SPICA
Space Infrared Telescope for Cosmology and Astrophysics

The next-generation space infrared astronomy mission

SPICA
Space Infrared Telescope for Cosmology and Astrophysics

Windows on the Universe, ICISE,
RENCONTRES DU VIETNAM
August 2013

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for SPICA Team
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JAXA

Development of Space IR Astronomy

Wavelength

Submm
Far-IR
Mid-IR
Near-IR

100μm
10μm
1μm

1980 1990 2000 2010 2020 Years

Initial Survey Era

1st insight of evolution of matter by Detailed Observations

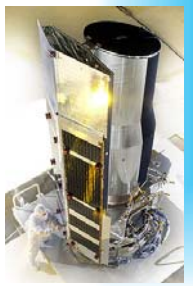
New Generation All-Sky Survey

Resolution of Evolution of Matter in the Universe

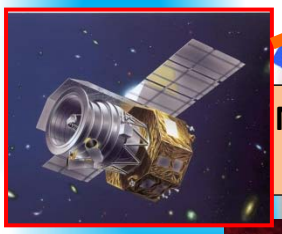
IRAS (surveyor)
1983（USA/UK/Netherlands）
Diameter：0.57mϕ
Wavelength：8～100μm

IRTS (surveyor)
1995（Japan/US）
Diameter：0.15mϕ
Wavelength：1～700μm

ISO(Observatory)
1995-1998（ESA）
Diameter：0.60mϕ
Wavelength：2.4～240μm



SPITZER (Observatory)
2003- (USA)
（2009 Liq. He boiling-off）
Diameter：0.85mϕ、Wavelegth：3～180μm

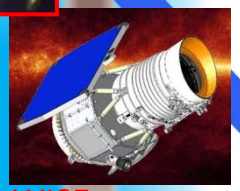


AKARI (surveyor)
2006- 2011 (Japan)
Diameter：0.685mϕ
Wavelength：2～180μm

Herschel (observatory)
2009- 2013（ESA）
Diameter 3.5mϕ
Wavelength: 55～700μm

Improvement of Observation technology

Improvement of Observation technology



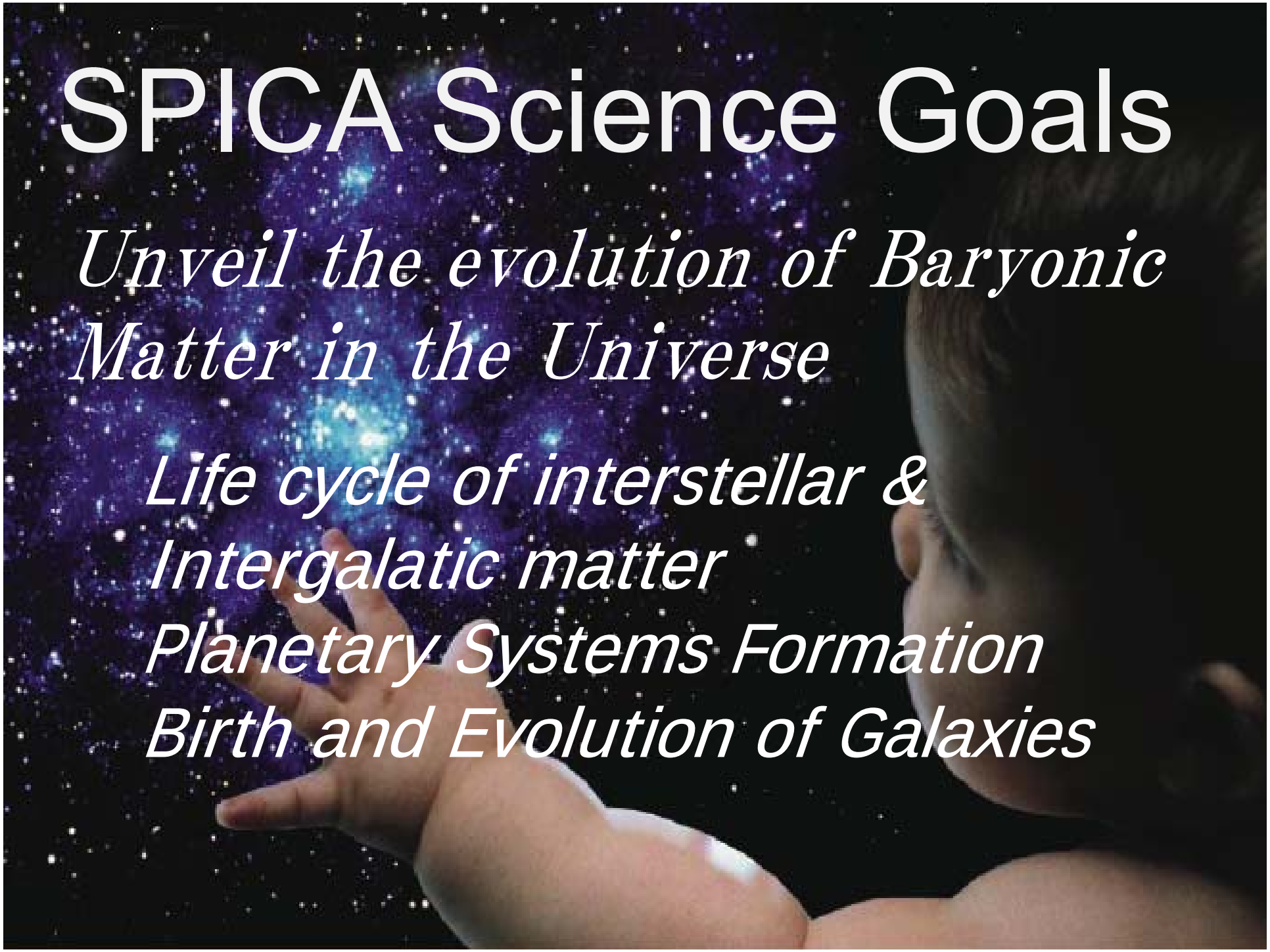
WISE(surveyor)
2009-2011 (USA)
Diameter：0.4mϕ
Wavelength：3～25μm

SPICA (Observatory)
2023-（Japan (Asia)& Europe）
Diameter：3.2mϕ
Wavelength：5～210μm

JWST (Observatory)
2018- (USA)
Diameter：6.5mϕ
Wavelength：0.6～28μm

Outline of my Talk

- SPICA Scientific Goals
  - with a few slides on `Why IR Observatory in Space? ’
- Mission Overview
- Programmatic Status



SPICA Science Goals

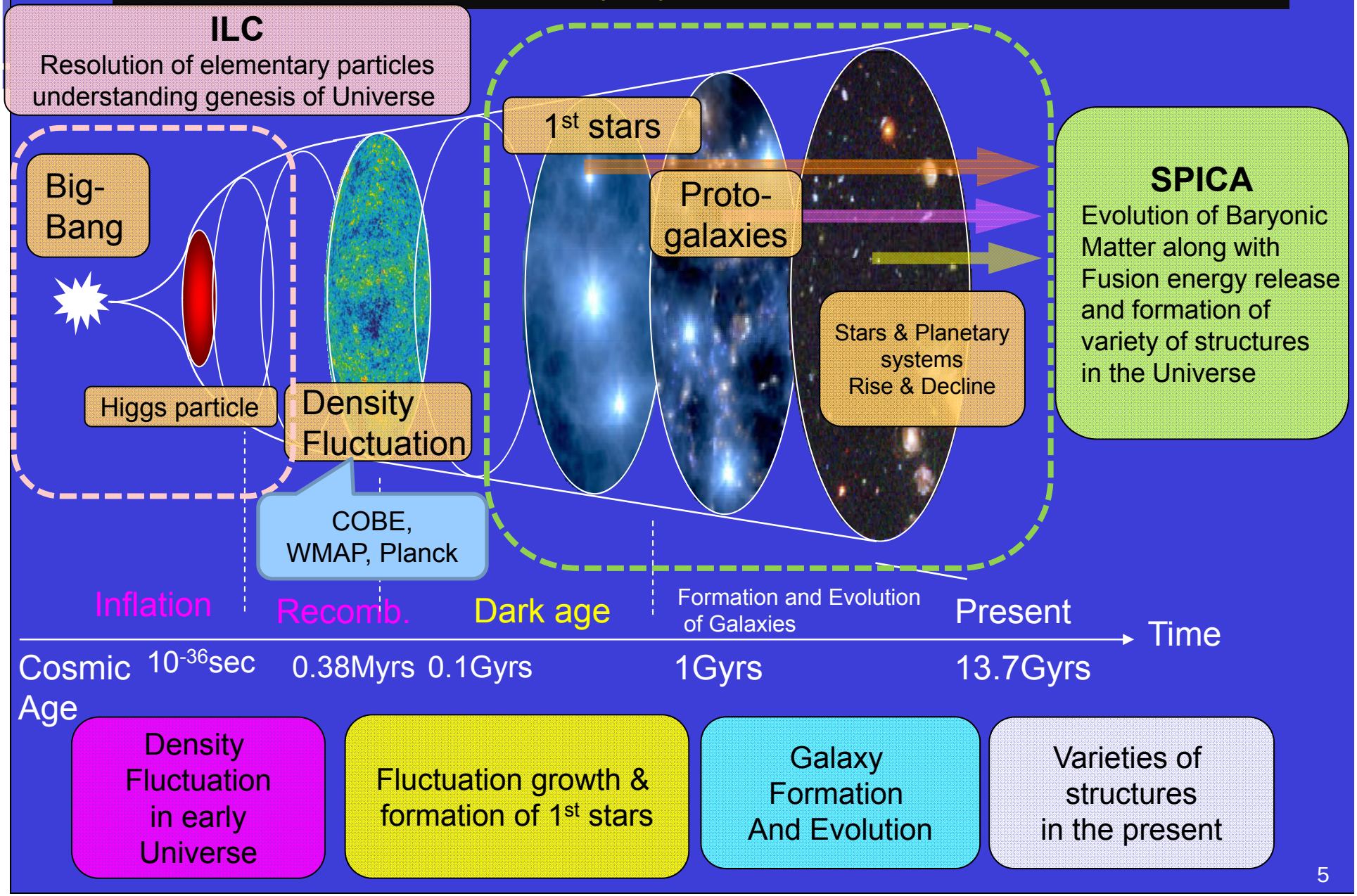
Unveil the evolution of Baryonic Matter in the Universe

