OBSERVATIONS OF SUPERLUMINAL MOTIONS IN 3C 120 +

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Superluminal motions were first seen in 3C 120 between 1972.5 and 1974.4 (Seielstad et al. 1979 and references therein). Between 1975 and 1980, the source was monitored along with 3C 273 and 3C 345 by the Caltech group. One reasonably clear episode of expansion was seen in 1979 (Walker et al. 1982) but, for most of the time, the source evolution was so rapid that it was difficult to relate the structures seen at successive epochs.

In 1981, the monitoring of 3C 120 was separated from that of the other sources so that more frequent observations could be made at one frequency and so that more stations could be used in order to improve the dynamic range of the maps. The dates, frequencies, beam sizes, stations, and total flux densities for all of the observations made since those described in Walker et al. (1982) are given in Table 1. The maps from the first 4 epochs in which the new observing style was used are shown in Figure 1. More complete details and the maps from the other epochs will be published elsewhere. The new observations provide a much clearer picture of the evolution of 3C 120 than was available before. It is apparent that the evolution is rapid and that the structure is complex, so it is not surprising that the earlier, more limited data produced ambiguous results.

The new maps show three components (labeled B, C, and D; A is the component seen in 1979) that are moving away from the eastern component. Component B was also seen in the maps from 1980 and early 1981. The eastern component is at a sharp end to the structures seen in the maps and displays more erratic flux density behavior than the other features. In the terminology of the core-jet models (e.g., Blandford and Konigl, 1979), it is assumed to be the core and it serves as the reference for measuring the positions of the other features. The separation of each component from the core as a function of time is

*The National Radio Astronomy Observatory is operated by Associated Universities, Inc., under contract with the National Science Foundation.

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R. Fanti et al. (eds.), VLBI and Compact Radio Sources, 121–124.

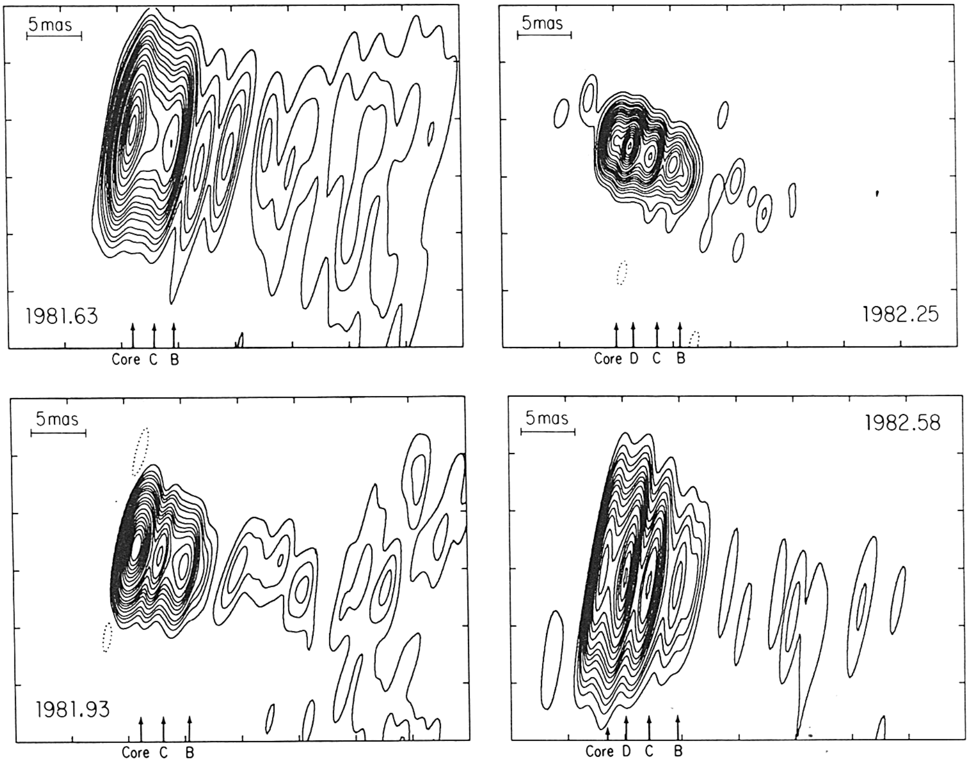

Figure 1. Hybrid maps of 3C 120 based on observations at 5.0 GHz at 4 epochs during 1981 and 1982 (See Table 1 for details). The feature labeled "core" is at the eastern end of the source and is the feature that is used as a position reference. The features labeled B, C, and D are those whose separations from the core are shown in Figure 2. The contour levels are -30, -20, -10, 10, 20, 30, 40, 60, 80, 100, 120, 150, 200, 250, 300, 400, 500, 600, 700, 800, 900, 1000, 1150, 1300, and 1600 mJy/beam. The 1982.25 map has additional contours at -5 and 5 mJy/beam. Because of missing short spacings, that observation was not sensitive to the low brightness features seen at the other epochs.

shown in Figure 2. The error bars reflect estimates of the uncertainty in the position of the component and the uncertainty in the position of the core. At the times of the birth of a new component, the core and the new component are not resolved, and the position of the core is especially uncertain. This accounts for the large error bars in 1981.25 and 1981.92.

