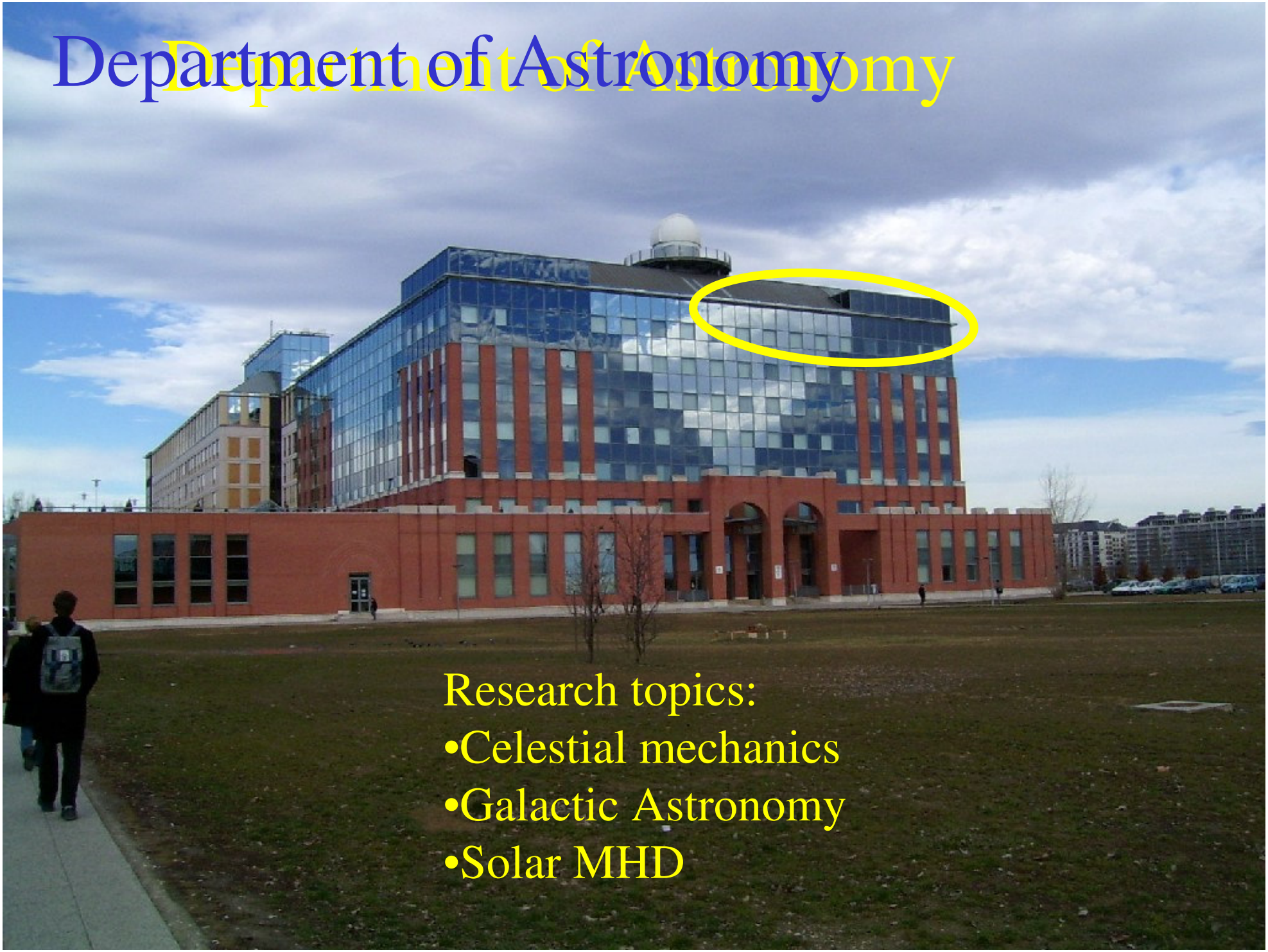
Recent results of ISOPHOT surveys

Tóth, L.V. (ELTE & Konkoly Obs., Budapest)

KISAG, 11 May 2006

Budapest, Eötvös University
Faculty of Natural Sciences

Department of Astronomy



Research topics:

- Celestial mechanics
- Galactic Astronomy
- Solar MHD

Abstract

ISOPHOT surveys

- Surveys with highest impact
- Recent results in the main fields
- Early phases of star formation & problems
- Isolated clouds including absolutely unimportant globules
- The colours of the Cepheus

ASTRO-F related activities in Hungary

ISOPHOT surveys, and their impact

ISOPHOT surveys: 288 abstracts in the ADS, Total citations: 5344

Most popular topics:

Dust content of actively star-forming galaxies

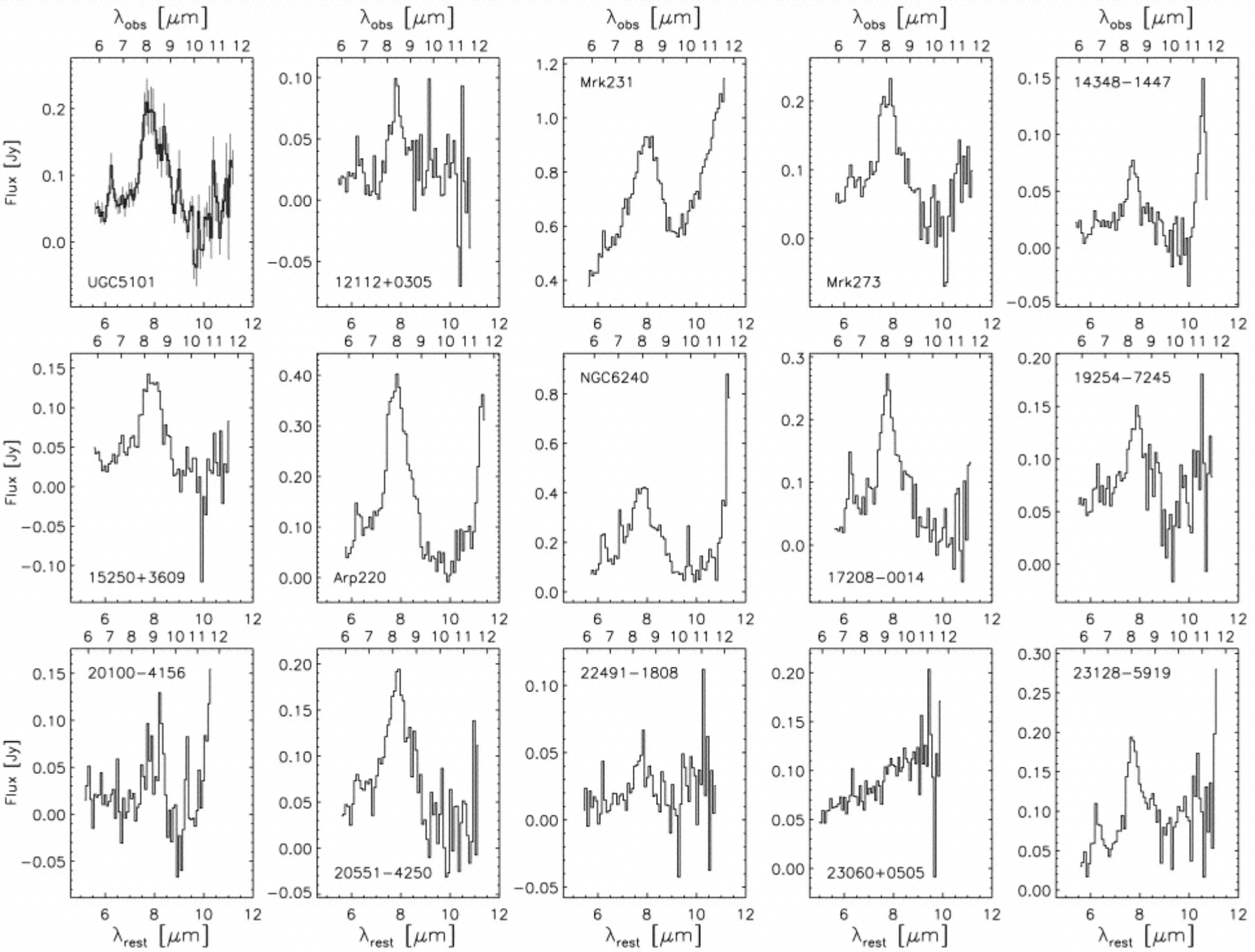
Genzel, R.; Lutz, D.; Sturm, E. et al. ***„What Powers Ultraluminous IRAS Galaxies?"*** 1998, ApJ 498, 579 (**515 cit.**)

Extragalactic background surveys on FIR faint regions

Puget, J. L.; Lagache, G.; Clements, D. et al. ***"FIRBACK. I. A deep survey at 175 microns with ISO, preliminary results"*** 1999, A&A 345, 29 (**127 cit.**)

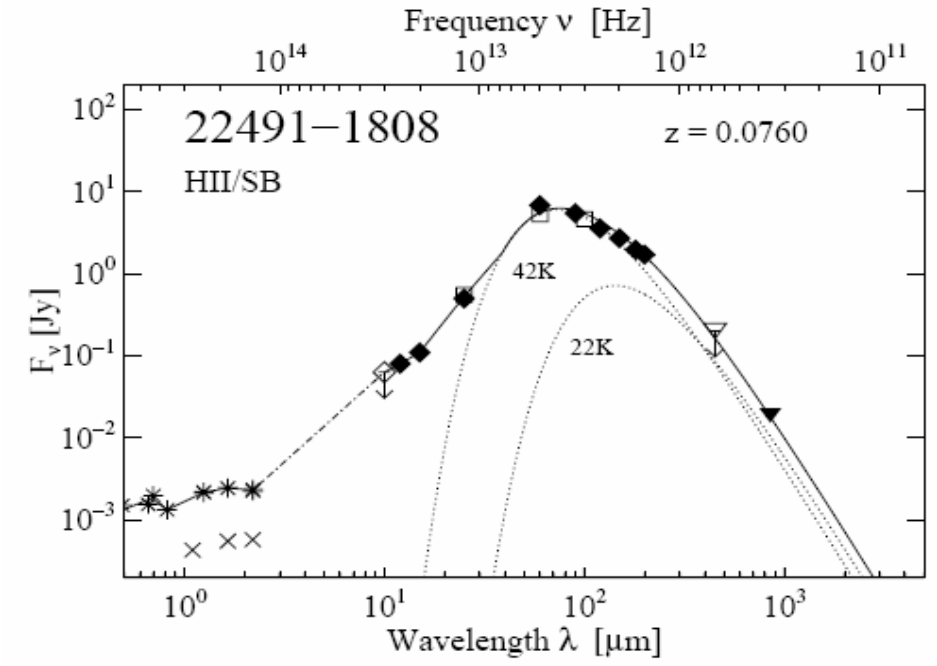
Circumstellar dust

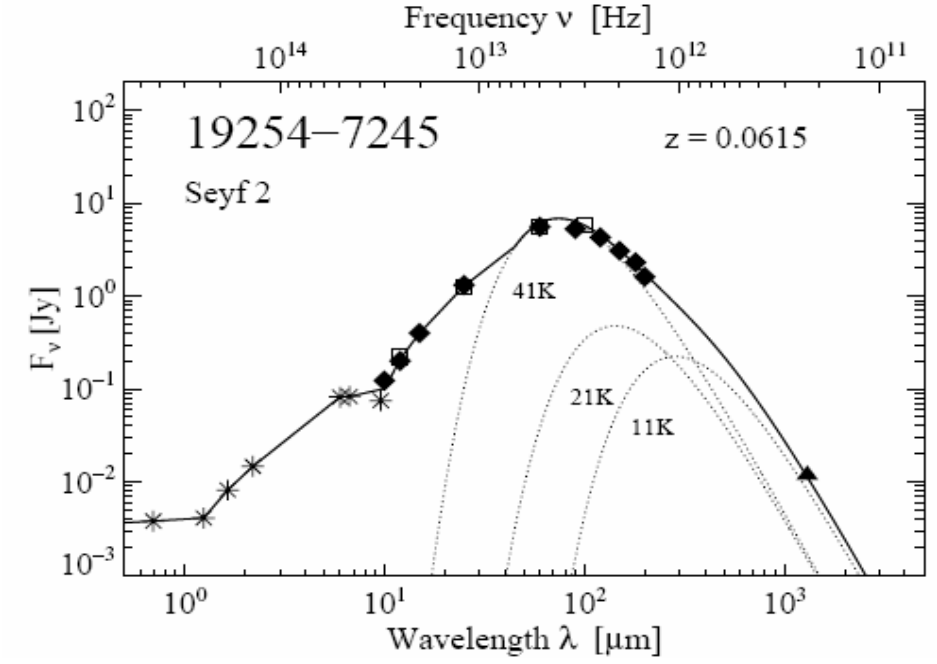
Spangler, C.; Sargent, A. I.; Silverstone, M. D. et al. ***"Dusty Debris around Solar-Type Stars: Temporal Disk Evolution"*** 2001, ApJ 555, 932 (**68 cit.**)



