Key Science with SPICA: Planet Formation and Detection

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in *Far-Infrared Astronomy from Space: A Community Workshop about the Future*

Star and Planet Formation / Recycling of Matter / Exoplanet Detection

SPICA Key Science 〜Global Understanding of Planets and their Formation〜

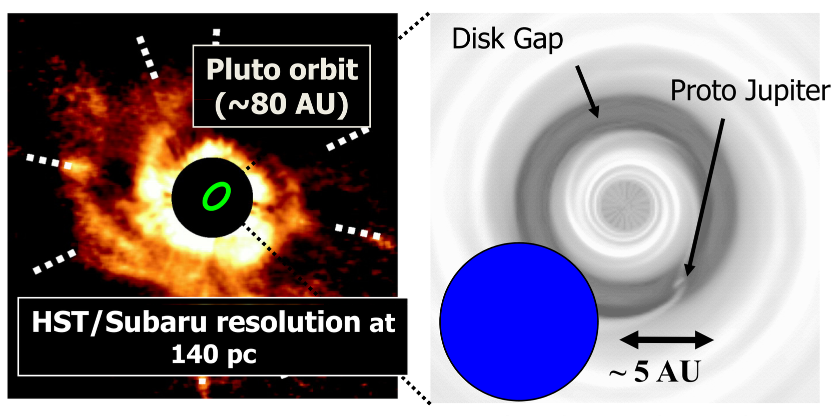
Why Space IR? Why SPICA?
- Low temperature objects and interstellar/circumstellar matters
- numerous molecular bands
- less extinction

Observation Targets
(A) Protoplanetary Disks
(B) Debris Disks
(C) Small Objects in the Solar system
(D) Exoplanets (direct detection)

Study Goals
- Planetary Formation Mechanism
- Planetary systems like our Solar system?
- Water and Organic Matter in exoplanets

Elucidation of origin and cycle of matter in Cosmos that constitutes planets and life!

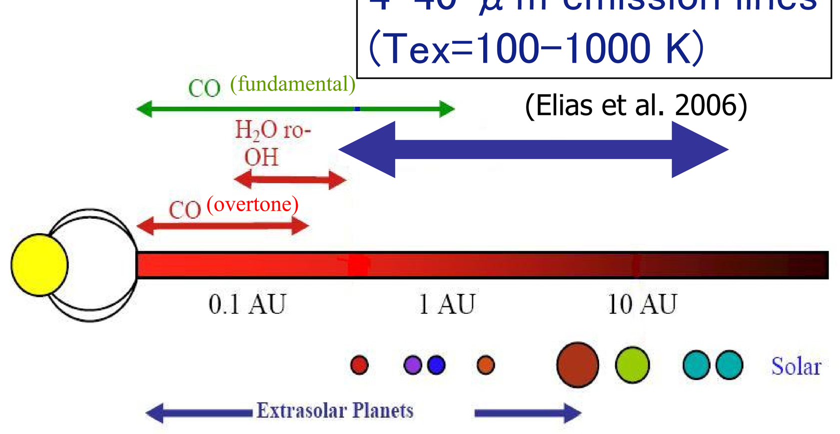
Observations of Protoplanetary Disks

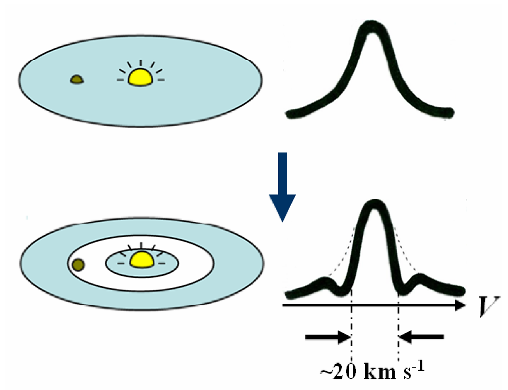


(Bryden et al. 1999)

- Direct observations of the regions whose scale is comparable to the Solar system size (<< 30 AU).

-SPICA will be also equipped with high spectral resolution (R~30000) spectrometer which can trace the emission lines very close to the central star.

