Looking for prematurely 'dying' young compact radio sources

Magdalena Kunert-Bajraszewska

Andrzej Marecki, Ralph E. Spencer

A division of radio sources according to their linear sizes

•linear size > **15-20 kpc** – Large Symmetric Objects (**LSO**), this group consists of **FRI** and **FRII** sources;

•linear size ≤ **10-15 kpc** – Compact Steep Spectrum (**CSS**) sources; CSSs with symmetric structures – Medium-sized Symmetric Objects (**MSO**);

•linear size < **1 kpc** – GHz-Peaked Spectrum (**GPS**) sources; GPSs with symmetric structure – Compact Symmetric Objects (**CSO**).

An evolutionary sequence:

GPS/CSO → CSS/MSO → LSO

Selection of a new sample of CSS sources

Scientific goal:

Analysis of morphology of new candidates for weak CSS sources.

Sample selection:

- 60 CSS sources from VLA FIRST survey > 150 mJy at 5 GHz ;
- all sources possess steep spectra and they appear as single which means more compact than FIRST beam – 5.4".

All the sources were initially observed with MERLIN at 5 GHz.

Results:

- relatively large sources with angular sizes in the range 1"- 5"; reobserved with MERLIN at 1.6 GHz (Kunert et al. 2002);
- compact sources with angular sizes in the range 0.2"- 1"; they have been observed with EVN at 5 GHz and with VLBA at 1.6 GHz (Marecki et al. 2003);
- compact objects with angular sizes < 0.2", unresolved with MERLIN but still having very steep spectra ($\alpha <= -0.7$), we labelled them *'ultra-compact steep spectrum objects'* (6 sources).

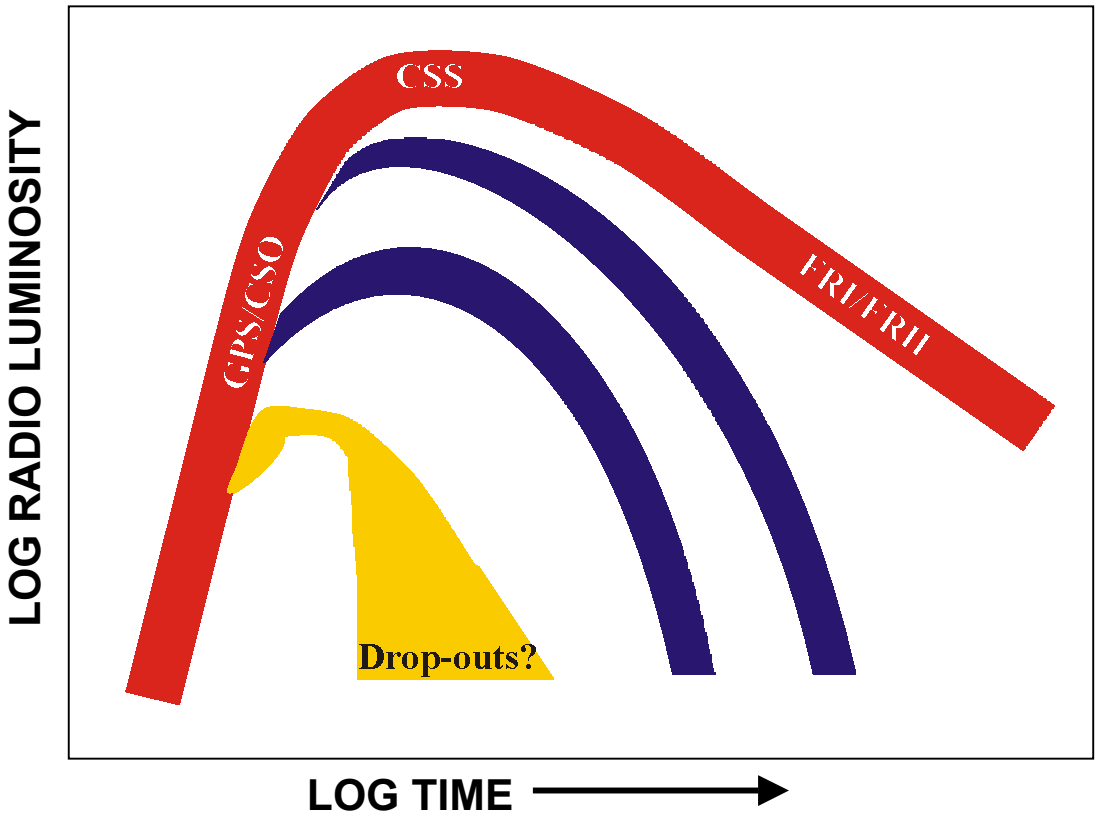
Observations of selected group of ultra compact objects

