VLBI OBSERVATIONS OF THE SUPERLUMINAL SOURCES 3C 273 AND 3C 279 +

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Monitoring of the radio structure in the core of 3C 273 has yielded a series of hybrid maps in which substantial source evolution can be seen. We discuss the superluminal motion of components in the jet of 3C 273, and the evolution of their flux densities and spectra. For 3C 279 we identify a new epoch of superluminal expansion with v/c = 6.5.

3C 273. We have observed the quasar 3C 273 at intervals of about 6 months, alternating between 5.0 and 10.7 GHz, using a VLBI network of at least 5 telescopes. Since 1979 the Effelsberg telescope has been included, effectively doubling the angular resolution available. Figure 1(a) shows the sequence of maps obtained at 5.0 GHz. The 1981.26 map was made from more extensive observations than the others and is of higher quality. A weak extended outer component was detected on this map (C_2 in the convention defined on the 2.3-GHz map of Cohen et al. 1983). Most striking is the 'core-jet' morphology, which is seen in all our maps of 3C 273, and by Pearson et al. (1981) at 10.7 GHz. The superluminal motion of C_3 away from the core (D), which can be seen in Figure 1(a), is a continuation of that seen by Pearson et al. Note the bending of the jet: the source axis curves through $\gtrsim 30^o$, but a line joining C_3 and C_2 lies within about 1^o of the direction of the optical jet. Thus the bend occupies only $\sim$0.05 % of the total jet length.

Figure 1(b) shows the component motions as measured from the complete sequence of 5.0 and 10.7-GHz maps. C_3 shows no evidence for acceleration or frequency-dependence in its motion, and has an apparent speed v = 10.0 $\pm$ 0.3 c (H_o = 55 km/s/Mpc, q_o = 0.05). C_4 has the same speed, to within the errors, and there is evidence in these and more recent data for motion with a similar speed in the knot C_5. Because of poor NS resolution, no change in PA has been seen for an individual knot; such changes should become measurable if components follow the jet curvature.

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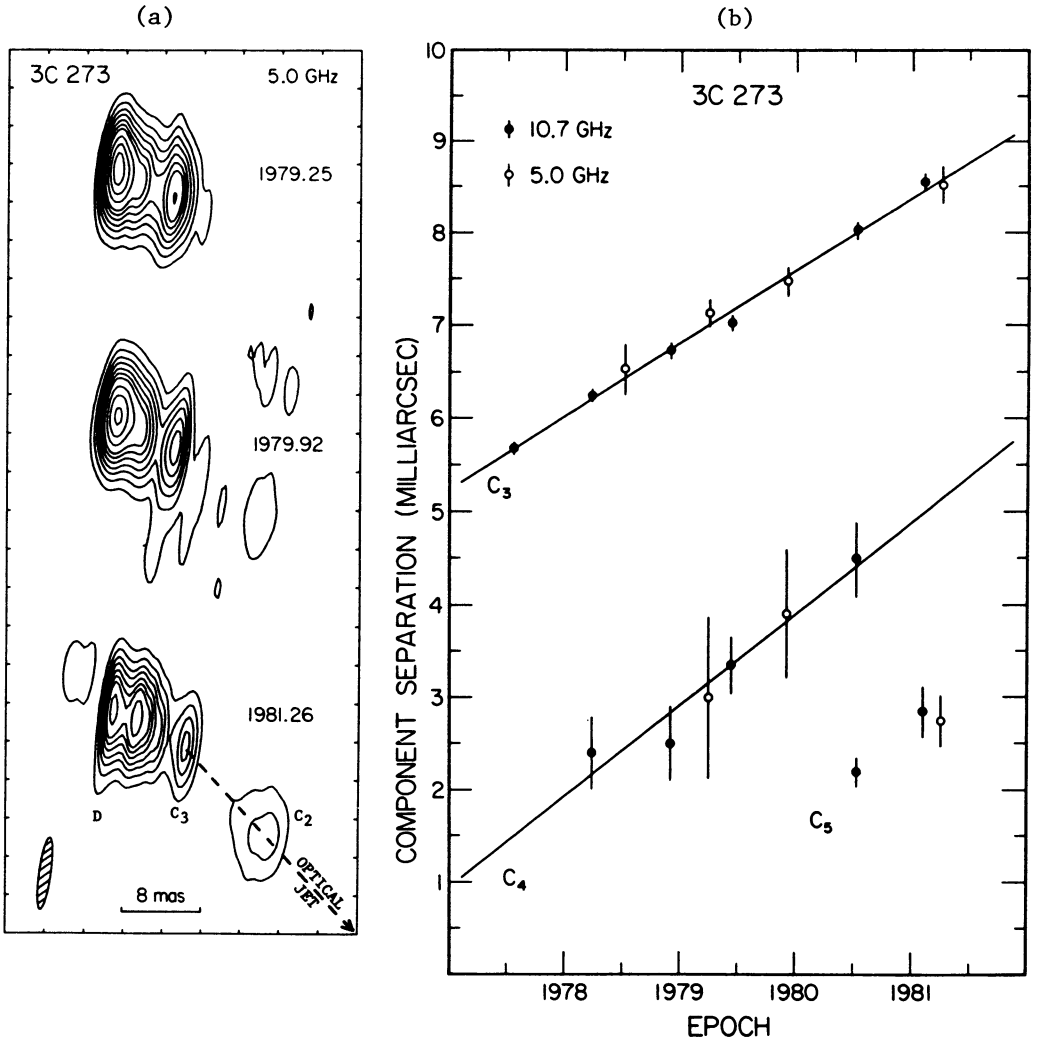

Figure 1. (a) Hybrid maps of 3C 273 at 5.0 GHz from three epochs. The 7.5 x 1.15 mas beam is shown as a shaded ellipse. Contours at -0.3, 0.3, 0.6, 0.9, 1.2, 1.5, 2, 2.5, 3, 4, 5, and 6 Jy/beam. (b) Component separations from the core of 3C 273, measured from the 5.0 and 10.7 GHz hybrid maps. Straight lines show linear least-squares fits to the motion of components C_3 and C_4.

The basic evolution seen in our data is one of ´birth´ of new components, their motion away from the core, and decay; such behaviour is expected if the core is the ´central engine´ which eventually supplies energy to the large-scale structure via a jet. We find that the knot flux densities decay with half-lives of 1-2 years, but with no obvious change in spectra (Unwin et al. 1983 found a slight spectral steepening of the knots in the jet of 3C 345). Several of the knots appear resolved, especially at 10.7 GHz, but we are not able to measure the presumed expansion directly from the maps.

3C 279. This low-declination ($\delta = -5^{\circ}$) quasar has had relatively few VLBI observations since its discovery as the first superluminal source (Whitney et al. 1971). We now have four hybrid maps made since 1981. The core is very compact, and only slightly resolved on the 5.0-GHz map. The two 10.7-GHz maps and the 22.2-GHz map all show the source as a close double, with separation $\approx$ 1.2 mas in PA $\approx 225^{\circ}$, and with roughly comparable component flux densities. Between 1981.1 and 1983.1 the separation increased at 0.17 mas/yr, (corresponding to v = 6.5 c), only one third of the rate found by Cotton et al. (1979) for epoch 1971. The spectral index of the NE component is flatter than that of the SW component, which is the expected sense for a core-jet picture of the VLBI structure: the arcsec-scale jet seen with the VLA (de Pater and Perley 1983) is in PA 206°, about 20° different from the VLBI structure.

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