Mid-InfRAred Camera w/wo LEns (MIRACLE) for SPICA

preliminary design

SPICA/MIRACLE team
Takehiko WADA (ISAS/JAXA)
wada@ir.isas.jaxa.jp

Mid-Infrared Camera for SPICA

direct successor of AKARI/IRC and Spitzer/IRAC

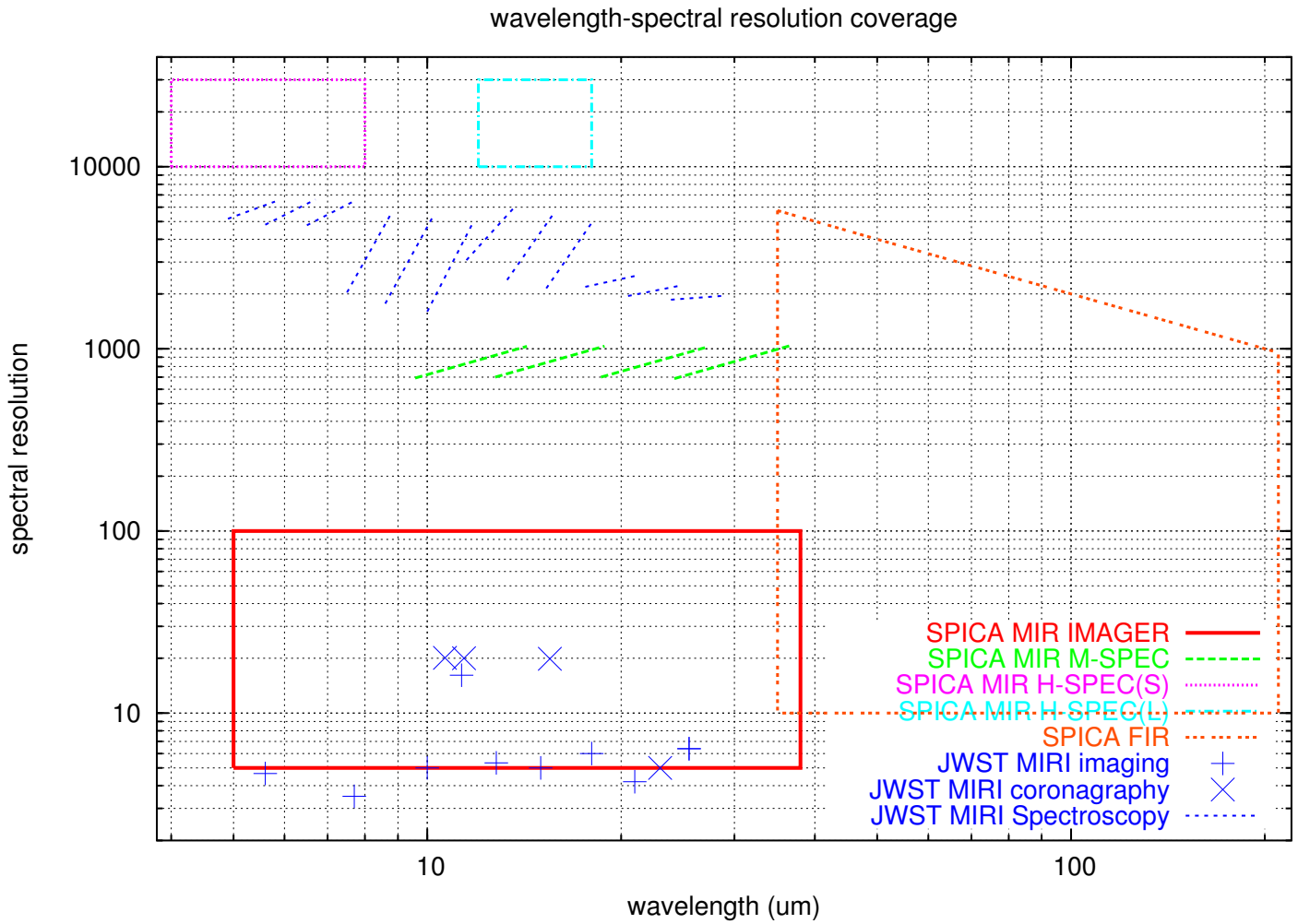
- continuous coverage in 5-40 um (or longer)
- diffraction limited angular resolution
- wide field of view for large area survey
- low resolution spectroscopic survey
  - slit-less spectroscopy
  - long-slit spectroscopy

