RevMexAA (Serie de Conferencias), **17**, 267–267 (2003)

Galaxy Evolution: Theory and Observations (Cozumel, Quintana Roo, México, 8-12 April 2002)
Editors: Vladimir Avila-Reese, Claudio Firmani, Carlos S. Frenk & Christine Allen

LARGE QUASAR GROUPS AS A TOOL TO STUDY GALAXY EVOLUTION

L.E. Campusano,[1] G.M. Williger,[2] R.G. Clowes, [3] C.P.Haines[3] and M.J.Graham[4]

Quasars have been found to cluster generally on scales $\leq 10h^{-1}$ Mpc. However, quasar clustering has also been observed on larger scales in the form of Large Quasar Groups (LQGs) (see Clowes 2001 and references therein). The LQGs —structures 100–200h^{-1} Mpc in size, are possibly physical enhancements in the underlying mass density of the Universe, with the member quasars immersed in high-redshift counterparts of local structures such as the "Great Wall" of galaxies. This link between quasars and the large scale structure (LSS) of galaxies is consistent with the current view that the formation of quasars is closely related to the formation of galaxies, and with the recent finding that on the scales of superclusters ($\sim 60h^{-1}$ Mpc) low-z radio-quiet ($z < 0.3$) quasars follow the LSS traced by galaxy clusters.

The largest known structure in the high redshift universe is mapped by at least 18 quasars and spans $\sim 5° \times 2.5°$ on the sky, with a bright quasar spatial overdensity of 6–10 times above the mean. This LQG at $z \sim 1.3$ provides an extraordinary laboratory $\sim 100 \times 200 \times 200h^{-3}$ comoving Mpc^3 in size ($q_0 = 0.5$, $\Lambda = 0$, $H_0 = 100h$ km/s Mpc^{-1}) covering $1.20 < z < 1.39$ in redshift. We have probed the galaxy content of this LQG, which is known to have a LSS foreground structure at $z \sim 0.8$, via direct imaging and through a survey for Mg II absorption from galaxy haloes via background quasars.

We have conducted ultra-deep optical and deep near-infrared observations in a small field around the $z = 1.23$ radio-quiet quasar J104656+0541 in this LQG, in search of associated galaxy clustering (see Haines et al. 2001). In particular, we found 86 galaxies in the $2.25 \times 2.25\,\mathrm{arcmin}^2$ K-band field, with galaxy excesses at all magnitudes. The total excess is due entirely to extremely-red galaxies, indicating a likely cluster at $z \geq 0.8$. The red sequence galaxies are concentrated in two compact groups (see Fig.1), appearing to be part of a larger structure extending over 3–4 Mpc, suggesting a rich cluster being formed through the progressive coalescence of subclusters and which triggered the formation of the observed quasar at their confluence. The search for Mg II absorption systems in a $\sim 2.5° \times 2.5°$ subfield in the LQG (see Williger et al. 2002) revealed a 2.4σ overdensity of absorbers (38 observed/24 expected) to a rest equivalent width limit of $W_0 = 0.3$ Å over $0.69 < z < 2.02$. If we draw 10000 random samples from a Poissonian number distribution with a mean of 24, then we would expect 3.4 ± 1.8 Mg II absorbers at $1.2 < z < 1.4$, resulting in a 4.3σ overdensity in that redshift bin. The same redshift interval is occupied by the large quasar group, implying that the Mg II and quasar overdensities are related. A minimal spanning tree test also supports a structure of Mg II absorbers coincident with the LQG and indicates a foreground structure populated by Mg II absorbers and quasars at z$\sim$0.8.

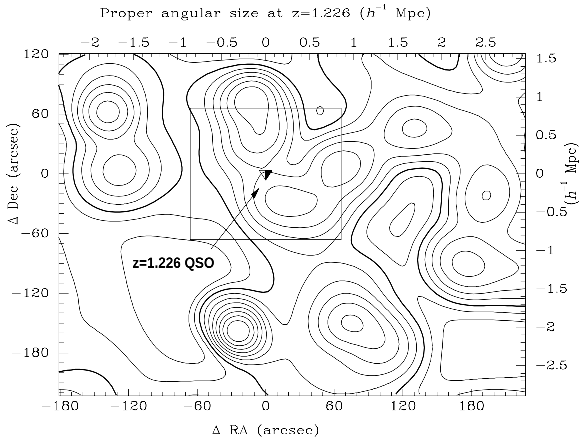

Fig. 1. Estimated density distribution of the red galaxies in the region centered on the quasar J104656+0541. The central box indicates the area covered by K imaging, while A and B label the two, possibly merging, clusters at z$\sim$ 1.3. Notice the off-center position of the quasar with respect to the density peaks.

[1]Departamento de Astronomía, Universidad de Chile, Casilla 36-D, Santiago, Chile (luis@das.uchile.cl).
[2]John Hopkins University,Baltimore, MD 21218, USA.
[3]U. of Central Lancashire, Preston PR1 2HE, UK.
[4]Imperial College, London SW7 2BW, UK.

REFERENCES

Clowes, R.G., 2001, in ASP Conf. Ser. 232, 108

Haines, C. P., Clowes, R. G., Campusano, L. E., & Adamson, A. J., 2001, MNRAS, 323, 688

Williger, G.M., Campusano, L.E., Clowes, R.G., & Graham, M.J., 2002, ApJ, in press