Universe

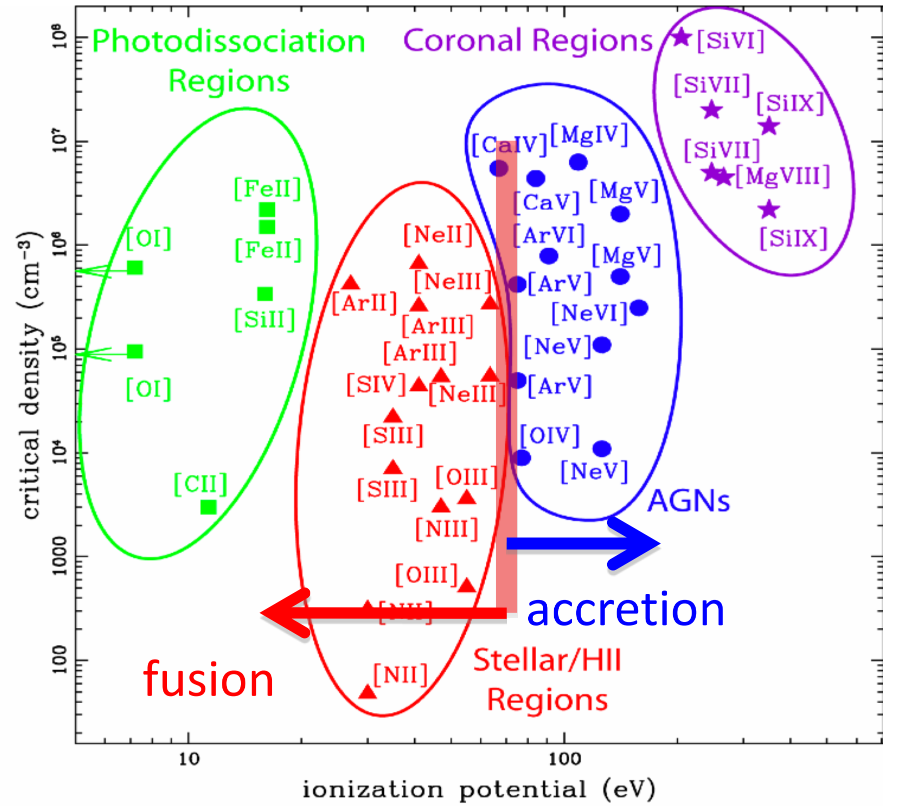
Fluctuation growth & formation of 1st stars

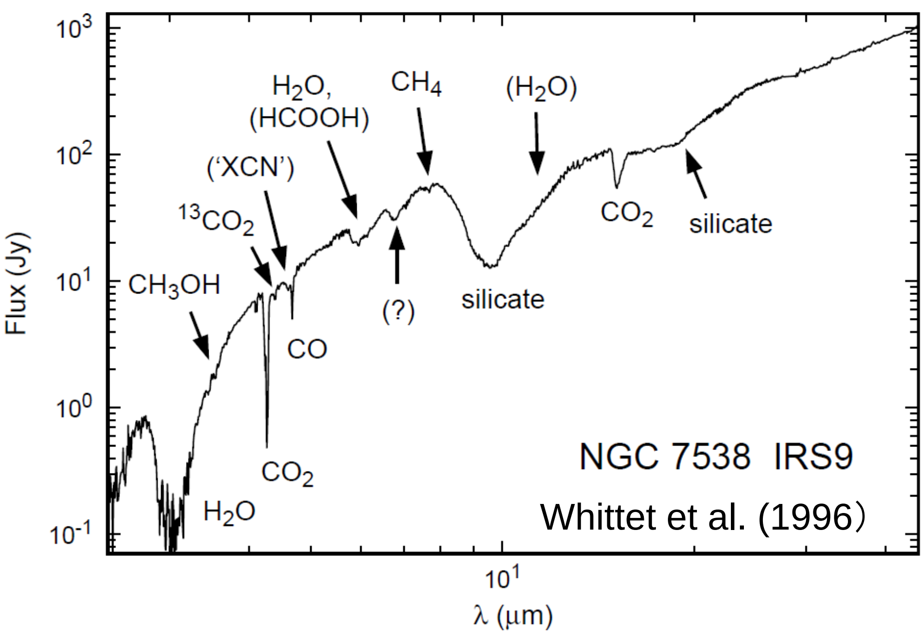
Galaxy Formation And Evolution

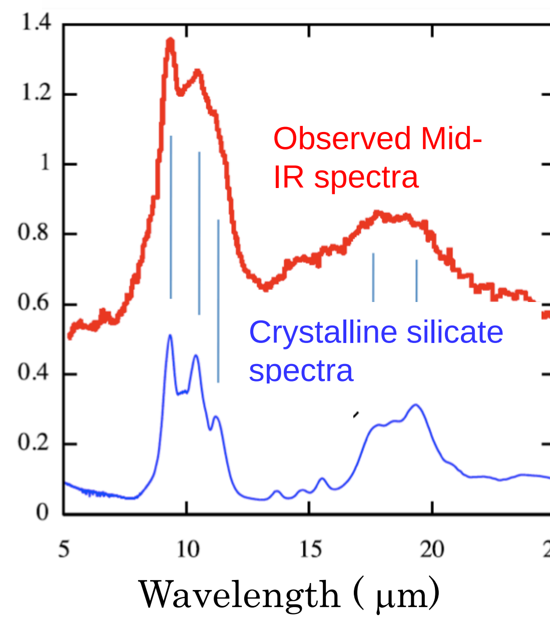
Varieties of structures in the present

Why Infrared spectra?

- Abundant spectral lines from atoms, ions and molecules for diagnostic tool.
- Broad-band spectral features provide the information of composition of solid state particles with ices