Specifications

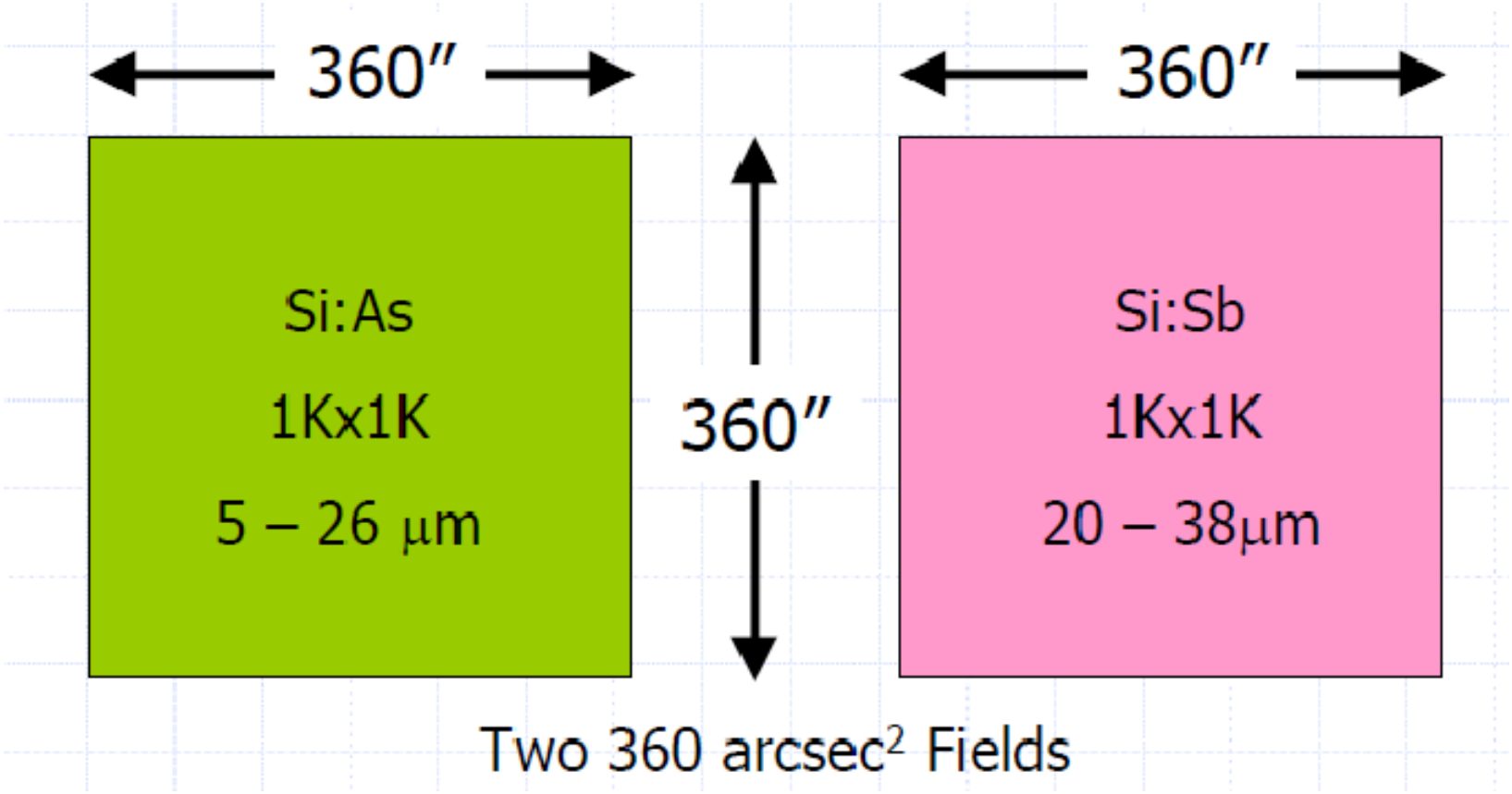
Mid-InfRAred Camera w/wo LEns (MIRACLE) for SPICA
is aimed for wide field imaging and low resolution spectroscopy
<specifications>
wavelength 5-38um
spectral resolution 5-200
FOV 6'x6' x 2
Observational mode broad band imaging (bandpass filters)
slit-less and slit spectroscopy (grism)
detector Si:As 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

