AKARI Observations and SOFIA

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(University of Tokyo)

AKARI Mission
JAXA, Nagoya-U, U. of Tokyo, NAOJ, ..
International collaboration with ESA, IKSGO, & SNU

2009.11.17 SOFIA telecon

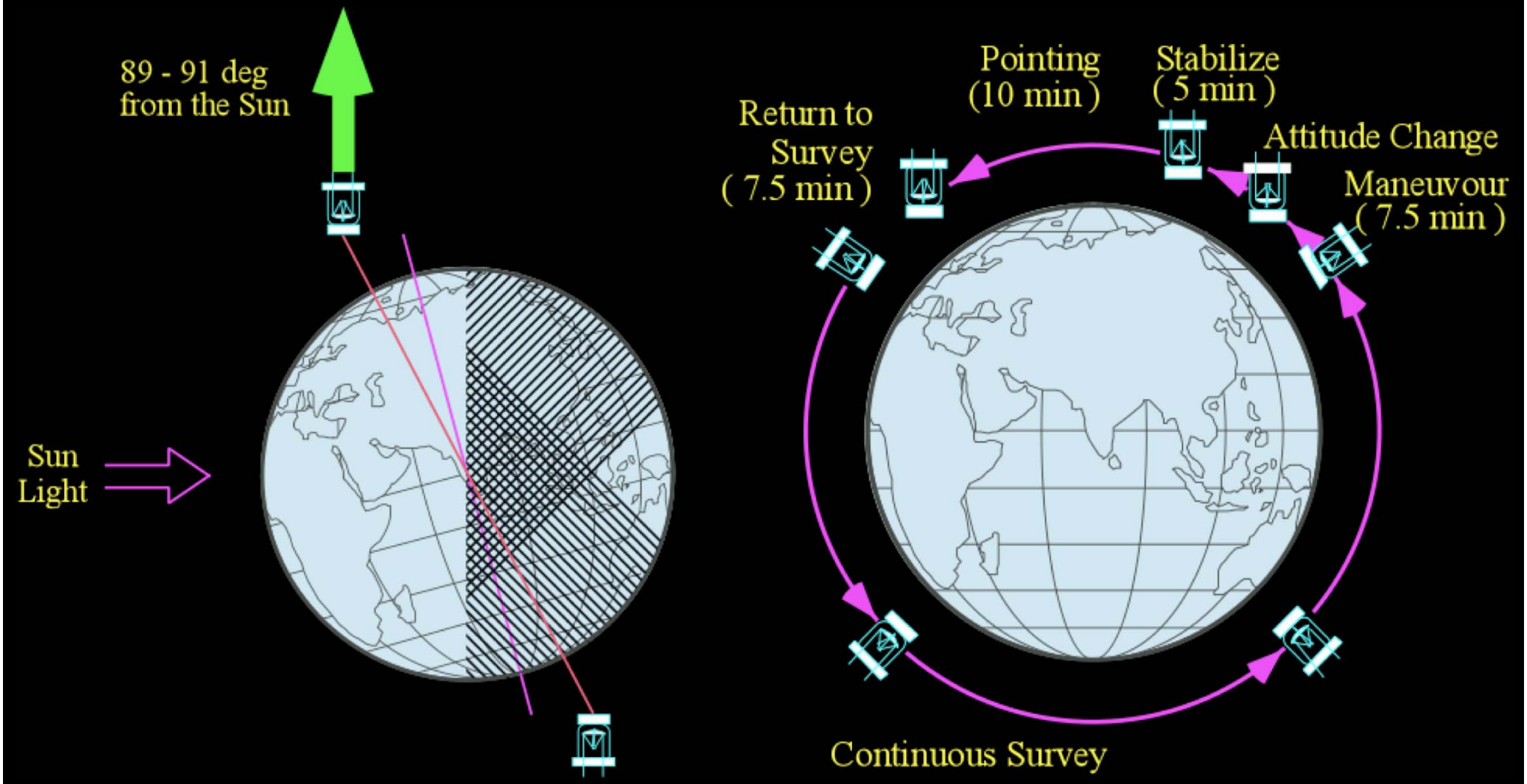
AKARI satellite

70cm SiC mirror
180L LHe + cryocoolers
on a 700km sun-synchronous polar orbit
18 month cold mission
(2006.2-2007.8)

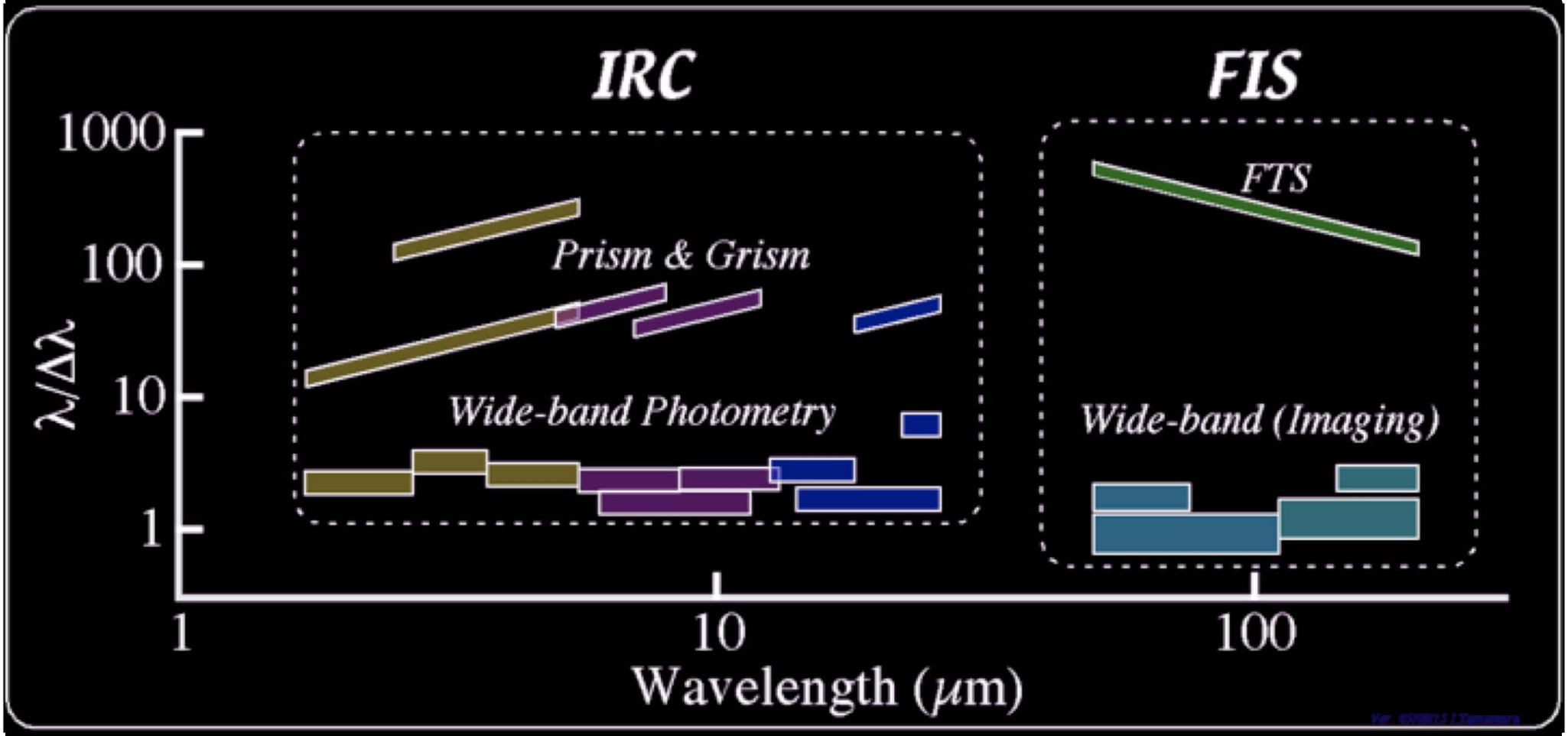
All-sky survey surpasses IRAS database
(9, 18, 65, 90, 140, 160μm)
+
Pointing observations of imaging and spectroscopy in 2-180μm