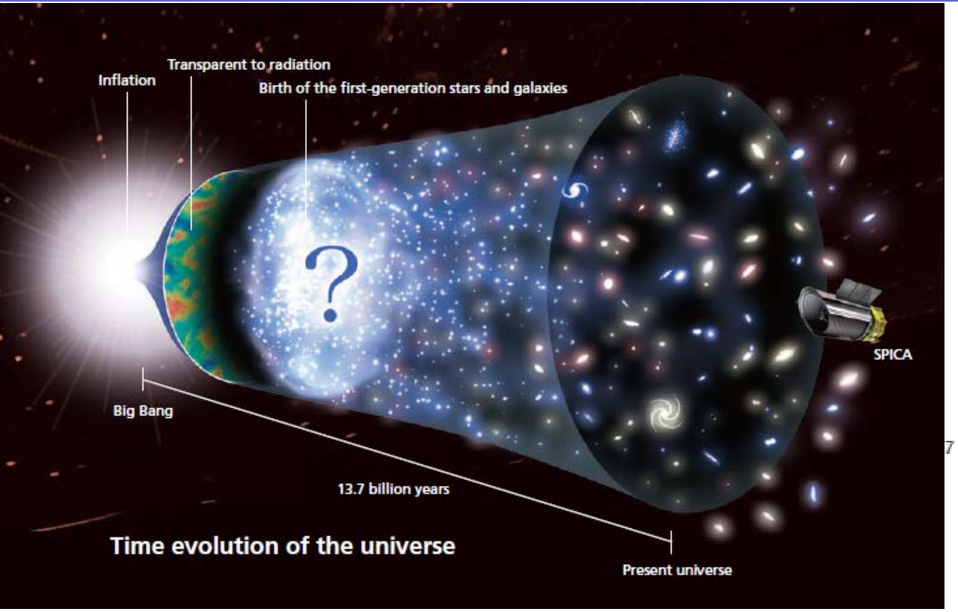




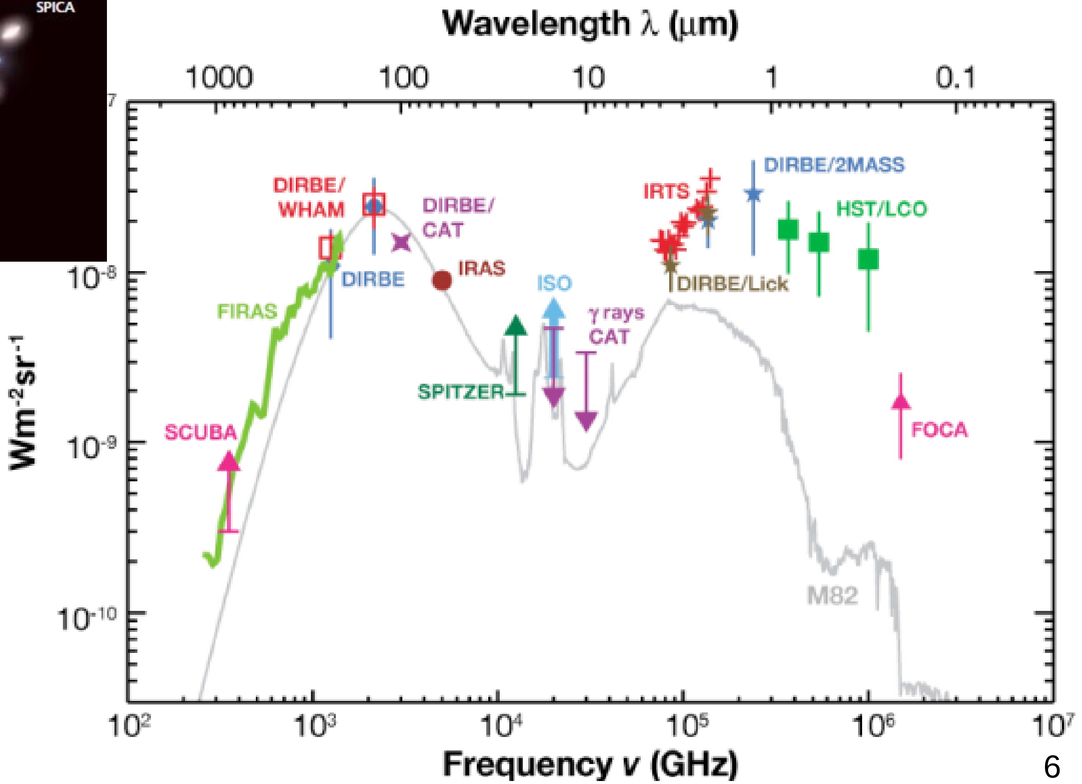


Infrared spectrum of the debris disk around a star HD154014 (Fujiwara et al. 2010)

One of Primary Scientific Goals: the birth & evolution of galaxies



- Cosmic IR background tells us that about half of nuclear fusion energy is hidden by dust



→ **Hidden Universe to be revealed by FIR Observations**

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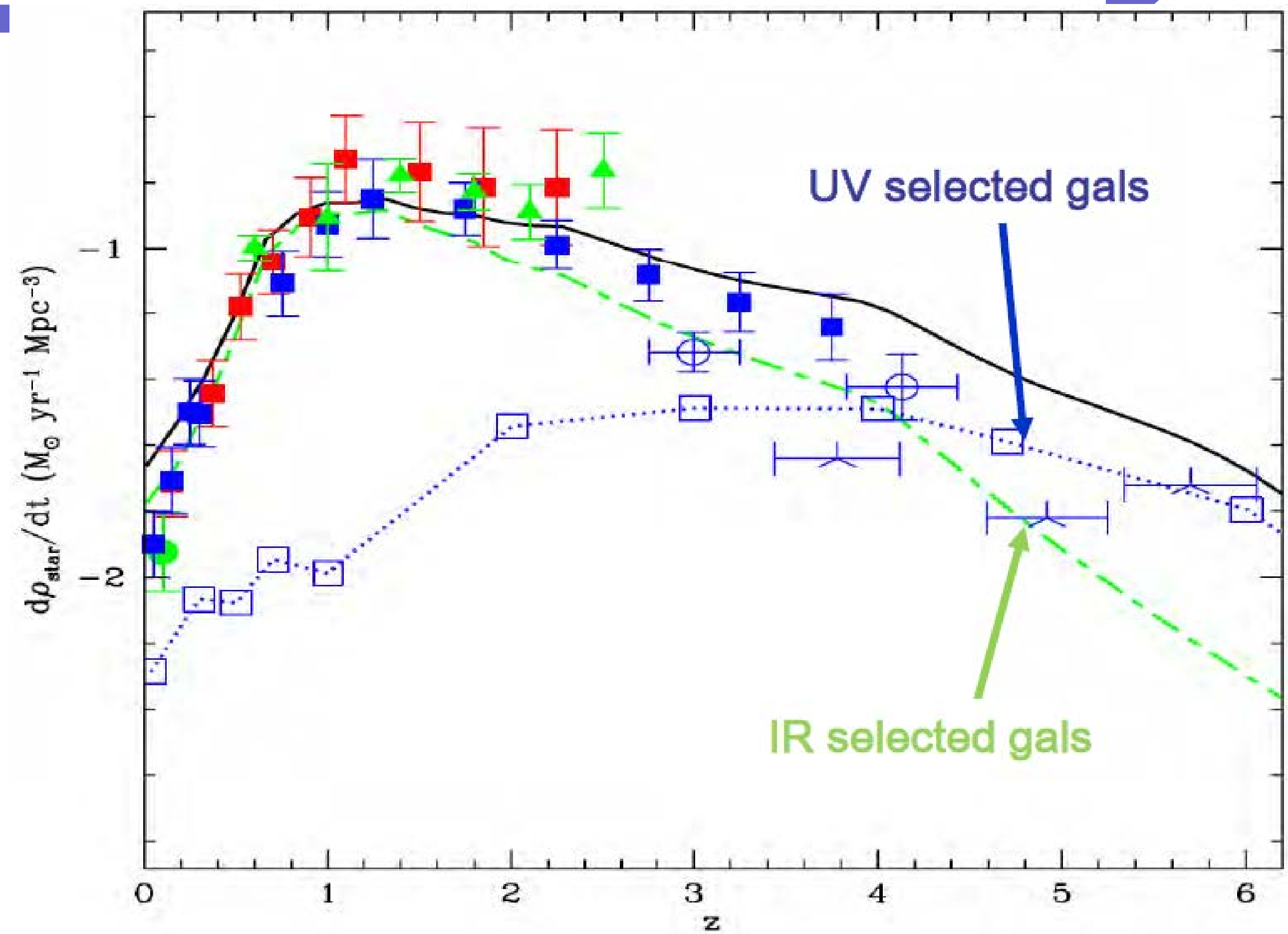
Cosmic Star-formation History revealed with Herschel

The bulk of SF activity at z<3-4 appears to be produced by strongly dust-extinguished galaxies

