Final Analysis of ELAIS 15 μm Fields

Data Reduction with the LARI Method

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Exploiting the ISO Data Archive: Infrared Astronomy in the Internet Age *Sigüenza, 24-27 June 2002*

The ELAIS Survey

- Largest ISO Open Time single project (375 h)
- Up to 12 deg^2 mapped in four ISO-CAM/PHOT bands (7, 15, 90, 175 μm)
- IRAS $I_{100\ \mu m} < 1.5$ mJy/sr, no IRAS $S_{12\ \mu m} > 0.6$ Jy sources , $|\beta| > 40°$

	ISO-CAM		*ISO-PHOT*	
Detector	LW	LW	C100	C200
Filter	LW2	LW3	C90	C160
λ/μm	6.75	15	95.1	174
$\Delta\lambda/\mu$m	3.5	6	51.4	89.4
Gain	2	2	n/a	n/a
$TINT$/s	2	2	20	32
			12	
$NEXP$	10	10	n/a	n/a
$NSTAB$	80	80	n/a	n/a
$PFOV/''$	6	6	43.5	84.5
$NPIX$	32	32	3	2
M, N	28, 14	28, 14	10, 20	13, 13
			20, 20	
$dM, dN/''$	90, 180	90,180	130, 130	96, 96
			75, 130	

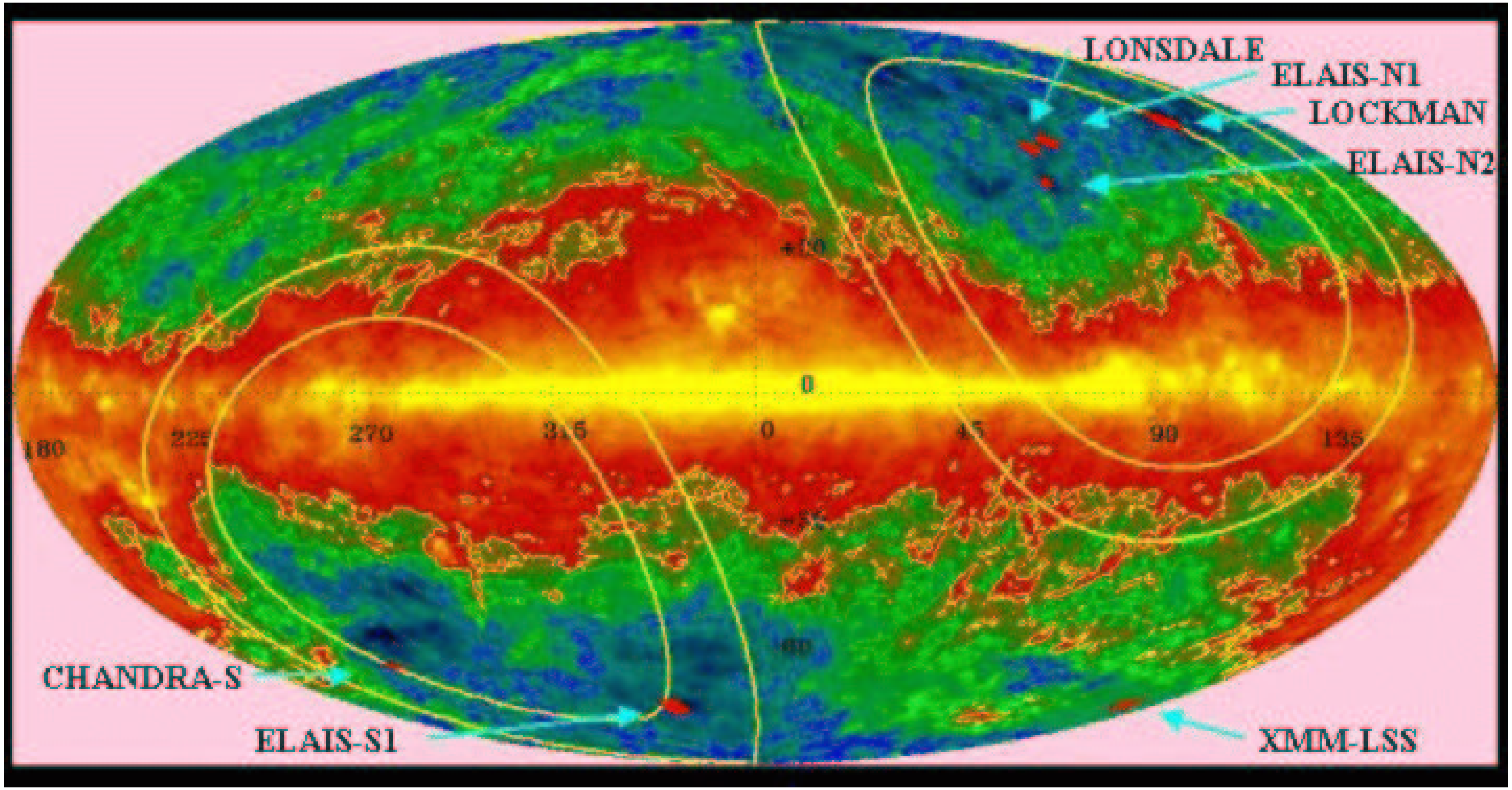
Field	Wavelength/μm			
	6.7	15	90	175
N1		2.67	2.56	2*
N2	2.67	2.67	2.67	1
N3	1.32	0.88	1.76	
S1	1.76	3.96	3.96	
S2	0.12	0.12	0.11	0.11
X1		0.16	0.19	
X2		0.16	0.19	
X3		0.16	0.19	
	5.87	10.78	11.63	3.11
X4		0.09	0.11	
X5		0.09		
X6		0.09	0.11	

