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Survey and Analysis of 1–22 GHz Spectra for the Full Sample of 660 AGNs North of Declination –30°

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Abstract. Measurements of broad-band 6-frequency 1–22 GHz spectra of 660 compact extragalactic radio sources were performed in 1997 (for declinations $-30° < \delta < +43°$) and 1998 (north of +49°) at RATAN–600. "Average rest-frame" statistical spectral shapes for different subsamples of sources are analyzed. These shapes and each spectrum observed can be represented as the sum of a spectrum of an extended optically thin component (magnetized envelope/lobe), constant or slowly variable and dominating at lower frequencies, and a spectrum of a compact component (relativistic jet), dominating at higher frequencies, with any type of variability. We have revealed specific radio features of the EGRET subsample; this favors the models suggesting a relation between the emission mechanisms in radio and gamma-ray ranges. Sources are sampled for which the most compact VLBI structure is expected.

1. The Sample, Observations and Discussion of Results

About 700 sources north of declination −30° were selected from the Preston et al. (1985) VLBI survey with correlated flux density more than 0.1 Jy at 13 cm. Observations reported here were done in December, 1997, at the northern sector of RATAN–600 for the declination range from −30° to +43° (Kovalev et al. 1999), and in July/September, 1998, at the southern sector for sources north of declination +49°, at six wavelengths of 1.4, 2.7, 3.9, 7.7, 13, and 31 cm. Observations of the sources, located in the declination gap from +43° to +50°, are planned to the end of 2001 at an upgraded sector of the telescope.

The analysis of one-epoch spectra allows one to identify the broad-band emission of a compact continuous jet in the longitudinal magnetic field for almost all the objects of the sample. In addition, a second component at lower frequencies with a steep spectrum is visible in many sources. The second component can be explained by the emission of an extended magnetized envelope/lobe which accumulates the relativistic particles from the jet in peripheral regions of an object. The distributions of spectral parameters obtained testify in favor of the common physical nature of quasars and BL Lacs. The peak histogram value of the turnover frequency is about 10–20 GHz in the rest frame for the total sample investigated.

In Figure 1 the average rest-frame statistical spectral shapes for several subsamples of objects are presented. These spectra are constructed by averaging the spectral indices. The frequency range for each two-point spectral index was corrected by a factor of $(1 + z)$ before calculations, where z is the redshift. The most flat cm spectral shape is observed for γ-ray-bright and highly polarized objects, supporting the suggestion that the majority of them are the most active amongst all of the compact extragalactic sources. The high frequency portion of the spectra is the most flat for γ-ray bright objects. This fact gives an advantage to models implying a physical relation between γ-ray and radio emission (by Compton or synchrotron mechanisms) and indicates the peculiarity of the EGRET sample in comparison with the parent sample of flat-spectrum radio sources. The mean spectral shapes obtained are interpreted by the combined emission from an envelope/lobe and a continuous jet with quasi-stationary ejection, each of them contributing differently to the total emission.

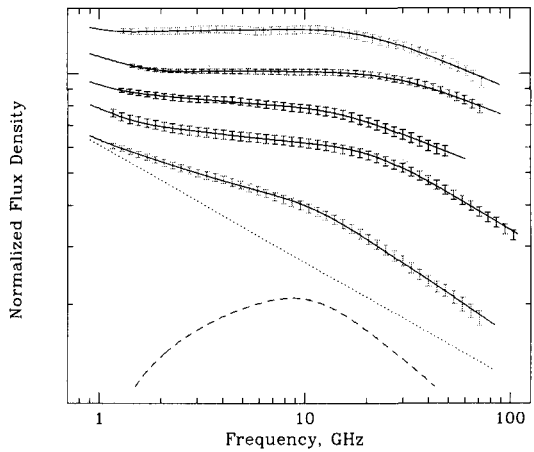

Figure 1. The average rest-frame statistical spectral shapes for several subsamples of sources with error bars. Spectra are vertically shifted for the sake of convenience. The total sample of about 660 objects is involved. From top to bottom are spectra for highly polarized objects, EGRET detected objects, BL Lacertae objects, quasars, and galaxies. Fitted total model spectra are shown by solid curves. For galaxies model spectra are also plotted for the jet (dashes) and extended component (short dashes), the sum of which gives the resulting model spectrum.

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