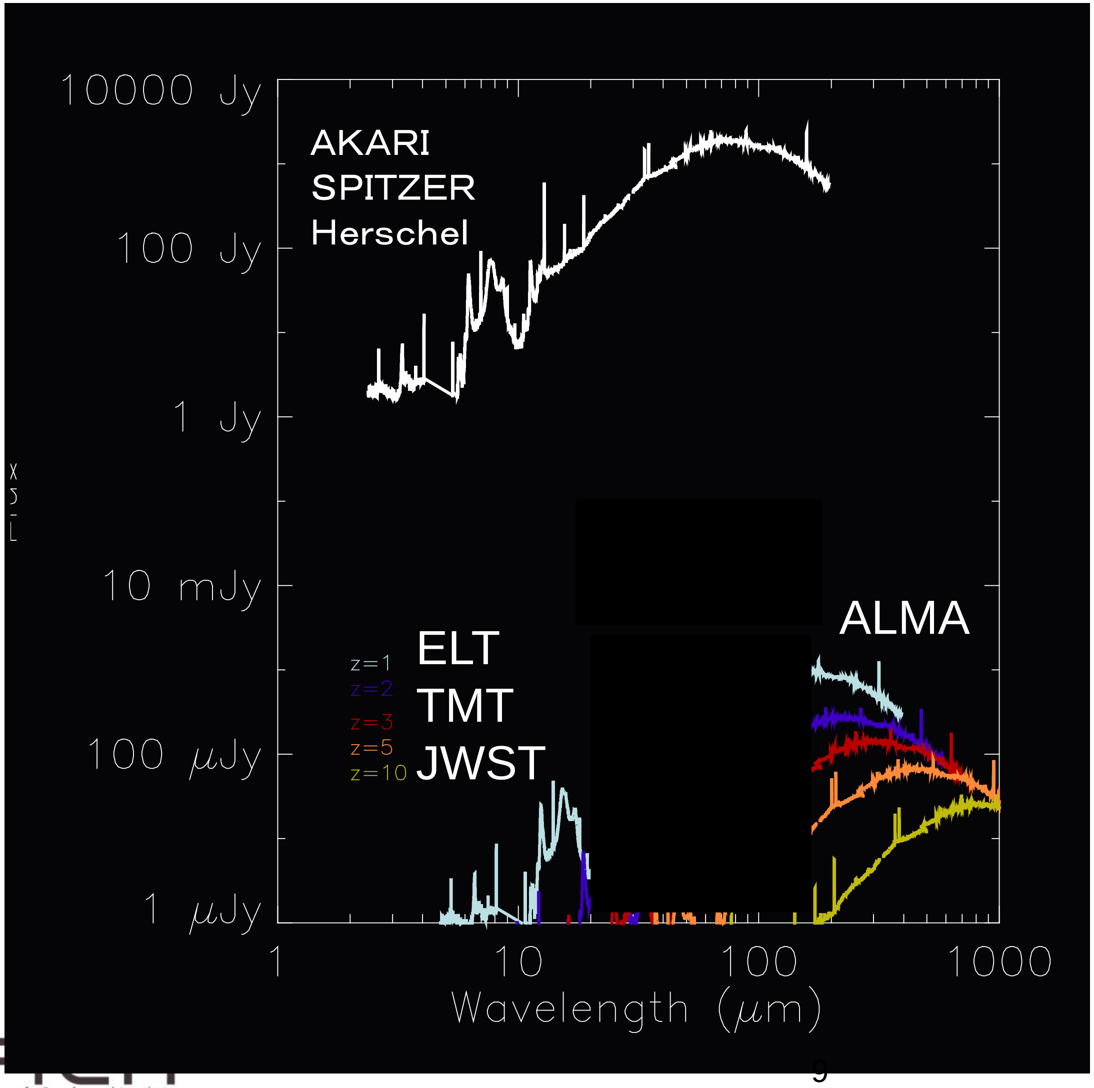


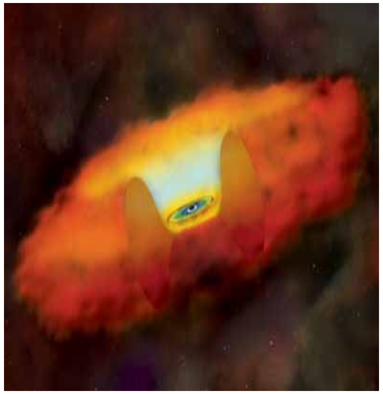
Herschel: COSMOS+WIDE

Vaccari et al. 2013； Marchetti et al. 2013


GOODS-N: 250/350/500 μm
250 μm
350 μm
500 μm
But,What are they ?
Why this happens?
Spectroscopy!!
10 arcmin

