SPECTROSCOPY OF QSOs FROM THE TEXAS RADIO SURVEY

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We report briefly on our optical spectroscopy of QSOs from the radio survey in progress at the University of Texas Radio Astronomy Observatory (UTRAO). The radio survey, under the direction of Dr J. N. Douglas, covers declinations north of -36 degrees, in strips that are 9 degrees wide in declination. Preliminary results for the strip centered at +18 degrees have been published (Douglas et al. 1980) and other strips are currently being prepared for publication. The complete catalogue will list 1 arcsec positions and some structure information for about 75,000 sources stronger than about 250 mJy at 365 MHz. Optical identifications are made from the Palomar Observatory Sky Survey plates using an interactive laser measuring machine (Ghigo 1977), and the accuracy of the radio source positions allows the identifications to be made regardless of the colours of the objects. Optical spectroscopy of a sample of about 300 QSO candidates brighter than 19 mag, drawn from the +36, +18 and -12 degree strips, is being carried out at McDonald Observatory using an Intensified Dissector Scanner at the cassegrain focus of the 2.7m reflector. Two image-tube and dissector chains are available, together covering the range 3200 - 8500 A; a typical spectrum takes 1 hour to obtain, with wavelength resolution of 10 A over a total range of 3000 A.

So far, we have new redshifts for 111 QSOs and probable redshifts for 28 others, while about 20 more objects show only a single emission line in the spectra that we have obtained so far. We are trying to be spectroscopically complete because the goal of the study is an improved radio-optical luminosity function for radio-selected QSOs; this, of course, takes time because the 'difficult' redshifts need more than one spectrum (often with both image-tube chains), while redshifts around z = 2 take much less time to observe. The 111 redshifts have been communicated to A. Hewitt and G.R. Burbidge for inclusion in their updated QSO catalogue. While the spectroscopy must be completed before we can draw any firm conclusions about the radio-optical luminosity function and its evolution with redshift, we can make some preliminary remarks.

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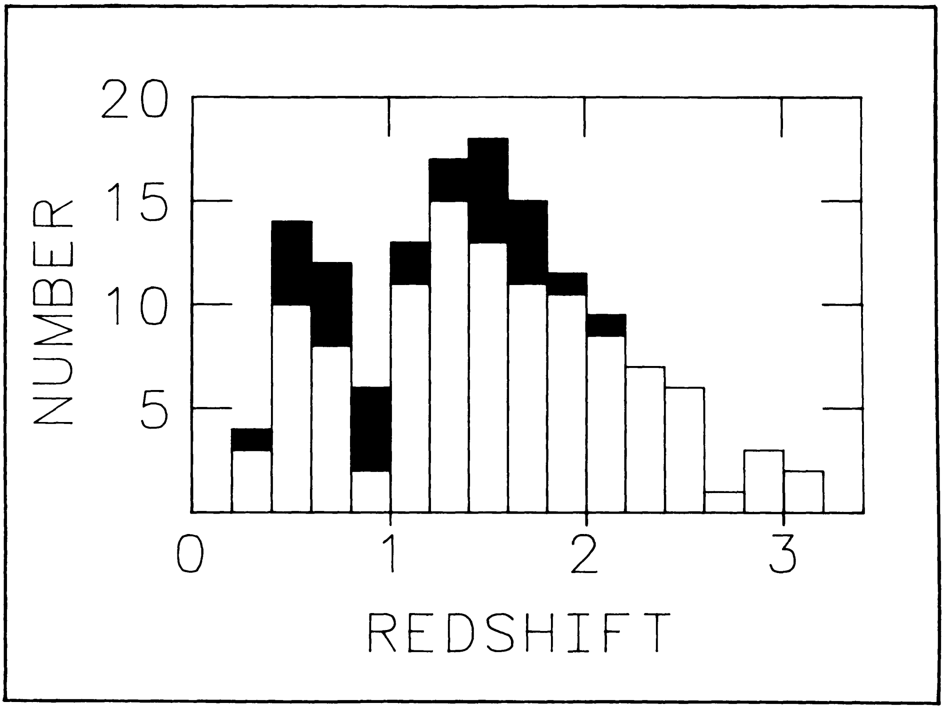

Figure 1. Histogram of new redshifts for UTRAO QSOs

The redshift histogram to date is shown in Figure 1, with the 'probable' values shaded; from our previous experience, about 70% of these will turn out to be correct when we obtain better spectra. It is clear that the probable redshifts tend to be smaller than the certain ones, at about the 1% significance level, for reasons well known to most QSO spectroscopists: redshifts of 1.7 and above are usually unambiguous because of the strong lines of Lyman-α and C IV (1216, 1549 A), while at redshifts near 0.7 only Mg II is a reliable line on survey-quality spectra (the C III] line is weaker).

The median redshift of the objects in Figure 1 is about 1.5, which is significantly higher than those for earlier samples of QSOs selected at low radio frequencies, e.g. 0.9 - 1.1 for the 3C and 4C samples discussed by Wills and Lynds (1978). The optical limits of all these samples are similar, and part of the difference is a result of the fainter radio limit for the UTRAO sample, but there may be some selection effects that will be revealed only after the completion of the spectroscopy. First, as already mentioned, the lower redshifts are more difficult spectroscopically, and many of the one-line objects probably fall in this category, together with some objects that have so far revealed no lines at all in their spectra. Second, the

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complete sample includes objects whose redshifts were known already and which should therefore be added to Figure 1; their inclusion actually makes little difference to the median redshift. Third, the UTRAO survey was made with an interferometer and therefore discriminates against sources with angular diameters larger than about 1 arcmin, which tend to be those of lower redshift. If we make the pessimistic assumption that the UTRAO survey misses 10% of all QSOs above 250 mJy, and that these excluded objects all have redshifts below $z = 1$, and we further assume that all our one-line objects are below $z = 1$, then the median redshift is marginally consistent with those for the 4C samples analysed by Wills and Lynds.

BL Lac objects are rather rare among our QSO candidates, as is true for most low-frequency radio surveys; we do occasionally find them by their lineless spectra and significant brightness changes, and have confirmed most of them by their high optical polarisation. There are, surprisingly, no new coincidences between UTRAO sources and objects in the General Catalogue of Variable Stars (see Wills et al. 1986), although 0716+332 brightened from 20 mag to about 15 mag earlier this year (Wills 1986).

Because at least two of the astronomers involved in the organization of this meeting (Professors Fang LiZhi and Chu YaoQuan) have investigated periodicities in QSO redshift distributions, we thought it would be appropriate to examine this new sample for such effects. We have therefore used the 111 definite redshifts, supplemented in some cases by the 28 probable redshifts and/or the 100 or so previously-known redshifts for QSOs in the whole sample, to search for significant periodicities in various functions of redshift - specifically redshift z, $\log(1+z)$, and $(1-1/\sqrt{(1+z)})$ (cf. Fang et al. 1982). In none of the samples is there any evidence for periodicities in any of these functions at the 5% significance level.

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DISCUSSION

HAWKINS: Your discovery of an OVV quasar is interesting since in the complete sample of 400 variable quasars, none has an amplitude greater than 1 mag, and none appears to be an OVV object.

WILLS: That's interesting. We have a few at the 2 mag level, but 0716+332 is an extreme case. We tried it perhaps five times over the last few years, when it was about 20 mag, and would have given up on it, except that the telescope dome was misbehaving and I decided to clamp it in the west and observe objects that pass close to our zenith. Incidentally, it has a flat radio spectrum, unlike most of the UTRAO sources (it is a member of the sample discussed by us at IAU #119 - see page 499 of those Proceedings).

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