Multi-wavelength analysis of the peculiar Compact Steep-spectrum Source 3C 99

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Multi-wavelength data, which included interferometric polarization observations with MERLIN, EVN and VLBA, of the Compact Steep-Spectrum source 3C 99, were analysed. We made use of the continuous streaming model of Scheuer-Baldwin. We suggest that the source is a young radio source with a structure which is strongly affected by the asymmetric distribution of the interstellar medium.

1. The nature of 3C 99

1.1. *The new observations*

As a follow-up observing project of the results presented in Mantovani et al. (1990, 1997), the source 3C 99 was observed in dual polarization with MERLIN at 5 GHz, with the EVN at 5 GHz and more recently with the VLBA in dual polarization at 1.6 GHz and 5 GHz. As an example of the source structure on the milli-arcsecond scale the EVN image is presented in Fig. 1. The results of observations done at various bands of the electromagnetic spectrum taken from the literature, were also considered in the data analysis.

1.2. *Results from the data analysis*

The first aim of the analysis of the 3C 99 data, is to understand its nature among the AGNs thanks to a multi-wavelength study of its physical characteristics. 3C99 is a **Compact Steep-Spectrum Source** according to its radio properties. From the optical point of view, it has been classified as an **N-galaxy** (Spinrad et al. 1985), with a spectrum that presents only narrow lines (Hes et al. 1996). 3C 99 is extremely bright in the IR ($L_{60\mu m}$) = $10^{38.4}$ Watt/Hz; Hes et al. 1996), but as much faint in the X-ray band ($L_X < 10^{43}$ erg/sec from ROSAT data; Crawford and Fabian 1996). So we conclude that the classification of this source among the AGNs is uncertain: its high IR luminosity classifies it as a strong quasar, but this hypothesis seems to be excluded by its faint X-ray luminosity and by the absence of broad lines.

In the radio band, 3C 99 shows a triple asymmetric structure on the arcsecond scale; the central component, made up of two different parts which don't show relative motion, contains the radio nucleus of the source, which, however, was not clearly detected even with our VLBA observations. The asymmetry cannot be explained only with relativistic effects, because the nearest outer component to the central source is also the brightest one. We have tried to find a possible explanation to the radio asymmetry, introducing the hypothesis that this peculiar structure of 3C 99 is due to the combination of relativistic effects and of a strong asymmetry of the external medium. In particular we have made use of the **Scheuer-Baldwin model**, one of the so called "continuous streaming models", assuming that the external gas density decreases more slowly in the North-East direction, the side of the most bright and short jet.

We have concluded that 3C 99 jet major axis is at $30° - 40°$ about the line of sight,

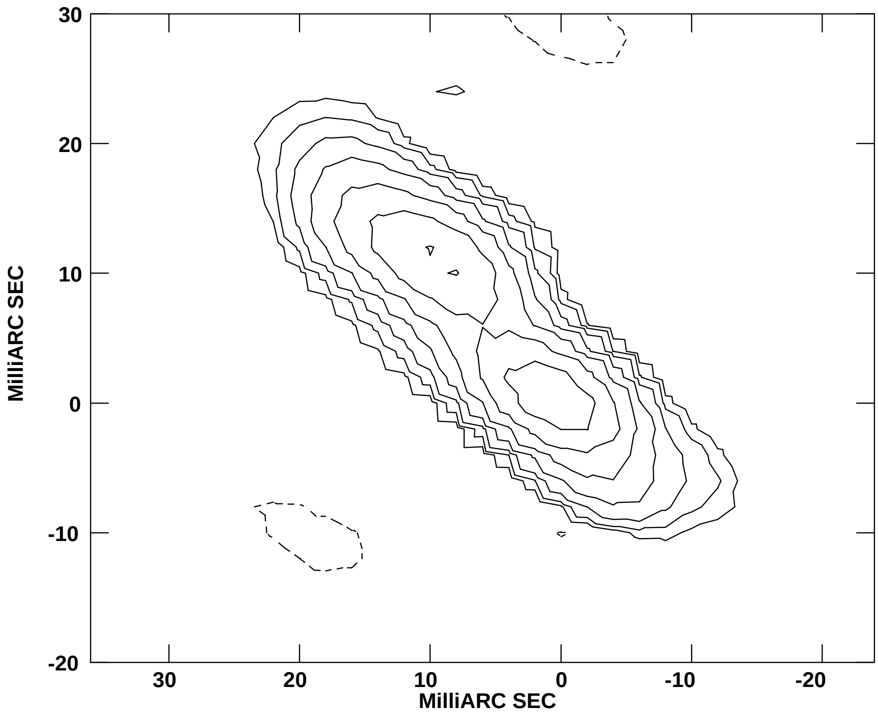

FIGURE 1. The EVN (epoch 1990.87) image of the central part of 3C 99 at 5 GHz. Contours are –0.4, 0.4, 0.6, 1, 2, 4, 6, 10, 15, 20, 30, 40 mJy/beam. The peak flux density is 43.3 mJy. The beam is 7.1×4.4 mas^2 at PA 65°.

with an almost relativistic jet ($\beta_1\sim 0.6$) and a counter jet with $\beta_2\sim 0.04$. The hypothesis that the gas density is proportional to r^{-2} (where r is the linear distance from the central region) on the side of the longest and less bright jet, and that it doesn't depend on r on the opposite side is compatible with the data and with the Scheuer-Baldwin model.

We have also estimated the age of 3C 99 with three different methods: from a spectroscopical and dynamical point of view and considering jets energetic. 3C 99 seems to be a young source, with an age of $4 - 7.5{\times}10^5$ years.

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