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RESULTS OF OBSERVATIONS OF 560 RADIO SOURCES AT A FREQUENCY OF 86 MHz

(Presented by Academician V. A. Ambartsumian on 29 XI 1967)

In the period from February 1965 to June 1967, on the East–West array of the range cross-shaped radio telescope of the Lebedev Physical Institute of the Academy of Sciences (DKR-1000), measurements were made of the flux densities of radio sources from the 3C ([1]) and 3CR ([2]) catalogs at a frequency of 86 MHz (560 sources in all). The antenna used is described in detail in ([3]). The resolving power, determined by the beam pattern, is $11'$ in right ascension and $5°$ in declination. A correlation receiver was used in the work; the circuit for connecting it to the antenna is described in ([4]).

The complete observational results are given in ([5,6]), where the right ascensions $\alpha_{1950.0}$, flux densities S, spectral indices x, and also the rms errors $\Delta\alpha$ and ΔS are given for all sources from the 3C and 3CR catalogs. The values of these quantities were obtained, as a rule, from no fewer than 5 records of each source.

Right ascensions were determined from the sidereal time at which the source passed through the maximum of the radio-telescope beam pattern. In addition to the correction for precession, a correction was introduced taking into account the inclination of the horizontal axis, the azimuth and collimation error of the instrument, and also the receiver time constant. These corrections were determined from 35 sources identified with optical objects, whose coordinates were taken from ([7]). The accuracy of determining $\alpha_{1950.0}$ for most sources is no worse than $\pm 1'$.

Measurements of flux densities were relative.

The following were used as the principal calibration sources: 3C 123, 218, 348, 353, 380, 409. Their flux densities after correction for angular sizes are:

$S_{123} = 368$, $S_{218} = 583$, $S_{348} = 684$, $S_{353} = 396$, $S_{380} = 120$, $S_{409} = 182$ (all in units of 10^{-26} W/m$^2 \cdot$ Hz).

In addition, 30 sources were used as secondary standards, so that on each record there were 2–4 calibration sources. The errors in determining S for most sources do not exceed 10%. The integral distribution of sources by flux densities at a

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Fig. 2. Histogram of spectral indices (in the frequency range 178-86 MHz). a —for sources of the 2CR catalog having $|b| \geq 10^\circ$; b —for quasars

Figure 2: Fig. 2. Histogram of spectral indices (in the frequency range 178-86 MHz). a —for sources of the 2CR catalog having $|b| \geq 10^\circ$; b —for quasars

frequency of 86 MHz was constructed (Fig. 1, b). In constructing this distribution, in order to exclude galactic objects, only those sources were used for which the galactic latitude $|b| \geq 10^\circ$.

The slope of the $\lg N - \lg S$ relation is $n = -1.78 \pm 0.15$. This value practically coincides with the value of n at the frequency 178 MHz (Fig. 1, *d*), which indicates the absence of any more or less significant change in the mean spectral index of the sources with flux density in the indicated frequency range.

On the basis of the measured flux densities at 86 MHz and their values at 178 MHz (3CR catalog), spectral indices x were obtained. Figure 2a shows the histogram of spectral indices of sources with Galactic latitude $|b| \geq 10^\circ$. The mean value is $\bar{x} = 0.89 \pm 0.02$, and the dispersion is $\sigma_x = 0.31$. Since the individual values were obtained with an error of ~ 0.20, the corrected value of the dispersion will be $\sigma_x = 0.24$.

Fig. 2. Histogram of spectral indices (in the frequency range 178-86 MHz).
a —for sources of the 2CR catalog having $|b| \geq 10^\circ$;
b —for quasars.

An analogous histogram was constructed for quasars (Fig. 2b). For them $\bar{x} = 0.89 \pm 0.05$ was obtained, which coincides with $\bar{x}$ for the other sources. The dispersion for quasars, $\sigma_x = 0.38$, somewhat exceeds σ_x for all sources. Although the indicated excess for quasars in the value of σ_x is small, it seems to us that it really exists.

In order to investigate the dependence of the spectral index on S, sources with $|b| \geq 10^\circ$ were divided into 5 groups according to flux densities. The mean values of the spectral indices and their errors for each of these groups are shown in Fig. 3. As can be seen from the figure, the mean value of the spectral index remains unchanged within the errors up to flux densities $S = 11 \cdot 10^{-26}$ W/m$^2 \cdot$ Hz and increases for weaker sources. A more detailed analysis showed that the reason for this increase in $\bar{x}$ is a systematic underestimation of the flux densities of weak radio sources in the 3CR catalog by approximately 5%. Introduction of the corresponding correction leads to a decrease of the mean spectral index for weak sources to the value

Fig. 3. Dependence of the mean spectral index $\bar{x}$ on the flux density S. The corrected value of $\bar{x}$ for weak sources is indicated by a cross

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$$\bar{x} = 0.88,$$

marked in Fig. 3 by a cross. In this case the mean spectral index found for all the sources entering into the histogram (Fig. 2a), with allowance for the indicated correction, decreases to 0.86.

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Note: Figure translations are in progress. See original paper for figures.