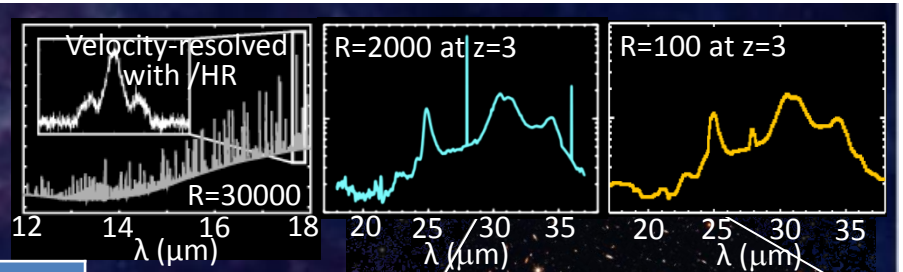
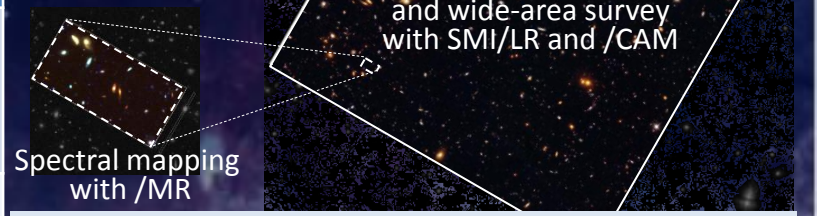
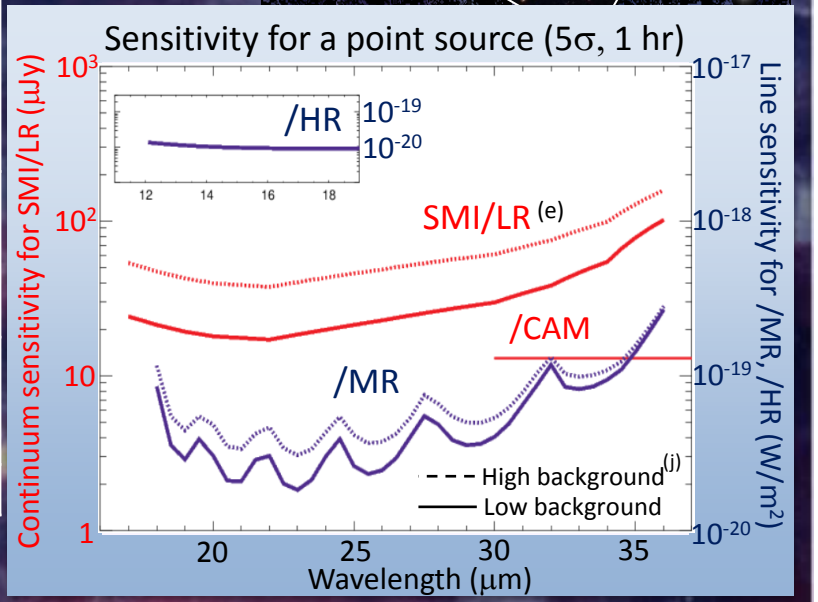
# SPICA / SMI Fact Sheet

SPICA Mid-infrared Instrument (SMI) covers the wavelength range of 12–36 μm with four channels: spectroscopy (SMI/LR, /MR, /HR) and imaging (/CAM).




| Parameter | SMI /LR | /CAM Slit viewer for SMI /LR | /MR | /HR |
|---|---|---|---|---|
| Band centre - μm | 27 | 34 | 27 | 15 |
| Wavelength - μm | 17 – 36 | 34 | 18 – 36 | 12 – 18 (a) |
| Spectral resolution *R* | 50 – 150 (b) | 5 | 1300 – 2300 (b) | 33000 (c) |
| (diffuse source) | (20 – 110) | | (1100-1400) | |
| Field of view | 600" x 3.7" | 600" x 720" | 60" x 3.7" | 4" x 1.7" |
| | 4 slits | | 1 slit | 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" | 0.7" |
| Detector 1K x 1K | Si:Sb | Si:Sb | Si:Sb | Si:As |
| Point source sensitivity (5 σ/1 hr)(d) | | | | |
| Continuum - μJy | 25 (e) | 13 | 280 (e) | 1400 (e) |
| Line - $10^{-20}$ W/m$^2$ (f) | 5 | | 2.8 | 1.0 |
| Survey speed - arcmin$^2$/hr (g) | ~28 | ~4500 | ~1.8 | |
| Diffuse source sensitivity (5σ/1 hr)(d)(h) | | | | |
| Continuum - MJy/sr | 0.04 | 0.05 | | |
| Line - $10^{-10}$ W/m$^2$/sr | | | 0.6 | 1.5 |
| Saturation limit – Jy | ~20 | ~1 | ~1000 | ~20000 |