Murakami et al. 2007 PASJ, 59, 369

AKARI observation modes

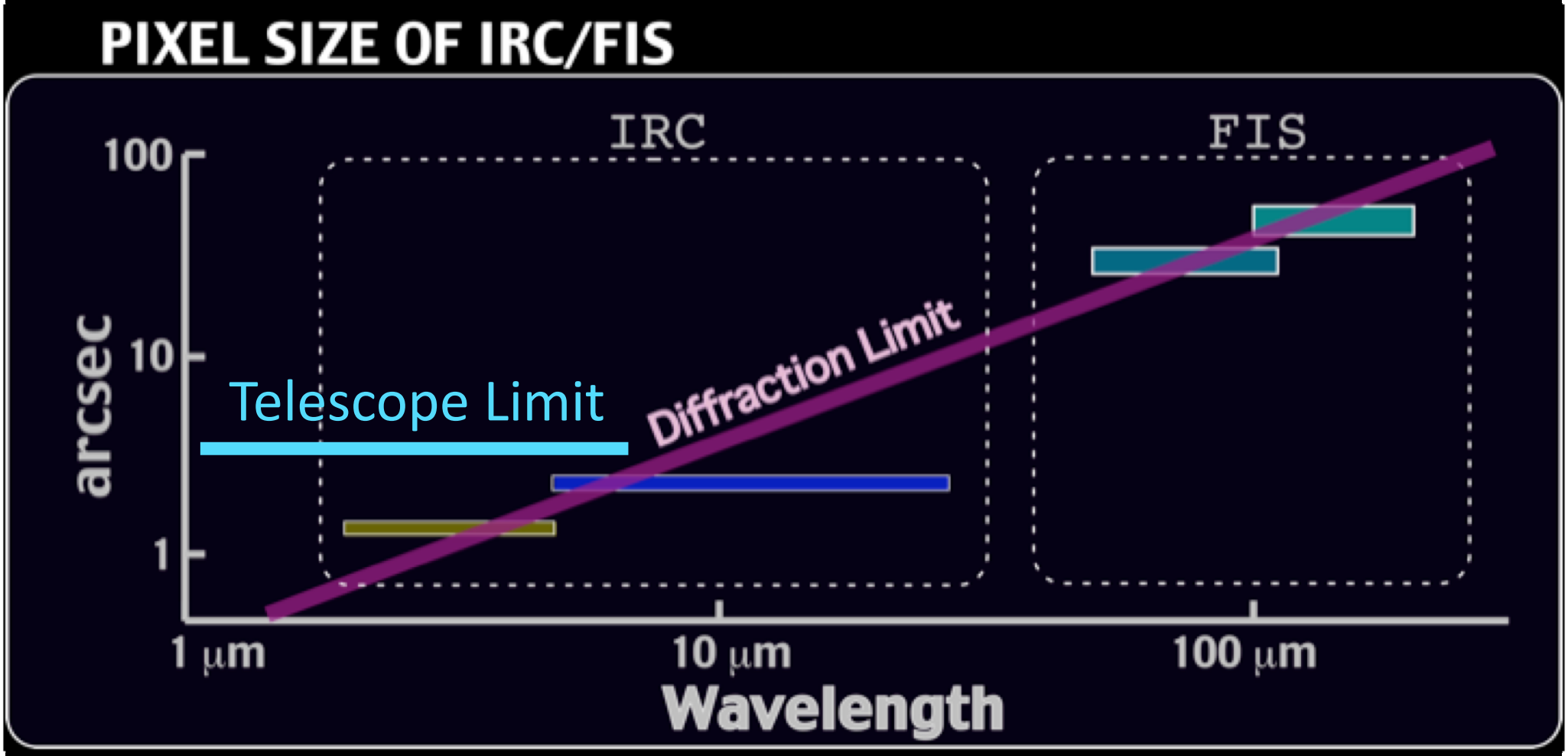


Instrument capability



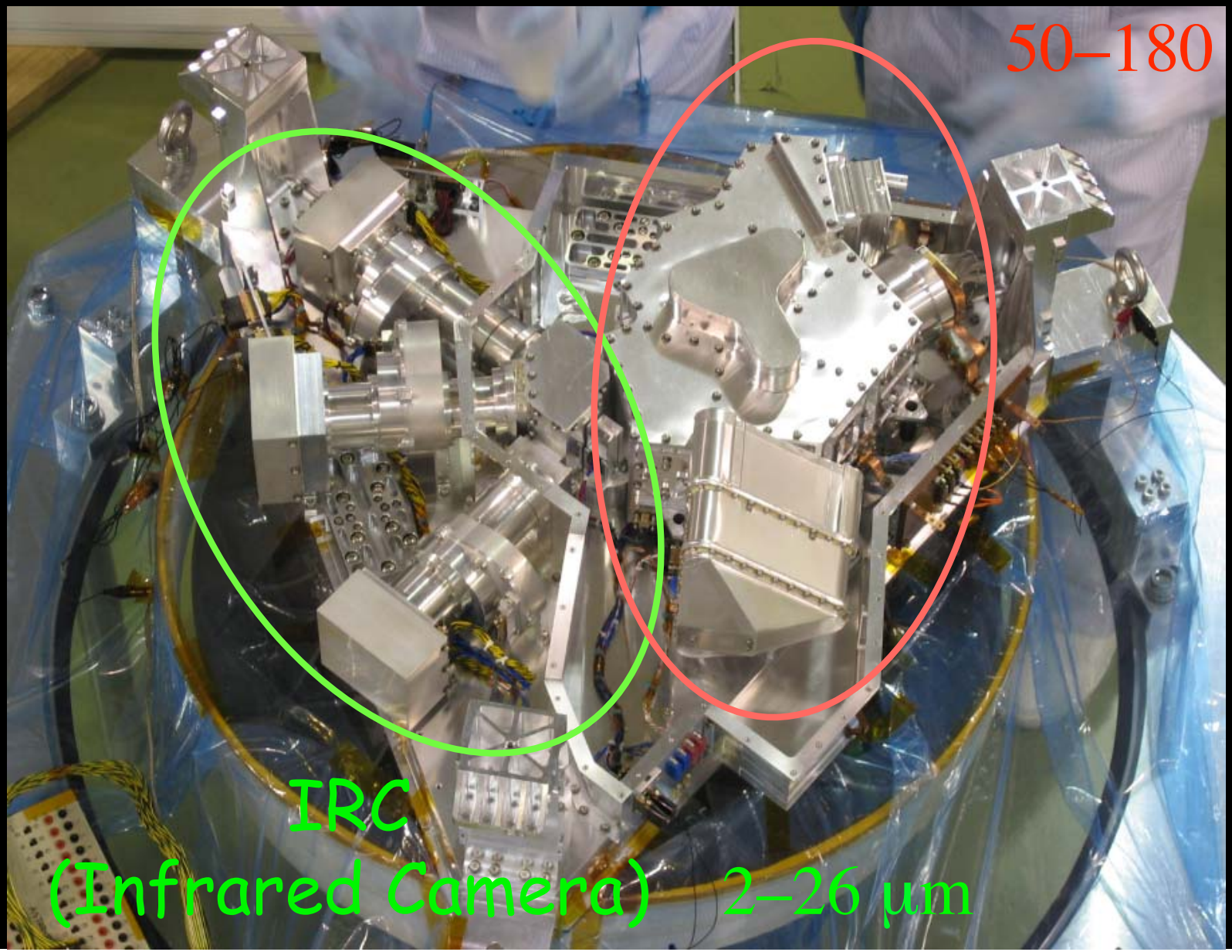
IRC: Onaka et al. 2007 PASJ 59, S401; Ohyama et al. 2007 PASJ 59, S411
FIS: Kawada et al. 2007 PASJ 59, S389; Kawada et al. 2008 PASJ 60, S389

Pixel scale


PIXEL SIZE OF IRC/FIS
IRC
FIS
100
10
1
arcsec
Telescope Limit
Diffraction Limit
1 μm
10 μm
100 μm
Wavelength

