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.)

EVN Observations of BL Lac Objects with Distorted Structures

P. Charlot
Observatoire de Paris, CNRS/URA 1125, Paris, France

H. Sol & L. Vicente
Observatoire de Paris-Meudon, CNRS/UPR 176, Meudon, France

Abstract. We present results of observations of two BL Lac objects, 0735+178 and 0723–008, with the European VLBI Network (EVN) at 1.7 GHz. These objects have a distorted morphology, characterized by a large misalignment between their inner and outer radio structures. Our EVN observations at intermediate resolution reveal the presence of a highly curved jet in 0735+178, providing evidence for continuity of the radio emission from milliarcsecond to arcsecond scales. No indication of connecting radio structure is found in the case of 0723–008.

A significant fraction of active galactic nuclei show large misalignment between their milliarcsecond-scale and arcsecond-scale radio structures (e. g., Pearson & Readhead 1988). This property is common among BL Lac objects and has often been interpreted as due to strong projection effects. However, a statistical analysis shows that projection effects alone cannot account for such misalignments and that BL Lac objects are intrinsically more distorted than other types of active galactic nuclei (Appl, Sol, & Vicente 1996). To further investigate the connection between these misaligned inner and outer radio structures, we have initiated a program for mapping BL Lac objects at intermediate resolution by using the European VLBI Network (EVN). The first results, on 1219+285, were presented by Charlot, Sol, & Vicente (1997). Here, we report results of additional observations for two other distorted sources, 0735+178 and 0723–008.

VLBI observations of 0735+178 and 0723–008 were carried out with the EVN at 1.7 GHz on 4 May 1995. The two sources were observed alternatively during a total of 12 hours with the Mark III recording system. The data were correlated at the Max-Planck-Institut für Radioastronomie in Bonn (Germany) and analyzed in the standard way with the NRAO Astronomical Imaging Processing System (AIPS) and the Caltech VLBI imaging software DIFMAP. Contour plots of the 1.7 GHz maps of 0735+178 and 0723–008 are shown in Fig. 1.

The morphology of 0735+178 is characterized by a large misalignment of $\sim 135°$ between the sub-milliarcsecond-scale VLBI jet at PA $\sim 45°$ (Bååth, Zhang, & Chu 1991) and the outer VLA structure at PA $\sim 180°$ (O'Dea, Barvainis, & Challis 1988). In our 1.7 GHz EVN map (Fig. 1), the jet emerges from the core at PA $\sim 60°$, consistently with that observed at the milliarcsecond scale by Gabuzda et al. (1994). Then, at ~ 30 mas from the core, it swings to the south, ending at PA $\sim 120°$ with its extremity pointing toward the southern outer jet (PA $\sim$ 160–180°) observed with MERLIN and the VLA (Bååth & Zhang 1991, O'Dea et al. 1988). Combining the global VLBI, EVN, MERLIN and VLA maps provides strong evidence for continuity of the structure from sub-milliarcsecond to arcsecond scales, with the largest bending occurring at the EVN scale.

0723–008 has recently been observed at 2 and 8 GHz during a survey of radio reference frame sources with the VLBA (Fey & Charlot 1997). These maps show a jet emerging from the core at PA $\sim -30°$ and ending roughly 40 mas north at PA $\sim 0°$. Our 1.7 GHz EVN map in Fig. 1 is consistent with this morphology. In particular, there is no indication for connecting emission towards the arcsecond-scale outer jet detected in the opposite direction (PA $\sim 180°$) by Rusk (1988).

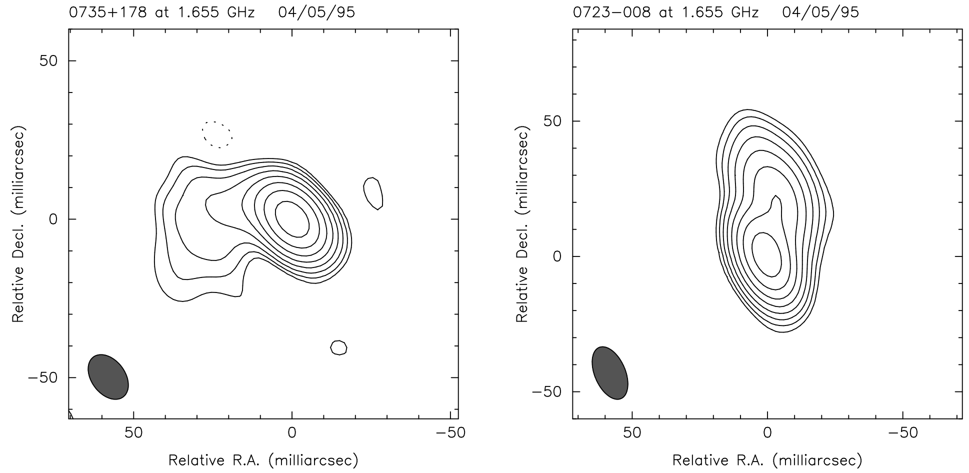

Figure 1. EVN maps of 0735+178 and 0723–008 at 1.7 GHz. Contours are drawn at ± 0.5, 1, 2, 4, 8, 16, 32, 64 % of the peak brightness of each map (1.81 Jy/beam for 0735+178 and 0.896 Jy/beam for 0723–008). The restoring beam is 16×11 mas^2 with PA = 37° for 0735+178 and 21×11 mas^2 with PA = 23° for 0723−008.

Still lower resolution observations, e. g., with MERLIN, are necessary to test further this hypothesis. An alternative scenario would be the existence of two actual opposite jets, one pointing northward observed at the inner scale, and the other pointing southward detected only at the outer scale.

Acknowledgments. The authors wish to acknowledge support for this research by the European Union under contract CHGECT920011.

References

Appl, S., Sol, H., & Vicente, L. 1996. *A&A*, **310**, 419–437.
Bååth, L. B., & Zhang, F. J. 1991. *A&A*, **243**, 328–332.
Bååth, L. B., Zhang, F. J., & Chu, H. S. 1991. *A&A*, **250**, 50–56.
Charlot, P., Sol, H., & Vicente, L. 1997. *Vistas in Astronomy*, **41**, 247–251.
Fey, A. L., & Charlot, P. 1997. *ApJS*, **111**, 95–142.
Gabuzda, D. C., et al. 1994. *ApJ*, **435**, 128–139.
O'Dea, C. P., Barvainis, R., & Challis, P. M. 1988. *AJ*, **96**, 435–454.
Pearson, T. J., & Readhead, A. C. S. 1988. *ApJ*, **328**, 114–142.
Rusk, R. 1988. *Ph.D Thesis*, University of Toronto.