SUPERLUMINAL ACCELERATION OF THE NEW COMPONENT IN 3C 345 +

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VLBI observations of 3C 345 at 10.8 GHz and 22.2 GHz show that the position angle of the new component is increasing as it separates from the core. Also, the apparent velocity of the component is increasing. This is the first clear evidence for non-radial motion and acceleration of an individual component in an extragalactic radio source.

The superluminal quasar 3C 345 has a curved, one-sided, jet-like radio structure (refs. 1, 2). VLBI components have been observed moving at apparent speeds of 13c to 17c (ref. 3). An extension of the core has been observed in 1977 and 1978 at 22.2 GHz in position angle -135° (ref. 4). A well-defined component was clearly detected in early 1981 at a similar position angle and a radial separation of ∿0.3 mas (ref. 5). We report here further observations of this component.

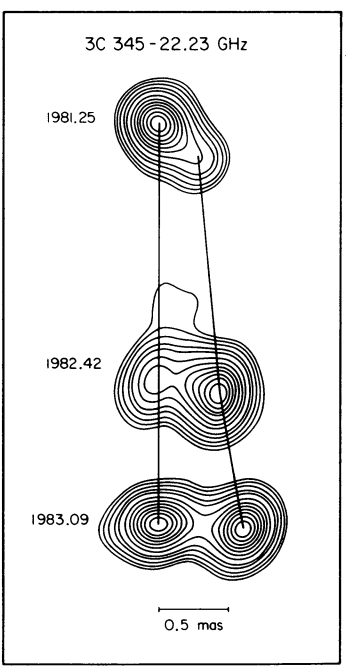

Figure 1

During the period 1981.1 to 1983.1, we have obtained three epochs of VLBI observations at 22.2 GHz (Figure 1) and four epochs at 10.8 GHz. The observations are described in detail elsewhere (refs. 5, 6, 7, 8). The radial separations and position angles of the western component relative to the core have been derived from model-fitting (Table 1). It is clear that the position angle of the western component has rotated ∿35° as its radial separation has increased from 0.3 to 0.6 mas. The radial separation at 22.2 GHz appears to be larger by ∿0.06 mas than at 10.8 GHz; this effect may be due to opacity gradients in the core or western component.

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TABLE 1 - Relative Positions and Velocities of Western Component

Freq. (GHz)	Epoch	r (mas)*	θ*	β_{app}*
22.23	1981.25	0.37 ± .01	-128° ± 5°	6.8 ± 1.2
22.23	1982.42	0.45 .02	-103° 2°	11.2 2.4
22.23	1983.09	0.61 .02	-93° 2°	
10.86	1981.10	0.32 ± .04	-132° ± 6°	4.1 ± 1.6
10.86	1982.10	0.35 .02	-115° 2°	
10.86	1982.86	0.49 .06	-97° 6°	9.9 1.6
10.86	1983.10	0.53 .02	-94° 4°	

* Errors represent ±3σ.

Apparent transverse velocities (relative to c) derived from the proper motion of the western component are also tabulated. (H_o = 55 km s^{-1} Mpc^{-1}, q_o = 0.05). The apparent velocity definitely increases with separation from the core. This result is significant at the 5σ level for both frequencies.

The observed non-radial trajectory of the component can be interpreted as a straight line which does not intersect the core, or as a curved path which originates in the core. The first case might occur if there were more than one supermassive body in 3C 345 (ref. 9). This explanation appears contrived because of the near equality of flux densities of the strongly-beamed core and western component.

In the latter explanation, projection effects will strongly amplify intrinsic curvature of the path. We have reproduced the observed trajectory with a simple curved path in a plane with an intrinsic curvature of <2° (ref. 8). However, we note that for such a path, the change in angle to the line-of-sight is too small to account for the large observed increase in the apparent velocity; intrinsic acceleration would be necessary. In order to explain both the trajectory and acceleration, a model with additional degrees of freedom will probably be required (e.g. non-radial shocks in a broad ejection cone).

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