Extragalactic Astronomy II Lecture 7

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Main morphological features of a radio galaxy



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- Jets: occur on pc and kpc scales. In quasars and more luminous radio galaxies they are one sided. Two sided in less luminous galaxies.

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• Hotspots: not always present, sometimes multiple hotspots seen, intermediate steep spectrum, less steep than lobes.

FR 1 and FR 2 morphologies - Fanaroff & Riley (1974)





What differences do you see?

FR1: weaker lobes, less well collimated jets, **lower radio luminosity**, associated with cD galaxies in clusters, often show bent-tail structures, higher optical luminosity. Two sided jets usually seen. steep spectra at outer edge of lobes. Usually no hotspots.

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FR2: strong emission from lobes (hotspots often seen), collimated jets, **high radio luminosity**, hosted by massive ellipticals, but somewhat less optically luminous than the FR1 hosts. Jets often one sided. Outnumber FR1s by a huge factor in current generation surveys.

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FR1 or FR2?



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FR1 or FR2?



Spectral index map of a FR1 galaxy



Spectral-index distribution between 240 MHz (GMRT) and 1.55 GHz. Kolokythas et al. (2015)

Determining age from Spectral index



Due to many other commitments, I will be unable to take my lecture on 19 May. We will have the next lecture on Friday, 21 May at the usual time.

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Radio galaxy morphologies can be very diverse





Taylor et al.

Wide-angle tail galaxies



Narrow angle tail radio galaxy 3C129



What may be responsible for the bending of the jets?

Giant radio galaxies - largest individual objects



Dabhade et al. (2020); Machalski et al. (2008);Ishwara-Chandra &

High z radio galaxies - X-ray emission from lobes



Why is there X-ray emission from the lobes?

Tamhane et al. (2015) $_{\circ}$

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