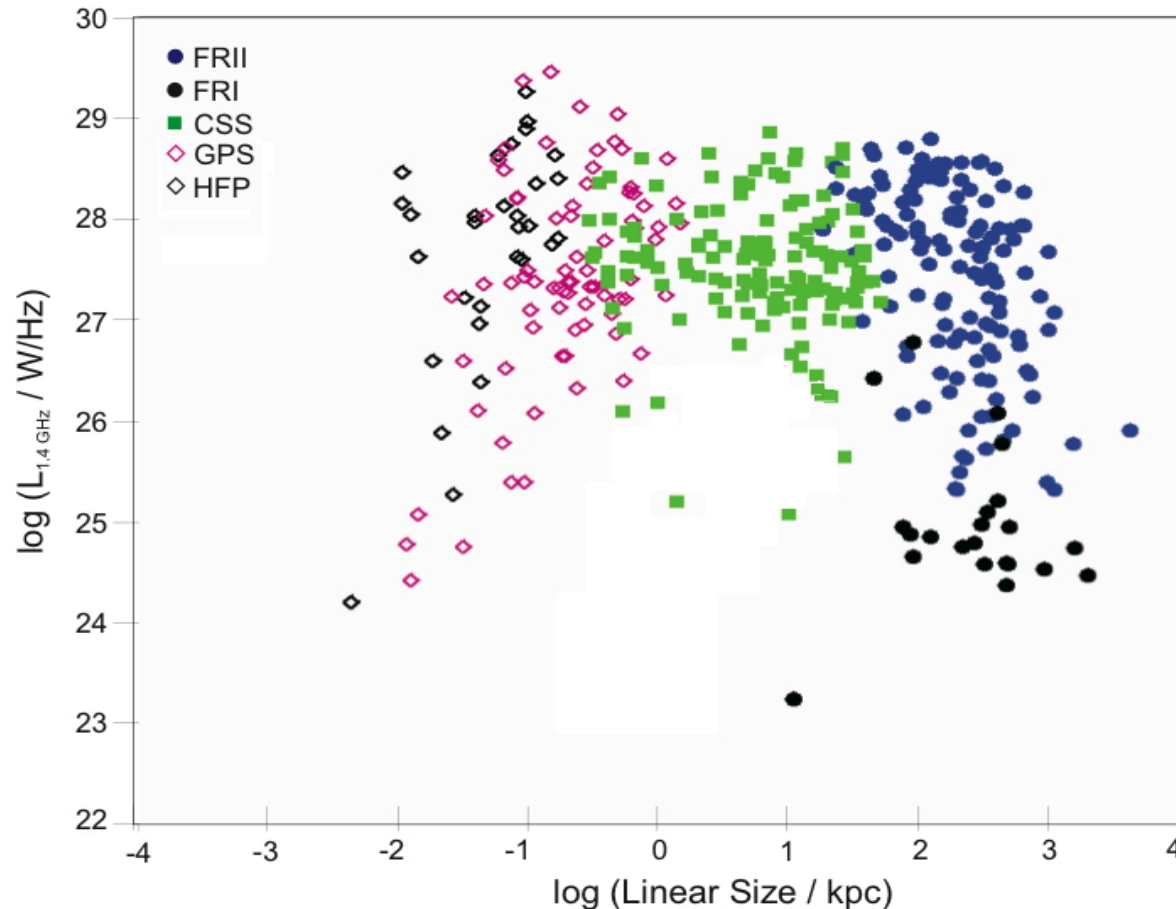




Dichotomy in the population of young AGNs: optical, radio and X-ray properties

Magdalena Kunert-Bajraszewska

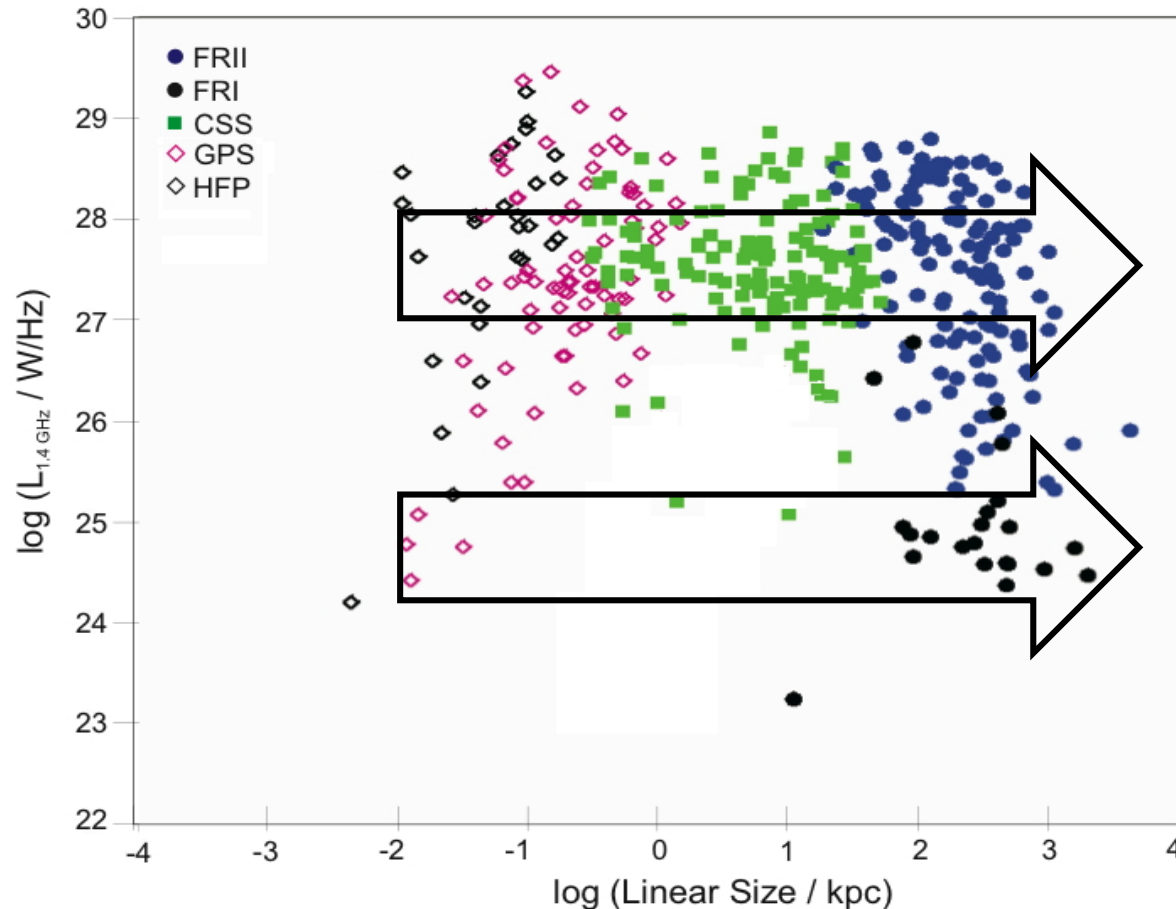
Linear Size vs Luminosity, namely evolution



HFP/GPS (< 1 kpc) $\Rightarrow$ CSS (< 15 kpc) $\Rightarrow$ FRI/FRII (> 15 kpc)

(Readhead+1994, Fanti+1995; Taylor+1996; O'Dea & Baum, 1997; Snellen+2000, Marecki+2003, Gugliucci+2005, Kunert-Bajraszewska+2010, An&Baan, 2012, Dallacasa+2013, Maciel+2014)

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Research methodology

Selection criteria of a new sample

- sources more compact than FIRST beam (5.''4) and surrounded by empty field (radius 1');
- luminosity $L_{1.4 \text{ GHz}}$: $10^{23} - 10^{26} \text{ W/Hz}$;
- spectral index: $\alpha_{1.4 \text{ GHz}}^{4.85 \text{ GHz}} > 0.7$;

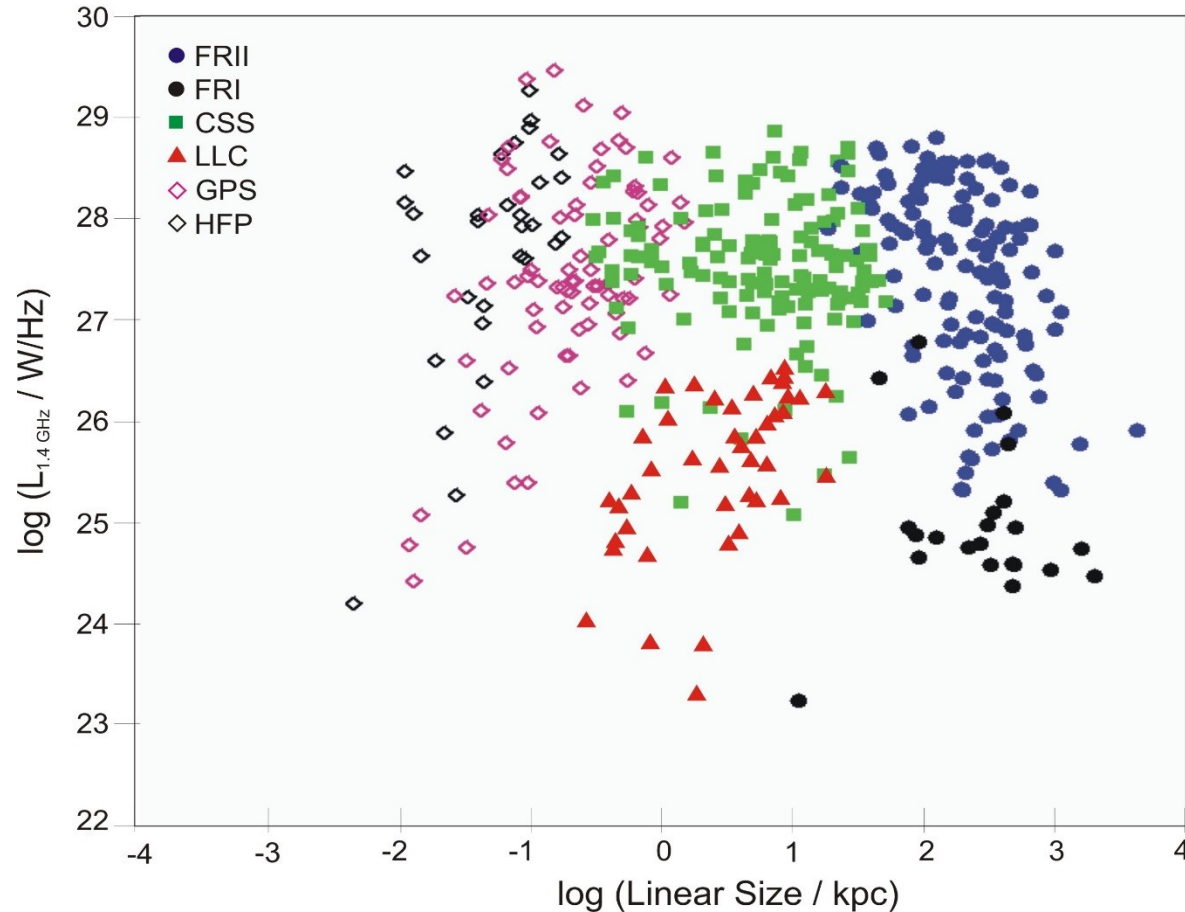
Final sample: 46 low-power compact sources

