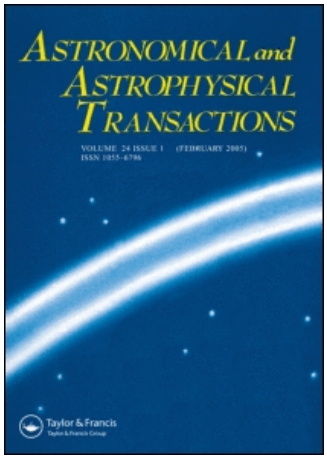


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# Steep-spectrum UTR sources in FIRST survey

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# STEEP-SPECTRUM UTR SOURCES IN FIRST SURVEY

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In an attempt to find further candidates for high-redshift radio galaxies, we searched the UTR-2 catalogue of decametric radio sources for steep-spectrum (SS) objects ($\alpha \leq -1.1$, $S \sim \nu^{\alpha}$). Radio counterparts and radio continuum spectra were prepared using the CATS database of radio source catalogues. High-resolution images of SS sources were extracted from the FIRST 1.4 GHz survey, yielding accurate positions and sizes for 43 SS sources. The search for optical counterparts from the APM (object) and DSS (image) databases, as well as infrared and X-ray identifications of these UTR sources are in progress. Two examples are shown.

KEY WORDS Radio sources: continuum spectra, optical identification

The UTR catalogue of 1822 decametric radio sources (Braude et al. 1994; *www.ira.kharkov.ua/UTR2*) covers about 30% of the sky north of −13° declination. It is presently the lowest-frequency source catalogue of its size, and provides an ideal basis to improve the poor optical identification content of sources selected at decametric frequencies. Verkhodanov *et al.* (2000) described our goal to find radio-optical counterparts for all UTR sources, using the CATS database (*http://cats.sao.ru*; Verkhodanov *et al.*, 1997).

We were able to fit spectra for all but 7 of the 2314 radio counterparts to the 1822 UTR sources. For 39% of these counterparts the best fit was a straight (S) spectrum, for 8% it was a convex ($C^-$) curve, and for 53% it was a concave ($C^+$) curve in the lg (frequency)–lg (flux) plot. In the hope of finding more examples of very distant radio galaxies, we concentrated on a subsample of 225 steep-spectrum (SS) sources with a straight spectrum of slope $\alpha \leq -1.1$, $S \sim \nu^{\alpha}$). To further increase the radio-positional accuracy for subsequent optical identification, we searched for radio counterparts of these 225 sources in the 1999 version of the FIRST catalogue (*http://sundog.stsci.edu/first/catalogs*) which yielded 43 FIRST counterparts.

The radio morphology for the 43 SS sources is as follows: 4 have jetted or complex structure, 22 are of FR-II type, 8 are compact, 7 slightly extended, and 2 are 'clumpy' sources. For some of the sources an optical identification is already known (see Andernach *et al.*, 2001 for a few examples). In Figure 1 we present

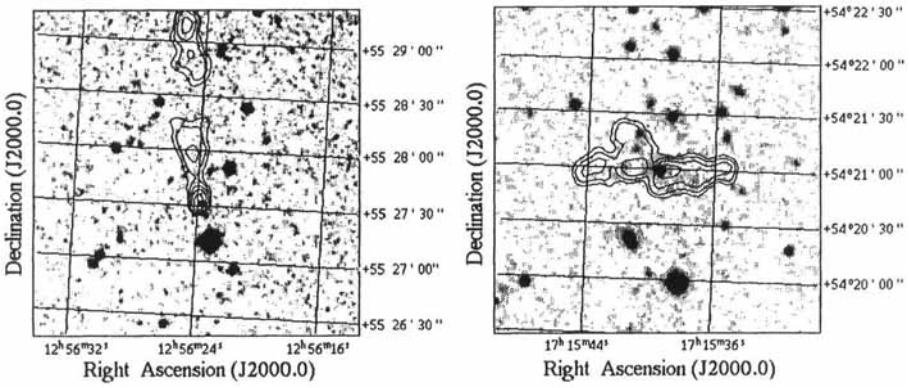


**Figure 1** Examples of FIRST maps of the multicomponent objects GR1256+56 (left) and GR1713+54 (right) overlaid on DSS-2 images. See the text for comments on these sources.

FIRST images of two previously unidentified UTR radio sources, both with a spectral index of $\alpha = -1.1$, overlaid on the second-epoch Digitized Sky Survey (DSS-2, *http://archive.stsci.edu/dss/dss_form.html*). In the low-resolution surveys 87GB, 6C and WENSS, the radio centroid of GR1256+56 is in between the two FIRST components shown in Figure 1. The optical object of the southernmost component appears to be located in a group of galaxies, and could be the parent galaxy (or QSO) of a source with a long radio tail extending towards the north. Alternatively, it could be a classical double of FR II type with outer hot spots and a steep-spectrum bridge. In this case, the optical identification requires the detection of a radio core. With its largest angular size of 2 arcmin, it would then be a giant radio galaxy. GR1713+54 (Figure 1, 4C+54.36) is centred on an uncatalogued galaxy, which shows diffuse optical emission along the radio axis, and appears to be a member of a group of galaxies. No redshift is known for either of the two sources.

For the optical identification of the other sources we are employing available resources like object catalogues from APM (*http://www.ast.cam.ac.uk/~apmcat*) and COSMOS (Drinkwater *et al.*, 1995) as well as the image archive of DSS-2.

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