

## The Double–Double Radio Galaxy 3C293

S. A. Joshi<sup>1,\*</sup>, S. Nandi<sup>2</sup>, D. J. Saikia<sup>1</sup>, C. H. Ishwara-Chandra<sup>1</sup>  
& C. Konar<sup>3</sup>

<sup>1</sup>*National Centre for Radio Astrophysics, Pune University Campus, Pune 411 007, India.*

<sup>2</sup>*Aryabhata Research Institute of Observational Sciences, Manora Peak,  
Nainital 263 129, India.*

<sup>3</sup>*Institute of Astronomy and Astrophysics, AS, Taipei 10617, Taiwan.*

\**e-mail: sjoshi@ncra.tifr.res.in*

**Abstract.** We present the results of radio continuum observations at frequencies ranging from  $\sim 150$ – $5000$  MHz of the misaligned double–double radio galaxy (DDRG) 3C293 (J1352+3126) using the GMRT and the VLA, and estimate the time-scale of interruption of jet activity to be less than  $\sim 0.1$  Myr.

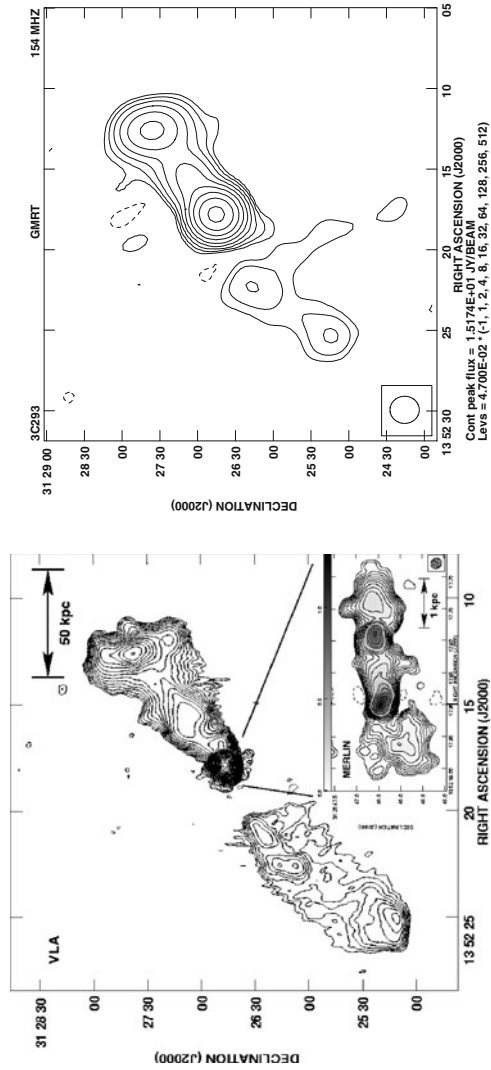
*Key words.* Galaxies: active—galaxies: nuclei—galaxies: individual: 3C293—radio continuum: galaxies.