ELAIS within ISO Extragalactic Surveys

Name	λ (μm)	Integration (s)	Area (deg^2)
PHT Serendipity Survey	175	0.5	7000
CAM Parallel Mode	7	150	33
ELAIS	7, 15, 90, 175	40, 40, 24, 128	6, 11, 12, 1
CAM Shallow	15	180	1.3
FIRBACK	175	256, 128	1, 3
IR Back	90, 135, 175	23, 27, 27	1, 1, 1
SA 57	60, 90	150, 50	0.42, 0.42
CAM Deep	7, 15, 90	800, 990, 144	0.28, 0.28, 0.28
Comet fields	12	302	0.11
CFRS	7, 15, 60, 90	720, 1000, 3000, 3000	0.067, 0.067, 0.067, 0.067
CAM Ultra-Deep	7	3520	0.013
ISOHDF South	7, 15	> 6400, > 6400	$4.7 \cdot 10^{-3}$, $4.7 \cdot 10^{-3}$
Deep SSA13	7	34000	$2.5 \cdot 10^{-3}$
Deep Lockman	7, 90, 175	44640, 48, 128	$2.5 \cdot 10^{-3}$, 1.2, 1
ISOHDF North	7, 15	12800, 6400	$1.4 \cdot 10^{-3}$, $4.2 \cdot 10^{-3}$

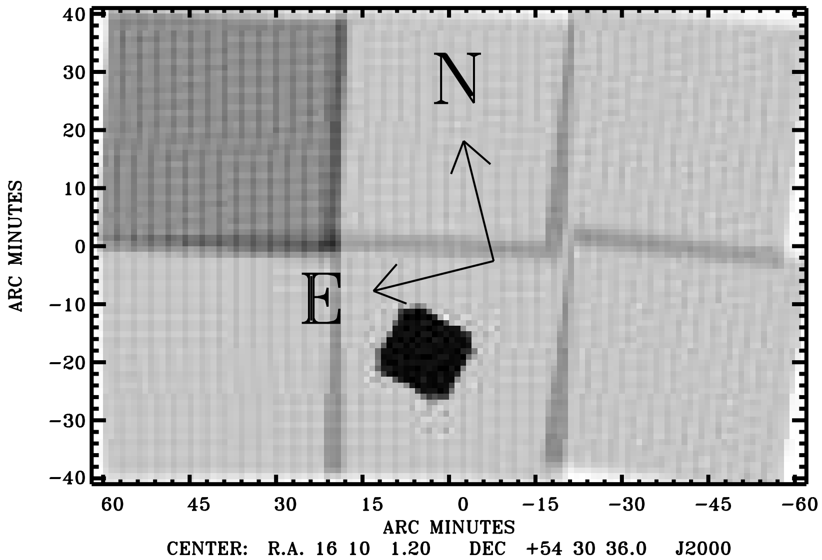
- Different choices are complementary in exploring the Depth-Area plane
- ELAIS furtherly bridges the gap between IRAS and ISO deep surveys

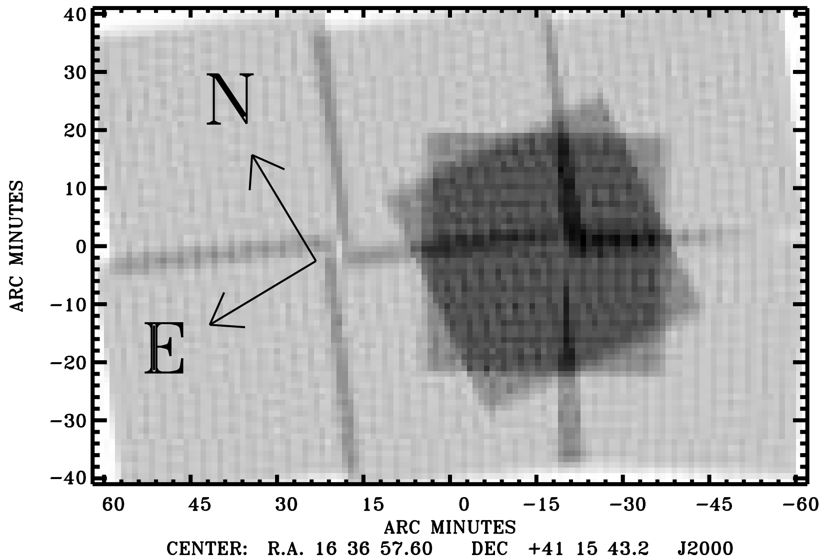
ELAIS Science Rationale

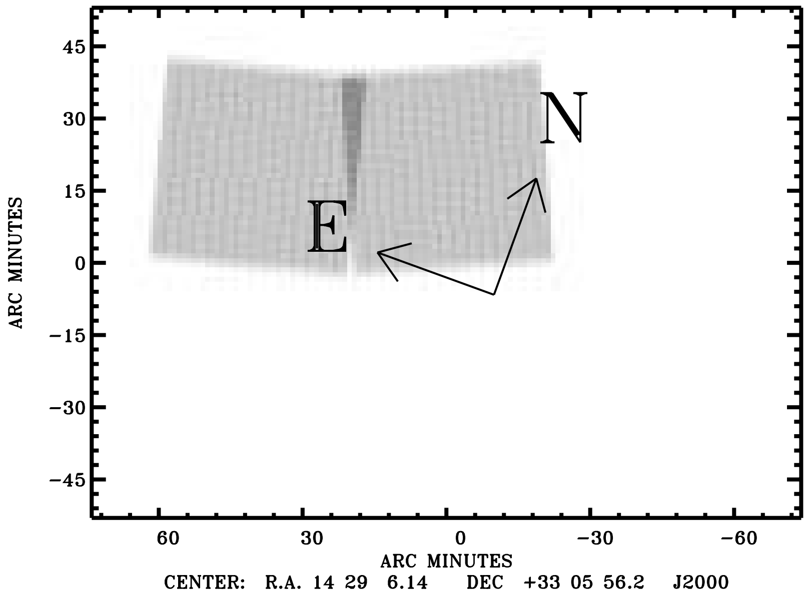


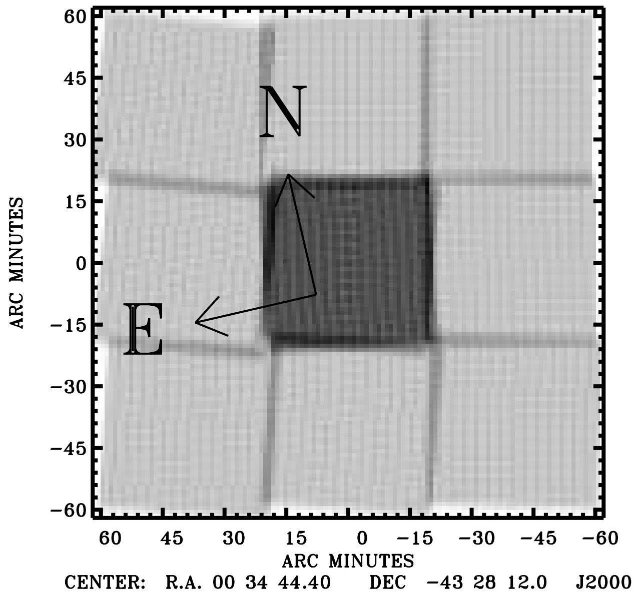
- SFH in the Universe
- Starbursts and AGNs
- ULIRGs
- CIRB Resolution
- Dust in normal galaxies
- Serendipity...

