Possible Single Dish Sciences proposed from ASIAA

Hiroyuki Hirashita
(ASIAA, Taiwan)

ASIAA Single Dish Discussion Group

1. Why Single Dish?

Suitable for diffuse source/survey.
Easy for the first experiment to grasp the global structures.

Our telescope!
Free for 11 months in a year.
Chance to execute our own science (or establish our original idea) with a large degree of freedom (even a time-consuming one).

2. General Requirement

Exploring a new thing $\Rightarrow$

(1) Opening a new wavelength: THz.

(2) Submm for summer.

(3) Construction as early as possible.

3. Scientific Cases

"Star formation" - its processes and consequences

(1) Chemistry and evolution in diffuse to dense ISM.
(2) Dust formation and evolution.
(3) Time-variable FIR-submm Universe.

(1) Chemistry and evolution of diffuse to dense ISM

Panoramic View by Continuum

Multi-scale fragmentation processes.

Sensitivity < 0.5 mJy/beam

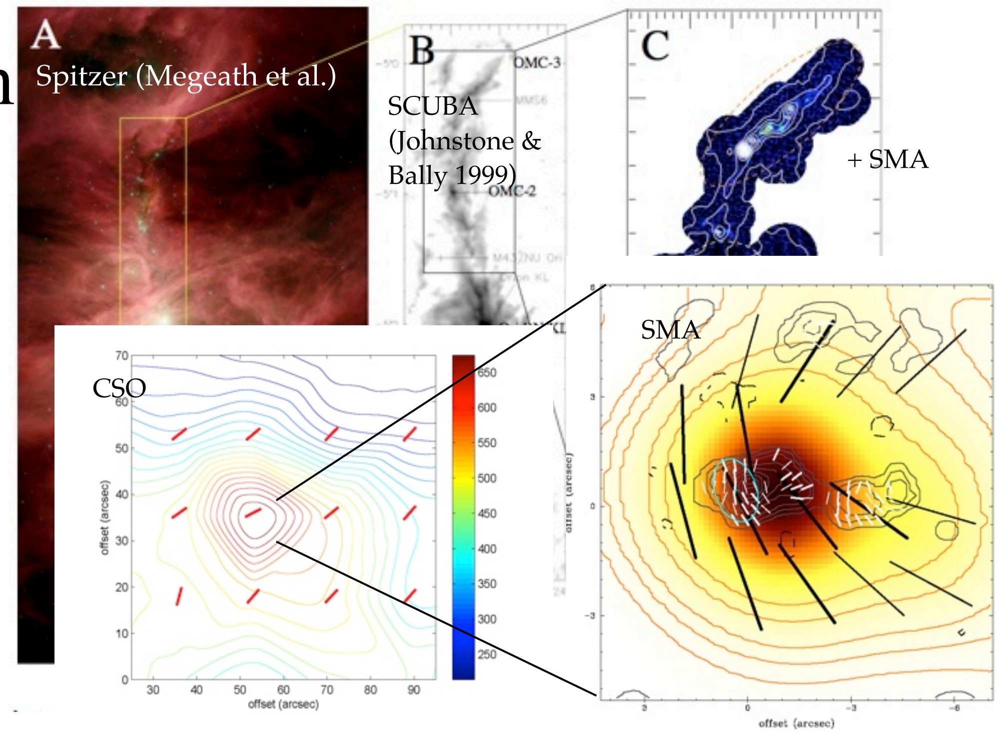
Area: square degree

(or targeted on 10□’)

Polarization to see magnetic field structures over arcmin (between core and large scale) in THz:

Sensitivity: 10 mJy/□”

S. Takahashi, P. M. Koch



al.

Tang et al.