ISOPHOT-S spectra by Genzel et al. 1998

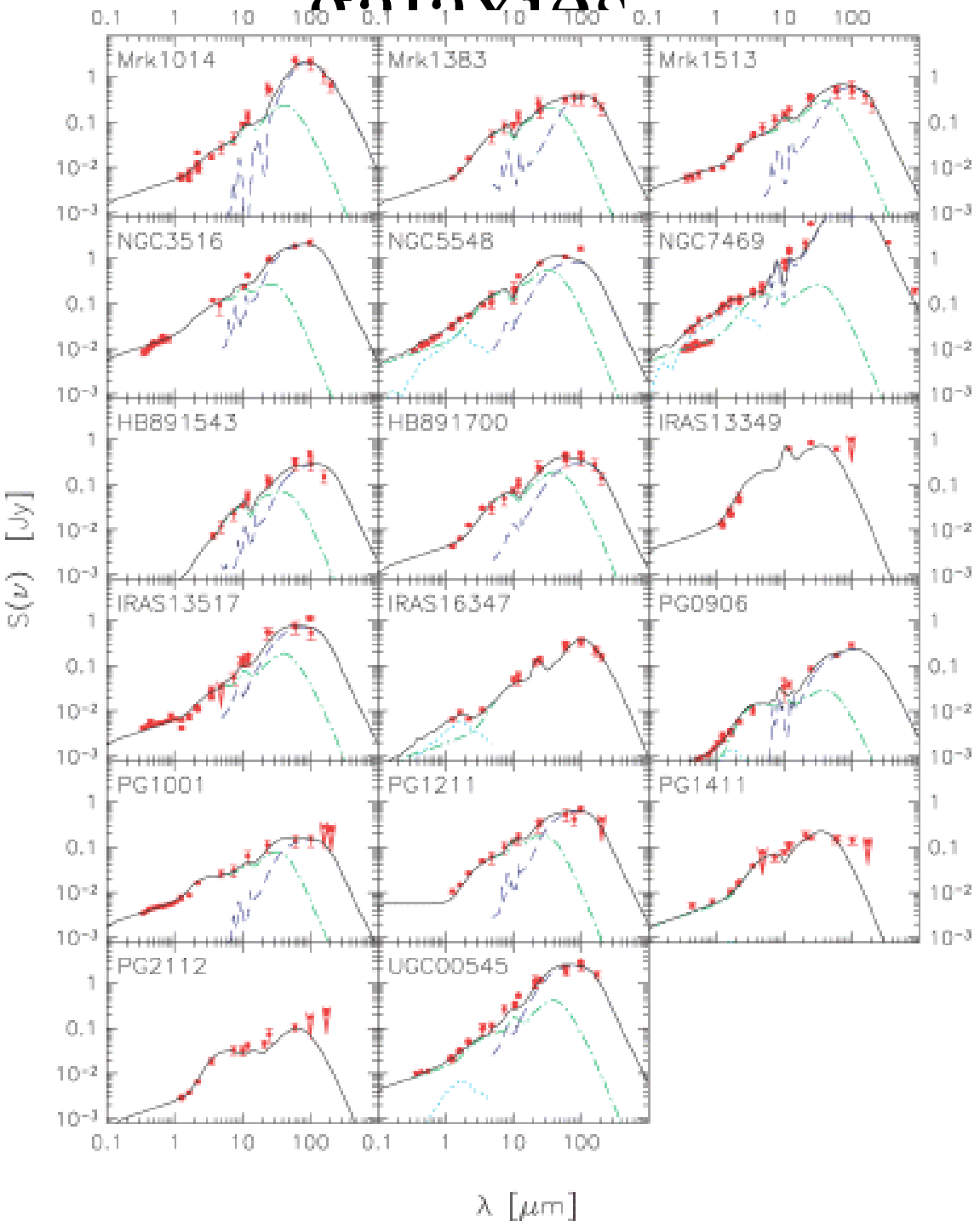
„Infrared to millimetre photometry of ultra-luminous IR galaxies" U. Klaas et al. 2001, A&A





- 41 bright ultraluminous infrared galaxies (ULIRGs)
- the most complete set of infrared photometric templates obtained to date (2001) on ULIRGs in the local universe.
- suggests that the FIR-submm SEDs are composed of several (at least two) λ^{-2} modified blackbodies with cool to cold temperatures

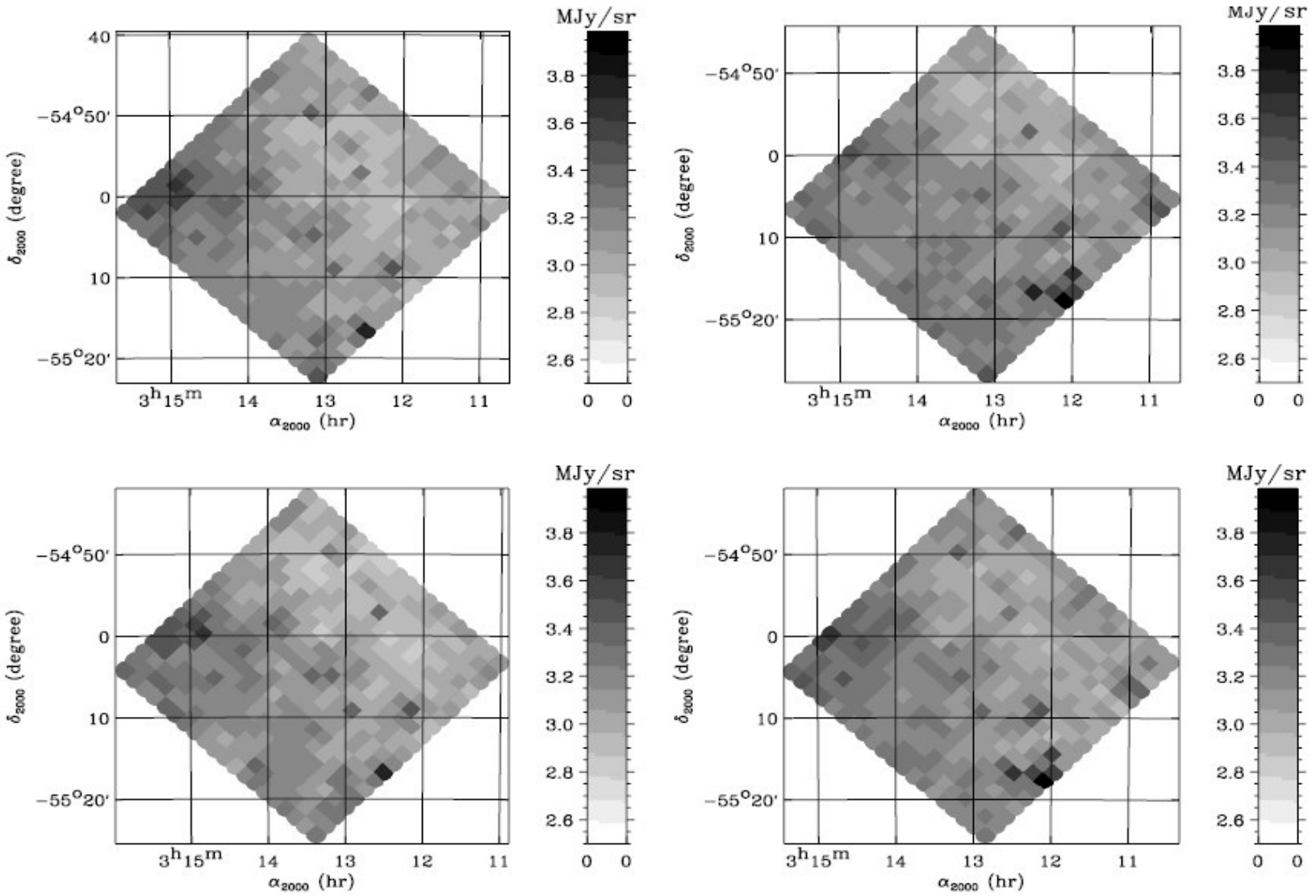
Dust in actively star-forming galaxies



Fritz, J., Franceschini, A. & Hatziminaoglou, E. 2006, „Revisiting the infrared spectra of active galactic nuclei with a new torus emission model"

MNRAS **366** (3), 767-786.

Extragalactic background



Puget et al. 1999

170μm ISOPHOT 19x19 raster images with 2pixels dith.

The European Large Area ISO Survey

KEY SCIENTIFIC GOALS

- The star formation history of the Universe
- Ultra-luminous infrared galaxies at high z
- Emission from dusty tori around AGN
- Dust in normal galaxies to cosmological distances
- Circumstellar dust emission from galactic halo stars
- New classes of galactic and extragalactic objects
- The extragalactic background

