THE RADIO SPECTRUM ACROSS THREE TAILED RADIO GALAXIES

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Multifrequency observations with large single dishes are the ideal tool to examine the variation of the shape of the radio spectrum across extended extragalactic radio sources. Three complex low luminosity sources with angular extent $20' < \theta < 30'$ have been mapped with the 100-m telescope of the MPIfR at frequencies 2.7, 4.9 and 10.7 GHz (HPBW = 4!4, 2!6 and 1!2 resp.). To extend the frequency range we used published low frequency maps for the spectral comparison, too. Thus at least four maps with angular resolution ≦ 4!4 were available for each source. All maps were (if necessary) corrected for sidelobes, then cleaned from obvious background sources and finally smoothed to the same beam of 4!4 HPBW. To look for spectral curvature a spectrum of the form $\ln S = a_1 + a_2 \ln \nu + a_3 (\ln \nu)^2$ was fitted to the brightness data for each sampling point of the map. We chose two parameters to characterize the spectral shape. The first is the *mean spectral index*, $\bar{\alpha}$, defined as the slope of the fit curve at the geometric mean of the lowest and highest observing frequency. As a measure of the spectral curvature we derived the *change of spectral index*, $\Delta\alpha$, along the fit curve between the lowest and highest observing frequency, i.e. $\Delta\alpha$ positive for a concave (= flattening) spectrum and vice versa. In the following the results are briefly summarized (see Andernach, 1981, for details).

Figure 1a shows our 10.7 GHz map of *3C40* in Abell 194. In this map the main part of the source appears as an asymmetric wide-angle-tailed radio galaxy with N547 as the parent galaxy. A separate component is due to emission from N541 and "Minkowski's object". The 2.7 and 4.9 GHz data suggest a highly polarized, steep spectrum radio bridge connecting N541 and the N545/7-system. The far northern tail is the only place in our sample of sources, where we could detect a spectral break in the radio spectrum as expected from synchrotron losses. The age derived from the break frequency and equipartition arguments corresponds to a particle transport speed of 2000 km s^{-1}, not too far from bulk velocities in other radio jets inferred from different arguments. The need for in situ particle acceleration is evident from Figure 1b, since the spectrum *flattens* with frequency (i.e. $\Delta\alpha > 0$) over a large extent of the source. This feature is also present in the two other sources, the

D. S. Heeschen and C. M. Wade (eds.), Extragalactic Radio Sources, 41–42.

https://doi.org/10.1017/S007418090002725X Published online by Cambridge University Press

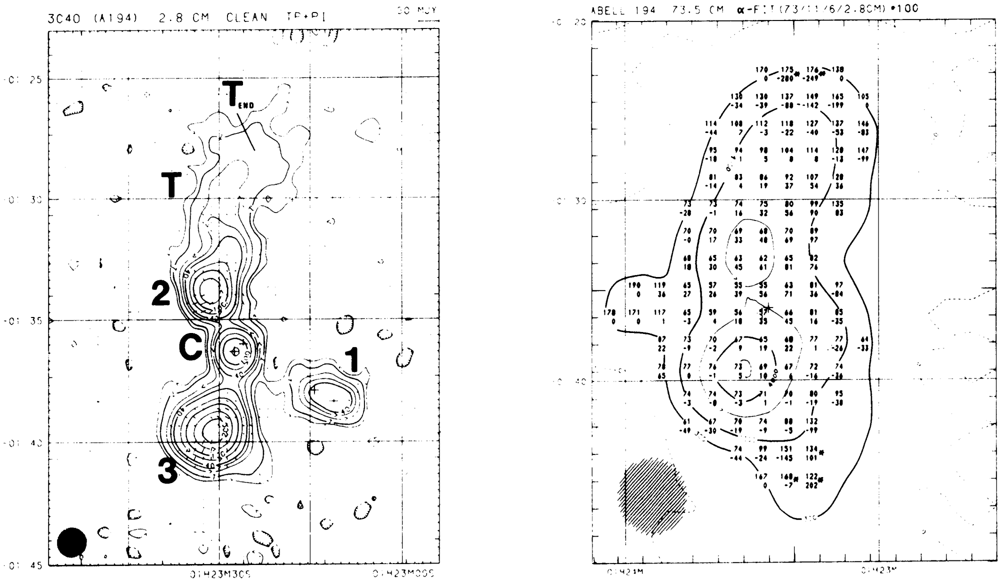

Figure 1: *(a)* 3C40 at 10.7 GHz with sidelobes removed. Contours in mJy/beam and E-vectors of polarized intensity are given. The crosses mark (in incr. R.A.) N541, Minkowski's object, N545 and N547. *(b)* Radio spectrum across 3C40 as derived from maps at 408 MHz (Schilizzi et al., 1972), 2.7, 4.9 and 10.7 GHz. $\bar{\alpha}$ is given above $\Delta\alpha$ (see text, each multiplied by 100). For a few points at the edge only two ($\Delta\alpha = 0$) or three frequencies (asterisk!) could be used.

twin-jet source *HB13* and the head-tail radio galaxy *2247+11 (N7385)*. For these sources we compared our data with low frequency maps of Masson (1979) and Schilizzi and Ekers (1975). In all three sources the observed flattening of the spectrum in the inner jets cannot be explained by the influence of the flat spectrum cores alone. Instead the data suggest the inner jets to have a rather flat high frequency spectrum ($\alpha \lesssim 0.4$). In the case of 2247+11 we observe this flattening even at the far end of its tail. Since our maps also indicate a bifurcation of the tail, we propose the plasmon with the flattening spectrum to be in turbulent motion (either falling or rising) through the ambient medium, leaving behind a secondary "detached" tail.

I thank the Deutsche Forschungsgemeinschaft for financial support under grants Re 304/7 and Re 304/9.

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