MAPPING THE RADIO SKY: COMPACT RADIO QUASARS FROM THE PARKES 2.7 GHz SURVEY

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ABSTRACT. We are investigating a complete sample of flat-spectrum extragalactic radio quasars drawn from the Parkes 2.7 GHz survey. The sample is being used to map the space distribution of radio quasars and to determine their luminosity function. Accurate positions are being measured for a selection of the brighter quasars in order to establish an extragalactic position reference frame in the Southern Hemisphere.

INTRODUCTION

During the late 60s and early 70s a radio survey of the southern sky was undertaken with the Parkes 64-m radio telescope. This survey, carried out at a frequency of 2.7 GHz, was the first to reveal the large numbers of flat-spectrum, compact radio quasars that had been largely missed in the earlier low-frequency surveys. The survey was a major undertaking, covering the whole sky accessible to the Parkes radio telescope (all declinations south of +25°), except for the area within 10° of the galactic plane, and listing some 12,000 sources. Figure 1, reproduced from Bolton et al. (1979), shows the regions covered and the limiting flux densities reached. Although many contributed to this program, the driving force was John Bolton.

Optical identifications were based on the measured Parkes positions and showed that many of these flat-spectrum radio sources were

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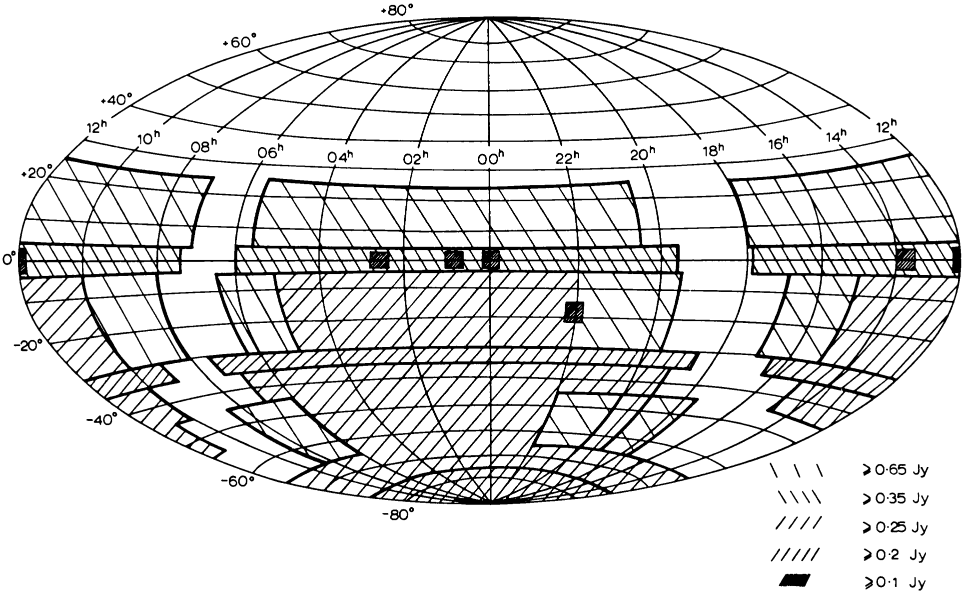

Fig. 1 - The regions of the sky surveyed in the Parkes 2.7 GHz survey. The completeness levels are indicated by the hatching.

identified with quasars. Low-resolution optical spectroscopy, mainly undertaken with the Anglo-Australian telescope (AAT) (see Jauncey et al. 1984 and references therein), soon uncovered a veritable "zoo" of unusual objects. It was the optical identifications, based upon accurate positions and radio/optical positional agreement, that revealed the effects of colour selection on the redshift distribution: quasars were found in the redshift range 2 to 3 that did not have an ultra-violet excess and quasars were found in the redshift range above 3 that were not even blue. This program has been very successful in finding high-redshift quasars. Indeed, it was the discovery of the redshift 3.78 radio quasar, PKS 2000-330 (Peterson et al. 1982), from this sample that stimulated much of the current activity in optical searches for high-redshift quasars.

The Parkes 2.7 GHz survey forms a radio "Carte du Ciel" for the southern sky and has laid the foundation for a wide variety of investigations. Prominent among these is our mapping of the space distribution of radio quasars, as well as our radio/optical position reference-frame program, both of which are described below.