Life cycle of interstellar & Intergalatic matter

Planetary Systems Formation

Birth and Evolution of Galaxies

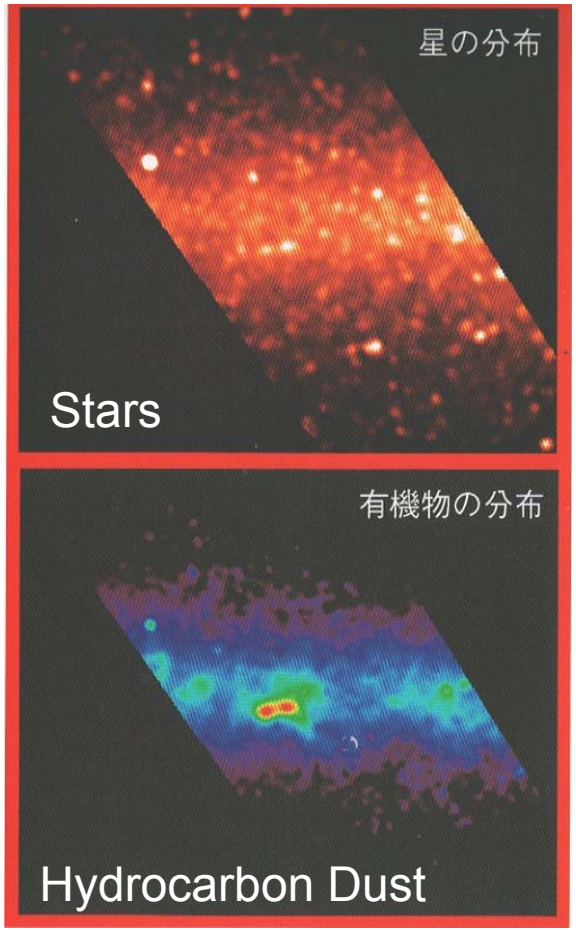
Cosmic History from Genesis of the Universe to Stars & Planetary systems Formation



SPICA reveals Evolution of Baryonic Matter in the Universe

- Early Universe after Big-Bang
  - Only H & He
- Present Universe
  - Various metal elements exist in Gas and Dust (solid state particles)
  - Hydrocarbons are ubiquitously distributed in the Milky-way Galaxy
- Various metal elements were formed in stars, and matters were evolved through the life cycle of the stars

Results from IRTS (1995)



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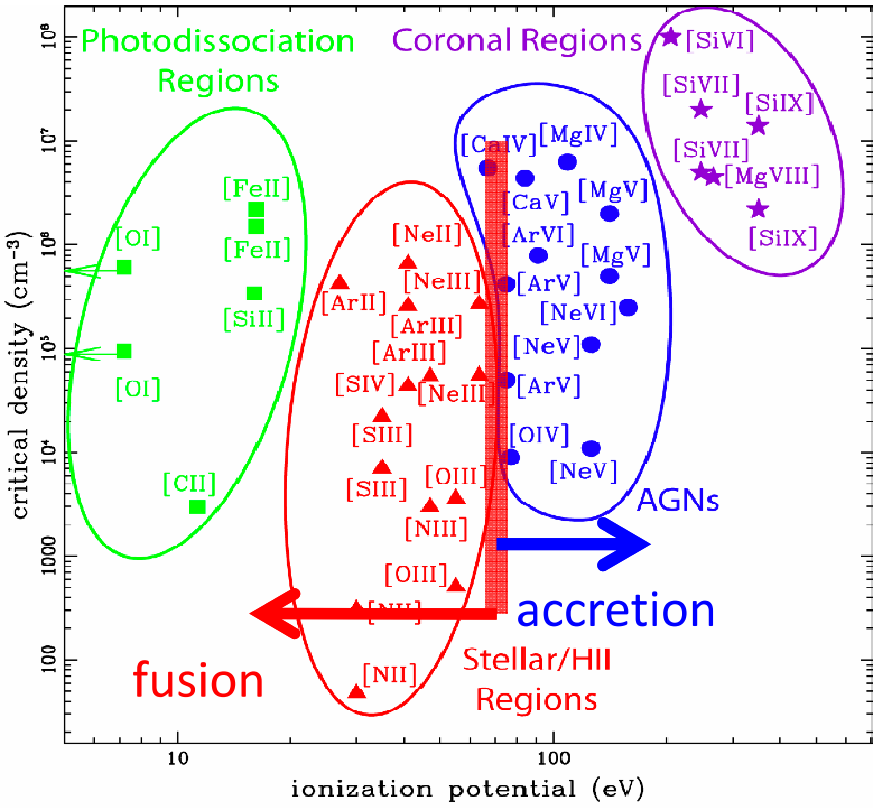
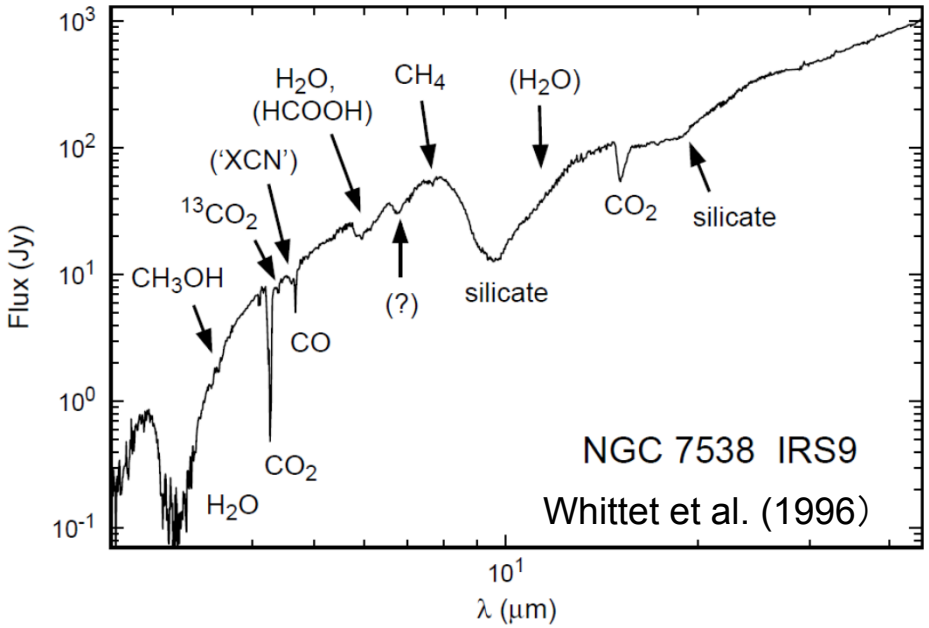
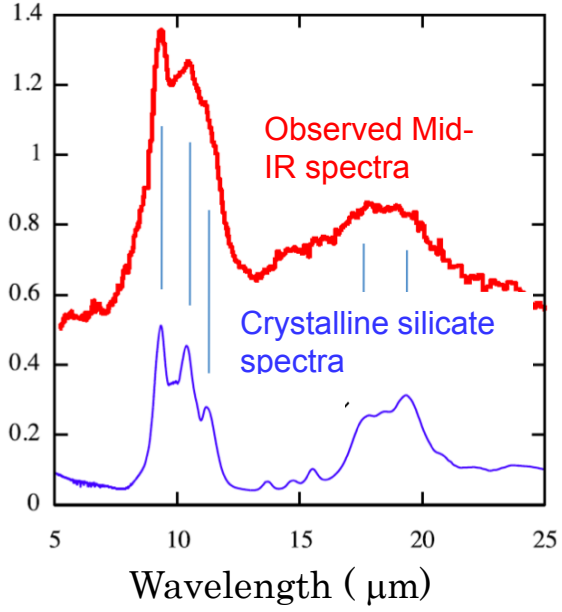
Why Infrared spectra?