*** Similar resolution to SMA/ALMA but different wavelength**

*** Higher resolution than other single dishes (Herschel, SHARC-II, BLAST-pol)**

Chemistry View by Lines

N. Hirano, S. Takakuwa

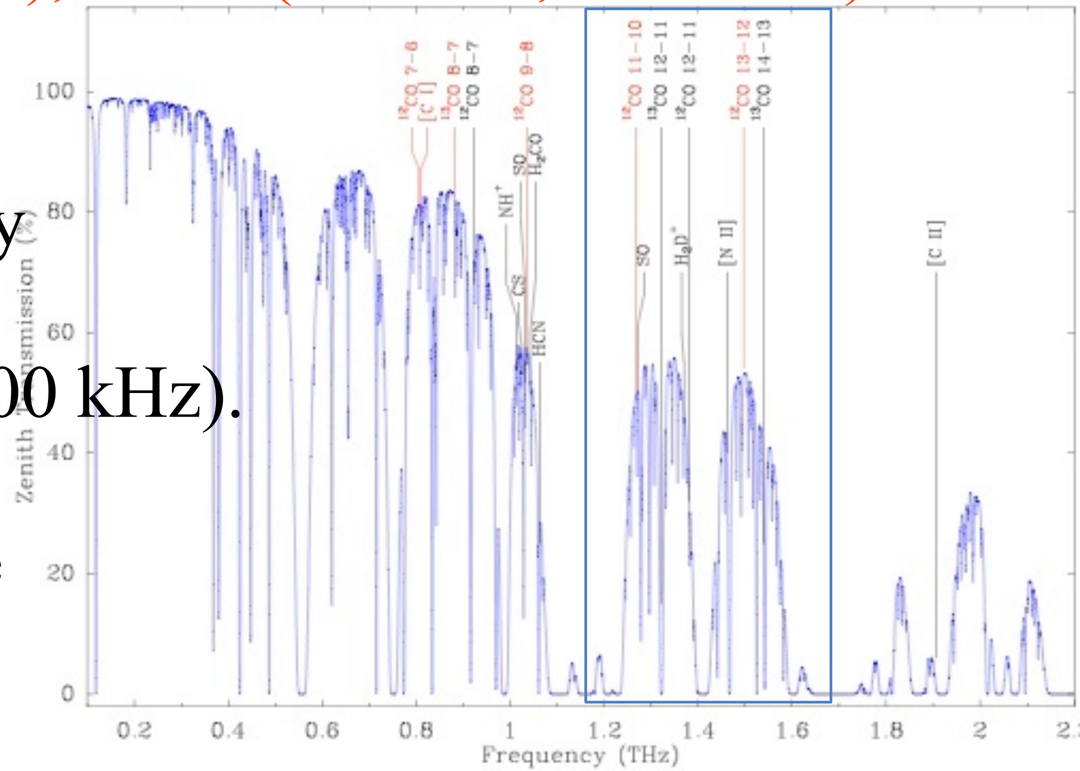
H_3^+ and CH are key elements in interstellar chemistry from diffuse to dense ISM ($H_3^+ + X \rightarrow HX^+ + H_2$, $CH \rightarrow$ carbon chain/organic molecules).

H_2D^+ (1.4 THz, 372 GHz), D_2H^+ (1.5 THz, 692 GHz): free from depletion on dust.

CH (1.48 THz)

Wide area (> deg) survey with high frequency resolution ~ 0.1 km/s (500 kHz).

[N II] (1.5 GHz) to trace ionized regions.