ELAIS CAM 15 μm Dataset









The Data Analyses

Available automated methods useless

Aaargh! $\Downarrow$ Aaargh!

Preliminary Analysis based on "eye-balling"

...mumbling... $\Downarrow$ ...mumbling...

...mumbling... $\Downarrow$ ...mumbling...

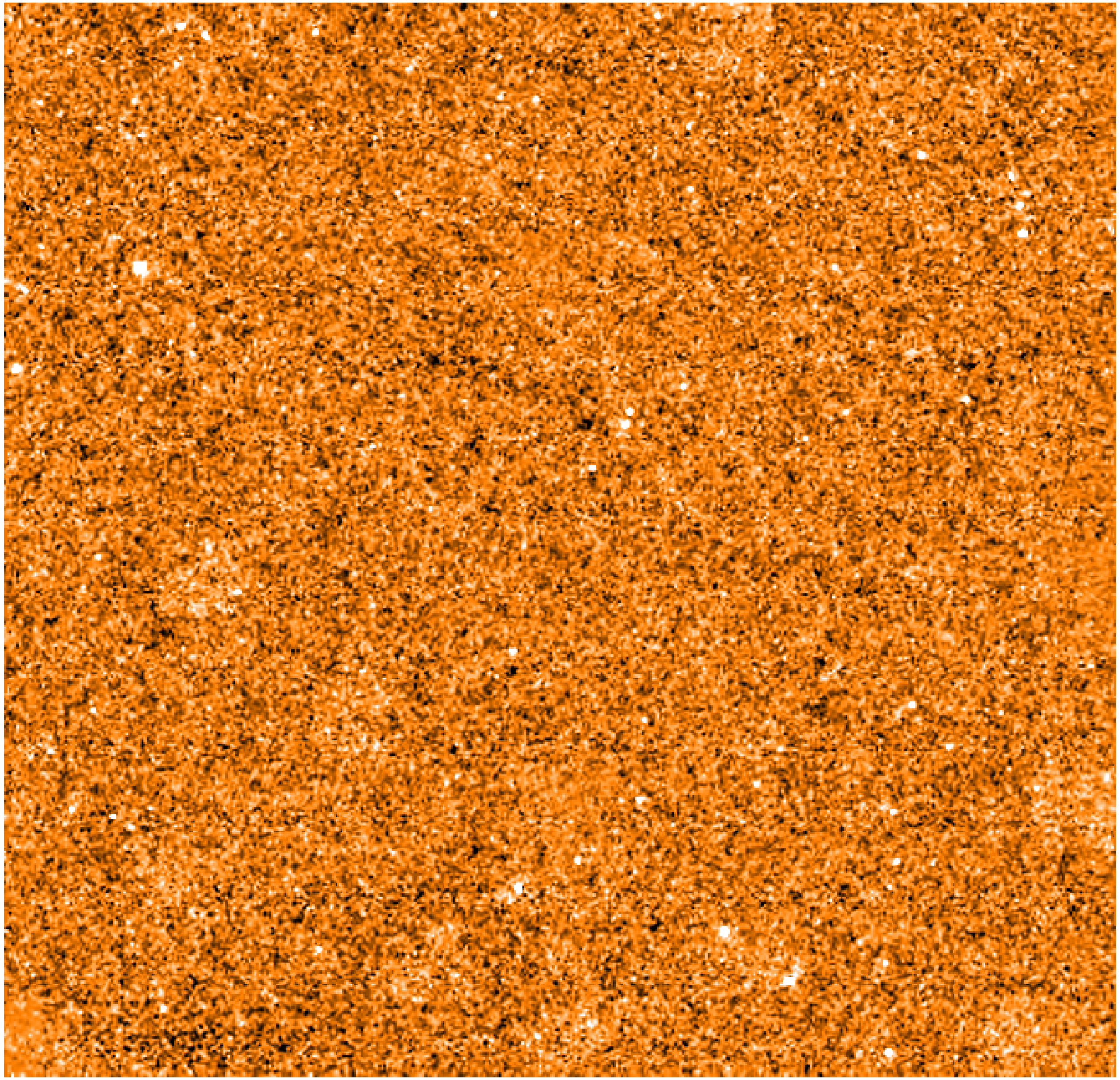
...mumbling... $\Downarrow$ ...mumbling...

The LARI Method and Final Analysis I (Lari et al. 2001)

...mumbling... $\Downarrow$ ...mumbling...

