(z=1–2). The near infrared features prominently in searches for the "first sources" which may have turned on some time during the Dark Ages (z=7–10) – these studies are greatly hampered by the forest of extremely bright OH lines. Many hundreds of OH-suppressing bundles could be robotically positioned over a large field of view to study high redshift sources selected from optical, infrared, sub-mm, or radio surveys. These are just a few of the ideas and concepts under study.

Postscript. These are early days for OH-suppressing fibres and there is a great deal to be learnt. We have identified more than a dozen prototypes for development in 2005 and 2006. The single mode fibres are ready for immediate use on diffraction limited, AO-corrected telescopes, and are perfectly suited to the existing 8–10m telescopes and the next generation of Extremely Large Telescopes. Multimode fibres, which tackle the contemporary problem of OH suppression in natural seeing, are a more challenging prospect and are under development. We will keep the community posted on our technological developments as we pass the various milestones in the development plan.

References

Bland-Hawthorn J. 2004, SPIE, 5492, 1678
Bland-Hawthorn J., Englund M. & Edvell G., 2004, Opt. Express, **12,** 5902
(see http://www.opticsexpress.org/abstract.cfm?URI=OPEX-12-24-5902)
Maihara, T. et al. 1993, PASP 105, 940
Offer, A.R. & Bland-Hawthorn, J. 1998, MNRAS, 299, 176
Parry, I.R. et al. 2000, SPIE, 4008, 1193
Rousselot, P. et al. 2000, A&A 354, 1134

SOUTHERN VISTAS OF THE LOCAL UNIVERSE: WHAT'S NEW IN THE 6DF GALAXY SURVEY

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Over the past three years, the 6dF Galaxy Survey (6dFGS; Jones et al. 2004) has steadily accrued the redshifts for thousands of galaxies over the southern sky (http://www.mso.anu.edu.au/6dFGS/). Its goal is to map our southern view of the nearby universe through around 150,000 galaxies, on a scale comparable to the successful 2dF and Sloan Redshift surveys, but with peculiar velocities (as well as redshifts) for 10 percent of the sample. At last count, 115,000 spectra had been observed over 80 percent of the sky, yielding 71,000 extragalactic redshifts from the 85,000 spectra processed to date. Many of these data have already been made public through the 6dF Online Database, maintained by the Royal Observatory in Edinburgh (http://www-wfau.roe.ac.uk/6dFGS/) The next major data release is planned for March next year, and there will be a workshop on "Science With the 6dFGS" in April 2005.

The main observational objective of the 6dFGS is to measure the redshifts for a near-complete sample of 114,000 galaxies with K<12.75. A further 24,000 galaxies in four subsidiary catalogues additionally furnish target lists complete to (b_J, r_F, J, H) = (16.75, 15.60, 13.75, 13.05). A dozen or so specialty samples fill out the remaining free fibres, having been selected from the near-infrared, radio and x-rays.

When the 6dFGS winds up in late 2005, it will have covered more than 8 times the area of the 2dF Galaxy Redshift Survey (2dFGRS; Colless et al. 2001), and more than twice that of the Sloan Digital Sky Survey (SDSS; Blanton et al. 2001). Figure 1 shows how the final sample sizes of each will compare as a function of redshift, with the median redshift of the 6dFGS (16,000 km/s) about half that of the other two. In this way, 6dFGS provides a complementary view of the more nearby universe in the south, beyond the sky coverage of the SDSS, and closer than 2dFGRS.

However, there are two important differences that set the 6dFGS apart from its wide-area redshift contemporaries. The first is its near-infrared target selection. Not only does this mitigate the effect of Galactic extinction (permitting unprecedented coverage down to 10^{o} from the Galactic Plane), but it also biases the survey towards the older, evolved stellar populations responsible for the majority of stellar mass in a galaxy. The second important difference is the 6dFGS Peculiar Velocity Survey, which uses the same 6dF spectra as the redshift survey to measure the peculiar velocities and masses of the 15,000 brightest early-type galaxies (Campbell et al., in prep.). Doing so affords new leverage in the determination of several key cosmological parameters, in a way unmatched by pure redshift surveys (Burkey & Taylor 2004).

