IAU Colloquium 164: Radio Emission from Galactic and Extragalactic Compact Sources
ASP Conference Series, Vol. 144, 1998
J. A. Zensus, G. B. Taylor, & J. M. Wrobel (eds.)

Low-luminosity BL Lac Objects and Flat-spectrum Radio Galaxies

M. Bondi & D. Dallacasa
Istituto di Radioastronomia, CNR, Bologna, Italy

M. J. M. Marchã
DICE Universidade de Lisboa, Lisboa, Portugal

C. Stanghellini
Istituto di Radioastronomia, Noto, Italy

Abstract. We present first results from a new sample of low radio luminosity flat spectrum radio galaxies.

The 200-mJy sample (Marchã et al. 1996) is a flux limited set of about 60 flat spectrum nearby radio galaxies. Spectroscopic and polarimetric observations have allowed us to classify the radio galaxies in four classes. 1) BL Lac objects and candidates: common practice classifies as BL Lac objects those having break contrast ≤ 0.25 and EW ≤ 5 Å; we call candidates those objects with low contrast (< 0.4) and small EW lines ($<$20 Å). The candidates show significant optical polarization as well. 2) "Boring Galaxies": are characterized by weak lines, contrast > 0.4 and no optical polarization. 3) "Sy-type" galaxies: EW $>$ 100Å (not considered further). 4) Hybrid objects: 2 objects show non-thermal continuum and EW intermediate between BL Lacs and Sy-type objects.

We have selected for EVN and VLBA observations at 18 and 6 cm, respectively, all the objects belonging to the 200-mJy sample not previously observed with VLBI and with a core peak flux density exceeding 100 mJy. The list contains 14 objects: 8 BL Lacs and candidates, 4 "boring galaxies", and 2 hybrid objects.

We estimated the beaming parameters using the jet-counterjet brightness ratio (R). We used a 1σ limit for the counterjet when it was not detected. All the values have been calculated at the base of the jet, corresponding to a distance of about 4-5 mas from the core (Table 1). From R we derived the minimum velocity ($\beta_{\rm min}$) and the maximum value for the angle to the line of sight ($\theta_{\rm max}$). For objects with a known X-ray flux from literature we calculated the minimum Doppler factor due to synchrotron self-Compton limit (Ghisellini et al. 1993).

There is no significant difference in the derived beaming parameters and the mas scale morphology between the BL Lac objects and the candidates. This means that the usual BL Lac definition seems to be too strict, BL Lacs have wider ranges in contrast and equivalent widths. Optical and radio polarization should be used to identify lower power BL Lac objects.

The Doppler factors derived from synchrotron-self-Compton arguments are in agreement with those found by Ghisellini et al. (1993) for radio selected BL Lac objects. In particular, our objects belong to the lower values tail of the δ distribution with values significantly lower than those for objects belonging to the 1 Jy sample.

Symmetric objects (0729+562 and 1558+595) are found among the so-called "boring galaxies", and so is for the only object without extended emission (2202+363). The last "boring galaxy" (1241+735) shows a one-sided core jet

https://doi.org/10.1017/S025292110004505X Published online by Cambridge University Press

	(1) IAU Name	(2) z	(3) β_{min} [c]	(4) θ_{max} [degrees]	(5) δ_{SSC}
Hybrid objects	0125+487	0.067	0.75	41	
	1646+499	0.045	0.68	47	≥ 0.20
Boring galaxies	0729+562	0.104	0.1	84	
	1241+735	0.075	0.68	47	
	1558+595	0.057	0.14	82	
	2202+363	0.073			
BL Lac objects and candidates	0109+224		0.78	39	≥ 0.52
	0149+710	0.022	0.79	38	
	0210+515	0.049	0.68	47	≥ 0.12
	0651+428	0.126	0.61	52	
	1055+567	0.410	0.72	44	≥ 0.26
	1215+303		0.60	53	≥ 0.42
	1959+650		0.67	48	≥ 0.16
	2344+514	0.039	0.57	55	≥ 0.18

Notes: (1): name; (2): redshift; (3)-(4): minimum velocity and maximum angle to the line of sight from jet-counterjet brightness ratio; (5): Doppler factor derived from SSC arguments.

morphology more typical among BL Lac objects. This radio galaxy is one-sided on arcsec scale as well, and it might be a BL Lac object swamped by the host galaxy.

When an arcsecond scale jet is present, its position angle is in good agreement with that on the milliarcsec scale. This is probably an indication that these objects are not so closely aligned to the line of sight as the higher luminosity BL Lac objects. A second epoch VLBA polarimetric observation at 6 cm has been recently approved. These new data will allow us to study possible superluminal motion and the polarization properties in these objects.

Acknowledgments. MB and DD acknowledge financial support from the EU under contract CHBGCT920212. DD acknowledges the IAU for partial financial support. The National Radio Astronomy Observatory is a facility of the National Science Foundation, operated under a cooperative agreement by Associated Universities, Inc.

References

Ghisellini, G., et al. 1993. *ApJ*, **407**, 65–82.
Marchã, M. J. M., et al. 1996. *MNRAS*, **281**, 425–448.

https://doi.org/10.1017/S025292110004505X Published online by Cambridge University Press