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Wide-field spectroscopy of Abell 1689 and Abell 1835 with VIMOS

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Spectroscopic surveys can add a third dimension, velocity, to the galaxy distribution in and around clusters. The largest wide–field spectroscopic samples at present exist for near-by clusters. Czoske et al. (2001: A&A 372, 391; 2002: A&A 386, 31) present a catalogue of redshifts for 300 cluster members with $V \lesssim 22$ in Cl0024+1654 at $z = 0.395$, the largest currently available cluster redshift catalogue at such a high redshift. In that case, it was only the redshift information extending to large cluster-centric distances which revealed the complex structure of what appeared in other observations to be a relaxed rich cluster.
The recent advent of high-multiplex spectrographs on 8–10 meter class telescopes has made it possible to obtain large numbers of high-quality spectra of galaxies and around clusters of galaxies in a short amount of time. The data described by Czoske et al. (2001) were obtained over the course of four years. Samples larger by a factor of $2\ldots3$ can now be obtained in ~ 10 hours of observation time. Here I present the first results from a spectroscopic survey of the two X-ray luminous clusters Abell 1689 ($z = 0.185$) and Abell 1835 ($z = 0.25$).
We use the VIsible imaging Multi-Object Spectrograph (VIMOS) on VLT UT3/Melipal. The field of view of VIMOS available for spectroscopy consists of four quadrants of $\sim 7' \times 7'$, the separation between the quadrants is $\sim 2'$. Using the LR-Blue grism, one can place $\sim 100\ldots150$ slits per quadrant. The resulting spectra cover the wavelength range $3700\ldots6700$ Å with a resolution $R \simeq 200$. We use as the basis for object selection panoramic multi-colour images obtained with the CFH12k camera on CFHT (Czoske, 2002, PhD thesis), covering $40' \times 30'$ in *BRI* for A1689 and *VRI* for A1835. The input catalogue has been cleaned of stars.
We attempted to cover the entire CFH12k field of view by using 10 VIMOS pointings for each cluster. Due to technical problems with VIMOS only 8 and 9 masks were observed in service mode for A1689 and A1835, respectively. 4 of these masks did not fully meet the observational constraints although the spectra are at least partly usable.
In the observed masks, slits were placed on 3373/3542 objects in A1689 and A1835 respectively. The sample was cut at $R = 23$, where objects fainter than $R = 22$ were allowed to appear on several masks to provide higher signal-to-noise for these faint objects. For each mask three exposures were obtained for a total integration time of 54 minutes. The results presented in this contribution are based on subsets of 1312 and 1427 objects with $R < 22$ in the two clusters which constitute $\sim 40\%$ of the total samples.

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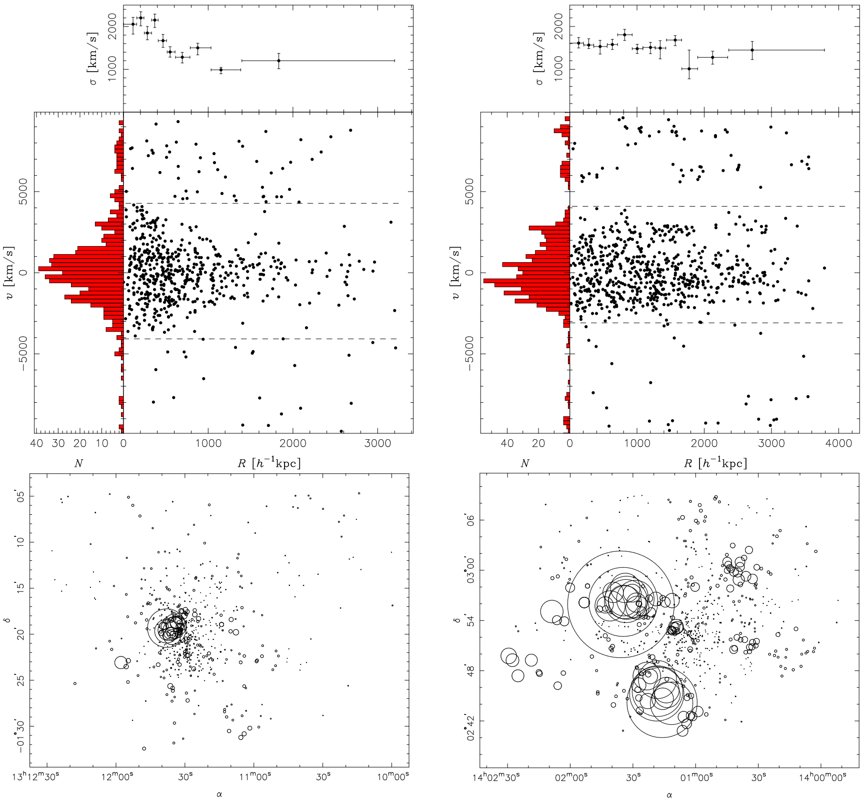

Fig. 1: The figures in the upper row show the redshift distribution for galaxies near the mean cluster redshifts of Abell 1689 (left) and Abell 1835 (right) as derived from the VIMOS data. The central panels plot relative velocity as a function of distance from the cluster centre, the left hand panels histograms of the total redshift distribution and the top panels velocity dispersion profiles (VDP). We find 525 cluster members (defined by the dashed lines) in the subsample for A1689 and 630 cluster members for A1835. We apply the substructure test described by Dressler & Shectman (1988: ApJ 95, 985). The DS test computes a statistic δ for each galaxy which compares the local redshift velocity distribution based on the 10 nearest neighbours to the global distribution. The bottom figures plot circles of radius $\propto \exp(\delta)$ at the spatial positions of cluster member galaxies. **A1689:** On large scales the distribution of galaxies in this cluster appears very regular, with clearly defined "caustics" whose amplitude decreases strongly with clustercentric radius. This is also reflected in the VDP which decreases from $\simeq 2100\,\mathrm{km/s}$ in the central bins to $\simeq 1200\,\mathrm{km/s}$ for the outer bins. The plots hints at the presence of a distinct subgroup in the cluster center at a clustercentric velocity of $\sim 3000\,\mathrm{km/s}$ which might artificially enhance the central velocity dispersion. In the DS plot, the only apparent distinct group of galaxies lies at $\sim 2'$ to the north-east of the cluster center. The location of this group, which has been seen in previous redshift samples, corresponds to a group of bright galaxies in images of the cluster. **A1835:** The distribution of galaxies in this cluster seems more extended than the distribution of A1689, although a detailed investigation of the completeness of the samples is necessary to assess the validity of that statement. The VDP is flat at $\sim 1500\,\mathrm{km/s}$. From the histogram and the redshift–distance plot it is clear, however, that the VDP at large radii includes a contribution from a seemingly separate band of redshifts at $\sim 3000\,\mathrm{km/s}$ and might thus be overestimated at $R \gtrsim 1\,h^{-1}\,\mathrm{Mpc}$. From the DS plot it is immediately apparent that the infall region is much more structured than the one of A1689, indicating that these clusters inhabit rather different environments. The difference in the spatial concentration of the galaxy distributions in A1689 and A1835 agrees with results from weak lensing analyses by Clowe & Schneider (2001: A&A 379, 384; 2002: A&A 395, 385), who find concentration parameters of $c = 7.9$ for A1689 and $c = 2.9$ for A1835.