Pathways through an Eclectic Universe
ASP Conference Series, Vol. 390, © 2008
J. H. Knapen, T. J. Mahoney, and A. Vazdekis, eds.

The ALHAMBRA Survey

M. Moles,[1] J. A. L. Aguerri,[2] E. J. Alfaro,[1] N. Benítez,[3]
T. Broadhurst,[4] J. Cabrera-Caño,[5] F. J. Castander,[6] J. Cepa,[2]
M. Cerviño,[1] A. Fernández Soto,[7] R. M. González Delgado,[1]
L. Infante,[8] V. J. Martínez,[7] J. Masegosa,[1] I. Márquez,[1] A. del Olmo,[1]
J. Perea,[1] F. Prada,[1] J. M. Quintana,[1] and S. F. Sánchez[9]

[1]*Instituto de Astrofísica de Andalucía (CSIC), E-18008 Granada, Spain*
[2]*Instituto de Astrofísica de Canarias, E-38200 La Laguna, Spain*
[3]*IMAFF (CSIC), Madrid, Spain*
[4]*School of Physics and Astronomy, Tel Aviv University, Israel*
[5]*Facultad de Física, Universidad de Sevilla, Sevilla, Spain*
[6]*Institut d'Estudis Espacials de Catalunya, CSIC, Barcelona, Spain*
[7]*Department d'Astronomia i Astrofisica, Universitat de Valencia, Valencia, Spain*
[8]*Departamento de Astronomía, Pontificia Universidad Católica, Santiago, Chile*
[9]*Centro Astronómico Hispano Alemán, Almería, Spain*

Abstract. ALHAMBRA is a survey of eight separate regions of the sky with a total area of 4 sq. deg. The fields are observed with the LAICA (visible) and OMEGA-2000 (near infrared) cameras mounted on the 3.5 m telescope of CAHA observatory. The survey is done with a set of 20 adjacent medium-band filters that cover the visible range. These filters, together with three standard near-infrared ones, allow for a detailed measurement of the spectral energy distribution and redshift of a multitude of objects, stretching over an unprecedented range of distances for such a large-area survey. In particular, the basic motivation of the whole ALHAMBRA project is the cosmic evolution of galaxies. ALHAMBRA has been designed to cover the niche between deep pencil-beam surveys, which are necessarily restricted to small areas, and large-area shallow surveys that only probe the local Universe. The project enjoys Spanish guaranteed observing time status at the Calar Alto facilities. In this poster, we present the project and the first results obtained.

1. Goals of the Project

ALHAMBRA (Advanced Large, Homogeneous Area Medium-Band Redshift Astronomical; Moles et al. 2005) will produce accurate photometric redshifts for a large number of objects, enough to track cosmic evolution in a kind of cosmic tomography. ALHAMBRA is imaging 4 sq. deg, with 20 contiguous, equal-width (310 Å), medium-band filters covering from 3500 to 9700 Å, plus the standard $JHK_{\rm s}$ near-infrared (NIR) bands. The optical photometric system has been designed to maximize the number of objects with accurate classification by spectral energy distribution and redshift, and to be sensitive to relatively faint emission features in the spectrum. The observations are being carried out with the Calar Alto 3.5 m telescope using the wide field cameras in the optical, LAICA, and in

the NIR, OMEGA-2000. The magnitude limit, for a total of 100 ks integration time per pointing, is $AB = 25$ mag (for an unresolved object, $S/N = 5$) in the optical filters from the blue to 8300 Å, and ranges from $AB = 24.7$ to 23.4 mag for the redder ones. The limit in the NIR, for a total of 15 ks exposure time per pointing, is $K_s = 20$, $H = 21$, $J = 22$.

We will obtain accurate redshift values ($\Delta z/(1+z) \leq 0.03$) for about 6.6×10^5 galaxies with $I \leq 25$ mag (60% completeness level), and $z_{\rm med} = 0.74$. This accuracy, together with the homogeneity of the selection function, will allow the study of the large scale structure evolution, the galaxy luminosity function and its evolution, the identification of clusters of galaxies, and many other studies, without the need for any further follow-up. It will also provide exciting targets for detailed studies with 10 m-class telescopes. Given its area, spectral coverage, and depth, the ALHAMBRA survey will also produce valuable data for Galactic studies.

The survey will provide a 50% completeness limit of $AB \sim 24.2$ mag for objects with secure redshift. For objects with high quality redshifts the equivalent limit will be $AB \sim 25.4$ mag. An extra advantage of the ALHAMBRA data is that the redshift determination is based on the general shape of the spectrum and not on particular emission and/or absorption features. It is precisely because of this absence of biases that the survey is more valuable, and because of the testability associated with the photometric redshift measurements that the survey is especially adapted to studies of cosmic evolution. The median redshift of ALHAMBRA (90% completeness) will be $\sim$0.63, with approximately 2000 galaxies with secure redshifts $z \geq 5$.

Because of its very nature ALHAMBRA occupies a niche which lies halfway between traditional photometric and spectroscopic surveys. Over half a million galaxies down to $AB \sim 25$ mag will be observed, with high quality redshifts being measured for them. This represents a number of objects comparable to that of the widest spectroscopic surveys, but covering considerably smaller areas. On the other hand, ALHAMBRA will reach deeper than most photometric surveys over a relatively large area.

Further details about the project are available at http://alhambra.iaa.es:8080/ and a recent press release in http://www.caha.es/alhambra-the-history-of-the-universe-at-sight.html or http://www.uv.es/obsast/alhambra/pressrelease.html.

References

Moles, M., et al. 2005, astro-ph/0504545

Figure 1. Image formed by combining the individual optical frames (only 15 filters in this case) corresponding to a 15 arcmin area of the Alhambra-8 field.