Superluminal Behaviour of the Double-Lobed Radio Galaxy 3C111

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Due to sensitivity problems only about a dozen of the powerful double-lobed radio galaxies have so far been mapped with VLBI. Even less is known about the time dependence of the small scale structure in these objects (Preuss and Alef, 1987). We have recently reported the first results of our monitoring program of classical double sources. We observed strong changes of the pc-scale structure in 3C111 (Götz et al., 1987) and 3C390.3 (Alef et al., 1987) implying "superluminal behaviour" in both sources. This is the first time that such a phenomenon has been found in lobe-dominated radio galaxies. Both objects are Broad Line Radio Galaxies of type N, and their radio emission from m to cm wavelengths is dominated by their outer lobes which are ~300 kpc apart (H_0= 50 km/s/Mpc).

In this paper we give a brief interim report about another, more recent VLBI observation of 3C111 at 6cm wavelength. The central component of 3C111 is relatively strong (~1.5 Jy at 6 cm) and emits about 1/3 of the total flux density at 6 cm. We reobserved the source 1986.9 with an 8-station global array using the MKII (2 MHz) VLBI system. As a result, we obtained the map shown in Fig. 1 along with maps of previous observing epochs. As an example of the drastic changes in the measured data we also show in Fig. 1 the visibility curves for the baseline Effelsberg - Green Bank (fringe spacing ~1.9 milliarcs).

The overall structure of the maps 1980.4 and 1986.9 is elongated in P.A. ~63°. The bright core is slightly elongated in the same direction taking into account the ellipticity of the convolving beam. The direction and orientation of the milliarcs structure are the same as that of the one-sided large-scale jet ~100" in extent (Linfield and Perley, 1984). We note a certain similarity in the general morphology (a bright core at the SW end of an elongated "knotty" feature) of our 1980.4 and 1986.9 maps and Linfield's 1982.6 6 cm map (Linfield, 1987). But given the strong structural changes from epoch to epoch, unambiguous identification of subcomponents from different maps is not possible. More frequent sampling is needed for reconstructing the evolution of the source morphology over the time span of 6.5 years. But if interpreted as propagation effects, the rapid changes clearly imply a superluminal phenomenon. That is, the emergence of the secondary component visible in 1986.9 out of the bright core in a time span <1.5 y means apparent motion at a velocity >9.6 c.

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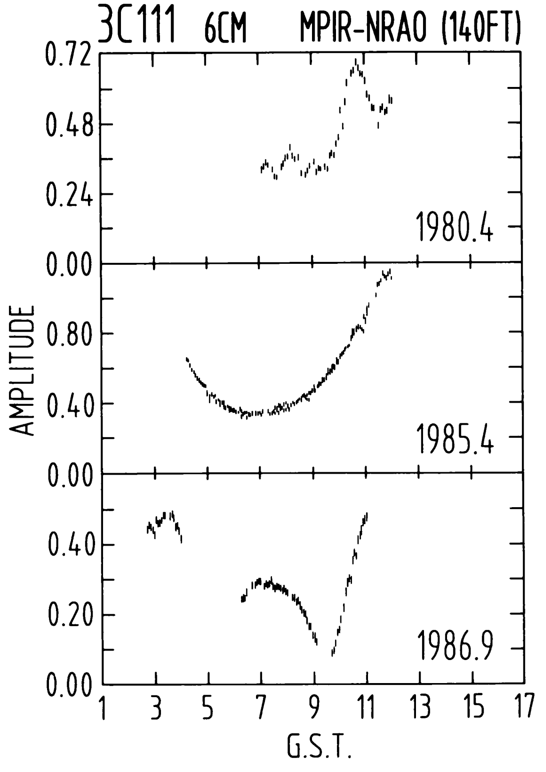

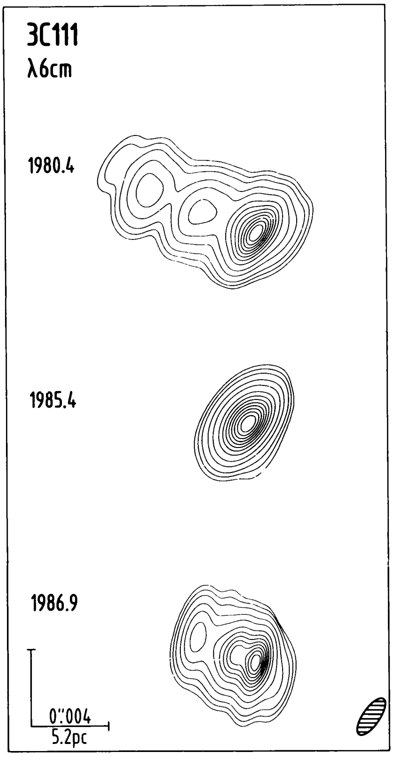

Fig.1: a) (left hand) Amplitudes of the correlated flux density vs. Greenwich Sidereal Time for the baseline Effelsberg- Green Bank for the 3 given observing epochs. b) (right hand) VLBI maps of 3C111 for 3 epochs. The contour levels are 0.5, 1, 2, 5, 10, 20,..., 90% of the maximum brightness (~3 x 10^{11}K all epochs).

References

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