A COMPLETE SAMPLE OF FLAT-SPECTRUM RADIO SOURCES FROM THE PARKES 2.7 GHz SURVEY

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ABSTRACT. We describe our complete sample of flat-spectrum radio sources with fluxes >0.5 Jy selected from the Parkes 2700 MHz catalogue. The sample covers all right ascensions and declinations from +10° to -45°, but excluding the galactic plane ($b < 10°$), and contains some 400 sources.

1. INTRODUCTION

We are investigating a sample of flat-spectrum radio sources drawn from the Parkes 2.7 GHz survey (see Bolton et al. 1979 and references therein) complete to 0.5 Jy. The sample covers 4.5 sr of sky and comprises some 406 sources. Accurate radio positions are being measured (McEwan et al. 1975; Condon et al. 1977, 1978; Jauncey et al. 1982) for all sources and optical identifications are being made from the UKST IIIa-J sky survey. Redshifts are being sought with the Anglo-Australian telescope (see e.g. Jauncey et al. 1984 and references therein), with results so far for 245 sources. The program is aimed at determining, in an unbiased manner, the space distribution of quasars with redshifts over a large area of sky.

2. THE SURVEY

All sources have been selected from the Parkes 2.7 GHz survey and cover the declination range +10° to -45°, excluding the region within 10° of the galactic plane. The basic sample comprises both the steep- and flat-spectrum sources, but we are concentrating initially on the flat-spectrum sources. The compact nature of these radio sources means that accurate radio positions can be readily measured and thus unique optical identifications, based on positional coincidence alone, can be made to the 22.5 mag limit of the J survey (Jauncey et al. 1982).

This is a long-term program, under way now for about 15 years, and making use of a wide variety of telescopes, both optical and radio.

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There are a number of advantages for the present sample:

1. The survey covers a large area of the sky and thus avoids small area effects.
2. The large sample size reduces statistical fluctuations and provides reliable information on the minority populations, e.g. BL Lac objects, etc.
3. Accurate radio positions are being measured for all objects, allowing reliable optical identification to the 22.5 mag limit of the UKST IIIa-J survey without any reliance on colour or morphology. This is particularly important in avoiding redshift-dependent effects of the type found in optically selected samples based on colour selection or objective prism data.
4. The identification rate is high, about 80% (Jauncey et al. 1982), and the objects are identified primarily with quasars.
5. Redshifts are being sought for all objects to the 22.5 mag limit with the AAT. This, in turn, will provide an unbiased determination of the space distribution of quasars to the largest redshifts yet found for radio selected objects (Peterson et al. 1982).

The advantage of radio selected samples over optically selected samples cannot be over-emphasized, since the radio samples are complete to a well-determined flux density limit and are free from the redshift-colour selection effects that plague optical samples. For example, Table I shows the colours that have been obtained now for four quasars with redshifts >3.5. Three of these are found to lie very close to the region defined by normal stars in both the J-V versus V-R and J-R versus R-I two-colour diagrams. Thus, although quasars with $z > 3.5$ can be found by colour selection, the high star contamination makes it very difficult to assemble complete and statistically significant optical samples of such objects.

TABLE I - Colours of some high-redshift quasars.

Name	z	I	R	V	B	U
PKS 2000-330[a]	3.78	16.99	17.17	17.17	19.20	>22.0
HAZ 0055-2659[b]	3.68	17.30	17.46	17.91	19.06	18.97
DHM 0054-284[c]	3.61	17.68	18.15	18.61	20.21	>22.0
PKS Anon[d]	3.78	16.47	16.77	17.47	19.05	>22.0

[a]Peterson et al. (1982); [b]Hazard and McMahon (1985); [c]Shanks et al. (1983); [d]G.L. White et al. (unpublished data).

3. PRELIMINARY RESULTS

The faint flux density limit and the population of flat-spectrum quasars allows us to penetrate a larger volume of space than the 3CR sample of steep-spectrum low-frequency selected quasars. Recent observations on the AAT have doubled the number (from 2 to 4, or 3% of the total number with redshifts) of quasars with redshifts >3.5 in this sample. In all, the present flat-spectrum sample shows 43 (17.6%) quasars with redshifts >2, compared with 2% for 3CR.

No sharp cutoff is apparent in the present redshift distribution, but rather a steady turndown above a redshift of 2. It appears that the higher redshift quasars are to be found predominantly amongst the weaker radio sources and amongst the fainter identifications, since there is a weak but significant correlation (with a large scatter) of redshift with radio and optical flux density. In particular four radio quasars with redshifts above 3.5 have J magnitudes ranging from 18.6 to 22.5, a range of four magnitudes for essentially the same redshift. As redshifts are now being obtained for the predominantly fainter identifications, we expect to find more high-redshift quasars in our sample.

We also expect to see in the Hubble diagram some effect for the highest-redshift objects caused by an increasing density of absorption lines in the Lyman forest (see e.g. Hunstead et al. 1986). This may cause a dramatic decrease in the brightness of these objects in the J band.

A preliminary analysis of the present database indicates that there is no significant difference in the number-magnitude or number-redshift distributions for the flat- and steep-spectrum radio quasars, in agreement with the results for the stronger sources as found by Wall and Peacock (1985).

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