- 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

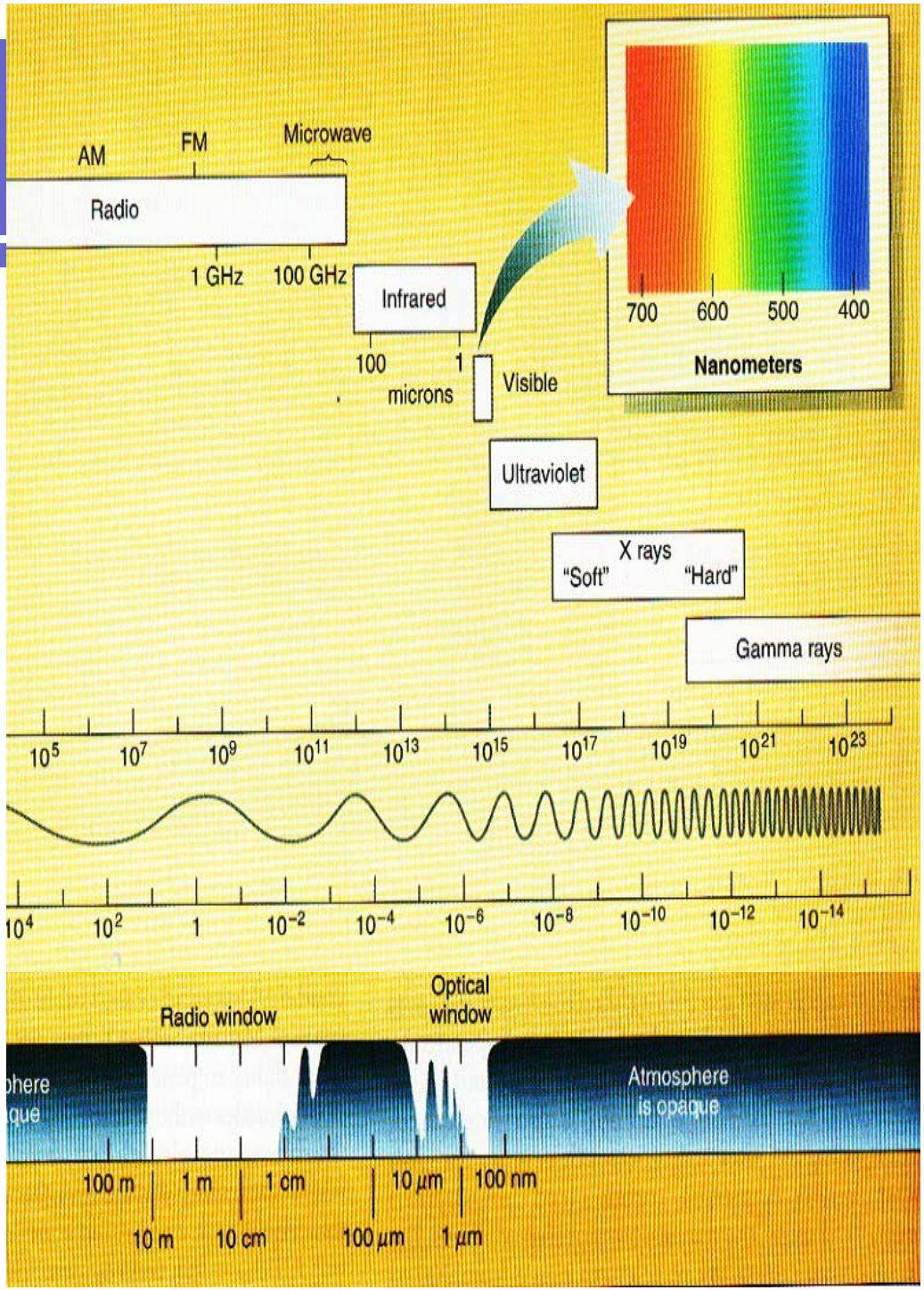






Infrared spectrum of the debris disk around a star HD154014 (Fujiwara et al. 2010)

Observation from Space is essential: very limited atmospheric windows on the Universe



Earth's atmosphere blocks most of the electromagnetic waves

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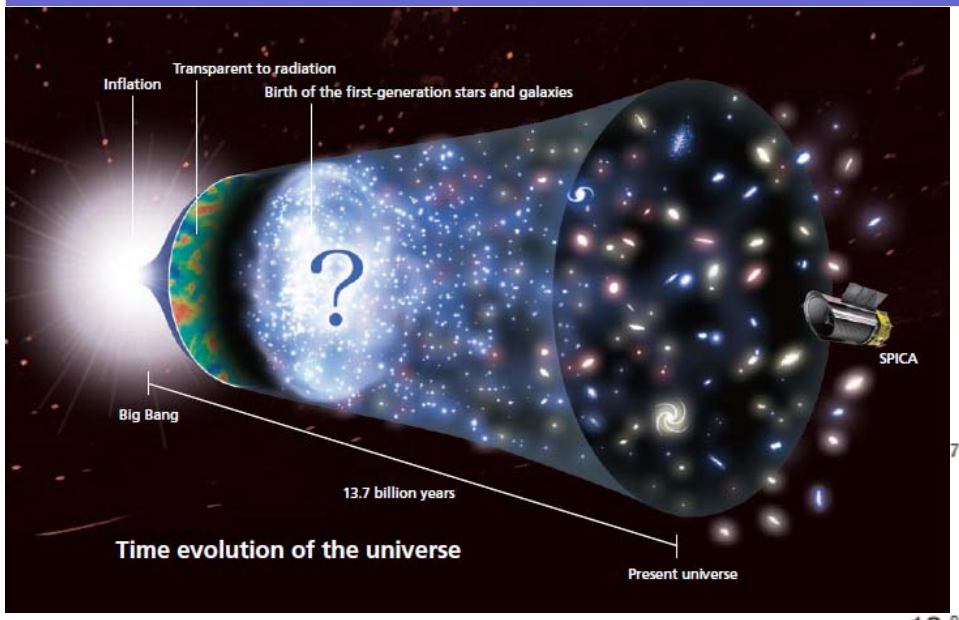
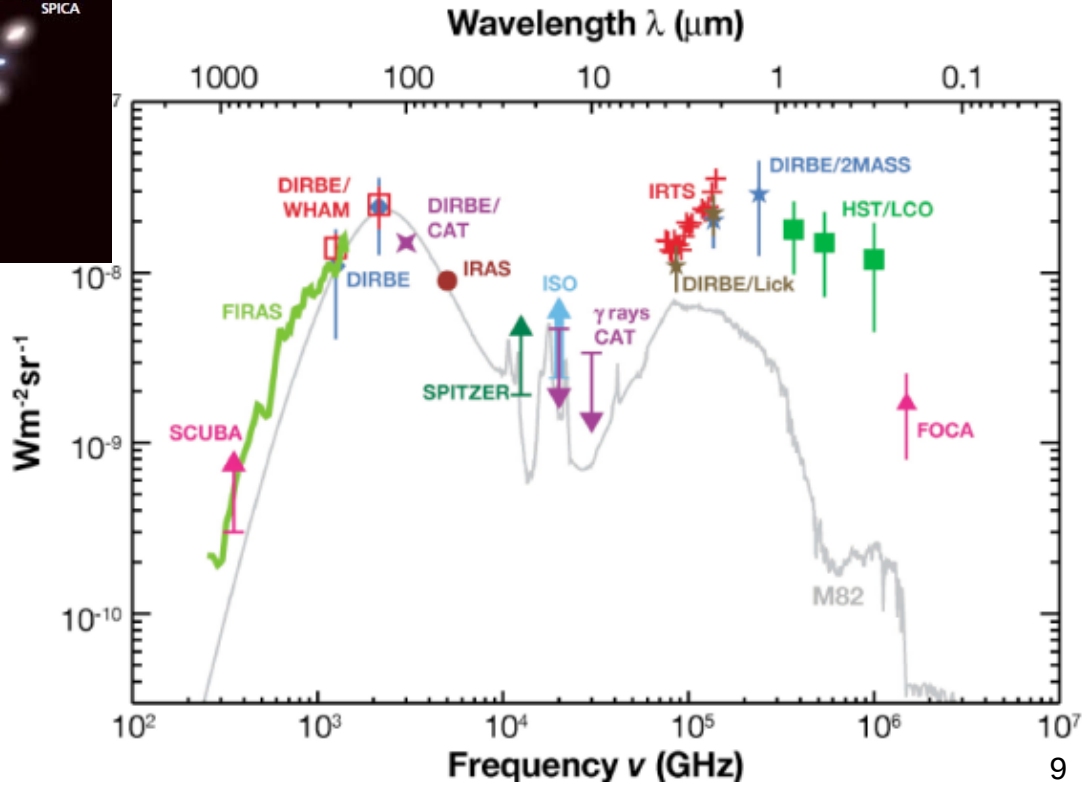
One of Primary Scientific Goals: the birth & evolution of galaxies