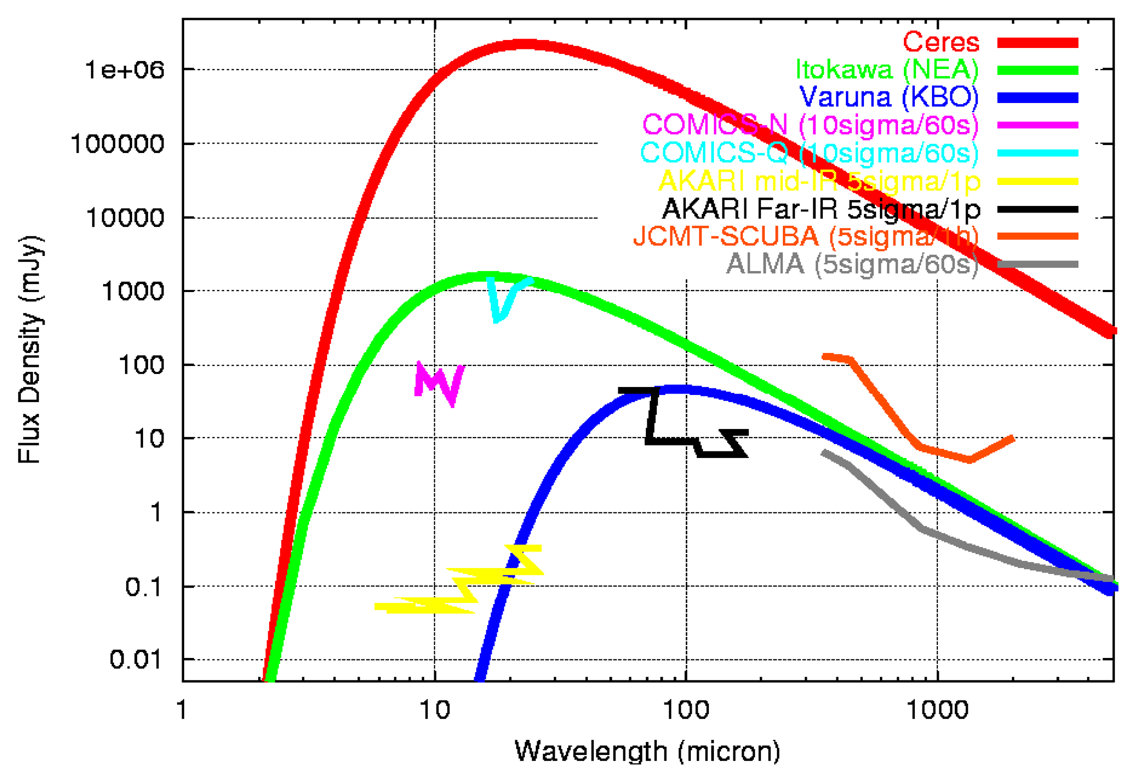




Observations of Solar System Objects

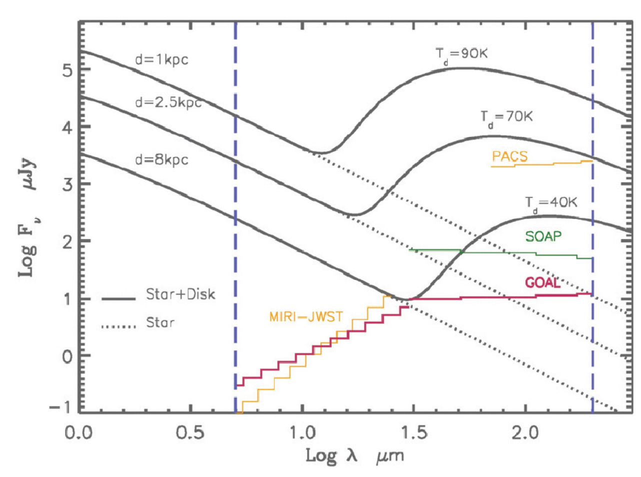
- Determination of size distribution and albedo of small asteroids and EKOs (Edgeworth-Kuiper Belt Objects).
- By covering wide wavelengths, 5-200 um, these critical parameters are well derived.

Where were the planetesimals formed and was the planet formation stopped.
→ providing basic information for planetary formation.



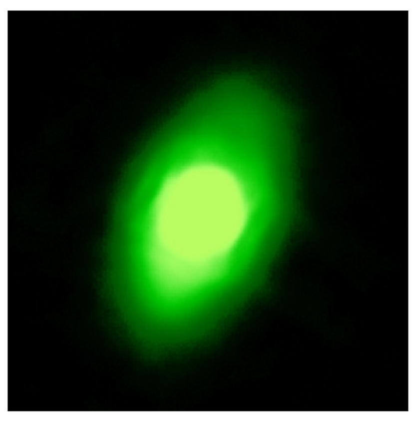
Space/Ground-based telescope sensitivity and SEDs of small objects in the Solar system.

Observations of Debris Disks



The predicted photospheric emission for an A0 (Vega-like) star as a function of wavelength and distance form the Sun. The photometric sensitivity of SPICA, JWST-MIRI and Herschel PACS are shown for comparison along with example disk excesses. A G2 (Solar type) star at 2 kpc would look like an A0 star at 8 kpc.
(from ESA CV SPICA document)

AKARI has detected several new 24 micron excess sources from its all-sky IRC data.



Spitzer MIPS image of Fomalhaut (24 μm)

SPICA enables 10-100 times deeper surveys and ~5 times higher spatial resolution studies.
→ How common is the Solar system?

Direct Detection and Spectroscopy of Exoplanets

SUBARU coronagraph:
- Covering near-infrared wavelengths.
- Suitable for detecting young and outers planets.

SPICA coronagraph:
- Covering mid-infrared wavelengths.
- Benefit from less contrast due to thermal emission.
- Making use of the state-of-the-art coronagraph and wavefront correction with cold MEMS.

Targeting dozens of nearby stars!
Spectroscopy for atmospheric studies (also with transit spectroscopy)
Comparison with our Solar system planets.