Characterizing Hidden Nature of Galaxies



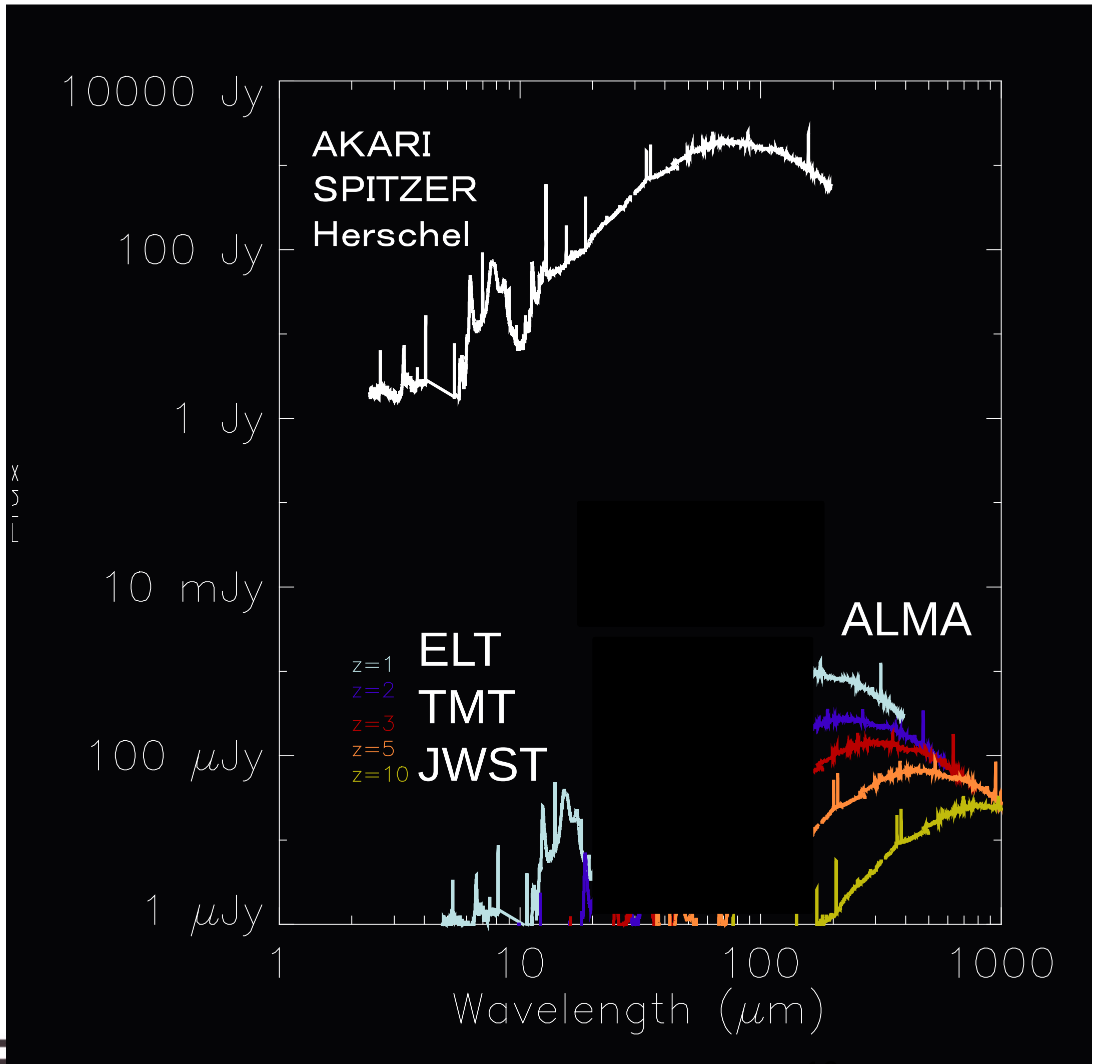


Revealing true nature of obscured galaxies、

Srarburst and /or Super Massive Black holes

SPICA observations are essential

Characterizing
Hidden Nature of Galaxies



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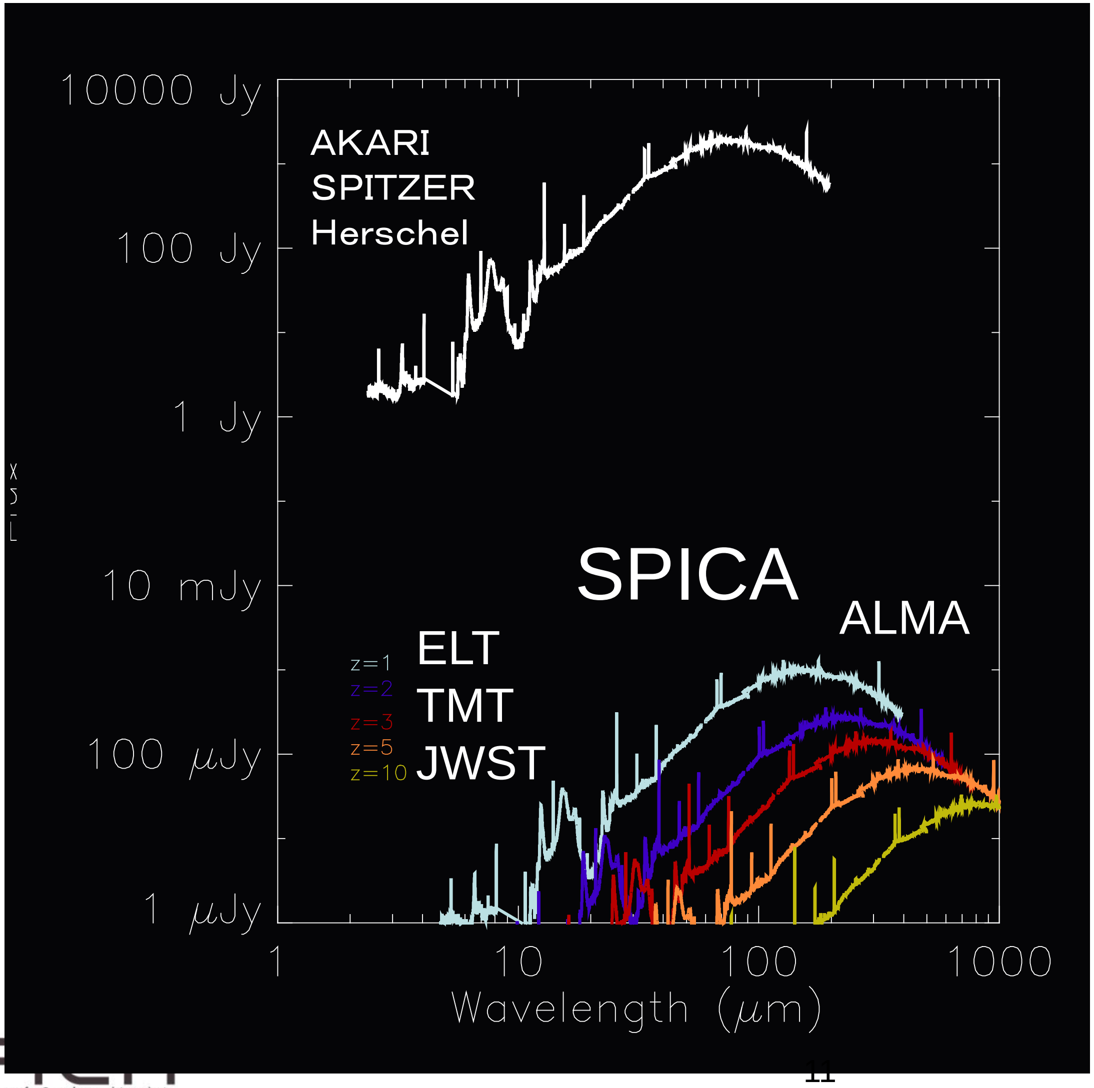
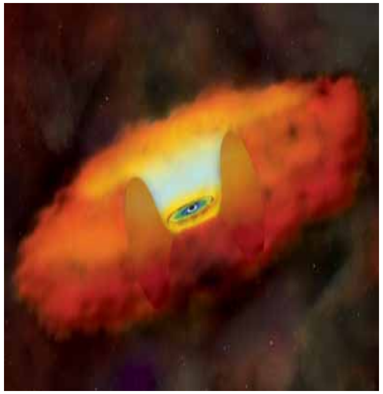
Characterizing Hidden Nature of Galaxies





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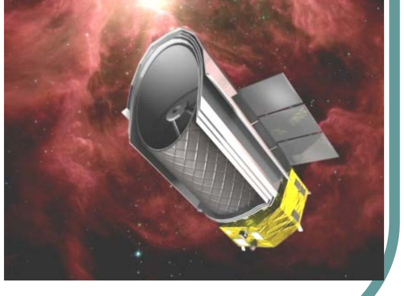
JAXA Japan Aerospace Exploration Agency

Mission Overview



Unveil the evolution of Matter In the Universe

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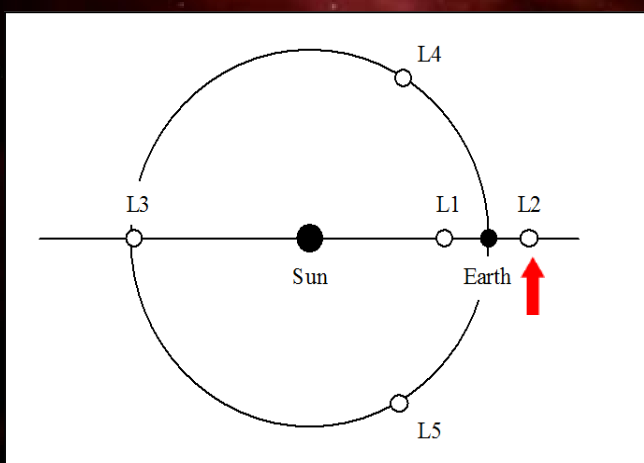
SPICA Mission Overview

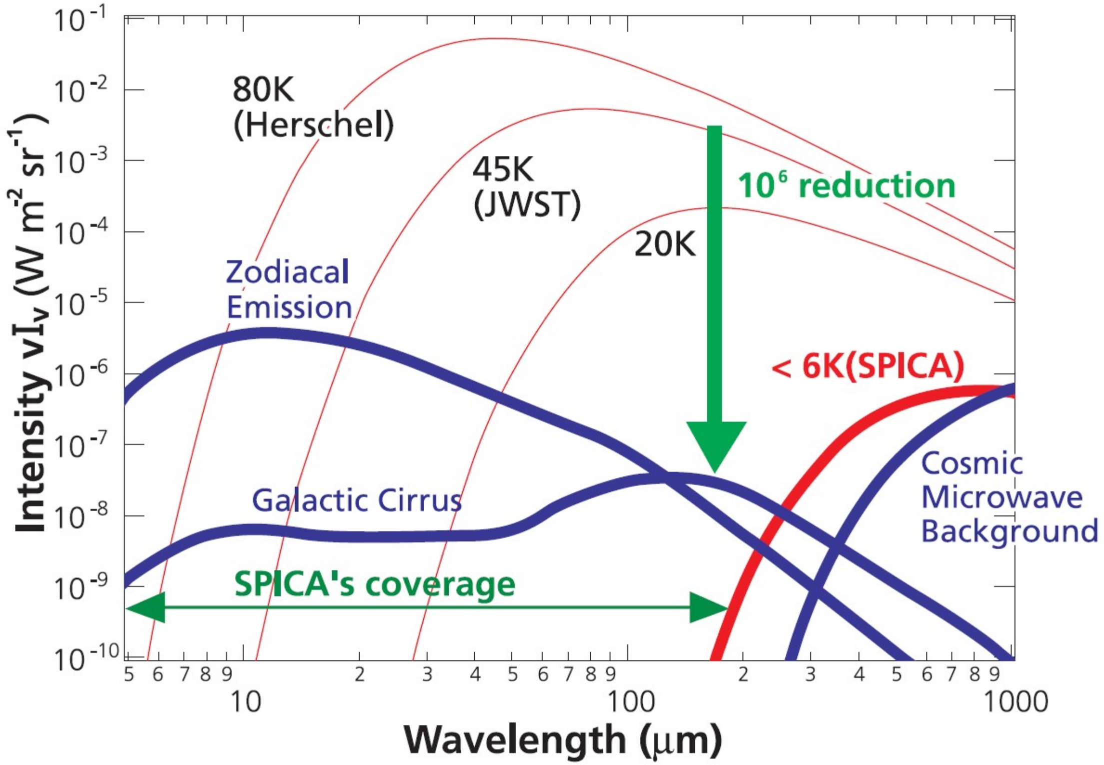
- Telescope 3.2m (EPD 3.0m), 6K
- Orbit: Sun-Earth L2 Halo
- Mission Life: 3 years (nominal), 5 years (goal)
- Weight: 3.7 t



- Next-Generation Infrared Space Observatory with superior Sensitivity and good spatial resolution in mid- and Far-IR (5-210μm)
- International Mission
  - Japan, Europe, Korea, Taiwan

Requirements: Cooled Telescope

- T<10 K is required to improve sensitivity
  - Background Radiation can be reduced by a factor of one million !



