The Mid-Infrared Camera and Spectrometer for SPICA: General overview and Taiwan's contribution

Ciska Kemper

Institute of Astronomy and Astrophysics, Academia Sinica

Outline

- The MCS consortium & Instrument Specifications
- Highlights of the three science cases
  - The Drama of Galaxy Formation
  - The Recipe for Planet Formation
  - The Transmigration of Dust in the Universe
- Taiwan's contribution to MCS
  - Scientific underpinning and definition of instrument specs
  - Filters
  - Calibration lamp
  - Detectors

The MCS consortium & Instrument Specifications

MCS Consortium:

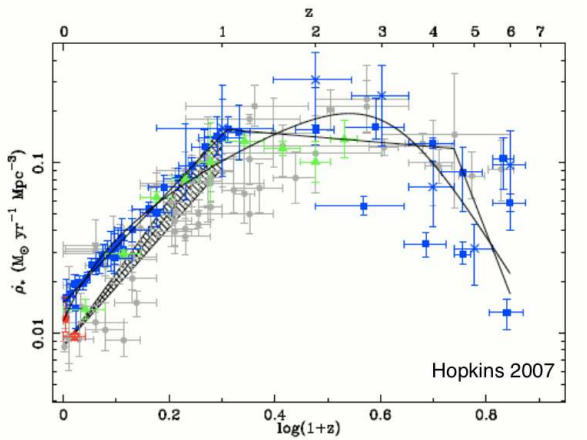
- Japan & Taiwan
- PI: H. Kataza
- Project Scientist: T. Onaka
- $>$ 90 Co-Is

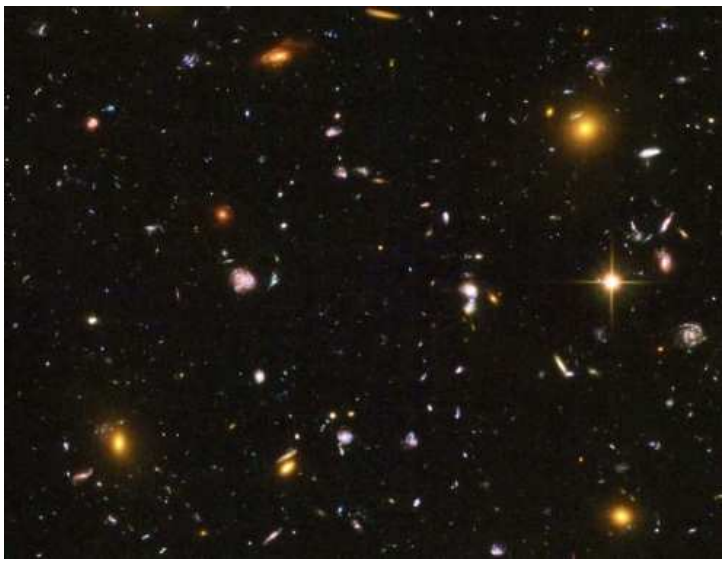
Instrument Specifications:

- WFC
  - FOV: $5' \times 4'53''$
  - 20 – 38 μm (WFC-L); 5 – 25 μm (WFC-S)
  - $R = 10$ (WFC-L); $R = 5$ (WFC-S)
  - filters not decided yet, may include low ($R = 50$) and medium ($R = 200$) resolution grisms & narrow-band filters
- HRS-L; 12–18 μm; $R = 20,000 - 30,000$
- MRS-S,-L; 12.2 – 37.5 μm; $R = 1000 - 2000$

The Drama of Galaxy Formation (I)

- Star formation over cosmic time
- Role of AGN in galaxy evolution
- Assembly of Milky-Way type galaxies