Observations:

Merlin L-band and C-band

$H_0 = 71 \text{ km s}^{-1} \text{ Mpc}^{-1}$, $\Omega_{\Lambda} = 0.7$, $\Omega_M = 0.3$, $S \sim \nu^{-\alpha}$, steep spectrum for $\alpha > 0.5$

Linear Size vs Luminosity, namely evolution



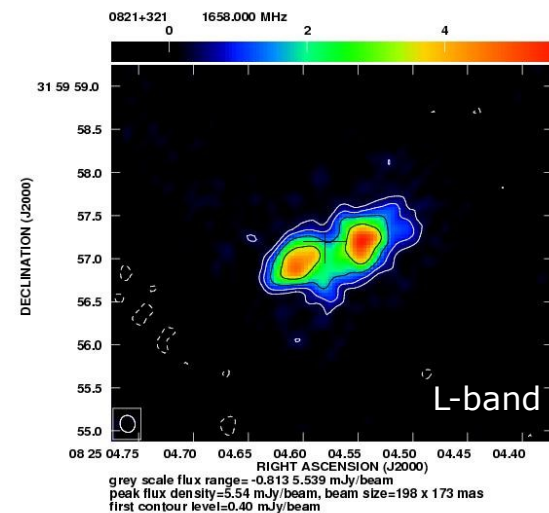
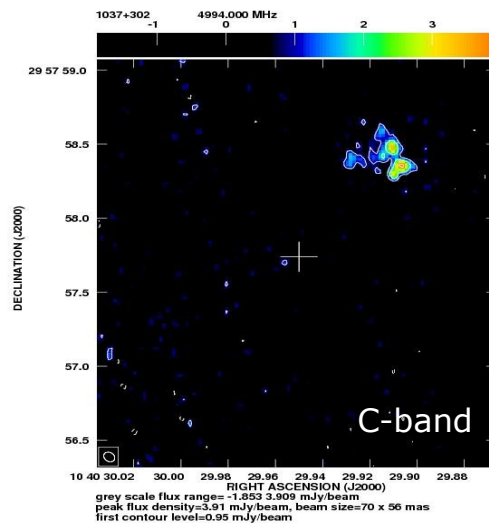
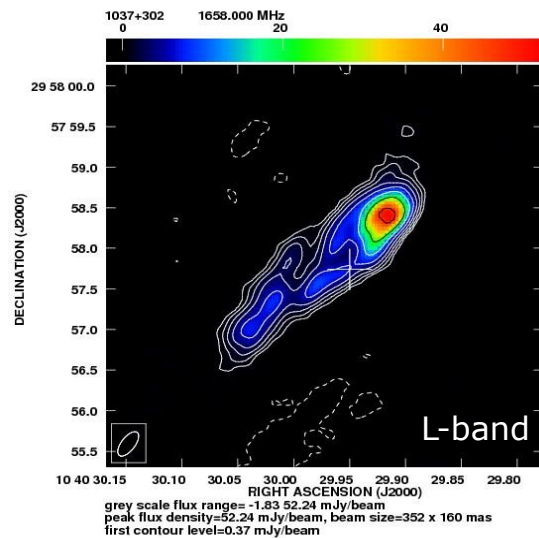
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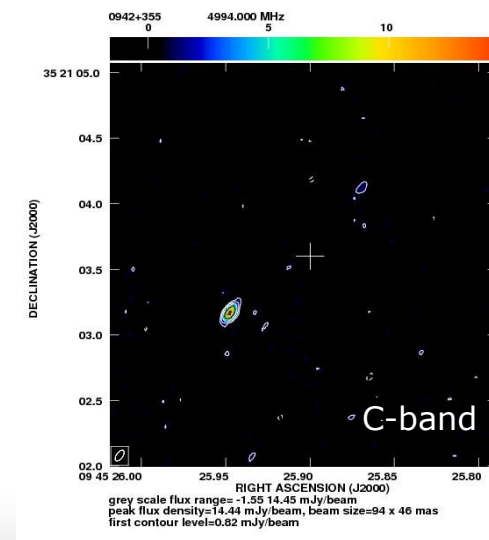
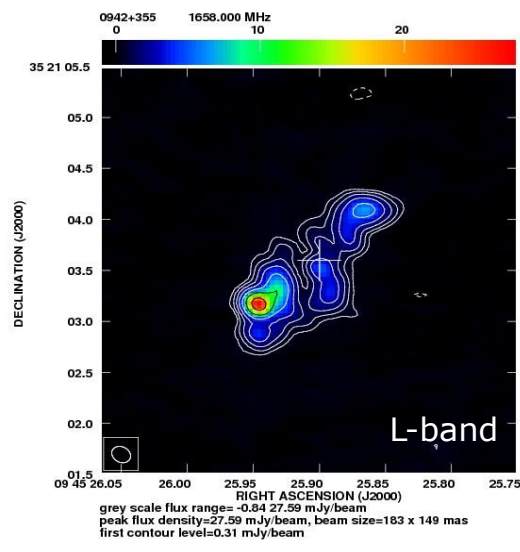
M.

(Kunert-Bajraszewska+2010, Kunert-Bajraszewska&Labiano2010)

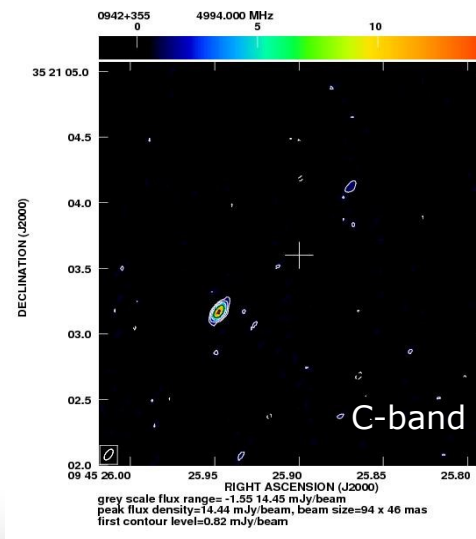
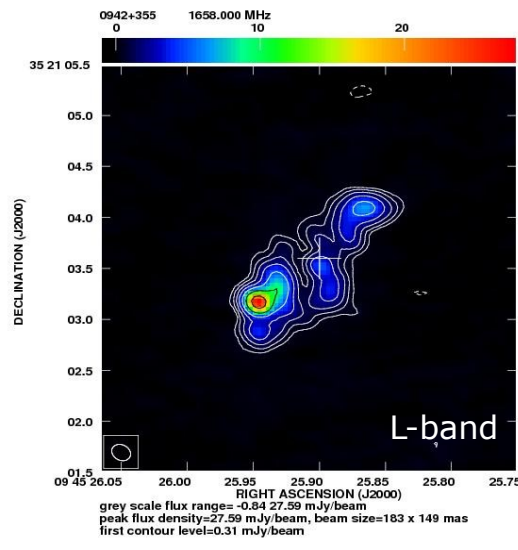
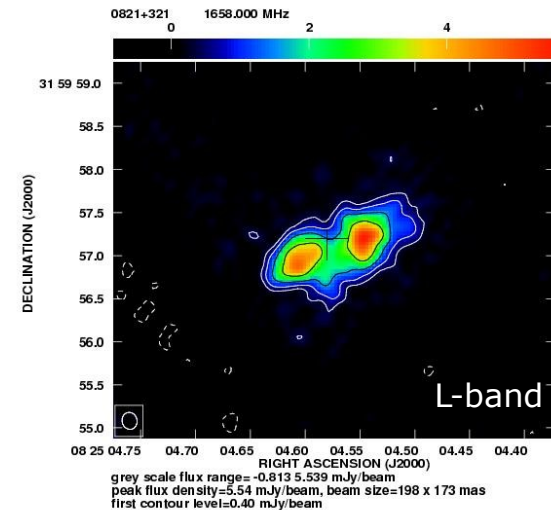
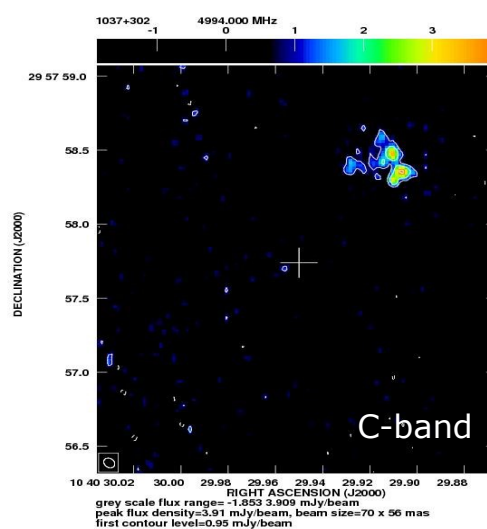
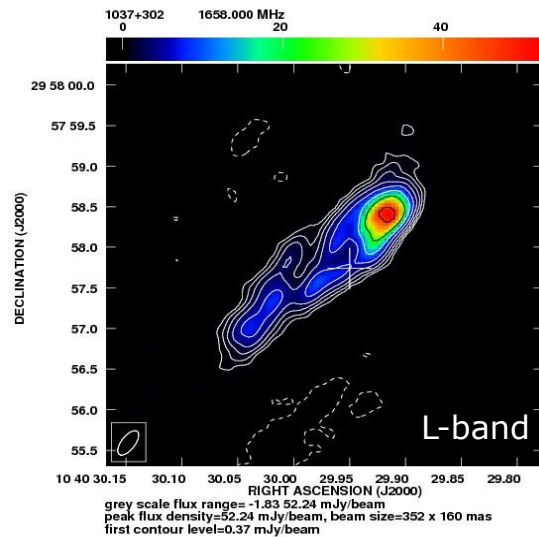
MERLIN high resolution observations