MAPPING THE SPACE DISTRIBUTION OF RADIO QUASARS

This program is built around a complete sample of 400 flat-spectrum Parkes radio sources stronger than 0.5 Jy at 2.7 GHz and lying within the declination range +10° to -45°. Accurate radio positions have been measured for all of these sources and optical identifications made with the SERC and Palomar Sky Survey plates. Spectroscopy on the

AAT has been completed for 70% of the identified quasars and the resultant redshift distribution is shown in Figure 2. There is a broad peak

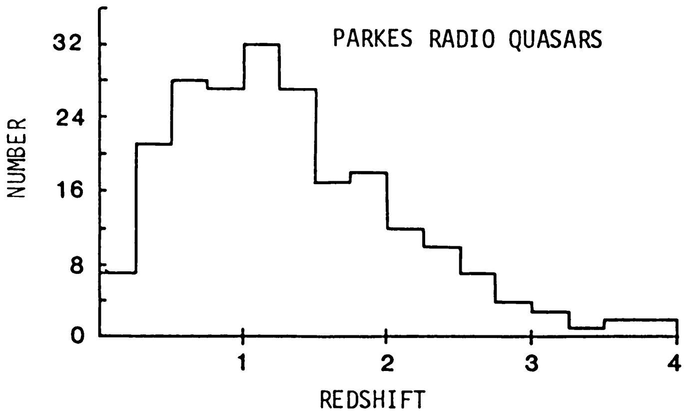

Fig. 2 - The redshift distribution for those quasars from the complete sample that have measured redshifts.

around z = 1, and a steady decrease at larger redshifts. We see no evidence for a cutoff at redshifts >3; the sample shows nine quasars with redshifts >3, and four with redshifts >3.5.

Figure 3 shows the present redshift distribution as a function of right ascension for the sample sources. Although incomplete this figure reveals no clear evidence for clustering at the present level of analysis, though a more thorough investigation cannot be undertaken until the spectroscopy has been completed for the remainder of the sources.

RADIO/OPTICAL POSITION REFERENCE FRAME

Because of their milliarcsecond structure and large redshifts these compact radio quasars form an ideal basis for the construction of a near-inertial radio position reference frame (see Argue et al. 1984). A major VLBI program is under way to determine radio structures and accurate positions for a selection of the stronger radio sources south of declination -30° that have been identified with brighter quasars. Upon completion this will eventually provide a radio reference frame with milliarcsecond precision.

Optical positions are now being measured with plate material from the AAT to allow a direct radio/optical comparison. Preliminary results reveal no obvious discrepancy at the 0.2 arcsecond level, though the full precision available optically will have to await successful Hipparcos and Space Telescope launches (see White et al. 1985).

CONCLUSIONS

The Parkes 2.7 GHz radio survey has, like the Carte du Ciel, provided a fundamental sky survey upon which a number of extensive astrophysical investigations are being based. The radio survey maps the extragalactic universe in the same way that the Carte mapped the Galaxy,

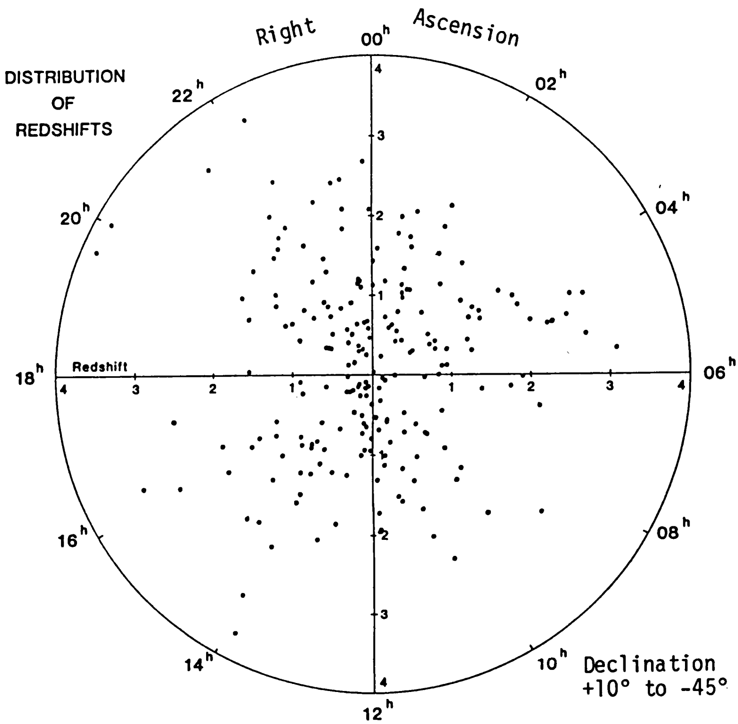

Fig. 3 - The redshift distribution plotted against right ascension for the sources from the complete sample.

and the astrometry from both surveys will ultimately provide fundamental position reference frames for the future, as well as the means to tie them together with milliarcsecond precision.

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