1. VLBA+Effelsberg observations at 1.6 GHz.
2. VLBA observations at 5, 8.4 and 15 GHz.

Source name	RA h m s	DEC ° ' "	ID	z	LAS mas	LLS pc h^{-1}
0809+404	08 12 53.124	40 18 59.878	G	0.551	14.87	76.27
0949+287	09 52 06.091	28 28 32.406	–	–	308.79	–
1159+395	12 01 49.965	39 19 11.023	G	2.370	41.08	224.06
1315+396	13 17 18.635	39 25 28.141	G	1.560	30.00	177.42
1502+291	15 04 26.696	28 54 30.548	–	–	41.60	–
1616+366	16 18 23.581	36 32 01.811	–	–	55.00	–

The luminosity evolution proposed for extragalactic radio sources

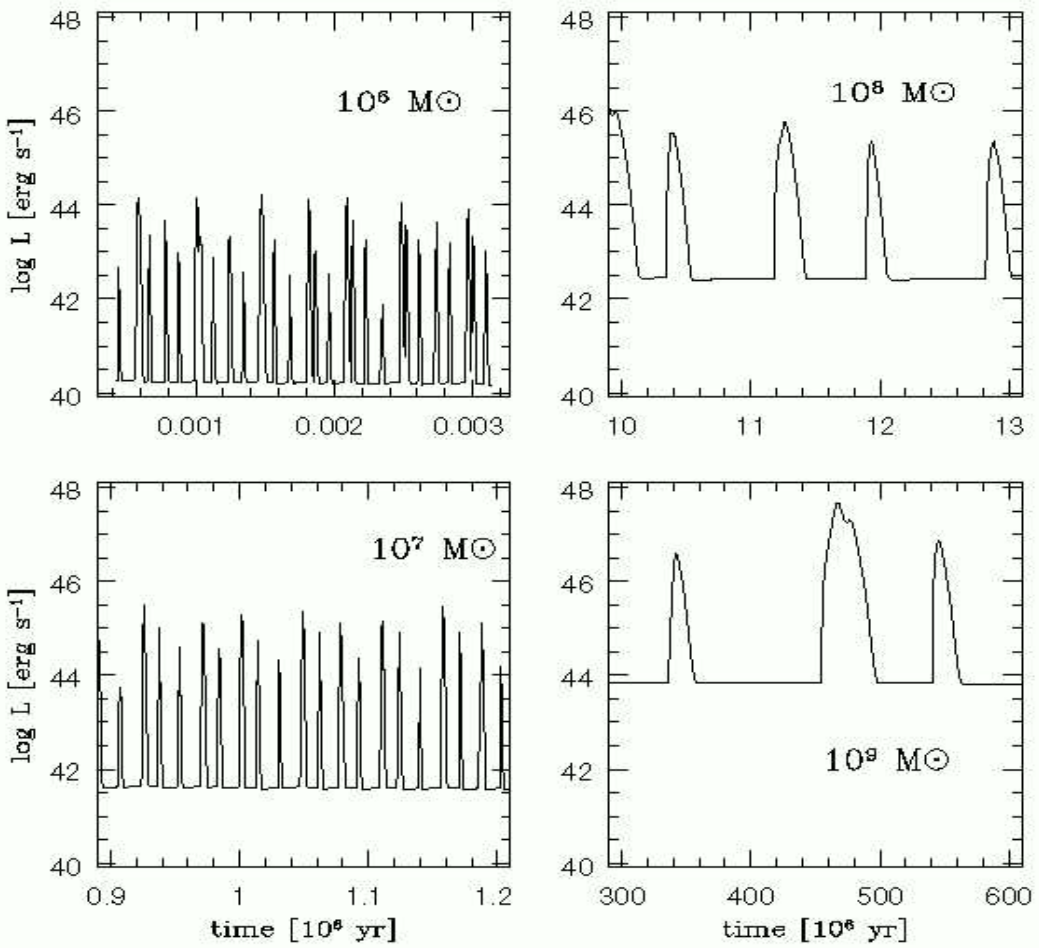
Snellen et al. 1999