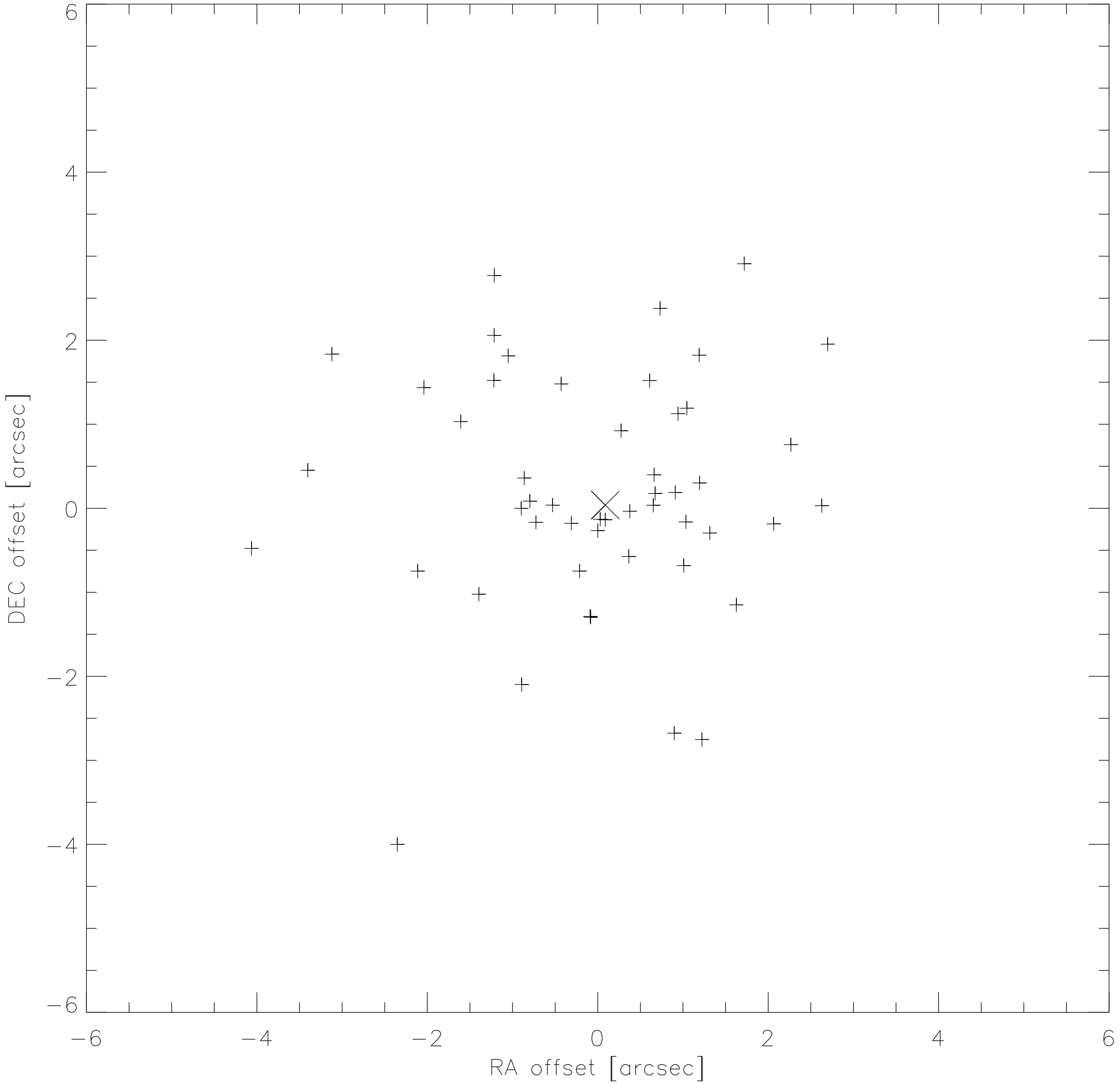
Final Analysis II (see poster by Lari et al. and talks by Fadda & Rodighiero)

Raster Maps



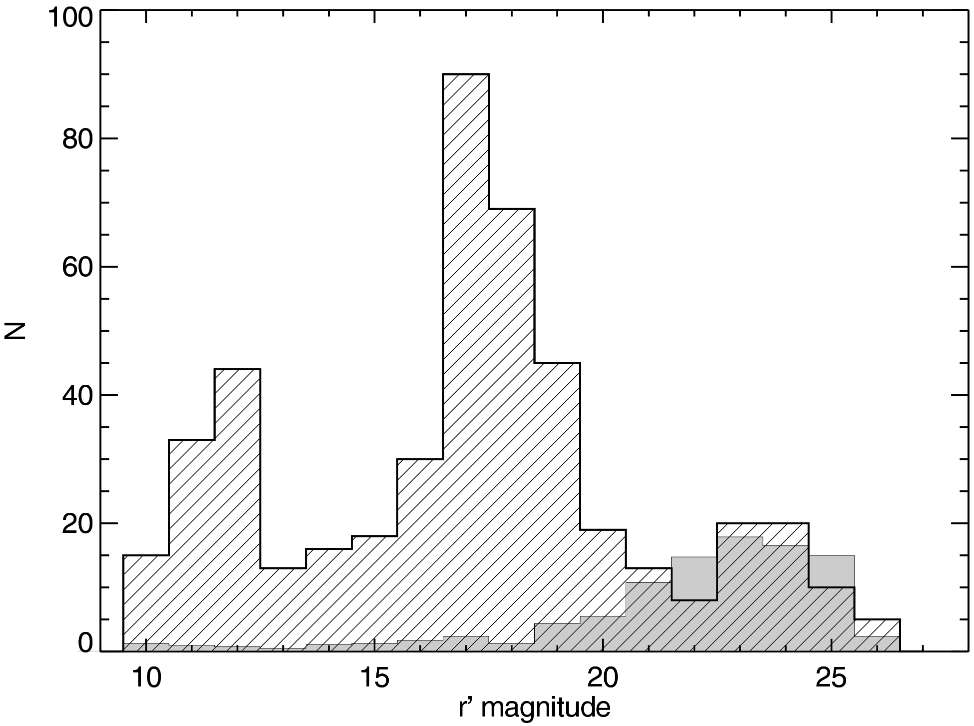
- $40' \times 40'$ maps
- $\simeq$ 90 sources each