On-board Instruments

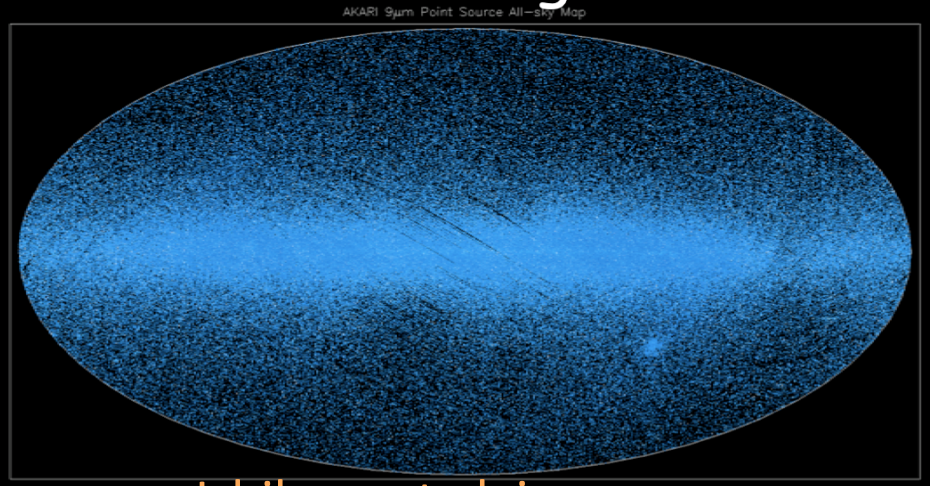
(Far-Infrared Surveyor) FIS

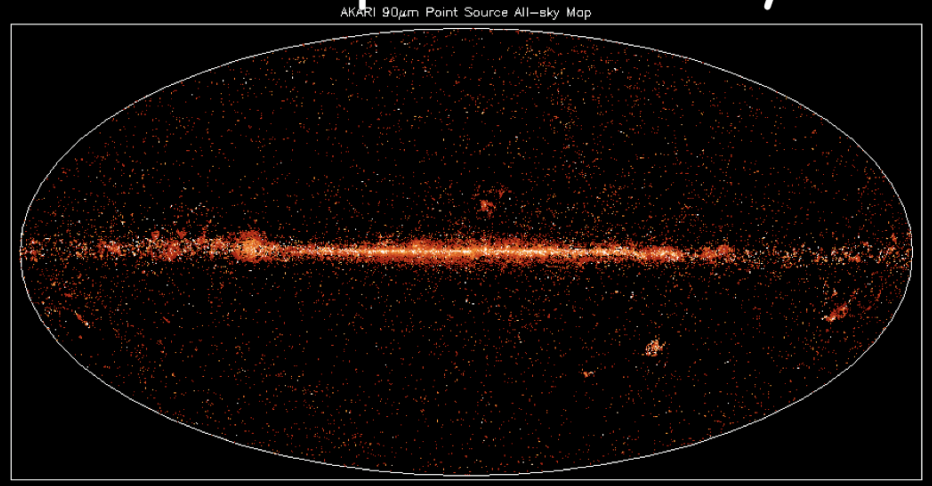


AKARI all-sky survey

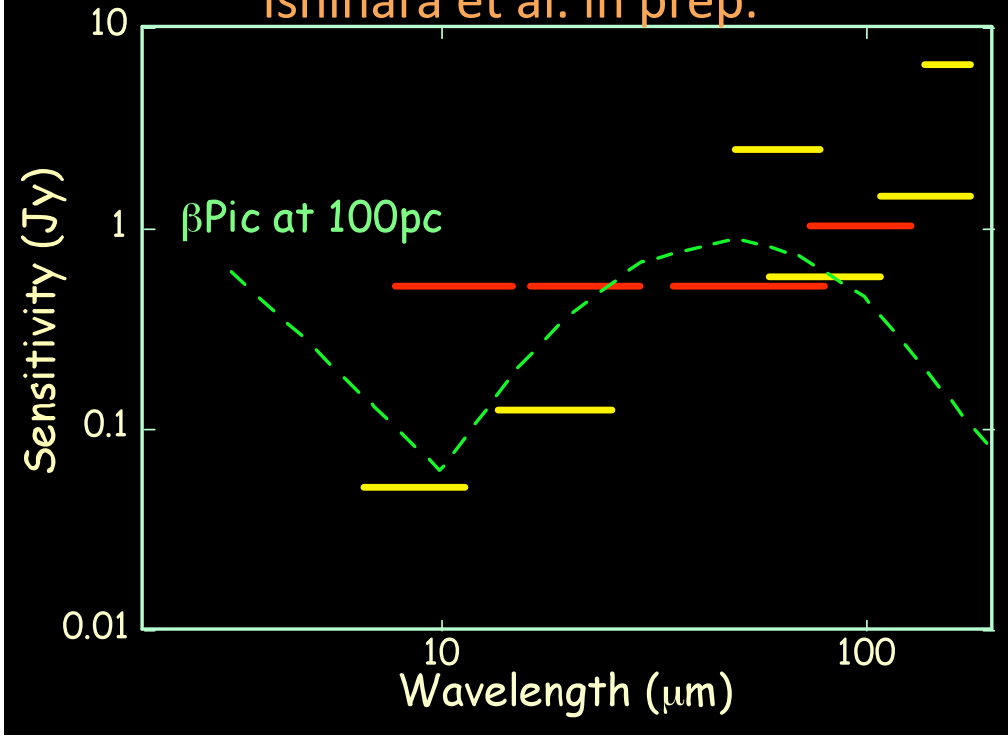
9μm source (~850,000) 90μm source (~290,000)

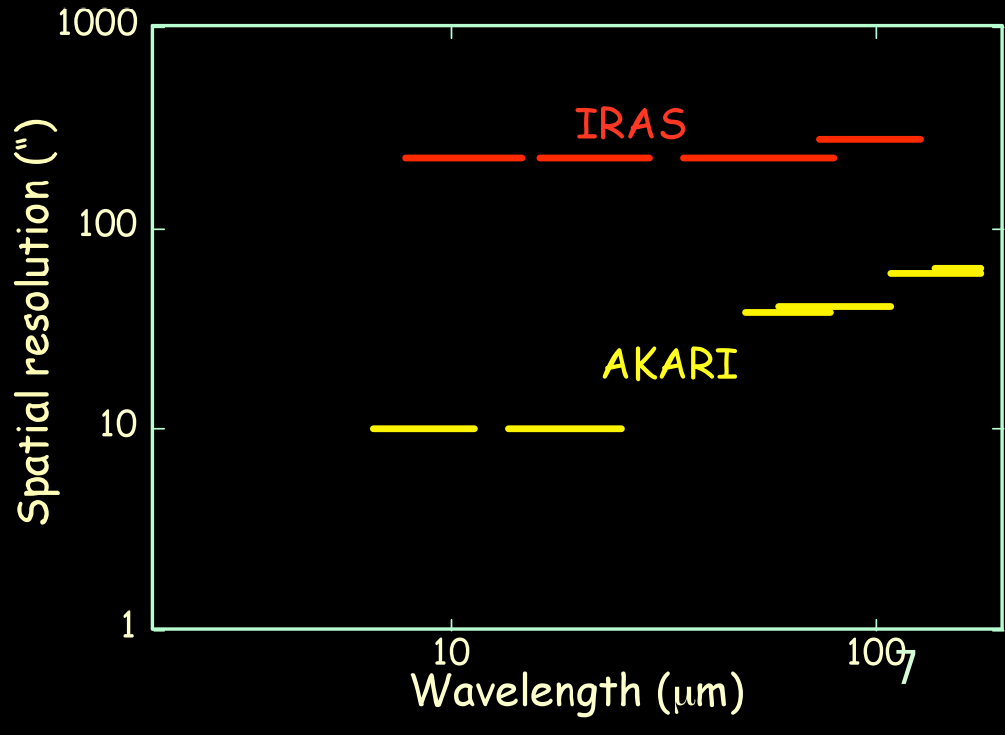
Point source catalogs will be released to the public in early 2010