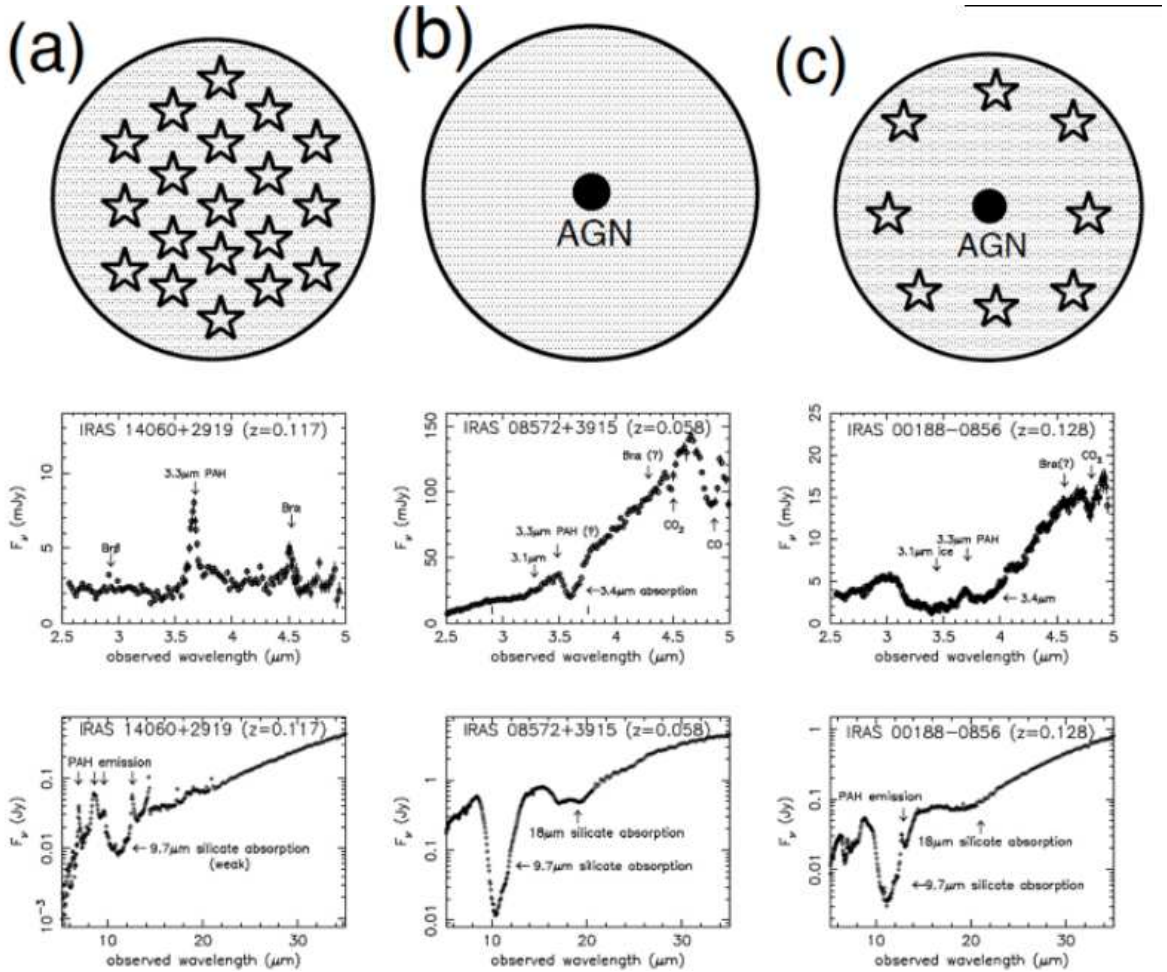




- For $4 < z < 10$ optical/NIR tracers of SF fall in MCS range, e.g. Hα, Lyα
- Does SFR really peak at $z \approx 2 - 3$?

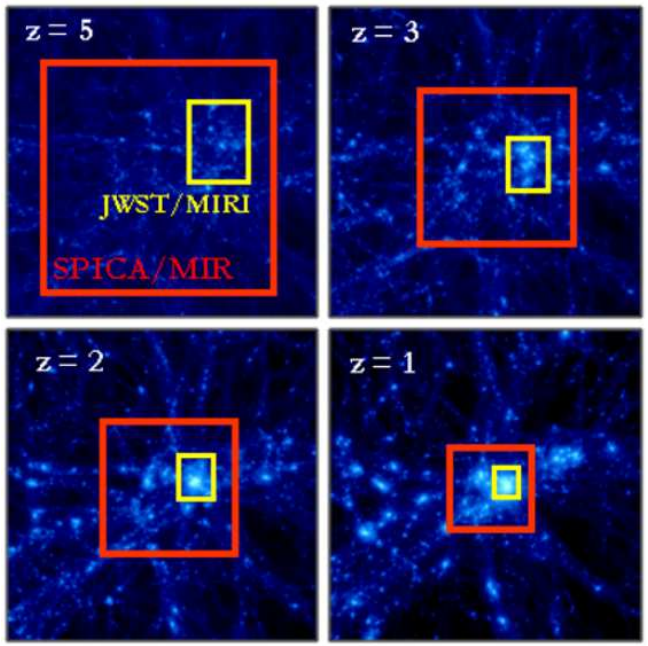
The Drama of Galaxy Formation (II)

Coeval growth of black holes and host galaxies



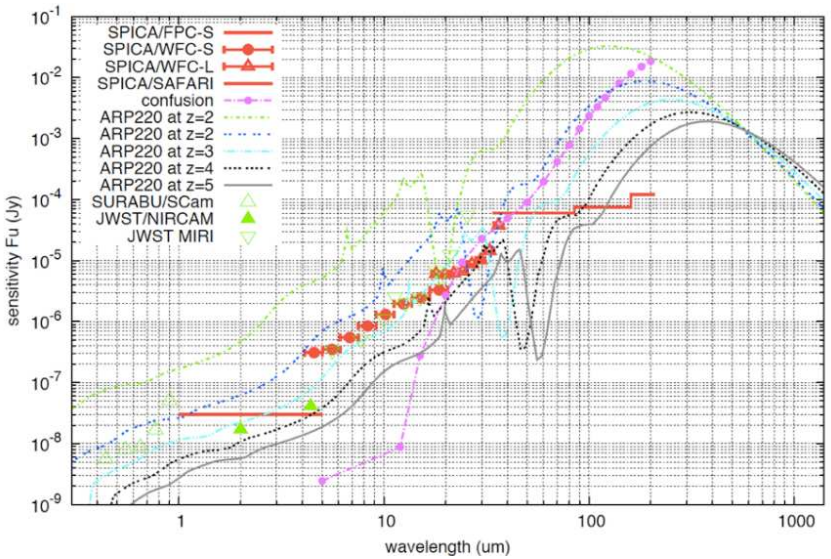
The Drama of Galaxy Formation (III)

