QSO selection in the ALHAMBRA* survey

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We characterize the efficiency of the ALHAMBRA survey to derive highly accurate photometric redshift (photo-*z*) for AGN. In the past, variability and host galaxy contamination did not allow the same photo-*z* precision for AGN as for the normal (inactive) galaxies. We present the results for the QSO photo-*z* calibration making use of the available spectroscopic information from other major cosmological surveys (e.g. COSMOS, GOODS, SDSS, DEEP, SWIRE & AEGIS). With the appropriate selection of templates, the analysis of the ALHAMBRA fields shows an excellent agreement between the spectro-*z* and photo-*z*, obtaining $\sigma[\Delta z/(1+z)] \sim 0.02$ with a low fraction (~9%) of catastrophic failures. This initial step is fundamental for any further analysis of individual or statistical properties of the ALHAMBRA AGNs.

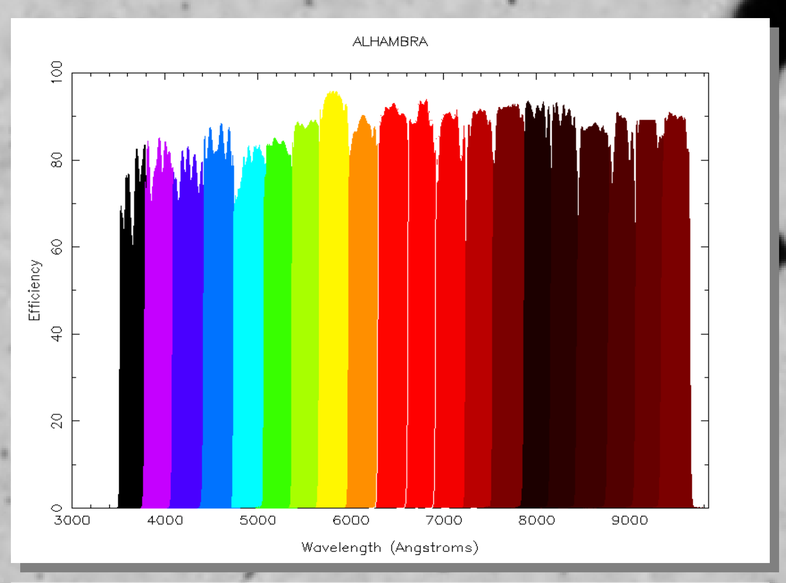
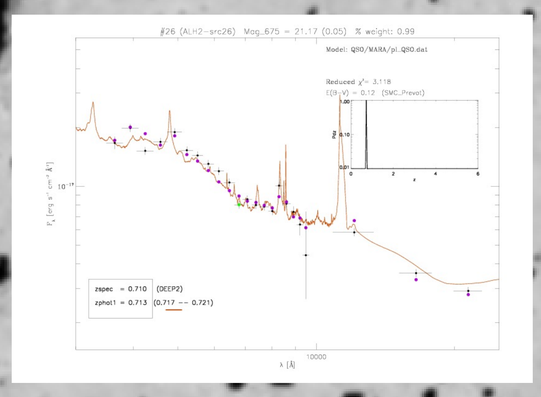
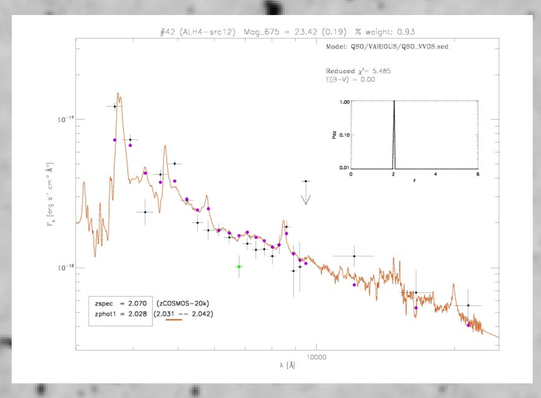


Fig 1. Coverage of the 20 contiguous, equal-width, non-overlapping, medium-band optical filters set of the ALHAMBRA survey. This filters set, covering the range 3500-9700Å (1), is complemented by the 3 standard *JHKs* filters in the near-IR (3).





