Radio cores in blazars

By T. VENTURI[1], D. DALLACASA[2]
S. TORRI[2] AND F. MANTOVANI[1]

[1]Istituto di Radioastronomia, CNR, Via Gobetti 101, 40129 Bologna, Italy
[2]Astronomy Dept., University of Bologna, Via Ranzani 1, 40127 Bologna, Italy

We present results and first epoch parsec-scale images from a monitoring program on five γ–ray loud blazars selected on the basis of their total flux density variability. We observed 0048−097, 0235+164, 0954+658, 1510−089 and 1749+096 with the Very Long Baseline Array simultaneously at 8.4 GHz and 22 GHz. Comparison between our high quality images and previous results from the literature suggest that 0954+658 and 1510−089 are superluminal radio sources, with a Lorentz factor γ of the order of $\sim 2-3$.

1. Introduction

Flux density variability at high frequencies in compact extragalactic radio sources is usually intrinsic and contains important pieces of information on the size of the emitting region, the orientation of radio plasma to the line of sight and its intrinsic plasma speed. Furthermore, the delay of radio flares going from high to low radio frequencies, coupled with the knowledge of other parameters, such as, for example, the optical depth, is crucial to locate its position within the radio source. Variable radio sources are the best candidates for the detection of structural changes and proper motion, and to derive estimates on their intrinsic (local) Lorentz factor.

In this paper we present VLBA radio images and preliminary results for five γ–ray loud blazars, i.e. 0048−097, 0235+164, 0954+658, 1510−089 and 1749+096. These sources were selected from a sample of variable γ–ray loud blazars monitored at 8.4 GHz and 5 GHz with the VLBI antenna located in Medicina (Bologna, Italy) (Venturi et al. 1999). 1510−089 is a high polarisation quasar, while all other sources are BL-Lacs. They all showed strong variability since 1996 in the form of *(a)* major radio flares (0235+164); *(b)* periodic variations (0048−097); *(c)* complex light curves (the remaining sources).

2. Observations and Images

We observed these sources with the Very Long Baseline Array (VLBA) in snapshot, dual polarisation mode at 8.4 GHz and at 22 GHz in January 1999. The total integration time on source was ~ 2 hours at each frequency. The angular resolution of our observations is ≤ 1 mas at both frequencies and the rms in the final images ranges from 0.07 mJy/beam to 1.8 mJy/beam, depending on the frequency and peak in the image.

0048−097 and 0235+164 are unresolved at both frequencies and have a flat spectrum, i.e. $\alpha \sim 0.3$, in the range of our observations. The three remaining sources exhibit a core-jet morphology, suitable for the detection of proper motion.

3. Preliminary Results

The two sources shown in Figure 1 are the best candidates for the detection of superluminal motion. Second and third epoch monitoring with VLBA are in the observing queue and they will allow proper image comparison and analysis. At this stage we searched for images at comparable frequency and resolution from the literature (Gabuzda et al. 1994)

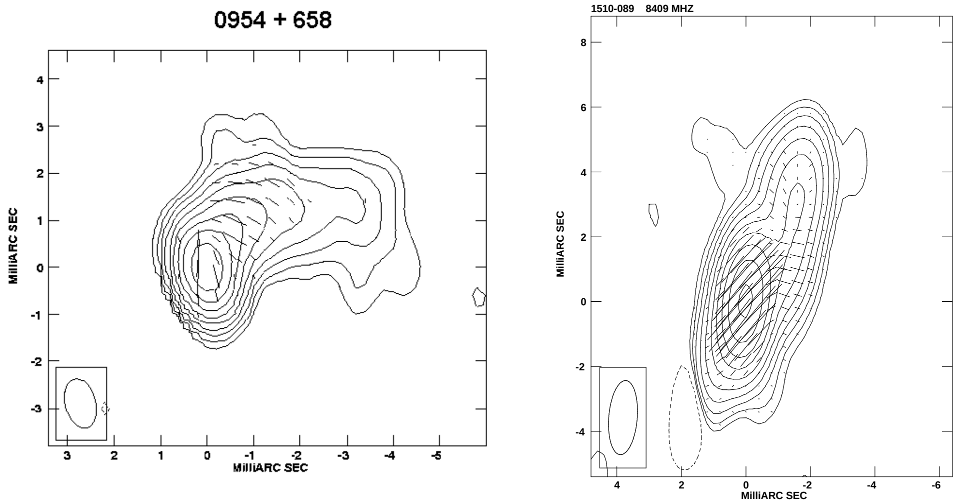

FIGURE 1. Left - 8.4 GHz image of 0954+658. The restoring beam is 1.07×0.65 mas, in p.a. 14°; the rms in the image is 0.07 mJy/b and the contours are 0.07 × −3, 3, 6, 12, 24, 96, 192, 375 mJy/b. The polarisation vectors (electric vector) is superposed. Right - 8.4 GHz image of 1510−089 with electric field vectors superposed. The restoring beam is 2.29×0.88 mas, in p.a. −4.6°; the rms in the image is 0.26 mJy/b and the contours are 0.26 × −3, 3, 6, 12, 24, 96, 192, 375 mJy/b.

and from the VLBA geodetic database (Fey et al. 1997). On the basis of our preliminary component identification we found that both sources have superluminal components. The innermost component along the jet of 0954+658 has a superluminal speed with $\beta_{app} \sim 1.3$, leading to a minimum value of the Lorentz factor $\gamma_{min} \sim 1.7$. In the case of 1510−089 we identified two knots along the jet, and we derived $\beta_{app} \sim 2.7$ and 1.6 moving outwards along the jet. The inferred Lorentz factors are ∼ 1.9 - 2.8.

The images shown in Figure 1 show the orientation of the magnetic field assuming that Faraday rotation is negligible. In 0954+658 the field is parallel to the jet direction, as expected for BL-Lac objects. The case of 1510−089 is more complicated. Here the magnetic field rotates along the jet and from the inner to the outer part. It is interesting to note that this source is also characterised by a high fractional polarisation, i.e. ∼ 7%.

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