ESO Imaging Survey: Finding Targets for VLT

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Abstract. Data from the wide-angle, moderately deep ESO Imaging Survey have been used to produce target lists for the first year of the VLT. About 250 candidate clusters of galaxies have been identified from the $I$-band images covering $\sim 17$ square degrees. In addition, using the multicolor data available over an area of 1.3 square degrees over 300 potentially interesting point-sources have been selected. The color-selected targets include low-mass stars/brown dwarfs, white-dwarfs and quasars. Images, object catalogs and derived target lists are available from the world-wide web (http://www.eso.org/eis).

1 Introduction

The ESO Imaging Survey (EIS) was conceived as a public survey to provide the ESO community with suitable data for producing target lists for the first year of VLT operation [7]. EIS has been carried out as a concerted effort of ESO and its community to optimize the one-year period available between the re-commissioning of the NTT in July 1997 and the deadline for proposals for the first period of scientific operation of the VLT. To maximize the return a new framework was established by ESO and the Observing Program Committee whereby a Working Group was created to define the goals and to oversee the execution of a public imaging survey. A Visitor Program was also created to allow tapping on the expertise of different European groups to develop the tools required for the efficient translation of raw images into potentially useful target lists. As a by-product the project has also been used to establish the infrastructure (pipeline processing, archive, object-oriented database) required to cope with the large increase in the data flow expected from new CCD-mosaic cameras under development for La Silla and Paranal, fully dedicated for wide-field imaging.

The first phase of EIS (EIS-wide) consisted of a moderately deep ($I \lesssim 23.5$) wide-angle survey, covering four patches of sky spread over the right ascension range $22^h < \alpha < 9^h$, thus providing targets nearly year-round. The observations of EIS-wide have already been completed and all the data in the form of photometrically and astrometrically calibrated pixel maps, object and derived catalogs are publicly available. These data can be retrieved from the web via an user interface built in collaboration with the ESO Science Archive group as a prototype for future distribution of public data. Table 1 summarizes the position of the EIS patches and the area covered in each of the passbands.
considered.

Table 1. EIS-Wide Sky Coverage

| Patch | α      | δ      | B   | V   | I   |
|-------|--------|--------|-----|-----|-----|
| A     | 22:42:54 | -39:57:32 | 1.2 | 3.2 |     |
| B     | 00:49:25 | -29:35:34 | 1.7 | 1.7 | 1.8 |
| C     | 05:38:24 | -23:51:00 | -   | -   | 6.0 |
| D     | 09:51:36 | -21:00:00 | -   | -   | 6.0 |

A full description of the EIS pipeline and the quality of the data for each patch can be found in papers that accompanied each data release [2] [6] [1]. The computed star counts are, in general, consistent with model predictions, while the galaxy counts obtained for each patch are internally consistent and in good agreement with those of other authors. Moreover, we find that the $I-$band observations are sufficiently deep to search for distant clusters. Internal and external comparisons of the galaxy angular two-point correlation function are also in good agreement, indicating that the derived galaxy catalogs are uniform.

At the time of this writing, we have already started the second phase of EIS (EIS-deep) which consists of a deep, multicolor survey in five optical and three infrared passbands covering 75 arcmin$^2$ of the HST/Hubble Deep Field South (HDFS), including the WFPC2, STIS and NICMOS fields, and a region of 100 arcmin$^2$ selected for deep X-ray observations with AXAF. The data will be used to find U- and B-dropouts and to produce galaxy samples with photometric redshifts from which galaxies in the redshift range $1 < z < 2$ can be drawn for follow-up spectroscopic observations in the infrared.

2 Cluster Candidates

Cluster candidates were identified using a cluster finding pipeline implemented at the back-end of the EIS pipeline [3]. The search algorithm is based on the matched-filter technique [5] and it was chosen to facilitate the comparison with the results of one of the few systematic searches for optically-selected distant clusters [5]. It should be emphasized that the primary goal of the EIS team has been to prepare a list of cluster candidates for follow-up observations and not to produce a well-defined sample for statistical analysis. Instead, our main concern has been to minimize the number of false detections, thereby increasing the yield in future follow-up work. For this purpose the analysis has been restricted to the most uniform surveyed areas and parameters were chosen conservatively, using an extensive set of simulations. We point out that the derived catalog is not unique, given the various underlying assumptions of the method and our particular choice of parameters. However, since the data are public, other groups may produce their own catalogs using different
methods (e.g., Lobo, this conference). A comparison of various catalogs will be instructive in evaluating the strengths and weaknesses of different algorithms.