DEFINITION

- The *A*dvanced *L*arge, *H*omogeneous *A*rea, *M*edium-Band *R*edshift *A*stronomical (ALHAMBRA) survey (6) has been designed for cosmic evolution studies and to provide optimal compromise between large area, depth and spectral resolution (2; see Fig. 1).
- The survey covers ~3 deg². An example of the quality of the data is given in the central panel of Fig. 2.

AIMS

- Calibration of the ALHAMBRA database for the selection of QSO and their photo-z determination (*COMPLETED*).
- Generation of an ALHAMBRA QSO database (*Work in progress*).
- Study the space density of QSO and its change with cosmic time (luminosity functions) comparing it with the findings at other wavelengths and selection criteria (*Work in progress*).
- Extend the analysis to lower luminosity (Seyfert nuclei) and highly obscured sources, Seyfert-2 and QSO-2 (*Work in progress*).
- Fraction and environment and fueling of AGN in the "local" (*z*<0.8) universe (*Work in progress*).
- Search for particular and exotic sources like BAL-QSO, EROs, DRGs, Lyman-break galaxies and very high-z objects (*Work in progress*).

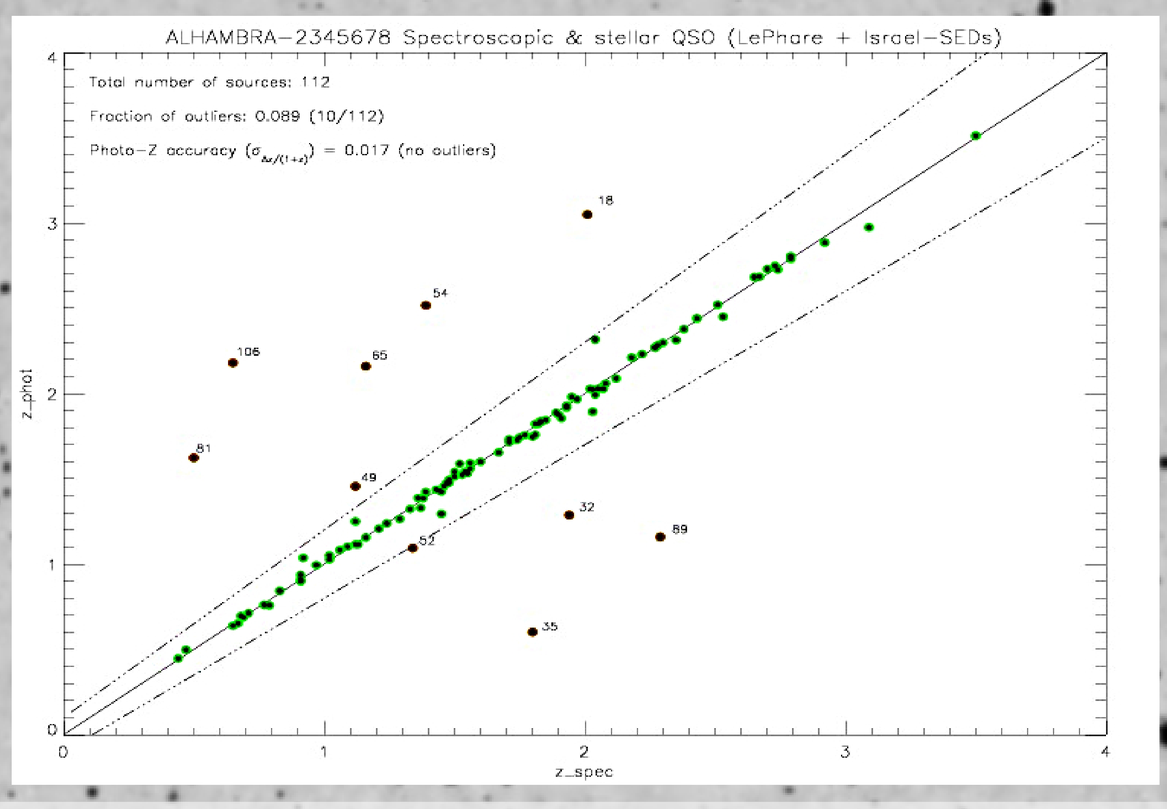
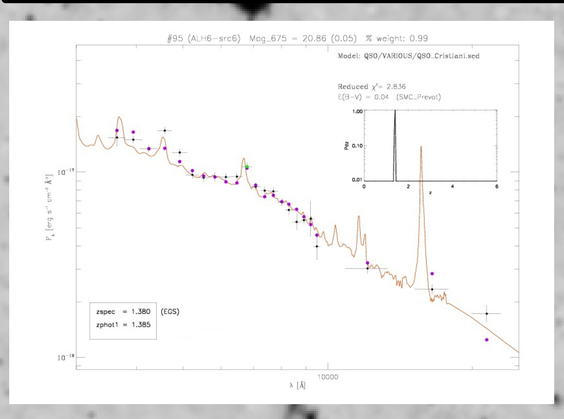