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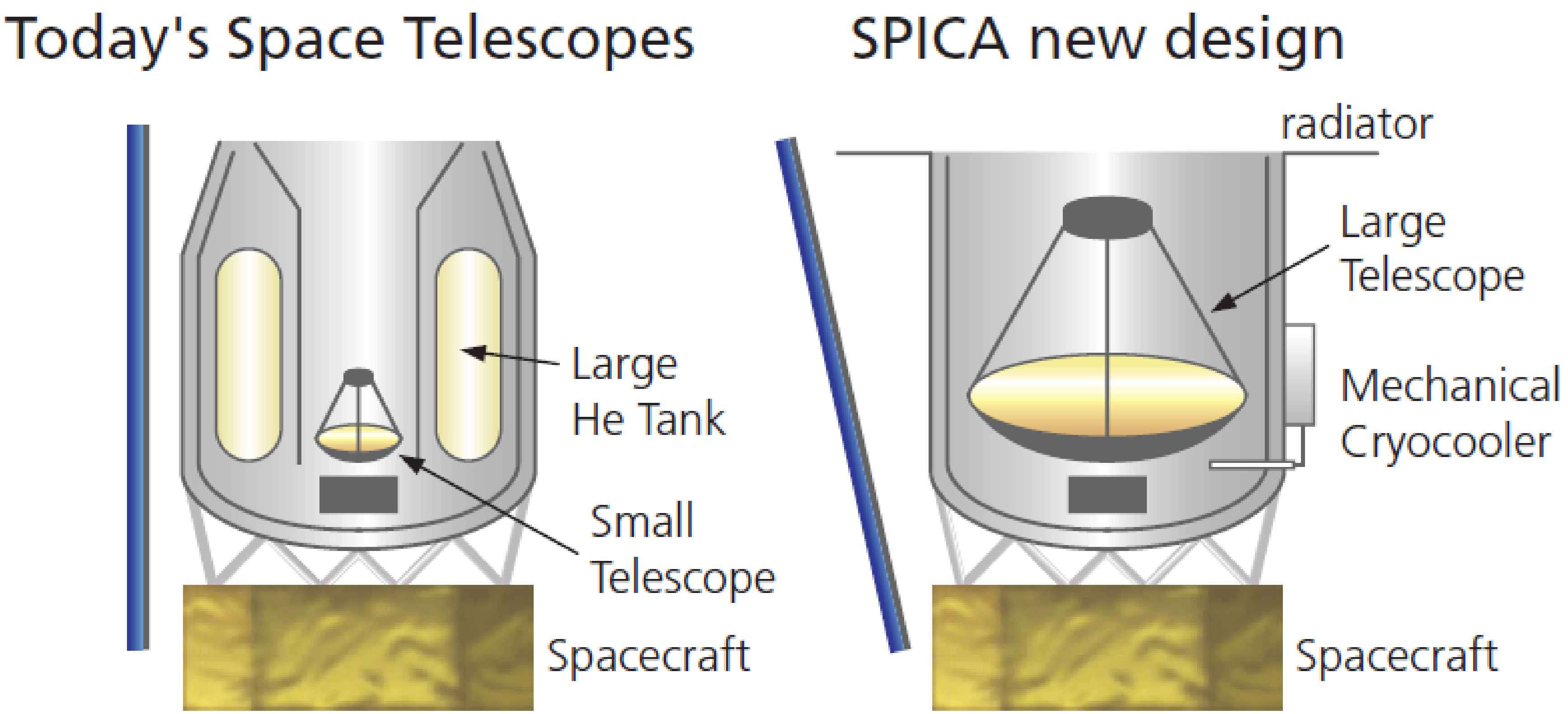
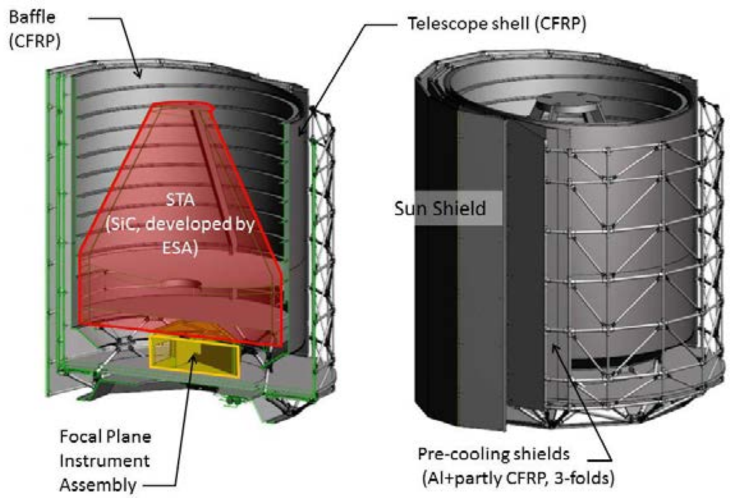
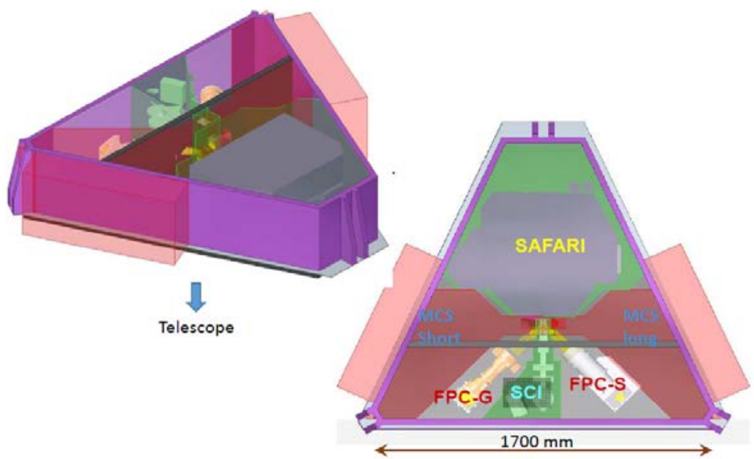
Cryogen-free mission



Lighter and Larger

SPICA Focal Plane Instruments





- SAFARI
  - Far-infrared (34-210μm) imaging spectrometer
  - P.I. SRON (Netherlands) with SAFARI Consortium
- MCS
  - Mid-infrared (5-38μm) camera & spectrometer
  - P.I. JAXA, Universities, and ASIAA (Taiwan)
- SCI
  - SPICA coronagraphic instrument (4-28μm)
  - P.I. JAXA with Nagoya Univ.
- FPC
  - Near-infrared (0.7-5μm) camera and spectrometer
  - P.I. KASI (Korea)

