

## ON THE CONCENTRATION OF HIGH REDSHIFT QUASARS IN THE REGION OF M33

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**ABSTRACT.** We have investigated the strong concentration of high redshift radio quasars in a large area of the sky near M33 reported by Arp. Selection effects appear to be important in determining the significance of the inhomogeneity.

A striking example of an inhomogeneous distribution of quasars pointed out by Arp (1984, *J.A.A.* 5, 31 and *Ap.J.* 277, L27) is the apparent concentration of high redshift ( $z > 1.4$ ) Parkes and 3C quasars in a  $\sim 700 \times 200$  region extending to the south-west of M33. We have investigated the concentration by using the Veron & Veron Catalogue of Quasars (ESO publication, 1985). Since the exact demarkation of the region near M33 in somewhat arbitrary we have considered a slightly larger area made up of two rectangles (for ease of selection of quasars) as shown in Fig.1. The comparison area (also shown in Fig.1) is obtained by shifting the RA by exactly  $12^h$ . Because redshift measurements are by no means complete for the Parkes catalogues, any possible biases in the regions selected for redshift measurements can be minimized by including quasars from other catalogues, which cover the same areas of the sky in the two regions. We have therefore included quasars from the 4C, B2 and Ohio surveys as well. Although the  $z$  distribution for all such quasars in the  $21-03^h$  region does appear to peak at somewhat higher redshifts than that for the  $09-15^h$  region, (Fig.2) the difference is not statistically significant even at the 10% level.

There are 41 quasars with  $z > 1.4$  in the  $21-03^h$  region and 40 in the  $09-15^h$  region. Counting the Parkes and 3C quasars alone, the numbers are 31 and 21 respectively. The difference is clearly not significant. We do not also find any significant difference in the distributions of  $V$  magnitudes of the quasars in the two regions as claimed by Arp. The smaller number of high  $z$  quasars in the  $09-15^h$  region could arise partly from the fact that many quasars in this region were first identified from Parkes observations of 4C sources selected at 178 MHz (Wills & Bolton 1969, *A.J.P.* 22, 775). These observations excluded most of the region between  $21^h$  and  $03^h$  where many quasar identifications have been made from surveys at 2.7 GHz. At high and intermediate flux levels high redshift quasars are more likely to be found in high frequency surveys (Kapahi & Kulkarni 1986, this symp.).

It should be noted however that we have not exactly verified Arp's claim of a  $14\sigma$  difference (22 quasars versus 2 in the two regions) because his comparison was based on the following additional restrictions, i) the regions compared had the outline shown by the dotted line in Fig.1, and the comparison sample was obtained by shifting the outline by  $13^h$  in RA, (ii) Only Parkes and 3C quasars were considered, (iii)  $z$  and  $V$  ranges were restricted to  $1.4 \leq z \leq 2.4$  and  $17 \leq V \leq 19$  respectively. If we duplicate his analysis as closely as possible we do indeed find a large difference (23 quasars versus 5). But then it is not clear if the regions used and the restrictions imposed have been chosen in order to emphasize the difference.

Arp has also noted that the inhomogeneity is supported by the number of radio sources in a Parkes survey of the zone  $4^\circ < \delta < 25^\circ$ , complete to 0.5 Jy at 2.7 GHz; the number of quasar candidates (before spectroscopy) is 3 times larger and the number of all radio sources about 2 times larger in the 21-03h region than in the 09-15h region. The Parkes survey (Shimmins et al. 1975, A.J.P. Ap.Supp. 34, p63) referred to by Arp is, however, not a complete sample by itself; it is only a supplementary list of sources that should be added to those already published in that declination zone. The previous lists are i) the main listing of the Catalogue for  $\delta < 20^\circ$  (Ekers 1969, A.J.P. Ap.Supp.7); ii) the  $20^\circ < \delta < 27^\circ$  region (Shimmins & Day, 1968, A.J.P., 21, 377) and 2.7 GHz observations of 4C sources with  $4^\circ < \delta < 20^\circ$  (Wills & Bolton, 1969, A.J.P. 22, 775). If the comparison is restricted to all radio sources with  $S_{2.7} \geq 0.5$  Jy, the total number in all three lists in the region  $4^\circ < \delta < 25^\circ$  is found to be 177 in the 21-03h region and 151 in the 9-15 region. The difference is clearly not significant, nor is there any significant difference in the numbers of all quasars (including those without measured redshifts).

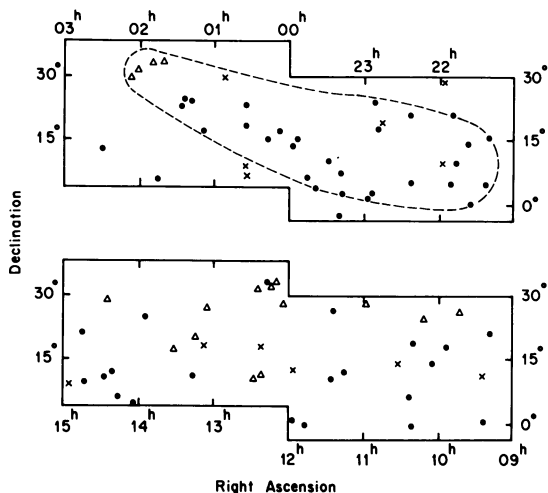


Fig.1. Quasars with  $z > 1.4$ .  
 ● 3C & Parkes; x 4C;  $\Delta$  B2 & Ohio

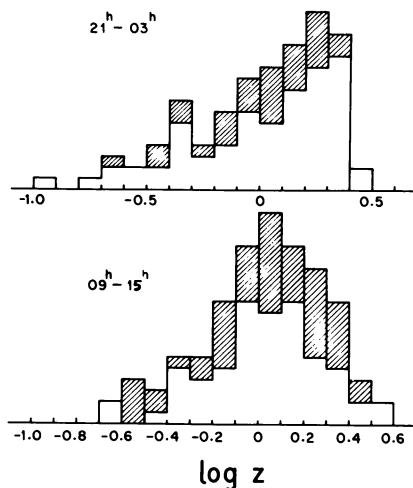


Fig.2. Redshift distributions.  
 Hatched region refers to 4C, B2 & Ohio sources