Earlier AAO Newsletter articles have covered the details of the 6dF instrument (Saunders et al. 2001), target selection (Saunders et al. 2003), and First Data Release (Saunders et al. 2004). Here, we summarise the most recent results from the 6dFGS, concentrating on the luminosity function and its relationship to galaxy colour.

Figure 2 shows the sky distribution of all 6dF and

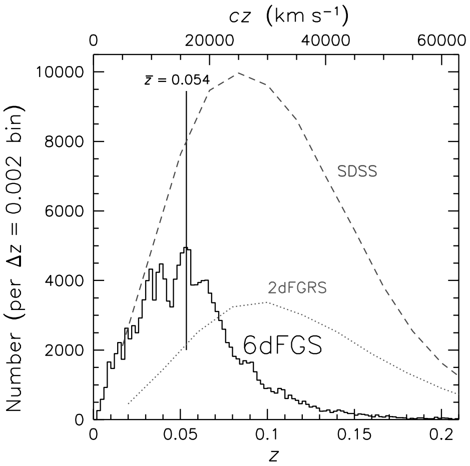

Figure 1: Number-redshift distribution for the 6dFGS, 2dFGRS and SDSS. The mean redshift for the 6dFGS is 0.054. The 6dFGS and SDSS distributions have been normalised to yield the expected final totals, since both surveys are still underway.

literature redshifts in the range 600 < *cz* < 24,000 km/s (71,700 galaxies). This is the most detailed map to date of the nearby large scale structure of our local universe. Both figures show velocity projections from the series of concentric hemispherical shells of thickness 3000 km/s in recession velocity, *cz*. Although 6dFGS observations are still underway and sky coverage is not yet complete, a number of familiar local large scale structures are already plainly apparent. The Shapley Concentration and Hydra-Centaurus Supercluster dominate the sky around (RA,Dec) ~ (14h,–30°), between velocities of ~6000 to 18000 km/s. Much nearer, the Great Attractor/Abell 3627 structure at (RA,Dec) ~ (18h,–60°) is one of the main features at cz < 6000 km/s. Other southern superclusters such as the Eridanus/Fornax (3h,–45°) and Pavo-Indus (21h,–60°) systems are also seen.

The observing strategy has been to divide the southern sky into roughly equal thirds: (a) a central declination strip between –42° < δ < –23°, (b) an equatorial strip covering δ = –23° to the equator, and (c) a polar cap down to δ = –42°. Observations for strip (a) initiated the survey and this region is now largely complete, as are the majority of fields along strip (b). The polar region (c) will be completed last of all, and it is here where the greatest degree of incompleteness is seen in Fig. 2. Sky incompleteness aside, the large scale structures observed in the 6dFGS tend to be more clumped than the 2dF or SDSS redshift surveys. This is because the near-infrared selection and shallower flux limits of 6dFGS are more sensitive to red E/S0 galaxies than surveys selected in the visible, and such galaxies tend to dominate cluster environments.

Figure 3 shows the preliminary $1/V_{max}$ luminosity derivations with best-fitting Schechter function (Schechter 1976). All show close agreement with recent surveys in the same (or similar) passband, particularly in the near-infrared. This is no mean achievement. With current redshift surveys now routinely sampling many thousands of galaxies, it is the systematic uncertainties that determine the precision of an individual LF. Hence, locating the M^* turn-over point is a relatively straightforward exercise, although differences in photometric zero-point can contribute non-negligible offsets between different surveys. In contrast, features