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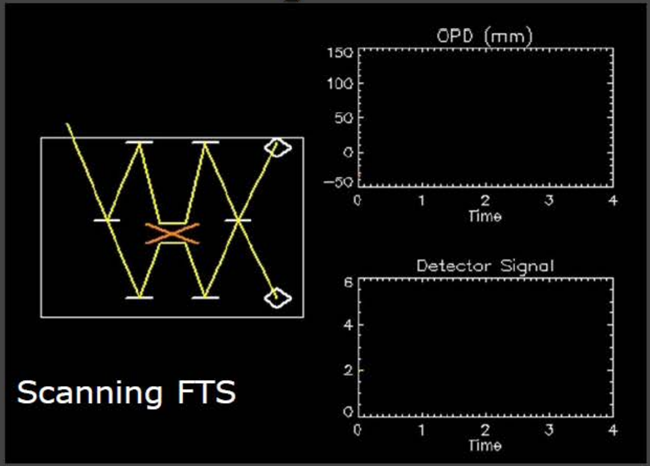
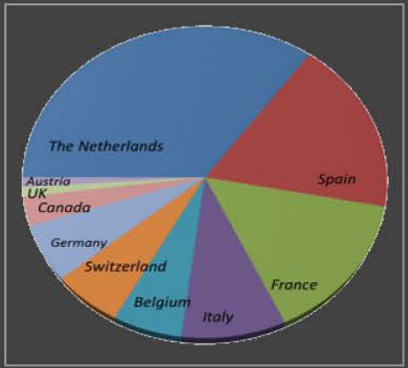
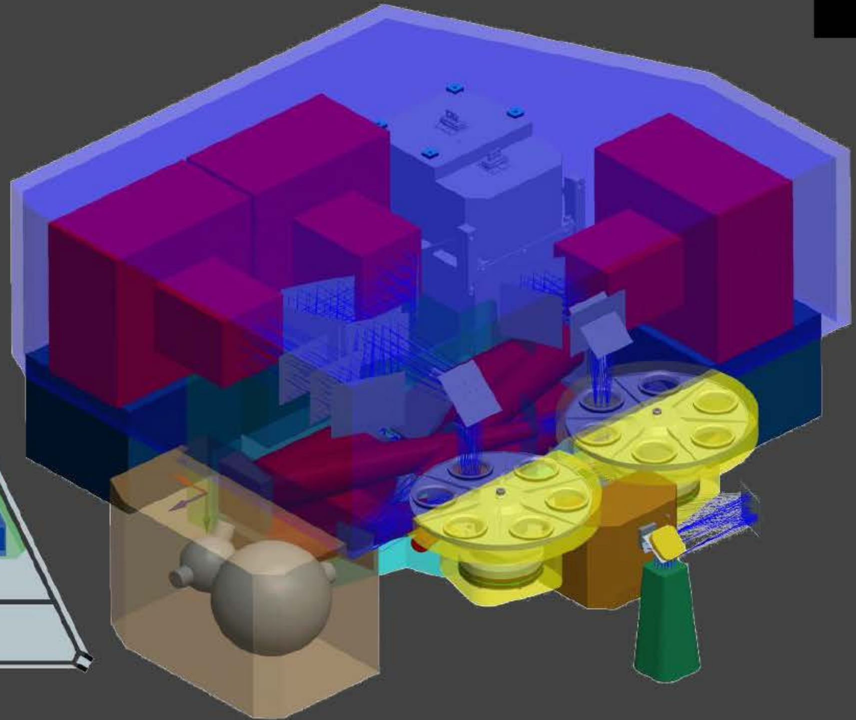
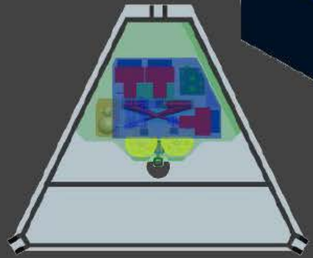
The SAFARI instrument - summary

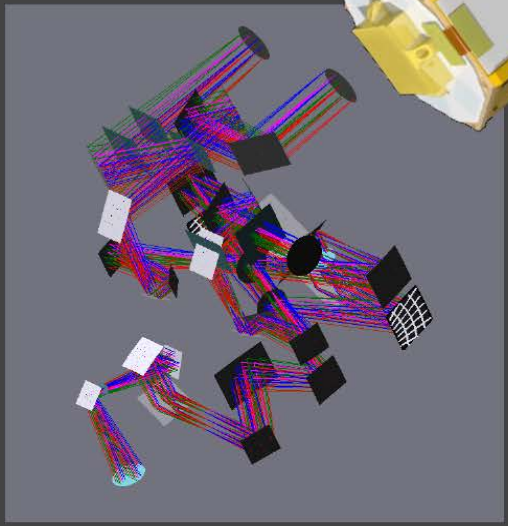
- Scanning Fourier Transform Spectrometer with 2'x2' FoV
- Simultaneously observing in 3 bands (34-210μm)
- Ultra sensitive TES detectors/SQUID read out at 50 mK
  → almost ***200 times*** more sensitive than Herschel
- Frequency Domain Multiplexing
- To be built by an SRON-led consortium
  - ~15 institutes in Europe, Canada, Japan - cost ~170M€

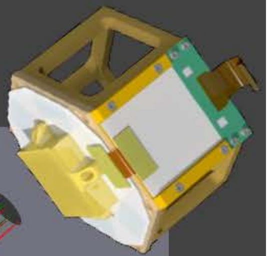












SAFARI

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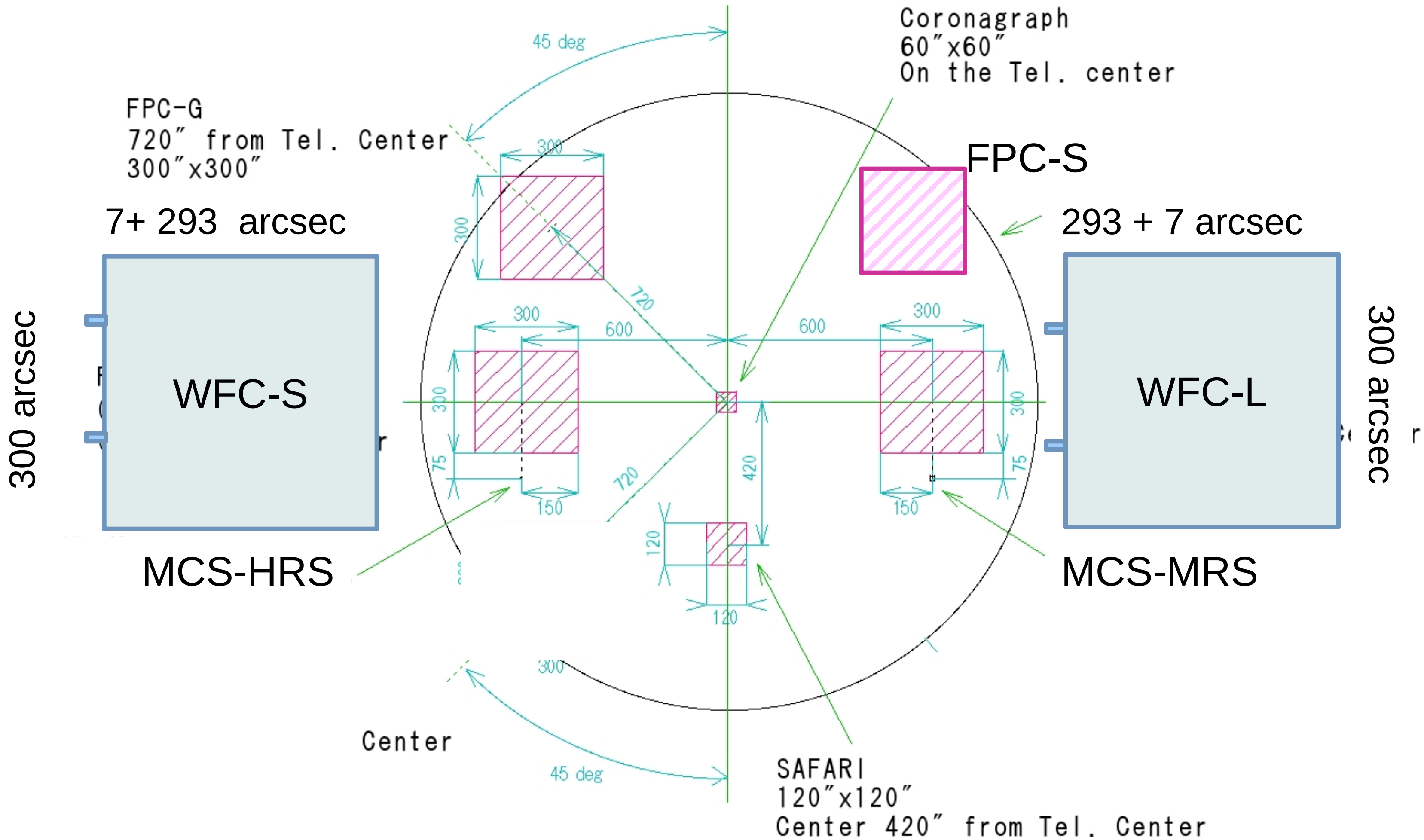
For MCS & FPC ..

