Final Analysis of ELAIS 15 μm Observations

Mattia Vaccari (Department of Astronomy, University of Padova)

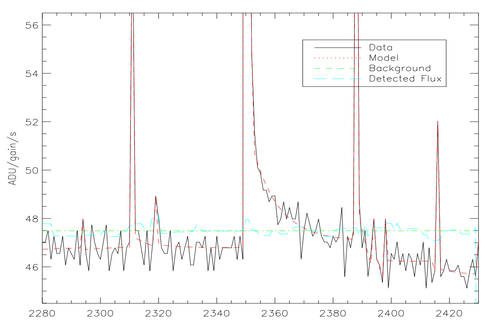
C. Lari (Inst. of Radioastronomy, CNR, Bologna)
L. Angeretti (Dept. of Astronomy, Univ. of Bologna)
D. Fadda (Instituto de Astrofisica de Canarias)
C. Gruppioni (Padova Astronomical Observatory)
F. Pozzi (Dept. of Astronomy, Univ. of Bologna)
O. Prouton (Dept. of Astronomy, Univ. of Padova)
A. Franceschini (Dept. of Astronomy, Univ. of Padova)
S. Oliver (Astronomy Centre, Sussex)
M. Rowan-Robinson (Imperial College, London)
G. Zamorani (Dept. of Astronomy, Univ. of Bologna)

Introduction

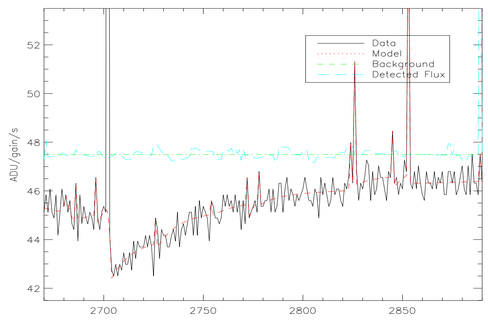
The European Large Area ISO Survey (ELAIS, Oliver et al., 2000, MNRAS, 316, 749) was the largest non-serendipitous extragalactic survey carried out by ISO, covering about 12 deg^2 at 15 and 95 μm and smaller areas at 7 and 175 μm, bridging the flux gap between IRAS all-sky survey and ISO deeper surveys. Thanks to an extensive multi-wavelength coverage, ELAIS fields have now become the best studied sky areas of their size, and natural targets of on-going or planned large-area surveys with the most powerful ground- and space-based facilities. Hence the need of reducing ISO data with the uttermost care and thus provide the community with an agreed-upon legacy from the ISO mission.

LARI Method

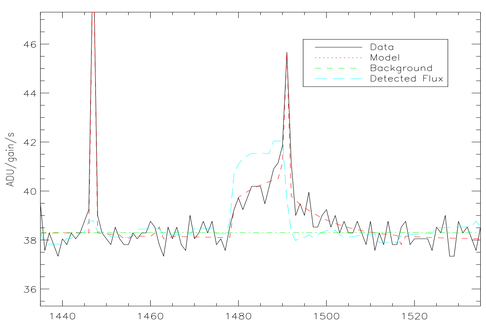
Final Analysis of ELAIS 15 μm observations in its main fields S1, N1, N2 and N3, chosen for their being sky regions with $I_{100\ \mu\mathrm{m}} < 1.5$ MJy/sr, no $S_{12\ \mu\mathrm{m}} > 0.6$ Jy sources and $|\beta| > 40°$, was carried out using a refined version of the LARI method (Lari et al., 2001, MNRAS, 325, 1173), a technique specifically developed for the detection of faint sources in ISOCAM raster observations. The method describes the sequence of readings, or time history, of each pixel of ISOCAM detectors in terms of a mathematical model for the charge release towards the contacts based on the assumption of the existence of two charge reservoirs evolving independently with a different time constant and fed by both the photon flux and the cosmic rays. Under these assumptions, different kinds of glitches (i.e. the effects of cosmic ray impacts on time history) are identified and modelled as free discontinuities in charge release, leading to very accurate modeling of detectors' behaviour and reliable source detection.