lack of radio core
+
weak, relaxed lobes



MERLIN high resolution observations



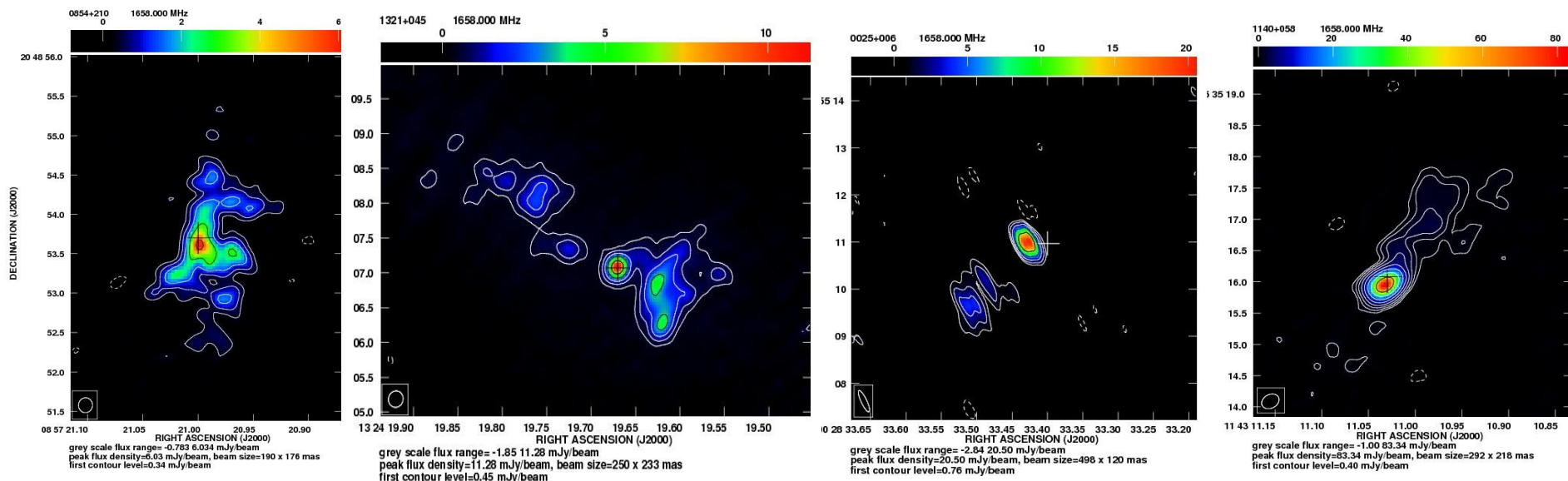
lack of radio core
+
weak, relaxed lobes

Fading compact objects?

*Giroletti+2005,
Kunert-Bajraszewska+2006,
Orienti+2010*

MERLIN high resolution observations

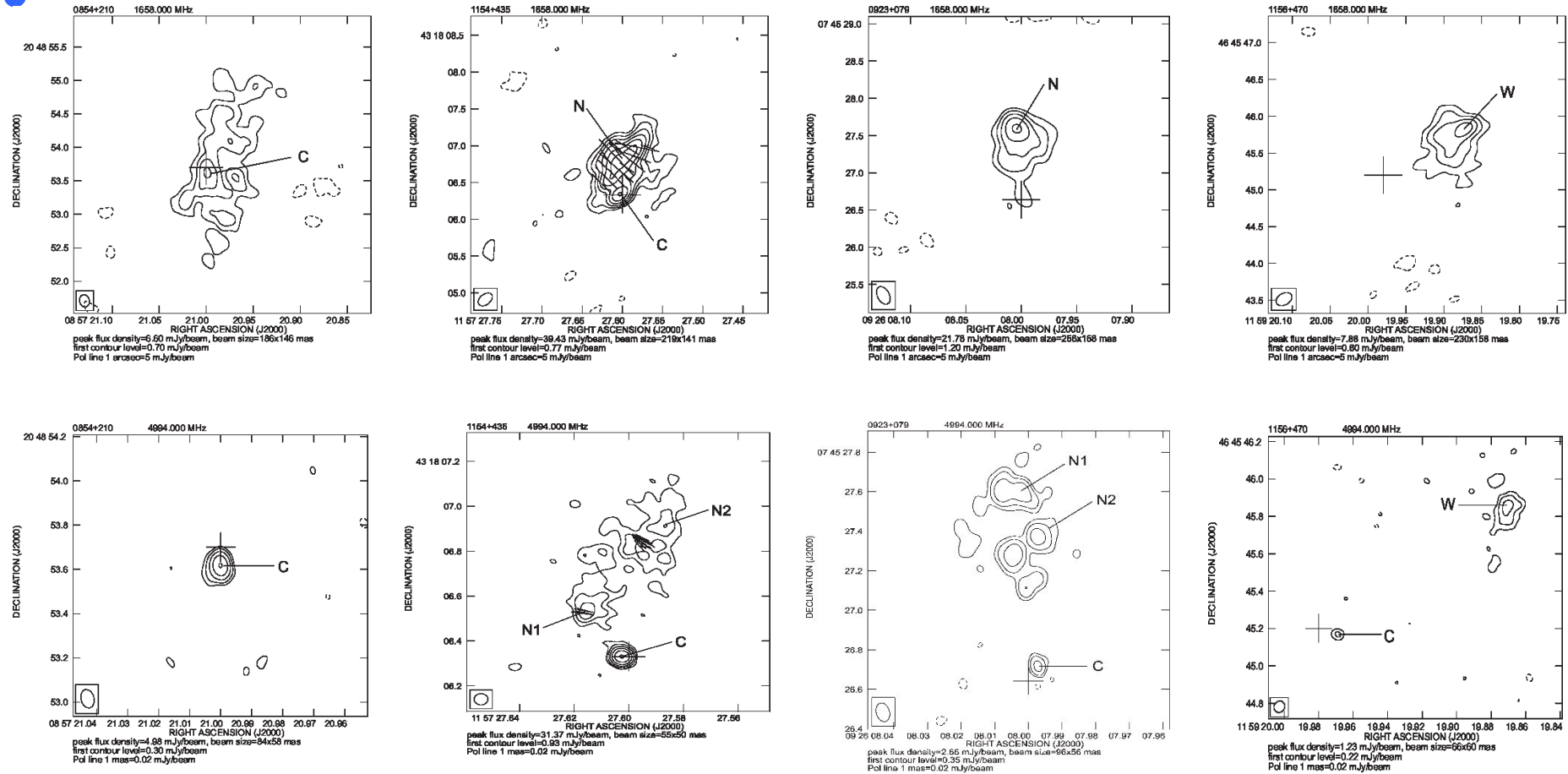
Objects with core detection.



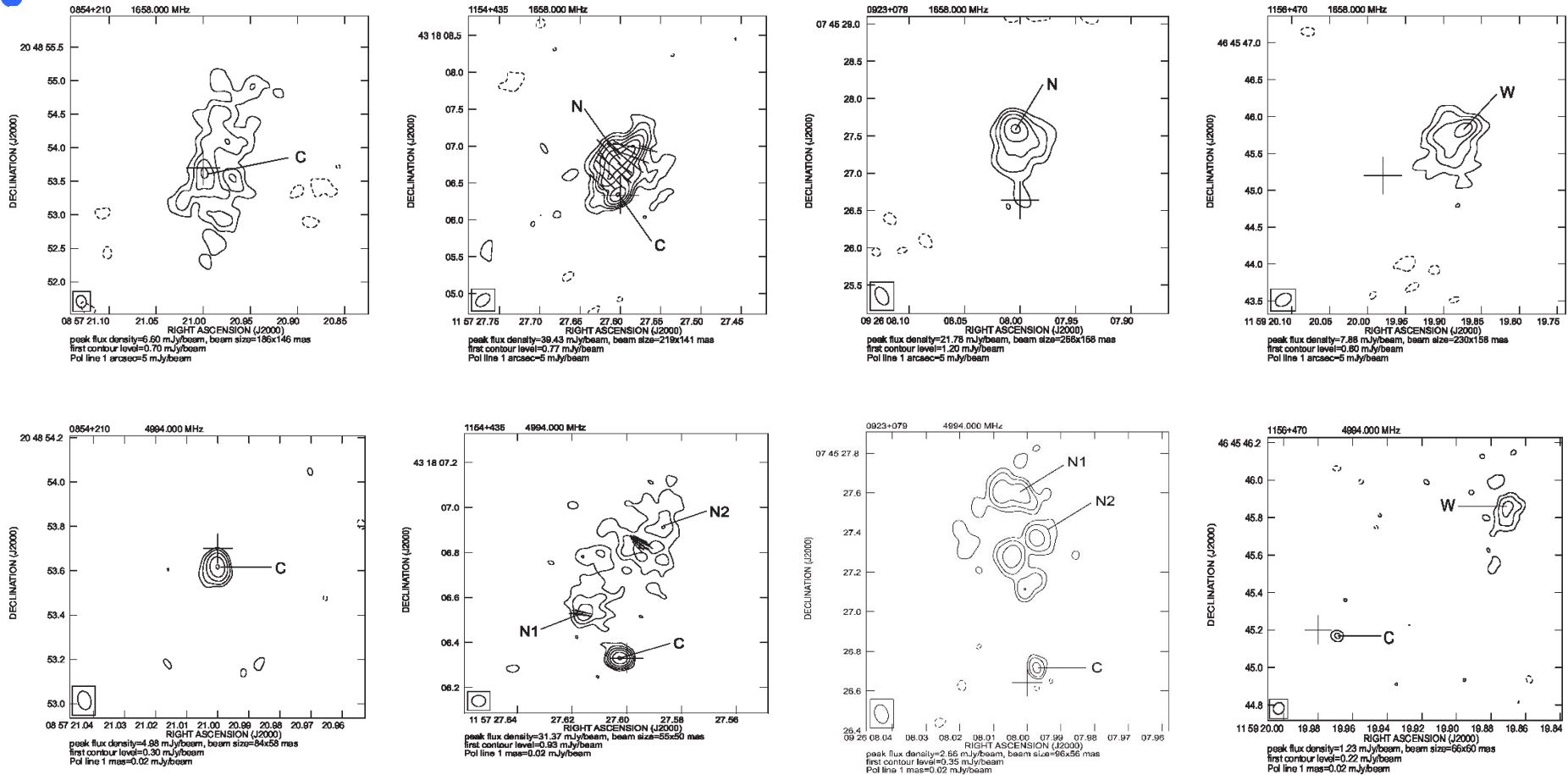
weak radio lobes or jet + radio core as the brightest component

(Kunert-Bajraszewska+2010, Kunert-Bajraszewska&Labiano2010)