We claim that the evolutionary track proposed by Snellen et al. 1999 is not the only one possible!

The theory of Super Massive Black Holes (SMBH) accretion disc instabilities

Hatziminaoglou et al. 2001



According to this theory the mass of the SMBH determines both the length of the activity phase of the AGN and the timescale of the activity re-occurrence.

Let's summarize our idea.

Full evolutionary track looks as follows:

ignition of activity → GPS/CSO → CSS/MSO → FRI/FRII → decline of activity → quiescence

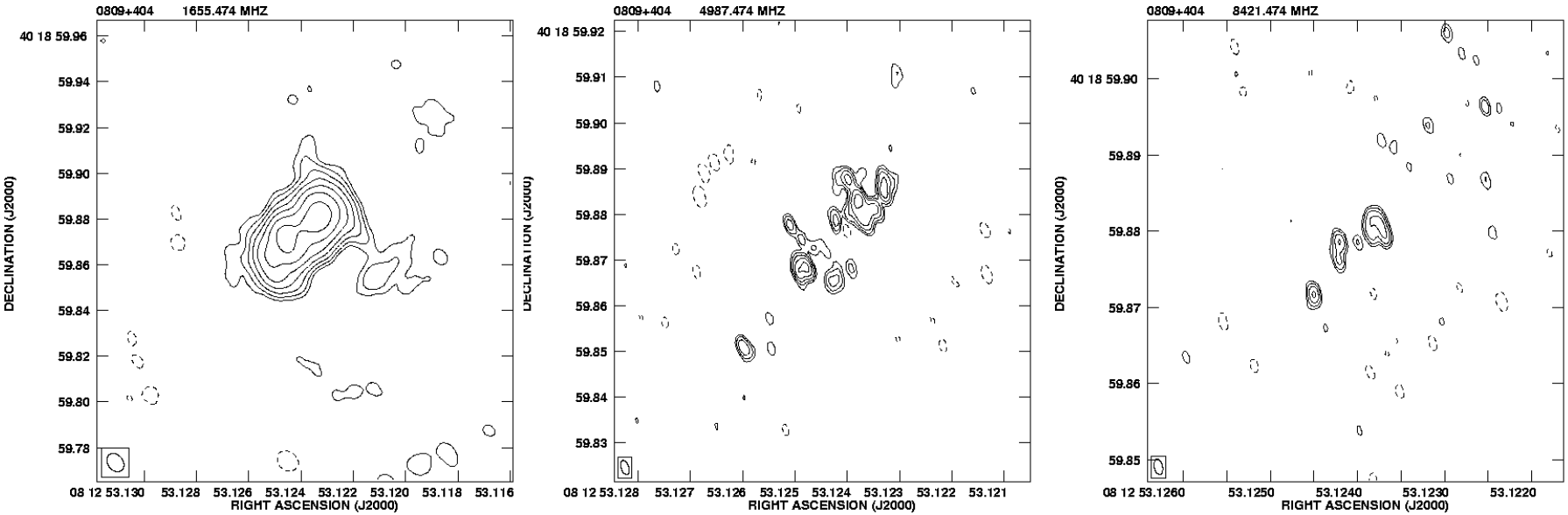
But if the energy supply cuts off earlier, the evolutionary track will shrink to:

