P-089

SPICA Mid-Infrared Instrument (SMI)

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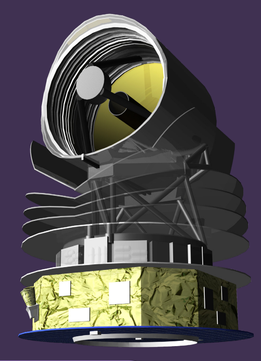


SPICA Mid-infrared Instrument (SMI) is one of the two focal-plane scientific instruments planned for SPICA. SMI covers a wavelength range of 12–36 μm with the three spectroscopic channels: low-resolution spectroscopy (LRS; 17 – 36 μm, plus broad-band camera at 34 μm), mid-resolution spectroscopy (MRS; 18 – 36 μm), and high-resolution spectroscopy (HRS; 12 – 18 μm).

SMI specifications

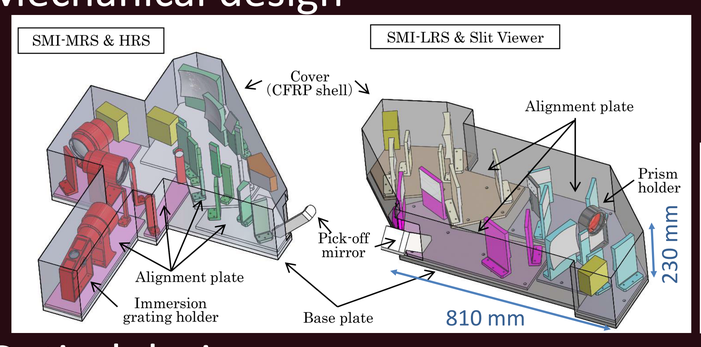
➢LRS: prism (4 slits, 10’ long, R~100), combined with a 10’x12’ slit viewer. High-speed dust-band mapping.

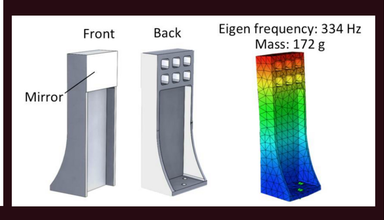
➢MRS: Echelle grating with a cross-disperser (1’ long, R~2000), combined with a beam-steering mirror. High-sensitivity multi-purpose spectral mapping.

➢HRS: CdZnTe immersion grating (R~30000), realizing compact optics. High-resolution molecular-gas spectroscopy.

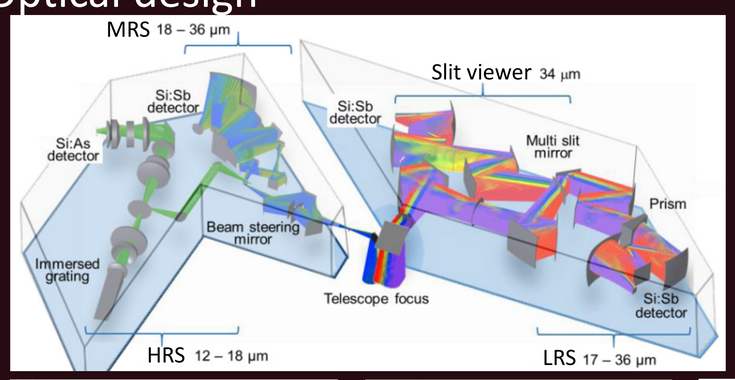
Parameter	LRS	Slit viewer for LRS	MRS	HRS
Band center - μm	27	34	27	15
Wavelength - μm	17 – 36	34	18 – 36	12 – 18
Spectral resolution *R* (diffuse source)	50 – 120 (20 – 110)	5	1300 – 2300 (1100 –1400)	28000
Field of view	600” x 3.7” 4 slits	600” x 720”	60” x 3.7” 1 slit	4”x1.7” 1 slit
Band centre FWHM	2.7”	3.5”	2.7”	2”
Pixel scale	0.7” x 0.7”	0.7” x 0.7”	0.7”	0.5”
Detector 1K x 1K	Si:Sb	Si:Sb	Si:Sb	Si:As
Point source sensitivity				
Continuum - Jy	50	13	400	1500
Line - 10^{-20} W/m^2	8		4	1.5
Survey speed - arcmin^2/hr	~16 (100 μJy @ 30 μm)	~5900 (100 μJy @ 30 μm)	~1.5 (3×10^{-19} W/m^2 @ 28 μm)	
Diffuse source sensitivity (5σ, 1 hr)				
Continuum - MJy/sr	0.05	0.05		
Line - 10^{-10} W/m^2/sr			1	1.5
Saturation limit - Jy	~20	~1	~1000	~20000

