

# ***Radio properties of steep spectrum and flat spectrum Seyfert nuclei***

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# *Seyfert nuclei*

- Low radio power  $L_{1.4 \text{ GHz}} < 10^{20-23} \text{ W/Hz}$ ;
- Radio structures with hints on jets;
- Misalignment between pc- and kpc-scale jets;
- In steep spectrum nuclei the pc-scale emission is much fainter than the kpc-scale emission, even in case the nucleus is unresolved



steep-spectrum low-surface brightness component

- In flat spectrum nuclei all the emission is concentrated in the centre

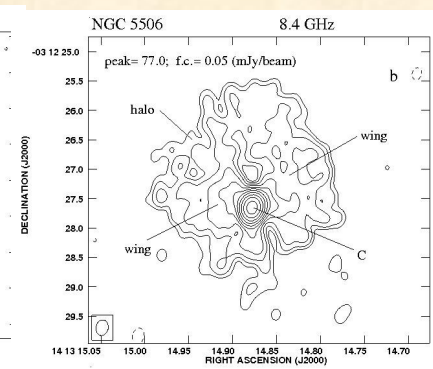
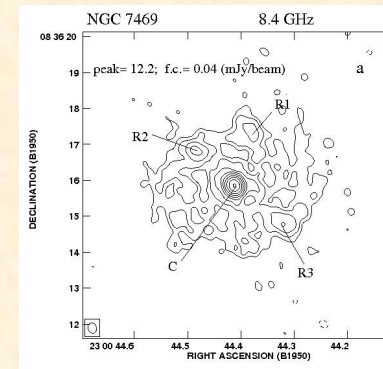
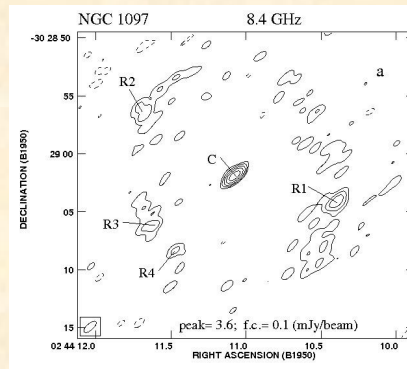


lack of extended features like jets

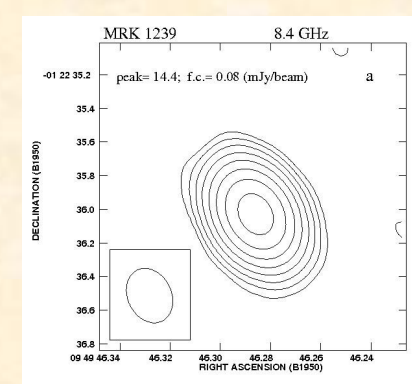
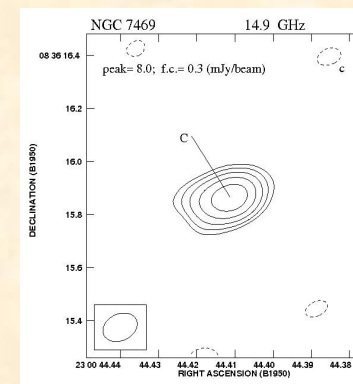
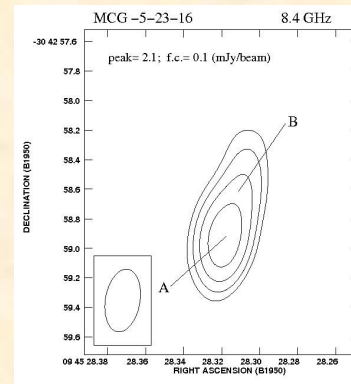
# Arcsecond-scale radio structure

Archival VLA data at 1.4, 4.8, 8.4 and 15.3 GHz of 7 of the nearest and brightest Seyfert nuclei from the Southern Hemisphere (Reunanen et al. 2010).

kpc-scale diffuse emission from either star-forming region or non-thermal origin



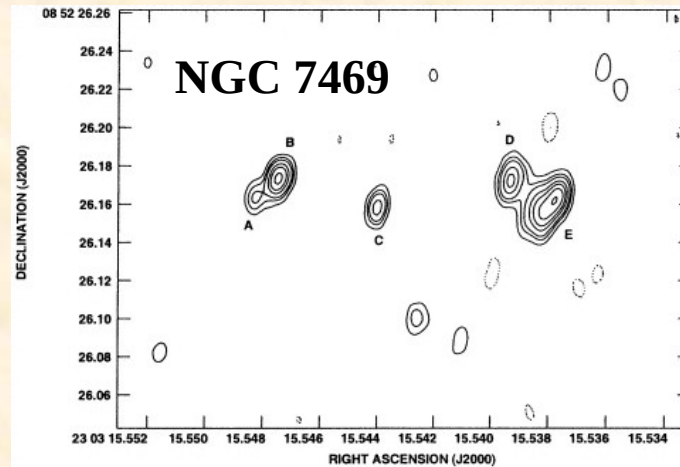
Seyfert nuclei unresolved or with hints of core-jet structures



