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White Dwarfs in the ALHAMBRA Survey

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Abstract. A new high visual depth survey is presented. New cool white dwarfs will eventually be discovered, which will undoubtely increase the statistical significance of the white dwarf luminosity function. Moreover, by increasing the sample of known white dwarfs, we will be able to determine which ones are members of a binary system and which of those binary systems are detached and composed by a main sequence star and a white dwarf. Hence, comparison of their corresponding ages will provide tight constraints on the evolutionary models.

1. Introduction

The ALHAMBRA (*Advanced Large, Homogeneous Area Medium Band Redshift Astronomical*) survey is a general-purpose survey whose primary aim is to provide a large area of 8 square degrees, magnitude-limited photometric catalogue in 20+3 bands, which will include reliable and precise photometric redshifts for about 10^6 galaxies and AGNs. Figure 1 shows the eight 1-square degree fields selected by the ALHAMBRA Team, four in each Galactic hemisphere to allow continuous observations throughout the year. Some of them have been chosen intentionally to overlap with other publicly available surveys for the sole purpose of verifying calibration methods and comparing results. The images will be taken by the LAICA camera at the Calar Alto 3.5 m telescope using a constant-width, nonoverlapping 20-filter system in order to provide a complete, contiguous spectral coverage in the optical wavelength range (3500–9700 Å), and also JHK observations with the Omega Prime camera at the same telescope. Although this survey is specially well suited for the analysis of cosmic evolution (large scale structure, galaxy luminosity function, galactic population studies, supernovae, QSOs,. . .) it will also be helpful to detect new white dwarfs.

In Figure 2, the limiting AB magnitudes are expressed as a function of the wavelength for different filters in the optical range. The goal of this survey is to reach, in the optical range, a constant flux, $AB = 25$ at $S/N = 5$, in all the filters from 3500 to 8300 Å, and from $AB = 24.7$ to 23.4 for the remaining filters.

The exposure time necessary to reach the quoted limit has been computed for each filter and it is indicated in ksecs in each of the bins.

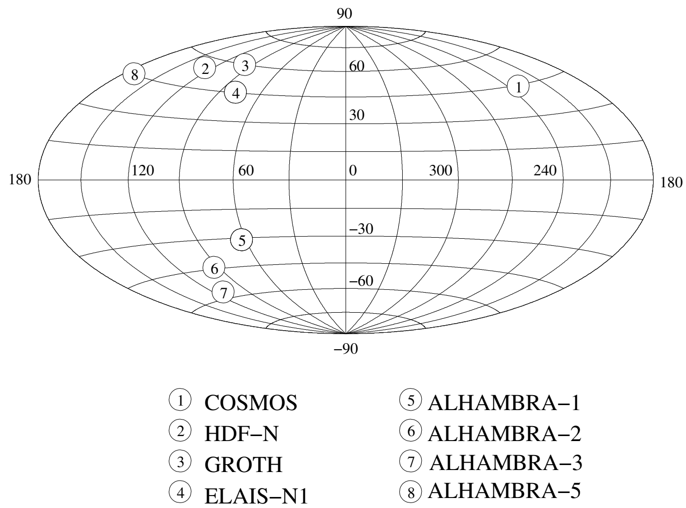

Figure 1. Fields chosen by the ALHAMBRA team.

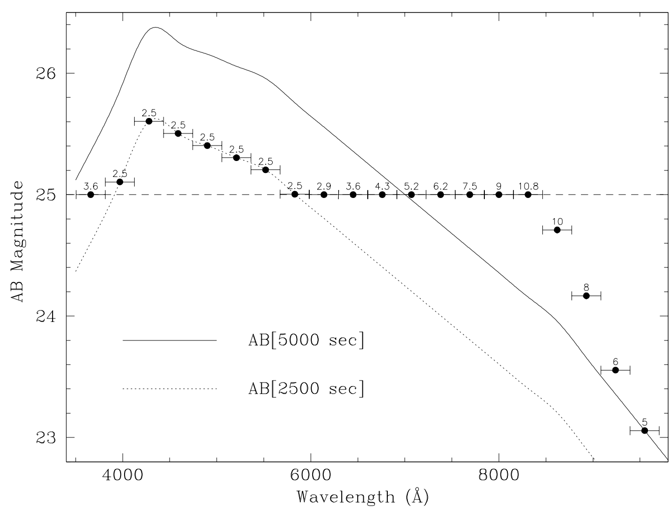

Figure 2. Limiting *AB* magnitudes versus wavelength for different filters.

2. Comparison with Other Surveys

A comparison of the main characteristics of the ALHAMBRA Survey and those of some publicly available surveys can be found in Table 1. The ALHAMBRA Survey will provide observations over a large area, as well as very high resolution and deep visual detection. This is the most important aspect that distinguishes this survey from the rest.