- 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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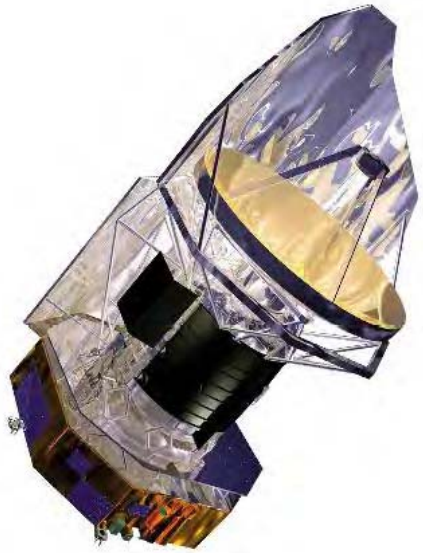
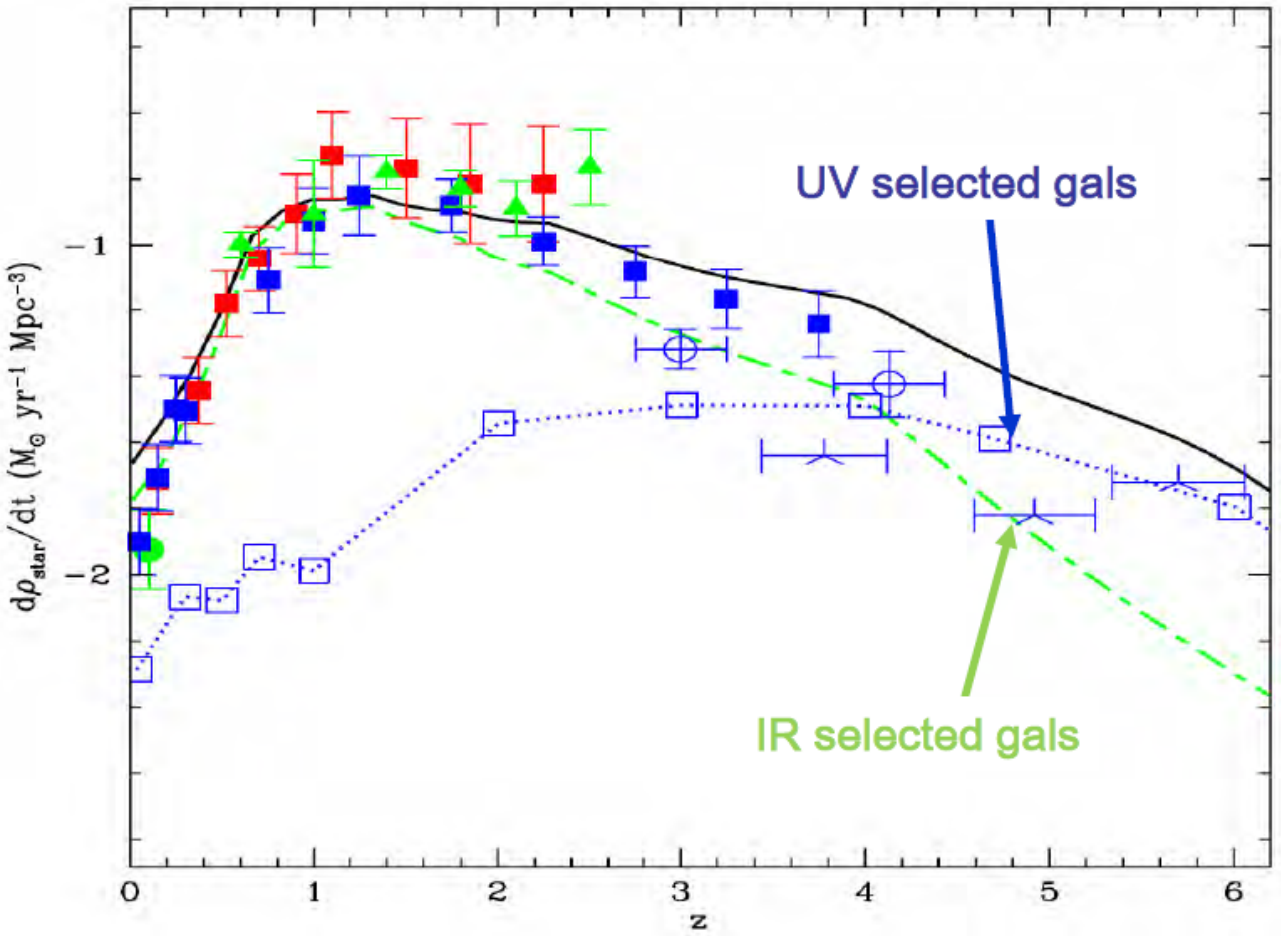
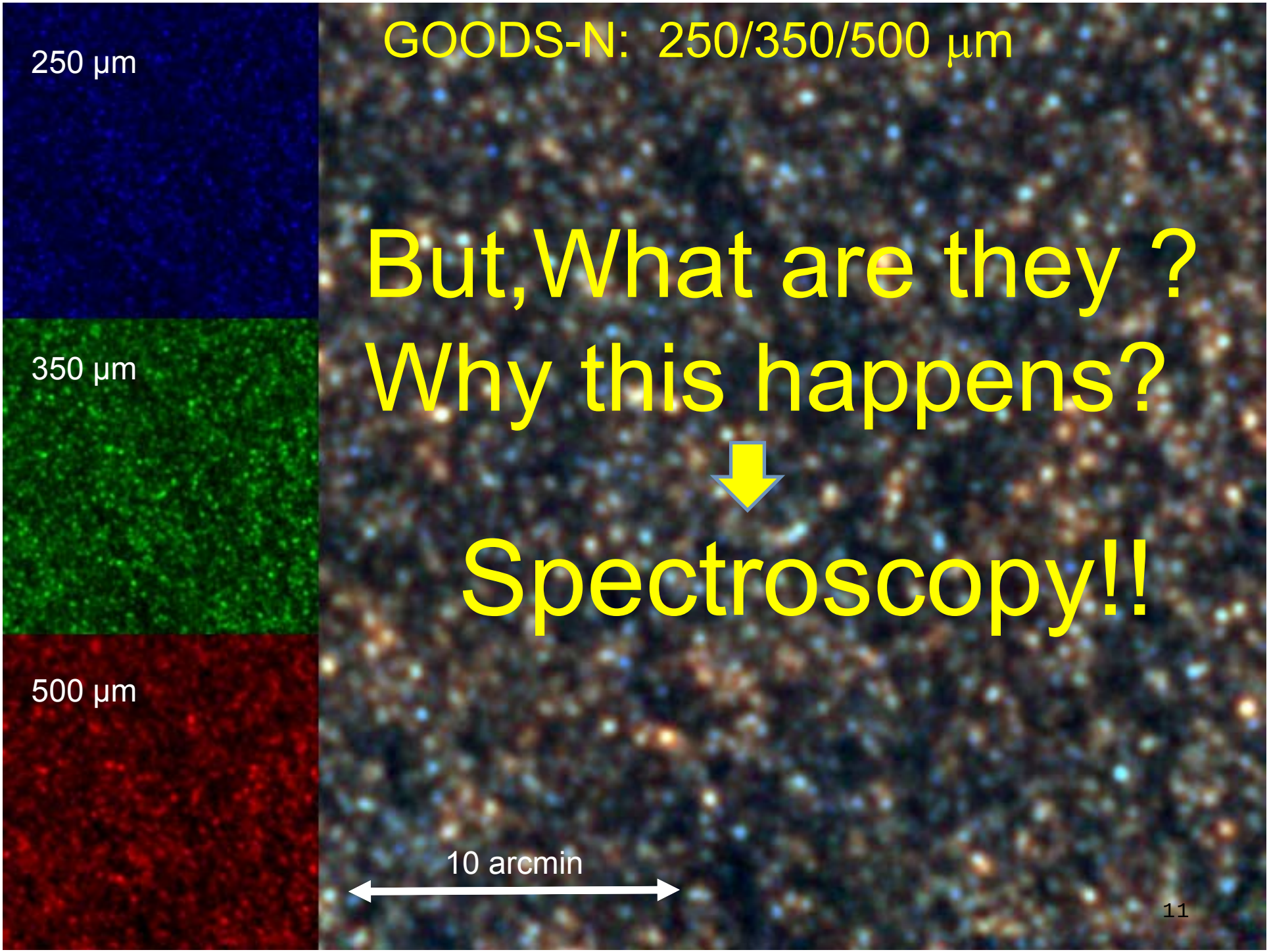
Cosmic Star-formation History revealed with Herschel