The two important results from the separation measurements are that the velocity of a feature is constant and that different features in the same source can have different velocities. The first result is

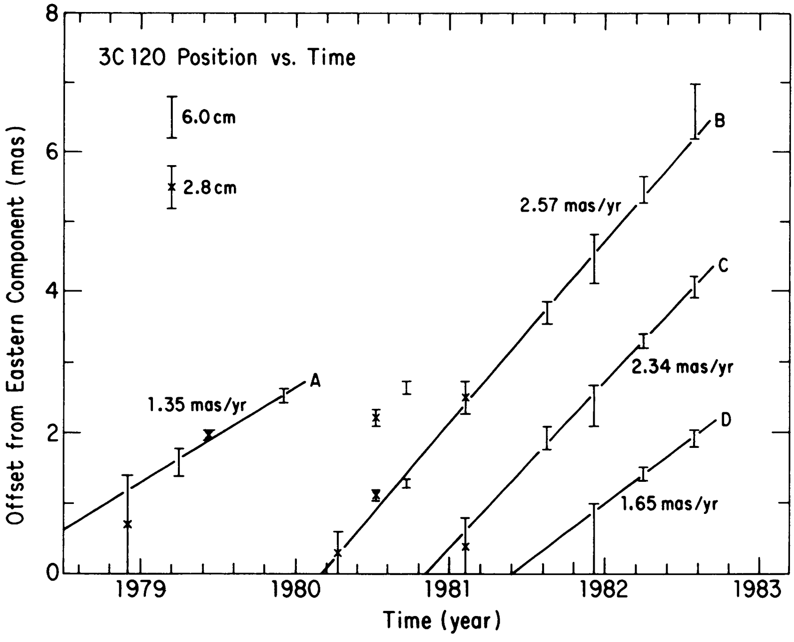

Figure 2. Separation of features from the eastern feature (core) as a function of time. Angular rates are shown for the feature seen in 1979 (Walker et al. 1982) and for the three features seen in the recent observations. The rates are the result of fits to the data. The rate of component D is poorly determined. For z = 0.033 and a Hubble constant of 100 km s^{-1} Mpc^{-1} one milliarc-second per year corresponds to 1.52 times the speed of light.

Table 1: Experiments

Epoch (yr)	Wavelength (cm)	Beam Axes (mas)	Beam PA (deg)	Stations[1]	Total Flux Den. (Jy)
1980.52	2.8	0.5 x 5.5	- 9	BKGFO	3.3
1980.72	6.0	1.0 x 8.1	-10	BKFO	3.8
1981.10	2.8	0.8 x 3.5	-10	KGFO	3.2
1981.63	6.0	1.3 x 8.9	-11	BKGFVO	3.1
1981.93	6.0	1.0 x 5.6	-13	BSKGFVOH	3.7
1982.25	6.0	1.0 x 3.2	-13	BSAGFVOH	3.9
1982.58	6.0	1.0 x 9.7	-10	BKGFVO	3.5

[1]Abbreviations: B: Bonn, S: Onsala, A: Arecibo, K: Haystack, N: NRL, G: Green Bank, F: Fort Davis, V: VLA, O: Owens Valley, H: Hat Creek.

based on component B which was observed from when it was blended with the core to when it was over 6 milliarc-seconds from the core. The second result is based on the variations by nearly a factor of two in the velocities of the various components. Note that the velocity of the 1972-1974 component was very close to the velocity of component A. It is not yet clear whether components seen at the same time have the same velocity.

The observations show that the flux density of the core has varied significantly but not in an obvious systematic manner, other than contributing to the over all decrease in the total flux density of 3C 120 seen over the last several years. The moving components either decreased systematically in flux density with time (features A, B and maybe D) or were constant over the period of the observations analyzed so far (feature C). New components were seen first as a brightening of the core, usually at times when there were indications that the core was slightly resolved. By the time the observations resolved a new component from the core, the rise in flux density was over.

The high dynamic range maps also revealed the presence of structures on scales of tens of milliarc-seconds. These structures are clearly real but are very poorly constrained by the 5 GHz data. Subsequent observations at 1.6 GHz show a jet extending to 0.2 arc-seconds. They are discussed elsewhere in these proceedings by Benson et al.

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