Table 1. A comparison of the characteristics of the ALHAMBRA survey with other surveys.

Survey	I_{AB} limit	Area [□°]	Spectral Range	Resolution
COSMOS	27.0	2	gI	2.5
HDF-N	28.0	0.001	UVI	4.0
SDSS	21.3	8000	$Ugriz$	6.0
NOAO	26.0	18	$BRIJHK$	4.0
COMBO-17	24.0	1	3650–9140 Å	25.0
ALHAMBRA	25.0	8	3500–22000 Å	25.0

3. Colour-Colour Diagrams

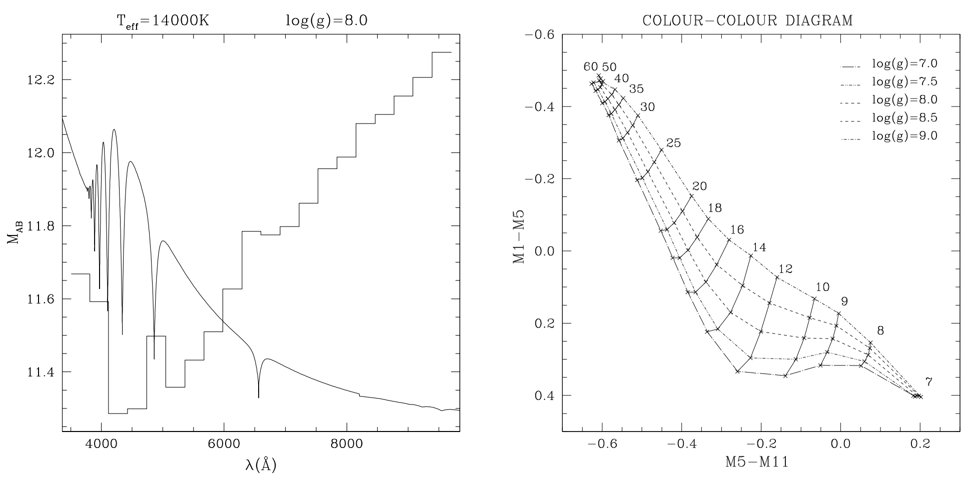

Figure 3. *Left*: AB magnitudes and theoretical spectra versus wavelength for a DA white dwarf with $T_{\rm eff}$=14000 K and $\log g = 8.0$. *Right*: Colour-colour diagram for a set of DA white dwarfs

A set of theoretical spectra for DA white dwarfs ranging in temperature from 7000 to 60000 K and in surface gravities from 10^7 to 10^9cm/s^2 from the Koester database has been used to compute AB magnitudes for each spectra. In the left panel of Figure 3, a typical DA white dwarf spectrum can be seen, as well as the corresponding AB magnitudes (histogram) obtained for each of the filters of the ALHAMBRA survey.

Once the results of the ALHAMBRA survey become available, it will be necessary to place those objects of interest in a colour-colour diagram. The right panel of Figure 3 shows an example of a colour-colour diagram in which a wide grid has been plotted. For this case we have considered the magnitudes obtained taking into account the filters 1, 5 and 11 of the photometric system of

Table 2. Number of white dwarfs expected to be detected in each of the fields of the ALHAMBRA survey.

Field	Disk	Halo
COSMOS	36	2
HDF-N	31	1
GROTH	32	1
ELAIS-N1	37	2
ALHAMBRA-1	51	3
ALHAMBRA-2	33	2
ALHAMBRA-3	33	1
ALHAMBRA-5	30	2

the ALHAMBRA survey. Other combinations are possible as well and provide also useful information.

4. Expected Number of White Dwarfs

Assuming a standard initial mass function, a constant star formation rate and the white dwarf cooling sequences of Salaris et al. (2000), the white dwarf luminosity functions for both the halo and the disk populations can be computed (García–Berro et al. 1997; García–Berro et al. 2004), and taking into account the limiting V magnitude of the survey, which turns out to be 25.5, the expected number of white dwarfs can be derived for each of the above mentioned fields. A total number of 300 white dwarfs is expected to be detected in the ALHAMBRA survey. In Table 2 we detail the number of white dwarfs potentially detected in each of the fields of the ALHAMBRA survey, for both the Galactic disk and halo white dwarf populations.

5. Conclusions

In summary, the ALHAMBRA survey will provide us with a handful of new white dwarfs which will increase the actual sample of known objects. Moreover, in such a sample there will probably be some detached binary systems containing a white dwarf and a main sequence star. If this is the case, the possibility of comparing their respective ages would arise. Follow-up observations of these white dwarfs will be, nevertheless, necessary.

References

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