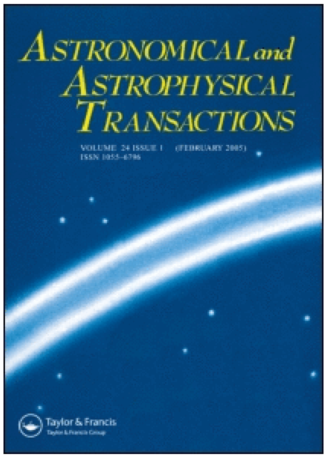

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Is there a simple dependence between the scales of radio sources and their radio luminosities?

N. S. Kardashev [a]; B. V. Komberg [a]; V. I. Zhuravlev [a]
[a] Astro Space Center, Academy of Sciences, Moscow, Russia

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IS THERE A SIMPLE DEPENDENCE BETWEEN THE SCALES OF RADIO SOURCES AND THEIR RADIO LUMINOSITIES?

N. S. KARDASHEV, B. V. KOMBERG, and V. I. ZHURAVLEV

Astro Space Center, Academy of Sciences, Profsoyuznaya 84/32, 117810 Moscow, Russia

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Calculation of the dependence $L_r - l_r$ for radio sources is of major importance for revealing the processes of evolution of radio lobes and for investigating the characteristics of environments at different z. It is shown that calculation and analysis of this dependence requires a more refined method of approach to the selection of experimental data, taking into account different selective effects.

KEY WORDS Active galaxies, quasars, evolution

In I. S. Shklovsky's paper of 1962, based on the information available at that time on about three dozen of the nearest extensive radio sources, two sequences were singled out in the $\log L_r$(160 MHz)–$\log l_r$, plane: a "main" sequence ($L_r \sim l_r^{+2.5}$) and a "giant" sequence ($L_r \sim l_r^{-4.8}$) (Figure 1). In the following years, a number of authors returned to this problem, using much better statistics not only for radio galaxies, but also for radioloud quasars. For example, in Nilsson *et al.* (1993), the dependencies $\theta - z$ and $\log L_r$(10 MHz – 10 GHz) – $\log l_r$ (Figure 2) were analysed for 267 radio galaxies and 273 quasars with radio morphology of type FR II.

Using the latest data, we have calculated the dependence $\log L_r$(178 MHz) – $logl_r$, for about 500 radio galaxies of different types from the 3C and 4C catalogues (Figure 3). It is obvious from Figure 3, that the sequences seen by Shklovsky (1962) have been washed out, and correspond to the envelopes of the entire data set. This is a consequence of the revealed dependence of L_r upon the redshifts z of the sources. According to the conclusions of Singal (1993), following from the analysis of about 800 FR II radio sources, we have the ratio:

$$l_r = l_0 \left(\frac{P}{P_0}\right)^{\beta} (1+z)^n,$$

where $P_0 = 10^{26.5}$ W Hz^{-1}; l_0 = const (but is different for radio galaxies and quasars); $\beta = -0.23$, $n = -0.1$ for quasars; $\beta = 0.35$, $n = -3.0$ for radio galaxies.