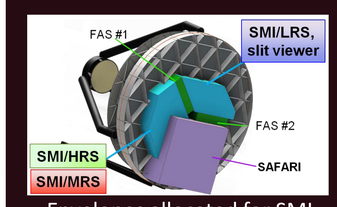
Mechanical design



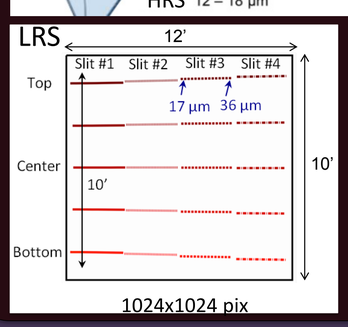


Optical design





Envelopes allocated for SMI



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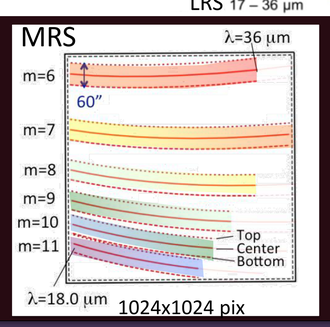

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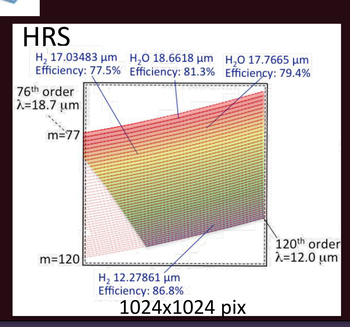

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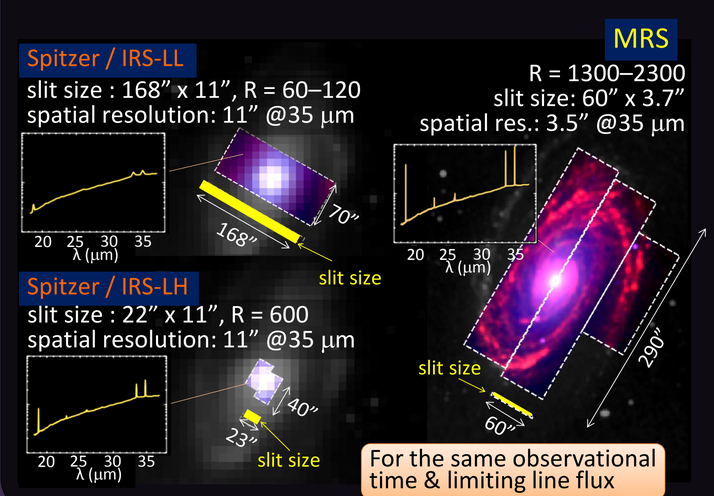
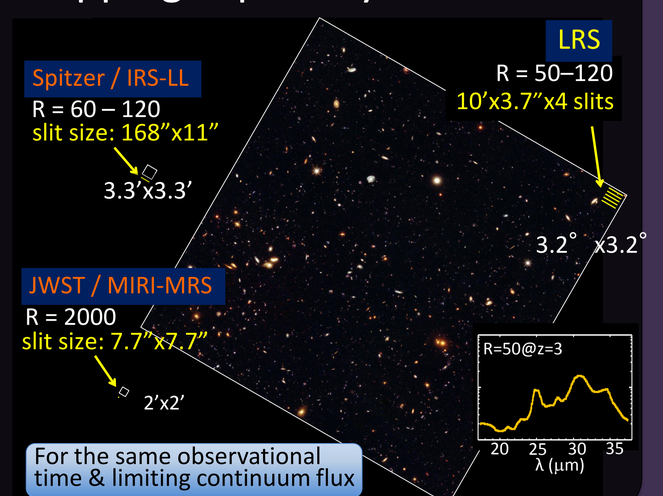
Demonstration of SMI mapping capability

