THE EXTENDED RADIO STRUCTURES OF QUASARS AND RADIO GALAXIES

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ABSTRACT. We have observed 20 classical double radio galaxies and quasars with MERLIN at 151 MHz. We discuss the systematic variation of the bridge structures with radio power and the nature of the identification.

1. INTRODUCTION & OBSERVATIONS

Because spectral index differences between compact 'hotspots' and extended bridge structure are often >1, the dynamic range required to study bridges is more than ten times smaller at 151 MHz than at GHz frequencies. This, together with a 3" resolution giving 10-20 beams across typical bright (3C) sources, and 500:1 dynamic range where not noise-limited, makes MERLIN an excellent tool for studying such bridge emission.

A previous VLA snapshot study (Leahy & Williams 1984, hereafter LW) detected bridges in virtually all sources with P(178 MHz) < 10^{27} W Hz^{-1} sr^{-1}, but for more powerful objects the proportion of detected bridges dropped rapidly. We have therefore observed a number of quasars and very powerful radio galaxies in the hope of finding this "missing" emission at 151 MHz. Examples of the results are shown in Fig. 1.

2. AXIAL RATIOS OF POWERFUL SOURCES

Even at the highest redshifts and powers, we always detect bridges extending back to the host galaxy, at least on one side. It is therefore clear that the large-scale disposition of synchrotron plasma is similar for all classical double sources. Even at 151 MHz the bridges are faint (<10% of the total flux) in the most powerful sources, as predicted by the "compactness" effect of Jenkins & McEllin (1977). The axial ratio (length over width) of such sources tends to increase with increasing power and compactness; this was first quantified by LW. Our new data (Fig. 2) appear to confirm this result at the highest powers; however there is a caveat: only one of our sources (3C68.2) is smaller than 30", whereas the median angular size for 3C sources at z > 1 is about 15". Thus we are sampling only the largest sources at z > 1, but most of the

G. Swarup and V. K. Kapahi (eds.), Quasars, 189–190.

population at z < 0.5. A correlation between axial ratio and linear size could give an apparent correlation with radio power.

3. DO QUASARS LOOK DIFFERENT?

Cores and jets in quasars are usually brighter than in radio galaxies of similar power. Our data suggest that, at least at lower powers, the extended structure is also different. Of particular interest is the tendency for quasars to produce a large, low-surface-brightness lobe at a large angle to the source axis, on the jet side only. Examples are 3C154, 249.1, 263 and 334. The same structure is known in 3C215 and 3C351 (Laing, private communication) and in 3C179 (Shone et al. 1985). Too few maps are available to decide how significant this effect may be.

Acknowledgements PWS and JPL thank S.E.R.C. for support. The data were reduced on the STARLINK node at Jodrell Bank.

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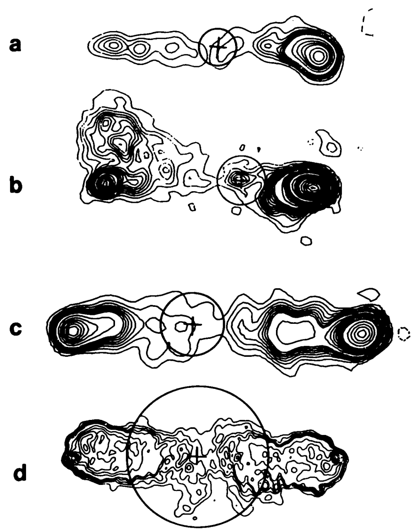

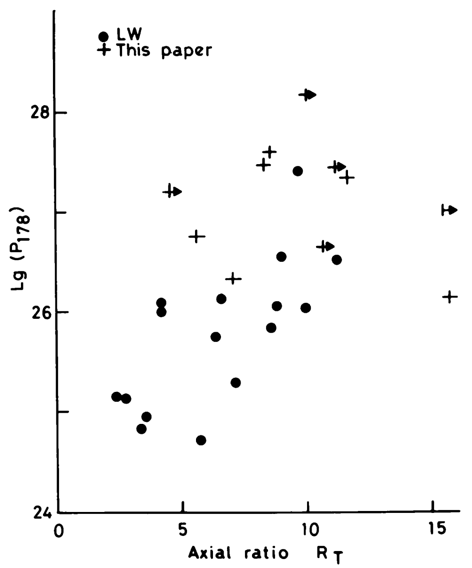

Figure 1. Maps of typical sources. Crosses mark the ID and circles are a standard 25 kpc radius (H_0=100,q_0=0). a) 3C68.1, QSO, z=1.24; b) 3C154, QSO, z=0.58; c) 3C268.1, Gal, z=0.97; d) 3C405, Gal, z=0.056.
Figure 2. Plot of Power at 178 MHz against total axial ratio R_T (as defined by LW) for galaxies in LW and this paper.