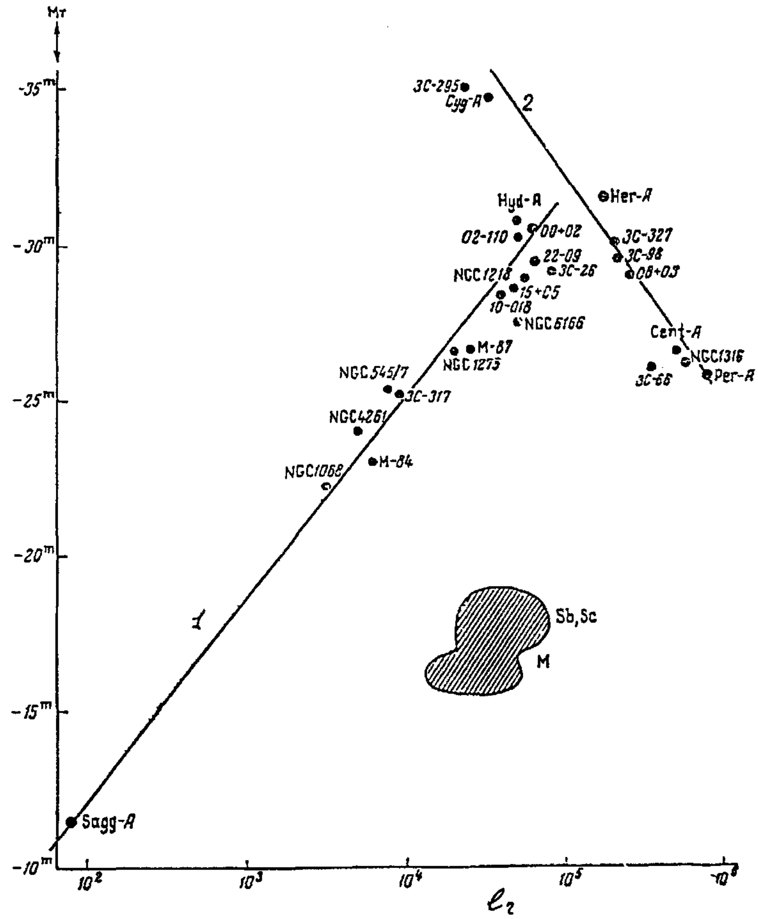

Figure 1 The absolute radio magnitude (M_r) vs. linear size (l_r): *1*, the "main" sequence; *2*, the "giant" sequence.

In addition, one should take into account that the observed radio sizes must somehow be corrected for the effect of projection, which cannot be insignificant due to the linearity of radio structures. Different methods for accounting for this effect have been suggested in the literature (see, for example, Best *et al.*, 1995). One such methods uses for l_r the sizes of separate extended radio lobes instead of the sizes of the entire radio sources. This procedure was used, for example, by Komberg and Smirnov (1985), where the dependence Σ_v–D_v was calculated for 55 extended radio lobes of nearby radio galaxies; here Σ_v is the radio brightness at frequency $v = 1400$ MHz. (This dependence was already taken into account by I. S. Shklovsky in 1976 in his analysis of processes of expansion of the radio envelopes SNR.) The slope of the dependence Σ_v–D_v for the SNR envelope turned out to be equal to $\beta = 3.4 \pm 0.5$, while for "plerions", $\beta = 2.35 \pm 0.2$ (Sakhibov and Smirnov, 1982).