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

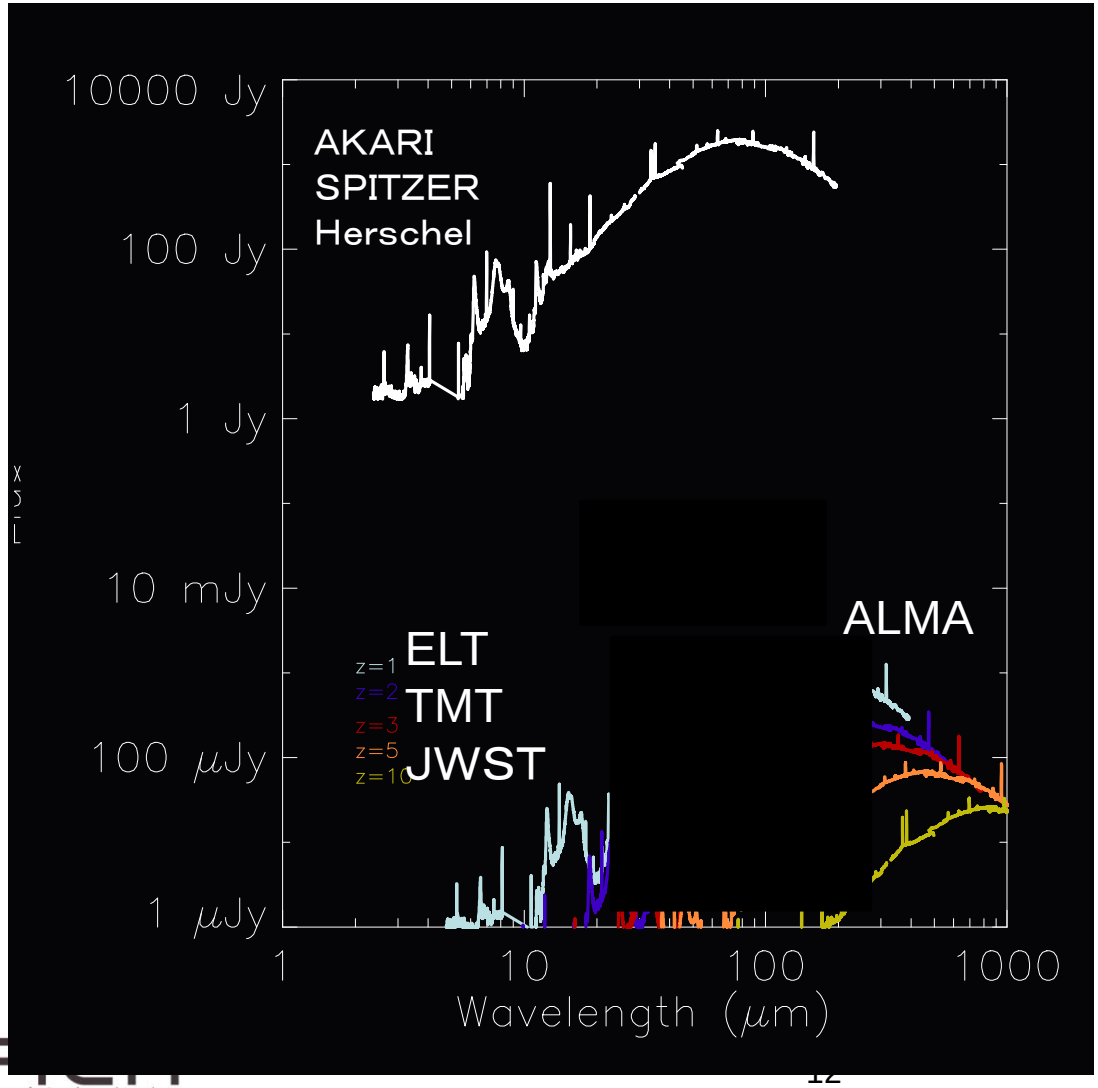




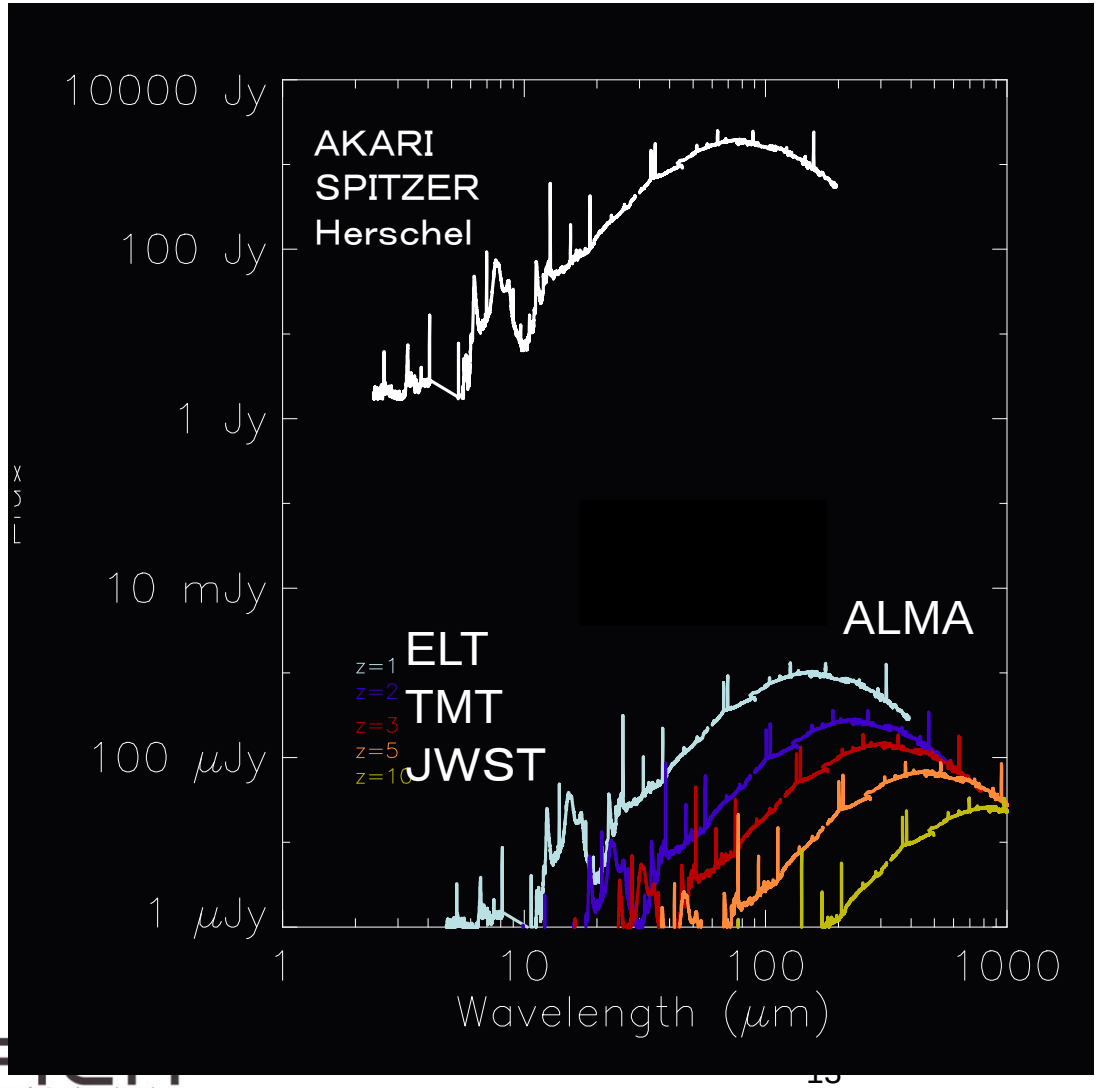
Herschel: COSMOS+WIDE
Vaccari et al. 2013; Marchetti et al. 2013