Galaxy environments:



- superior mapping compared to JWST/MIRI
  - FOV
  - sensitivity $> 20\,\mu$m

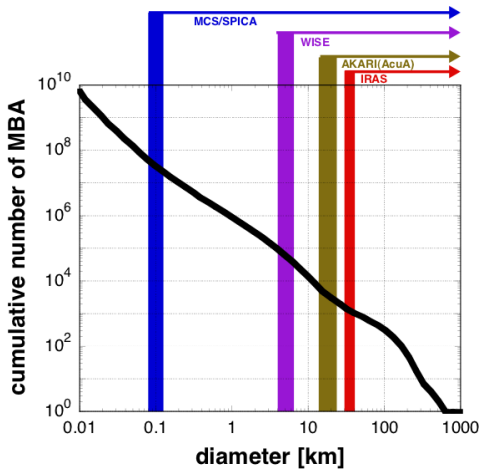
Spectral energy distribution: SPICA MCS and SAFARI synergy

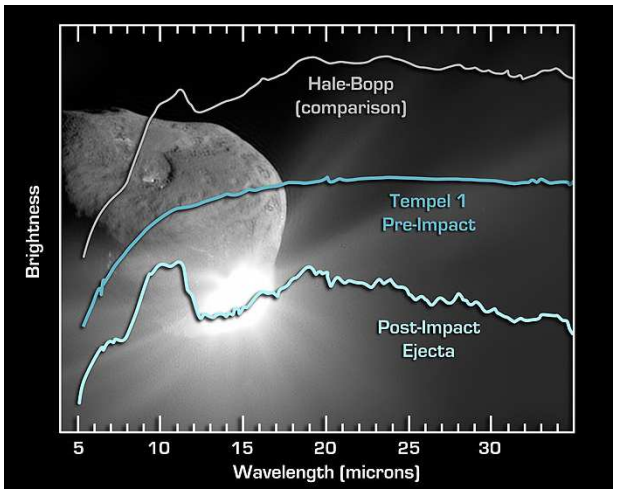


- Slitless spectroscopy

The Recipe for Planet Formation (I)

Solar system objects: surveys and mineralogy

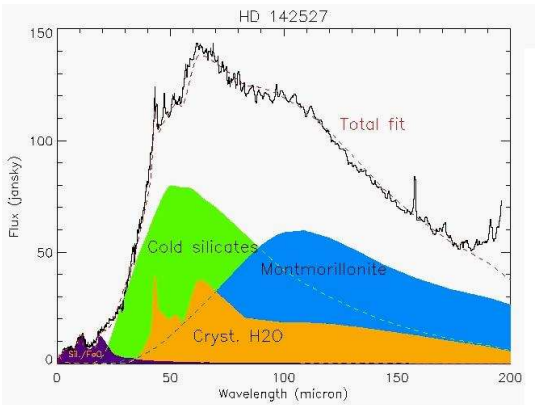




- IRAS: 2470 Main Belt Asteroids
- WISE: 130,000 MBAs
- SPICA/MCS: 10^{7-8} MBAs?