ignition of activity → GPS/CSO → CSS/MSO → decline of activity → quiescence

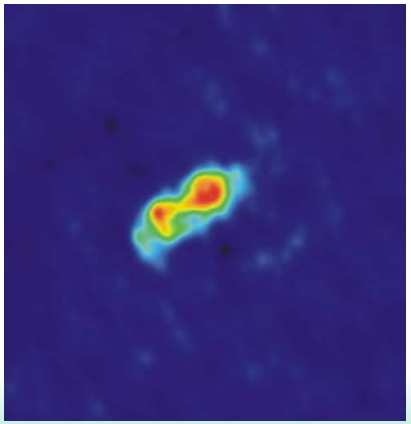
or even to:

ignition of activity → GPS/CSO → decline of activity → quiescence

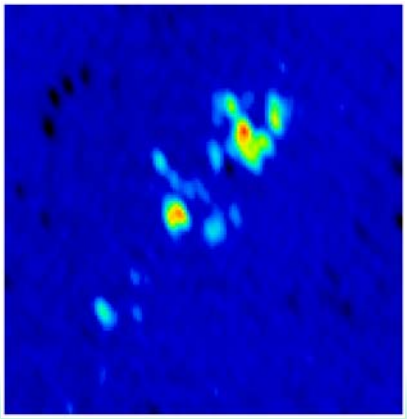
VLBA maps of 0809+404



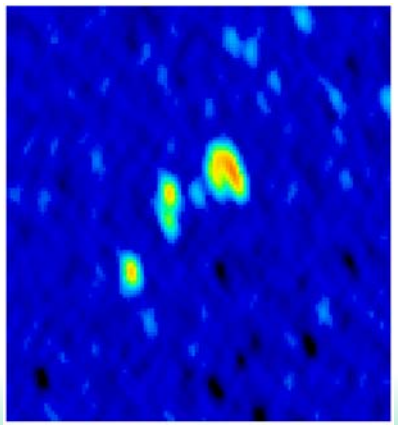
1.6 GHz



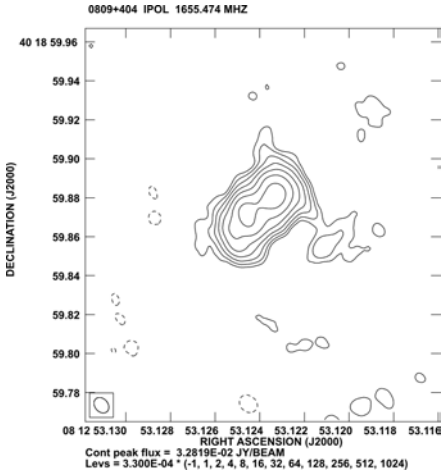
4.9 GHz