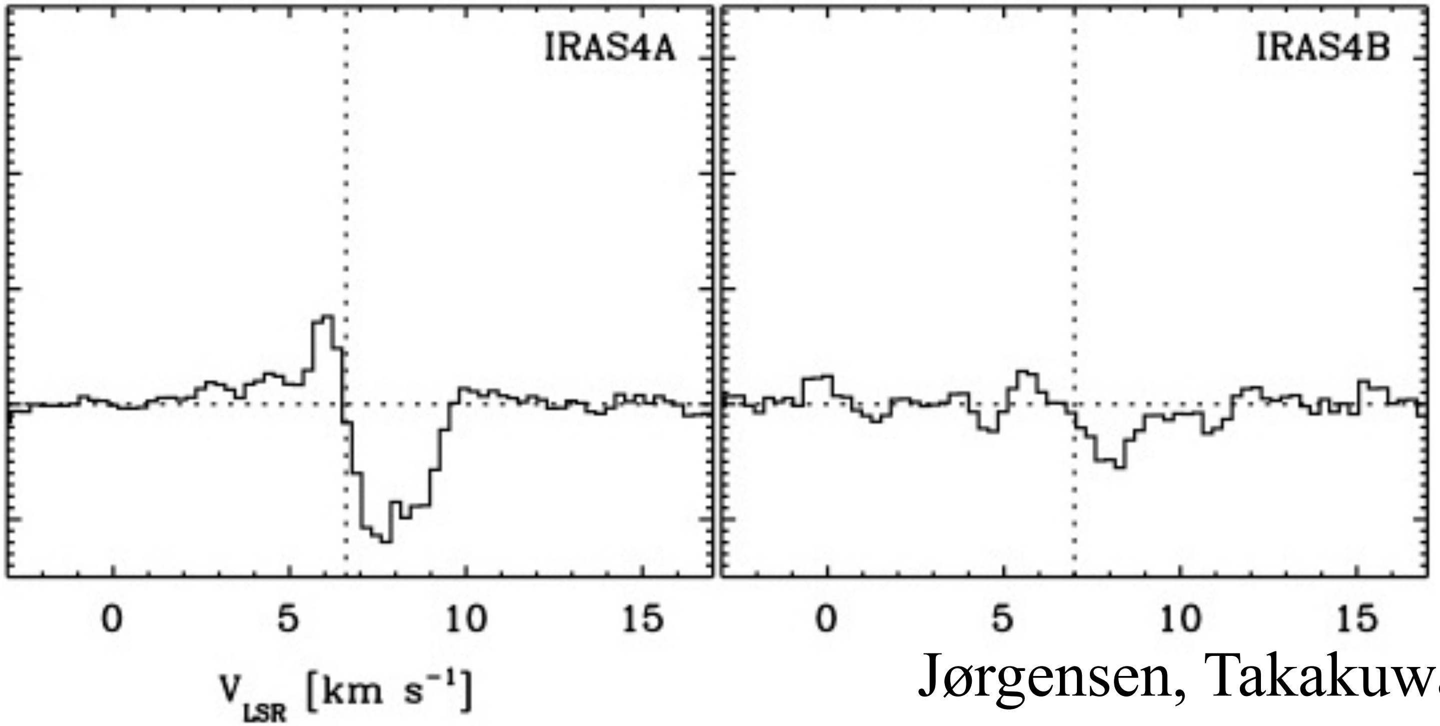
Unbiased Survey for Infall in First or Starless Cores

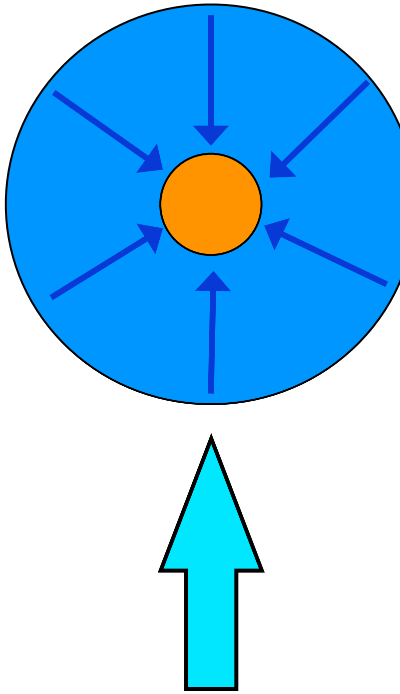
S. Takakuwa

Continuum is optically thick, so we see a different layer in different frequency.

CO absorption to detect an inverse P-Cygni profile.