MERLIN high resolution observations

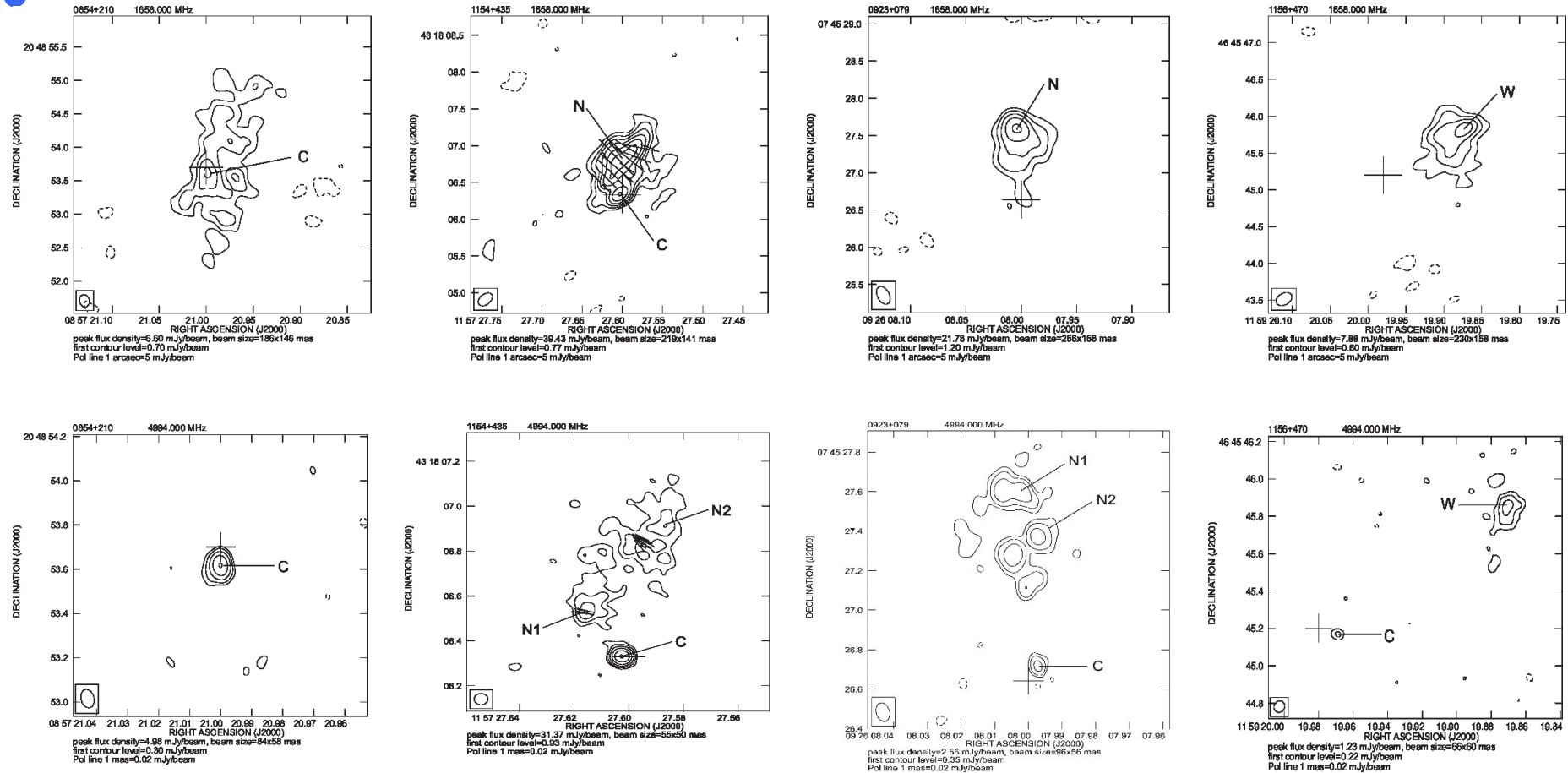


MERLIN high resolution observations



Core dominance: $\log R_{5\text{GHz}} = S_{\text{core}} / (S_{\text{tot}} - S_{\text{core}}) = -0.65$ (5 sources)

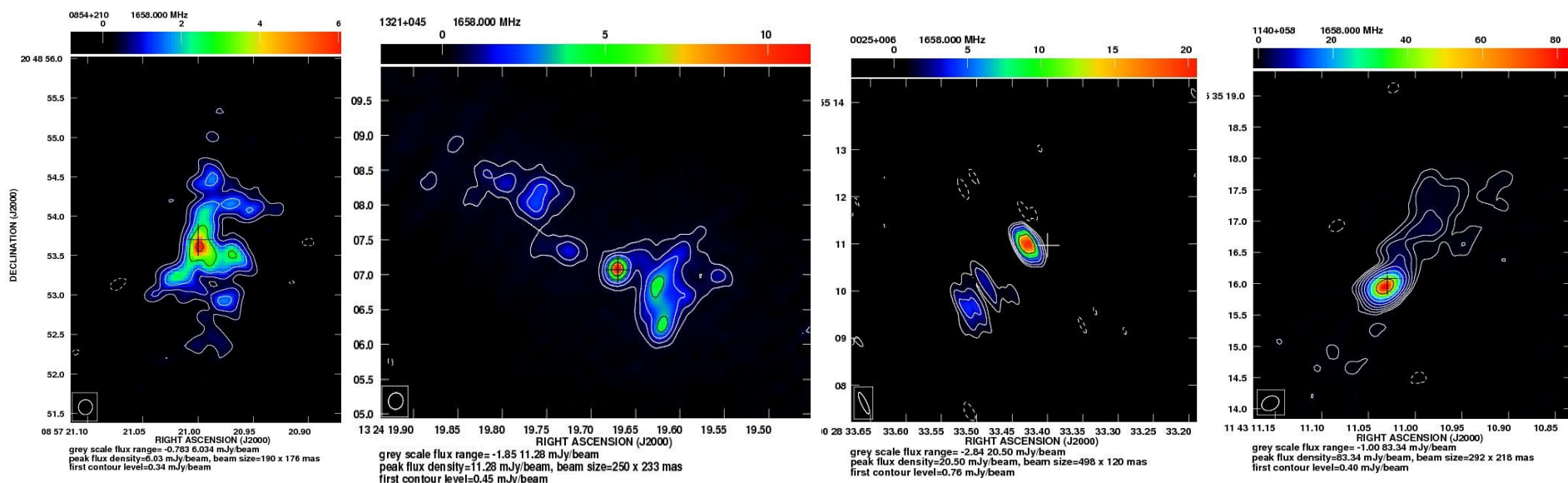
MERLIN high resolution observations



Core dominance: $\log R_{5\text{GHz}} = S_{\text{core}} / (S_{\text{tot}} - S_{\text{core}}) = -0.65$ (5 sources)
 -1.77 (FRII), -1.44 (FRI) (*Morganti+1993*), -1 (-2) for strong CSSs (*Saikia+01*)
 similar to **FRO** class (*Sadler+2014, Baldi+2015*)

MERLIN high resolution observations

Objects with core detection.

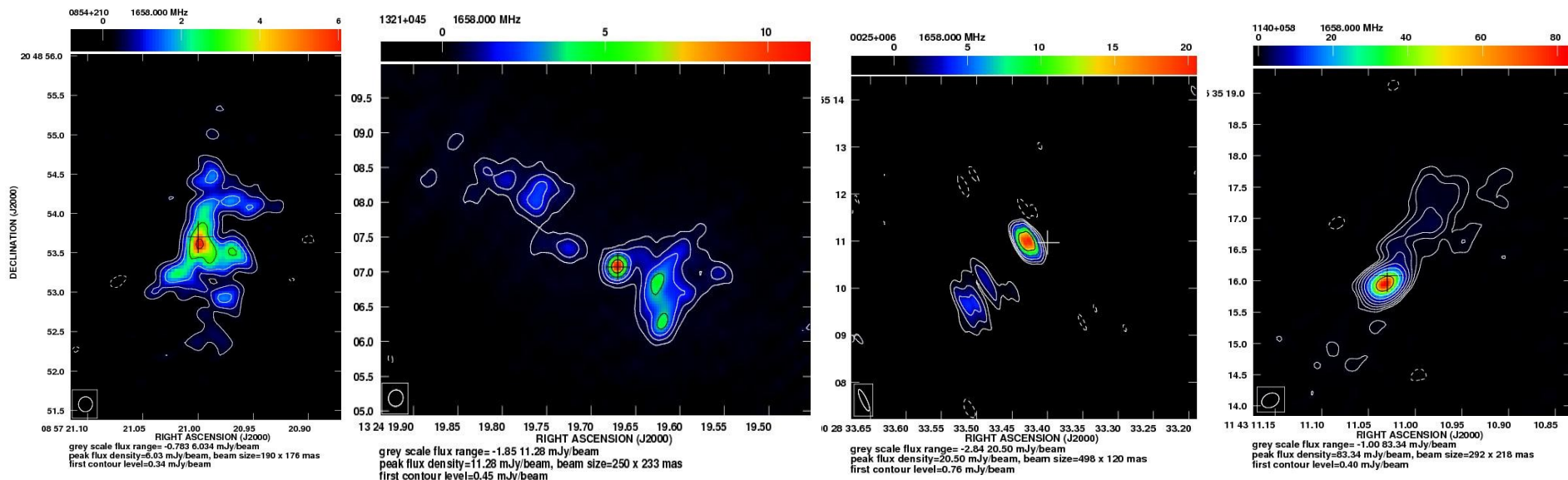


weak radio lobes or jet + radio core as the brightest component

(Kunert-Bajraszewska+2010, Kunert-Bajraszewska&Labiano2010)

