THE EUROPEAN LARGE AREA ISO SURVEY: ELAIS

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1. Introduction

I describe a project to survey ~ 13 square degrees of the sky at 15μm and 90μm with the Infrared Space Observatory (ISO). The European Large Area ISO Survey (ELAIS) is a collaboration involving 19 European institutes (in addition to the authors and others at their institutes the following people and others their institutes are involved I. Gonzalez-Serrano, E. Kontizas, K. Mandolesi, J. Masegosa, K. Mattila, H. Norgaard-Nielsen, I. Perez-Fournon, M. Ward) and is the largest open time project being undertaken by ISO. We expect to detect at least 1000 extra-galactic objects and a similar number of Galactic sources.

IRAS demonstrated the benefit of selecting objects in the far infrared. This wave-band is not sensitive to dust obscuration which biases optically selected samples. The emission arises from thermally heated dust and complements studies of emission directly from star-light, gas, or AGN engines.

The sensitivity of ISO is orders of magnitude better than IRAS. Using it for a survey thus allows us to explore star formation in IRAS-like populations to higher redshift and possibly unveil new classes of objects or unexpected phenomena.

2. Some Key Science Goals

The main extra-galactic population detected by IRAS was galaxies with high rates of star formation. These objects are now known to evolve with a strength comparable to AGN (Oliver *el al.*, 1995). The distance to which these objects were visible by IRAS was, however, insufficient to determine the nature of their evolution. The sensitivity of ISO will allow us to detect

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TABLE 1. Summary of Main Areas. These four areas comprise the main survey composed of $40' \times 40'$ rasters. In addition to the cirrus criterion $I_{100} < 1.5$MJy/sr, we restricted ourselves to regions of high visibility $> 25\%$ over the mission lifetime. For low Zodiacal background we required $|\beta| > 40$ and to avoid saturation of the CAM detectors we had to avoid any bright IRAS 12μm sources. (In addition to these are also 6 smaller rasters $20' \times 20'$ centred on well studied areas of the sky or high-z objects)

Area	Rasters	Nominal Coordinates J2000		$\langle I_{100} \rangle$ MJysr^{-1}	Visibility %	β
N1	3×2	$16^h10^m01^s$	$+54°30'36''$	1.2	98.0	73
N2	3×2	$16^h36^m58^s$	$+41°15'43''$	1.1	58.7	62
N3	3×2	$14^h29^m06^s$	$+33°06'00''$	0.9	26.9	45
S1	3×3	$00^h34^m44^s$	$-43°28'12''$	1.1	32.4	-43
Lock. 3	1	$13^h34^m36^s$	$+37°54'36''$	0.9	17.3	44
Sculptor	1	$00^h22^m48^s$	$-30°06'30''$	1.3	27.5	-30
TX1436	1	$14^h36^m43^s$	$+15°44'13''$	1.7	22.2	29
4C24.28	1	$13^h48^m15^s$	$+24°15'50''$	1.4	16.8	33
VLA 8	1	$17^h14^m14^s$	$+50°15'24''$	2.0	99.8	73
Phoenix	1	$01^h13^m13^s$	$-45°14'07''$	1.4	36	

these objects at much higher redshifts and thus obtain greater understanding of the cosmological evolution of star formation.

If elliptical galaxies underwent a massive burst of star-formation between $2 < z < 5$, they would be observable in the far infrared and may look like F10214 (Elbaz *et al.*, 1992). This survey will provide a powerful discrimination between this and a merging model whose components are individually too faint to detect.

IRAS uncovered a population with enormous far infrared luminosities, $L_{\rm FIR} > 10^{12} L\odot$. While most of these objects appear to have an AGN it is argued that star formation could provide most of the energy. Interestingly, most of these objects appear to be in interacting systems, suggesting a triggering mechanism. Exploration of these objects at higher redshift will have particular significance for models of AGN/galaxy evolution. Since AGN far infrared emission is relatively insensitive to inclination angle these objects may also constrain certain unification schemes.

F10214 was at the limit of IRAS sensitivity (Rowan-Robinson *et al.*, 1991) and new classes of objects may well be discovered at the limit of the ISO sensitivity. The lensing phenomenon which made F10214 detectable by IRAS may become more prevalent at fainter fluxes, increasing the proportion of interesting objects.

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3. Survey Definition

We were restricted to two bands and selected 15 μm (using ISO-CAM) which is sensitive to AGN emission and 90 μm (using ISO-PHOT) which is sensitive to emission from star formation regions. To complement deep CAM surveys (Franceschini *et al.*, 1995) we decided to sacrifice depth at the shorter wavelength for increased area, at the longer wavelength we aimed to reach the confusion limit. This lead us to an integration time of 20s for both with the CAM raster such that each sky position is observed twice. The CAM detector is an array of 32×32 pixels and we use a pixel field of view of $6''$, the PHOT detector we use is a 3×3 array with $43.5''$pixels.

The satellite is operated in raster mode and a single raster is $40' \times 40'$ (although with PHOT this area is observed in two halves). The main survey is 28 of these rasters grouped in four areas on the sky. Cirrus confusion is a particular problem, so our main selection criterion was low IRAS 100μm intensities, using the maps of (Rowan-Robinson *et al.*, 1991b).

4. Current Status

A CAM test raster and two PHOT half rasters were observed and have now been processed. As of 7th October observations of 4 rasters in S1 and all 6 in N1 have been completed. Subject to scheduling constraints we expect the remainder of the observations to be done by the end of January 1997.

Analysis of the CAM and PHOT test data suggest that we will reach a 5σ limit of around 2mJy at 15 μm and 50mJy at 90 μm .

Our WWW page can be found on `http://artemis.ph.ic.ac.uk/`

References

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