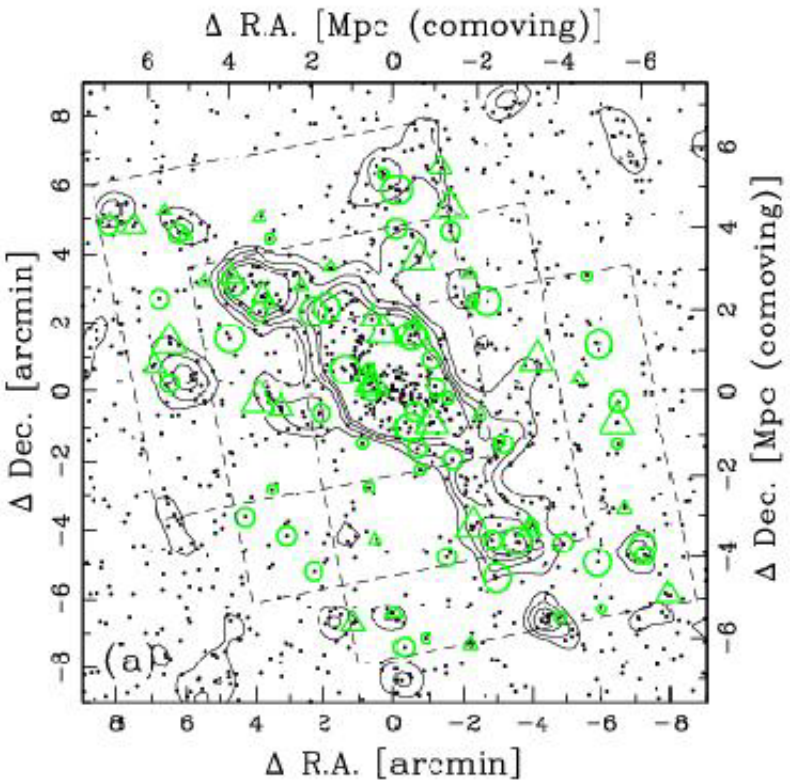


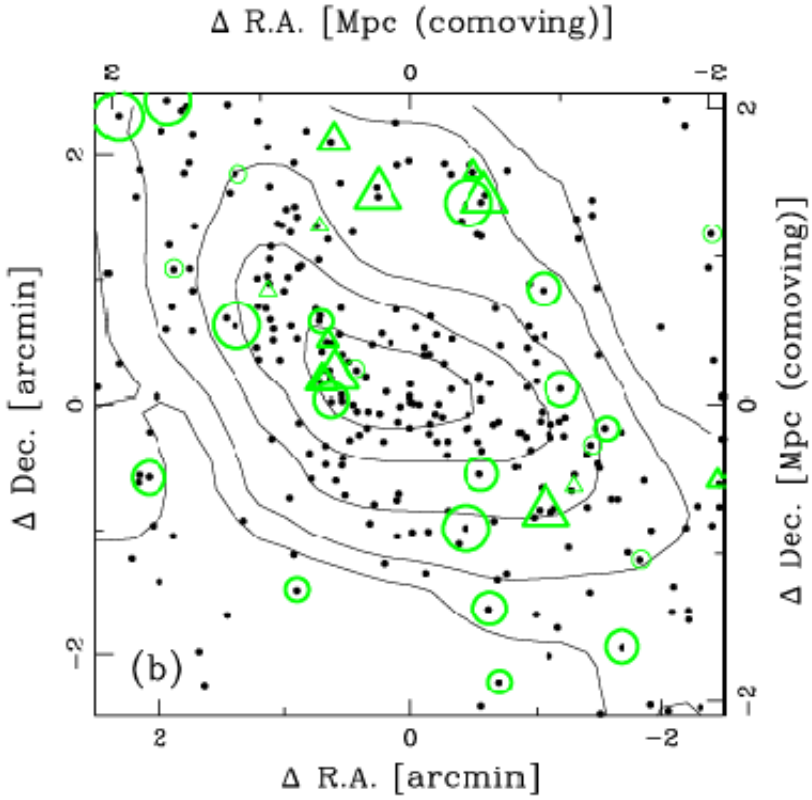
FOV



c.f. JWST/MIRI has small (1.3'x1.7') FOV

FOV

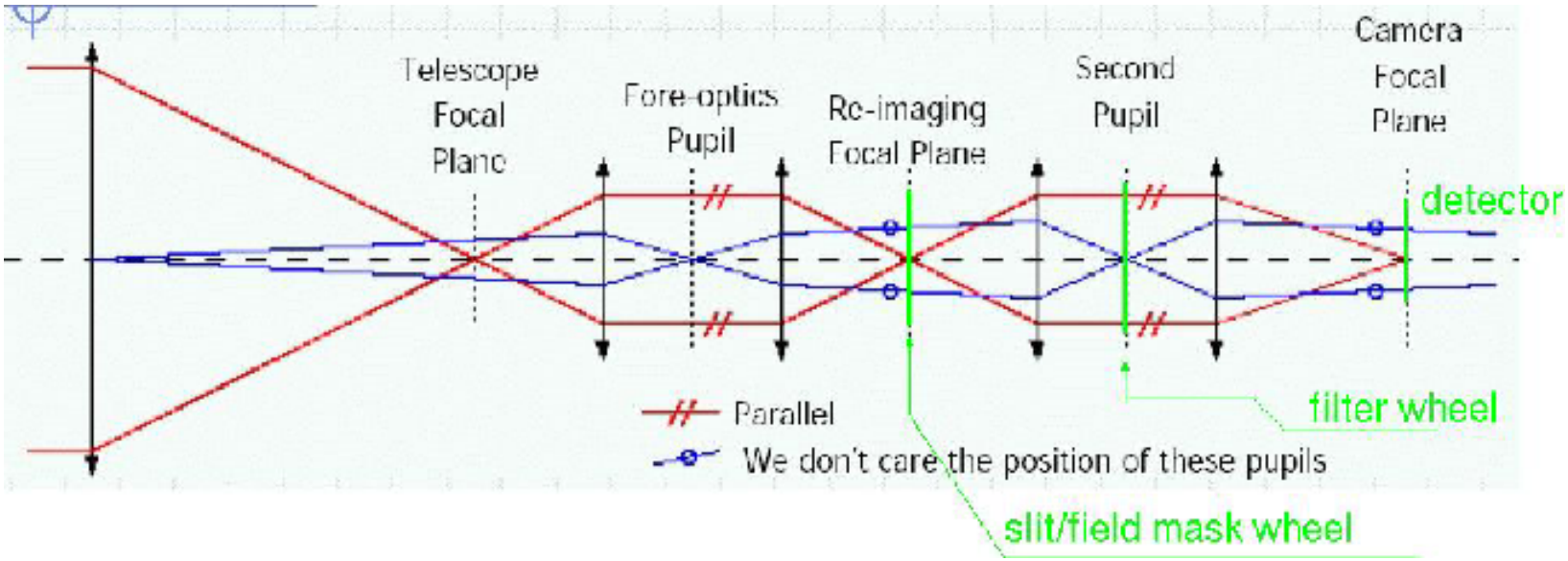




trace SF activity in cluster using rest frame 8um feature at z=1-3

(Koyama et. al. 2008)

