MORPHOLOGY OF STEEP SPECTRUM RADIO SOURCES SHOWING VARIABILITY AT LOW FREQUENCY

Franco Mantovani[1], Tom Muxlow[2] and Lucia Padrielli[1]

1. Istituto di Radioastronomia del C.N.R. - Bologna, Italy
2. Nuffield Radio Astronomy Lab. - Jodrell Bank, England

INTRODUCTION

The observed variability at low frequency of the radio sources can be explained within the framework of the generally accepted models either extrinsic (refractive scintillation in the interstellar medium) or intrinsic (bulk relativistic motion along direction near the line of sight) for variability. Both explanations require a large fraction of the source flux density to be contained in a small high brightness component, of tens of m.a.s. in size. Radio sources with steep straight spectral index are usually tens of Kpc sized, with weak central components and they do not generally show low frequency variability.

Therefore, selecting low frequency variable sources with straight steep spectral index, it would mean to select compact steep spectrum sources characterized by: i) physical size of few Kpc; ii) absence of dominant flat spectrum radio core.

This contribution deals with 8 of these sources.

VARIABILITY

All but two sources show high frequency variability generally much lower than the low frequency one or even absent. This seems to be a point in favour of an extrinsic cause of the low frequency variability as suggested by Rickett (1986). He pointed out that a correlation exists between the variability parameters, galactic coordinates, interstellar medium parameters. Following Fanti et al. (1987) we have figured out $m\tau$ (m, fractional rms variability; τ, the short and long variability time scale), θ_s the scattering angular size, θ_o a parameter depending on the medium characteristics and L, the thickness of the scattering medium, (Tab. 1).

θ_i is the source angular size, as derived from VLBI observations mainly at frequencies lower than 1 GHz; b is the sources galactic latitude.

1524-136 shows two values of $m\tau$ which are very different indeed. This is not expected if the refractive scintillation is the mechanism responsible for the low frequency variability. Moreover, 1524-136 at 50 cm shows an extended structure with lack of compact component, (Fig. 1).

M. J. Reid and J. M. Moran (eds.), The Impact of VLBI on Astrophysics and Geophysics, 125–126.

Table 1.

Name		S(Jy) 408MHz	b deg	θi m.a.s.	m τ (days) s	l	θs m.a.s.	θo m.a.s.	L pc
0320+053	DA101	6.5	-41	< 25	10.5	16.3	1.5	2.6	876
0358+004	3C99	5.0	-37	< 30	4.4		1.4	1.5	237
0518+165	3C138	16.4	-11	< 45	17.5		1.0	1.0	713
0548+165	DA190	4.2	- 5	< 25	52.1		1.2	1.4	255
1422+202	4C20.33	5.1	67	< 10	3.3		0.4	0.7	1724
1524-136	OR-140	6.1	34	100	2.5	38.8	9	27	35
2033+181		3.3	-13	< 30	10.5		5.2	5.0	533
2147+145		6.5	-30	< 30	7.3		1.2	1.6	517

The values figured out for θo suggest that a better determination of this parameter, assumed 8 mas by Rickett, is needed.

COMPACT STEEP SPECTRUM SOURCES

Four sources in our list have measured red-shift. For the remaining sources we have assumed z=0.5.

All sources show Linear Diameters smaller than that of an optical galaxy. This suggests we are dealing with compact steep spectrum sources where the radio morphology might be determined by propagation of jets through the interstellar medium, (see Tab. 2).

Table 2.

Name		Fringe Vis. 430 MHz	1660	z	O.I.	Lin. Diam. Kpc
0320+053	DA101	0.55	0.4	0.5	G	< 0.1
0358+004	3C99		0.3	0.426	G	8
0518+165	3C138	0.1	0.9	0.76	Q	4
0548+165	DA190	0.51	0.6			
1422+202	4C20.33		0.3	0.87	Q	40
1524-136	OR-140		0.4	1.687	Q	35
2033+181			0.6	0.5	EF	1
2147+145		0.33	0.6	0.5	EF	1

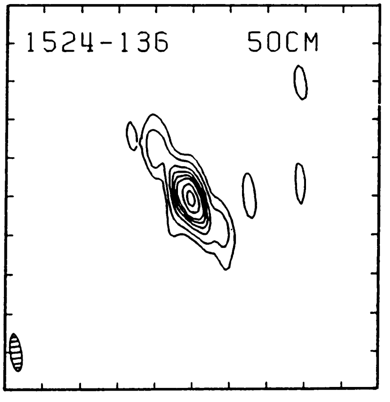

Fig. 1

CONT.LEV.=5.0 10.0 20.0 30.0 40.0 50.0 70.0 90.0 %

DISTANCE BETWEEN TICKS 200.0 M.A.S.

BEAM = 200 X 60 (8)

MAX. 1032.9 MJY

REFERENCES

Fanti R. et al., 1987, Superluminal R.S., ed. by J.A. Zensus, T.J. Pearson

Rickett B.J., 1986, Ap.J. 307,564

https://doi.org/10.1017/S0074180900134230 Published online by Cambridge University Press