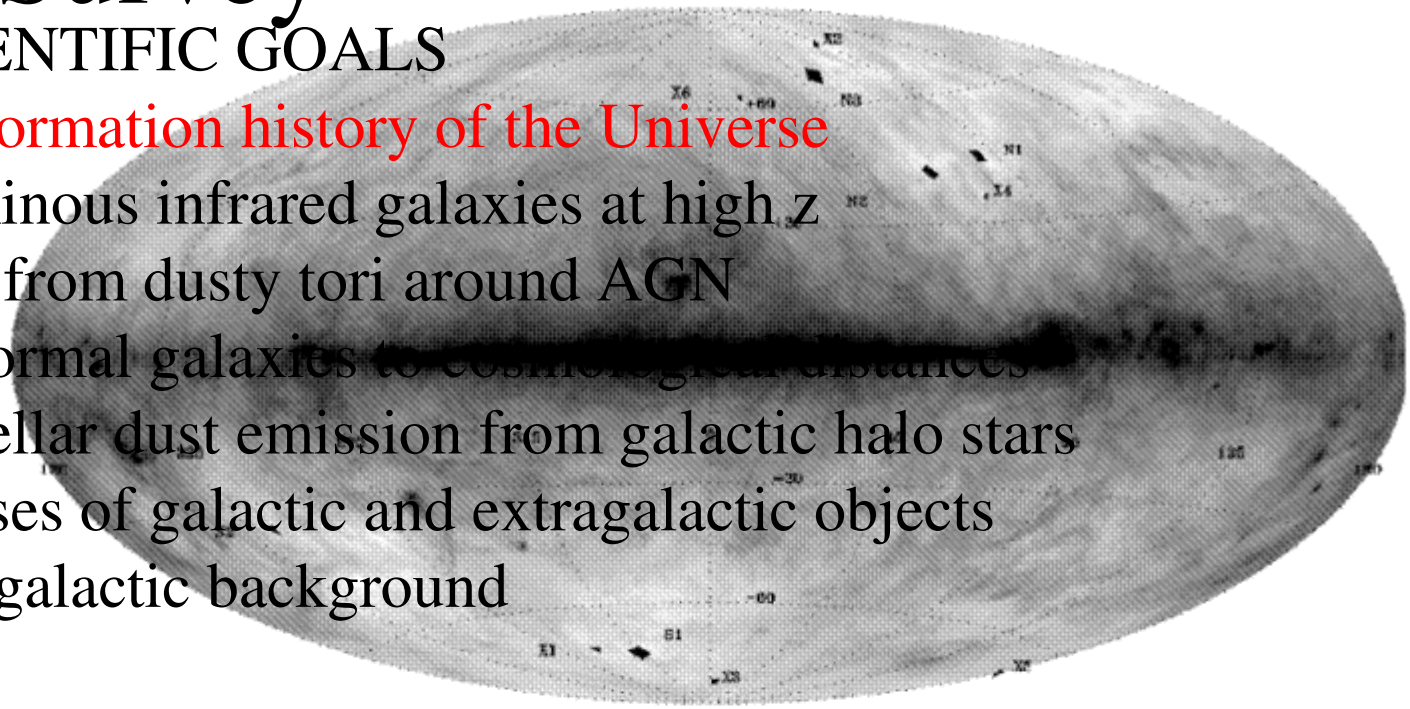
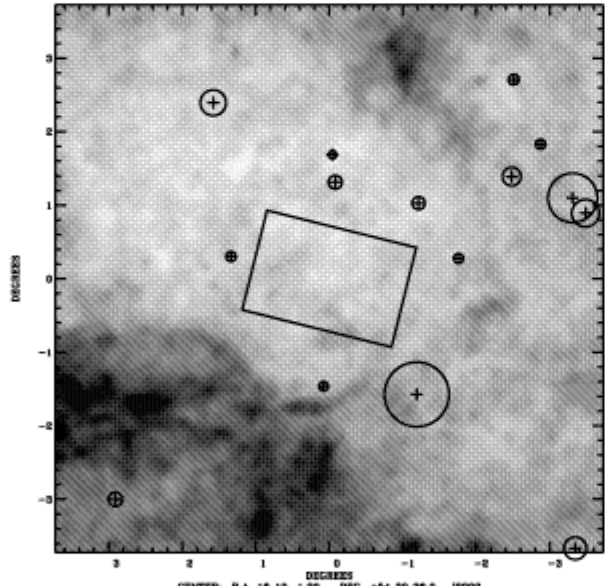
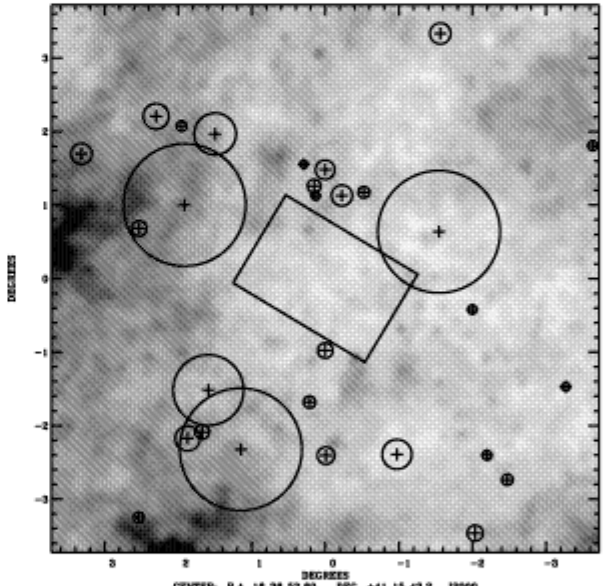


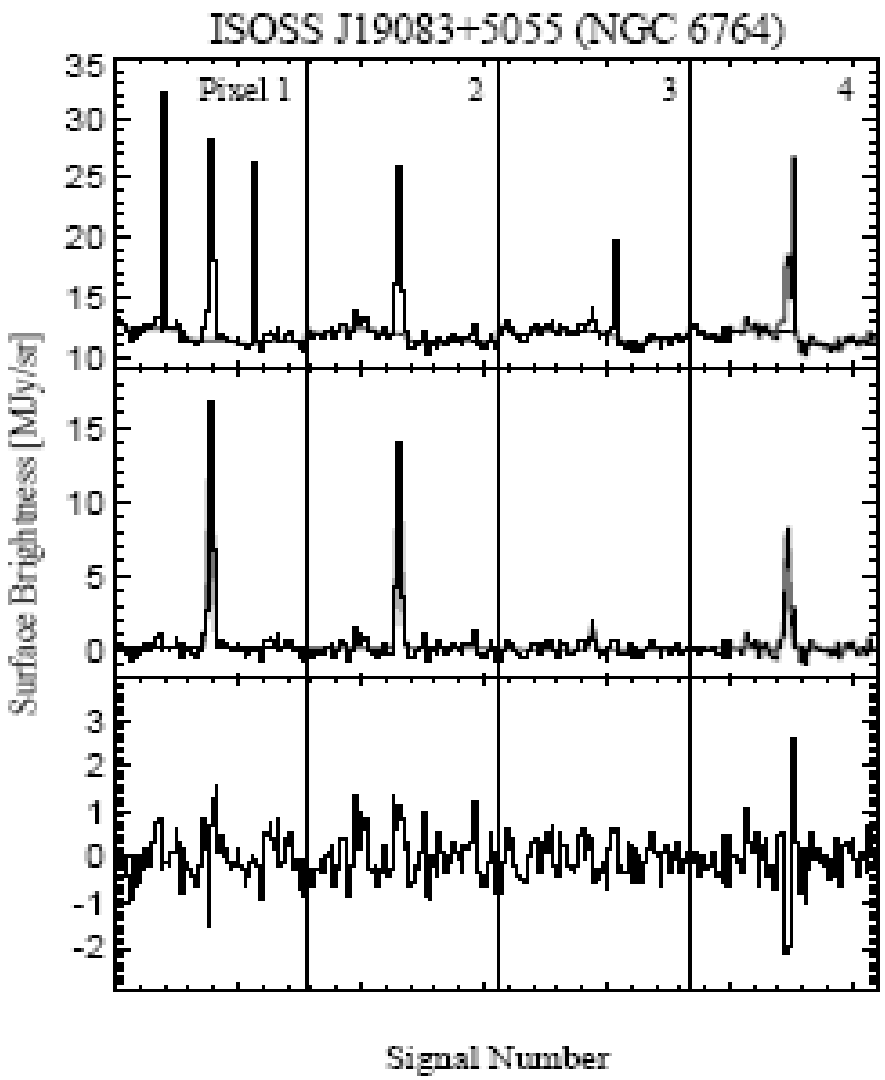
Figure 7. The location of the ELAIS survey fields overlaid on a Hammer–Aitoff equal area projection of the *COBE* normalized *IRAS* maps of Schlegel et al. (1998). Galactic latitude and longitude gridlines are overlaid.





)6)

ISOPHOT Serendipity Survey mode

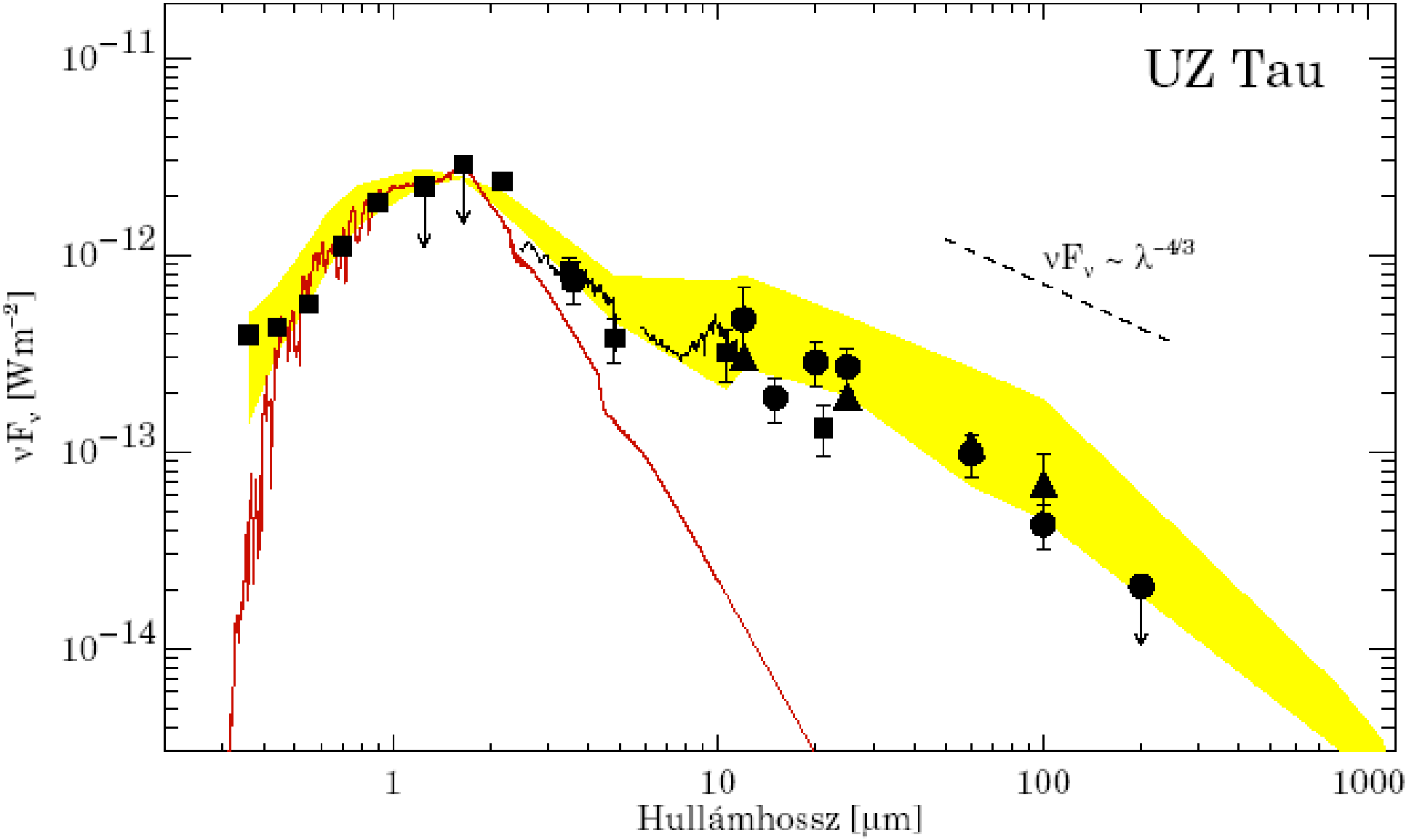


ISOPHOT C200 at 170micron
10% of sky

The ISOPHOT 170m serendipity survey I. Compact sources with galaxy associations M. Stickel et al. 2000, A&A, 359, 865

115 well-observed sources with a high signal-to-noise ratio in all detector pixels having a galaxy association

