4C39.25 - A CONTRACTING SOURCE?

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The quasar 4C39.25, whose nuclear radio structure was stable for many years, now shows a contraction in the brightness distribution. Possible explanations are discussed.

From 1972 until early 1979, at frequencies from 5 GHz to 15 GHz, the radio nucleus of the quasar 4C39.25 could be characterized as a simple double source, with a separation of 2.0 mas (Shaffer et al. 1977, and unpublished; Pauliny-Toth et al. 1981; Bååth et al. 1980). During these years, the strengths of the components changed in a manner consistent with evolving synchrotron-self-absorbed sources. The relative constancy of separation put 4C39.25 in marked contrast to the superluminal sources which it resembles in many ways, such as radio spectrum and variability.

4C39.25 has been observed two or three times per year at 8.4 GHz since late 1979 for NASA Crustal Dynamics Project Mark III VLBI geodesy experiments. These observations provide enough data to make low dynamic range (about 20:1) maps. The first map from 1979 November showed that 4C39.25 had contracted, with a component separation of about 1.8 mas. By the latest epoch for which I have a map, 1982 December, the peaks in the brightness distribution were only 1.6 mas apart. The apparent contraction rate is between 0.05 and 0.1 mas per year, or v/c between 1.4 and 2.8 for Ho=55 km $sec^{-1}Mpc^{-1}$(z=0.698). The contraction is confirmed by observations at 10.7 GHz in 1982 June (Shaffer, Romney, and Marcaide: private communication), which show that the first minimum in the visibility function has moved out from the origin. The equivalent separation at 10.7 GHz was 1.68 mas.

In 1979, the source was still very much the simple double source that was seen throughout the '70's, although at a somewhat smaller separation. By 1982, the source structure had become more complex and distinctly elongated along the almost east/west line of separation between the components. The probable core (the western component based on size and evolution) was relatively weaker at all wavelengths in the early '70's, but it strengthened continuously until it was the stronger component in the 1979 map. From 1979 to 1982, the western component weakened somewhat with respect to the eastern component. The total 8 GHz flux density of 4C39.25 reached a peak of about 11 Jy in 1972 and decreased almost linearly to about 6 Jy by the end of 1982 (Aller and Aller, private communication).

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This decline must have occurred almost totally in the eastern component. Its strength decreased by about a factor of three in the 1972-1982 interval, while the western component roughly doubled in strength, peaking about 1980, and then also starting to decline.

The decrease in the separation between the peaks in the brightness distribution of the two compact components in 4C39.25 is certainly real. Does this change represent a true contraction, though? If so, is the change consistent with the beaming models so in vogue at this time? Can the observations be explained by other than actual component motion?

The beaming model can give rise to (superluminal) contractions if the line of sight to the source lies in, or very close to, the plane which contains the curved trajectory of moving components. Curved trajectories are seen directly in transverse or oblique views of the sources 3C309.1 and 3C418 as shown in maps at this Symposium, and are postulated to explain the 1.3 cm observations of 3C345 (Moore, this Symposium). In this orientation, the constant separation from 1972 to 1979 occurs while the moving component is seen head-on, and the contraction occurs after the component "turns the corner" and starts to cut across our line of sight, in front of the quasar core. This explanation predicts that the components should eventually appear to merge. Later, the moving component should be seen on the other side of the core, giving the appearance of an expanding source. This model may explain the elongation seen in the 1982 map as radiation from material which trails the head of a beam that has just turned the corner. Unfortunately for this model, it is the supposed core (the western component) which seems to be most elongated, making it the beam rather than the core. Perhaps the rapid variation of this component and its smaller size are artifacts of our almost exactly head-on viewing of it.

Motion in a source can be mimicked by the appearance of new components. Stationary components of varying strength were postulated to explain superluminal motion until 3C273 and 3C345 were convincingly shown to be expanding (Pearson et al. 1981; Cohen et al. 1981). In 4C39.25, a new stationary component appearing between the two existing components can not be ruled out by current data. Neither can the ejection of a new component from the western core. In either case, a rather delicate balancing act in flux density between the old and new components must have occurred, since no rapid variations larger than 1 Jy have been seen, whereas the new component would have to be 2 to 3 Jy in late 1982 to cause the observed shift in the brightness peak. If a new component has been ejected from the core, 4C39.25 would be different from all other expanding sources. In those objects, all the non-core components move, whereas in 4C39.25 the eastern component is stationary. If a new component has been ejected, it may eventually run into the eastern component.

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