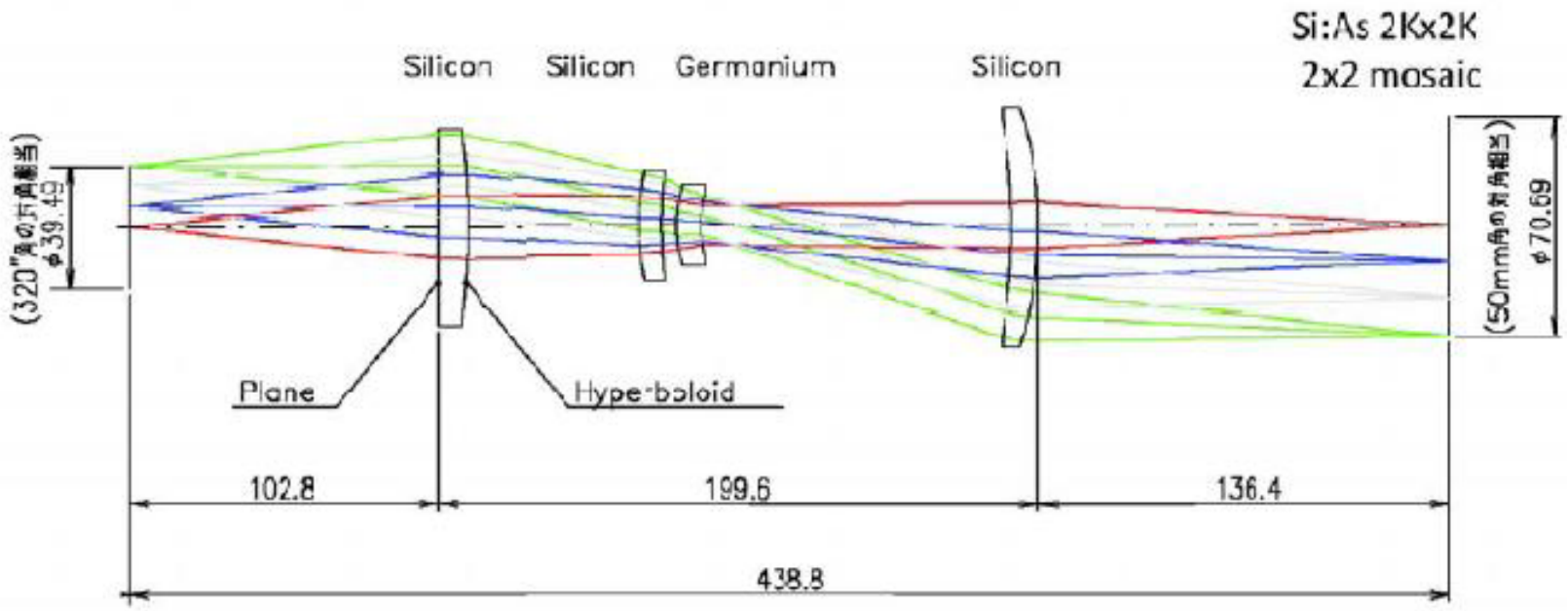
optical configurations



features

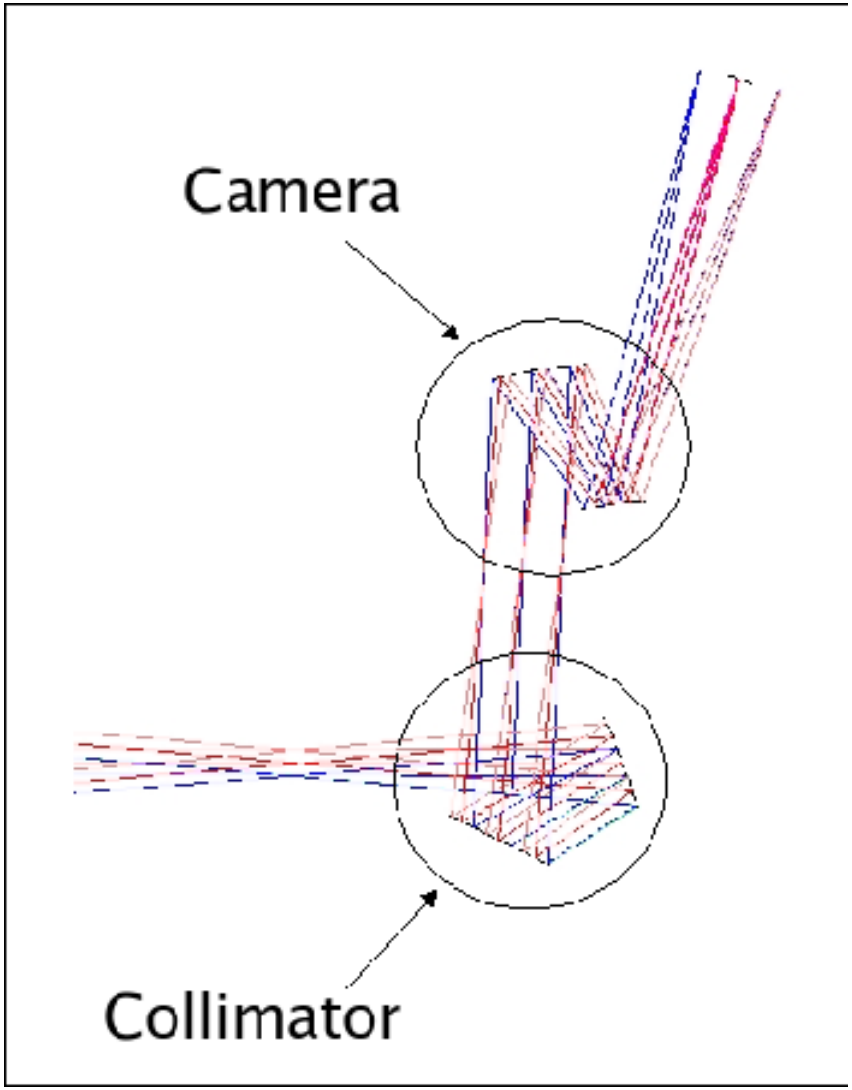
- Filter wheel at the pupil position
  - both imaging and spectroscopic observation
- field mask wheel at the focal plane
  - optimal mask for slit-spectroscopy