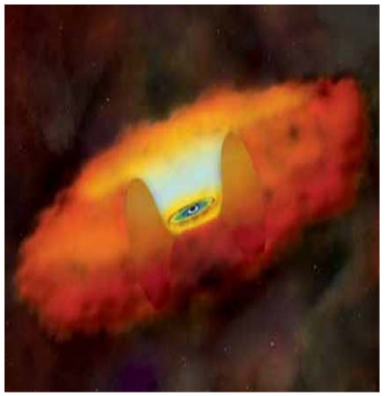

250 μm
350 μm
500 μm
GOODS-N: 250/350/500 μm
But,What are they ?
Why this happens?
Spectroscopy!!
10 arcmin

Characterizing Hidden Nature of Galaxies



Characterizing Hidden Nature of Galaxies





Revealing true nature of obscured galaxies、

Srarburst and /or Super Massive Black holes

SPICA observations are essential

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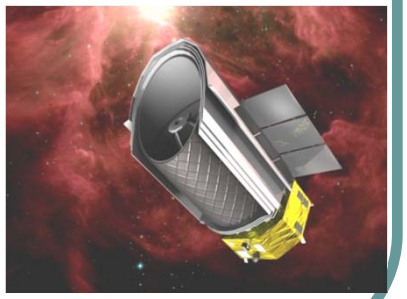
JAXA
Japan Aerospace Exploration Agency

Mission Overview




Unveil the evolution of Matter In the Universe
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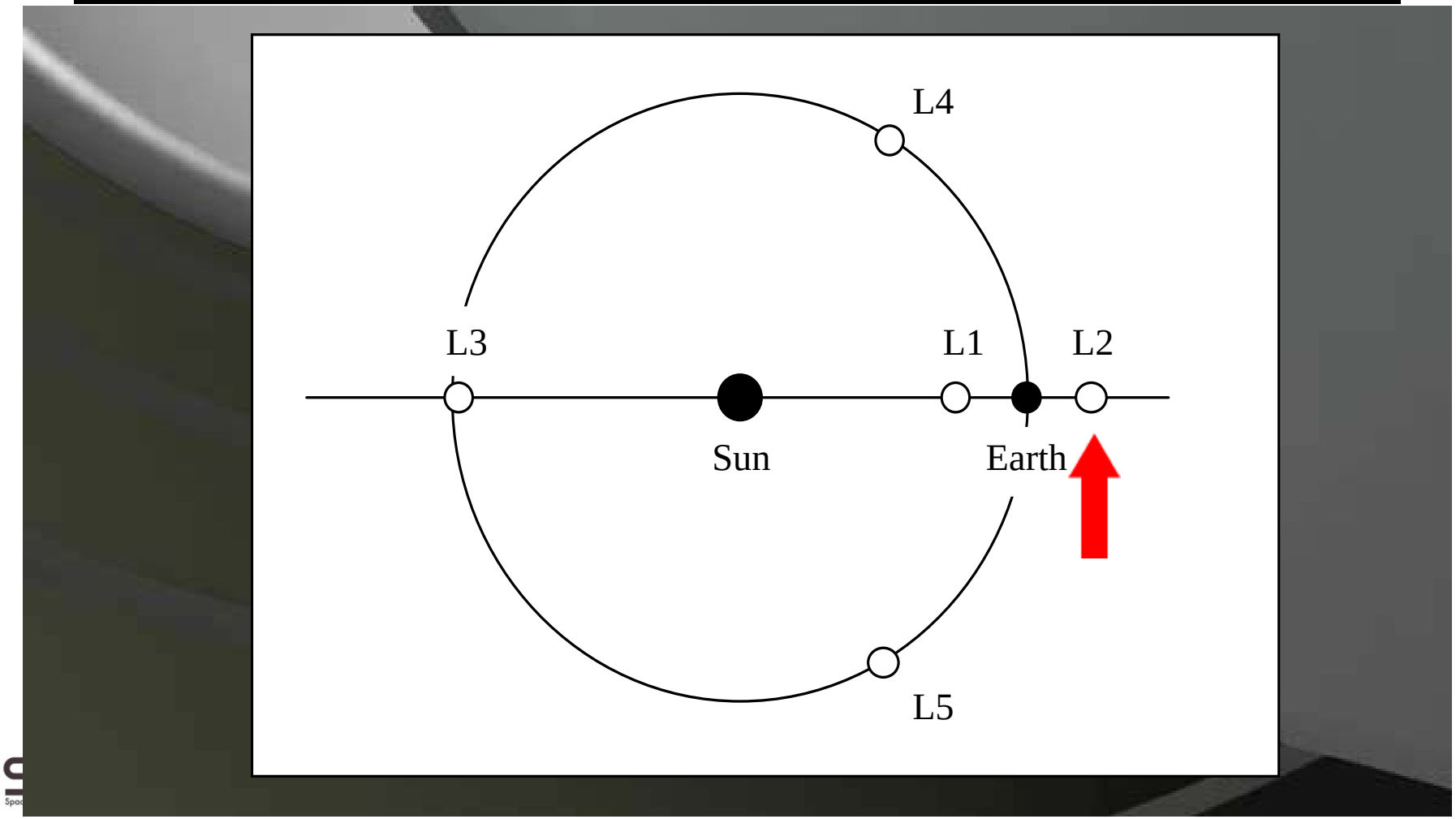
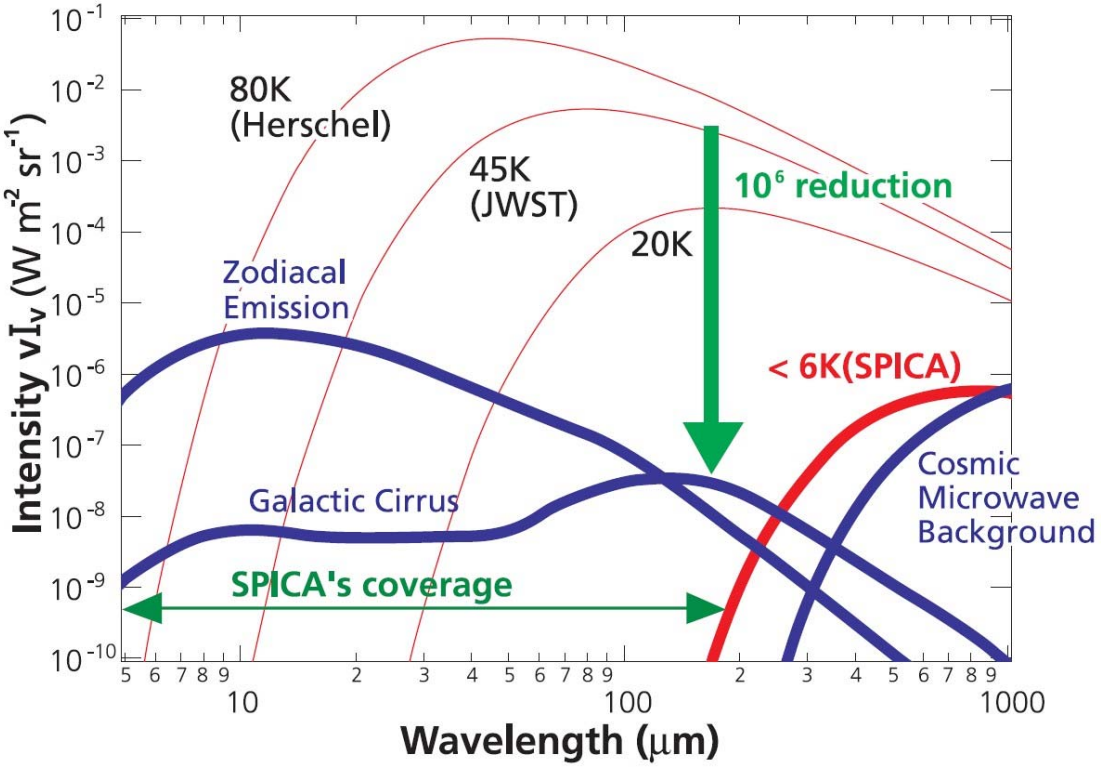
SPICA Mission Overview
•Telescope 3.2m (EPD 3.0m), 6K
•Orbit: Sun-Earth L2 Halo
•Mission Life: 3 years (nominal), 5 years (goal)
•Weight: 3.7 t
•Launch: 2022
• Next-Generation Infrared Space Observatory with superior Sensitivity and good spatial resolution in mid- and Far-IR (5-210μm)
• International Mission
• Japan, Europe, Korea, Taiwan (USA)

