Observations of the cores of extended quasars

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A critical test of the simple relativistic beaming models is provided by the search for structural changes in the weak cores of lobe-dominated quasars. In these sources, which are expected to be close to the plane of the sky, superluminal motion should be comparatively rare. We are engaged in the study of a complete sample of 30 extended quasars (Barthel et al.1984), ranging in projected size from $40h^{-1}$ to $200h^{-1}$ kpc (H_o = 100h, q_o = 0.05). High resolution multi-epoch observations have been obtained for two objects, the quasars 1721+343 and 0742+318, at 5 GHz (1982.3, 1983.3, 1986.5) and 10.7 GHz (1986.2, 1986.5). Superluminal expansion with transverse velocities of $3.1h^{-1}$ c has been detected in the core of 1721+343, which is the largest quasar known (Barthel et al., these proceedings). No superluminal motion was found in 0742+318. The large and small scale structure of 1721+343 are shown in fig.1a,b. The spectra of the individual components point to component A as the core ($\alpha_5^{10.7} = -0.3$).

First epoch transatlantic 5 GHz observations have been obtained of the mas-structure of the quasars 1055+201, 1222+216, 1830+285, 2209+080 and 2251+134. The cores of 1222+216 and 1830+285 show the familiar asymmetric core-jet structure. The cores of 1055+201 and 2251+134 are Gaussian-shaped and elongated in the direction of the extended structure. The mas-structure of 2209+080 was too weak to be mapped with our observations.

The morphological characteristics of the quasars that have been studied can be summarized as follows:

- The core structures are unresolved or core-jet, similar to the morphologies observed in compact radio sources in general.
- In all sources the mas-scale emission joins smoothly with the outer lobe structure. There is no evidence for bending of the radio structure on pc-scales.
- Three of the four sources in the original sample for which multi-epoch VLBI observations, by ourselves and others, are available, are found to display superluminal expansion: 0850+581 (Barthel et al. 1986), 1137+660 (Zensus et al. 1986), and 1721+343 (Barthel et al., these proceedings). Superluminal motion is apparently not restricted to compact sources, and actually occurs surprisingly often in objects of very large size.

M. J. Reid and J. M. Moran (eds.), The Impact of VLBI on Astrophysics and Geophysics, 133–134.

The occurence of superluminal motion in quasars of large projected sizes presents a challenge to beaming models. Several mechanisms have been suggested to overcome the deprojection problem, such as changing the position angle of the ejection axis between core and extended structure, or postulating the jet to have a wide cone angle initially and be collimated further out. For 1721+343 however, with its high degree of linearity and narrow kpc-scale jet, neither mechanism seems very likely. Orientation-independent models decoupling the observed radiation from the bulk particle flow (e.g. screen models or oblique shock models (Lind and Blandford 1985)) may be able to account for the superluminal motion in very extended superluminals more easily; we feel that these models deserve more attention.

References:

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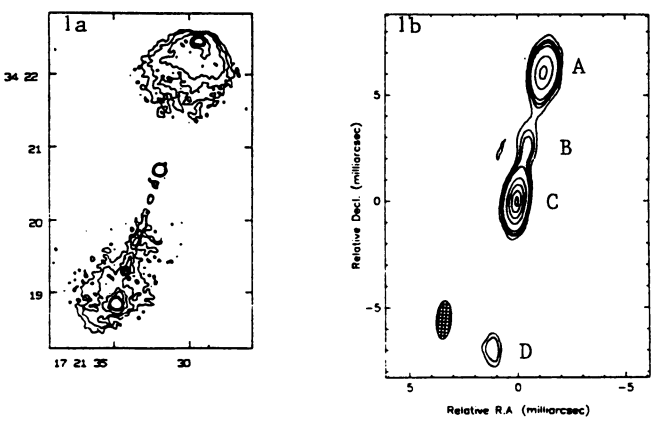
Fig.1: kpc and pc-scale structure
of 1721+343
(a) λ20 cm VLA map
(b) λ2.8 cm VLBI map



https://doi.org/10.1017/S0074180900134278 Published online by Cambridge University Press