MERLIN high resolution observations

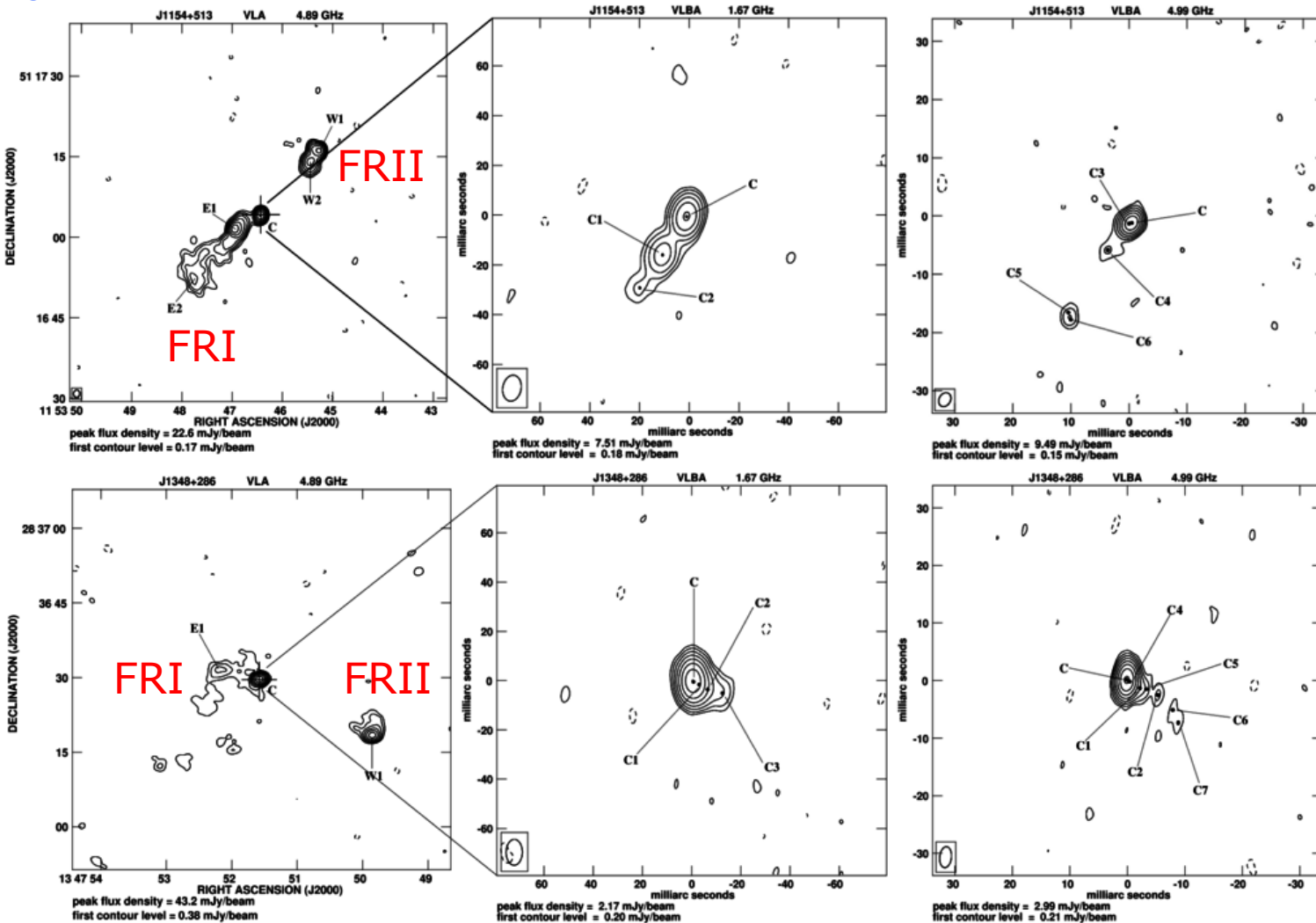
Objects with core detection.



weak radio lobes or jet + radio core as the brightest component
brightness asymmetry ~86% of objects

(Kunert-Bajraszewska+2010, Kunert-Bajraszewska&Labiano2010)

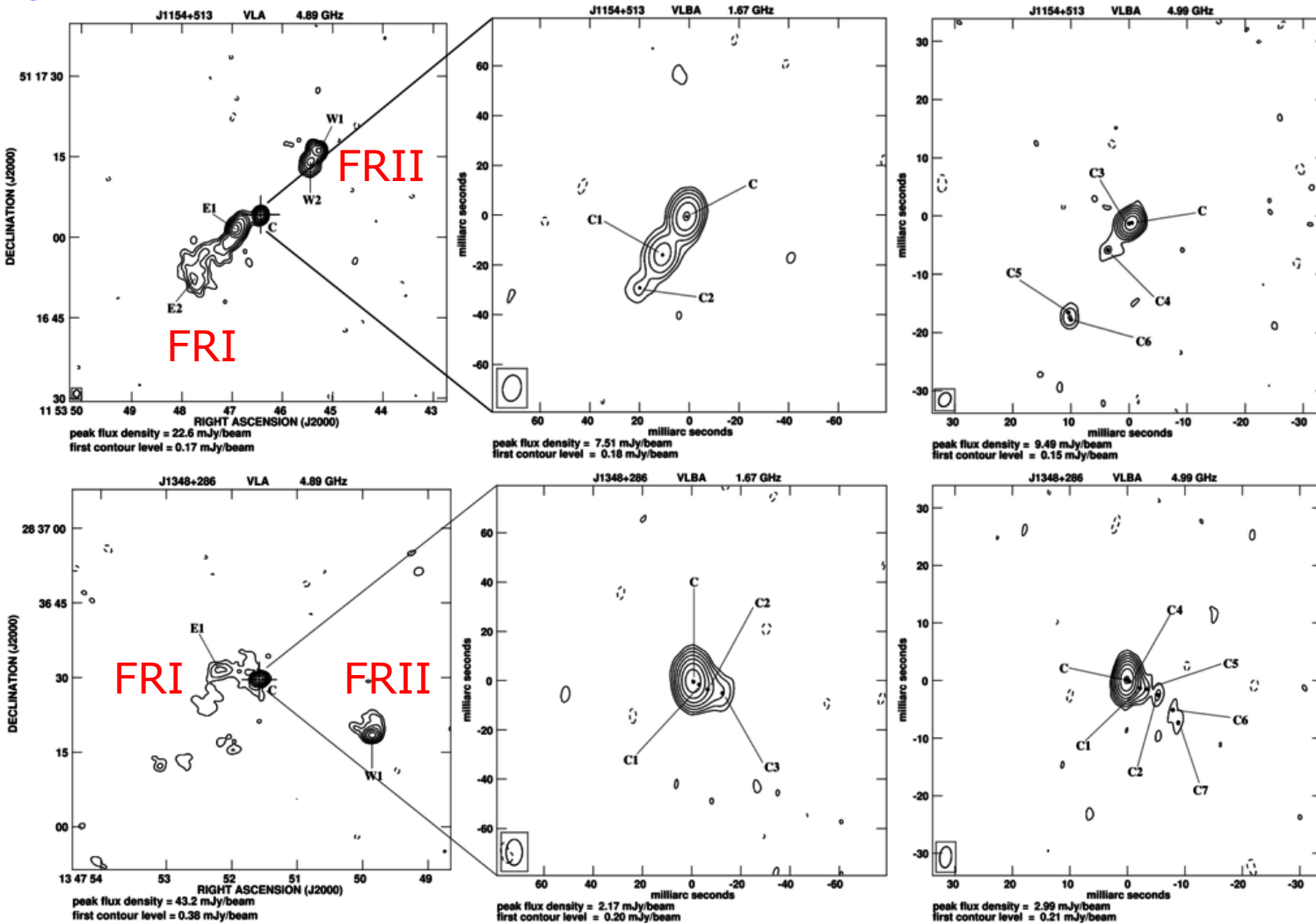
HYbrid MORphology Radio Sources



Cegłowski+2013,

(see also: Gawroński+2006, Perucho+2012)

HYbrid MORphology Radio Sources

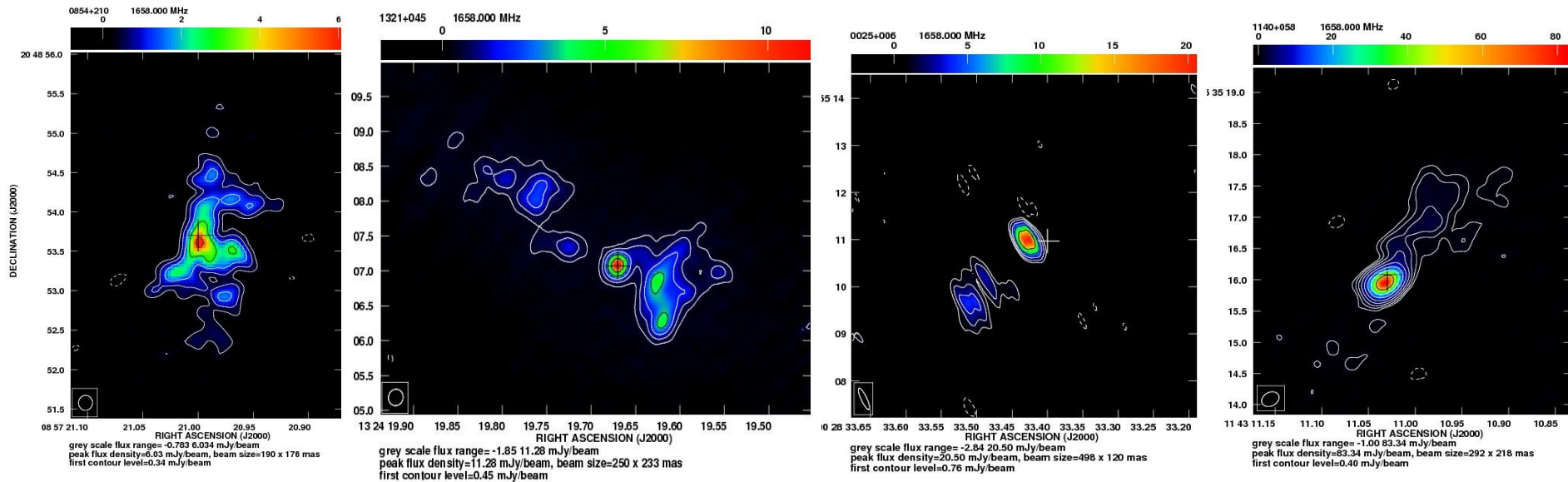


FRIIs
evolving in
heterogeneous
environment

Cegłowski+2013, (see also: Gawroński+2006, Perucho+2012)

MERLIN high resolution observations

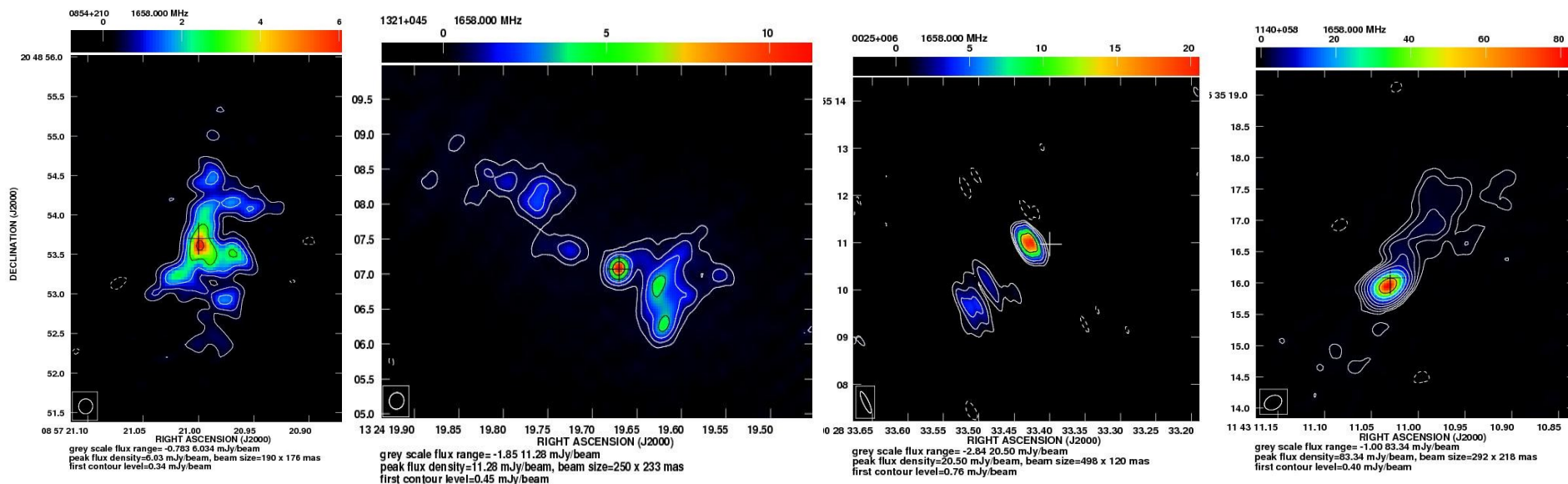
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MERLIN high resolution observations

Objects with core detection.

