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15-GHz observations of the quasars 3C 270.1 and 3C 275.1

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Summary. The quasars 3C 270.1 and 3C 275.1 have been observed at 15 GHz with resolutions of 0.65 arcsec in RA and 0.65 cosec δ arcsec in dec. In both cases a compact component coincident with the quasar has been found, and in both cases the quasar is displaced about 2 arcsec from the radio-source axis.

1 Introduction

The majority of the powerful extended extragalactic radio sources consist of two components on either side of the associated optical object; there is often a compact radio component coincident with this object. The optical object usually lies very close to the radio source axis, defined by the line joining the two outermost peaks of the source. However, Wills (1978), in his reinvestigation of the positions of the optical objects (mostly quasars) associated with a number of extended sources, finds a few sources in which the object is significantly displaced from the source axis, in particular the quasars 3C 270.1, 3C 275.1 and 3C 432. We present maps of two of these, 3C 270.1 and 3C 275.1, made at 15 GHz with the 5-km telescope in order to investigate this apparent displacement further.

2 Observations

The quasars 3C 270.1 and 3C 275.1 were mapped with the 5-km telescope at 15 GHz in 1977 January and February; the beamwidth of the telescope at this frequency is 0.65 arcsec in RA by 0.65 cosec δ arcsec in dec. In both cases the maps were made with 16 interferometer spacings. The observing technique described by Riley & Pooley (1978) was used to reduce the effects of fluctuations in the atmospheric phase path; in the case of 3C 270.1 the observations of the source were interleaved with those of ON 231, and in the case of 3C 275.1 with those of 3C 287. The positions of 3C 270.1 and 3C 275.1 have thus been determined relative to those of the two compact sources respectively; the positions assumed for these compact sources are given by Elsmore & Ryle (1976). The flux density scale is based on a value of $S = 3.7$ Jy for 3C 286.

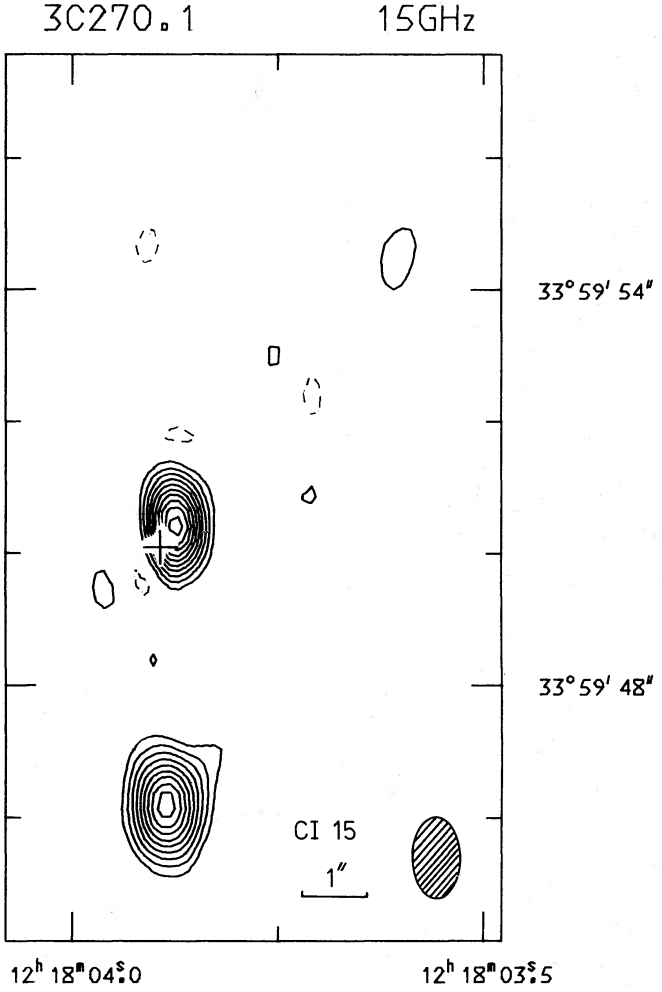

Figure 1. The map of 3C 270.1 at 15 GHz; the half-power beam shape is shown by a shaded ellipse. The contour interval is 15 mJy; this is the flux density in mJy of an unresolved source which would produce a change of one contour. The position of the quasar (Wills 1978) is shown by a cross whose extent indicates the uncertainty in position.