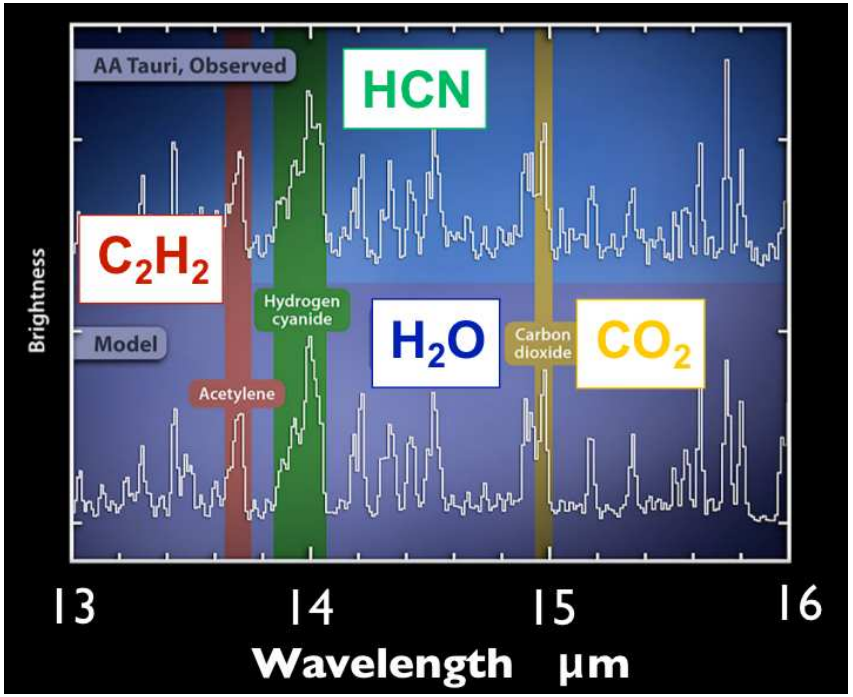
$\Rightarrow$ Size distribution

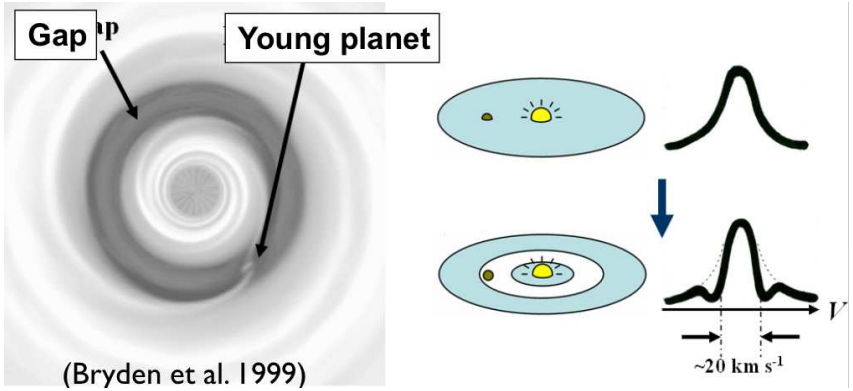
Combination with SAFARI:



The Recipe for Planet Formation (II)

Gas dissipation in planet forming disks

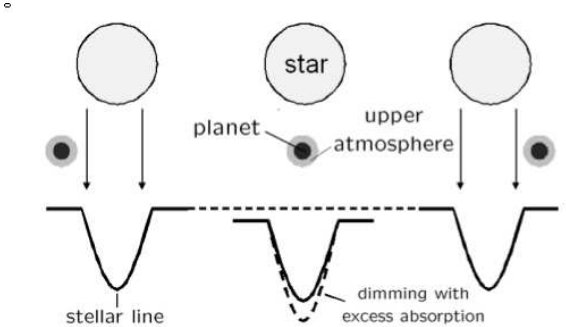


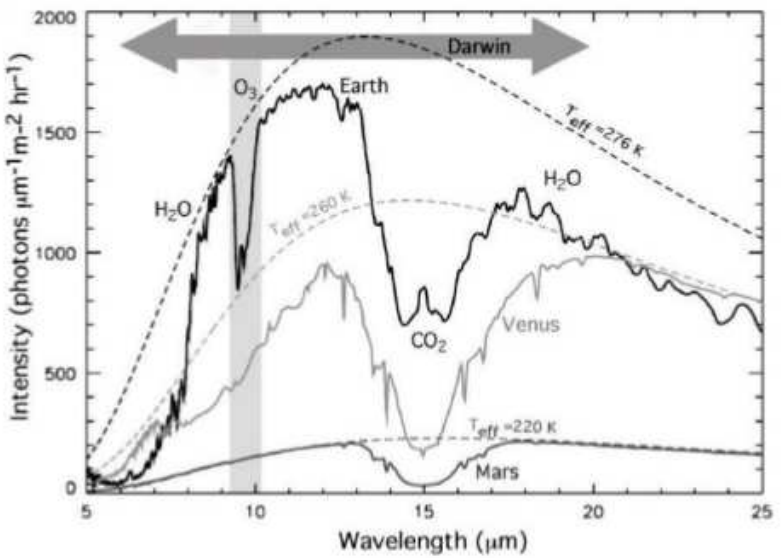


The Recipe for Planet Formation (III)

Atmospheres of transiting exoplanets

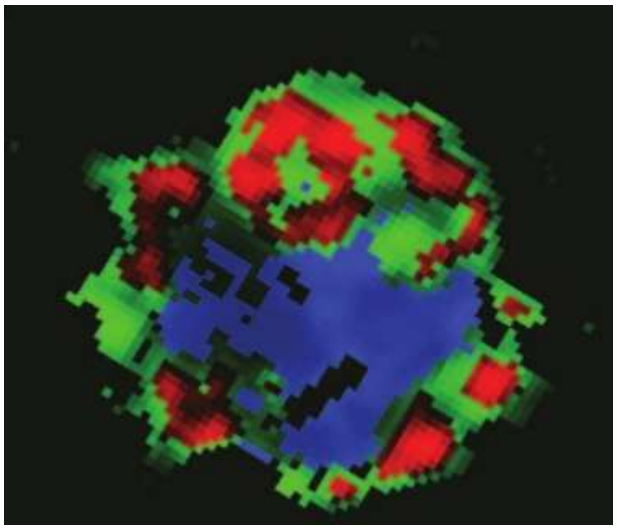
- MIR coronography is desired for observing exoplanets with ages close to our Solar System
  - Difficult to observe from the ground
- A combination with spectroscopy will allow for studies of
  - atmospheric composition
  - climate
  - exoplanet diversity
- In connection with SCI team