Frequency resolution: ~ 0.1 km/s, 500 kHz





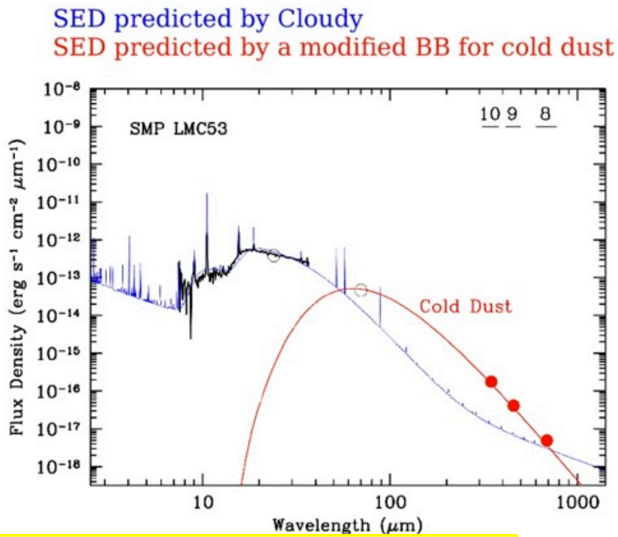
Jørgensen, Takakuwa, et al. (2007)

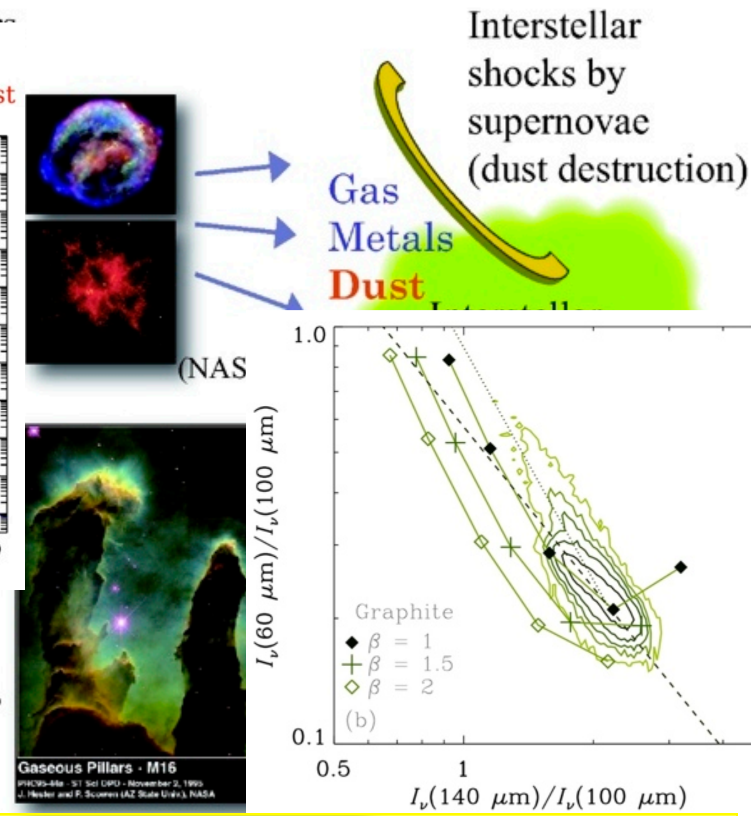
(2) Dust Formation and Evolution

Panoramic View of Dust Circulation

THz continuum (peak)
Higher resolution than Herschel.
Sensitivity
< 3 MJy/sr
= 0.07 mJy/□”

M. Otsuka, F. Kemper, H. Hirashita





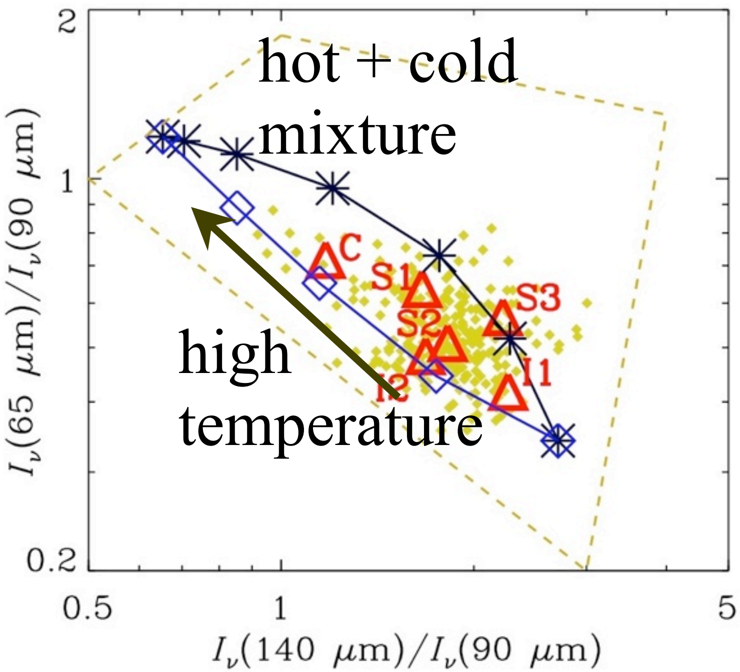
AGB stars: Origin of cold dust is not fully understood (Otsuka et al. 2011)