- See next two presentations by:
  - “The Mid-Infrared Camera and Spectrometer for SPICA: general overview and Taiwan's contribution” by Ciska KEMPER (ASIAA)
  - “Korean Contribution to SPICA: Development of NIR Instrument, FPC” by Woong-Seob JEONG (KASI)

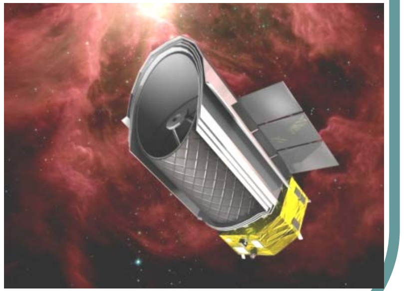
Field-of Views



Updated on June 2013

Seen from a telescope side

Programmatic Aspects



Situation in Japan

- SPICA FY 2014 budgetary proposal (Ministry of education proposal, end of August)
  - Only R&D activity was funded
  - Project itself was not funded
- Space Policy Committee, Cabinet Office of Japan Government , released new long-term plan of Space Science program of Japan (late Sep., 2013)
    - Strategic projects (300M$ class), one in 5 years (large projects need more discussions)
    - Small satellites (100-150M$), three in 5 years
    - Small projects (10M$/year), flexible
  - Astrophysics in the next 5 years
    - ASTRO-H (Launch FY 2015)
    - **SPICA**

SPICA has the top priority among future science satellite candidates, keeping consistency with the new long-term plan

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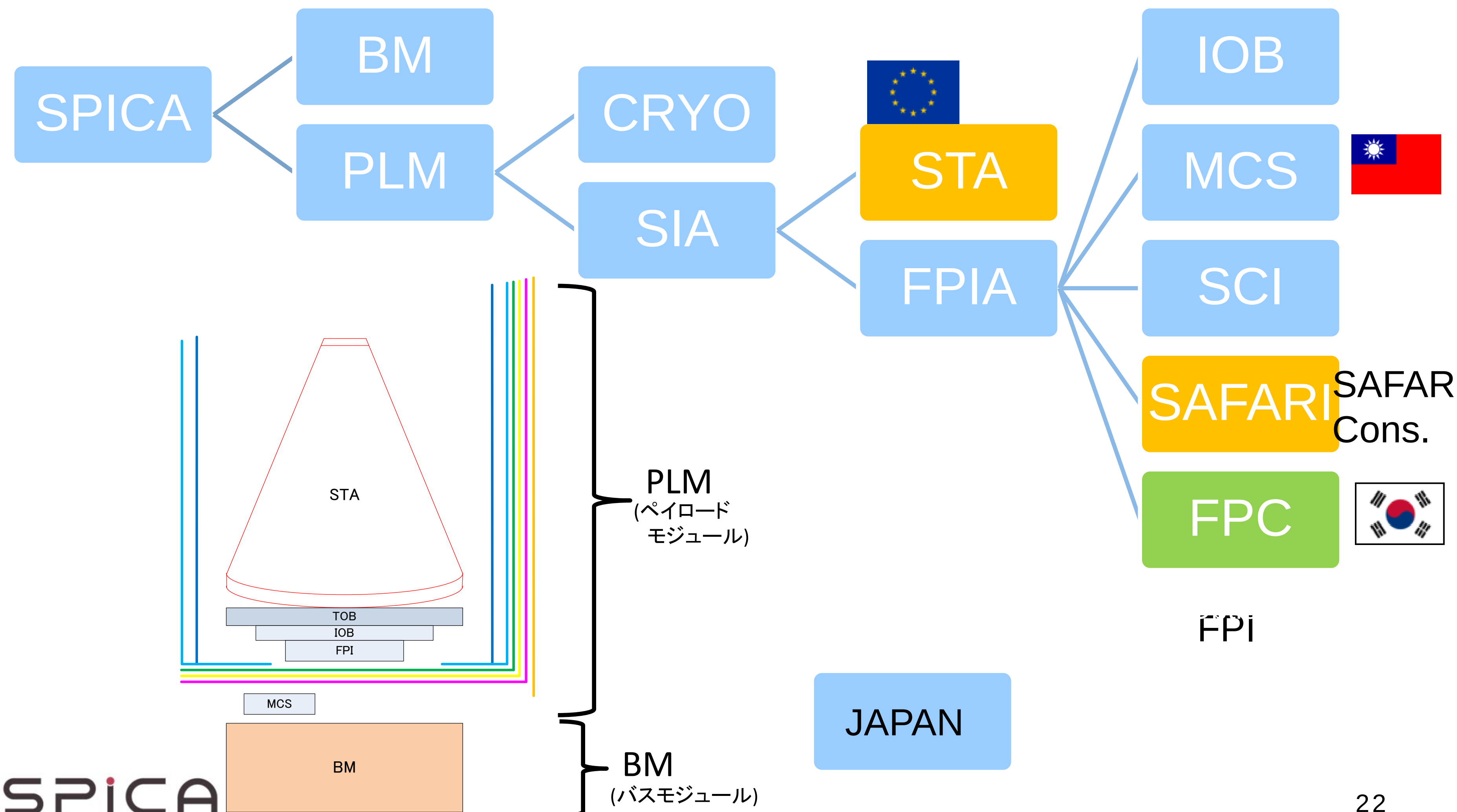
International Collaboration
= *Original Scheme* =



A New plan proposed

- Dedicated Discussions were held (among the director level) in order to establish a more feasible plan both from programmatic & technical points of view
- Proposal
  - To increase the role of European contribution, while keeping SPICA as a JAXA-led project
- Implication
  - Increases technical feasibility by using European technical heritage (e.g. Herschel , Planck)
  - No major change in the SPICA program as a whole (science goals, mission specifications). No change in the importance of Korea and Taiwan participation; essentially important
  - Major changes in the approval processes and schedule
    - Re-entering open competition in the ESA Cosmic Vision program (M-class mission, M4)
    - The project starts in 2017, and the launch in 2026 in the nominal track

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Present Killer Sciences From Asia (Japan/Taiwan/Korea)) to win the M4 Proposal !