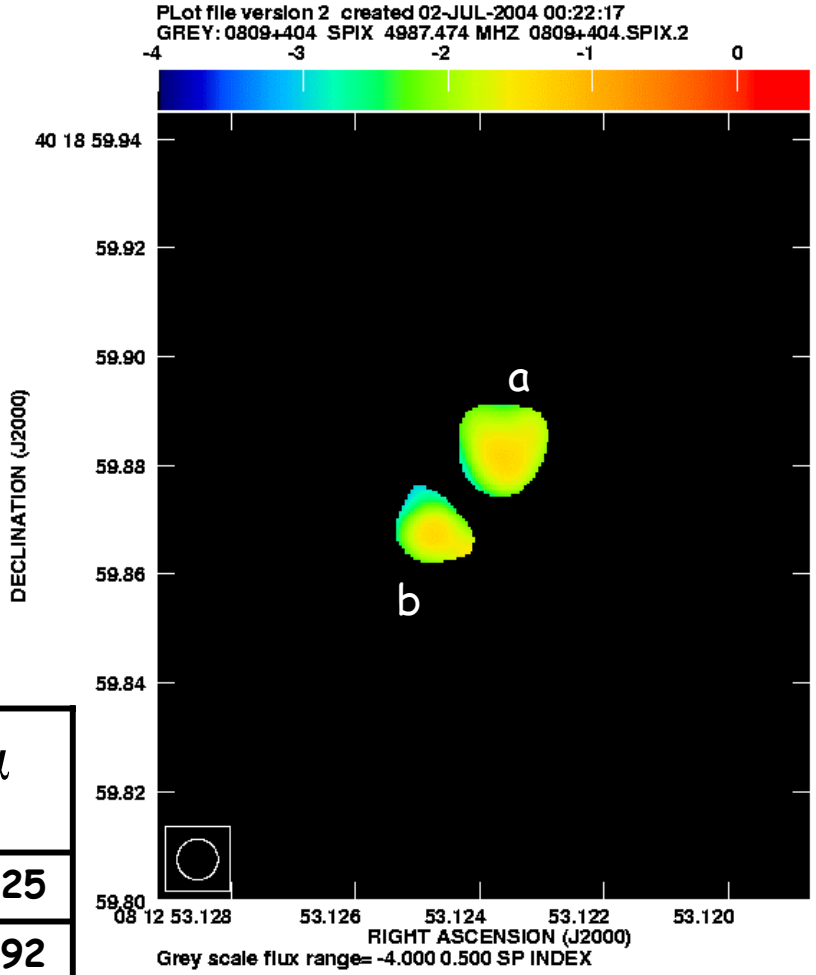
8.4 GHz

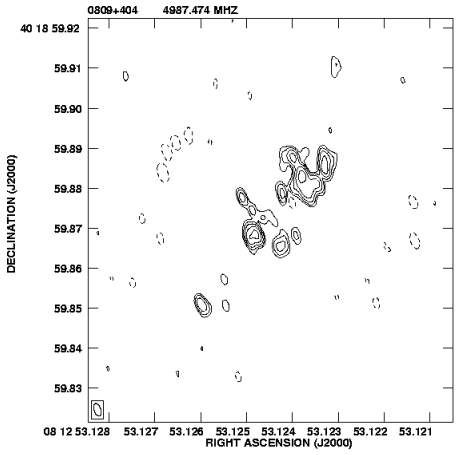


Spectral index map between 1.6 and 4.9 GHz



1.6 GHz

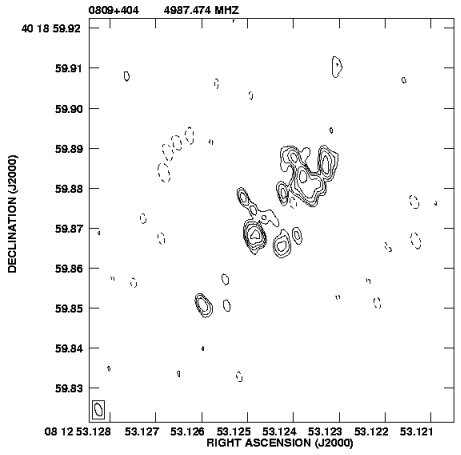




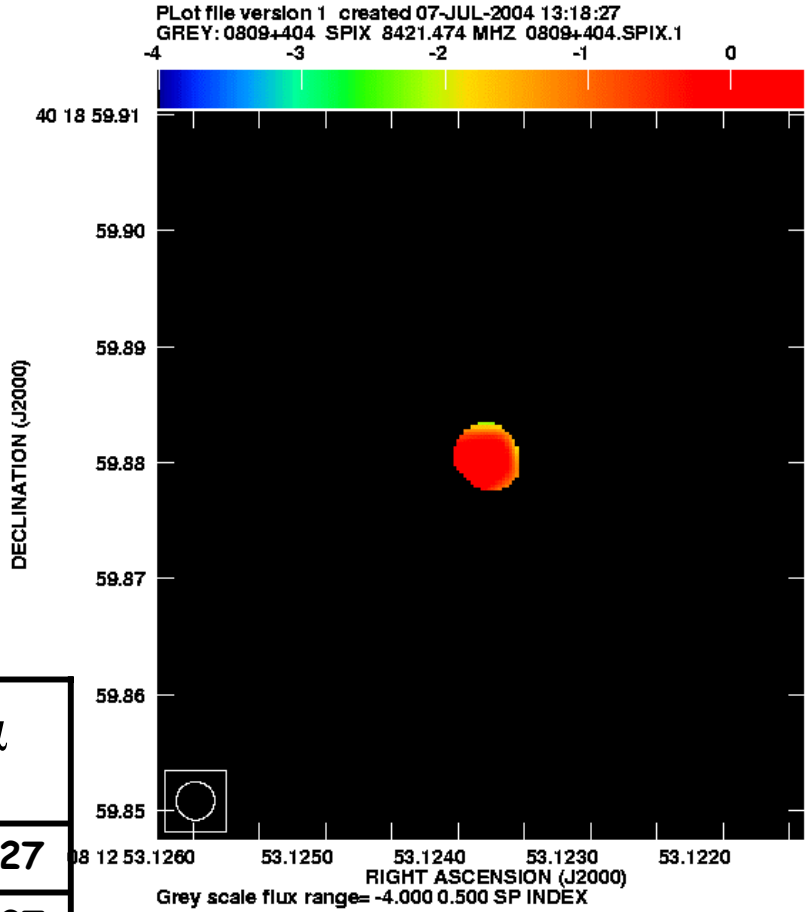
4.9 GHz

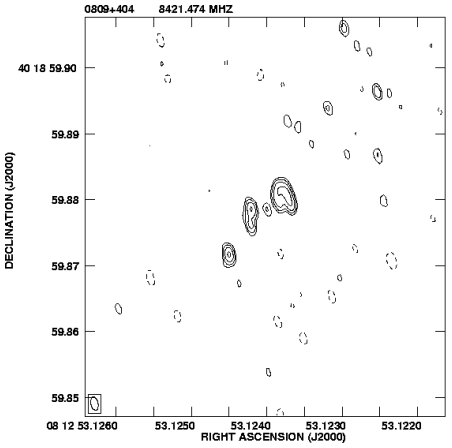
	$S_{1.6GHz}$ mJy	$S_{4.9GHz}$ mJy	α
a	155.5	12.9	-2.25
b	154.3	6.2	-2.92