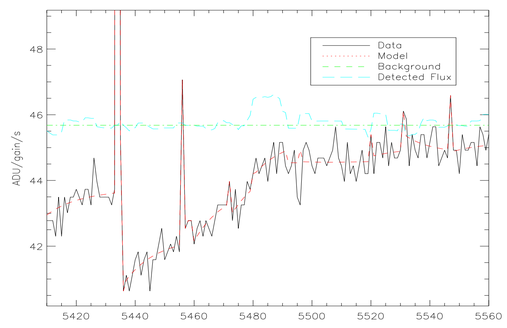
Fader



Dipper



Bright source



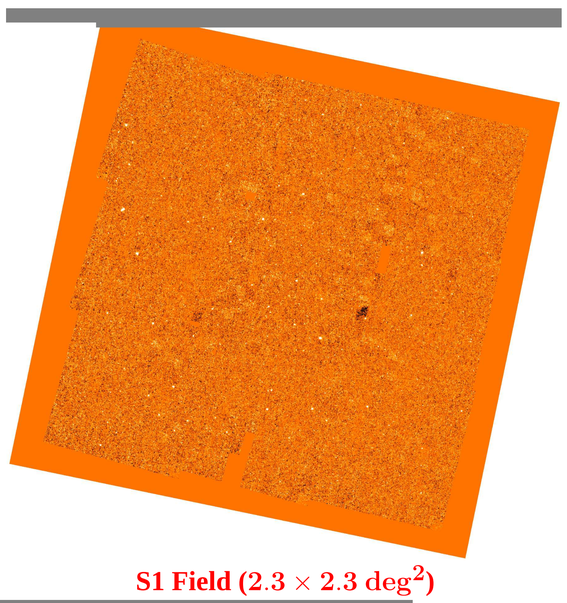
Faint source over a dipper

Data Reduction

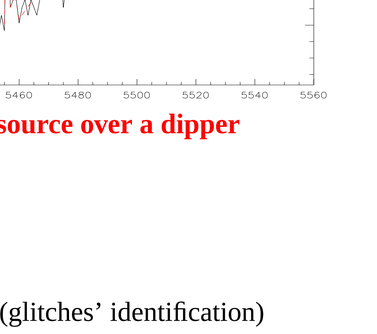
The applied reduction pipeline consisted of the following steps:

- CIA `raster` structure and `liscio` IDL structure building
- Dark current subtraction, background estimation and deglitching (glitches' identification)
- Time history fitting procedure and interactive "repair" on fitting failures
- Interactive checks on sources detected in time history
- Flat-fielding, mapping/mosaicing and source extraction
- Interactive checks on back-projected sources
- Source flux estimation through autosimulation, a procedure correcting from mapping effects arising from PSF undersampling
- A number of flux corrections, taking into account other less severe systematic effects

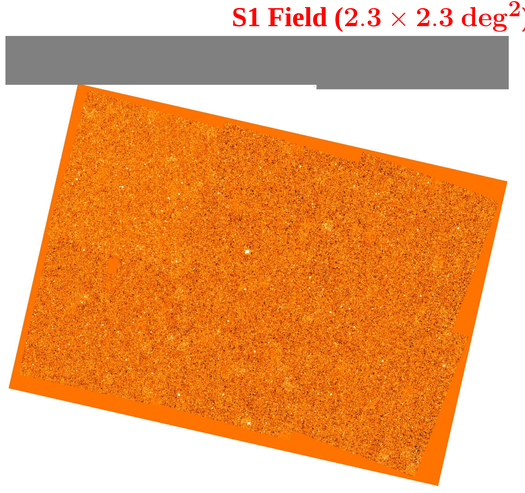
S/N Maps



S1 Field (2.3×2.3 deg^2)



N3 Field (0.9×1.5 deg^2)



N1 Field (1.5×2.1 deg^2)

N2 Field (1.6×2.1 deg^2)