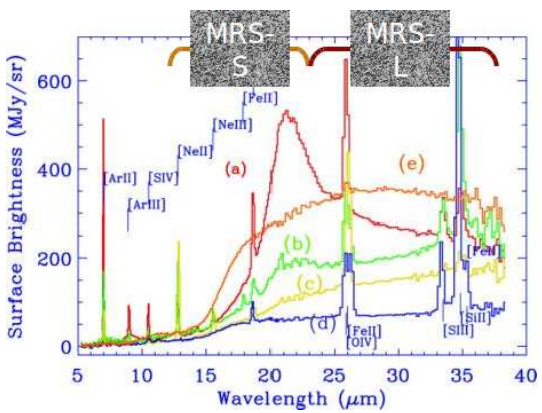


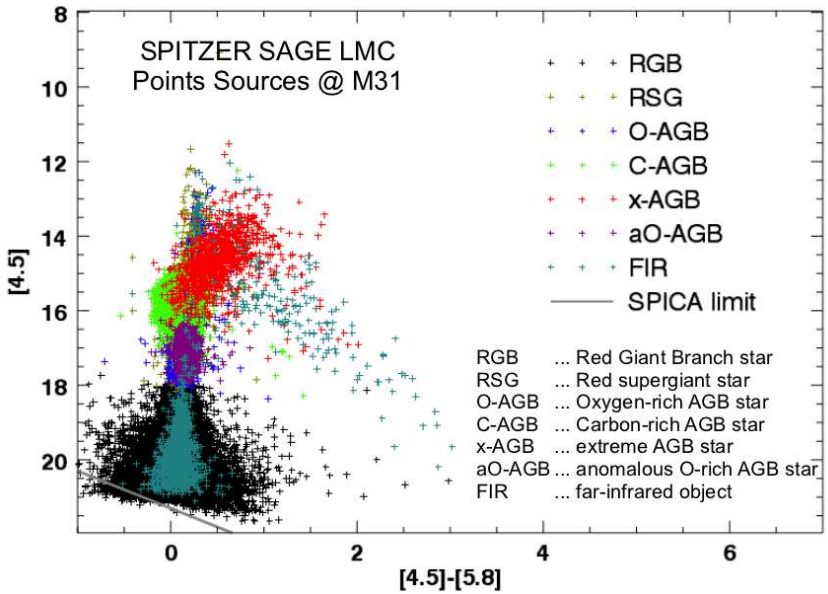
The Transmigration of Dust in the Universe (I)

Sources of dust on a galactic scale: AGB stars and SNe/SNR



Cas A (Rho et al. 2008)