optical design with lens



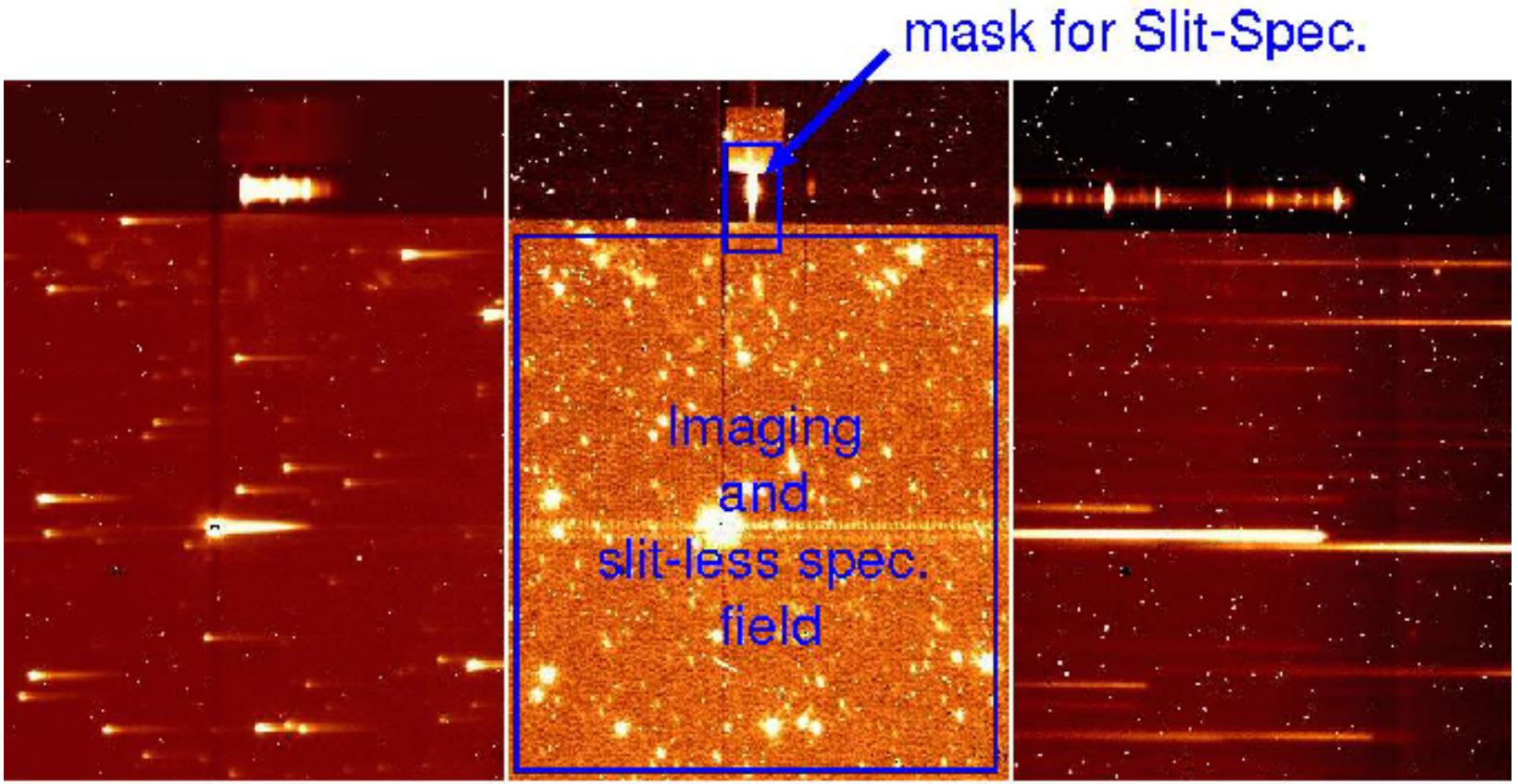
- Trial optical design has been done.
- compact optics maybe achieved.
- wide band width maybe be difficult to be achieved.
  - lack of mature optical material in these wavelength
  - AR coating maybe difficult (ghost image)

optical design without lens



(Chan and Prata 2005; Chan et. al. 2006)

