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The life cycles of radio galaxies

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Abstract. The morphology and spectra of extended radio emission from galaxies contain a record of their central activity and provide a unique opportunity to study the time scales of active galactic nuclei duty cycles. Deep low-frequency radio studies have proved to be useful in probing episodic or recurrent jet activity in radio galaxies.

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The classical powerful radio galaxies (RGs) have been known from about six decades. They are characterized by extended radio lobes with leading compact, bright hot spots, and often a compact central radio core. The lobes are powered by two relativistic jets emerging from a super-massive black hole at the centre of a parent galaxy. However, a small fraction of RGs show structures that can by accounted for as a product of repeated activity of the central active galactic nucleus (AGN). A striking example of episodic jet activity is when a new pair of radio lobes can be seen closer to the nucleus before the 'old' and more distant radio lobes have faded. This category of objects are called double-double RGs (DDRGs; Schoenmakers et al. 2000). Approximately sixty of such double-double radio sources are known in the literature (for a review, see Saikia & Jamrozy 2009; Nandi & Saikia 2012) and an example is provided in Fig.**??**

Moreover, diffuse relic radio emission due to some earlier cycle of activity can also be observed around young radio sources that are not characterized by a 'classical double' morphology. The recent observations suggest that around at least some RGs (e.g. 3C 388, Cen A and 4C +29.30), extended diffuse cocoons occur.

One should realize that from a technical point of view, it could be hard to detect diffuse large-scale radio emission from an old period of activity in the vicinity of young structures, which are usually much brighter than the preceding ones. DDRGs

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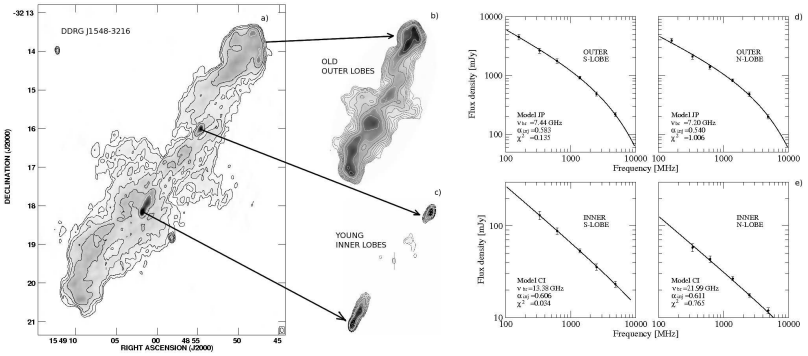

Figure 1. DDRG J1548-3216 (PKS 1545-321). a) 619-MHz GMRT image of the entire source. b) and c) Radio images of the outer lobes cleaned from the inner double structure and of the inner double structure, respectively. d) and e) Spectra of the outer lobes, fitted with the Jaffe-Perola model of synchrotron losses, and of the inner lobes, fitted with the continuous injection model, respectively. The age estimate of the outer and the inner lobes is about 70 and 10 Myr, respectively (for details, see Machalski et al. 2010).

possess steep radio-spectra and low surface brightness, therefore, low-frequency radio telescopes, like the Giant Metrewave Radio Telescope (GMRT) and the LOw Frequency ARray, are excellent tools for investigating large angular-size diffuse cocoons surrounding the current active objects.

In order to understand the cycles of AGN and the phases of jet interruption, it is crucial to determine ages of the charged particles in different places within the RG. The age can be determined using the classical synchrotron theory. Unfortunately, only a few large angular-size DDRGs have been fully analysed to date (Konar et al. 2013). The still limited number of well-studied DDRGs is a reason that there is a gap in the picture of RGs evolution and the phenomenon of recurrent jet activity remains an open problem.

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References

Machalski, J., Jamrozy, M., Konar, C., 2010, A&A, 510, 84
Konar, C., Hardcastle, M. J., Jamrozy, M., Croston, J. H., 2013, MNRAS, 430, 2137
Nandi, S., Saikia D. J., 2012, BASI, 40, 121
Saikia D. J., Jamrozy M., 2009, BASI, 37, 63

Schoenmakers, A. P., de Bruyn, A. G., Röttgering, H. J. A., van der Laan, H., Kaiser, C. R., 2000, MNRAS, 315, 371