Fig 3. Comparison between the best-fit photo-*z* solution and the measured spectroscopic redshift for the 112 point-like QSO present in the ALHAMBRA database (5). The 3-dot-dashed line represents our threshold ($\Delta z/(1+z) \geq 0.1$) between sources with a good fit (green-dots) and the outliers (red-dots; ~9%).



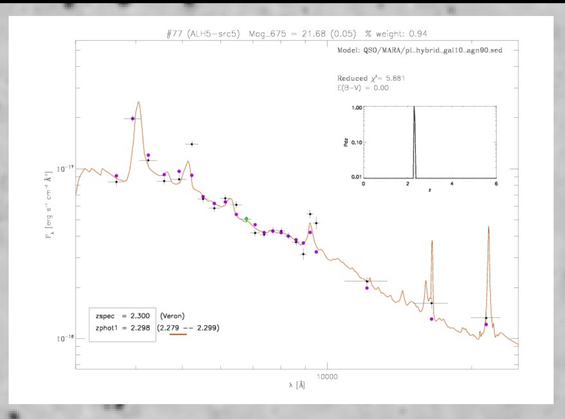


Fig 2. RGB 14'x14' color image of one of the ALHAMBRA fields in ALH2 combining the filters f892, f582 and f396. Around the central panel we show 4 examples of previously known QSO used for the photo-*z* calibration and representative of the final fit quality for these sources.

RESULTS

- The quality of the ALHAMBRA photometry and its ability to select QSO has been tested using a χ^2 fitting technique to a library of empirical and theoretical templates.
- The public code *LePhare* was used in the minimization process while the template library is formed by a set of 200 templates (50 normal galaxies and AGN + 150 stars).
- We find excellent agreement between the template models and the ALHAMBRA very-low-resolution spectra (Fig. 3) being able to correctly classify and assign a valid redshift to **91.1%** (102/112) of the spectroscopically identified stellar QSOs in ALHAMBRA.
- The quality of the photo-*z* solution is better than 2%, $\sigma[\Delta z/(1+z)] < 0.02$ with **8.9%** of outliers. This result is comparable to the most recent results for AGN photo-*z* determination in other relevant cosmological surveys like GOODS (4) and COSMOS (7).
- The search for template-selected-QSOs in the complete ALHAMBRA database, as well as the study of their space density distribution, is currently "work in progress" and is expected to be finished and submitted before then end of 2010 (5).

References

1. Aparicio-Villegas, T. et al., 2010, A, 139, 1242
2. Benítez, N, et al., 2009, ApJ, 692, L5
3. Cristóbal-Hornillos, D., et al., 2009, ApJ, 696, 155
4. Luo, B., 2010, ApJS, 187, 560
5. Matute, I., et al., in preparation
6. Moles, M., et al., 2008, AJ, 136, 1325
7. Salvato, M., et al., 2009, ApJ, 690, 1250

** http://alhambra.iaa.es:8080/alhambra/*