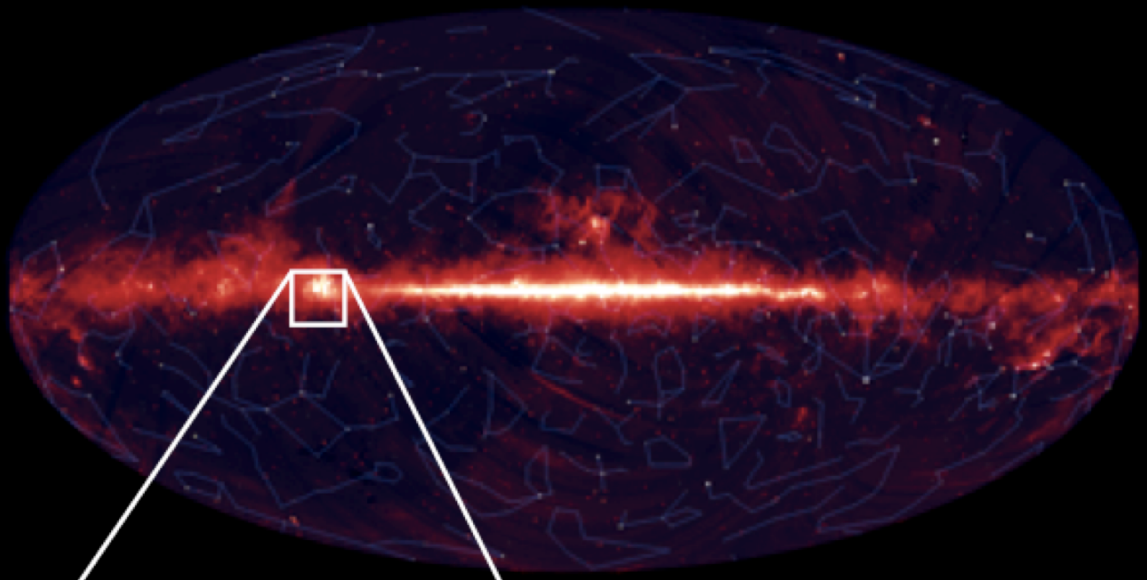


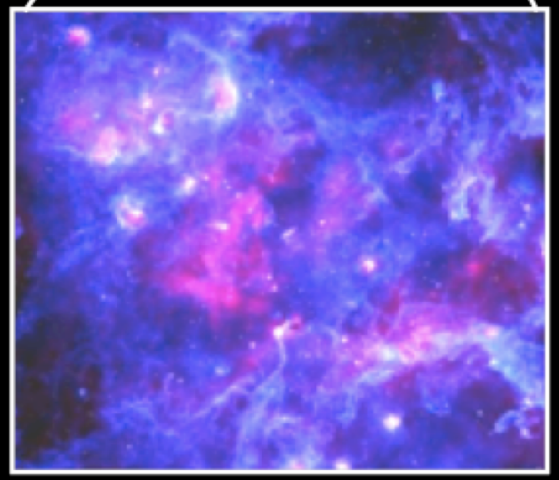
Ishihara et al. in prep.