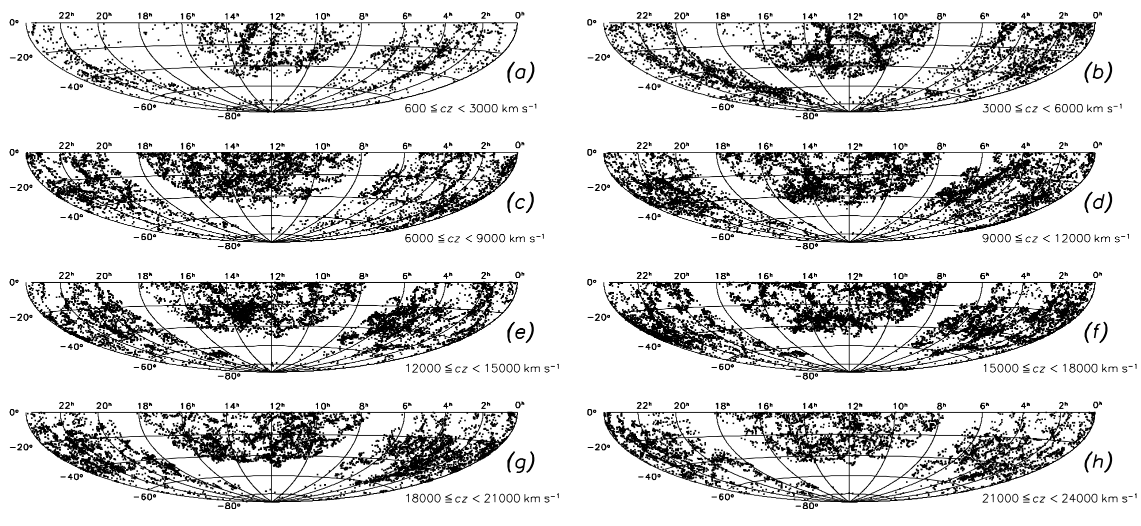

Figure 2: All-southern-sky projections of the 6dFGS to date. Each panel (*a* – *h*) corresponds to a 3000 km/s-thick hemispherical shell in recession velocity. Polar coverage is still largely incomplete.

such as the overall normalisation and faint end slope of the LF depend crucially on the amount of sky coverage, and whether the volume covered is representative of the Universe in general. In an upcoming paper, Jones et al. (in prep.) discuss these issues, and derive 6dFGS luminosity functions (LFs) in both the near-infrared and optical.

The *K*-band samples are a case in point. When the first tranche of 2MASS data became available, several groups independently derived the *K*-band LF from its overlap with redshift catalogues from the 2dFGRS (Cole et al. 2001), the Huchra ZCAT Catalogue (Kochanek et al. 2001), and the Sloan Early Data Release (Bell et al. 2003). The deepest of these (Cole et al.) also covers the smallest area of sky, and these authors have estimated that their potentially high exposure to cosmic variance could affect the mean number counts they used by 15%. Although only part-way through, the 6dFGS is the largest of all these studies, in terms of both sky coverage and sample size. We find a *K*-band LF with faint end slope between the steeper slope of Kochanek et al. and the very flat one of Cole et al. In all these surveys, properly characterising the faint end slope is one of the biggest challenges, due to its sensitivity to clustering in the very nearest galaxies. Ultimately, only the SDSS and 6dFGS surveys will have the sky area to average over the nearest large scale structures. Another effect that needs to be taken into account is that of the effect of peculiar velocity on the total recessional velocities measured for the nearest galaxies. Kochanek et al. corrected their velocities using the local flow model of Tonry et al. (2000) and then excluded all those with *cz* > 2000 km/s, at the expense of sample size. In the case of 6dFGS however, the peculiar velocity survey will provide the peculiar motion information required in order to neatly resolve this issue.

Early-type galaxies have long been known to populate LFs that are generally flatter, with brighter M^* than those of star-forming systems (Efstathiou, Ellis & Peterson 1988, Loveday et al. 1992, and references therein). Recent results from the 2dFGRS and SDSS surveys have reaffirmed these trends with unprecedented coverage and precision (Folkes et al. 1999, Blanton et al. 2001, Madgwick et al. 2002). Figure 4 shows the b_J and *K*-band LFs of Jones et al. from the 6dFGS after each has been separated into the reddest and bluest 25% of each sample. In the case of the *K*-band LF, they find that the faint end is essentially due entirely to a steeply rising population of faint blue galaxies while the bright end is dominated by the red population. A similar situation is seen in the b_J-band LF, although the bright end is equally populated by red and blue types. The underlying trend is for more luminous galaxies to be redder on average than faint ones, a relationship also observed in the SDSS and 2dFGRS data (Madgwick et al. 2002, Baldry et al. 2004). These