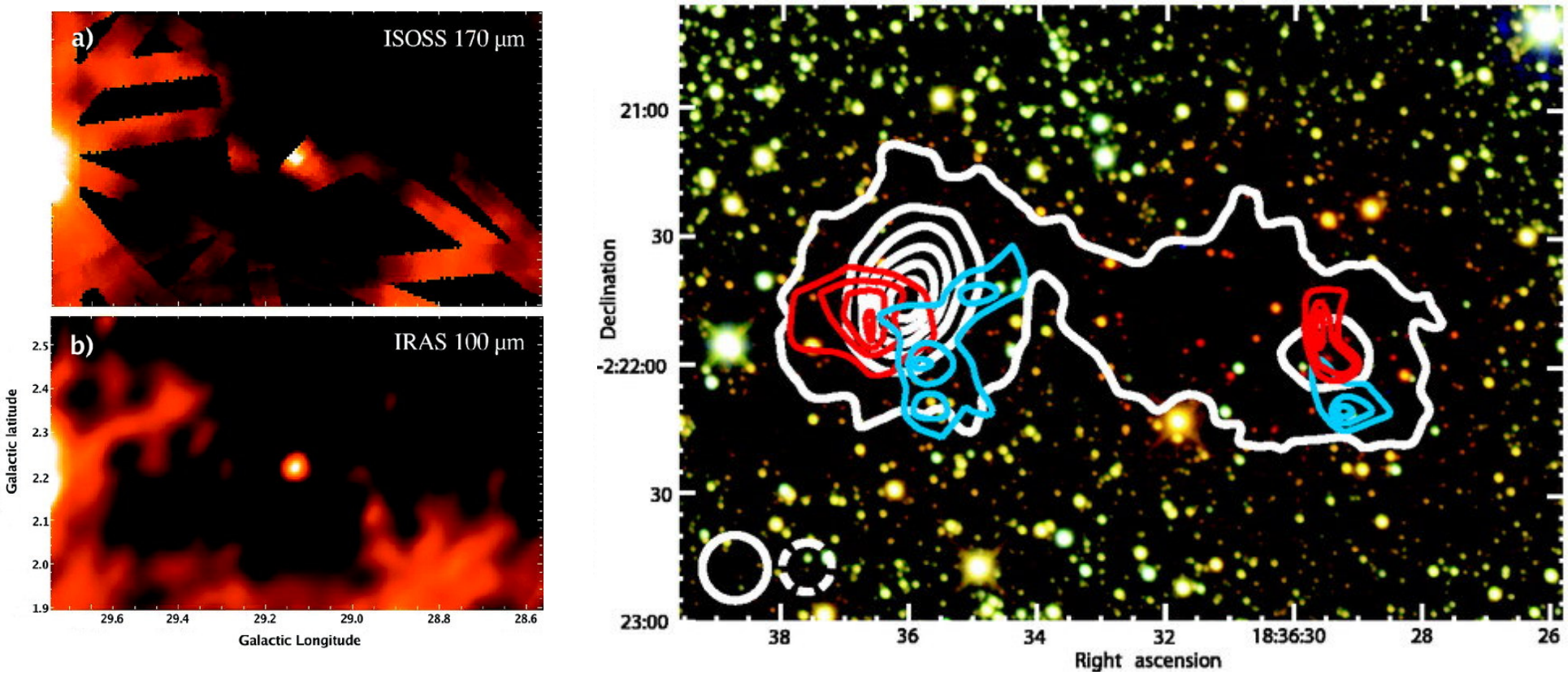
Circumstellar dust



TTauri type star with photospheric & circumstellar emission

(Kóspál et al. 2004)

Massive cores near ISOSS J183640221
Birkmann et al. 2006, A&A 637, 380



SMM1: T=16.5 K, signs of ongoing infall and outflows, has no near- or mid-infrared counterpart, M=75 M_{Sun} , may form an O star, a high-mass analog to the Class 0 objects.

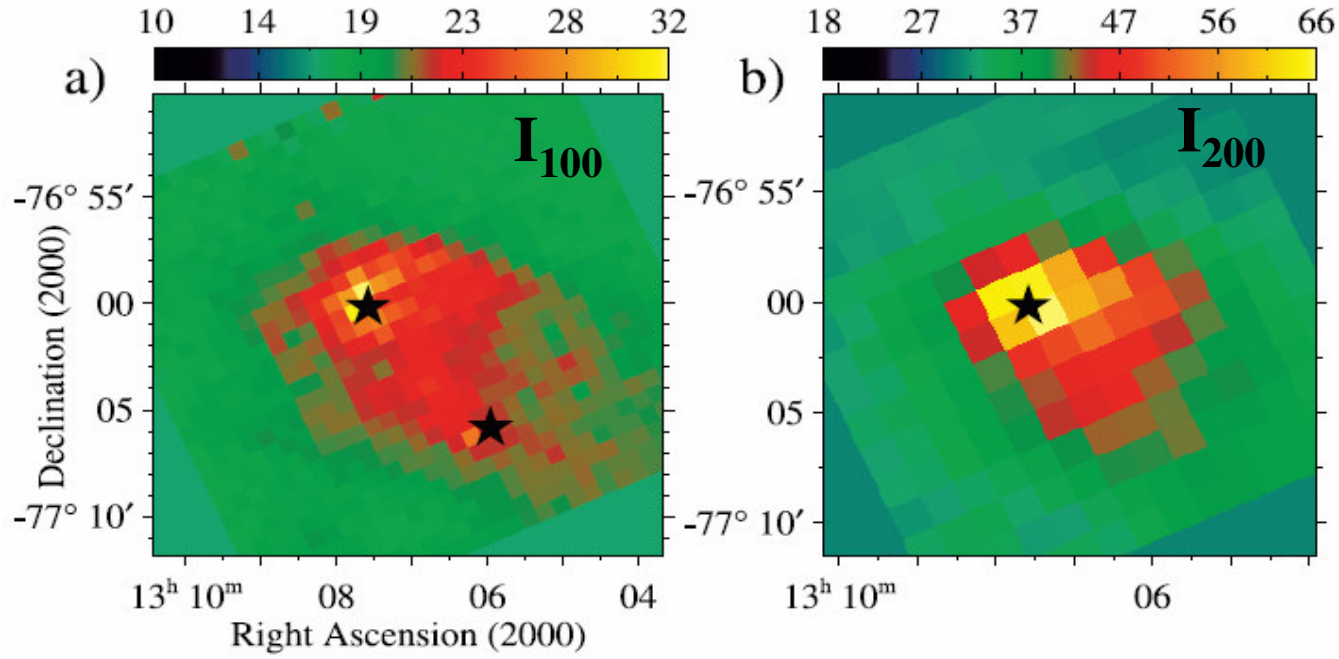
SMM2: T=12 K, M=280 M_{Sun} , may represent the initial conditions from which high-mass star formation occurs.

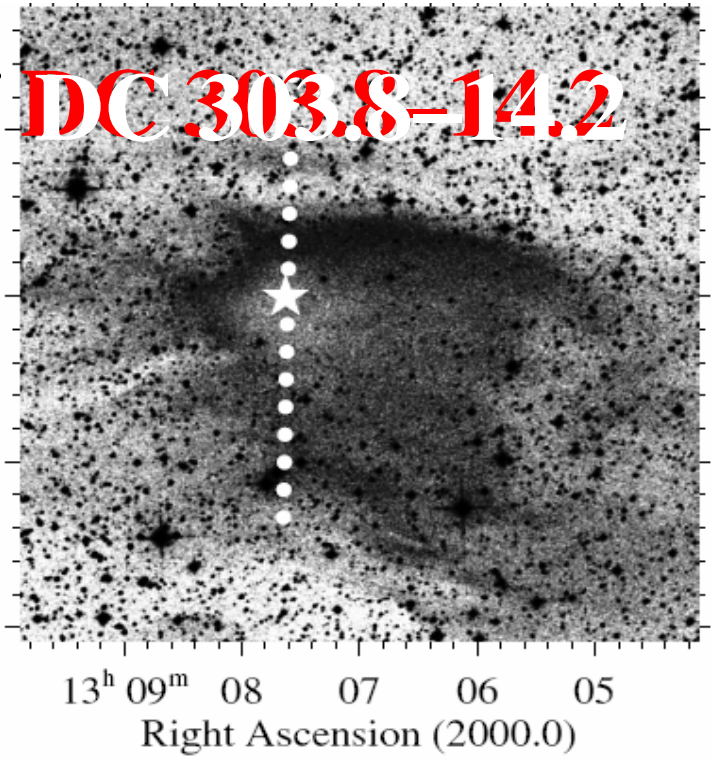
Do we know how low mass stars form? A biased list of caveats

- Timescale: “rapid” SF vs. ambipolar diffusion
  (eg. Elmegreen 2000 vs. Tassis & Muschovias 2004 ApJ)
- Trigger: (1) globule squeesing, (2) collect and collapse, (3) cloud collision (Elmegreen 1998)
- ISM properties: starless and star forming cores
  (eg. Tatematsu et al. 2004 ApJ, Crapsi et al. 2005 ApJ)
- IMF: census of very low mass and substellar obj.
  (eg. Luhman 2004 ApJ – revised deficit of BDs in Taurus)
- Star forming rate: without observational biases
  (see recently: Schmeja. Klessen, and Froebrich 2005 A&A)

(Unimportant) Globules

K. Lehtinen et al.2005: ISO study of DC 303.8–14.2



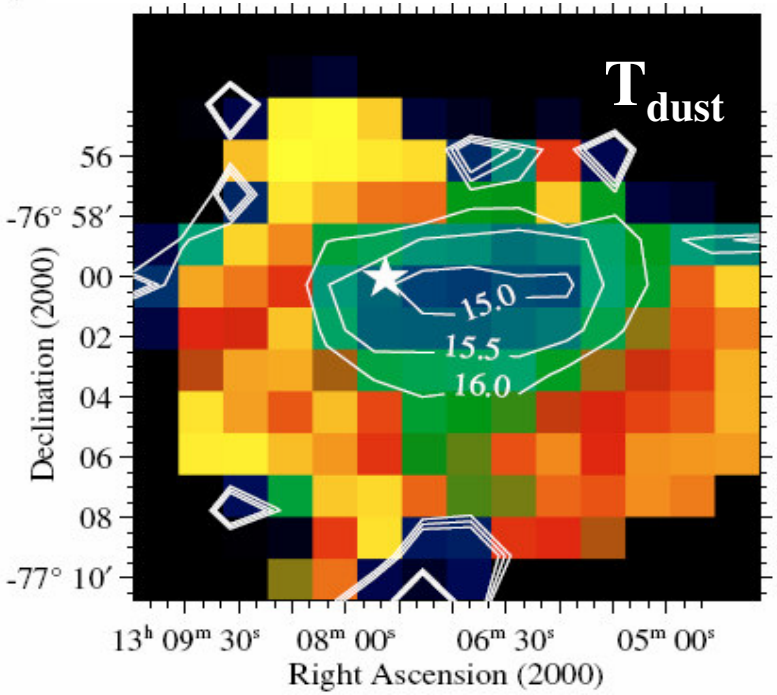


ISOPHOT observations:

- 7.7µm, 60µm photometry (along dotted line)
- 100µm, 200µm imaging photometry

Derived:

- FIR colour temperature distribution
- YSO at peak optical depth has no effect on T



Small molecular clouds whose extended FIR emission has been mapped by ISO (Lehtinen et al. 2005)