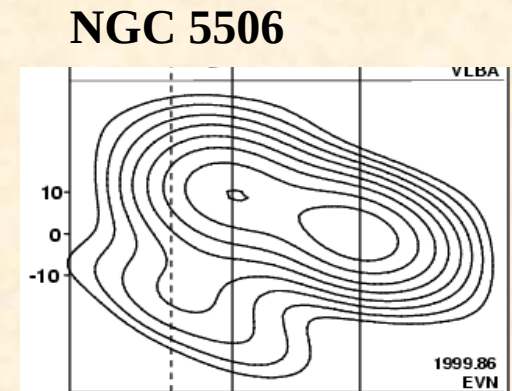
# Parsec-scale radio structure

Archival VLBA data at 1.6 GHz of Mkn 1239 and NGC 3783, while NGC 5506 and NGC 7469 have available information from the literature.

NGC 7469, NGC 5506 have a core-jet-like structure

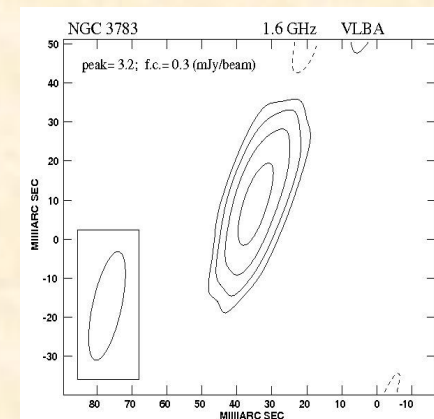
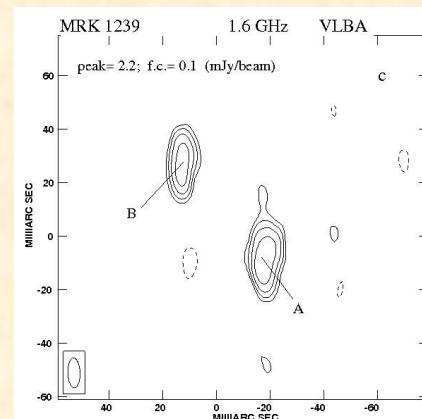


Lonsdale et al. (2003)



Middelberg et al. (2004)

Mkn 1239 is resolved in 2 components, while NGC 3783 is unresolved with  $LS < 4$  pc (Oriente & Prieto 2010)



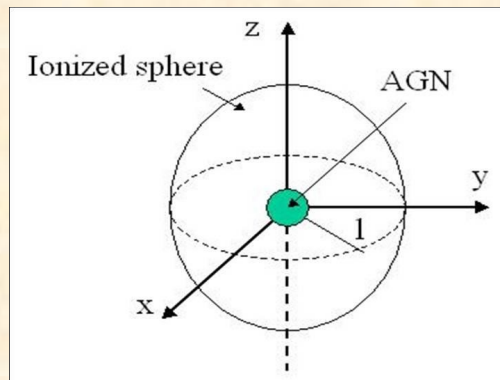
# The missing flux density

In this sample of steep-spectrum Seyfert nuclei only 20% - 50% of the flux density from the unresolved nucleus imaged with arcsecond resolution is recovered on VLBI images.

## Thermal free-free origin?

$$n_e^2 = 1.84 \times 10^{41} \left( \frac{T}{10^4 \text{K}} \right)^{1/2} D_L^2 S(\nu) V^{-1} g_{ff}^{-1}$$

$$n_e \sim 10^3 - 10^4 \text{ cm}^{-3}$$



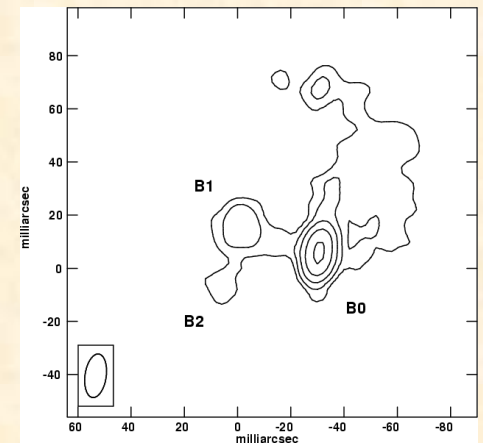
The gas should be too dense, no AGN emission would be visible.

## Non-thermal synchrotron origin?

Spectral index distribution in kpc- and pc-scale images suggests the presence of a steep-spectrum low-surface brightness component. In NGC 5506:

- $\alpha_{\text{VLA}} \sim 0.8$
- $\alpha_{\text{VLBA}} \sim -0.1$

Extended emission of non-thermal AGN-related origin, like jets, undetected for observational limitation.



Middelberg et al. (2004)

# ***Conclusions***

- **The radio structure on kpc scales of Seyfert nuclei is usually unresolved, with the presence of extended emission from star-forming regions;**
- **On parsec scales the radio structure is resolved with a core-jet-like morphology;**
- **In VLBI images of steep-spectrum nuclei only 20%-50% of the kpc-scale emission can be recovered. On the contrary, in flat-spectrum nuclei all the flux is concentrated in the centre.**
- **The missing flux likely comes from a distorted/disrupted jet, that probably does not form in flat-spectrum nuclei.**