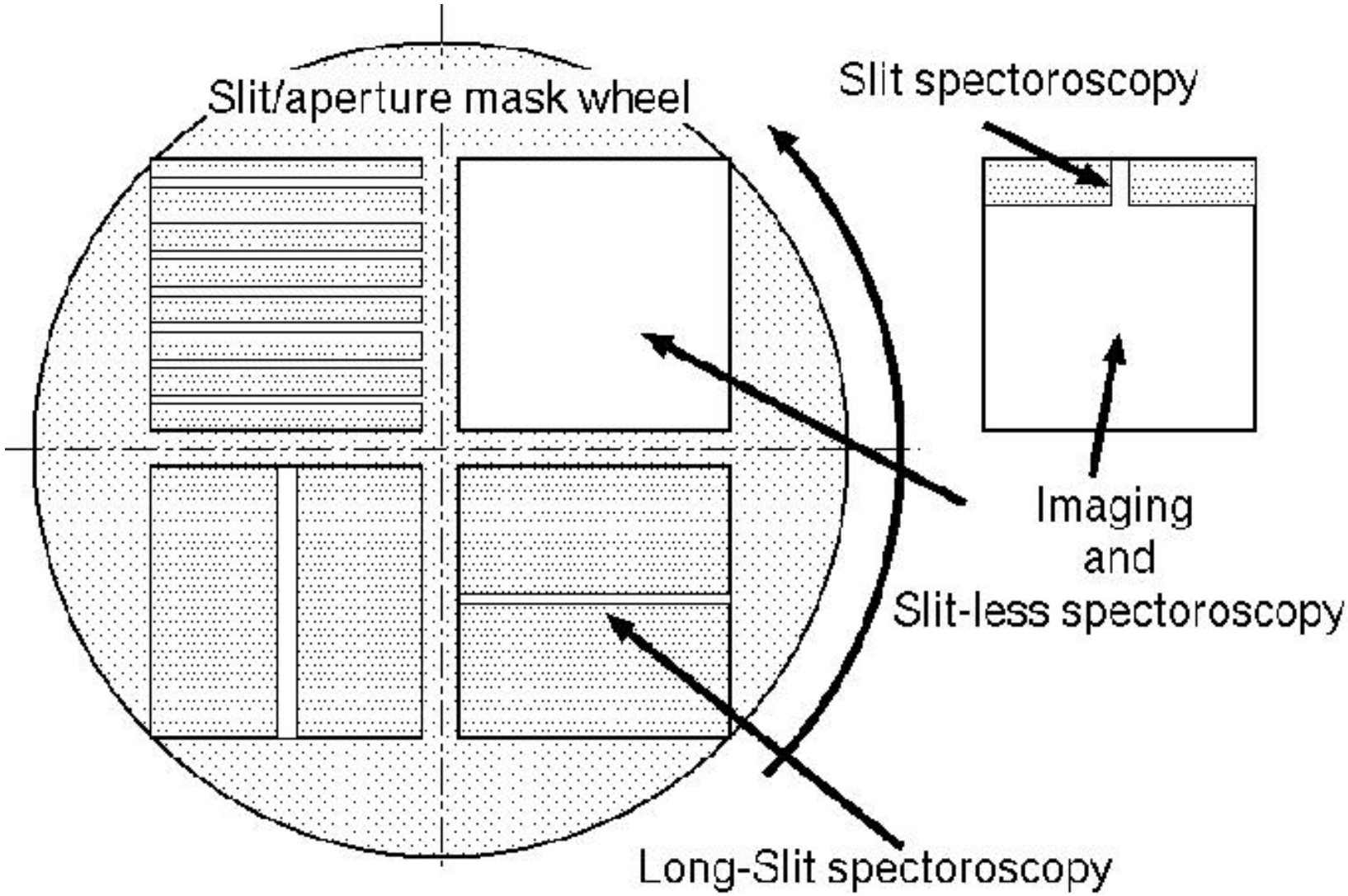
slit-less or slit spectroscopy



An example of slit-less and slit spectroscopic images obtained by AKARI/IRC.

AKARI/IRC is equiped with a small slit in its field mask.

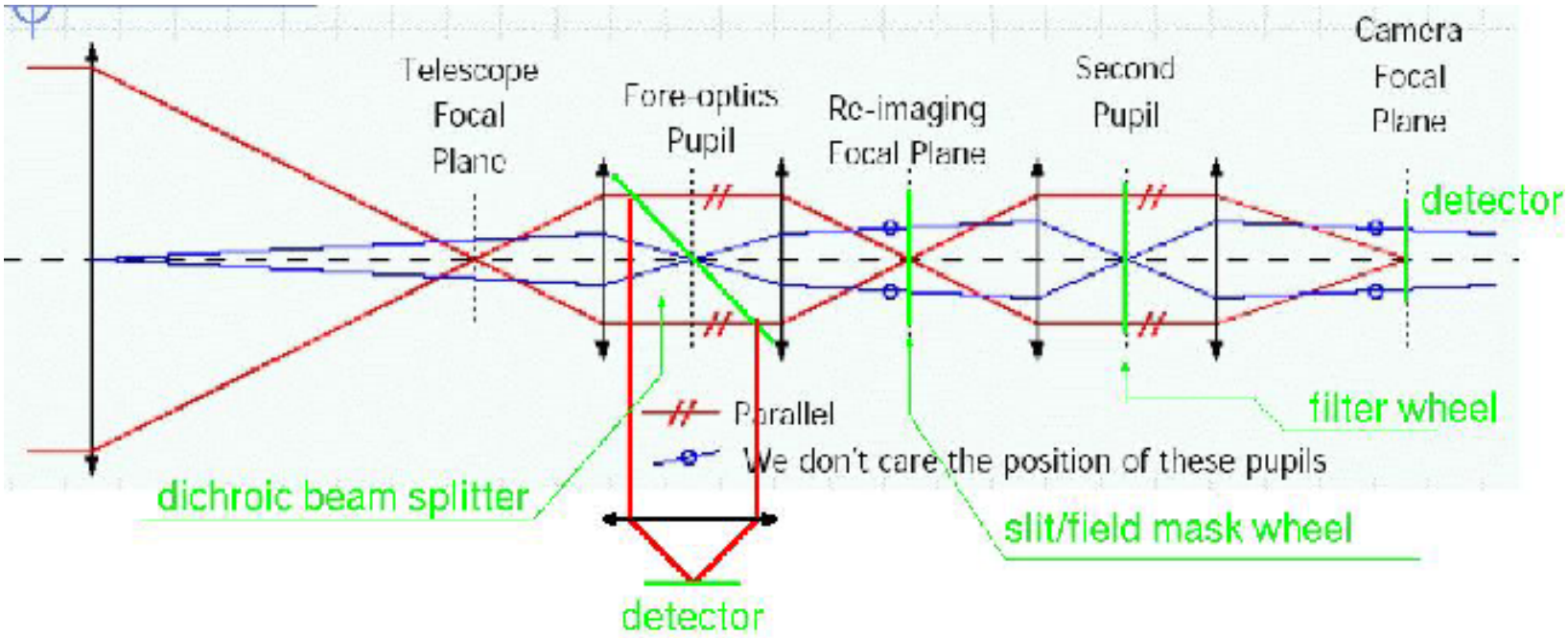
field mask wheel



field mask wheel is concidered.