Spectral index map between 4.9 and 8.4 GHz



4.9 GHz

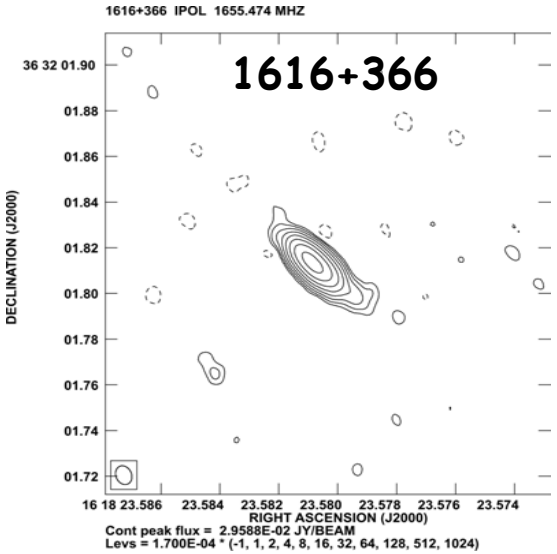


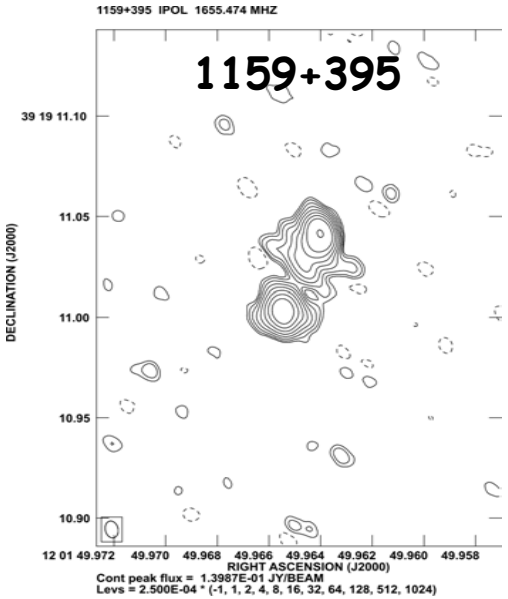


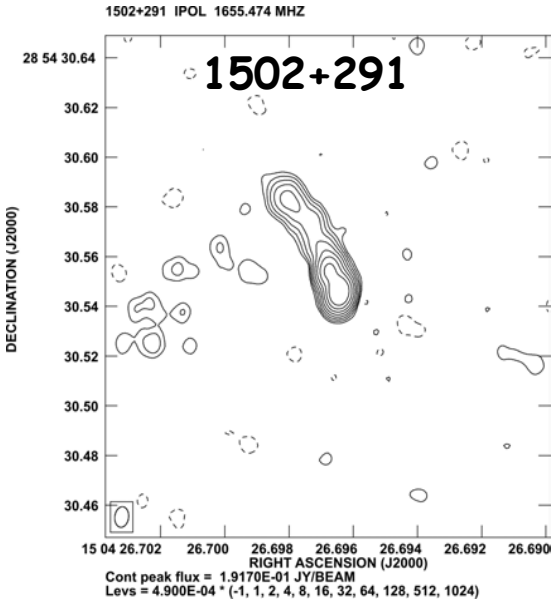
8.4 GHz

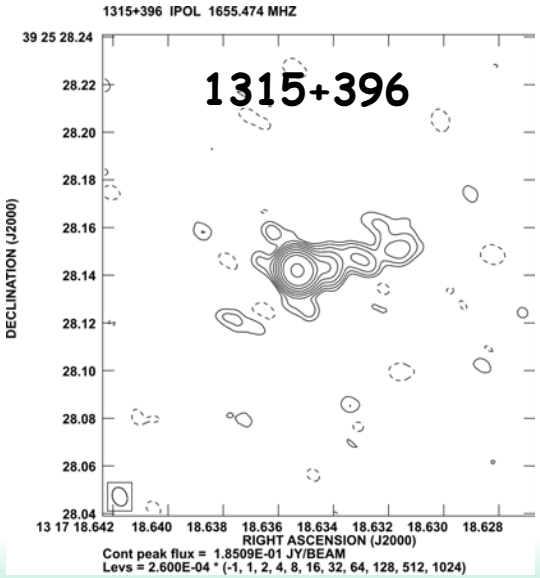
	$S_{4.9GHz}$ mJy	$S_{8.4GHz}$ mJy	α
a	12.9	6.7	-1.27
b	6.2	5.3	-0.27

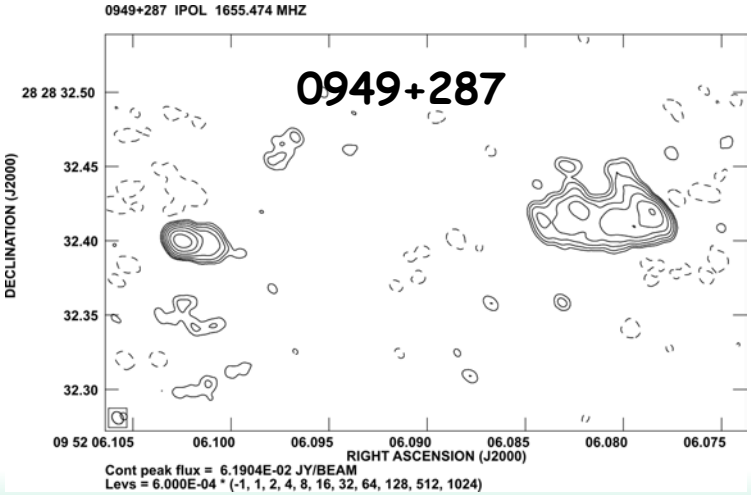
1.6 GHz VLBA maps of the other sources











Summary

1. We presented here the results of VLBA observations at 1.6, 5, 8.4 and 15 GHz of the most compact sources in our parent MERLIN sample.
2. Only three sources were detected at 15 GHz.
3. We measured the flux densities of the principal components of the sources and calculated the spectral indices.
4. We have made the spectral index maps of the sources.
5. At least 2 of the observed sources (0809+404, 0949+287) seem to fit to the picture of 'dying' radio sources.