3C236 - THE GIANT RADIO GALAXY WITH A COMPACT STEEP SPECTRUM NUCLEUS AND A COMPACT TWO-SIDED JET

R.T. Schilizzi[1], E.D. Skillman[1], G.K. Miley[2], P.D. Barthel[3], J.M. Benson[4] and T.W.B. Muxlow[5]

1. Netherlands Foundation for Radio Astronomy, Dwingeloo, NL.
2. Space Telescope Science Institute, Baltimore, MD, USA.
3. California Institute of Technology, Pasadena, CA, USA.
4. National Radio Astronomy Observatory, Charlottesville, VA, USA.
5. Nuffield Radio Astronomy Laboratories, Jodrell Bank, UK.

3C236 is the largest radio source known. It has a 39 arcmin double structure (3.0 Mpc, Ho=75 kms^{-1} Mpc^{-1}) in which the SE lobe is narrow and edge-brightened and the NW lobe more diffuse and centre-brightened (Barthel et al., 1985). About half the flux density comes from a steep spectrum (α=-0.7) radio core of overall size 1.3 arcsec (2.2 kpc) located in the centre of a 17m elliptical galaxy with redshift 0.0988.

Figure 1 displays the λ18 cm radio structure of the core derived from a combined 16-station MK2 VLBI/6-station MERLIN observation made in April/May 1984. Figure 2 shows the structure of the south-east component in more detail.

We identify the nucleus with the brightest component in the centre of the structure in Figure 2. It is the most compact component and has an inverted spectrum (α_{18}^{6}). Low level emission can be seen to the north east and south west of the nucleus. The ridge-line of the south-east jet oscillates about PA 115° with a period of ~115 mas (~200 pc). It passes through a transvere structure ~55 mas (90 pc) in dimension at a distance of 135 mas (230 pc) from the nucleus. The north-west jet is not as well defined as its counterpart to the south-east. However, the cocoon or sheath emission can be seen clearly, as can the first stages of the jet close to the nucleus. 77 mas away from the nucleus in PA ~55° lies the second brightest feature in the whole south-east component. It lies to the northern edge of the cocoon and is resolved.

Figure 1 shows the north-west component is a quite relaxed structure whose steepest intensity gradient is to the north-east near the warmspot (15 mJy at 18 cm). It subtends an angle of ~25° at the nucleus, substantially larger than the north-west lobe of the large-scale structure (14°). If the nuclear jet enters the north-west component via the warmspot, one could interpret the extension of the component as due to diffusion. Alternatively if the north-west component defines a wide cone of relatively decollimated emission,

M. J. Reid and J. M. Moran (eds.), The Impact of VLBI on Astrophysics and Geophysics, 127–128.

recollimation will need to occur before the beam reaches the large-scale north-west lobe.

The identification of the nucleus with the brightest component in the SE structure leads to the conclusion that 3C236 has a compact two-sided jet, with approximately equal brightness per beam on each side. It is thus unlikely that superluminal motion (slm) will be observed in this source if slm is due to relativistic beaming close to the line of sight.

The oscillations in the SE and NW jets and in the NW large-scale lobe may be due to helical Kelvin-Helmholtz instability modes, or perhaps precession of the ejection axis in the nucleus.

The transverse structure seen in the SE jet may be evidence of a shock in the energy flow. Observations at 6 cm (and polarisation at 18 cm?) may help elucidate its nature.

The radio emission in the nucleus occurs on a scale commensurate with that expected for the narrow line region (few kpc). Thereafter no emission is seen for distances of the order of 1 Mpc until the large scale lobes are encountered. This suggests that the energy transport becomes more efficient (so that the jet is no longer visible) approximately 1 kpc from the nucleus. This may mark the outer boundary of the narrow-line region in this galaxy.

REFERENCE

Barthel, P.D. et al. (1985) A. and A. 148, 243.

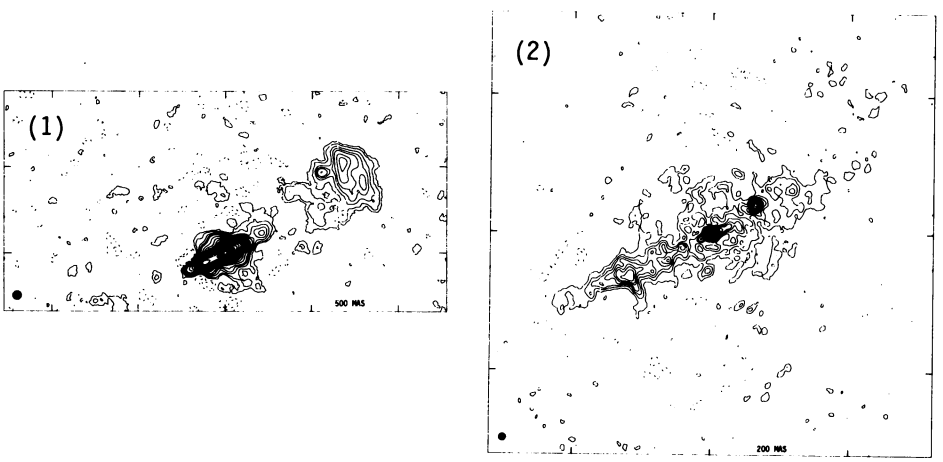

Figure 1: 3c236 at 18 cm; beam = 50 mas. Peak flux density is 372 mJy/beam, and the noise in the map is about 1.5 mJy/beam. Contours -5, -2.5, 2.5, 5, 10, 15, 20, 30, ..., 100, 120, ..., 200, 250, 300, 350 mJy/beam. The total extent of the central source is 2.2 kpc.
Figure 2: As for Figure 1 with a 10 mas beam and the NW component subtracted from the U-V data. Peak flux density is 218 mJy/beam, and the noise in the map is about 0.7 mJy/beam. Contours -4, -2, 2, 4, 6, 8, 10, 12, 15, 20, 25, ..., 50, 60, ..., 100, 125, 150, 200 mJy/beam.

https://doi.org/10.1017/S0074180900134242 Published online by Cambridge University Press