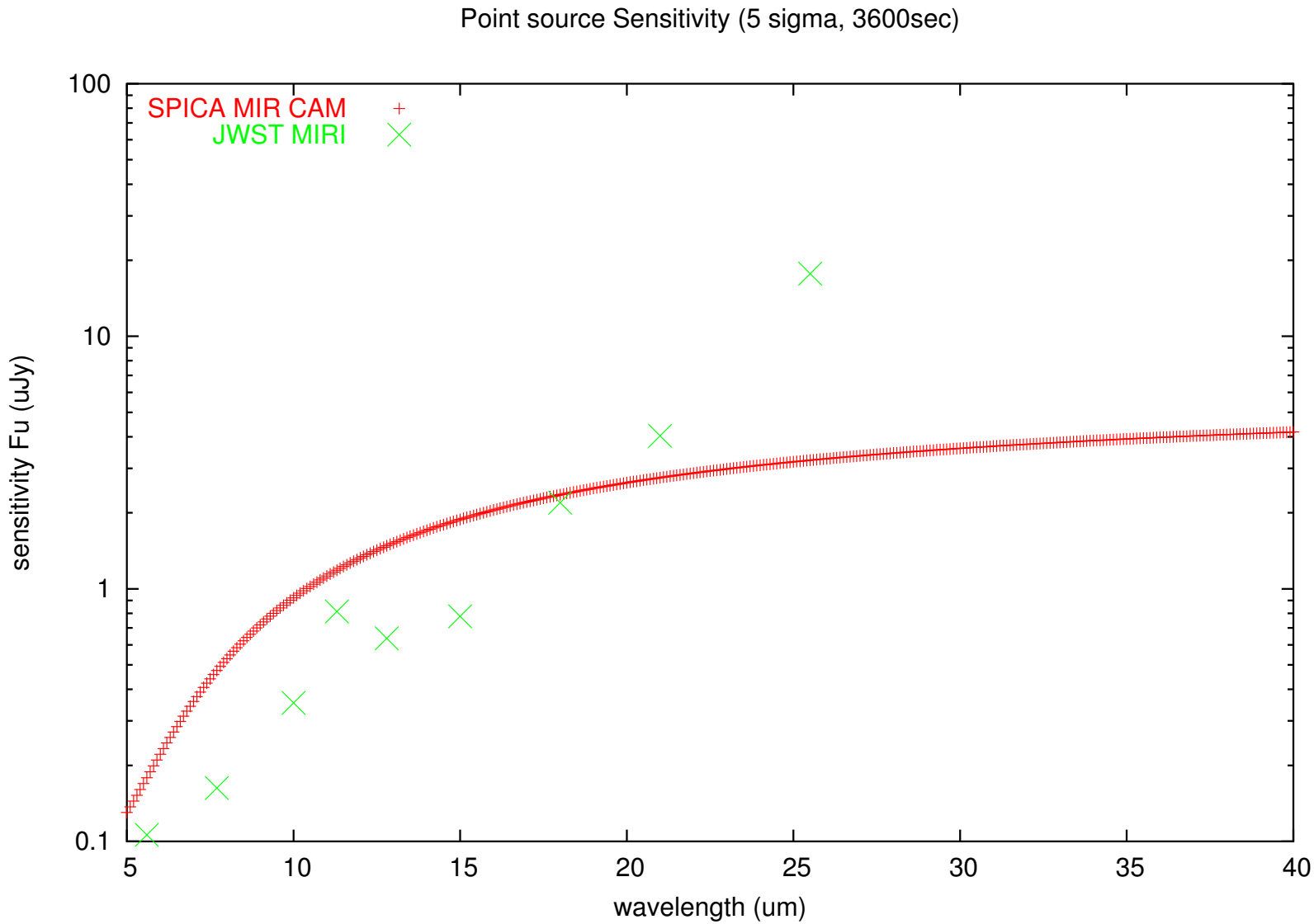
optimal field mask can be used for each observational mode.