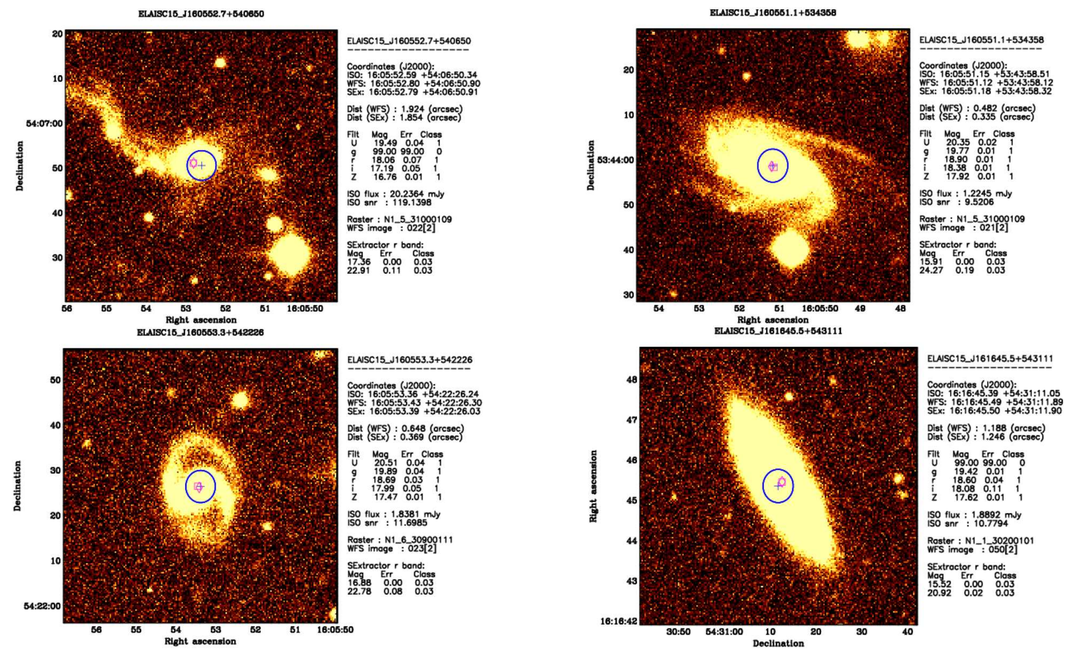
Catalogue

- 1923 sources detected with $S/N > 5$
- source density > 150 sources / deg^2
- spanning the 0.5 – 100 mJy flux range
- very high reliability

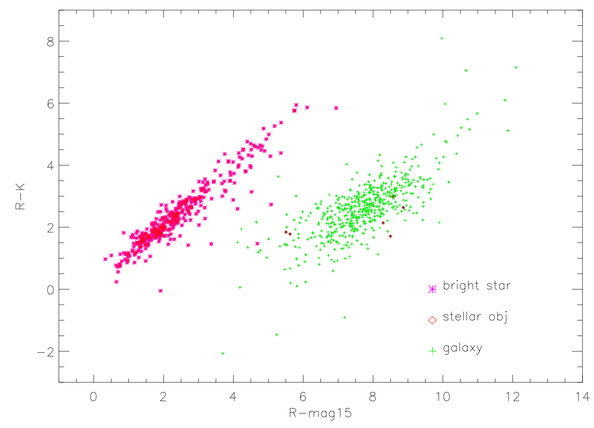
Field	Area [deg^2]	# of sources
S1	4.17	736
N1	2.84	490
N2	2.84	566
N3	1.00	131
Total	10.85	1923

Optical Identifications

Both archive and specifically acquired optical and near-infrared observational material (Gonzalez-Solares et al. 2003, La Franca et al. 2003, both in preparation) was employed to reliably identify optical counterparts to ISO detected sources and to study their morphological and physical properties.

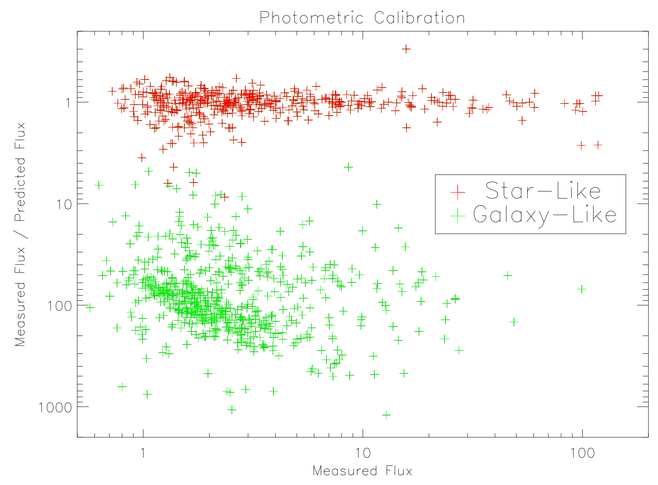


INT Wide Field Survey Finding Charts of ELAIS Sources (Courtesy of Eduardo Gonzalez-Solares)



Different well-populated color-color diagrams can be used as diagnostic tools.

Photometric Calibration



Photometric calibration was determined through the comparison between measured ISO stellar fluxes and stellar fluxes predicted on the basis of near-infrared magnitudes, following the recipe calibrated on IRAS and 2MASS data by Aussel et al. (2003, in preparation).

IRAS/ISO calibration factor turns out to be 1.0974 ± 0.0112 ...
... with a remarkably low scatter!

Conclusions

A technique for ISOCAM data reduction, the LARI method, was variously improved and applied to ELAIS 15 μm observations. Its application to the four fields composing the dataset has produced a catalogue of about 2000 sources detected with a S/N ratio greater than 5. Sources span the poorly covered 0.5 - 100 mJy flux range over an area of 10.85 deg^2. The combination of simulations and optical/near-infrared identifications shows that the catalogue is highly reliable and that a very good photometric calibration have been achieved. The catalogue and maps provides a substantial contribution to ELAIS multi-wavelength Final Catalogue (Rowan-Robinson et al., 2003, MNRAS, submitted, astro-ph/0308283) and a most precious database for the on-going work on 15 μm extragalctic source counts (Lari et al. 2003, in preparation) and multi-wavelength identification (Gonzalez-Solares et al. 2003, La Franca et al. 2003, Manners et al. 2003, Vaisanen et al. 2003, all in preparation).