A COUNTERJET IN THE NUCLEUS OF CENTAURUS A

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Abstract. Centaurus A (NGC 5128) is the nearest giant radio galaxy. It is a Fanaroff-Riley type 1 (low luminosity) radio source, but the compact radio source in the nucleus is strong enough that VLBI imaging has been possible with both the SHEVE array and the VLBA at several frequencies. These observations have detected a sub-parsec scale counterjet. This shows that jet formation in at least some FR I sources is intrinsically two-sided over very small distances and the radio jets in Centaurus A are probably only moderately relativistic. We also find evidence that the center of activity in Centaurus A is partially obscured by a disk or torus of dense plasma.

We observed Centaurus A at 8.4 GHz with a global (SHEVE+VLBA) array in October 1993. The resulting image is shown in figure 1a. The brightest peak corresponds to the inverted-spectrum core (as determined from nearly-simultaneous 4.8 and 8.4 GHz SHEVE images; Jauncey *et al.*

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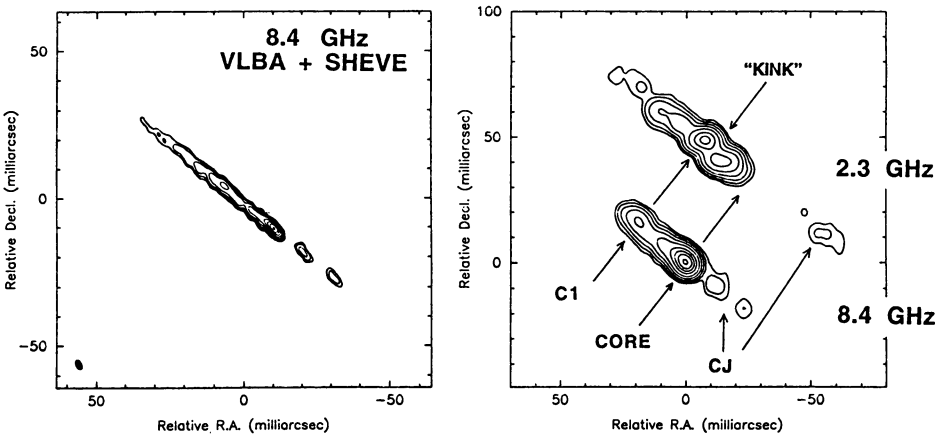

Figure 1. (a) 8.4 GHz global image; (b) Simultaneous 2.3 & 8.4 GHz VLBA images.

1995, Tingay *et al.* 1995, Preston *et al.* 1996). The two counterjet peaks are seen in both Mk-II and Mk-IIIA data sets from this experiment. Figure 1b shows images from a dual-frequency (2.3 and 8.4 GHz) VLBA experiment in July 1995. Both images have been convolved with the same 6 mas restoring beam. The core component in Centaurus A appears to have a remarkably inverted spectrum between 2.3 and 8.4 GHz ($\alpha \sim 4$), while the rest of the main jet has a flat or steep spectrum ($\alpha \leq 0$). In addition, the separation between the core and the first detectable peak in the counterjet is much greater at 2.3 GHz than at 8.4 GHz. Both of these effects can be explained if the central 0.4-0.8 pc of Centaurus A are seen through a nearly edge-on disk or torus of ionized gas. Vermeulen *et al.* (1994) and Walker *et al.* (1994) found a similar situation in 3C84. A 2-3 pc path through 10^4K gas with a mean electron density of $10^4 - 10^5$ cm^{-3} will give a spectral turnover frequency > 10 GHz due to free-free absorption. The jet/counterjet brightness ratio is quite small (~4-8) and the proper motions seen in the main jet are sub-luminal (Tingay *et al.* 1994, 1995). This supports the belief that the jets in FR I radio galaxies are not highly relativistic. Continuing VLBI observations of Centaurus A will allow proper motions in the jet and counterjet to be compared, which will set new constraints on the geometry.

References

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