SPICA is Japan (Asian)-led space observatory operated in S-E L2 point, 1.5 Million km away



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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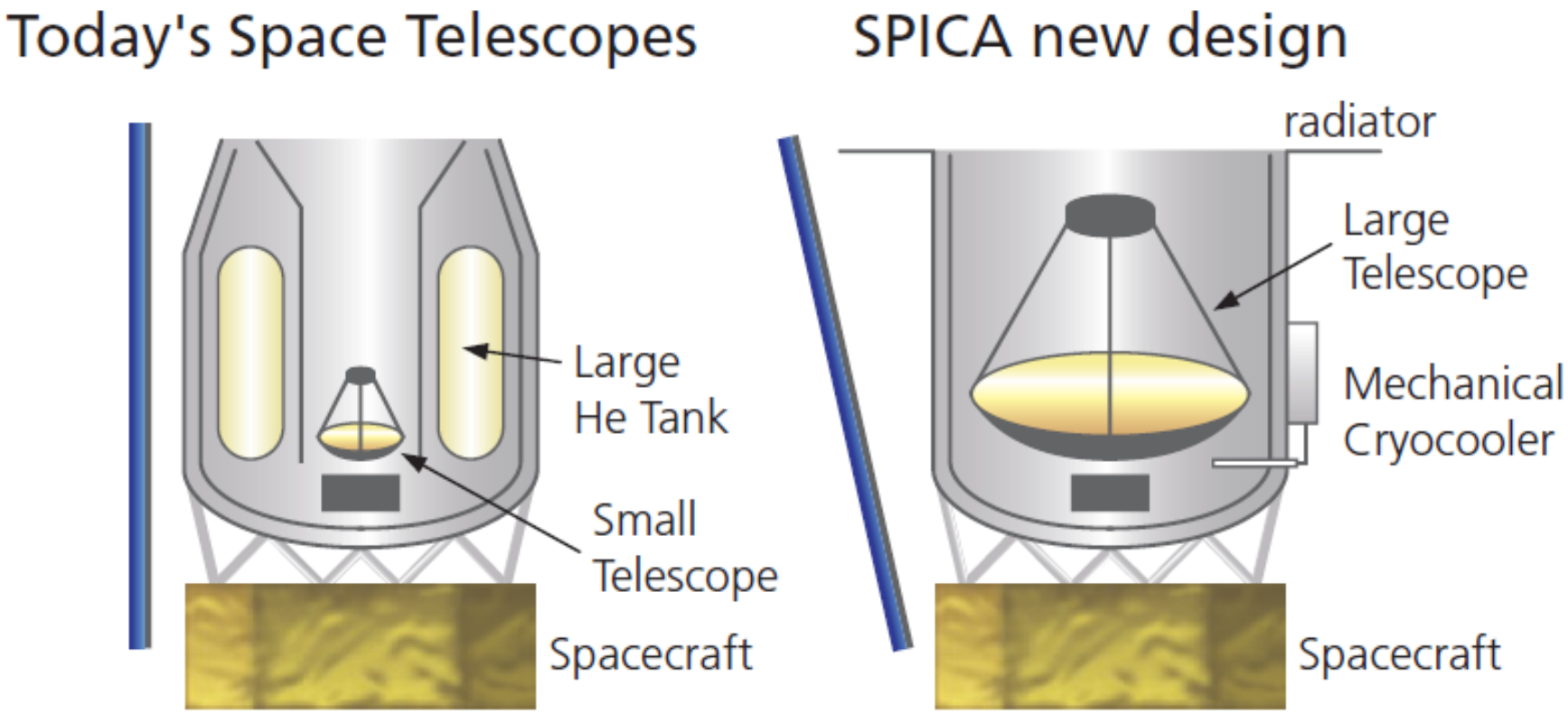
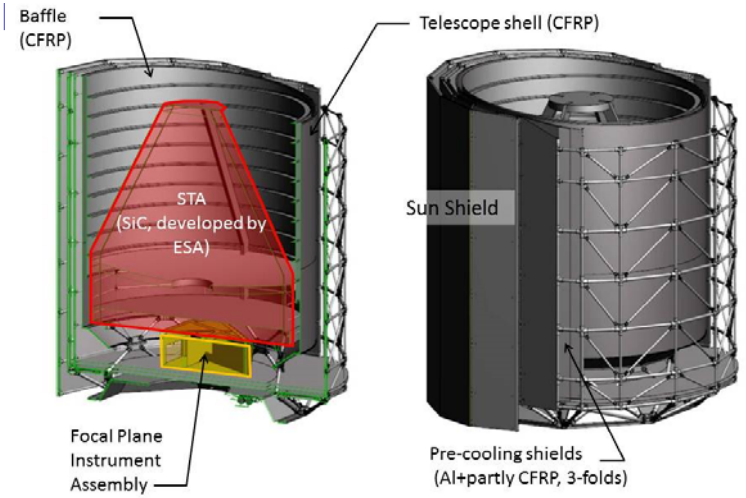
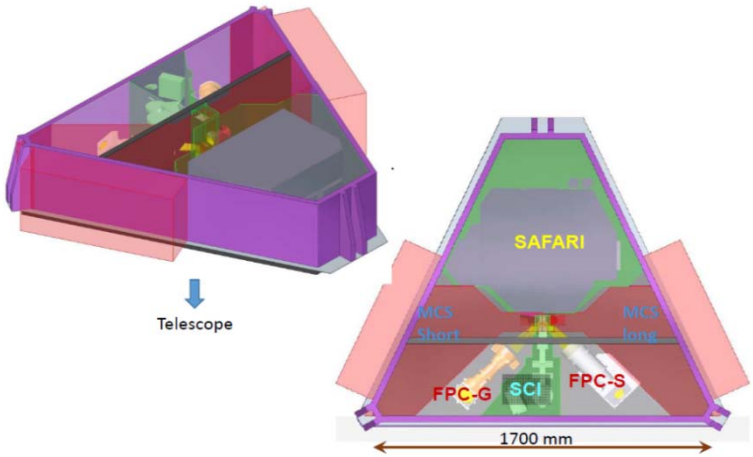
Cryogen-free mission



