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MILLIMETER-WAVE VLBI OBSERVATIONS OF COMPACT STEEP-SPECTRUM RADIO SOURCES

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ABSTRACT We report the observations of compact steep-spectrum radio sources (CSSs) by VLBI at 22 and 43 GHz and single dich at 22, 43, and 92 GHz. Our results show that CSS also has an active core as well as other AGNs.

INTRODUCTION

As summarized by Saikia (1989) and Fanti et al. (1990, hereafter F90), compact steep-spectrum radio sources (CSSs) are characterized by compact dimension ($\leq$15 kpc) and steep spectrum ($\alpha \leq -0.5; S \propto \nu^{\alpha}$). CSSs are exotic objects among most of extragalactic radio sources which usually follow size-to-spectrum relation; compact components (core) have flat spectrum and extended components (lobes) show steep spectrum. Although recent high resolution mapping studies revealed complex morphology of CSS (e.g. Fanti et al. 1985), but there is little information about core activity. To search an active core in CSS, millimeter-VLBI is one of the most powerful method.

OBSERVATIONS AND RESULTS

We observed 18 of the sample from the CSS list (F90). We used the Nobeyama 45-m and the Kashima 34-m Radio telescopes for 22.2- and 42.8-GHz VLBI. This 200-km east-west baseline named KNIFE provides minimum fringe spacing of 14 mas at 22 GHz and 7 mas at 43 GHz. We used K-4 recording terminals with bandwidth of 2 MHz $\times$ 16 channels and made correlations with National

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Astronomical Observatory Correlator. The fringes were detected in 9 of 18 sources at 22 GHz and 3 at 43 GHz. At Nobeyama we also measured the integrated flux densities at 22, 43 and 92 GHz. Calibrations of the flux densities were carried out by observations of Mars and 3C273.

DISCUSSION

All sources which is detected with 22-GHz VLBI showed flat or inverted spectrum compared with 2.3-GHz VLBI by Preston et al. (1985). This strongly suggests that CSSs also have a flat-spectrum core. We find a good correlation between the spectral index and the VLBI-to-total flux ratio (Kameno et al. 1992). Figure 1 shows this correlation compared with other flat-spectrum sources observed by KNIFE. The distributions smoothly connected. CSSs lie more lobe-dominant and steeper region because their lobes are compact. We can explain this correlation with two-components model which consists of a flat-spectrum core and steep-spectrum lobes.

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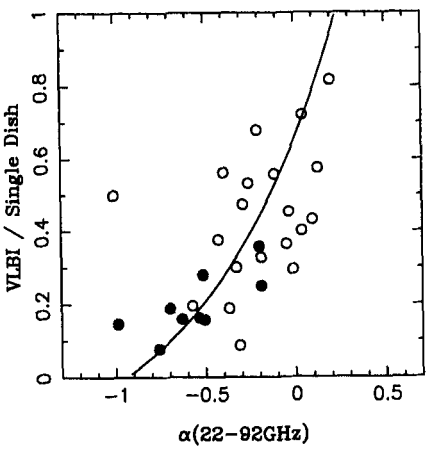

Figure 1: The diagram between spectral index in mm-waves (*holizontal*) and VLBI-to-total flux ratio (*vertical*). Eight CSSs (*filled circle*) and 21 active sources observed with KNIFE (*open circle*) are plotted. The solid line indicates the two-components model as figure 2.

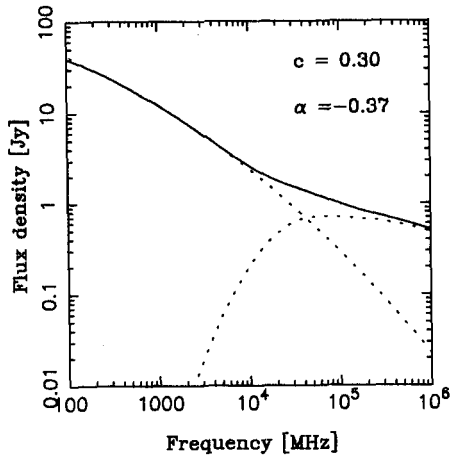

Figure 2: The best fitted two-components model which consists of a flat-spectrum core component with ν_{max}=55 GHz and steep-spectrum lobe component with α=-0.88. Various core-to-lobe flux ratio corresponds to various spectrum of total flux density.

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