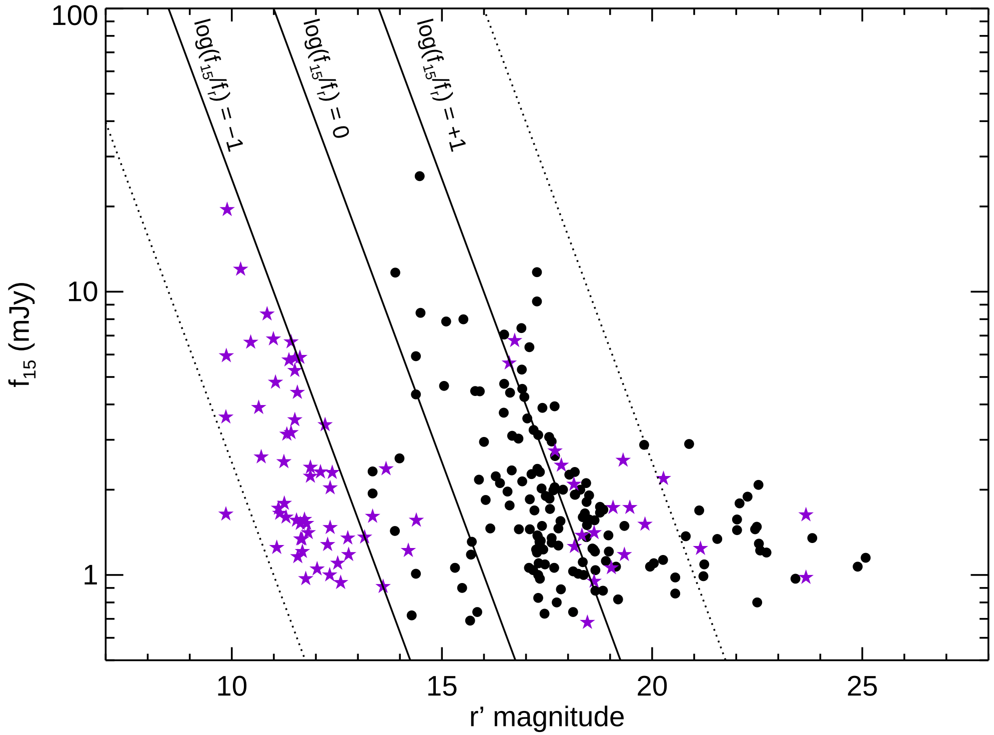
Astrometric Accuracy



- $\simeq$ 50 ELAIS-USNO identifications per raster
- σ_{RA} and $\sigma_{DEC} \simeq 1''$