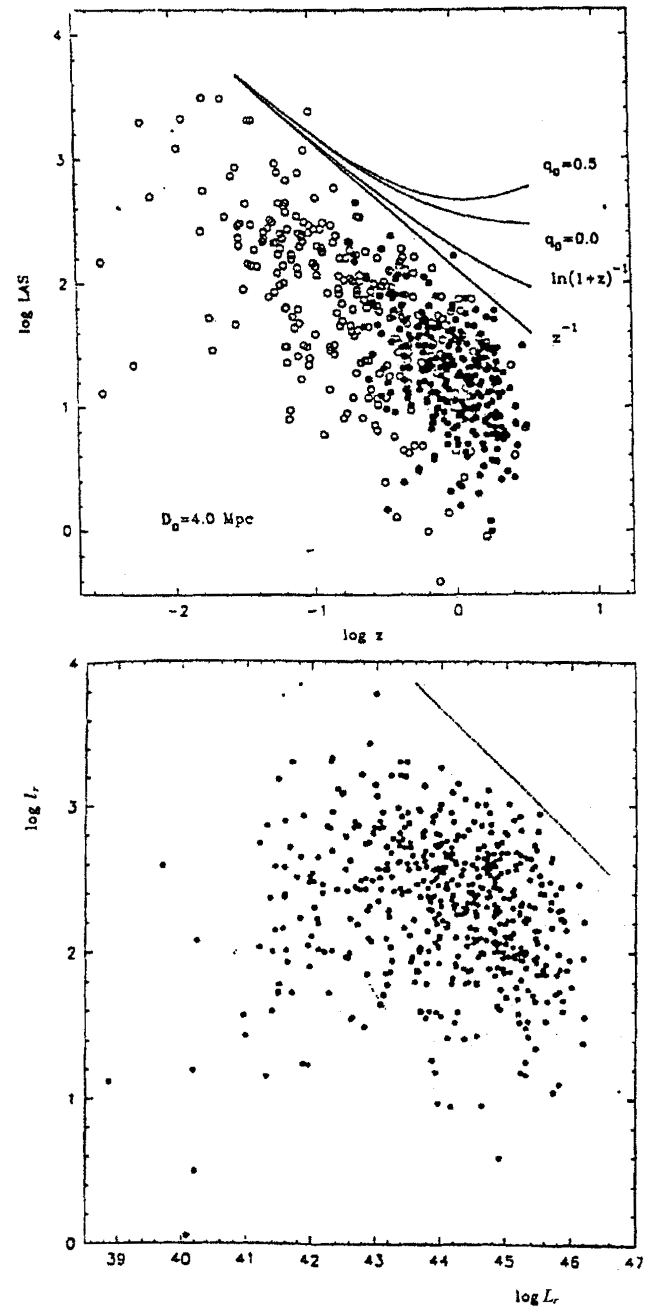

Figure 2 The largest angular size (LAS) vs. redshift (z). The behaviour of a 4 Mpc rigid rod is indicated in three world models together with a z^{-1} dependence. The open circles represent galaxies, and the filled circles, quasars (upper panel). The linear size (l_r) vs. the luminosity (L_r) is shown in the (lower panel).

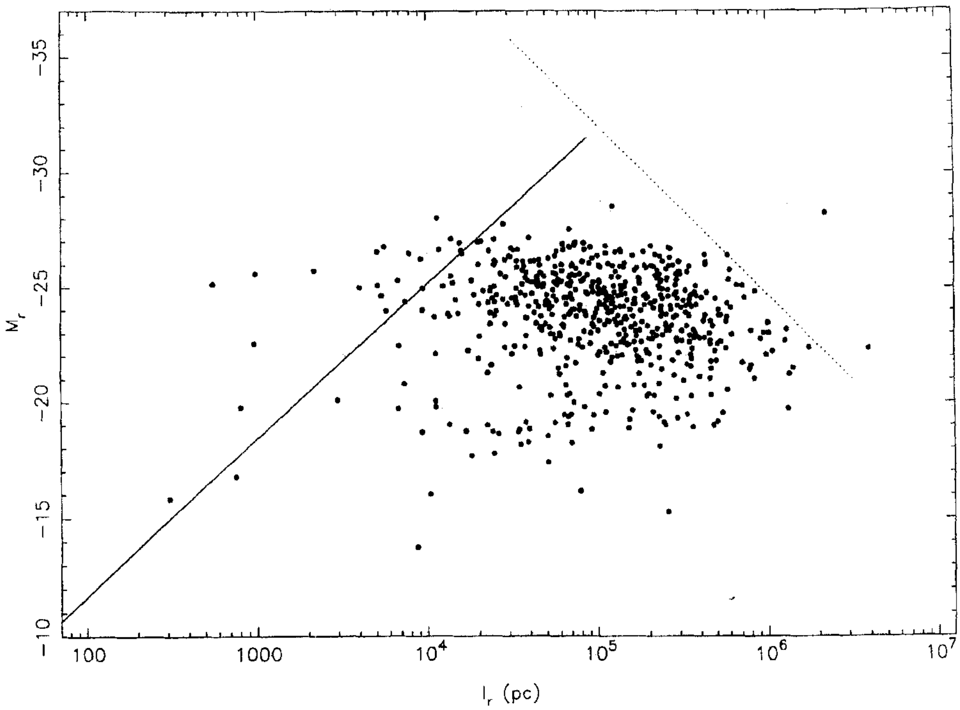

Figure 3 The absolute radio magnitude (M_r) vs. linear size (l_r) for our sample. The solid line indicates the "main" sequence; the dashed line the "giant" sequence.

The latter is close to the value $\beta = 2.5 \pm 0.3$, obtained by Komberg and Smirnov (1985) for radio galaxies. The dependence $\Sigma_v - D_v$ for radio sources from the 7C catalogue with $F_{151\mathrm{GHz}} = (0.4 \div 1)$ Jy is also cited by Gotter *et al.* (1996).

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