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.)

Sub-mas Jets in Gamma-Active Blazars: Results from High Frequency VLBI

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Abstract. We report new results from high frequency (22-86 GHz) VLBI monitoring observations of selected blazars. These Gamma-bright sources show pronounced correlated flux density variations over the full electromagnetic spectrum (radio to Gamma-ray bands). From our high-angular resolution images (0.1-0.2 mas), we find increasing evidence for a tight correlation between this activity and the production of new jet components. Here we present results for the 3 sources PKS 0528+134, 3C 273, & 0836+710.

0528+134: In 1991 and 1993 two jet components (N1 & N2) were ejected near times of prominent Gamma-flares (cf. Krichbaum et al. 1995). The 90 GHz light curve (Fig. 1a) shows quasi-periodic variations. The flare of 1993.5 probably is related with a corresponding Gamma-flare. New jet components (N2-N5) seem to appear at times of local minima in the light curve. Close to the core the components move along a bent trajectory (Fig. 1b; for motion further out see Britzen et al., these Proceedings, p. 43). This behavior suggests a geometrical interpretation, eg. within the lighthouse model (Camenzind & Krockenberger 1992). In contrast to this, the observed steepening of the radio spectrum ($\alpha_{22/90\mathrm{GHz}}$) between 1993 and 1996 and the lower amplitudes of the two recent Gamma-flares (peaking approx. 1995.3 & 1996.5) indicate that the Gamma-activity cannot be explained by geometrical effects alone.

3C 273: Two 86 GHz images (Fig. 2) show pronounced jet expansion between 1994–1995. Combining these images with data obtained at 22 & 43 GHz results in a tentative component identification, in which the (new) jet components C12, C13, & C14 were ejected in 1992.5, 1993.4, & 1994.3, respectively. Within the present uncertainties ($\Delta t = \pm 0.6$ yrs), it is therefore likely that C13 is related to the prominent Gamma-flare observed in 1993.9 (von Montigny et al. 1997).

0836+710: In Fig. 3a (left) we show the motion of the innermost jet component B3, which was ejected after a correlated Gamma-, X-ray, optical flare peaking early 1992 (Otterbein et al., in prep.). Fig. 3b (right) shows the evolution of the spectral turnover in the total spectrum of 0836+71 after subtracting the quiescent spectrum. The numbers indicate the time sequence (1992–1993). The observed adiabatic expansion ($S_m \propto \nu_m^{(0.4\pm0.2)}$) indicates that the outburst of 1992 has generated an electron spectrum, harder than typical for this source (cf. Qian et al., these Proceedings, p. 93).

References

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Krichbaum, T., et al. 1995. *Proc. Natl. Acad. Sci. USA*, **92**, 11377–11380.
von Montigny, C., et al. 1997. *ApJ*, **483**, 161–177.

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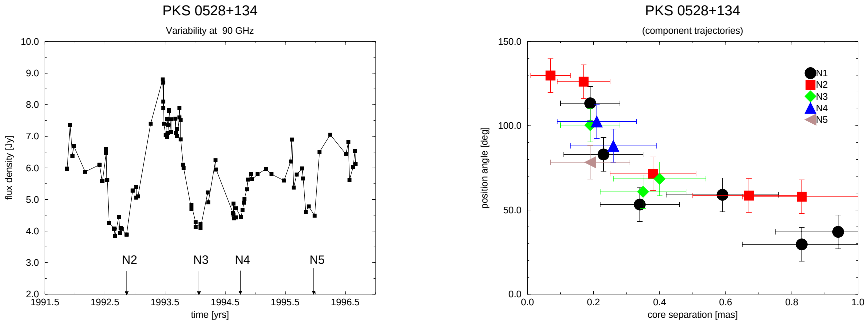

Figure 1. Lightcurve of 0528+134 at 90 GHz (cf. Ungerechts et al., these proceedings, p. 149). The arrows mark extrapolated ejection times of the new VLBI components. On the right the relative positions (r,pa) of the inner jet components are plotted.

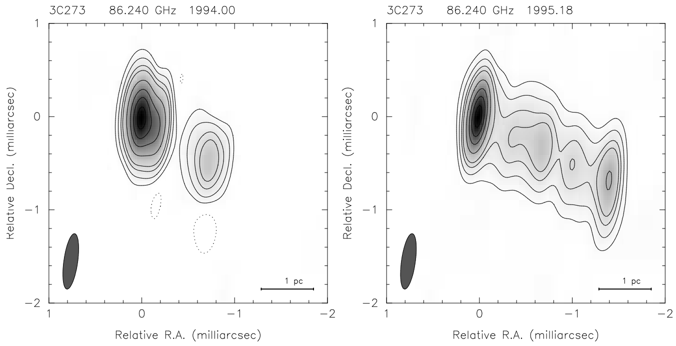

Figure 2. Expansion of the jet of 3C 273 at 86 GHz. Both images are restored with a beam of size 0.60 × 0.15 mas, $pa = -8°$. Contour levels are at -2, 2, 5, 10, 15, 30, 50, 70, 90 % of the brightness peak of 1.96 Jy/beam (left), respectively 4.84 Jy/beam (right).

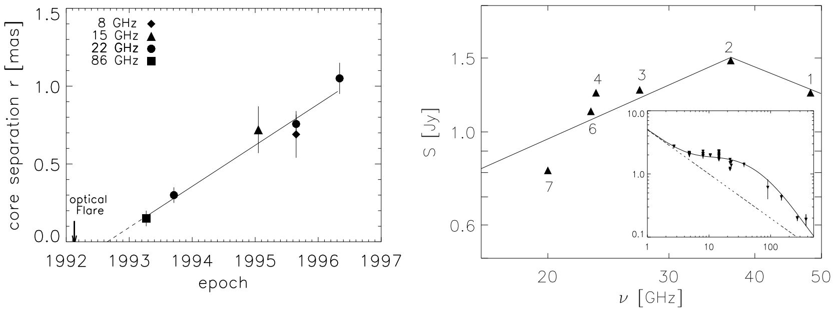

Figure 3. Motion of a new jet component B3, ejected after a correlated Gamma-/X-ray/optical outburst observed in the S5 blazar 0836+710 in 1992.13. The evolution of the spectral turnover is shown on the right, the insert shows a simultaneous spectrum for 1992.35. A data point of 1996.3 is from A. Marscher (priv. comm.)