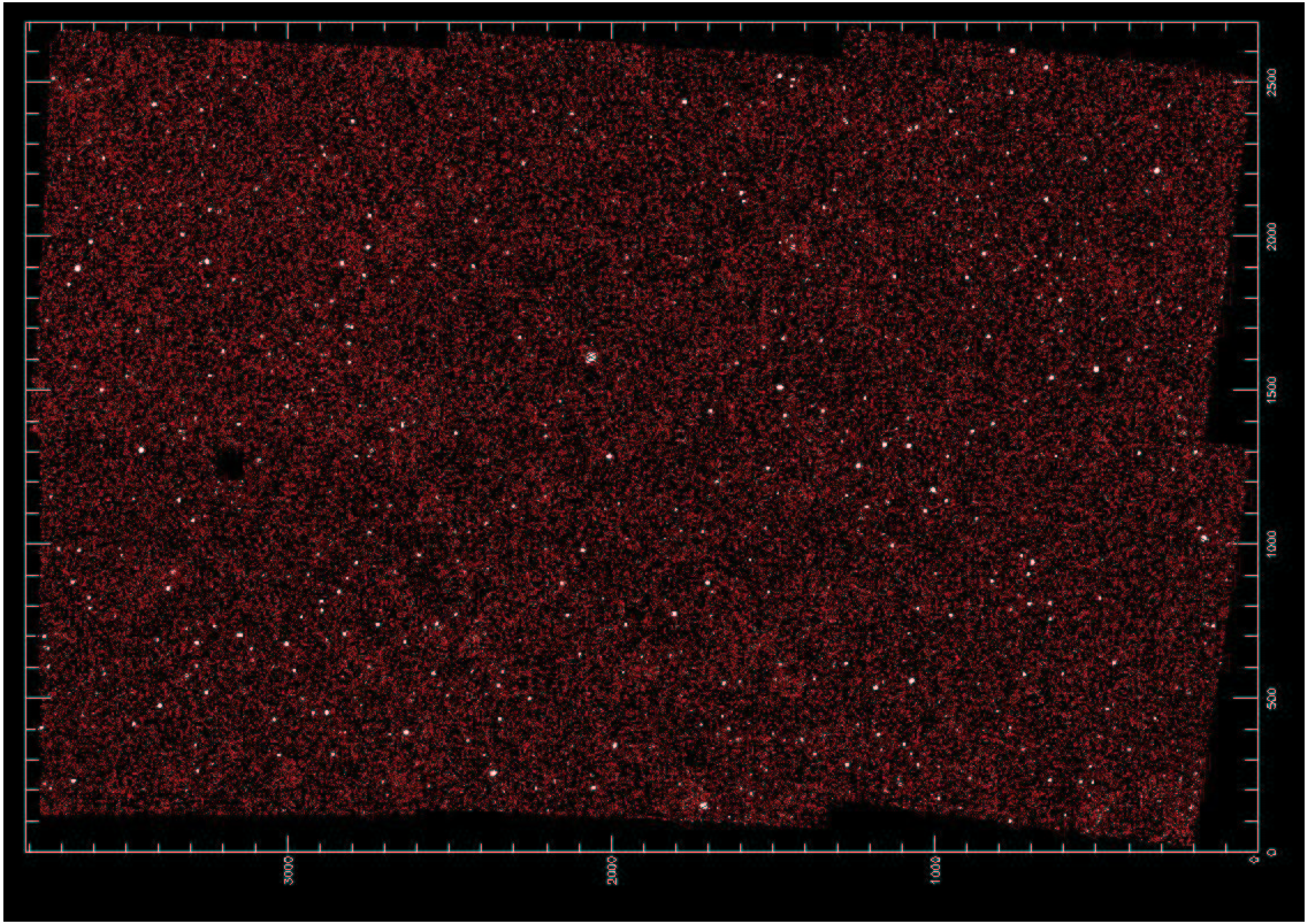
Optical Identifications



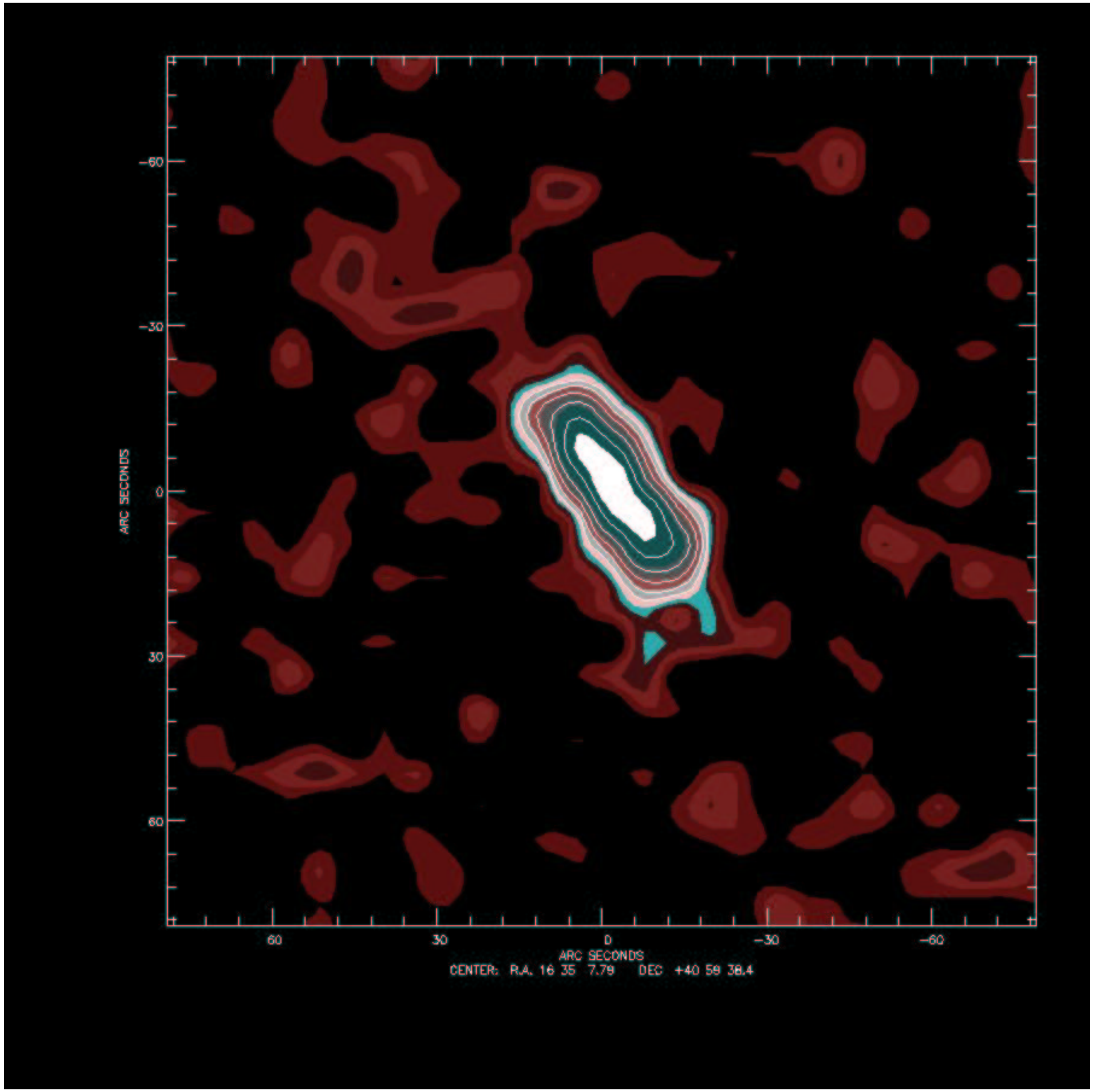


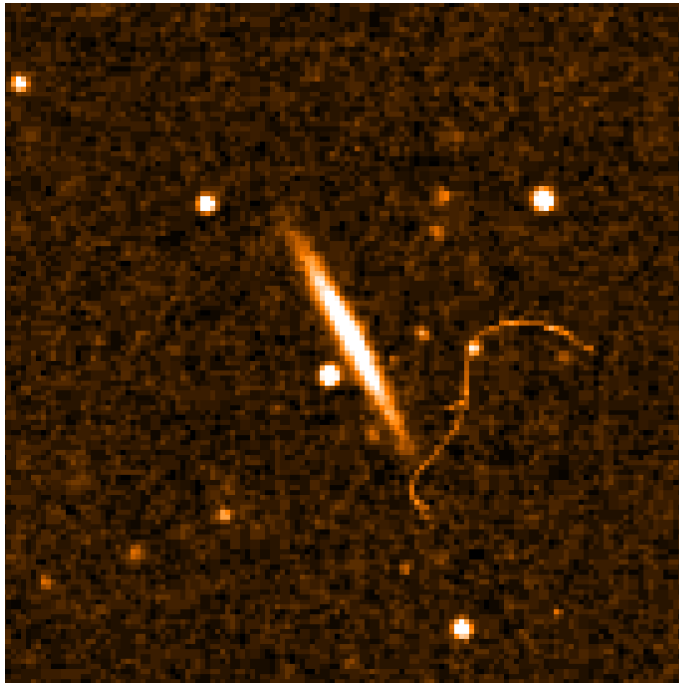
95 % of 15 μm sources have unambiguous optical counterparts (Gonzalez-Solares 2002, IAC, PhD Thesis)