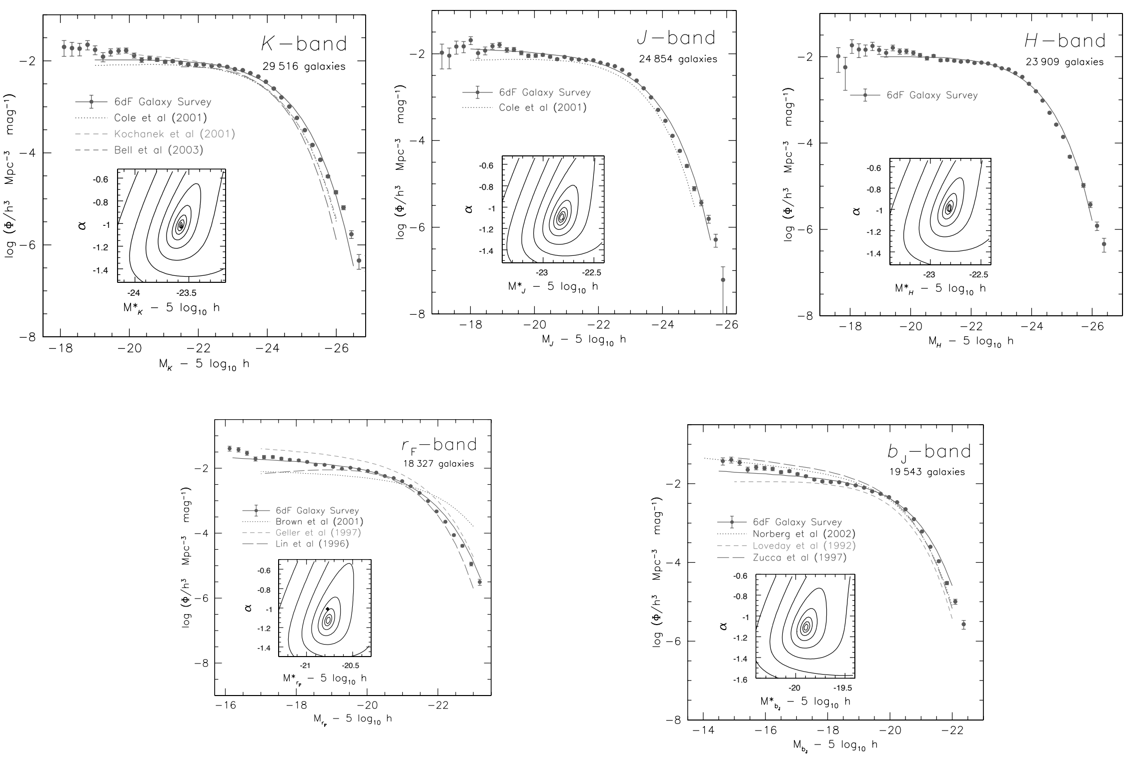

Figure 3: Preliminary near-infrared and optical luminosity functions for the 6dFGS (from Jones et al., in prep.).

surveys also find a demarcation in the colour distribution between early- and late-type populations. The original SuperCOSMOS b_J-photometry had plate-to-plate variations that hid this feature (J. Peacock, M. Read, priv. comm.). However, earlier this year the SuperCOSMOS magnitudes were successfully corrected for this problem. In a new paper, Jones et al. (in prep.) have taken the set of 25,700 6dFGS galaxies having both b_J and K-band photometry (as well as redshifts), and probed the dependence of LF shape on galaxy colour.

