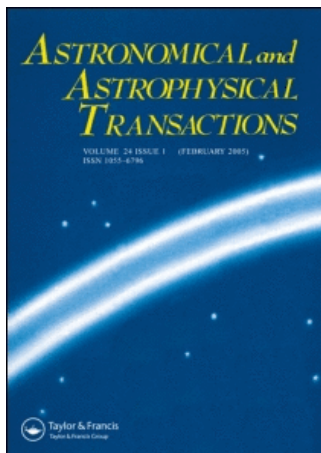


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THE UPDATE SPECTRAL CATALOGUE OF SOURCES OF THE DEEP RATAN-600 SURVEY

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The present spectral catalogue of RC sources is an updated and extended version of the spectral catalogue published earlier. The catalogue contains spectral and positional information for 529 RC sources in the 24-hour “Cold-80” strip survey, $\text{DEC} \sim 5^\circ$. The optical, X-ray and infrared data for identified sources are also included. Some statistical data of the update spectral catalogue of RC sources are presented.

KEY WORDS Radio sources, spectra, catalogues

1 INTRODUCTION

The RC catalogue is the result of the multifrequency survey of the strip sky $0^h < \text{RA} < 24^h$, $\text{DEC} = \text{DEC SS 433} (\sim 5^\circ)$ with the RATAN-600 during the “Cold-80” experiment (Parijskij *et al.*, 1991, 1992). The median width in declination is about $8'$. 1145 radio sources were detected in this strip of sky. For about 490 radio sources the spectra had been determined earlier (Bursov *et al.*, 1989, 1993), but a lot of new spectral information and identification methods have appeared in the years since the publication of the spectral characteristics of the RC catalogue sources. Therefore the necessity arises for completing this spectral catalogue. Thanks to the Internet and the new NRAO VLA Sky Survey (NVSS) data (Condon *et al.*, 1996) it has become possible to obtain much more precise coordinates of RC sources in the interval $0^h\text{--}9^h30^m$ in RA and to identify most of them in that interval. The identification was done by applying the APM program (automatic plate measuring, Irwin *et al.*, 1994) also using the Internet. About 100 RC sources with ultra steep spectra (USS) have been identified using the 6 m Russian telescope in the last few years (Kopylov *et al.*, 1995a,b; Parijskij *et al.*, 1996).

The updated spectral catalogue contains spectral and positional information for 529 RC sources (this makes up approximately 50% of the sources of the RC catalogue), optical identification, and data in the infrared (IRAS) and X-ray (Einstein,

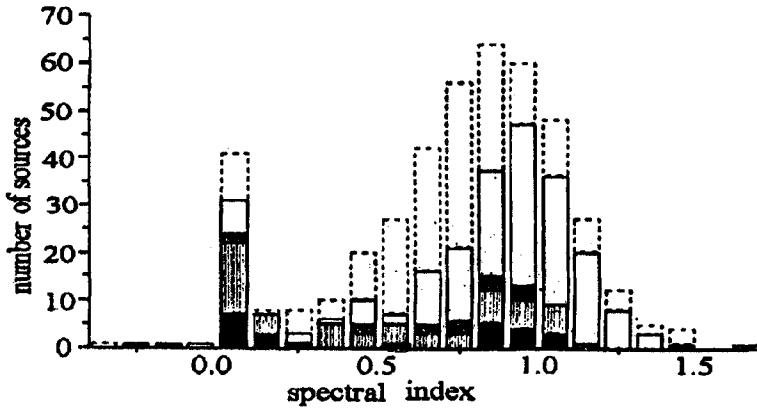


Figure 1 The spectral index distribution for 437 power spectrum sources (dotted line) of Table 1 (of Bursov *et al.*, 1996). Radio sources which have no optical counterpart on POSS1 are presented by the unhatched area. The sources identified on POSS1 are shaded (light shadow, the optical objects of not of established type; light-dark shadow, galaxies; dark shadow, quasars).

ROSAT) bands (when available). The observations carried out by N. N. Bursov in 1996 with the help of the RATAN-600 at the frequency 11 100 MHz are also considered.

2 THE CATALOGUE AND SOME STATISTICAL DATA

All the information collected in 119 papers on the RC sources were summarised in a special table (Bursov *et al.*, 1996; see Table 1). There the RC name of the source was given before the spectral data for every source in IAU J2000.0 format. The spectral index α ($S \propto \nu^{-\alpha}$) and red shift Z (when known) were presented too. The spectral index was determined by the least-squares method taking account of weights. The points that were strongly fallen out were omitted. There were also the radio positions (B 1950.0) of the source and of the main components and the rms errors of the coordinates; the frequency in MHz; the flux density and rms error in mJy; the optical positions of the identified candidates (B 1950.0); the visual stellar magnitude; the type of identified optical object; the X-ray band in keV; the flux and error in 10^{-12} erg cm $^{-2}$ s $^{-1}$; the infrared positions of the identified candidate (1950.0); the wavelength in microns; the flux density in mJy; and references. The spectral data for all 529 objects were shown by Bursov *et al.* (1996); see Figure 6). Here we present some statistical data of the update spectral catalogue of RC sources.