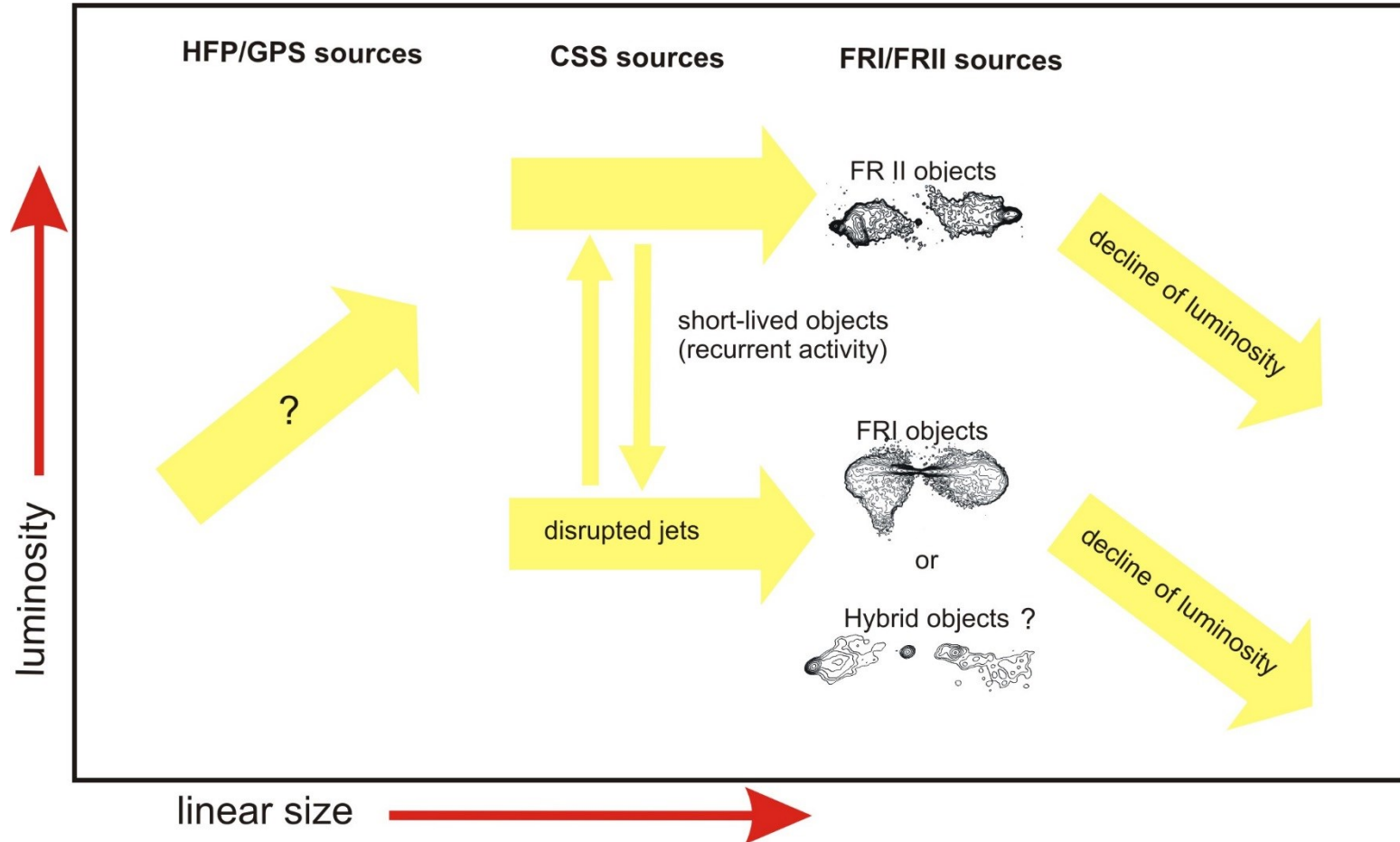


weak radio lobes or jet + radio core as the brightest component
brightness asymmetry ~86% of objects

environment or instabilities in the accretion flow or black hole spin ?

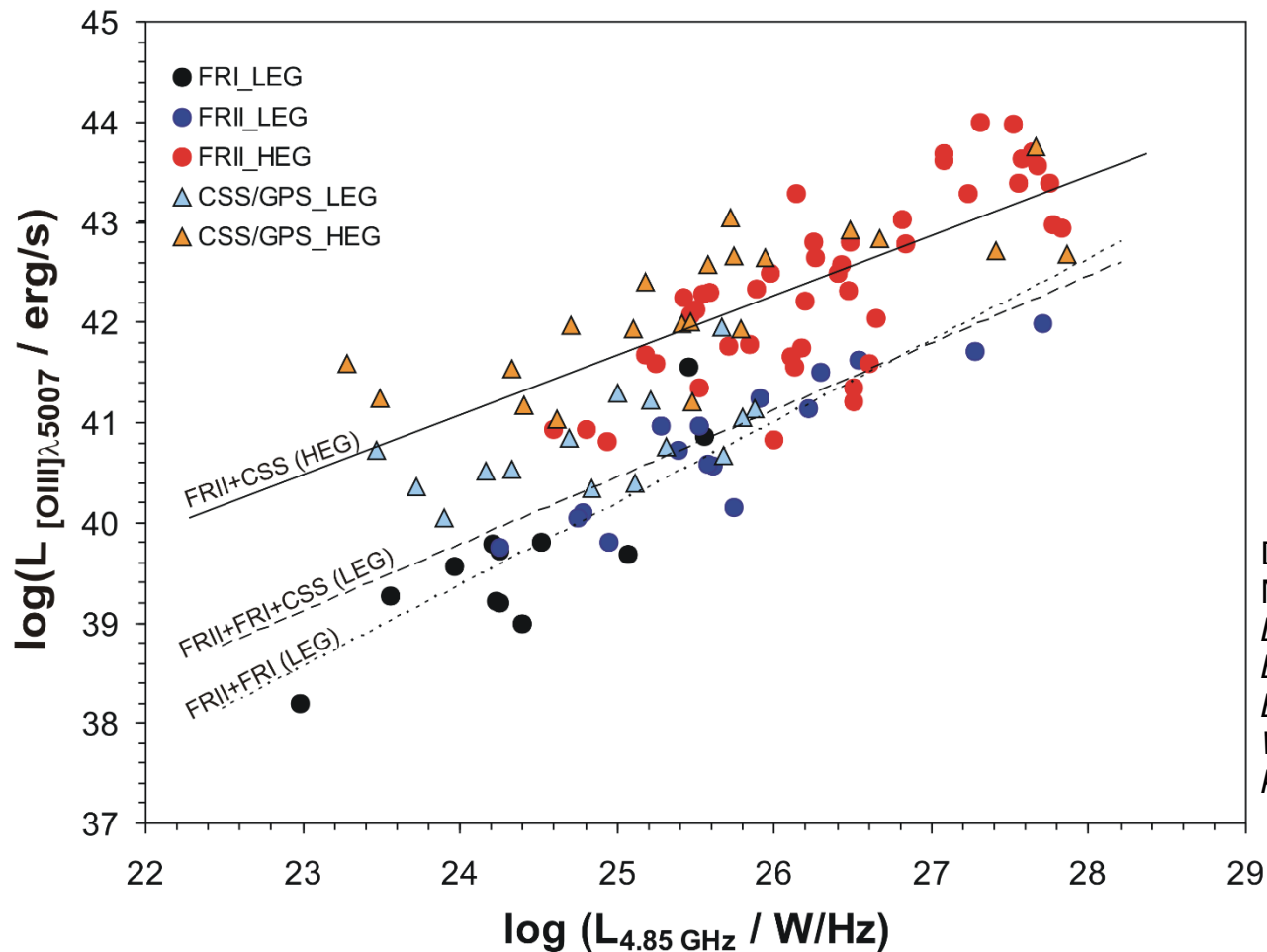
(e.g.: Holt+2006, Labiano+2008, Sikora+2007, Czerny+2009, Buttiglione+2010, Kunert-Bajraszewska & Labiano 2010, Dallacassa+2013, Morganti+2013, Maccagni+2014,)

Evolution scheme



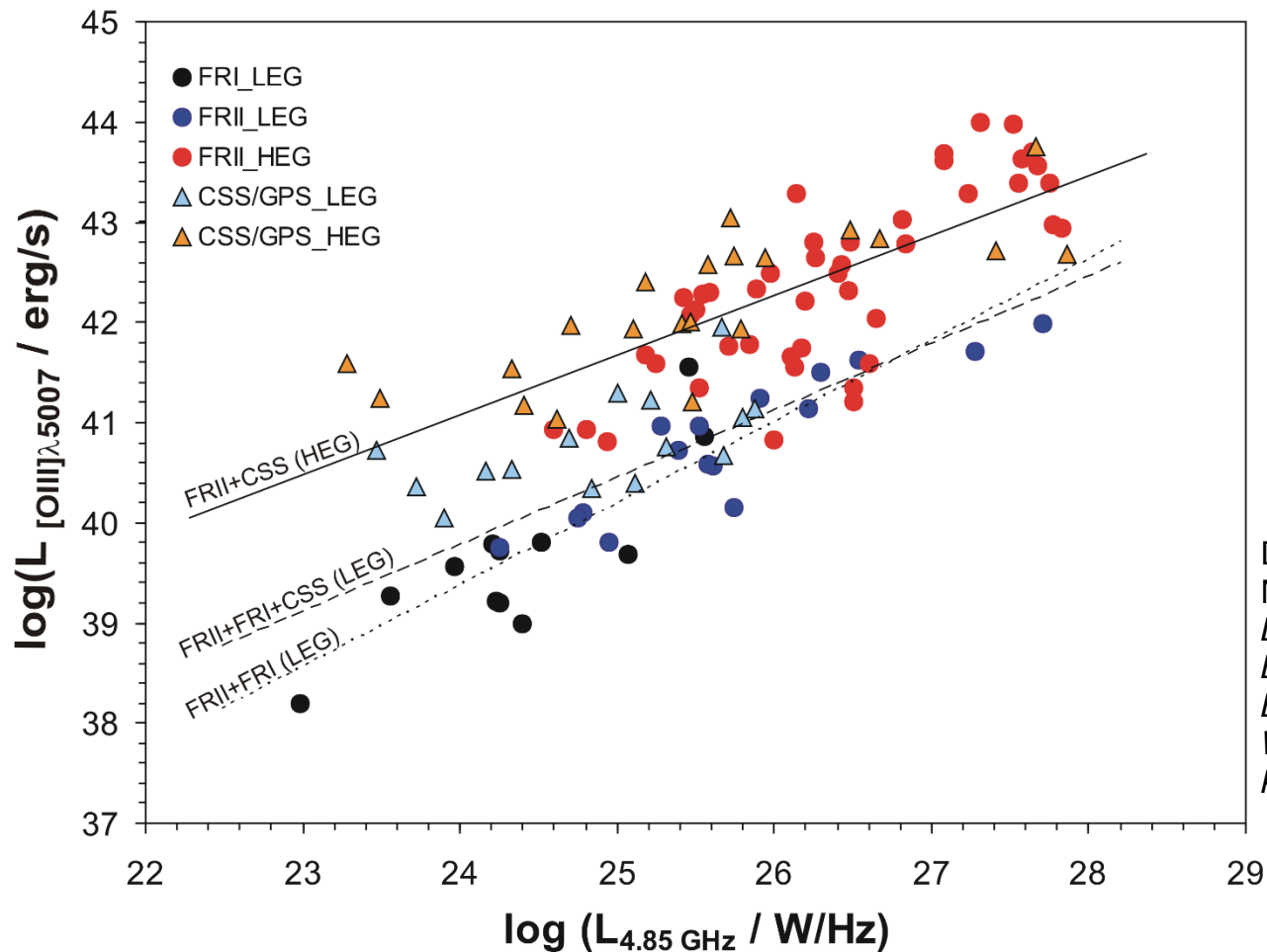
Kunert-Bajraszewska, Gawroński, Labiano, Siemiginowska, 2010, MNRAS, 408, 2261