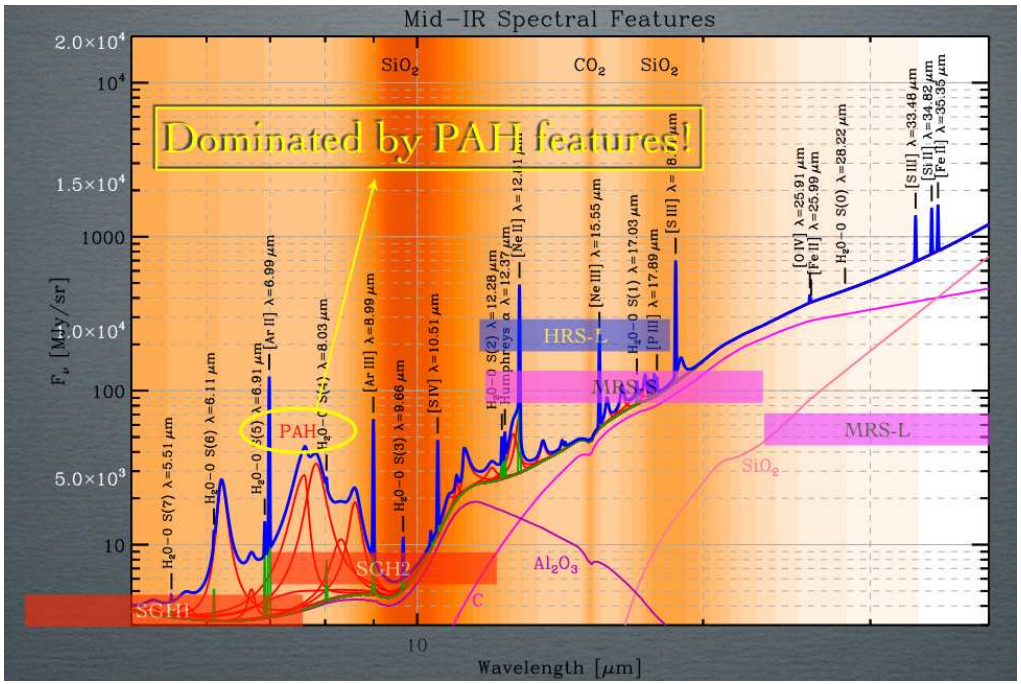


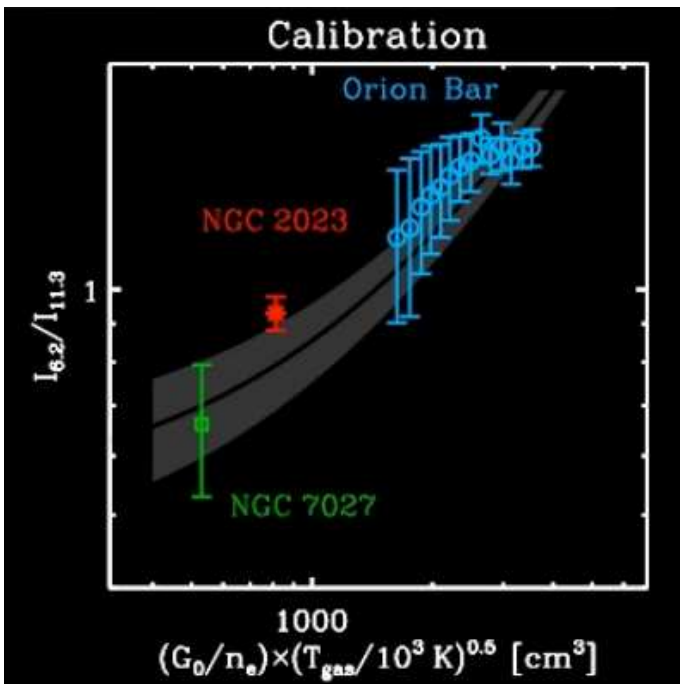


Dust production by AGB stars in M31

The Transmigration of Dust in the Universe (II)

The properties of dust and gas in the ISM

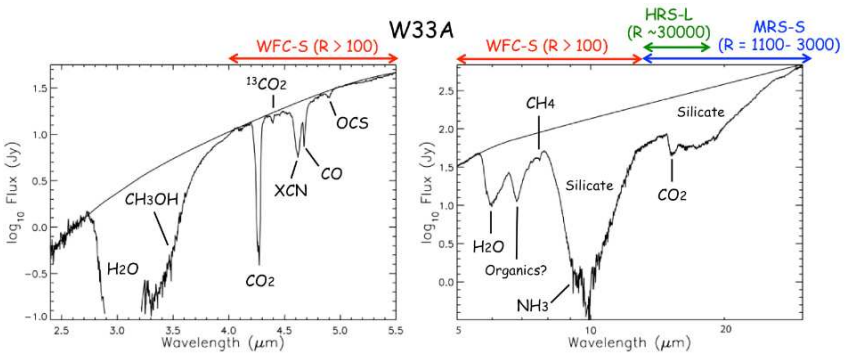


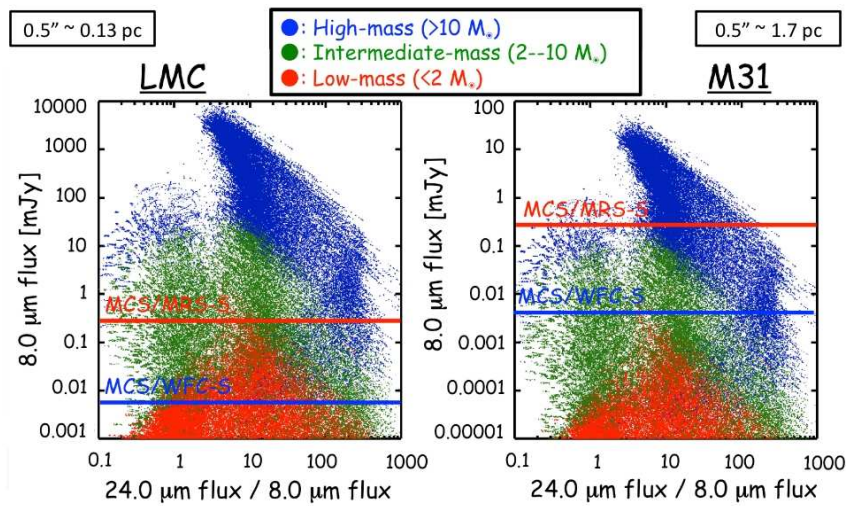


- PAH bands
- molecular lines
- atomic lines
- solid state features

The Transmigration of Dust in the Universe (III)

Circumstellar material around YSOs





Spectroscopic detection of extragalactic YSOs with MCS

- 1172 YSO candidates in the LMC (Gruendl & Chu, 2009): 277 observed with IRS
- 282 YSO candidates in the SMC
- M31 ?