For 62 objects out of the 529 table sources the spectral indices could not be calculated either because the data at close frequencies are available or the data are inconsistent. Nine sources have a giga-Hertz peaked spectrum (GPS radio sources), and 21 sources have a curved spectrum (18 sources with positive flux density gradients and three objects with negative ones). In Figure 1 the spectral index distribu-

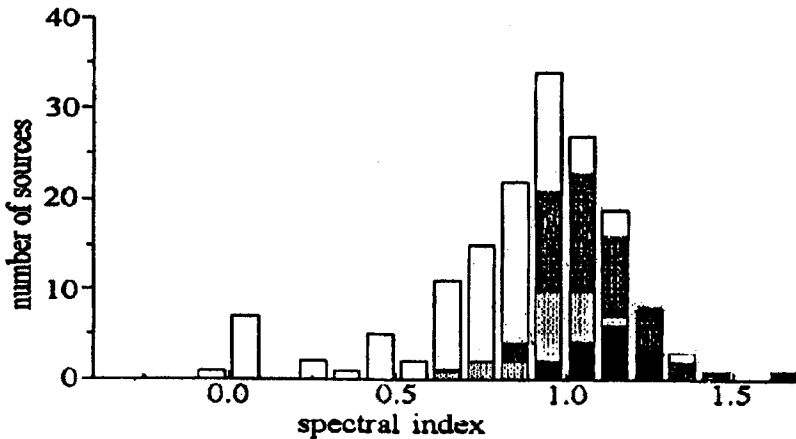


Figure 2 The spectral index distribution of 158 power spectrum sources which have no optical counterpart on POSS1. The shaded area represents the sources which have been observed with the 6 m telescope (light-shaded area, optical objects with $20 < m_R \leq 21.5$; light-dark shadow, optical objects with $21.5 < m_R < 24$; dark shadow, objects with $m_R \geq 24$).

tion for 437 power spectrum sources of the catalogue given (dotted line). The solid line represents the sources for which attempts at optical identification were made. The shaded area refers to the sources identified with optical objects on the Palomar Sky Survey plates by the APM method. Quasars and galaxies have different shading. The distribution has two maxima: one is in the interval 0–0.1, the other, of Gaussian shape, is in the interval 0.8–0.9.

106 radio sources were identified on the Palomar plates (26 quasars, and 16 galaxies), among them three with unknown spectral index, and two with a GHz-peaked spectrum. The majority of the sources with small spectral index are identified with bright objects. 173 radio sources have no optical counterpart on the Palomar plates (including 10 with unknown spectral index, one with a GHz-peaked spectrum, and three with a curved spectrum). 80 sources (out of these 173) are identified with weaker optical objects (not by Palomar plates, but using other techniques, the 6 m telescope, for instance (Parijskij *et al.*, 1996)): 20 sources are identified with optical objects with $20 < m_R \leq 21.5$ (two quasars and five galaxies), 44 with $21.5 < m_R < 24$ (no quasars and 15 galaxies) and 16 with $m_R > 24$ (no quasars and four galaxies).

Figure 2 presents the spectral index distribution of 158 sources with power spectra for which the optical candidate has not been found on the Palomar plate. The shaded area represents the sources which have been observed with the 6 m telescope. The sources which turned out to be equal to or weaker than 24 are heavily shaded.

In Figure 3 spectral index distributions are presented for radio sources identified with optical objects not on the Palomar plates with $20 < m_R \leq 21.5$, $21.5 < m_R < 24$ and $m_R \geq 24$ separately. They all have ultrasteepest spectra ($\alpha > 0.9$). Galaxies and quasars are differently shaded.