### 1. Introduction

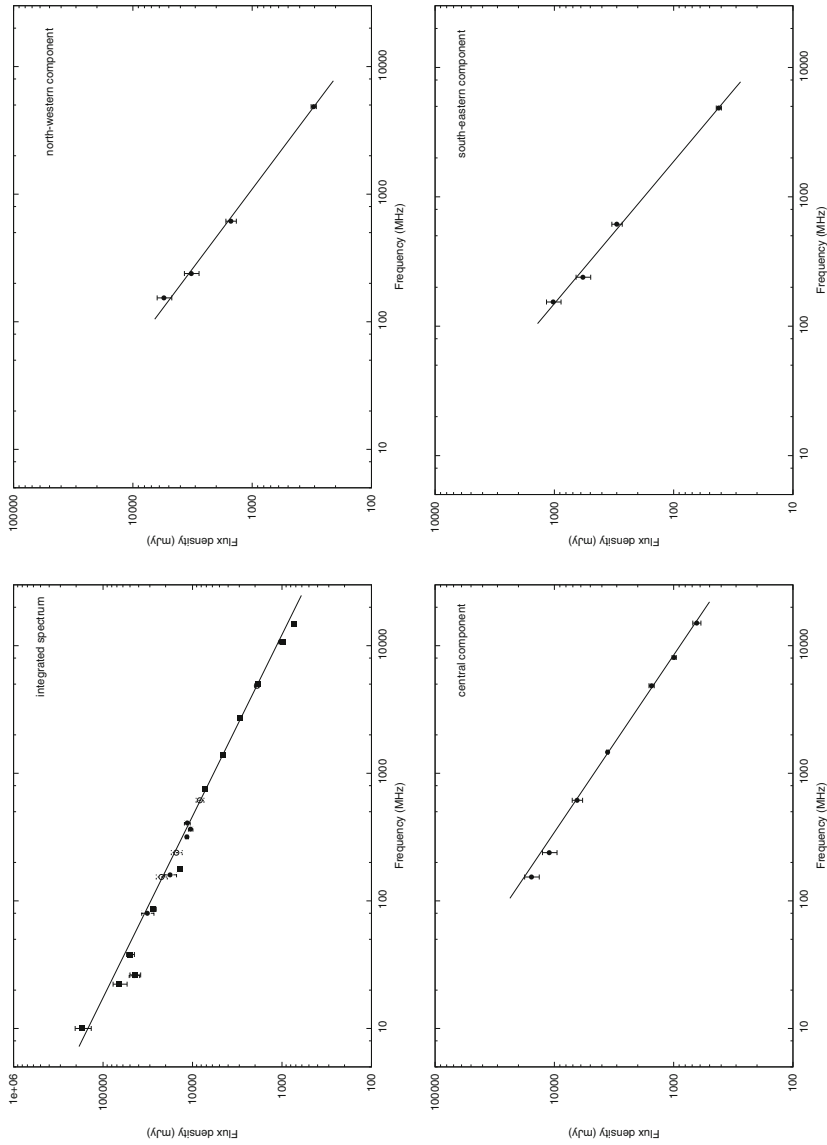
Radio galaxies are believed to be powered by active galactic nuclei (AGN). One of the interesting issues for all AGN is whether the active phases are episodic, and if so, the duration of these AGN phases. In radio galaxies and quasars, structural and spectral information can help distinguish different cycles of activity. The most striking examples are the DDRGs (see Saikia & Jamrozy 2009 for a review). Here we present the results of GMRT and VLA observations of the highly misaligned DDRG 3C293 (Fig. 1), which is associated with the peculiar optical galaxy VV5-33-12 (red-shift = 0.0450), which is likely to be a merger remnant.

### 2. Observational results and discussions

Combining the results of our observations (Joshi *et al.* 2011) with those from literature, we have determined the spectra of the central component and outer lobes up to frequencies of  $\sim 16$  and  $\sim 5$  GHz respectively. The spectra are consistent with power-laws. The integrated spectral index ( $S \propto \nu^{-\alpha}$ ) is  $0.71 \pm 0.01$ , while the spectral indices of the central, outer north-western and outer south-eastern components are  $0.72 \pm 0.02$ ,  $0.80 \pm 0.02$  and  $0.91 \pm 0.03$  respectively (Fig. 2). The magnetic field strengths are  $16.92 \pm 1.67$ ,  $1.12 \pm 0.11$  and  $0.88 \pm 0.09$  nT for these three



**Figure 1.** Left: VLA and MERLIN images showing the outer and inner lobes (Beswick et al. 2004). Right: GMRT image at 154 MHz (Joshi et al. 2011).



**Figure 2.** The integrated spectrum of 3C293 (upper left), and the spectra of the outer north-western (upper right), central (lower left) and the outer south-eastern (lower right) components.

components, yielding spectral ages of  $\lesssim 0.18$ , 16.9 and 23.0 Myr respectively. The prominent hot-spot in the north-western lobe as well as the age of the inner double structure suggests that the interruption of jet activity is  $\lesssim 0.1$  Myr.

### References

- Beswick R.J., Peck A.B., Taylor G.B., Giovannini G. 2004, *Mon. Not. R. Astron. Soc.*, **352**, 49.  
Joshi S.A., Nandi S., Saikia D.J., Ishwara-Chandra C.H., Konar C. 2011, *Mon. Not. R. Astron. Soc.*, in Press, (arXiv1102.3675J).  
Saikia D.J., Jamrozy M. 2009, *Bull. Astron. Soc. India*, **37**, 63.