Mosaiced Maps



Individual Sources





$\Uparrow$

UGC 10459

$\Updownarrow$

$\Leftarrow$ **ELAISC15_J163525+405542**

Final Analysis II Results

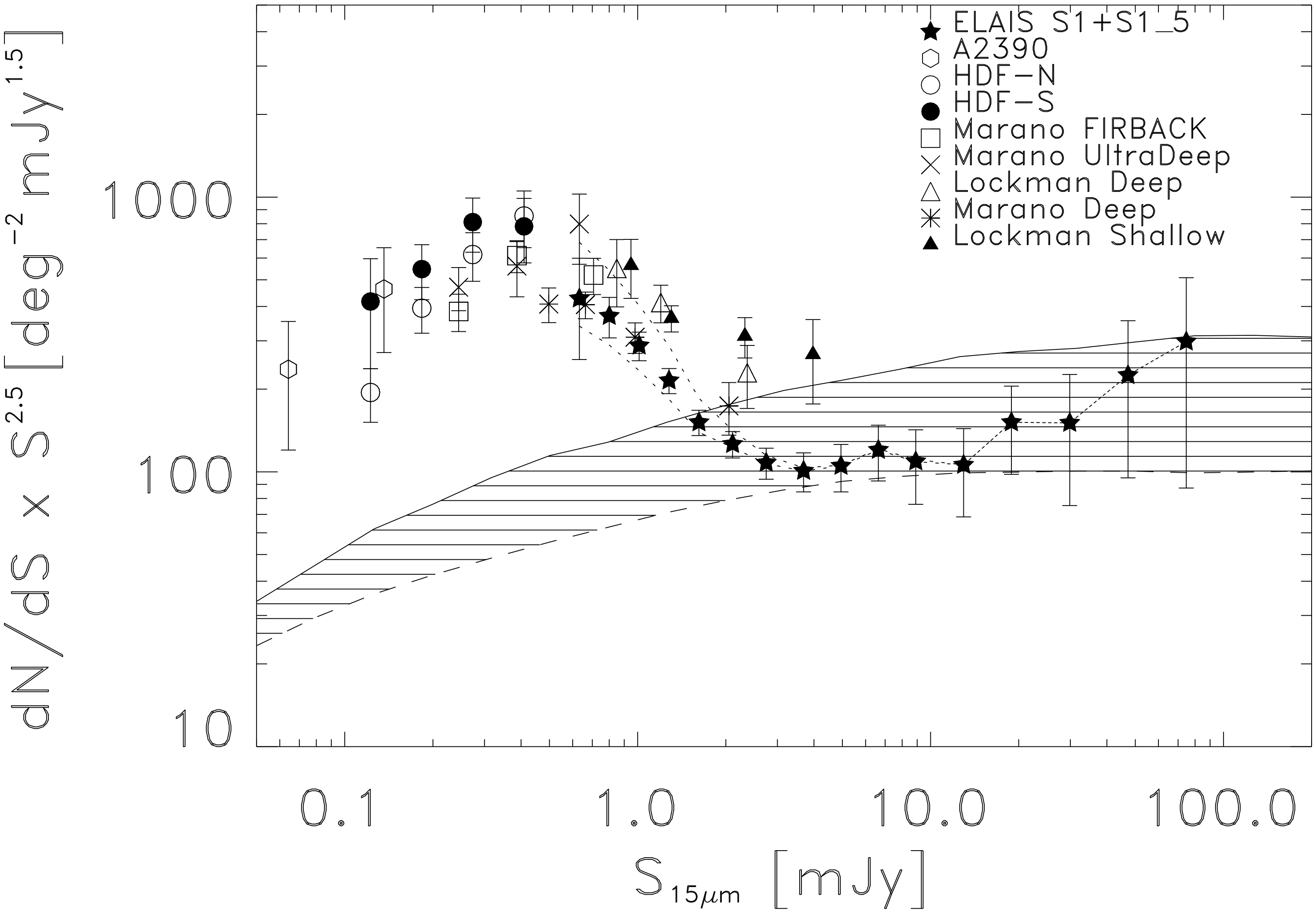
Final IA checks and simulations still to be performed

BUT

- 5-σ detections down to $\simeq$ 0.4 mJy
- Completeness: $>$ 99 % at 3 mJy and $>$ 90 % at 2 mJy
- $\simeq$ 150 sources/deg^2
- Improved astrometric and photometric accuracy
- Mosaiced Maps

	S1	N1	N2	Total
PA	189	129	141	459
FA-I	$\simeq$ 450	$\simeq$ 350	$\simeq$ 400	$\simeq$ 1200
FA-II	$\simeq$ 700	$\simeq$ 550	$\simeq$ 550	$\simeq$ 1800

