Mid-Infrared Camera w/wo LEEns (MIRACLE) for SPICA

preliminary design

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Mid-Infrared Camera for SPICA

direct successor of AKARI/IRC and Spitzer/IRAC

- continuous coverage in 5-40 um (or longer)
- diffraction limited angular resolution
- wide field of view for large area survey
- low resolution spectroscopic survey
  - slit-less spectroscopy
  - long-slit spectroscopy
Specifications

Mid-Infrared Camera w/wo LEns (MIRACLE) for SPICA is aimed for wide field imaging and low resolution spectroscopy

<specifications>

wavelength 5-38um
spectral resolution 5-200
FOV 6’x6’ x 2

Observational mode broad band imaging (bandpass filters)
slit-less and slit spectroscopy (grism)
detector Si:As 1Kx1K (5-20um)
Si:Sb 1Kx1K (20-38um)

*options
refractive optics design is done.
reflective optics design is underway.
number of filters and grisms are under discussion.
field mask changer (wheel) is considered to enable long-slit spectroscopy.
dichroic mirror may be installed for each FOV for multiple detectors.
BIB detectors sensitive in wavelength over 38um are studied.
Mid-Infrared Camera for SPICA will provide imaging and low resolution spectroscopy at 5-38um
c.f. JWST/MIRI has small (1.3’x1.7’) FOV
FOV
optical configurations

features

- Filter wheel at the pupil position
  - both imaging and spectroscopic observation
- Field mask wheel at the focal plane
  - optimal mask for slit-spectroscopy
optical design with lens

- Trial optical design has been done.
- compact optics maybe achieved.
- wide band width maybe be difficult to be achieved.
  - lack of mature optical material in these wavelength
  - AR coating maybe difficult (ghost image)
optical design without lens

(Chan and Prata 2005; Chan et. al. 2006)
slit-less or slit spectroscopy

An example of slit-less and slit spectroscopic images obtained by AKARI/IRC. AKARI/IRC is equipped with a small slit in its field mask.
field mask wheel

field mask wheel is considered.

optimal field mask can be used for each observational mode.
optical configurations

- dichroic beam splitter
  - observational efficiency
better sensitivity than JWST/MIRI over 18um
(cryogenic optics)
Survey speed

Point source Sensitivity (5 sigma) for 6x6 arcmin field with 3600 sec total observational time

- **SPICA MIR CAM (FOV=6x6 arcmin)**
- **JWST MIRI (FOV=1.7x1.3 arcmin)**

- Faster mapping speed than JWST/MIRI in all band (larger field of view)
Confusion noise
trade-off

- FOV or sampling
  - 1K x 1K pixels
  - 3’x3’ FOV with 0.18”/pixel (6um Nyquist sample)
  - 6’x6’ FOV with 0.36”/pixel (12um Nyquist sample)

- Slit changer or fixed (and small slit)?

- Slit spec. mapping or narrow band imaging?

- needs for wavelength coverage at 38-50um
technical challenge

optical filters over 30um

dichroic mirror covers 5-40um

reliable slit-wheel mechanism

reflective optical design