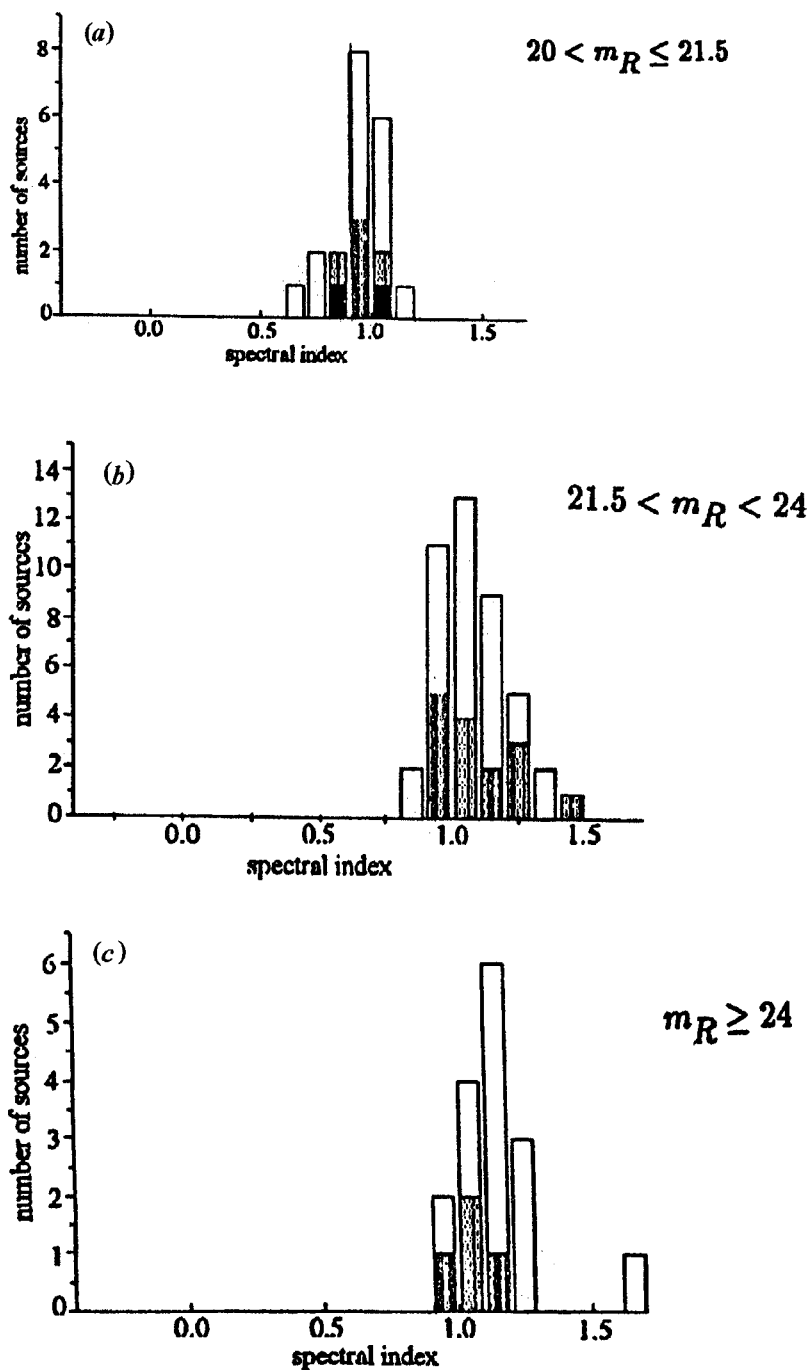


Figure 3 The spectral index distribution for radio sources identified with optical objects with the help of the 6 m telescope. Light shadow area, galaxies; dark-shaded area, quasars.

Figure 3 shows a tendency noticed before (McCarthy, 1993): the steeper the radio spectral index of the radio source the weaker its optical counterpart. As a rule, optically weaker objects are normally more distant. So the maximum of the spectral index distribution in Figure 3(a) ($20 < m_R \leq 21.5$) takes over 0.9–1.0; this maximum in Figure 3(b) ($21.5 < m_R < 24$) is shifted to 1.0–1.1 and in Figure 3(c) ($m_R \geq 24$) this maximum is within 1.1–1.2. It should be noted that there is not a single quasar among the optical candidates weaker than 21.5 stellar magnitude.

3 CONCLUSIONS

The main goal of the investigation of the RC catalogue radio sources is to understand the nature of all objects in rather a large selected area (about 100 sq. degrees) at a flux density limit between Green Bank (whole sky catalogue, Gregory *et al.*, 1996) and the VLA – a very deep but extremely small-field catalogue (Fomalont *et al.*, 1984).

- (1) 529 spectra of the RC catalogue sources are compiled, 38 spectra are new. Thus, about 50% of the RC objects are classified by spectral criteria up to now.
- (2) More than a half of the normal or USS objects are not visible on POSS1, as was expected. On the contrary, most of the flatspectrum sources have optical counterparts on POSS1.
- (3) We do not see a visible growth of population of radio sources with a GHz-peaked spectrum.
- (4) We confirmed the tendency of USS radio sources to be weak in optics.

We have great expectations of the new generation of catalogues in radio (the completion of the NVSS) and optics (POSS2). We are also going to be as deep as possible with our own facilities at the RATAN-600 multifrequency radio telescope.

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