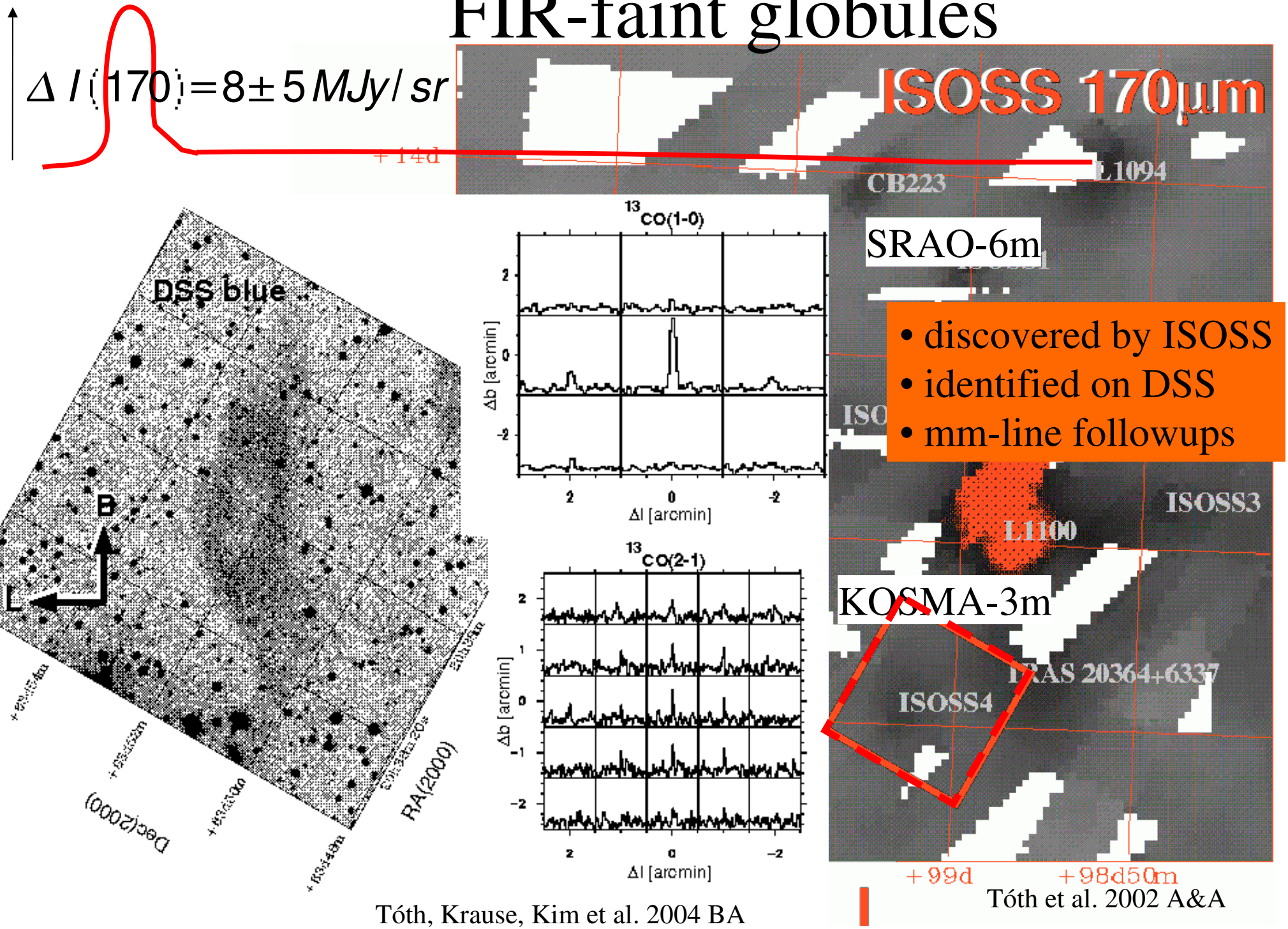
Cloud	Distance [pc]	Size [']	Size [pc]	Mass [$M_\odot$]	T_{dust} [K]	$\tau_{200\mu m}^{central}$ [10^{-3}]	$N_H^{central}$ [10^{22}]	YSO ?	Reference	Notes
DC 303.8–14.2	150	14 × 10	0.6 × 0.4	2.7	14.6 ± 1	1.2	0.5	Yes	This study	4, 5, 7
Thumbprint Nebula	200	7	0.4	1.9	13.5 ± 1	0.7	0.3	No	Lehtinen et al. (1998)	4, 5, 7
FS 2–137	140	20	0.8		$13.5^{+1.8}_{-1.7}$			No	Laureijs et al. (1996); FS	4, 5, 8
L 183	100	16	0.5	25	≲12	7	3	No	Juvela et al. (2002)	2, 4, 5, 7
CB 236	600	3.0 × 1.5	0.5 × 0.3	1.0	$12.5^{+0.8}_{-1.0}$	0.3	0.1	No	Richards et al. (1999); CB	1, 4, 5, 7
CB 220	600	3.0 × 1.5	0.5 × 0.3	3.3	$13.6^{+0.5}$	0.3	0.1	No	Richards et al. (1999); CB	1, 4, 5, 7
										3, 6, 9
										2, 3, 5, 10
L 1517B	140	4 × 3	0.2 × 0.1		10 ± 3			No	WTAK	2, 3, 5, 10
L 1544	140	8 × 4	0.3 × 0.2		9 ± 3			No	WTAK; WTMA	2, 3, 5, 10
L 1582A	400	7.4 × 4	0.9 × 0.5		15 ± 3			No	WTAK	2, 3, 5, 10
L 183	150	7 × 5	0.3 × 0.2		10 ± 3			No	WTAK; WTMA	2, 3, 5, 10
L 1696A	140	5 × 5	0.2 × 0.2		10 ± 3			No	WTAK; WTMA	2, 3, 5, 10
L 1689A	140	4 × 4	0.2 × 0.2		19 ± 3			No	WTAK	2, 3, 5, 10
L 1689B	140	7 × 4	0.3 × 0.2		11 ± 3			No	WTAK; WTMA	2, 3, 5, 10
L 63	160	6 × 6	0.3 × 0.3		11 ± 3			No	WTAK; WTMA	2, 3, 5, 10
B 68	200	4 × 4	0.2 × 0.2		10 ± 3			No	WTAK	2, 3, 5, 10
B 133	400	8 × 3	0.9 × 0.4		13 ± 3			No	WTAK; WTMA	2, 3, 5, 10

ISOSS J20246+6540, size ≤0.3pc, T_{dust} <14.5K, $N(H)_{central} = 9x10^{20}$ cm^{-2}

Small is beautifull?

Small is practical!