optical configurations



- dichroic beam splitter
  - observational efficiency

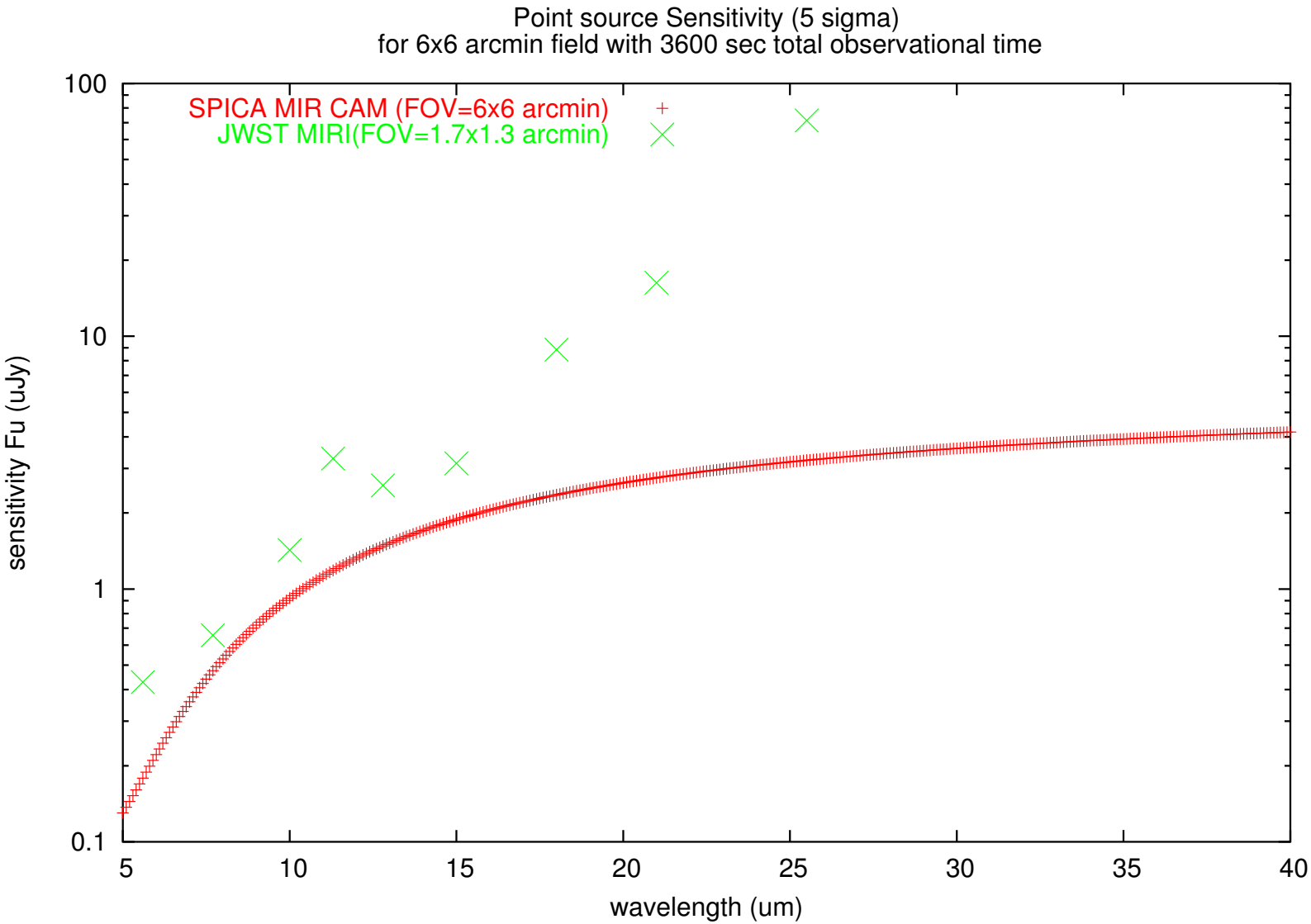
sensitivity



better sensitivity than JWST/MIRI over 18um

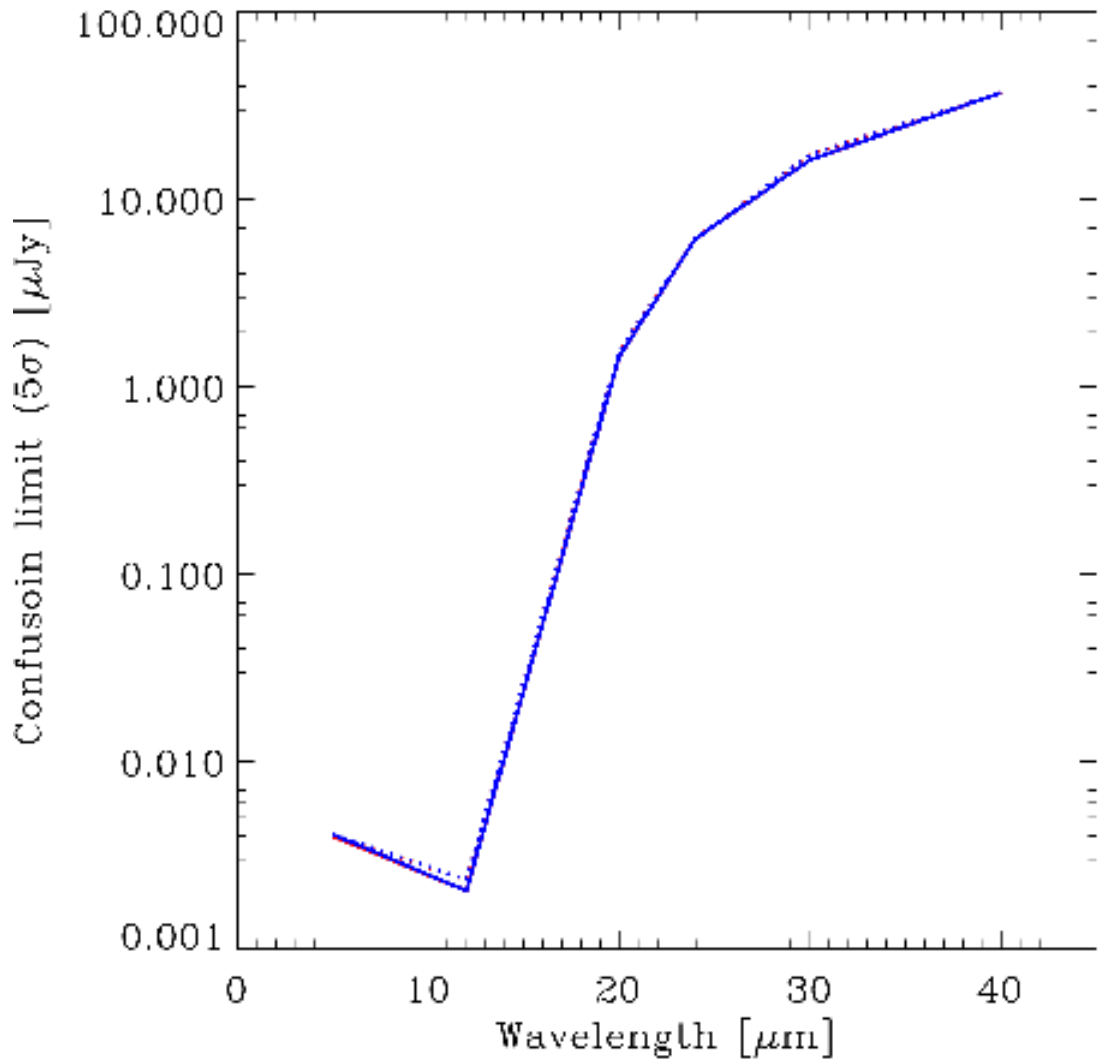
(cryogenic optics)

Survey speed



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

reflactive optical design