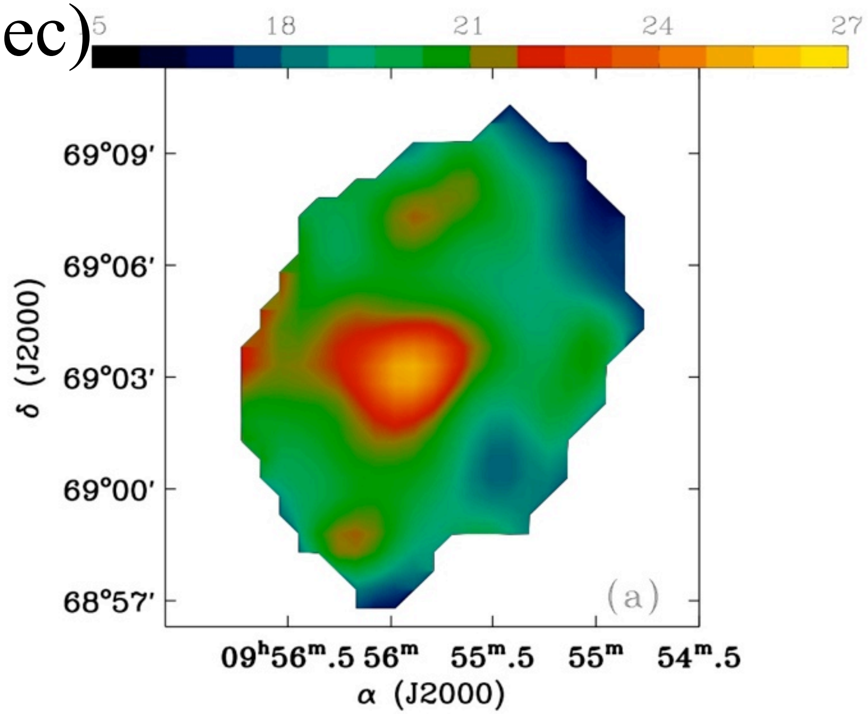
FIR colors are sensitive to dust properties (Hirashita et al. 2006)

Nearby galaxies

THz continuum
High-resolution (~ several arcsec)
(Sequence in the color-color diagram ⇒ dust properties)

S. Matsushita, H. Hirashita





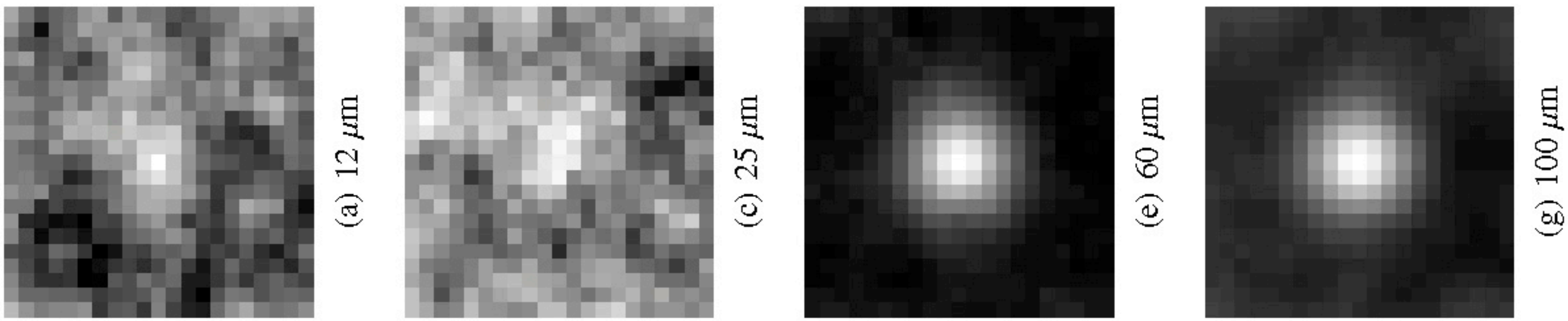
Dust temperature map (M81)
(Sun & Hirashita 2010)
+ dust emission properties