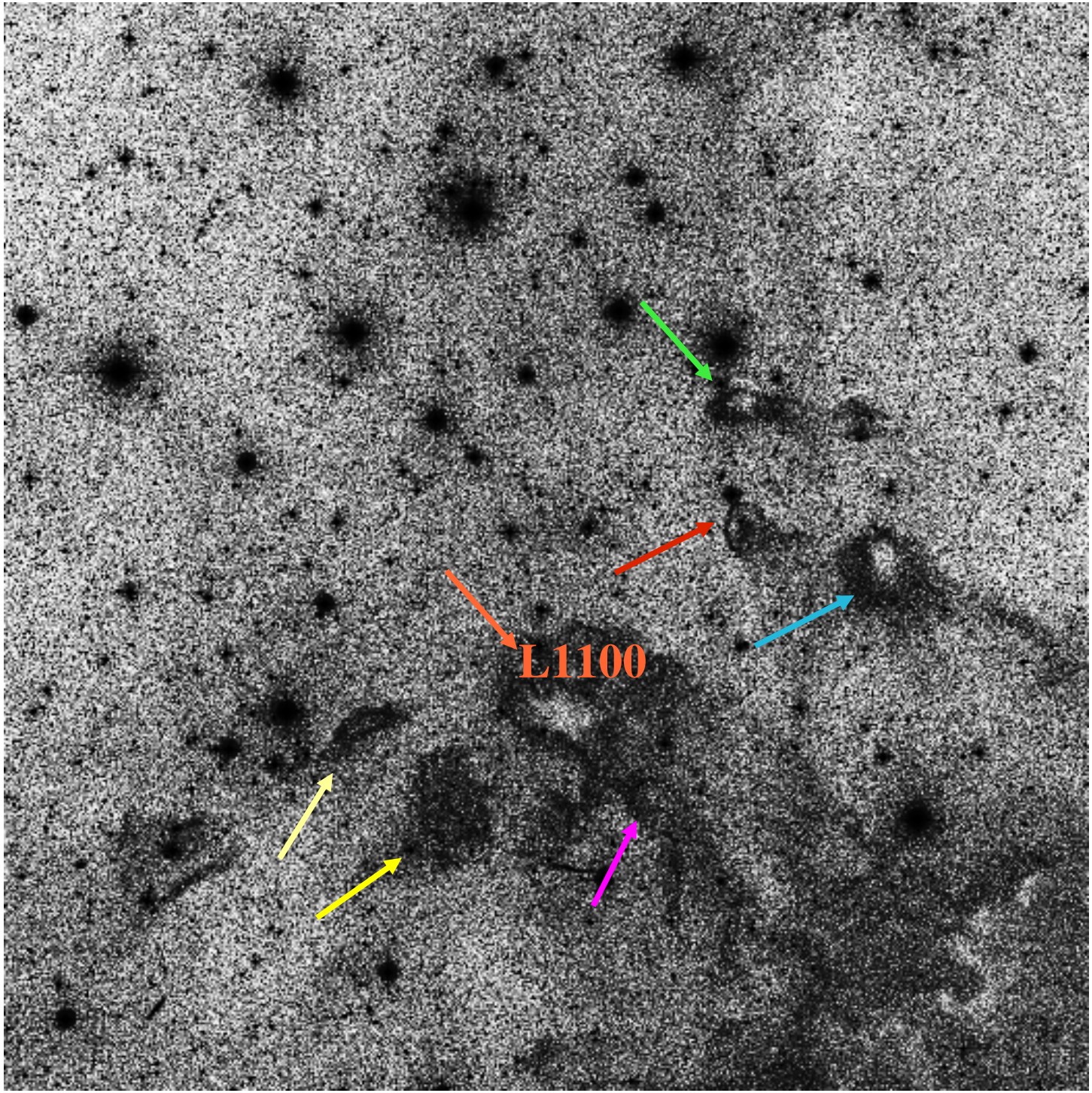
FIR-faint globules



Tóth, Krause, Kim et al. 2004 BA

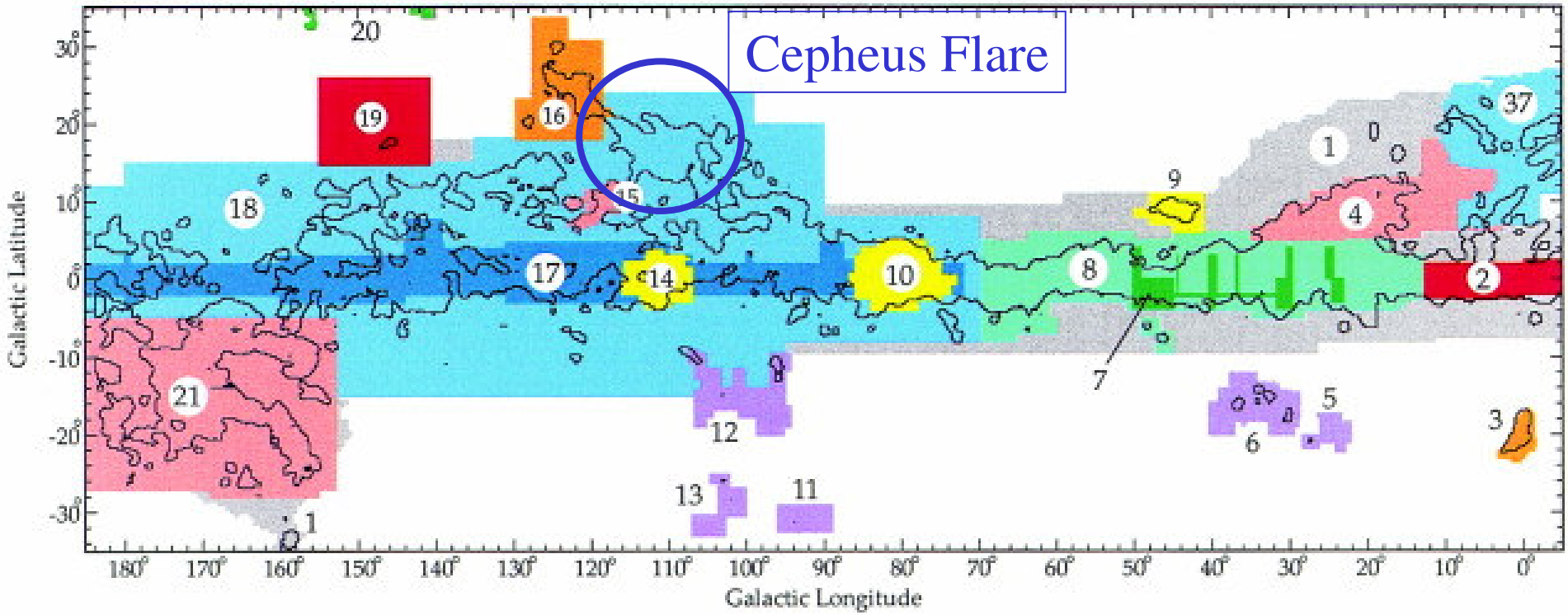
Tóth et al. 2002 A&A

Globule group at L1100



DSS B band

Tóth, Krause, Kim et al. 2004 BA

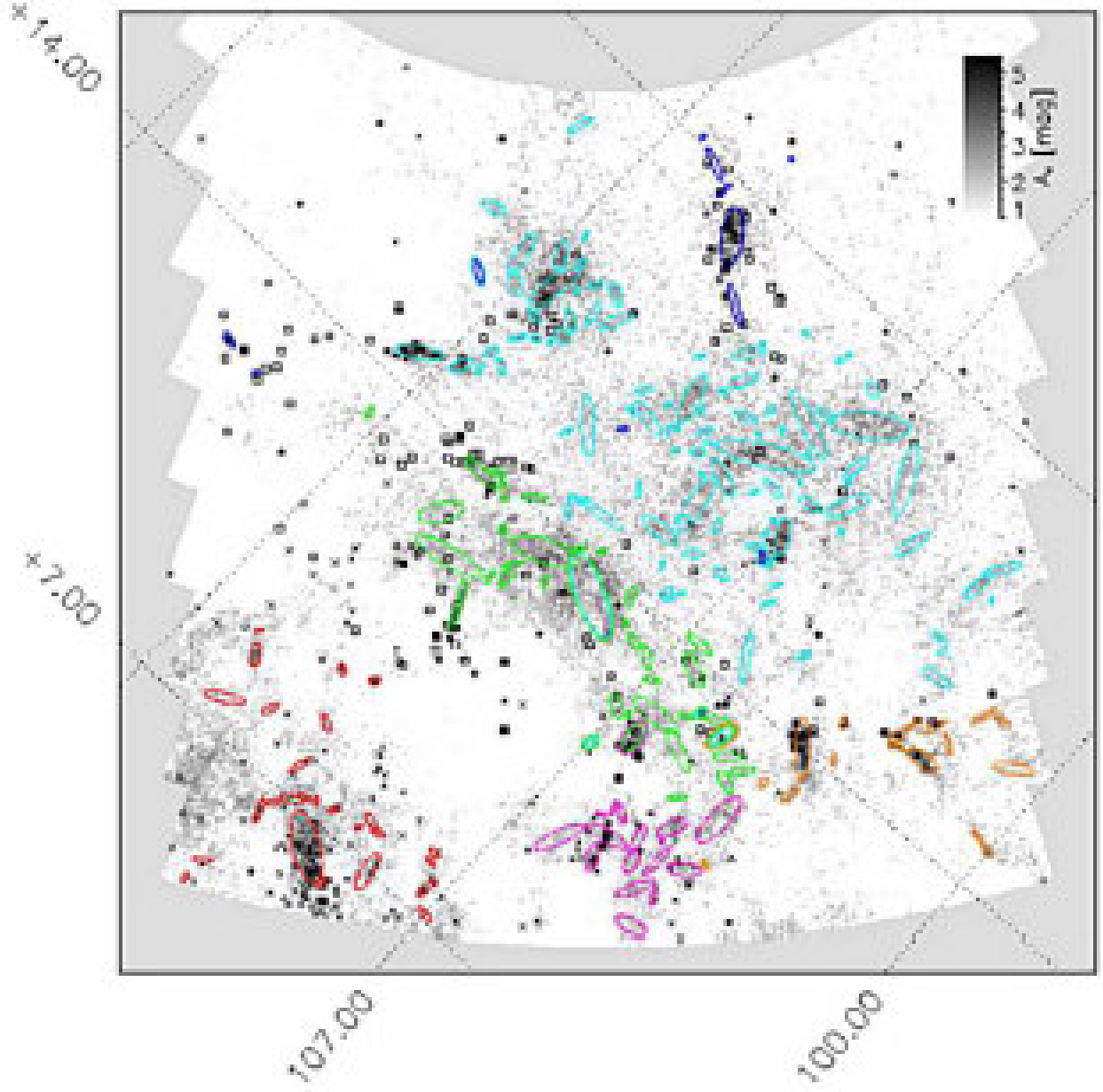


The Cepheus SF region

$M(total)=10^5 M_{Sun}$ assuming d~400 pc

NO MASSIVE STAR FORMATION

Cloud and * formation in Cepheus



- B and NIR extinction
- 208 dark clouds (157 new)

Colours : d=200 pc, d=300 pc, d=400 pc, d=450 pc, d=650 pc, d=900 pc.

- YSO candidates:

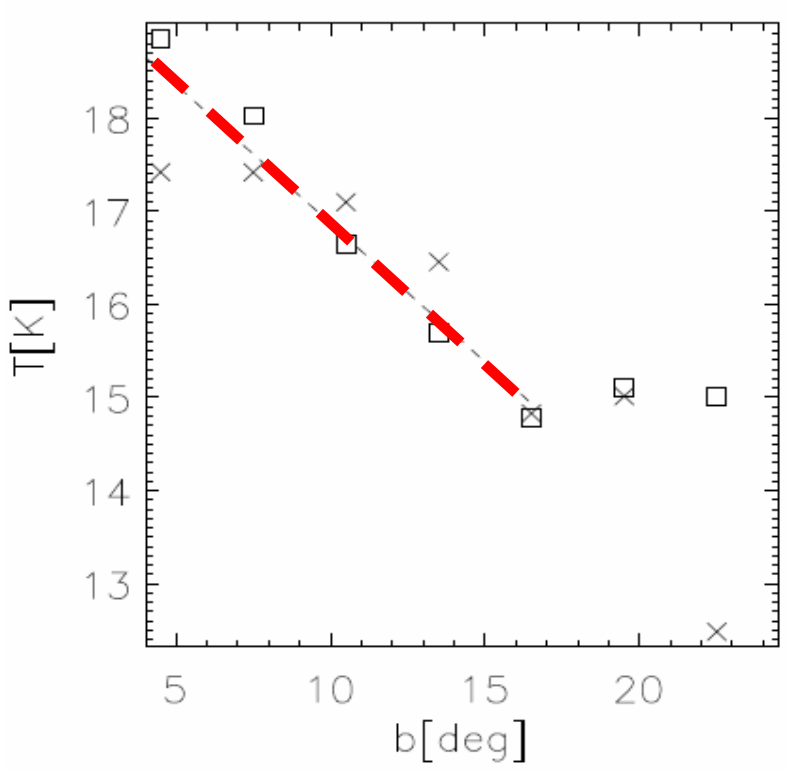
CTTs 2MASS (diamonds), IPSC and IFSC (x and +), Hα (Kun 1998) (squares)

Formation efficiencies:

- Clouds: 31000M_{Sun} , ~21%
- 156 YSOs, sfe<0.5% in clouds

Kiss, Tóth, Krause et al. 2006 A&A in press

FIR colour – galactic latitude dependent

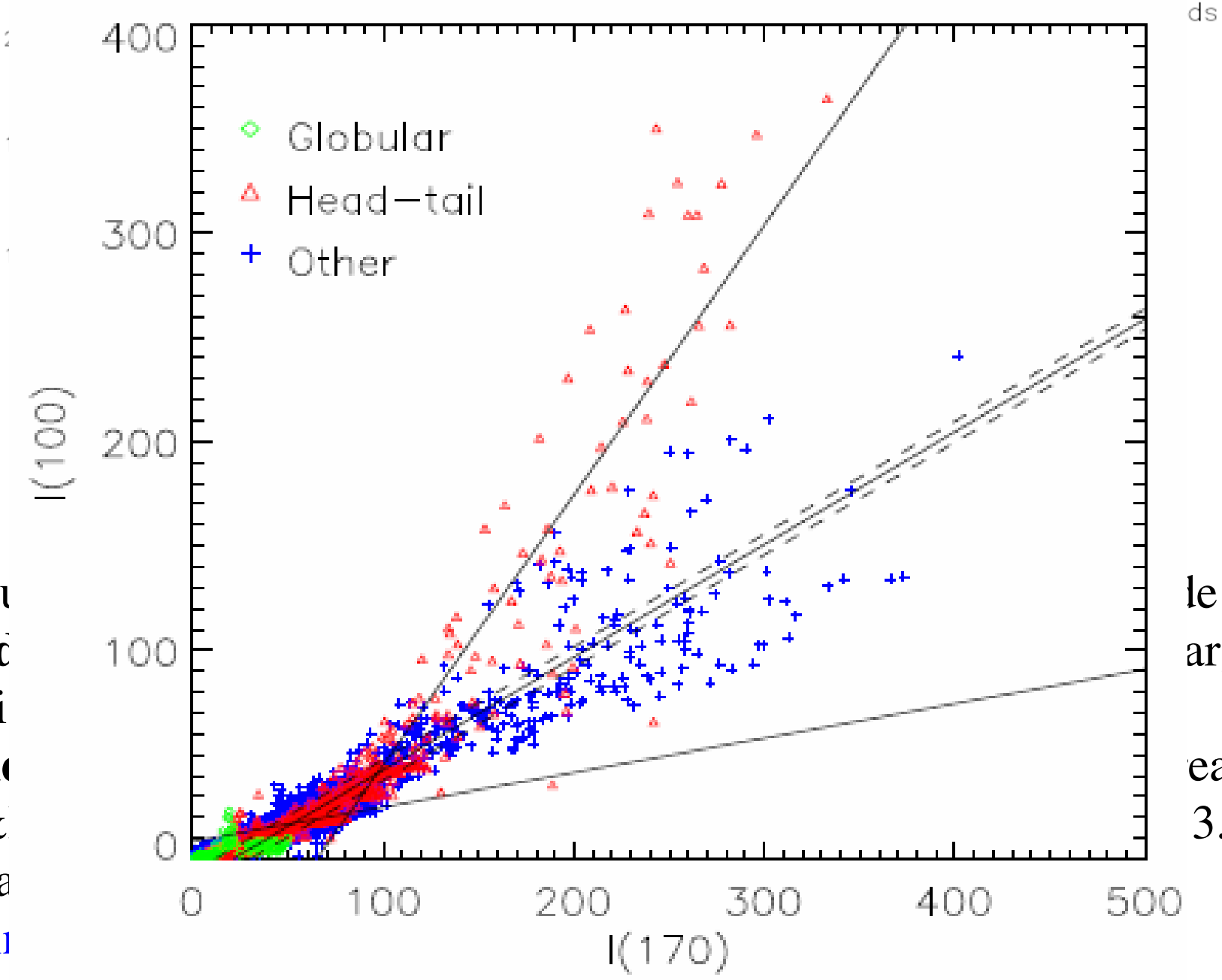


Mean (170/100) colour temperature versus galactic latitude in 3° steps from b=3° to b=24°. Squares: outside clouds, crosses: inside clouds. Dashed line: T_d/ [K] = 19.8 – 0.3 b/[deg] least squre fit at b<18°

Kiss, Tóth, Krause et al. 2006 A&A in press

FIR colour depends on cloud morphology

colours of clouds of head-tail and globule morphological classes.