Higher spatial resolution

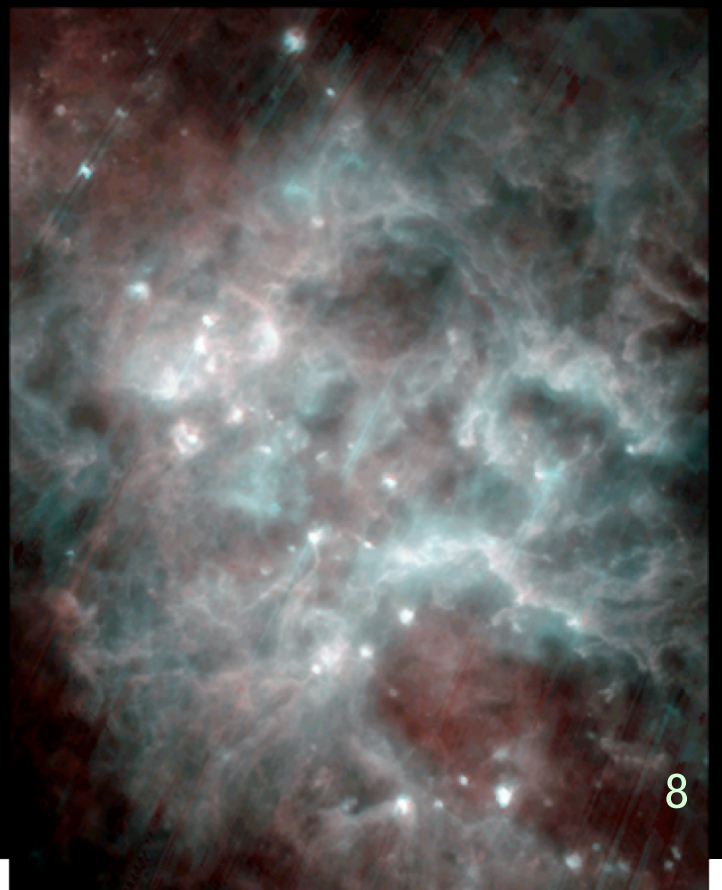




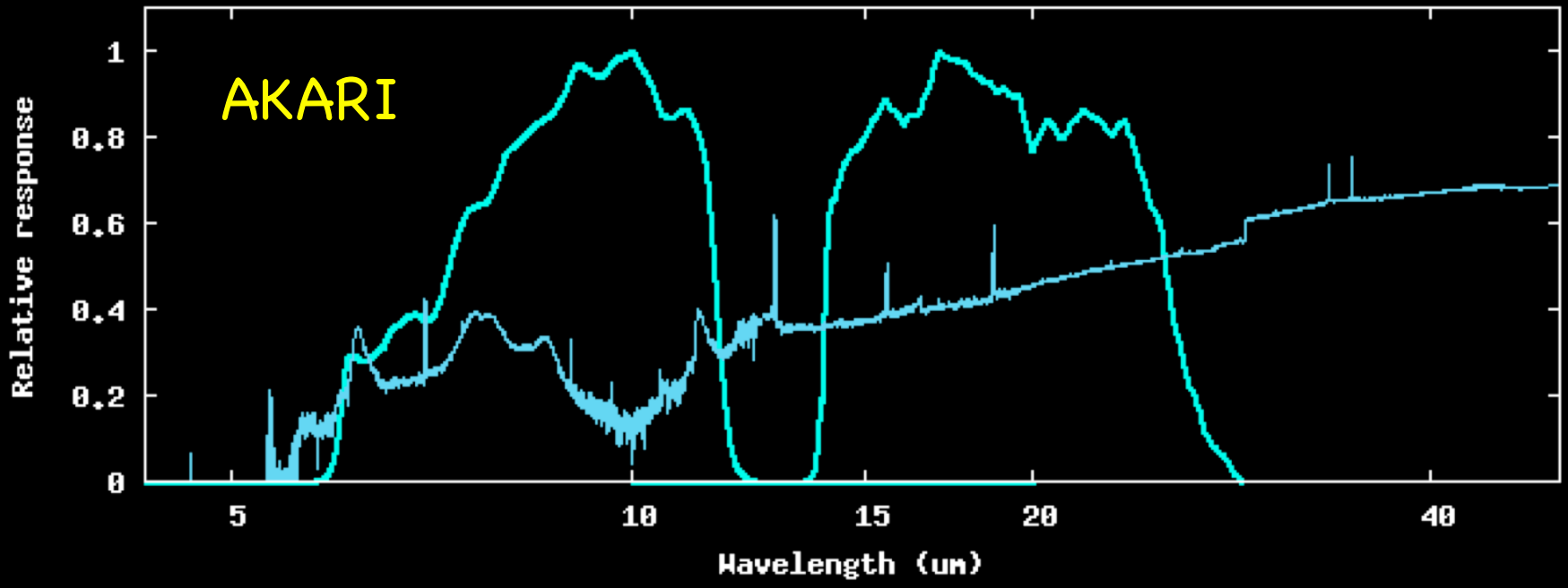
AKARI 9/18μm

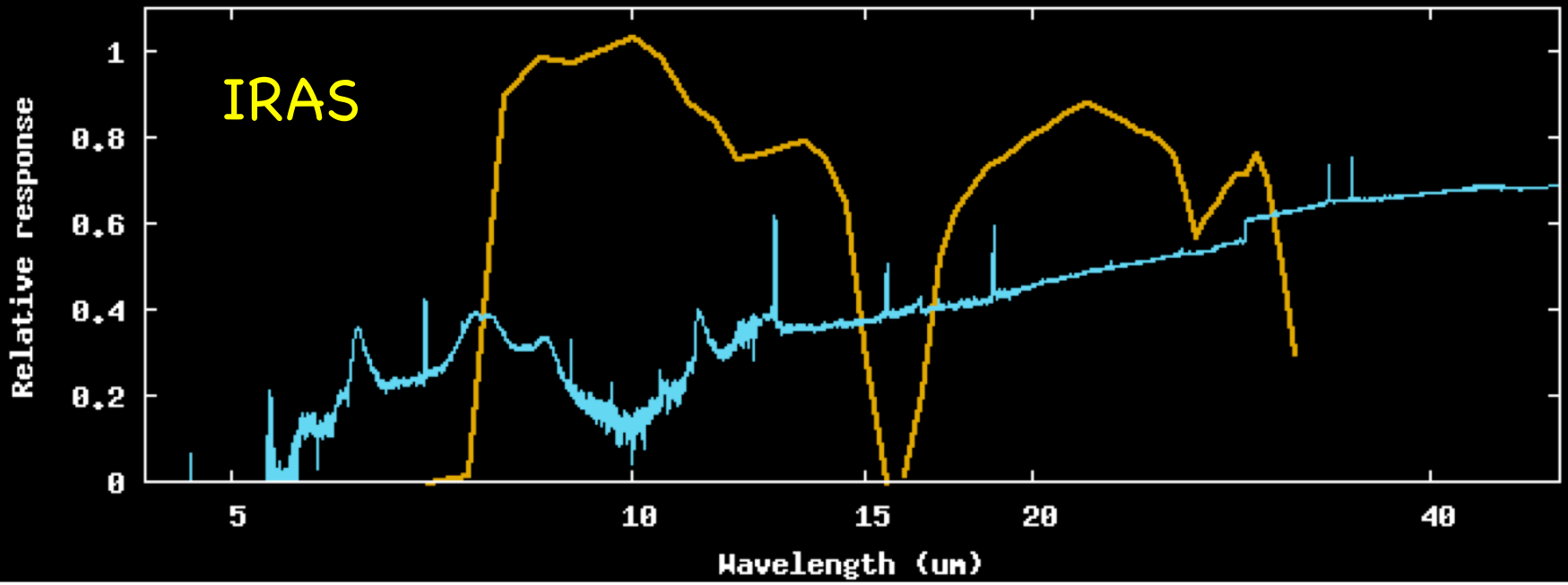
IRAS 12/25μm

AKARI 90/140μm



AKARI MIR all-sky survey filters

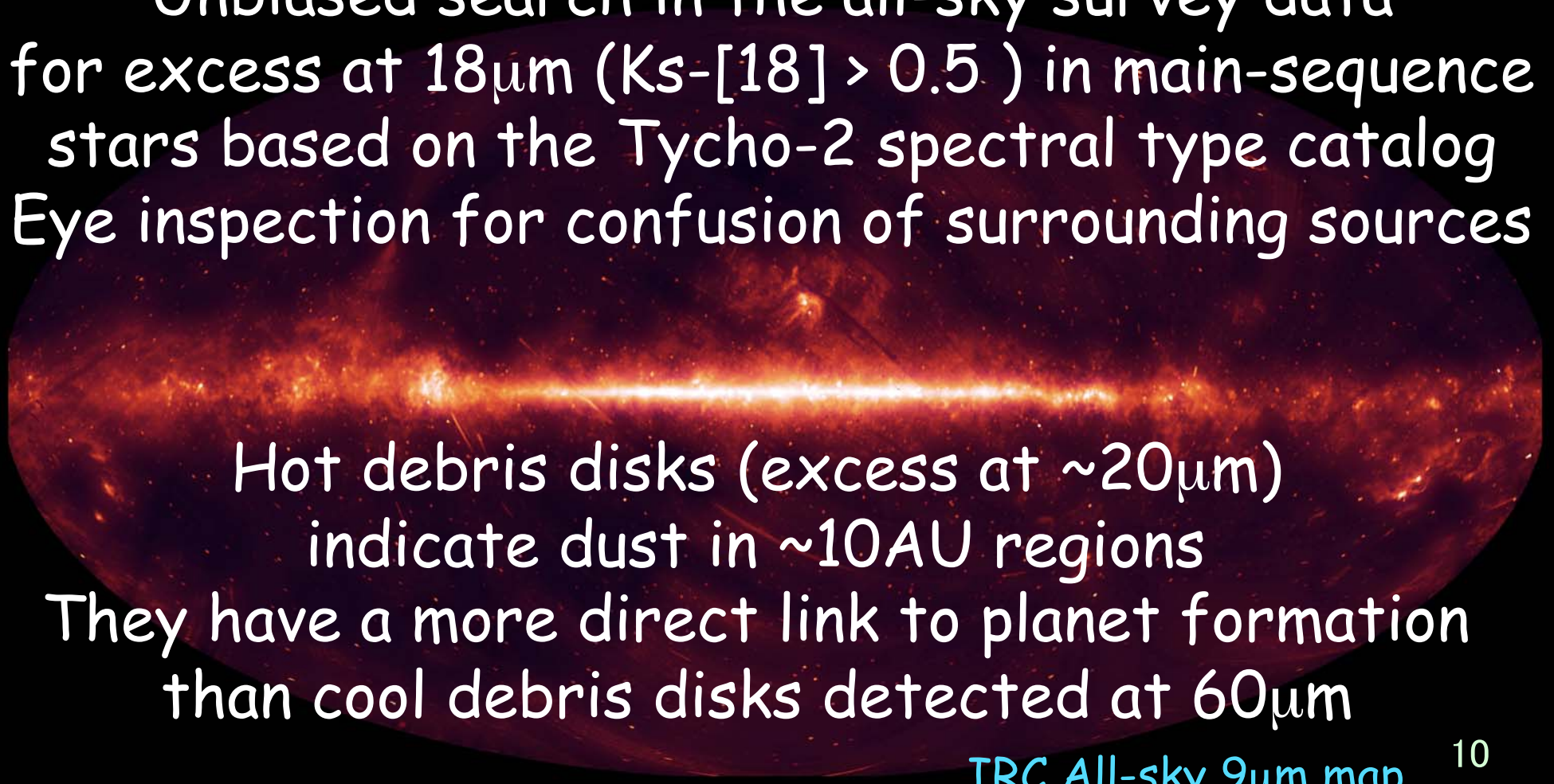




Search for hot debris disks in the MIR all-sky survey

Hideaki Fujiwara et al.

Unbiased search in the all-sky survey data
for excess at 18μm (Ks-[18] > 0.5) in main-sequence
stars based on the Tycho-2 spectral type catalog
Eye inspection for confusion of surrounding sources



Hot debris disks (excess at ~20μm)
indicate dust in ~10AU regions
They have a more direct link to planet formation
than cool debris disks detected at 60μm