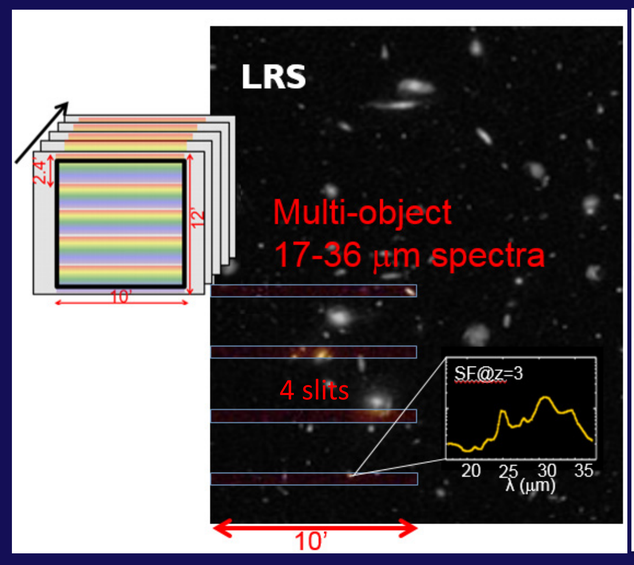




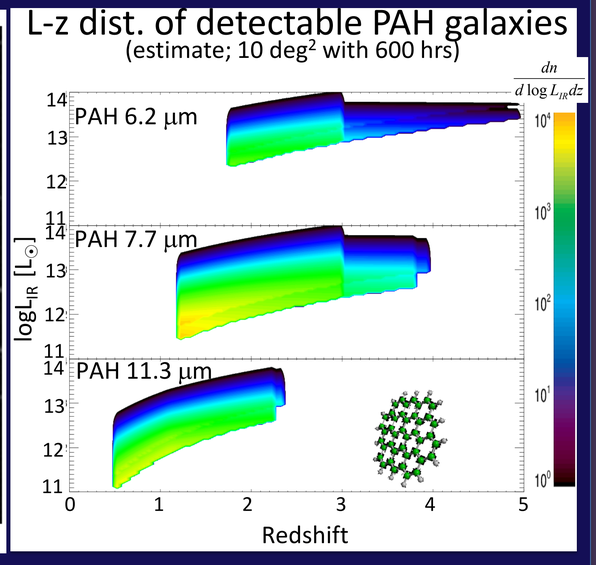
SMI key sciences

LRS surveys will detect organic matters (PAHs) from many high-z galaxies and minerals from many planet-forming disks, while MRS will characterize them. HRS will characterize molecular gases and resolve their velocities in planet-forming disks.

PAH galaxy survey in the Universe



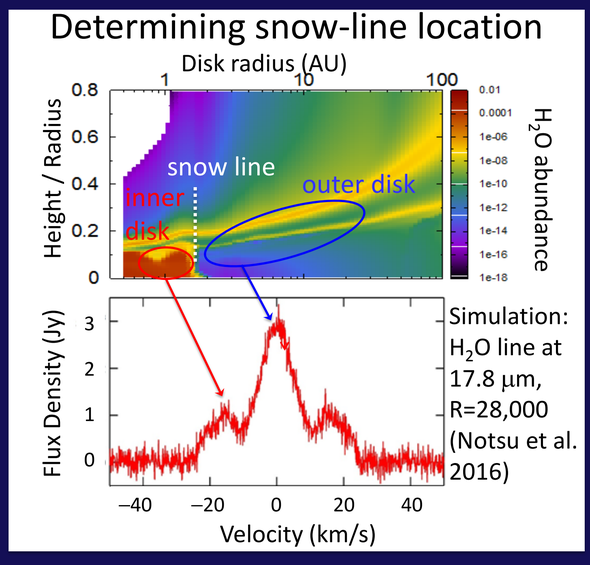
L-z dist. of detectable PAH galaxies
(estimate; 10 deg^2 with 600 hrs)



Wide area spectroscopic survey with LRS (10 deg^2; 600 hrs)
⇒ Detection of ~50000 PAH galaxies at z up to 5
⇒ Diagnosis of PAH galaxies,
& provision of targets for MRS and SAFARI
⇒ Characterization of PAH galaxies in the Universe

Protoplanetary/debris disks to our Solar system

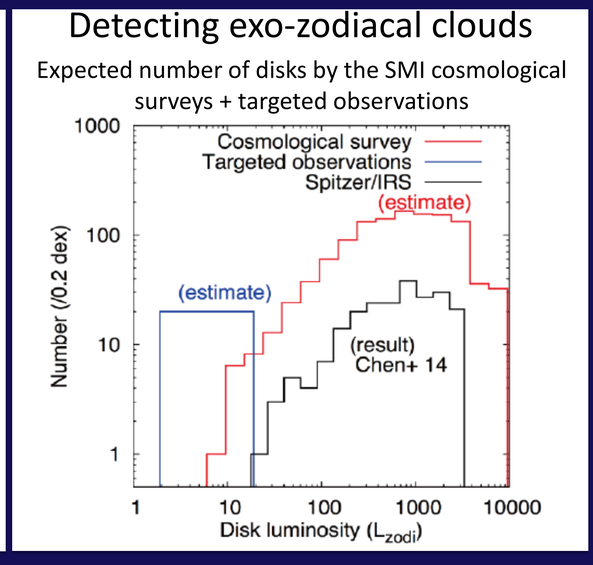
Determining snow-line location



Simulation: H_2O line at 17.8 μm, R=28,000 (Notsu et al. 2016)

Detecting exo-zodiacal clouds

Expected number of disks by the SMI cosmological surveys + targeted observations



High-resolution spectroscopy with HRS
⇒ Planet formation and evolution by probing gas dispersal, determining snow-line location
Wide area survey and targeted observations with LRS
⇒ Debris disks down to levels close to our Solar system.