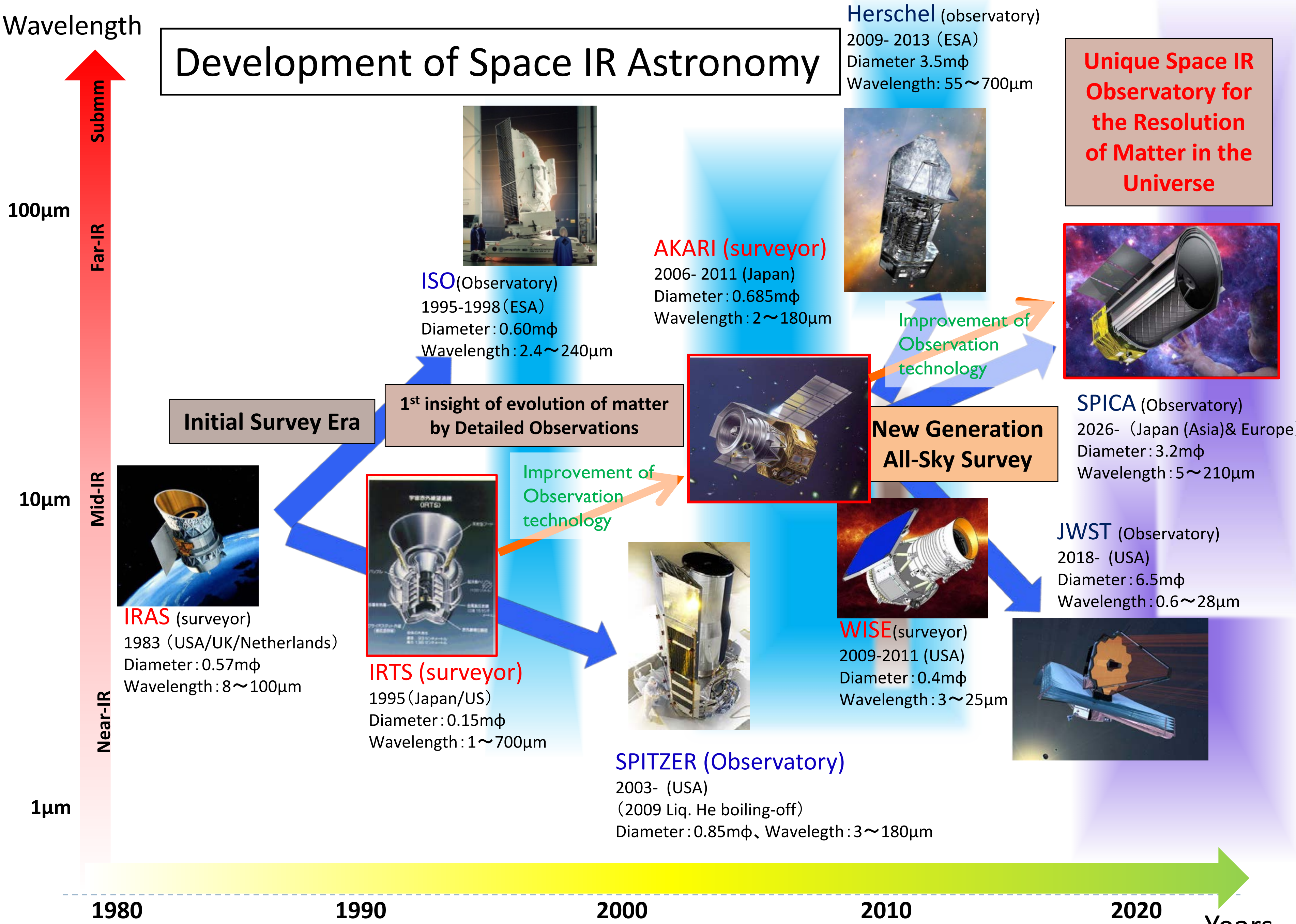
International SPICA Team

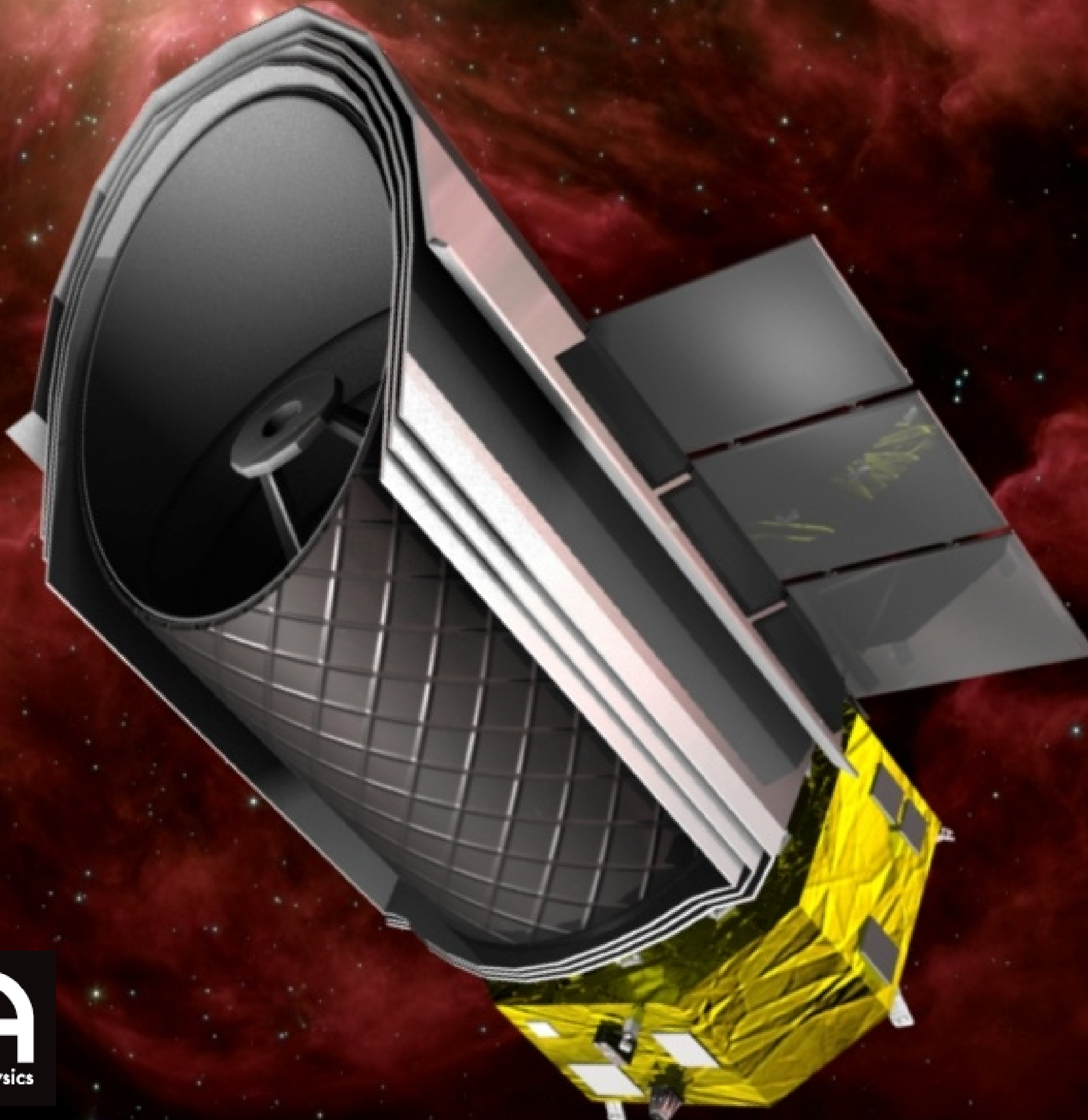
- 17 countries, regions and one International org.

Summary

- What's SPICA: next-generation space IR observatory, with cold (<6K) 3.2m diameter telescope
- *Much higher sensitivity in the thermal infrared than Herschel Space Observatory*
- SPICA can explore the evolution of Baryonic matter of various form in the history of the Universe
- Due to the budgetary situation in Japan, the international collaboration scheme needs to be revisited to increase the role of European contribution, while keeping SPICA as a JAXA-led project.
- Thus SPICA re-enters open competition in the ESA Cosmic Vision program (M-class mission, M4)
- In order to realize SPICA in 2020s, the international community support and collaboration with namely Asian partners are essential.

Development of Space IR Astronomy





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Space Odyssey