The total sample of EIS I-band cluster candidates consists of 252 objects in the redshift range $0.2 \leq z \leq 1.3$. The redshift distribution of the sample is shown in figure 1. The median redshift of the distribution is $z \sim 0.4$. Note that the EIS redshift distribution differs somewhat from that observed by PDCS, also shown in the figure. The number of EIS candidates decreases monotonically with redshift up to $z \sim 0.6$ with an extended tail beyond, in contrast to the PDCS which shows a relatively flat distribution peaking at $z \sim 0.4$.

Another way of further testing the reality of the detections is to use data in different passbands. Using the $V$-band data available for $\sim 2.7$ square degrees, clusters were identified and cross-correlated to the $I$ detections. The results can be summarized as follows: 1) About 90% of the cluster candidates with $z \leq 0.5$ and about 25% with $z > 0.5$, primarily rich clusters, are confirmed using the $V$ candidates; 2) Candidates at low-redshift show the red envelope in the C-M relation expected for ellipticals. The CM relation serves as an independent confirmation of the candidate clusters and an independent redshift estimate, by and large consistent with the estimates from the matched filter method.
3 Color-Selected Targets

Preliminary lists of other potentially interesting targets were also extracted from the multicolor data obtained for a 1.7 square degree region near the South Galactic Pole. The region was observed in $B, V$ and $I$ and offers a unique combination of area and depth. These lists contain a total of 358 objects ($I \lesssim 21.5$) over 1.27 square degrees, after eliminating regions observed under less than ideal conditions. Among the color selected targets are candidate very low mass stars/brown dwarfs (62), white-dwarfs (32), and quasars (264) [9]. These objects are natural candidates for follow-up spectroscopic observations and illustrate the usefulness of the EIS data for a broad range of science. The selected objects can be found in the web and can be examined by displaying side-by-side image postage stamps in the three passbands. Improvements in the sample selection are certainly possible and we encourage interested groups to produce their own samples. From the present data the derived samples typically include 50 to 100 candidates each. However, much larger samples will be available from the Pilot Survey to be carried out with the new wide-field camera on the 2.2 m telescope at La Silla.

4 Summary

One year after the first observations all the data for EIS-wide are available to the community. In addition, a basic pipeline for the processing of images is available which allows for the processing of individual frames, the coaddition of overlapping images, the extraction of objects and the preparation of color catalogs. The pipeline is currently being generalized to handle data from different detectors and CCD mosaics, an essential step for its use with the wide-field imager WFI@2.2m to be commissioned later this year.

The EIS candidate cluster catalog consists of about 250 candidates in the redshift range $0.2 < z < 1.3$, distributed over a wide range of right ascension, with candidates available year-round. This sample is currently the largest available in the southern hemisphere and confirmation work will start soon. EIS has also produced over 300 color-selected targets for different scientific goals. More importantly, these samples can grow in time if similar public surveys are carried out on the 2.2m telescope, with an efficiency at least 6 times higher than the original EIS at the NTT. It should be point out that a Pilot Survey on the 2.2m, which aims at completing EIS-wide, has already been scheduled for the beginning of 1999.

Acknowledgements. I would like to thank all the EIS team members for the magnificent work carried out over the past year. Without their dedication and commitment it would have been impossible to meet the strict deadline under which this survey was conducted. Special thanks to Alvio Renzini for his unconditional support and enthusiasm. Finally, we would like to thank ESO’s Director General Riccardo Giacconi for making this effort possible and for his and P. Rosati’s choice of the AXAF field.
References

[1] Benoist et al., 1998, submitted to A&A [astro-ph/9807334]
[2] Nonino, M., et al. 1998, A&A, in press, [astro-ph/9803336]
[3] Olsen, L.F., et al. 1998a, A&A, in press, [astro-ph/9803348]
[4] Olsen, L.F., et al. 1998b, submitted to A&A [astro-ph/9807156]
[5] Postman, M., Lubin, L.M., Gunn, J.E., Oke, J.B., Hoessel, J.G., Schneider, D.P., Christensen, J.A. 1996, AJ, 111, 615
[6] Prandoni, I., et al. 1998, submitted to A&A [astro-ph/9807153]
[7] Renzini, A. & da Costa, L. N. 1997, Messenger 87, 23
[8] Scudellaro, M. et al., 1998, submitted to A&A [astro-ph/9807336]
[9] Zaggia, S. et al., 1998, submitted to A&A [astro-ph/9807152]