Taiwan's contribution to MCS

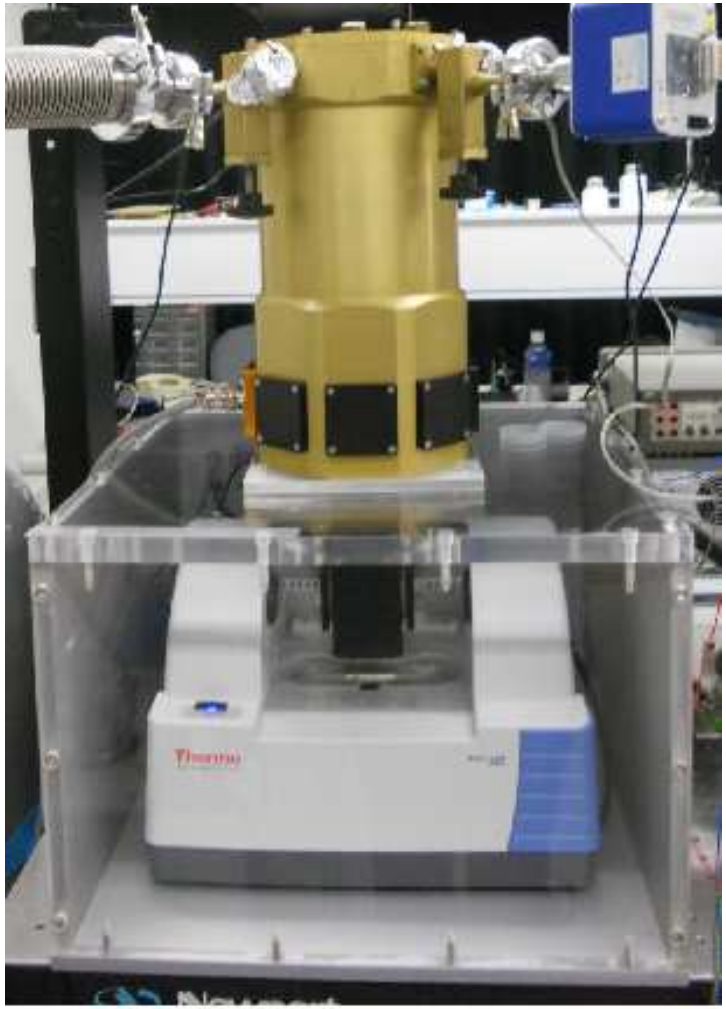
Taiwanese IR astronomy community:

- Strengthening science case
- Further instrument specifications (e.g. filter specification)
- Representative observations

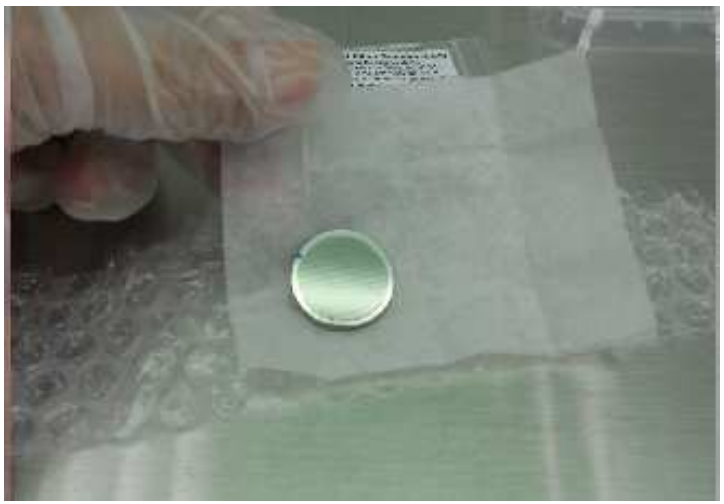
OIR lab ASIAA:

- Broadband filter development
- Calibration microlamp development
- Detector module development
  - Procurement and testing of 2k$\times$2k Si:As arrays and 1k$\times$1k Si:Sb arrays
  - Assembly of flight modules