Evolution scheme for HEG and LEG objects



Data from:
Morganti+1997
Labiano+2007
Buttiglione+2009
Buttiglione+2010
Willott+1999
Kunert-Baj+ 2010

Evolution scheme for HEG and LEG objects



Low excitation galaxies (LEG): GPS - CSS - FR (weak FR II and/or FR I)

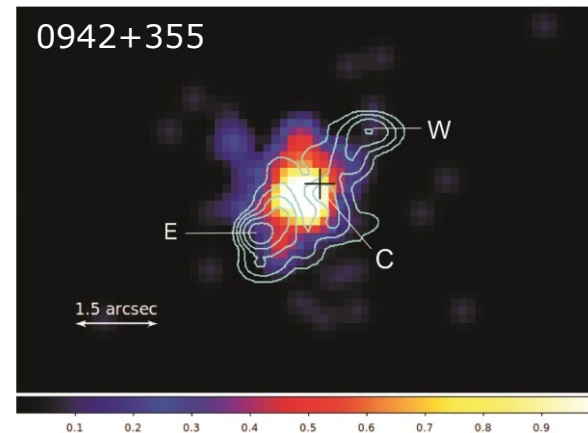
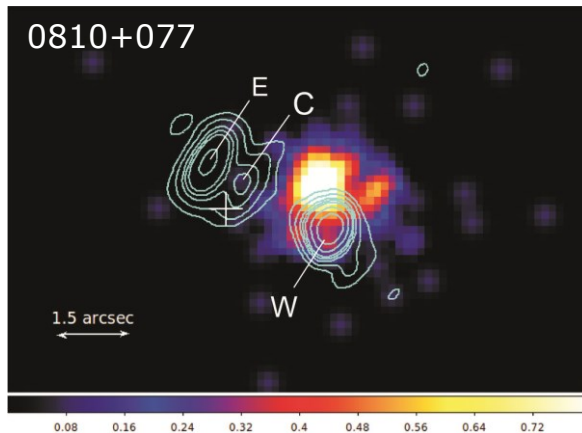
High excitation galaxies (HEG): GPS - CSS - FRII

(Kunert-Bajraszewska & Labiano, 2010)

M.

CHANDRA X-ray observations

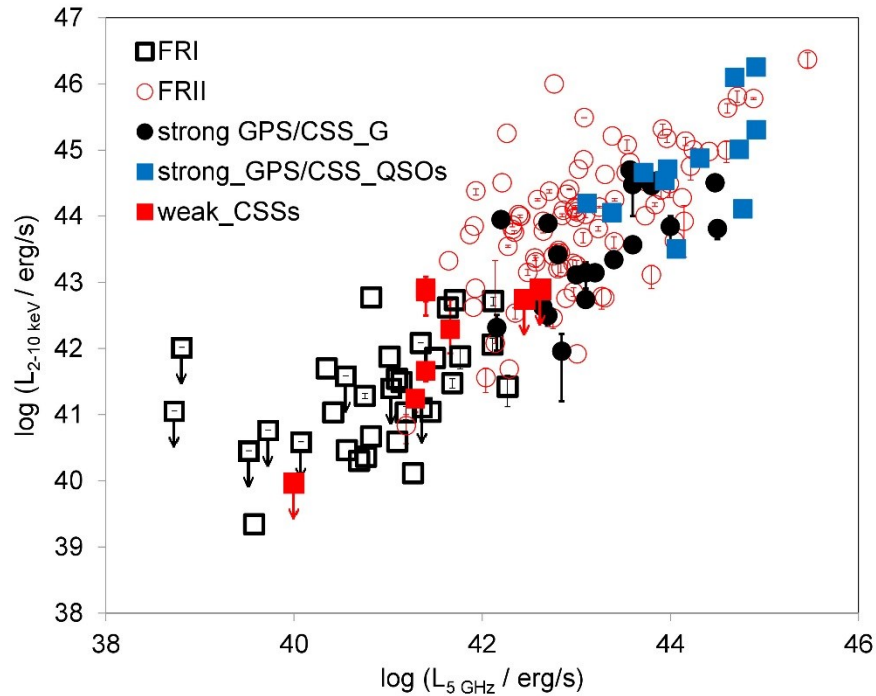
source	exposure time	total counts	Log ($L_{5\text{GHz}}$)	Log ($L_{2-10\text{ keV}}$)
0810+077	~ 10 ks	119	41.40	42.86
0907+049	~ 10 ks	3	42.62	42.90
0942+355	~ 10 ks	103	41.40	42.91
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1542-390	~ 10 ks	0	42.46	42.75
1558+536	~ 10 ks	9	41.40	41.66
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Kunert-Bajraszewska, Labiano, Siemiginowska, Guainazzi, 2014, MNRAS, 437, 3063