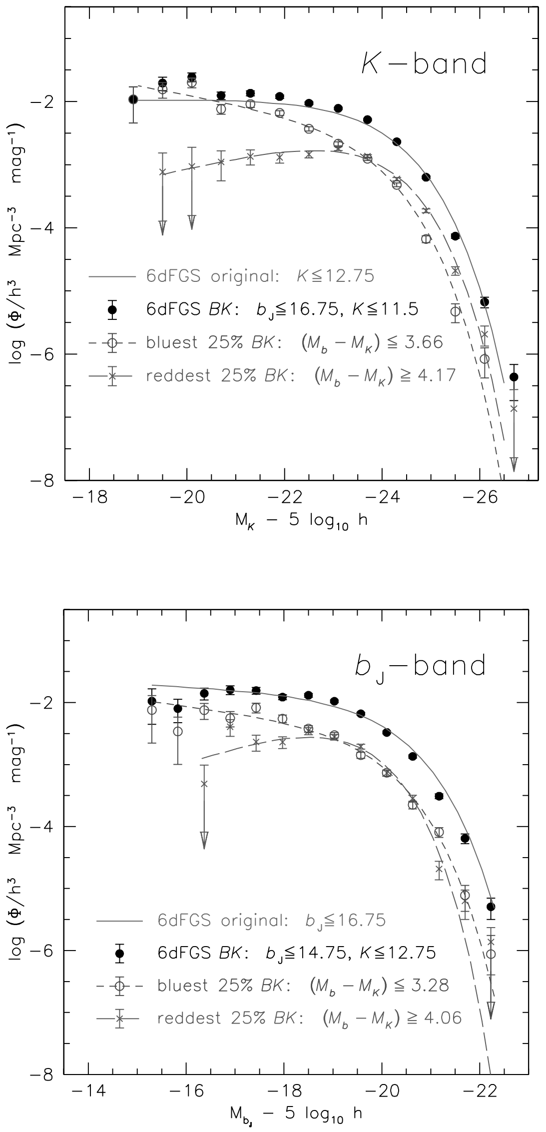

Figure 4: K and b_J -selected luminosity functions for different subsets of the 6dFGS. All K–band LFs are complete to K =11.5 while those in b_J are complete to b_J =14.75. The BK sample is that subset of the survey with both b_J and K photometry, in addition to extragalactic redshifts. Each of the BK samples has been normalised to the K or b_J LF from the full 6dFGS sample, the fit of which has been reproduced by the solid curve (after Jones et al., in prep.).

The 6dFGS looks forward to many more milestones in the year ahead. The Second Data Release in early 2005 will incorporate refined redshift measurements for catalogue members both old and new. It will double the number of redshifts, as well as include corrected b_J and r_F photometry. In April, the 2005 6dFGS Workshop to be held in Epping will welcome participants with an interest in the survey science from around Australia and abroad. As the year progresses, the final component of observing will fill out the region around the South Celestial Pole and complete the survey around July 2005. At the same time, distances and masses from the 6dF Peculiar Velocity Survey will give new meaning to the redshift survey in a manner unparalleled by any of the other major surveys to date. In sum, 2005 should prove to be an interesting year for the 6dF Galaxy Survey on many fronts.

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References:

Baldry, I., et al., 2004, ApJ, 600, 681
Bell, E., et al., 2003, ApJS, 149, 289
Blanton, M., et al., 2001, AJA, 121, 2358
Burkey, D., Taylor, A., 2004, MNRAS, 347, 255
Cole, S., et al. (the 2dFGRS Team), 2001, MNRAS, 326, 255
Colless, M., et al. (the 2dFGRS Team), 2001, MNRAS, 328, 1039
Efstathiou, G., Ellis, R., Peterson, B., 1988, 232, 431
Folkes, S., et al. (the 2dFGRS Team), 1999, MNRAS, 308, 459
Jones, D. H., et al., 2004, MNRAS, 355, 747
Kochanek, C., et al., 2001, ApJ, 560, 566
Loveday, J., et al., 1992, ApJ, 390, 338
Madgwick, D., et al. (the 2dFGRS Team), 2002, 333, 133
Saunders, W., et al., 2001, AAO Newsletter, 97, 14
Saunders, W., et al., 2003, AAO Newsletter, Special IAU Issue, 9
Saunders, W., et al. 2004, AAO Newsletter, 104, 16
Schechter, P., 1976, ApJ, 203, 297
Tonry, J., et al. 2000, ApJ, 530, 625