Red: clou

Greybod

total emi

Diamon

I(170) &

10, 100 a

Data poi

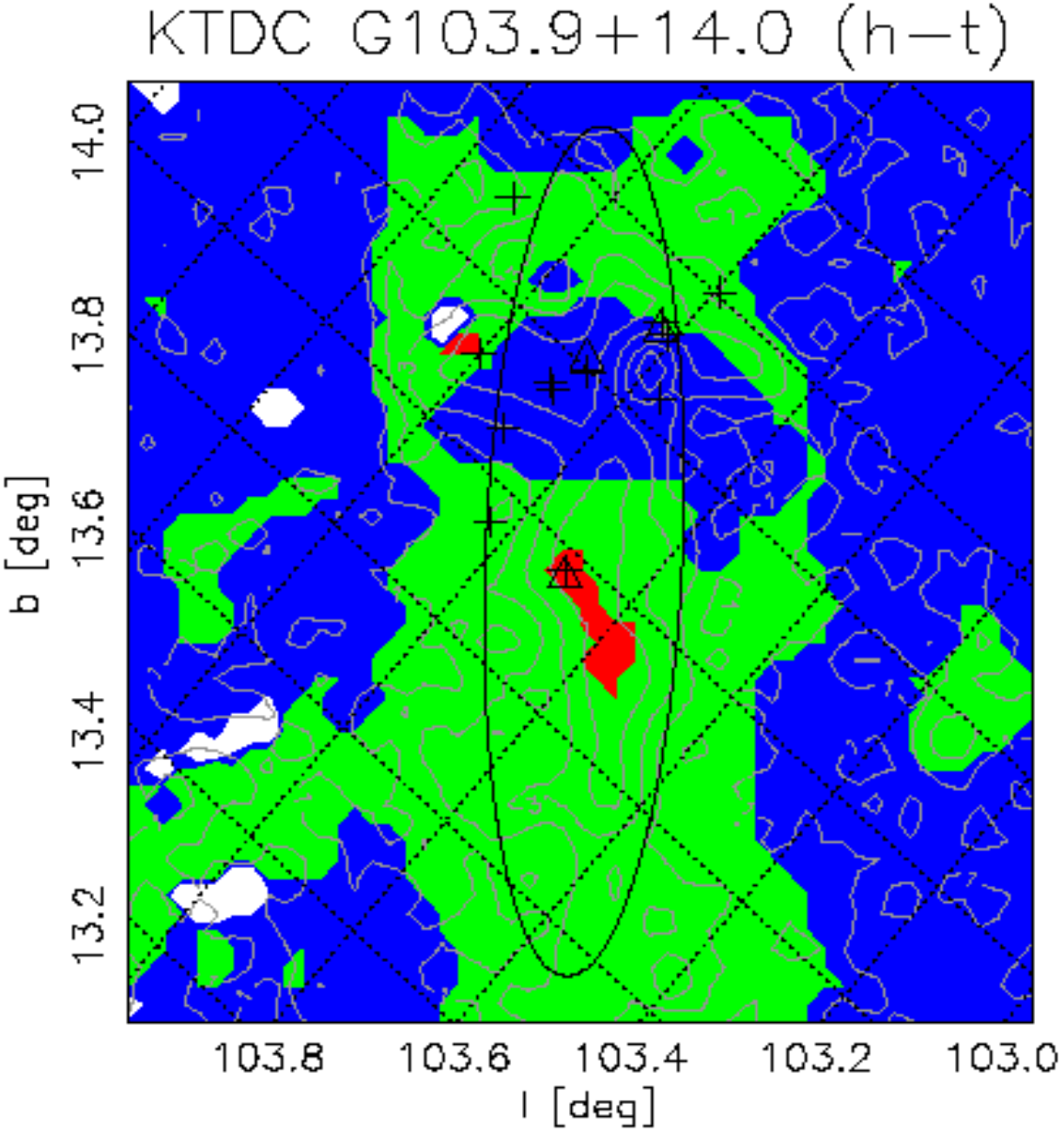
le clouds

arge sym:

easing

3.0, 5.0,

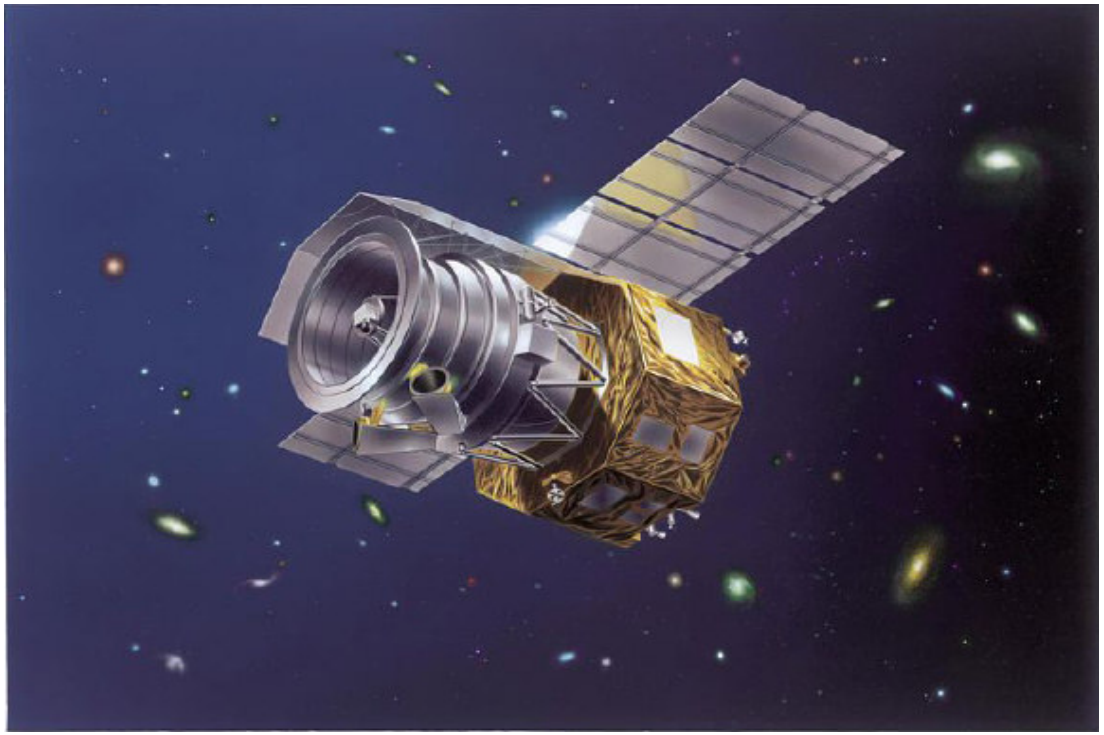
One of the Cep survey clouds



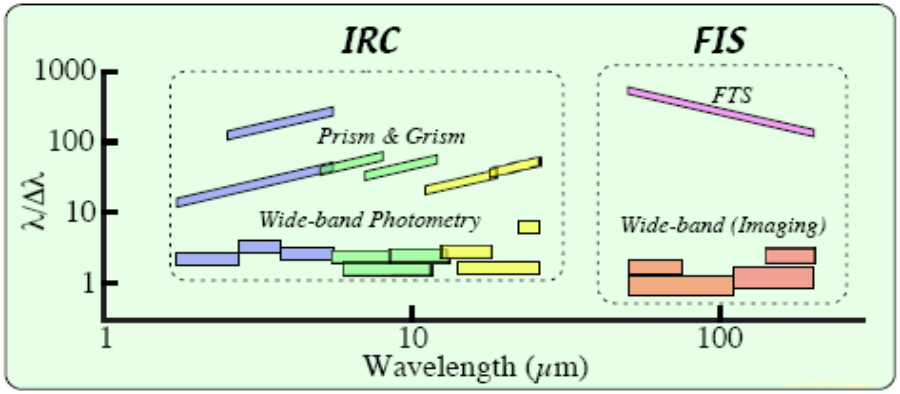
- Known as L1172
- Cold (red) & “warm” (blue) dusty cores
- Ammonia cores (triangles, B&M)
- YSOs (+)

Kiss, Tóth, Krause et al. 2006 A&A in press

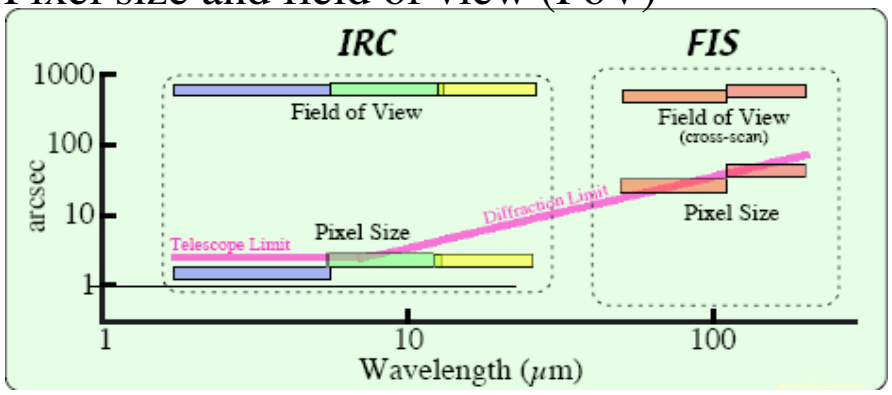
ASTRO-F (Akari) - the next survey



The wavelength coverage and resolving power



Pixel size and field of view (FoV)



All sky survey

IRC: 8.74(4.7) μm and 17.8(8.7) μm

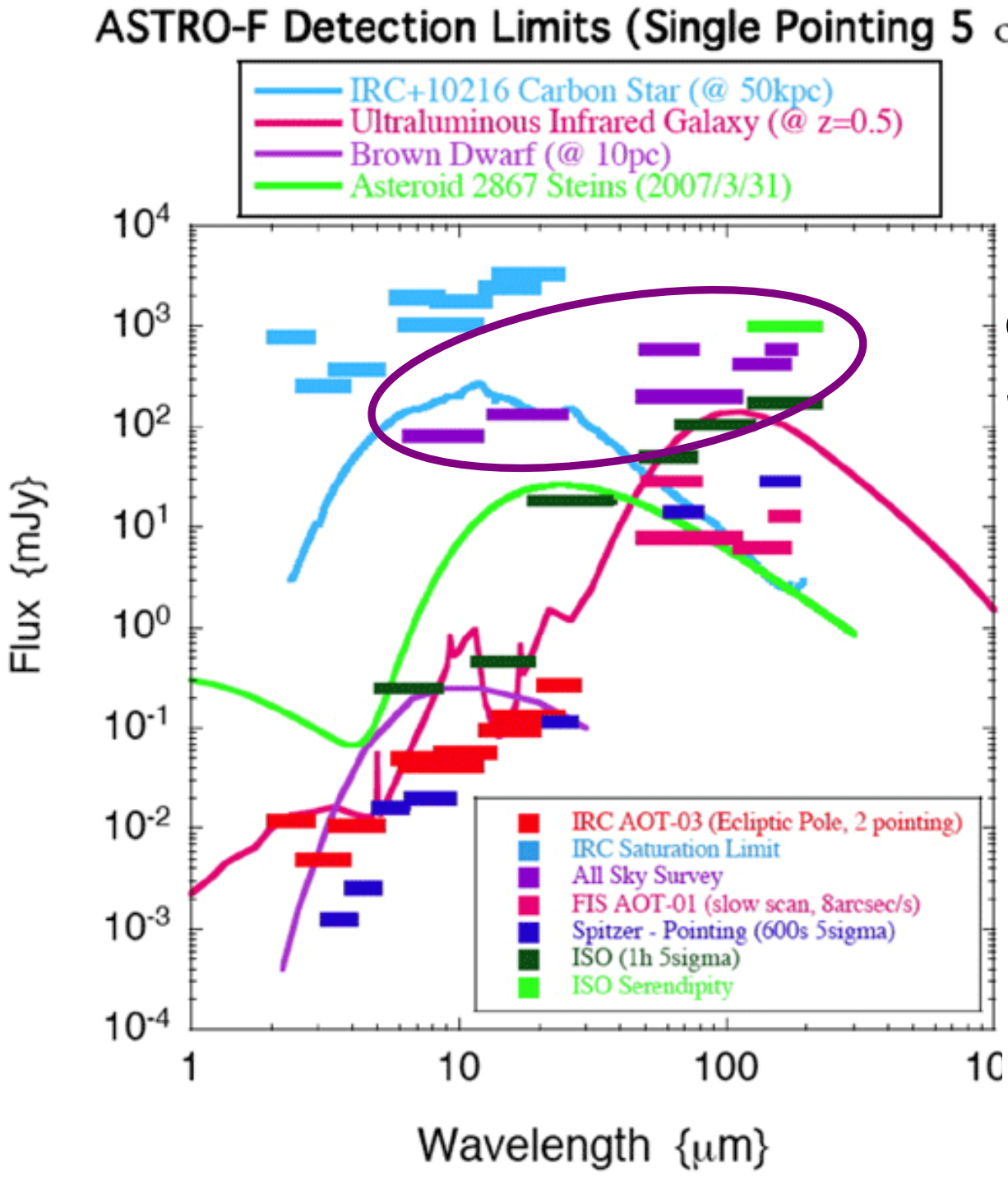
FIS: 45–75 μm, 45–110 μm
110–180 μm 140–180 μm

Pointing mode (limited)