(a) continuous coverage up to 18.1 μm + partial coverage for $H_2O$ 18.66 μm.
(b) λ/δλ = 150 (SMI/LR) and 1300 (/MR) at λ = 36 μm.
(c) designed for λ20 μm diffraction limited PSF.
(d) sensitivity estimated with Fowler-16 sampling for SMI/LR and /CAM (0.5 Hz), and with ramp curve sampling for /MR (0.5 Hz) and /HR (1 Hz sampling).
(e) continuum sensitivity rescaled with R = 50, R = 1300, and R = 25000 for SMI/LR, /MR and /HR, respectively.
(f) sensitivity for an unresolved line.
(g) survey speed for the 5 σ detection of a point source with the continuum flux of 100 μJy for SMI/LR at λ = 30 μm (/CAM at 34 μm) and the line flux of $3x10^{-19}$ W/m$^2$ for /MR at λ = 28 μm, both in the low background case with overheads of readout time included (32 sec/frame for SMI/LR and /CAM due to Fowler-16 sampling).
(h) sensitivity for a diffuse source in a 4" x 4" (SMI/LR , /MR) or 2" x 2" area (/HR).
(i) background levels are assumed to be 80 MJy/sr (High) and 15 MJy/sr (Low) at 25 μm.

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# How to make spectral mapping with SMI

15 May, 2019

- Slit length

  LR: 10 arcmin (very long) x 4 slits, MR: 1 arcmin (long),
  HR: 4 arcsec (short)

- Stepwise scan perpendicular to the slit direction

- Recommendation for the step size:

  overlap of each FoV by half a slit width.

  1.9 arcsec for LR, MR. 0.9 arcsec for HR.

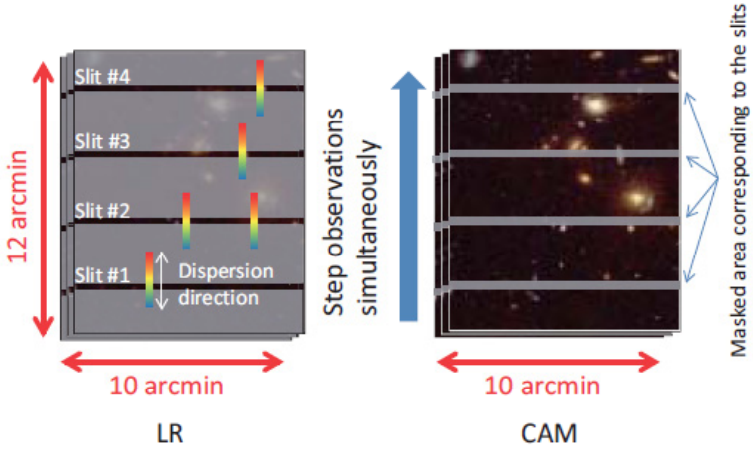
- In order to estimate the total time required for mapping, the observational efficiency of 70% should be considered,

  which accounts for time losses due to
  maneuver (+ telescope stabilization),
  Fowler sampling (only applicable to LR, CAM),
  thermal annealing (+ detector warming-up) before starting each SMI campaign,
  calibration, and so on.

# LR spectral mapping

- CAM needs to be operated simultaneously, which works as a slit viewer for LR. (CAM data are valuable not only technically for LR spectral image reconstruction, but also scientifically.)

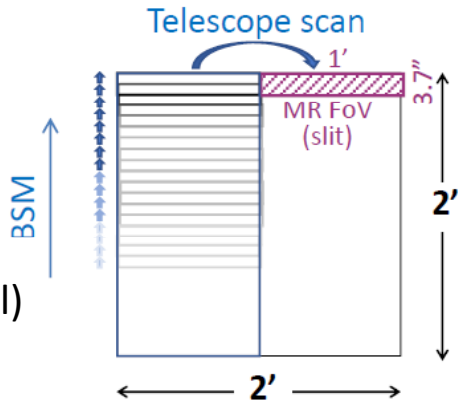
- Telescope (spacecraft) scan with 95 steps is needed (i.e., inter-slit 3 arcmin divided by half a slit width 1.9 arcsec) to cover 10 x 12 arcmin$^2$ area.




- Example: 12 x 10 arcmin$^2$ in 2 hrs

  LR on-source time: 2 hrs/95 x 1.5 (50% overlap) = 114 sec
  sensitivity: 260 μJy (see the last slide)
  CAM on-source time: 2 hrs, sensitivity: 9 μJy

# MR spectral mapping




- 1-D Beam Steering Mirror (BSM) is used.
- BSM scan with 32 steps is needed to cover 1 x 1 arcmin$^2$ area.
  BSM full stroke: ±0.5 arcmin (nominal), ±1 arcmin (goal)

- Example: 1 x 1 arcmin$^2$ in 1 hr
  MR on-source time: 1 hr/32 x 1.5 (50% overlap) = 169 sec
  sensitivity: 2x10$^{-19}$ Wm$^{-2}$ (see the last slide)

- Example: 1 x 1 arcmin$^2$ in 10 min
  MR on-source time: 10 min/32 x 1.5 = 28 sec (3x10$^{-18}$ Wm$^{-2}$)

# HR spectral mapping

- 1-D Beam Steering Mirror (BSM) is used. Due to the short slit, only 1-D spectral mapping is obtained with BSM.

# Sensitivity as a function of time