Cosmological Evolution of Dust

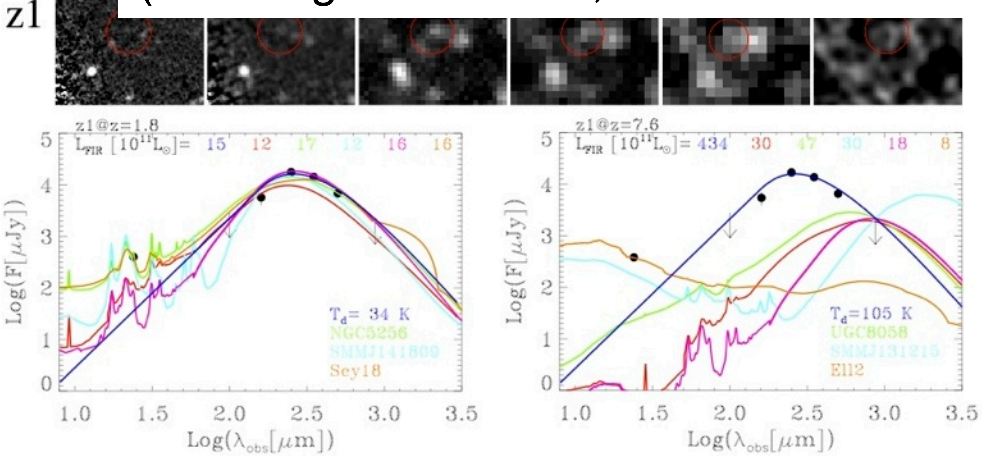
W.-H. Wang (high z), P. M. Koch (clusters)

Galaxy formation and evolution

Clusters of galaxies



(Stacking of about 10,000 clusters from IRAS; Montier and Giard, 2005)



Boone et al. (2011)

Sensitivity: 10 - 100 mJy/arcmin^2 $\Rightarrow$ stacking

Area: 1 - several arcmin $\Rightarrow$ multi-pixel, wide fov

High-resolution merits to subtract point-sources.

High-z Spectral Lines

Y.-T. Lin, W.-H. Wang

[C II] at $1.9/(1 + z)$ THz (main coolant)

([N II] $2.5/(1 + z)$, $1.5/(1 + z)$ THz)

Wide-wavelength spectrometer in sub-mm:

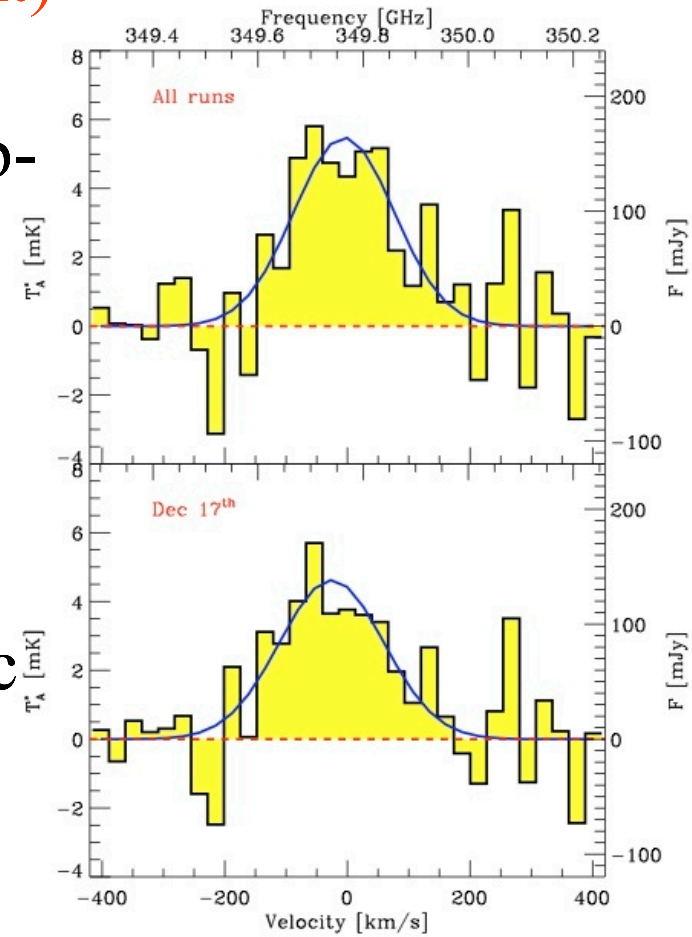
$z \sim 2$: [C II] 633 GHz,

[N II] 829 GHz, 487 GHz

$z \sim 3$: [C II] 475 GHz,

[N II] 614 GHz, 365 GHz

Area > 500 deg^2 for baryonic acoustic oscillation to determine the cosmological parameters (nature of dark energy, initial non-gaussianity, neutrino mass).



Maiolino et al. (2009)

(3) Time-Variable FIR–submm Universe

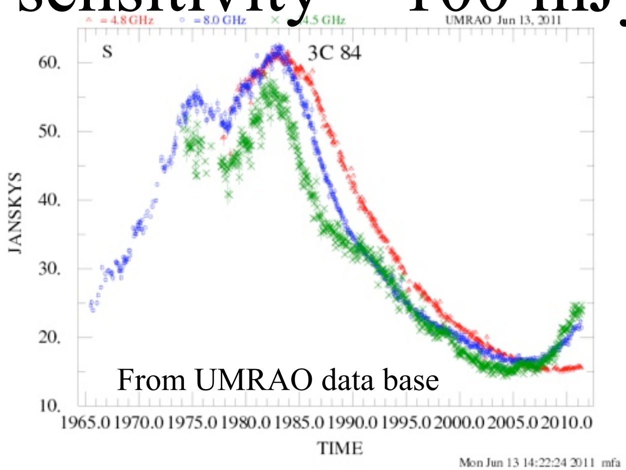
Monitoring of AGNs

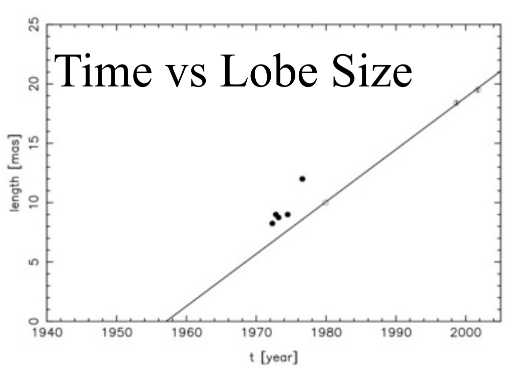
M. Nakamura, K. Asada

(1) Young radio galaxy

Submm/FIR can avoid f-f/ synchrotron self-absorption

sensitivity ~ 100 mJy





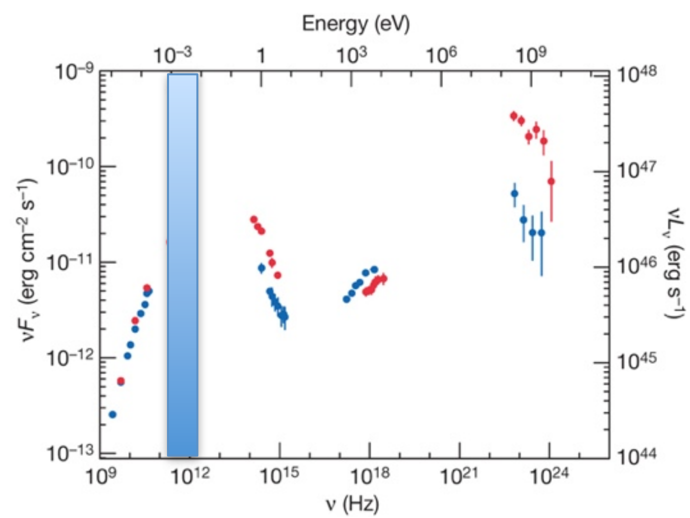
Born in 1959 !!