3 The results

The results are presented in Figs 1 and 2 and in Table 1; 1950.0 coordinates are used throughout. The observations were made with feeds having the E vector in pa 90° so that the maps represent the distribution of the Stokes parameters $I-Q$ across the source. The details in Table 1 are as follows:

(1) Source number.
(2), (3) 1950.0 coordinates of the peaks of emission, with estimated errors; the figures preceded by the word 'optical' are the coordinates of the associated quasar as determined by Wills (1978).
(4), (5) The angular extents of each component in RA and dec, assuming Gaussian brightness distributions.
(6) The flux density of each component at 15 GHz with estimated error.

3.1 3C 270.1

It can be seen from Fig. 1 that the extended component observed at 5 GHz with the 5-km telescope (Jenkins, Pooley & Riley 1977) is in fact two components; one of these is very

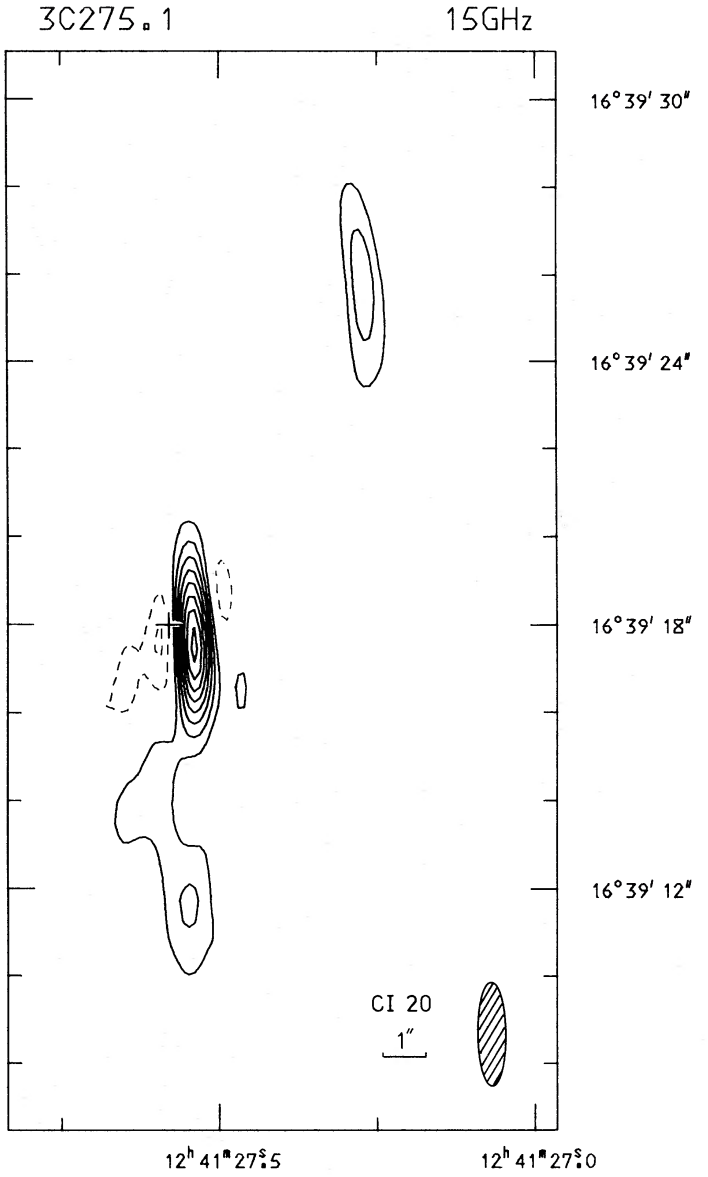

Figure 2. The map of 3C 275.1 at 15 GHz; the caption is as Fig. 1 except that the contour interval is 20 mJy.