IRC All-sky 9μm map

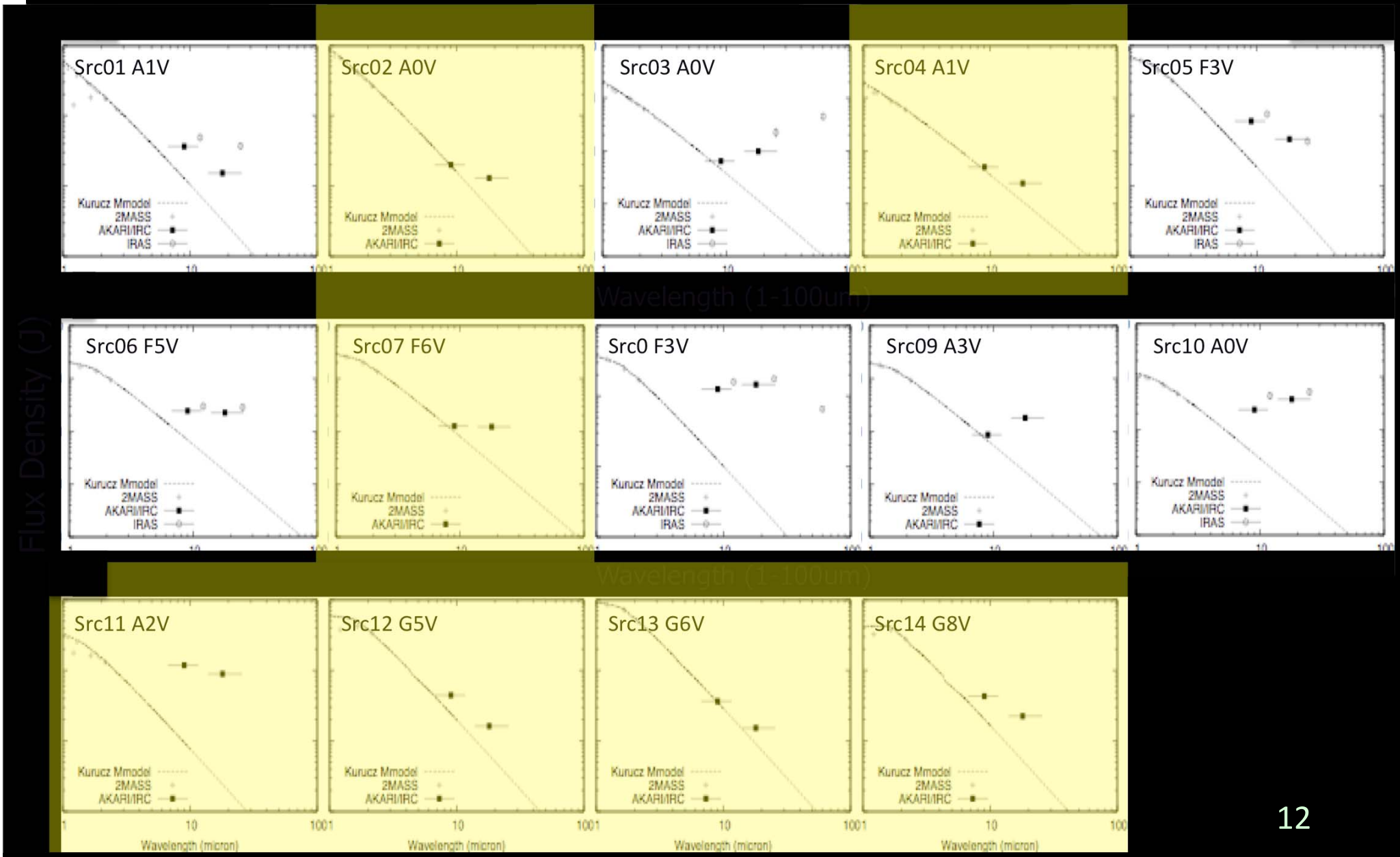
Detected debris disks

Detection of 18μm excess: 14/910 ~ 3.7%
(Fujiwara et al. in prep.)
smaller than Spitzer's results at 24μm
30% for A (Su et al. 2006); 6% for FGK (Beichman et al. 2006)

Spec. Type	Detection at 18 μm	Debris	Freq.(%)
A	196	15	7.7
F	324	12	3.7
G	173	3	1.7
K	144	2	1.4
M	19	0	0.0
Total	856	32	3.7

11 new debris disks discovered
Dependence of the frequency on the spectral type

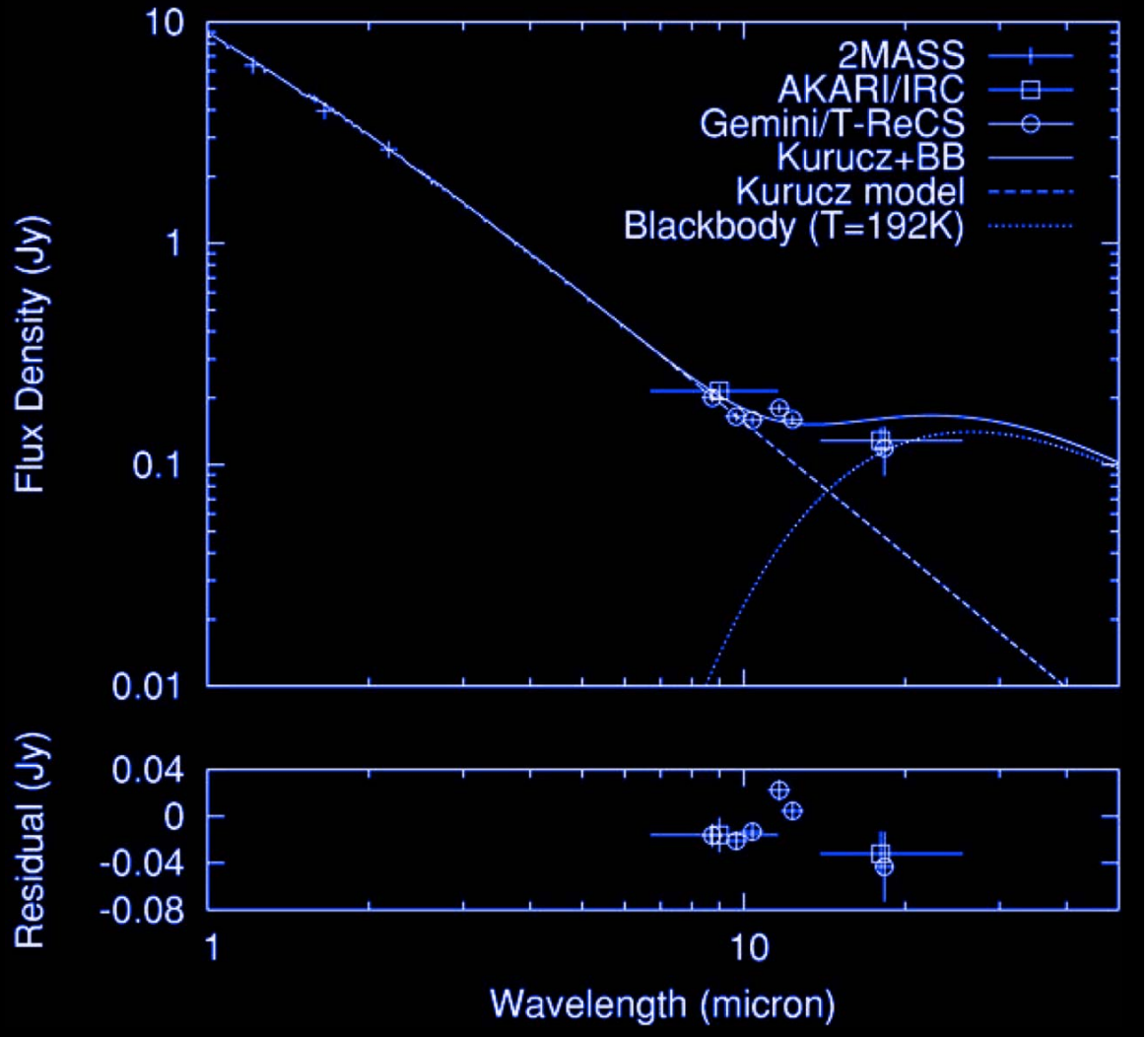
Results: Detected Debris Disks



Follow-up observations

HD106797
A0V@96+/-3pc
Multi-band MIR photometry at Gemini-S/T-ReCS
Excess at >10μm
T_d~190K
> typical debris
~15 AU
L_{IR}/L_{star}~1.3x10^{-4}
cannot be accounted for by steady state evolution models of supply by collisions

