A rotating helix in S5 1803+784

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Abstract

The blazar S5 1803+784 has been observed with VLBI at ν=1.6, 2.3, 5, 15 and 43 GHz (Marcaide et al. 1985, Guirado et al. 2001, Gurvits et al., Perez-Torres et al. 2000, Ros et al. 2000, 2001 and Kellermann et al. 1998) during the years 1993 - 2002. We made Gaussian modelfits for these datasets and found that the jet structure could be described with a number of stationary jet components. The most suitable model for S5 1803+784 capable of explaining these observations is a ***rotating helix***.

Introduction

The BL Lac object S5 1803+784, a compact flat-spectrum radio source with z = 0.68 (*Lawrence et al. 1996*) is a member of the complete S5 sample of 13 flat-spectrum radio sources. It has been observed for more than 30 years since the 1970's at different frequencies and with different resolution, what gives a unique possibility to investigate a long-term evolution of it's flux and structure.

On mas-scales the source shows a pronounced jet with prominent jet components located at relative core separations of 1.4, 5 and 12 mas.

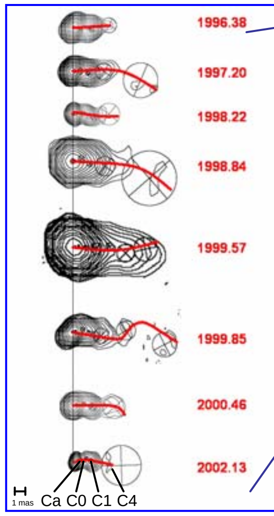

Fig. 1. Modelfit results for S5 1803+784 for 15 GHz and for the time period 1996.38-2002.13

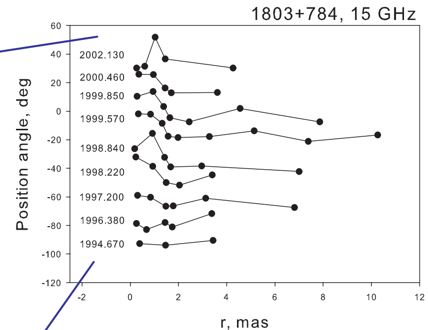

Fig. 2. Changes of position angle of all the jet components of S5 1803+784. Each curve is shifted to 15 deg in p.a.

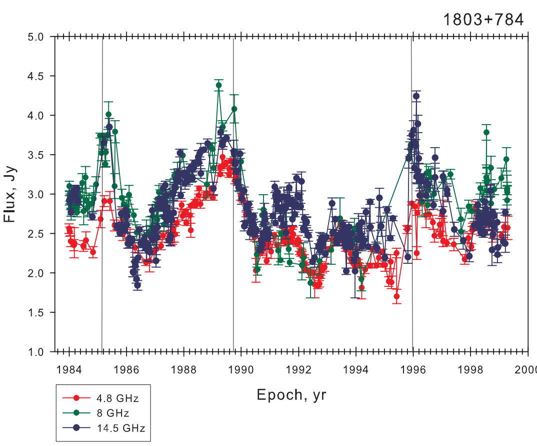

Fig. 4. 1803+784. Total flux density light curves for 4.8, 8 and 14.5 GHz. Data from the Michigan monitoring campaign

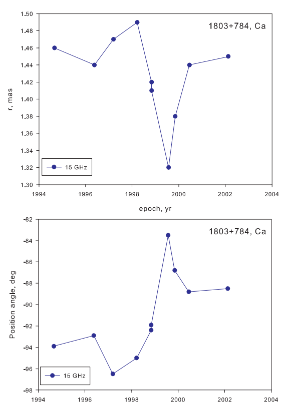

Fig. 3. Evolution of the position angle and core separation with time for the component Ca

Results

In fig. 1 we show the results of modelfitting for 15 GHz. In addition to a "stationary" component Ca of 0.3 mas distance from the core we find components at ~0.8 (C0), ~2 (C1) and ~3-4 mas (C4). The jet components remain at similar core separation between the epochs 1993.88 and 2002.13, while position angle of the components changes with time.

Fig. 2 shows the position angle of all the jet components at the observing epochs, indicating a gradual change in the shape of the jet. The cycle begins at ~1994 and finishes at around 2002. This 8-year cycle also seen in the plots of position angle and core separation versus time for the "stationary" component Ca (Fig.3).

Fig. 4 shows the evolution of the flux densities of S5 1803+784 between 1984 and 2000 at 4.8, 8 and 14.5 GHz data from the Michigan monitoring campaign (*Aller et al., 1985*). A comparison of figures 3 and 4 indicates that the maximal and minimal values of core separation and position angle in Ca coincide with the ejection of the two flares in 1996 and 2000. A four-year periodicity for the flux density of S5 1803+784 was claimed by *Kelly at al. 2003* in total flux density light curves by means of cross-wavelet transform. Future observations will show if a 8 year cycle with two ejections per cycle are a common phenomenon for this source.

The most simple model explaining this behaviour is a **twisted rotating helix** with the period ~8 years.

Observations

Besides over observations at 1.6 GHz we used data from the literature at ν=1.6, 2.3, 5, 15 and 43 GHz (*Marcaide et al. 1985, Guirado et al. 2001, Gurvits et al., Perez-Torres et al. 2000, Ros et al. 2000, 2001 and Kellermann et al. 1998*). We perfomed modelfits using circular gaussian components for all observations using the *DIFMAP* package. Circular components have been chosen in order to simplify the comparison, to decrease the number of free parameters and to avoid extremely elliptical components. We fitted every data set starting from a point-like model in order to find the optimum set of parameters.

Summary

- Based on VLBI data we find evidence for 5 stationary jet components in the mas-jet of S5 1803+784, whose position angle changes with time.
- The timescale of the changes in position angle is ~8 years whereas the period of the total flux density changes is ~4 years.
- The possible explanation of this behaviour is a **twisted rotating helix**.

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