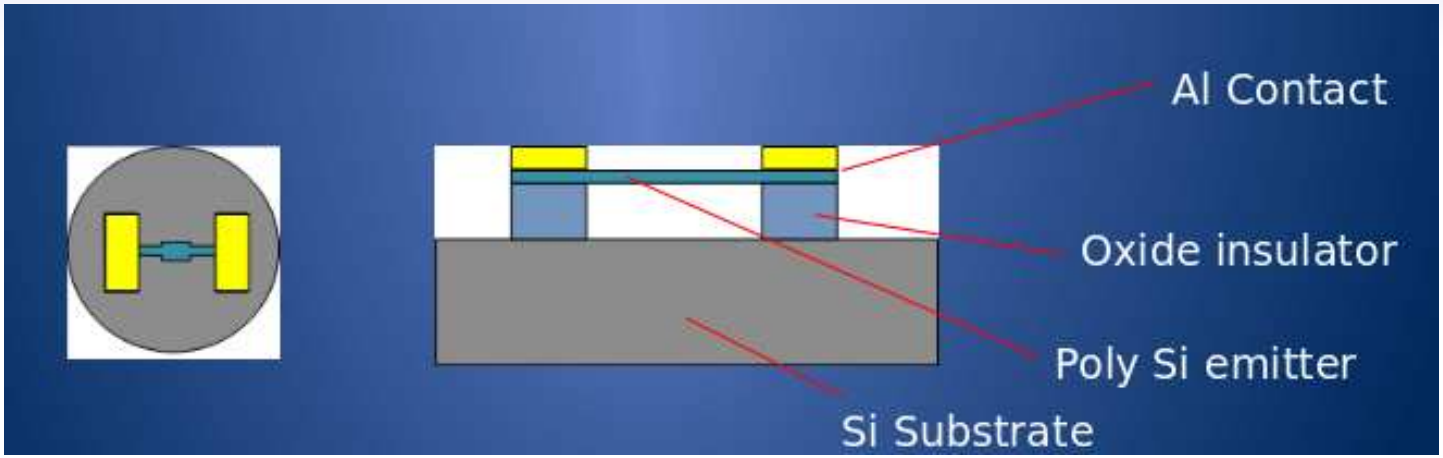
Broadband filter development

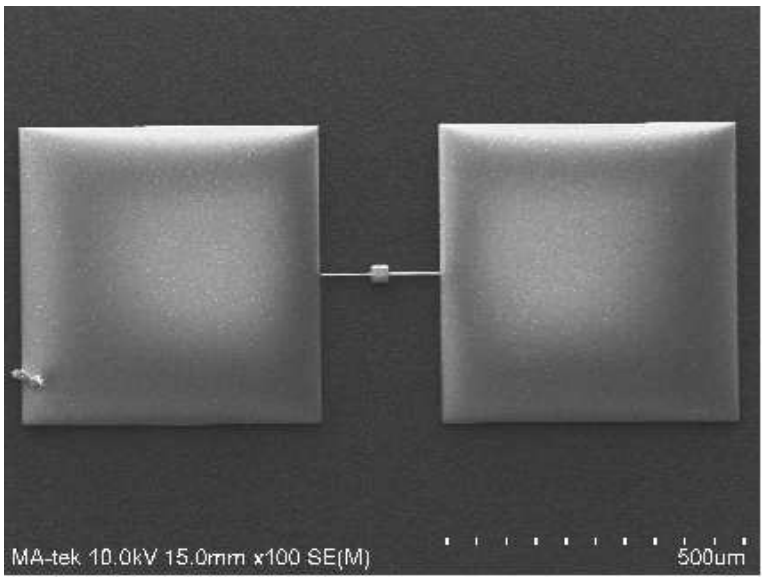


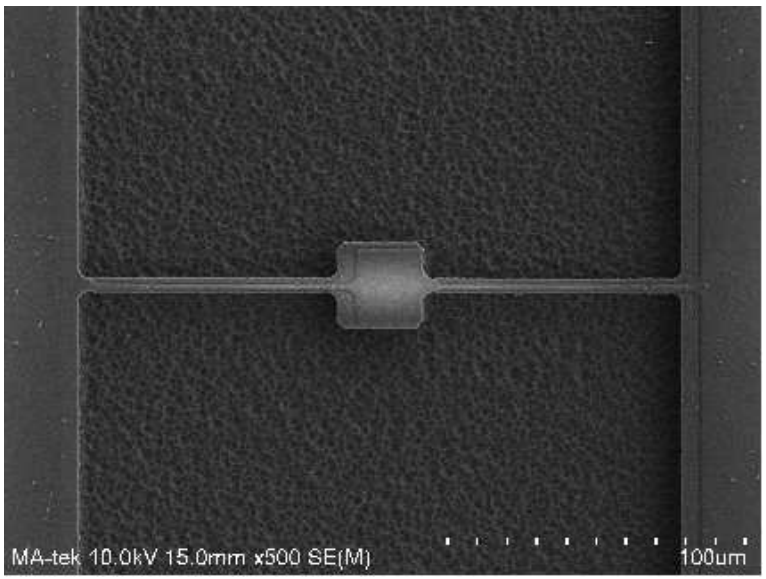
- Specification of filters needed
- Test setup



Calibration microlamp development







Summary

MCS is being developed by a Japanese/Taiwanese consortium
MCS will contribute to three main science cases:

- The Drama of Galaxy Formation
- The Recipe for Planet Formation
- The Transmigration of Dust in the Universe

Taiwan's contribution to MCS:

- Scientific underpinning and definition of instrument specs
- Filters
- Calibration lamp
- Detectors