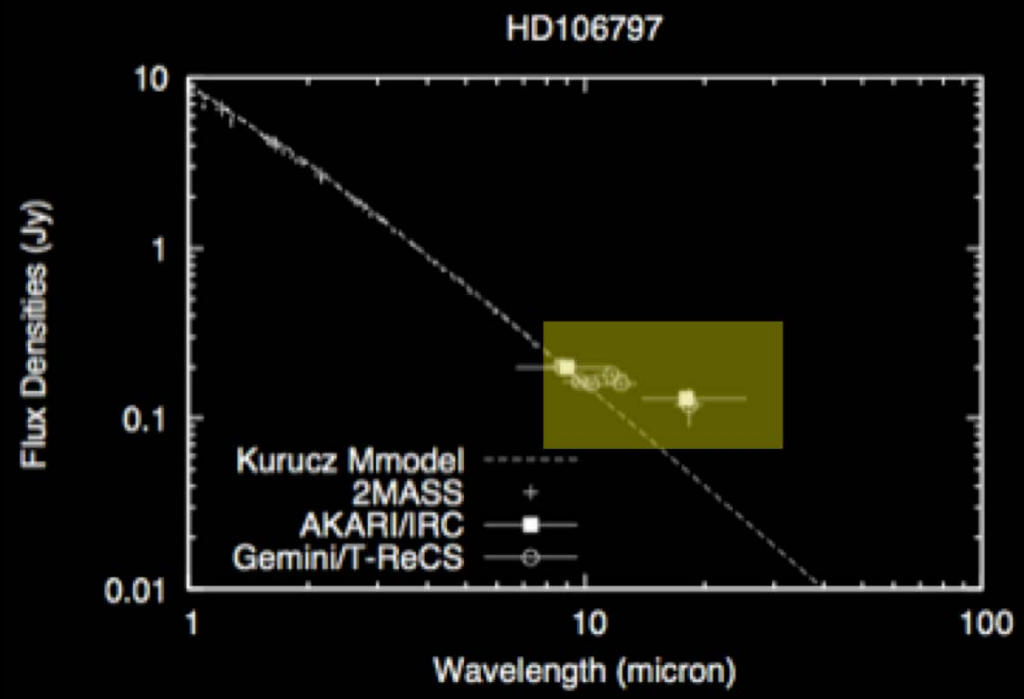
Fujiwara et al. 2009 ApJL, 695, L88

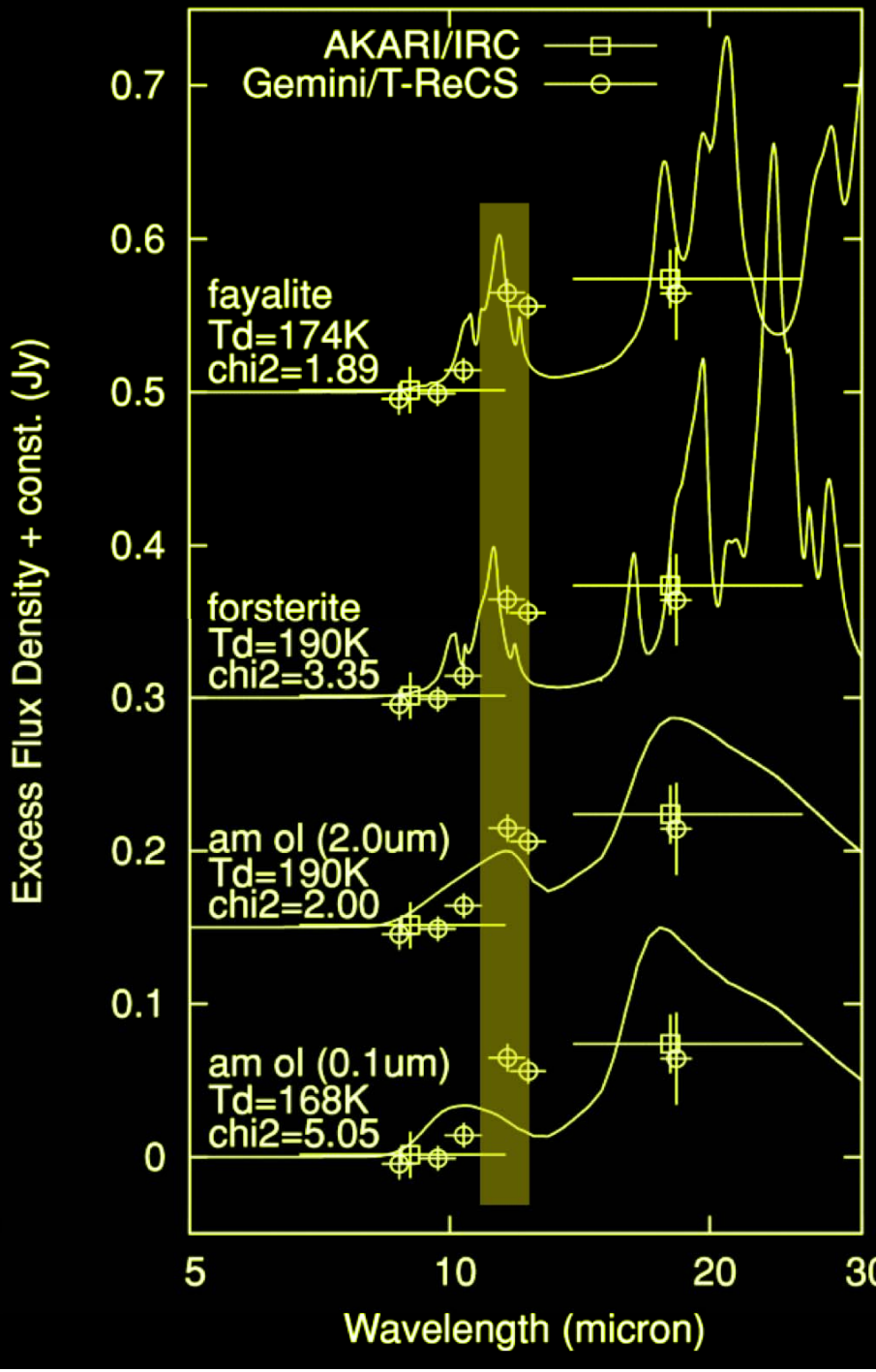


-> Transient event

Unusual 10μm feature

Bump at ~ 11-12 μm
indicates small grains
(~ (sub-)micron)
Crystalline silicate provides
a better fit than
amorphous





Follow-up observations: HD15407

HD15407: F3V, age = 2.1Gyr, [Fe/H] = +0.8, d=55pc

No evidence for excess in FIR

Spitzer/IRS Observations with SL/LL (5-37μm)

Even at 5μm, excess emission is seen
-> hot dust grains

How are they formed?

Fujiwara et al. submitted

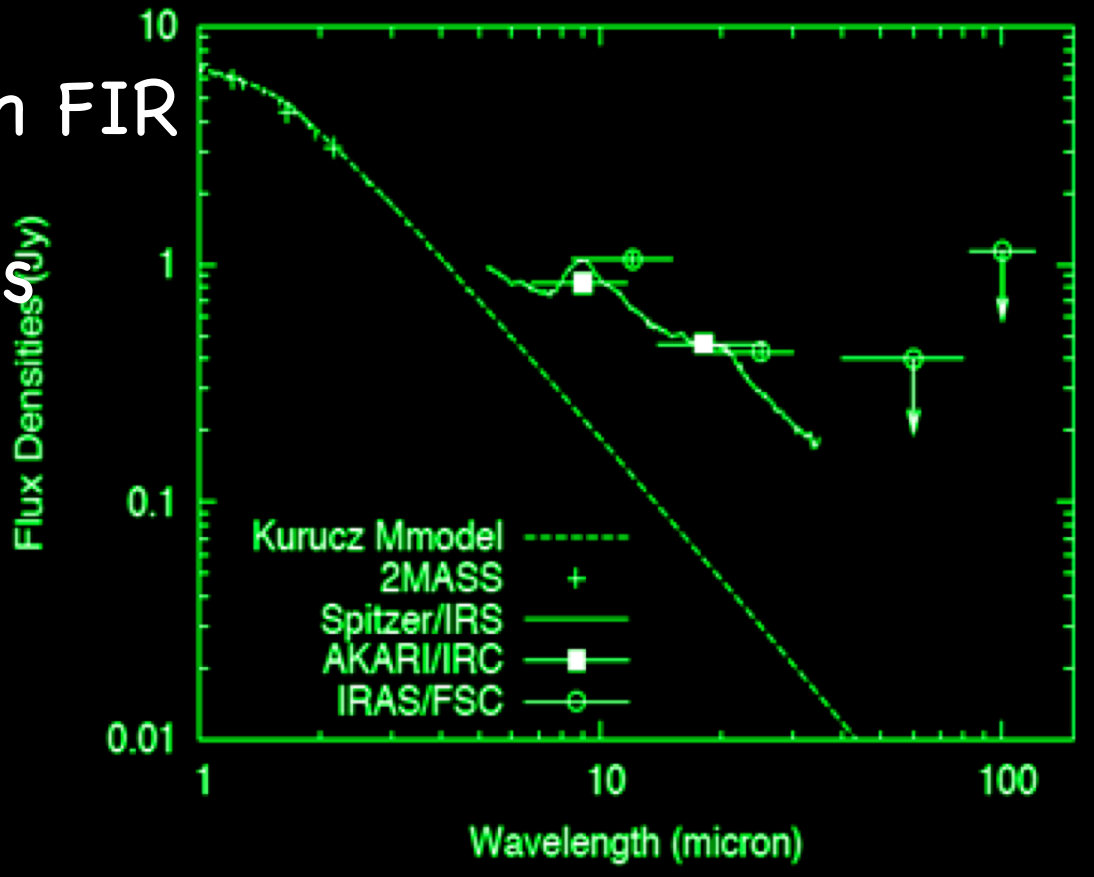


Fig. 1.— The NIR–FIR SED of HD 15407. The filled squares and open circles indicate the photometry with the *AKARI*/IRC and IRAS, respectively. The solid and dashed lines indicate *Spitzer*/IRS spectrum and the photospheric contribution fitted with the Kurucz model of F3 star (Kurucz 1992), respectively.

