HIGH-REDSHIFT MILLI-JANSKY RADIO GALAXIES

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The study of radio galaxies selected at mJy flux levels has the potential to resolve two important issues in observational cosmology provided redshifts can be determined or reliably estimated for complete samples of such sources. First, the deep flux limit, combined with the shape of the radio luminosity function means that the redshift distribution of such samples provides a much more powerful test of the existence of a high-redshift cut-off for radio sources (Dunlop & Peacock 1990) than can be provided by further studies of brighter radio samples. Second, as a consequence of selection from bright radio surveys, the detailed study of galaxies at $z > 2$ has to date been confined to objects of extreme radio power (*e.g.* 4C41.17, Chambers *et al.* 1990; B2 0902+34, Eales *et al.* 1993), and it has now become clear that the ultraviolet-infrared properties of such sources are strongly contaminated by processes connected to the AGN (Eales & Rawlings 1993; Dunlop & Peacock 1993). Being 100-1000 times less radio luminous than these extreme sources, mJy radio galaxies at comparable redshifts should provide much more representative probes of the formation and evolution of elliptical galaxies in general.

Accordingly, over the past few years we have been investigating the properties of radio galaxies with $S_{1.4GHz} > 1$mJy selected from the Leiden-Berkeley Deep Survey (LBDS) and its extensions (Neuschaefer & Windhorst 1995). This has given a statistically complete sample of 77 galaxies for which we now possess g, r, i & K photometry (plus J and H for a

R. Ekers et al. (eds.), Extragalactic Radio Sources, 581–582.

https://doi.org/10.1017/S0074180900081912 Published online by Cambridge University Press

subset of sources), enabling us to estimate redshifts from both spectral fitting (Dunlop & Peacock 1993) and from a modified version of the infrared Hubble diagram (Dunlop, Peacock & Windhorst 1995). A new programme of optical spectroscopy with the William Herschell telescope on La Palma, and the Keck telescope in Hawaii has now yielded spectroscopic redshifts for 3 sources along with the detection of a single weak line in a further 2 objects.

These spectroscopic redshifts agree to within 20% of the redshifts estimated from colours and K magnitudes, and give confidence that our estimated redshift distribution for the mJy sample is not likely to be seriously in error. This redshift distribution is consistent with the predictions of a power-independent high-redshift cutoff of the form displayed by luminous sources (Dunlop & Peacock 1990), and is clearly inconsistent with an unchanged radio luminosity function beyond $z \simeq 2$.

Given the ease with which even low-level star-formation activity can mask the properties of an underlying old stellar population, the objects of greatest importance for constraining the epoch of elliptical galaxy formation are the reddest galaxies at $z > 1.5$. We have therefore isolated a subset of 10 objects with $R - K > 5$ and $z_{est} > 1.5$ for intensive study. The initial results from this detailed investigation are extremely interesting. Most excitingly, as a result of 5 hours of integration with the Keck telescope, we have determined an absorption-line redshift of $z = 1.55$ for a mJy radio galaxy which is extremely red ($R - K = 6$), appears to be devoid of emission lines, and has an ultraviolet spectrum very similar to that produced by main-sequence stars of spectral type F/G. A fuller analysis of the rest-frame ultraviolet spectrum of this object indicates that the main-sequence turnoff point in this object must lie near spectral type F2, implying an age of 3.5 Gyr for solar metallicity. The existence of such an old galaxy at $z = 1.55$ sets strong constraints not only on the epoch of elliptical galaxy formation, but also on cosmological models (Dunlop *et al.* 1995), and so we are currently investigating the robustness of this age estimate as a function of assumed IMF and metallicity.

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