Lighter and Larger

SPICA Focal Plane Instruments





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

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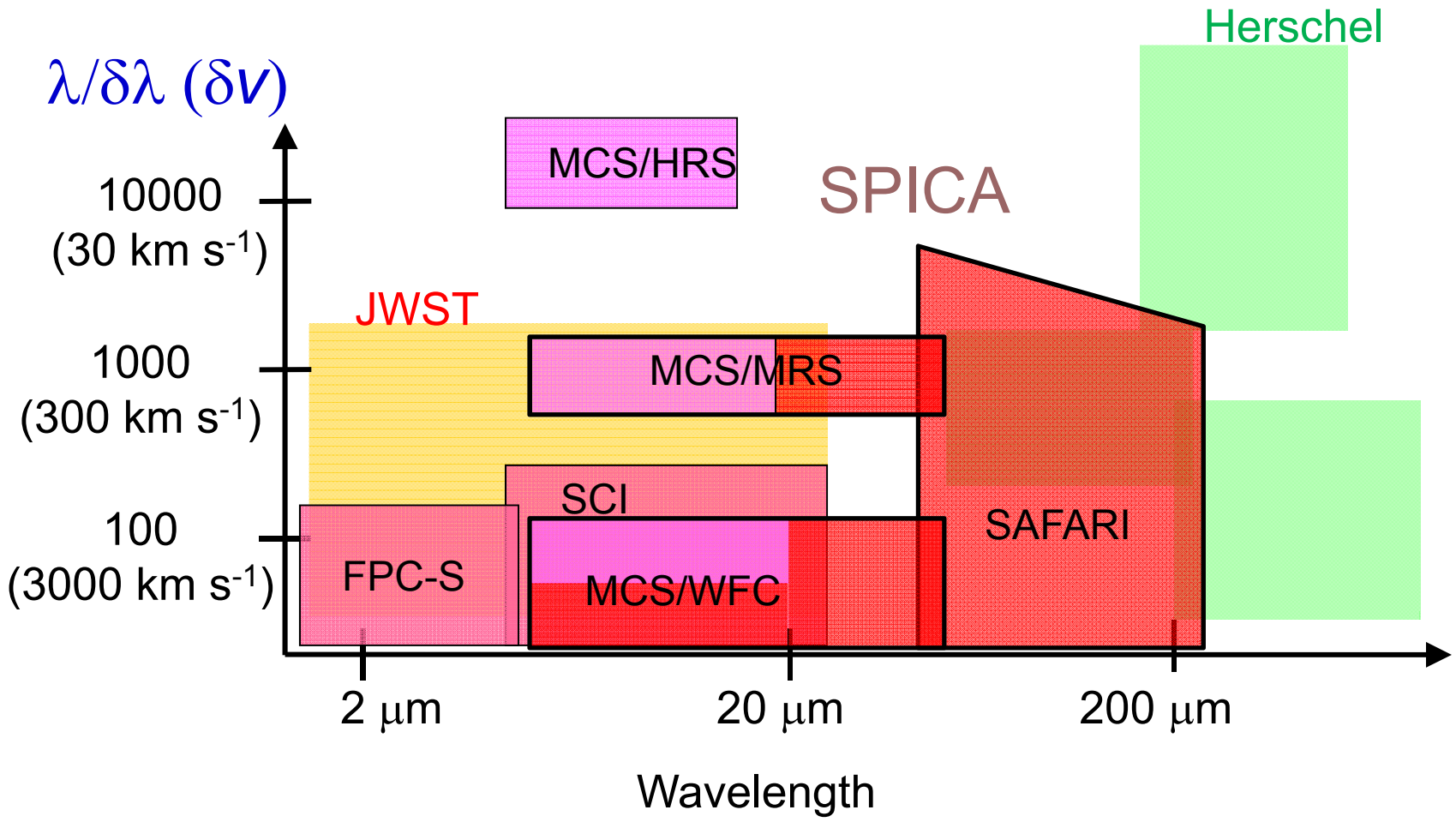
Focal Plane Instruments: baseline
Wavelength coverage vs Resolving Power



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MCS, SAFARI: Mandatory Instrument

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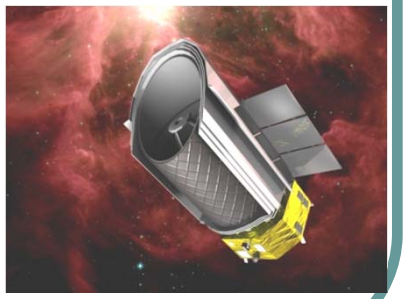
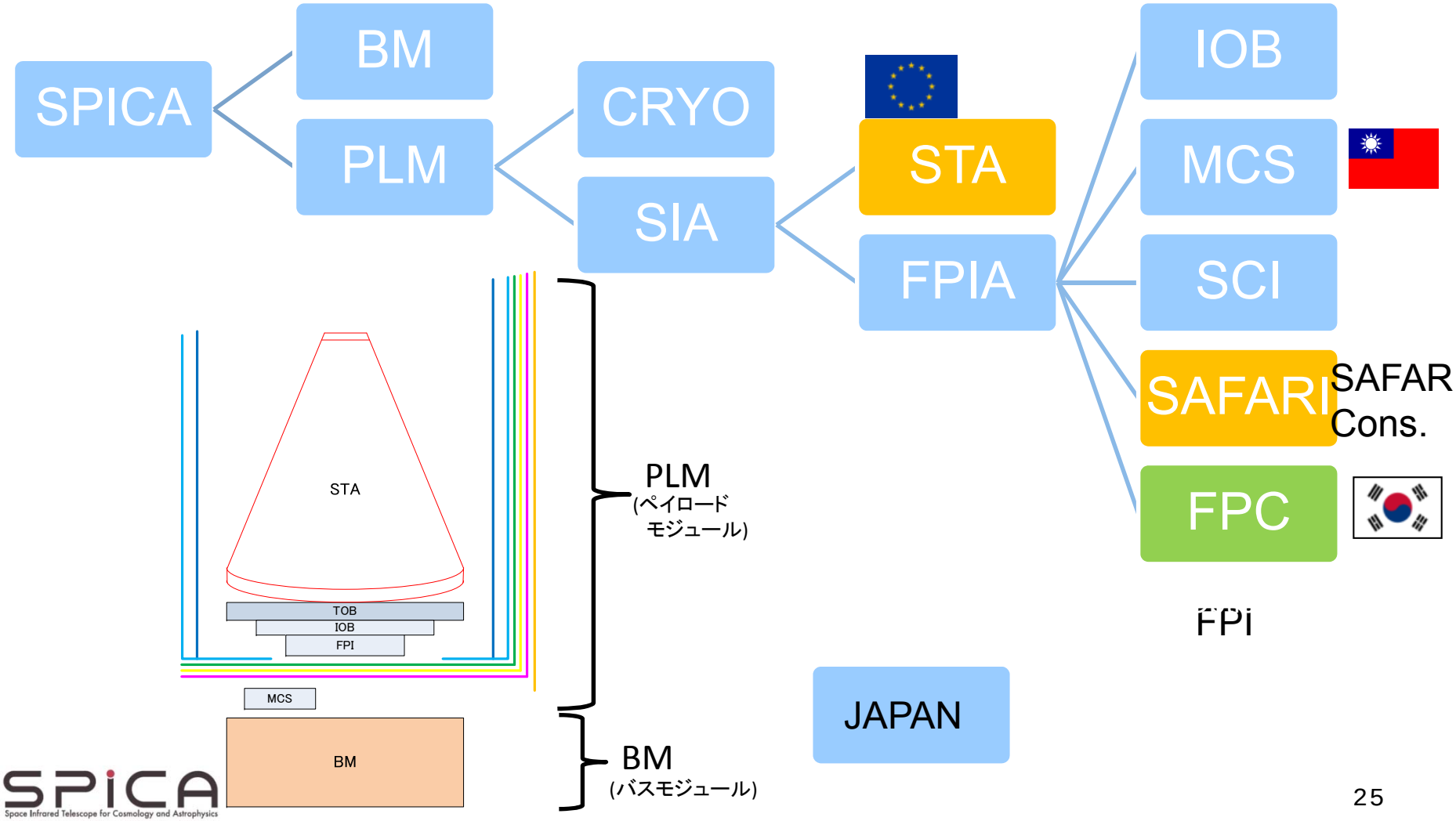
Programmatic Aspects



International Collaboration



SPICA Project Status

- JAPAN (JAXA)
  - Official SPICA Preproject team (Phase A & B1) established in 2008
  - Planning SDR and Phase-up Review (final approval) in FY2013
- ESA
  - Assessment Study completed
  - Supporting I/F definition
- SAFARI Consortium (PI: SRON)
  - SRON got funded ! (90% of that required)
  - Dedicated team has been working actively
- Korea Status (PI KASI)
  - Official Study Team formed with KASI as PI
- Taiwan (PI: ASIAA)
  - Concrete collaboration started.
- US Status (PI: TBD)
  - Assessment Study by 3 teams funded by NASA in 2010
  - Strong recommendation in the US Decadal Survey in 2010

Final Approval Required ! Strong Support by International Community is essential

International SPICA Team

- 17 countries, regions and one International org.

SPICA Space Infrared Telescope for Cosmology and Astrophysics

KAVLI IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

ACADEMIA SINICA

JAXA

esa

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
- The Japanese (Asian)-led international mission with ESA and European countries; international community support is essential !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Space Odyssey