Results: Dust Features

10 & 20μm features are different from the `standard silicate' features. The peaks are at ~9 & 20-21μm. The spectrum is well accounted for by a combination of silica and amorphous silicates.

The silica fraction (~40%) is high compared to other silica-objects (<15%)

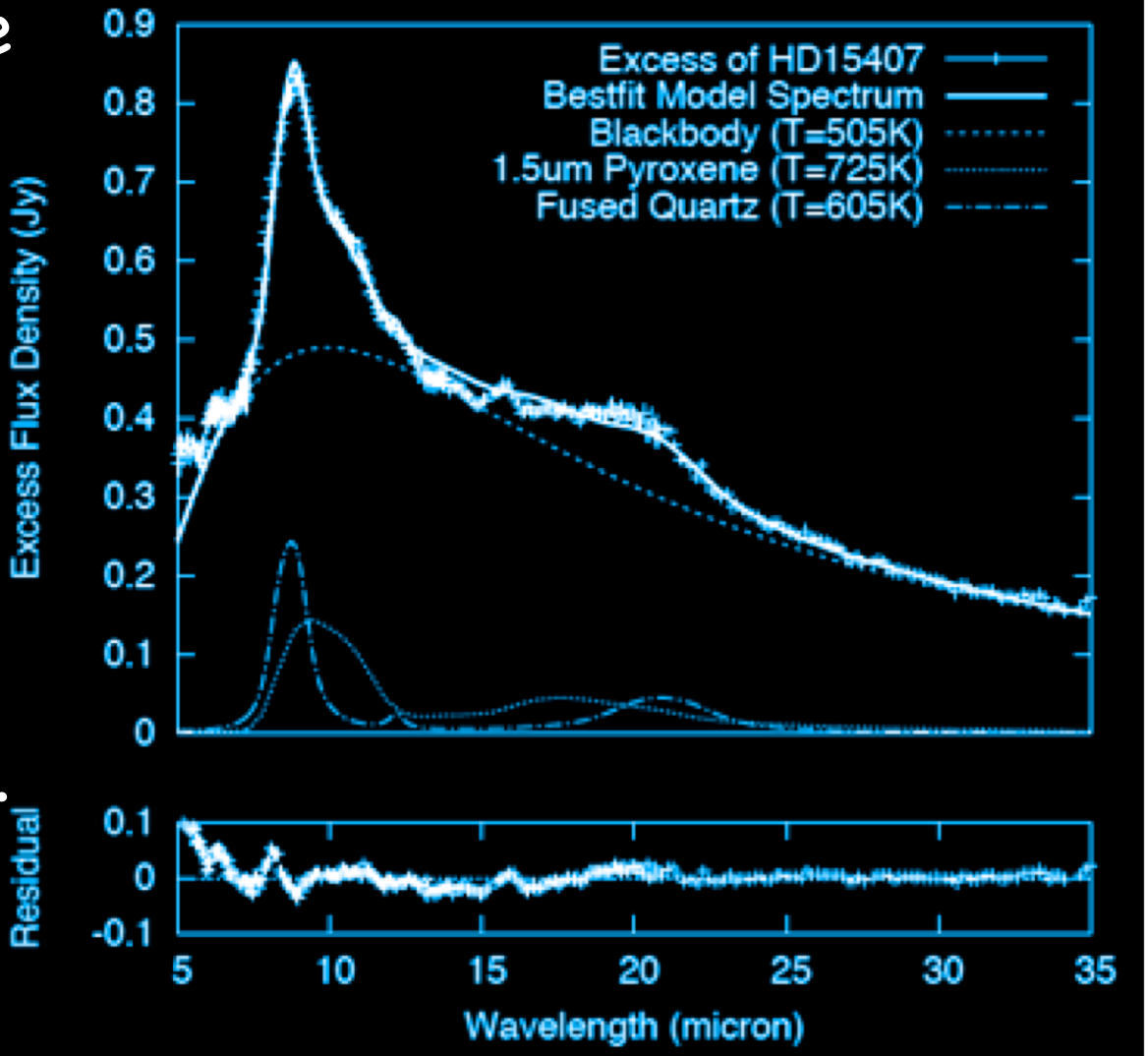
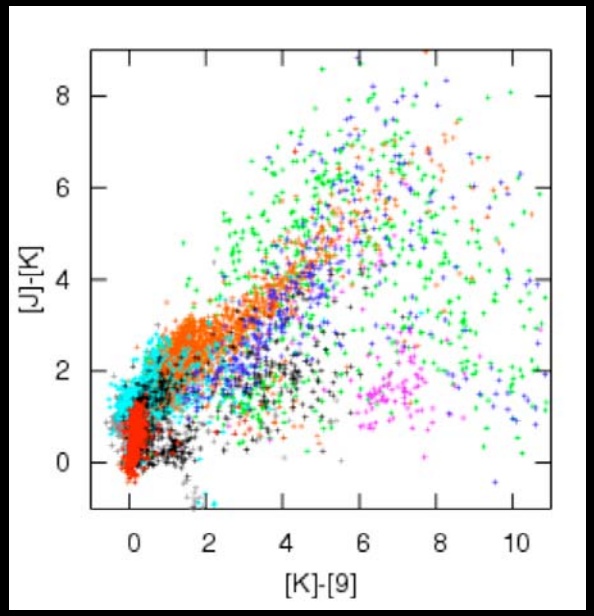


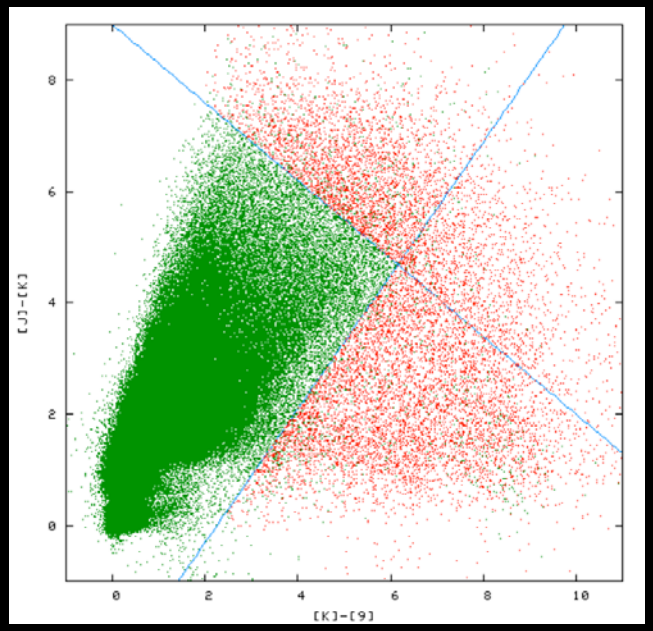
Fig. 2.— *Top*: The *Spitzer*/IRS spectrum of HD 15407 and the results of SED fitting with a model. *Bottom*: The residuals subtracted by the best-fit spectrum model.

On-going projects with AKARI
NIR spectroscopy (2.5 – 5μm)

NIR spectroscopic observations of very red objects
F(9mm)/F(Ks) > 2 for |b|>30 (AGN search)
(Oyabu et al. in prep.)

NIR spectroscopic observations of red objects
for |b|<30 (dusty Galactic objects)
(PI. D. Ishihara)





Possible SOFIA Observations

FORCAST MIR spectroscopy of objects selected from MIR all-sky survey & NIR spectroscopy

Complementary to AKARI NIR spectroscopy

Detection limits are similar (50-100mJy)

Hot debris disk candidates show a variety of silicate features, suggesting dust processing in the disk

We obtained IRS spectra for some of them, but not all of them

Ground-based spectroscopy is affected by atmospheric absorption; Q-band spectroscopy is not sensitive

MIR (>30μm) imaging may be interesting, but extended emission is not expected for hot debris disks

Thank you for your attention