The FIS single scan 5σ detection limits in the survey

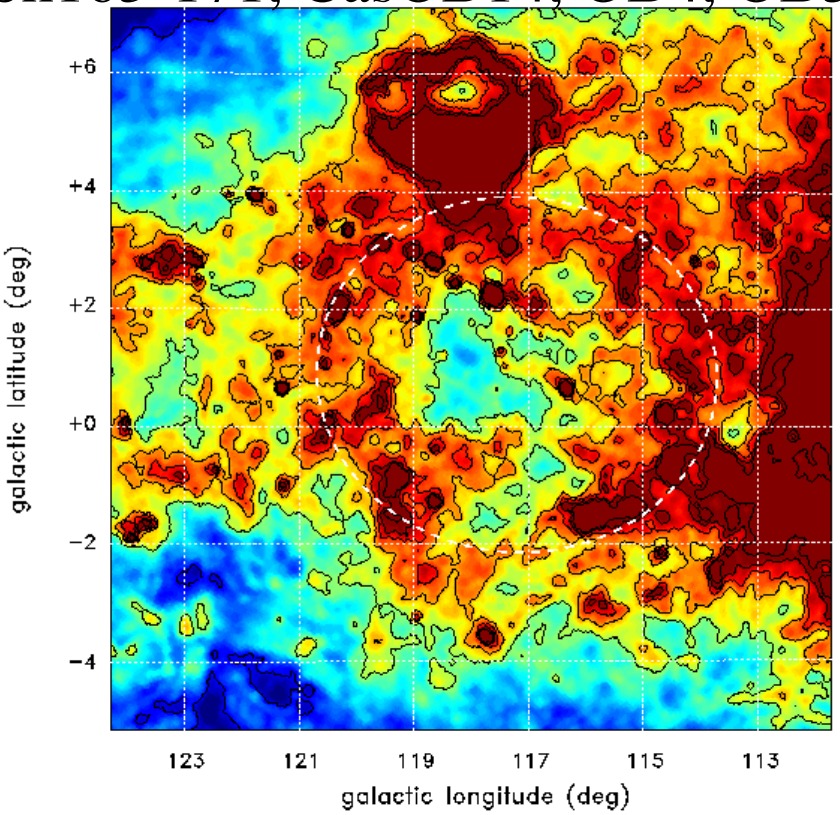
Readout	Point Source		Diffuse Source	
	Nominal	CDS	Nominal	CDS
	F_ν (mJy)		B_ν (MJy/sr)	
N60	600	1800	7.5	22.5
WIDE-S	200	490	2.5	7.5
WIDE-L	400	1230	2	6
N160	800	2620	3	9

CDS: Correlated Double Sampling.



New colours in a 10years old project by Akari all sky survey

GIRL117+0 in the Galactic plane
Sh163-171, CasOB14, OB4, OB5



Kiss, Moór, Tóth 2004 A&A

ASTRO-F plans and duties

- approval, and discovery of very cold cloud cores (VCCs, T_d<13K)
- new census of YSOs with $M_{disk} > M_{Moon}$ at 140pc
- FIR colour and dust opacity of GIRLs

The SF MP Hungarian Support Team

- Star Formation Mission Programme: ~25% of pointed time, key science of ASTRO-F
- **Support by the Hungarian team:**

  - **preparatory work:** revisiting the ISO data of nearby star forming regions, target selection for MP, providing confusion noise estimates

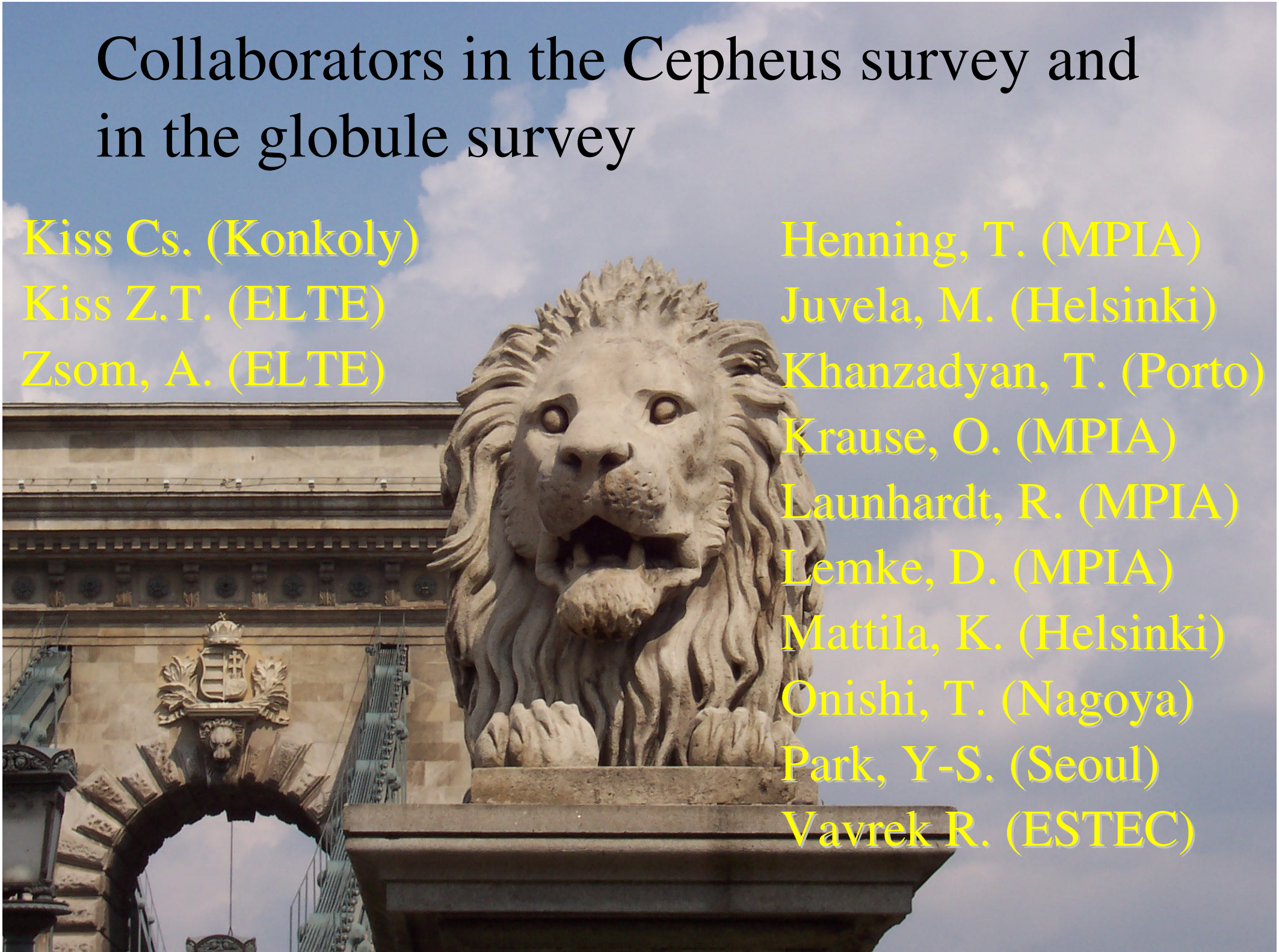
  - **Phase I:** data analysis and evaluation

- SF MP HST: Tóth, L.Viktor., (Kiss, Csaba), Kiss, Zoltán, Zsom, András

These were reported:

- Most cited ISOPHOT surveys
- A taste of recent results
- Very (FIR) faint globules
- Clouds, colours and star formation in Cepheus
- ASTRO-F SF MP Support Team in Hungary

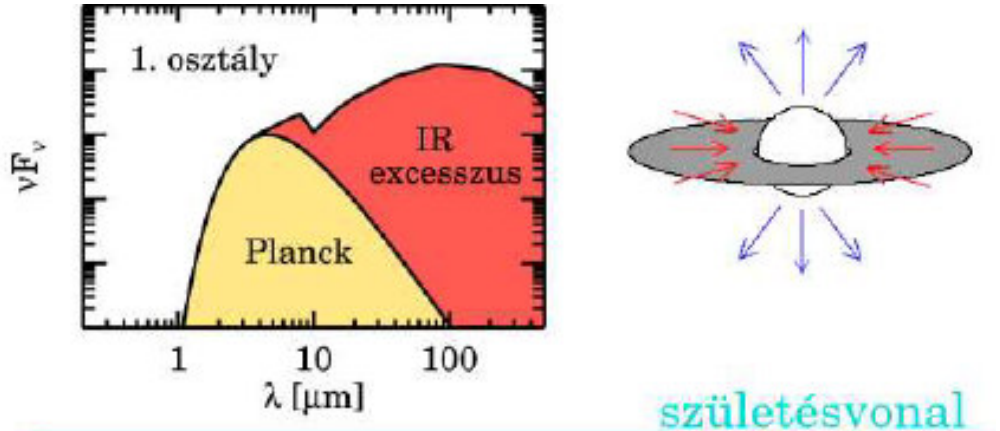
Collaborators in the Cepheus survey and in the globule survey

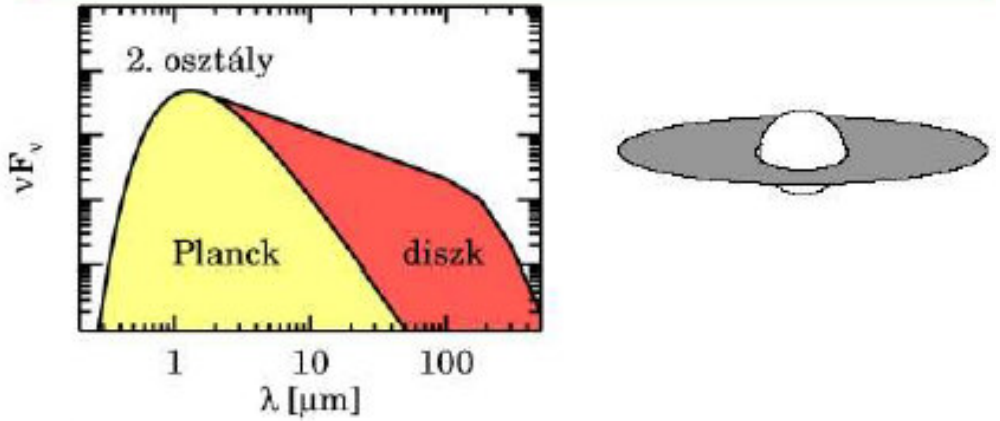


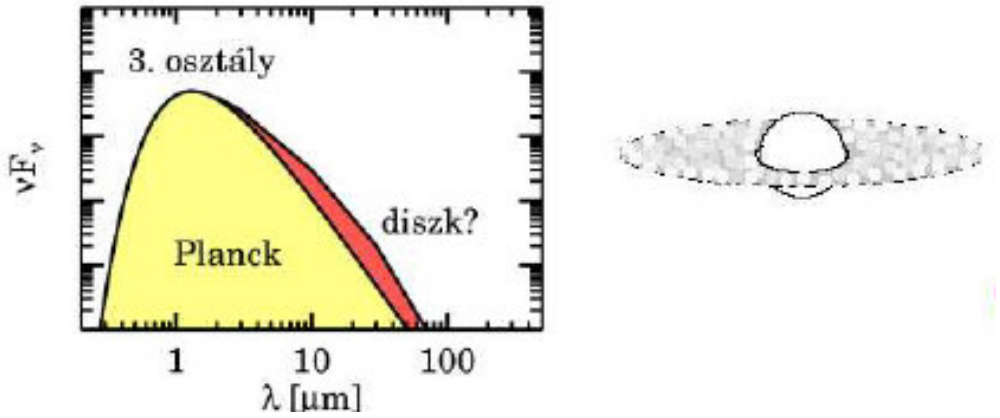
Kiss Cs. (Konkoly)
Kiss Z.T. (ELTE)
Zsom, A. (ELTE)

Henning, T. (MPIA)
Juvela, M. (Helsinki)
Khanzadyan, T. (Porto)
Krause, O. (MPIA)
Launhardt, R. (MPIA)
Lemke, D. (MPIA)
Mattila, K. (Helsinki)
Onishi, T. (Nagoya)
Park, Y-S. (Seoul)
Vavrek R. (ESTEC)

Early stellar evolution







- Class 0 and Class I: infall and outflow, protostars
- Class II: considerable disk, CTT
- Class III:some excess, WTT