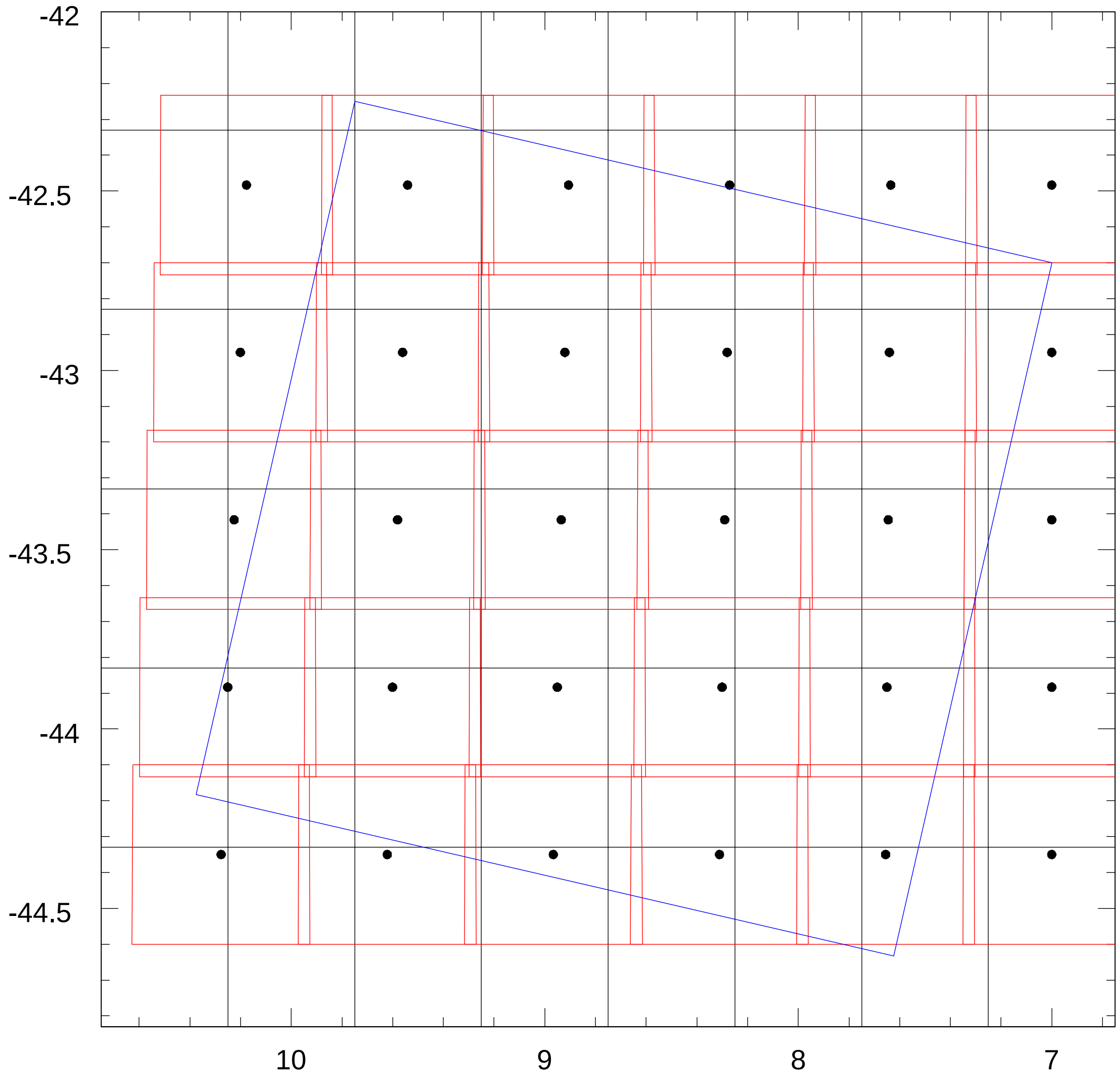
FA-I Extragalactic 15 μm Source Counts



Slope change at $S_{15\,\mu\mathrm{m}} \simeq 2$ mJy $\Rightarrow$ Strong Evolution!

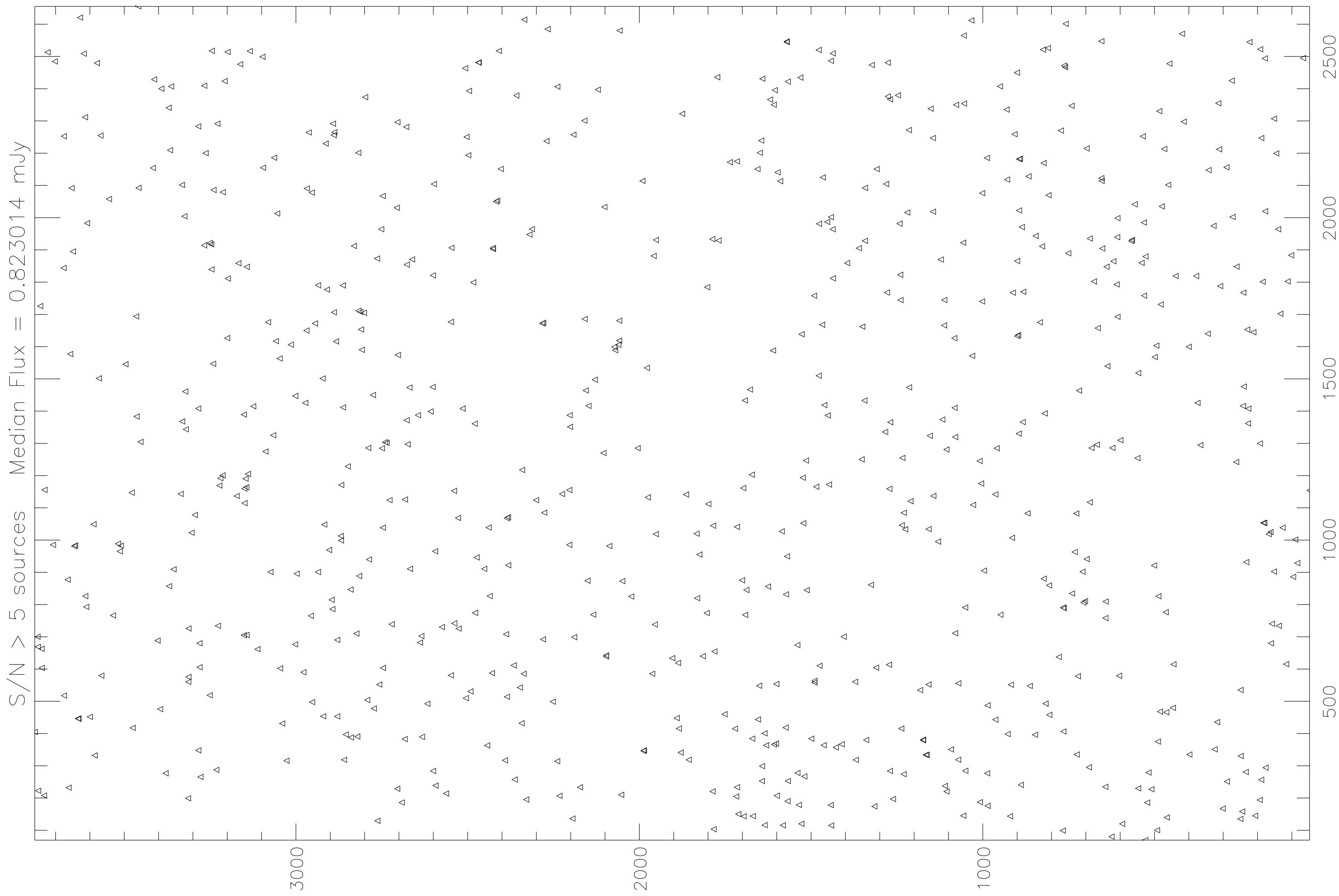
(Gruppioni et al. 2002, MNRAS, accepted, astro-ph/0205173)

Further Optical Follow Up: ESIS



- ESO-SIRTF Imaging Survey
- ESO Large Program (P.I. Alberto Franceschini)
- 6.25 deg^2 centered on S1
- BVR (WFI) + IZ (VIMOS)
- Optical identifications, colors, photometric redshifts and rough morphologies of 200,000 SWIRE sources

Is there clustering out there?



Future Work

- Finalization of 15 μm catalogues (!Flux Calibration!)
- Overall Extragalactic source counts
- Multi-wavelength identifications (PHOT data at 90 μm!)
- Optical follow-up
- Clustering?
- ...

Lessons to be learnt

- Good understanding of the instrumentation is VERY important
- Software development must be timely
- Even so, new instrumentation leads to new software needs

... but most importantly ...

Try and be realistic about timing!

A "Final Analysis" process has been developed...
...we do not expect the "Final Analysis" to be finished until
early 2000,
hence the release of our "Preliminary" products.
(Oliver et al. 2001)