Asada et al. (2006)

(2) Blasars

THz is just above the SSA peak ⇒ better determination of magnetic field.

sensitivity ~ 100 mJy



Abdo et al. (2010)

Gamma-Ray Bursts and Supernovae

K.Y. Huang, Y. Urata

Gamma-ray burst

Synchrotron from reverse shock

Origin of dark GRBs

*Prompt response (~ hrs)

*Long-term monitoring

*High resolution to avoid contamination

Ultraluminous supernovae

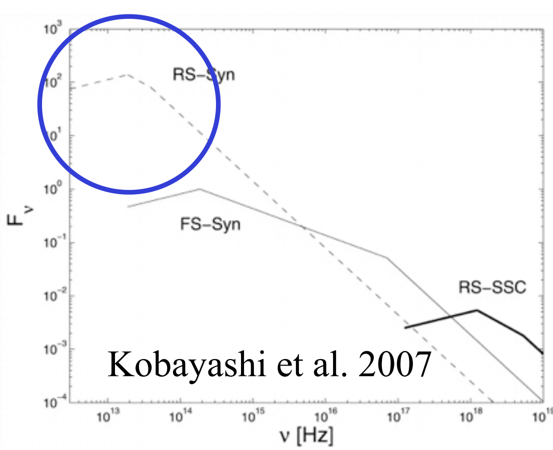
Dust formation

*Long-term monitoring (~ yrs)

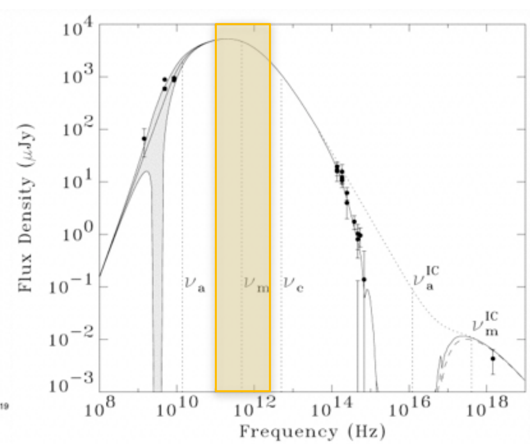
*Cold dust

*High resolution

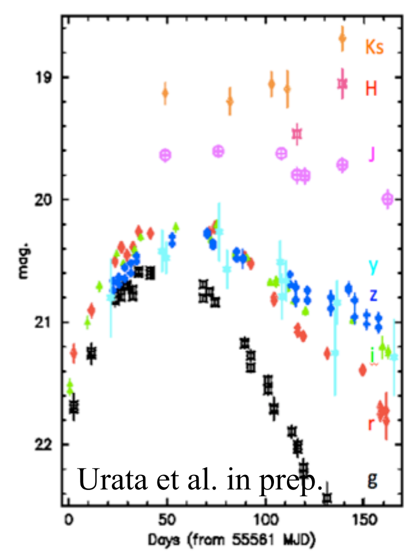
*Host galaxy properties



Kobayashi et al. 2007



Sign of the early dust (warm) formation with USNe



Urata et al. in prep.

3. Summary

(1) Our scientific interests are
  i) chemistry and evolution in diffuse to dense ISM,
  ii) dust formation and evolution, and
  iii) time-variable universe.

with wide area survey capability (~ arcmin) and higher resolution (than Herschel).

(2) Array of bolometer/heterodyne detectors are necessary.

(3) For lines, a high wavelength resolution (~ 100 kHz) is necessary for i).

(4) For continuum, a high sensitivity is required (~ 1 mJy / beam).

(5) Polarization capability is also required.