Table 1.

Source	RA				Dec				ω_α	ω_δ	Flux density	
	h	m	s	± s	o	′	″	± ″	″	″	mJy	±
3C 270.1	12	18	03.60	0.05	33	59	53.5	0.5	≈ 2	≈ 2	≈ 30	20
	12	18	03.874	0.010	33	59	50.40	0.2	< 0.3	< 0.3	160	30
	12	18	03.887	0.010	33	59	46.14	0.2	0.5	0.6	200	30
Optical	12	18	03.894		33	59	50.09					
3C 275.1	12	41	27.27	0.02	16	39	25.7	0.5	< 0.3	≲ 2.5	90	20
	12	41	27.54	0.02	16	39	17.6	0.4	< 0.3	< 2.2	220	30
	12	41	27.55	0.02	16	39	11.6	0.5	0.8	≲ 2.0	80	20
Optical	12	41	27.580		16	39	17.97					

compact (< 0.3 arcsec) and is coincident with the quasar, and the other, about 4 arcsec south of the quasar, has an angular size about 0.6 arcsec. The weaker component, observed at 5 GHz, 5 arcsec north-west of the quasar, is of very low surface brightness at 15 GHz and is barely visible in Fig. 1, although it can be seen when the map is convolved to the resolu-

tion of the 5-GHz map. The quasar lies 1.6 arcsec away from the line joining the peaks of the outer components which are themselves separated by 9 arcsec. Comparison of the 15-GHz map, convolved to the resolution of the 5-GHz map (2 arcsec x 2 cosec δ arcsec), with the 5-GHz map indicates that the spectrum of the compact component coincident with the quasar is flatter ($\alpha_5^{15} \lesssim 0.4$) than that of the outer components ($\alpha_5^{15} \approx 1.3$), where $S \propto \nu^{-\alpha}$.

3.2 3C 275.1

The structure of 3C 275.1 (Fig. 2) is similar to that of 3C 270.1. Again, the extended component observed at 5 GHz (Jenkins *et al.* 1977) is now seen to be double; one component of the double is compact and coincident with the quasar and the other is slightly extended and 6 arcsec south of the quasar. There is another unresolved component 9 arcsec north-west of the quasar. The quasar lies about 2 arcsec from the line joining the two outer components which are separated by 14 arcsec. The spectrum of the compact component coincident with the quasar is flatter ($\alpha_5^{15} \lesssim 0.2$) than that of the outer component ($\alpha_5^{15} \approx 1.0$).

4 Discussion

The quasars associated with 3C 270.1 and 3C 275.1 have redshifts of 1.519 and 0.557 respectively. Assuming an Einstein–de Sitter model with $H_0 = 50\ \mathrm{km\,s^{-1}\,Mpc^{-1}}$, $\Omega = 1$ and $q_0 = 0.5$, the luminosities of the two sources at 178 MHz are 2.5×10^{28} and $3.0 \times 10^{27}\ \mathrm{W\,Hz^{-1}\,sr^{-1}}$ respectively. For both sources, the linear separation of the two outer components is about 110 kpc and the quasar lies about 20 kpc from the axis on the plane of the sky. The majority of extended sources with comparable luminosities have basically linear structures (e.g. Wills 1978) and the departures from linearity observed in 3C 270.1 and 3C 275.1 are similar to those observed in the galaxies with wide-angled radio tails discussed by Owen & Rudnick (1976); the latter are much weaker cluster sources. These 'bent' structures have been attributed to motions of the associated galaxy through the intergalactic medium and it may be, as discussed by Wills, that this is the explanation for the structures of 3C 270.1 and 3C 275.1.

5 Conclusions

15-GHz observations of the sources 3C 270.1 and 3C 275.1 have revealed, for each source, a compact component with a flattish spectrum coincident with the associated quasar. In both cases, the quasar is displaced by about 2 arcsec from the radio-source axis and the displacement amounts to about 20 per cent of the length of the axis.

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