CHANDRA X-ray observations

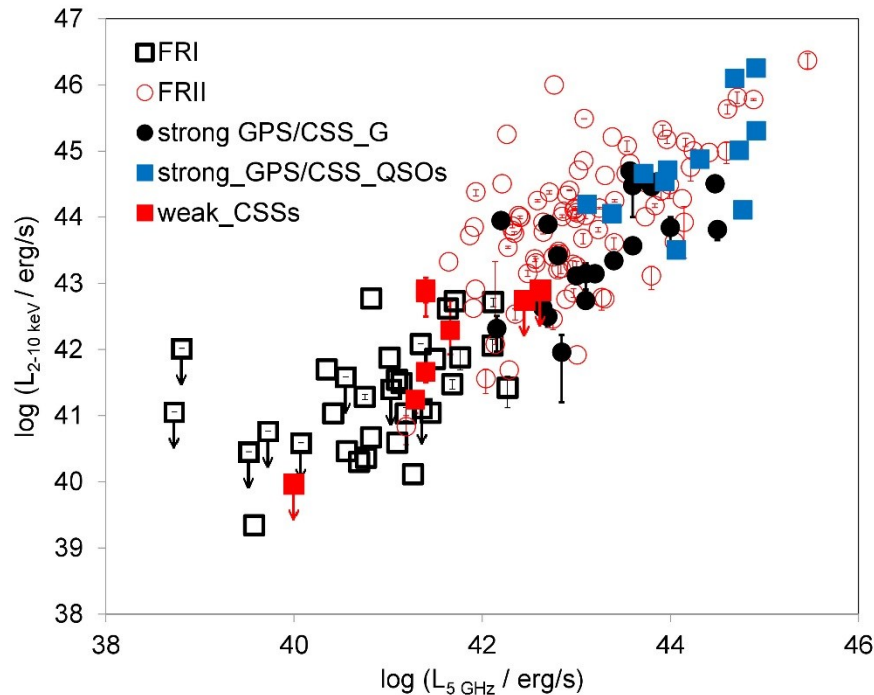
X – radio relation



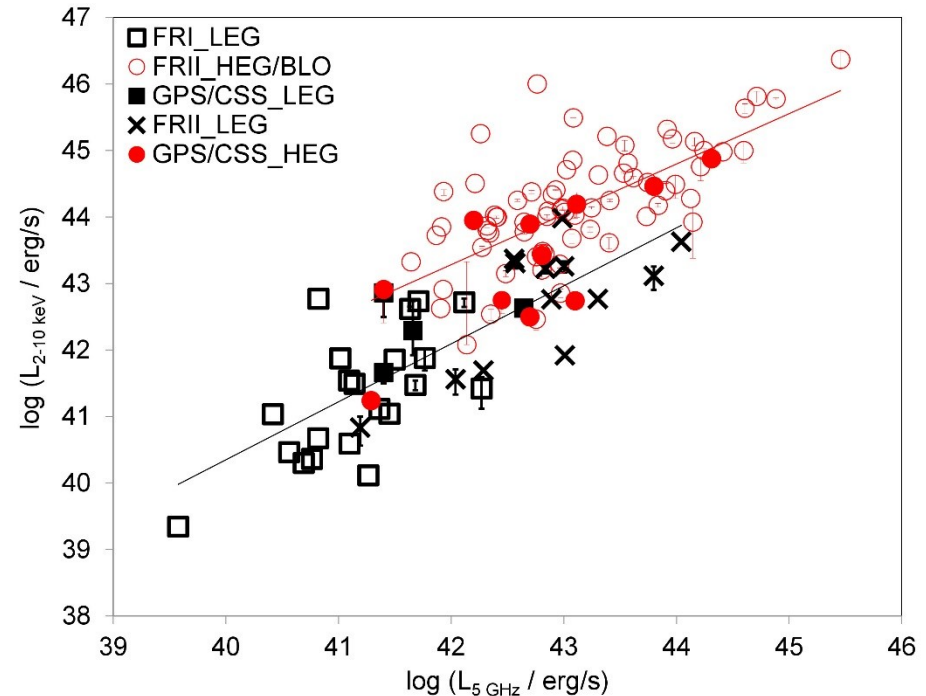
Kunert-Bajraszewska+2014

CHANDRA X-ray observations

X – radio relation



HEG/LEG division

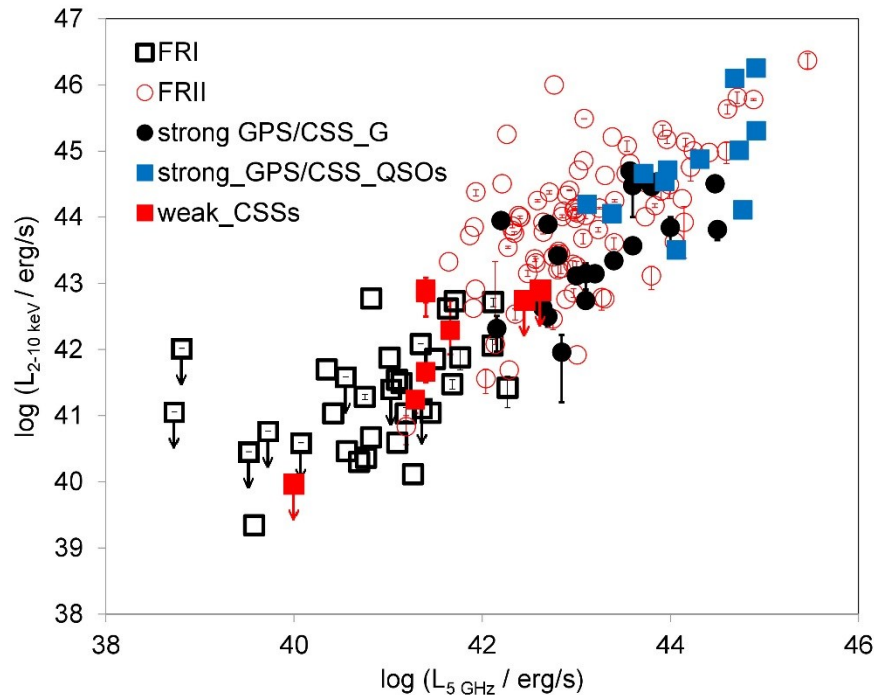


Data from: Sambruna+1999, Donato+1994, Grandi+1994, Evans+2006, Balmaverde+2006, Besole+2006, Hardcastle+2006, Siemiginowska+2008, Tengstrand+2009, Massaro+2010,2012).

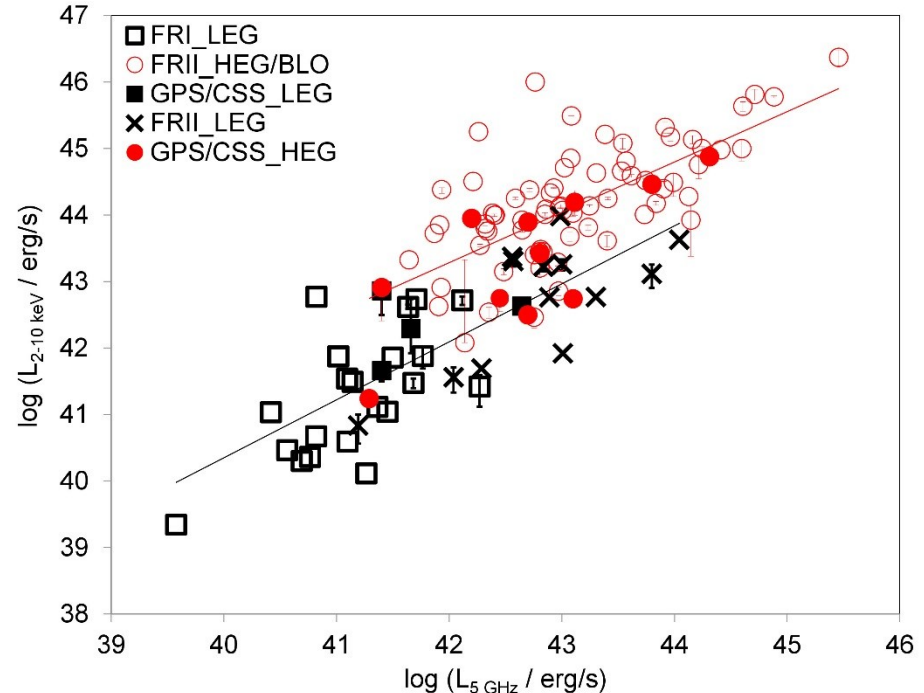
Kunert-Bajraszewska+2014

CHANDRA X-ray observations

X – radio relation



HEG/LEG division

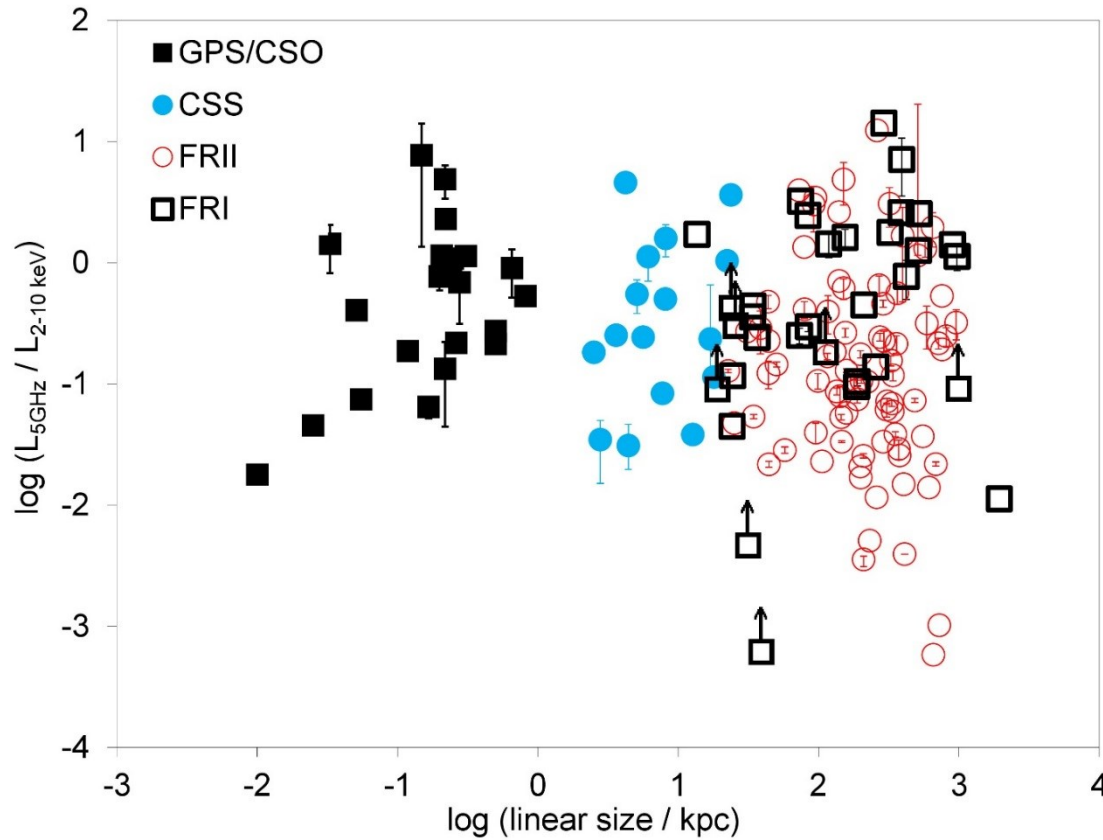


Data from: Sambruna+1999, Donato+1994, Grandi+1994, Evans+2006, Balmaverde+2006, Besole+2006, Hardcastle+2006, Siemiginowska+2008, Tengstrand+2009, Massaro+2010,2012).

The HEG and LEG objects occupy distinct locus in the radio/X-ray luminosity plane, notwithstanding their evolutionary stage.

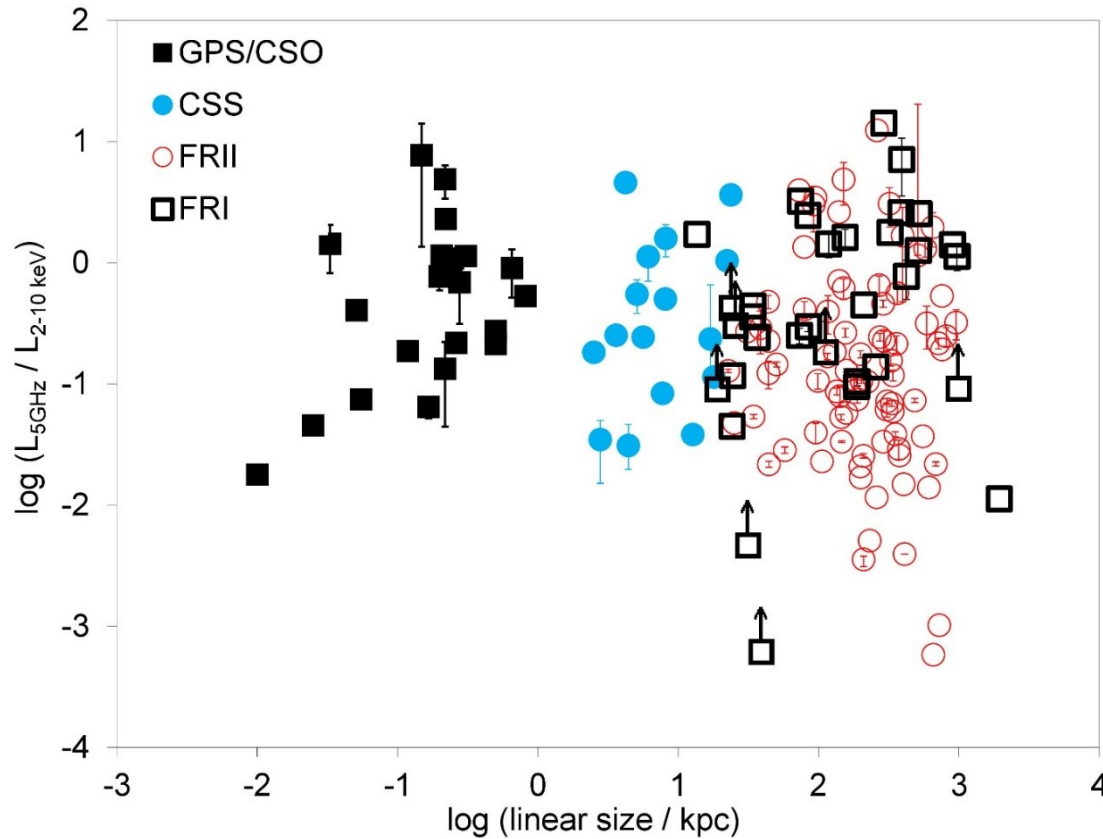
Kunert-Bajraszewska+2014

CHANDRA X-ray observations



Kunert-Bajraszewska+2014

CHANDRA X-ray observations



The division for two different X-ray emission modes originate:

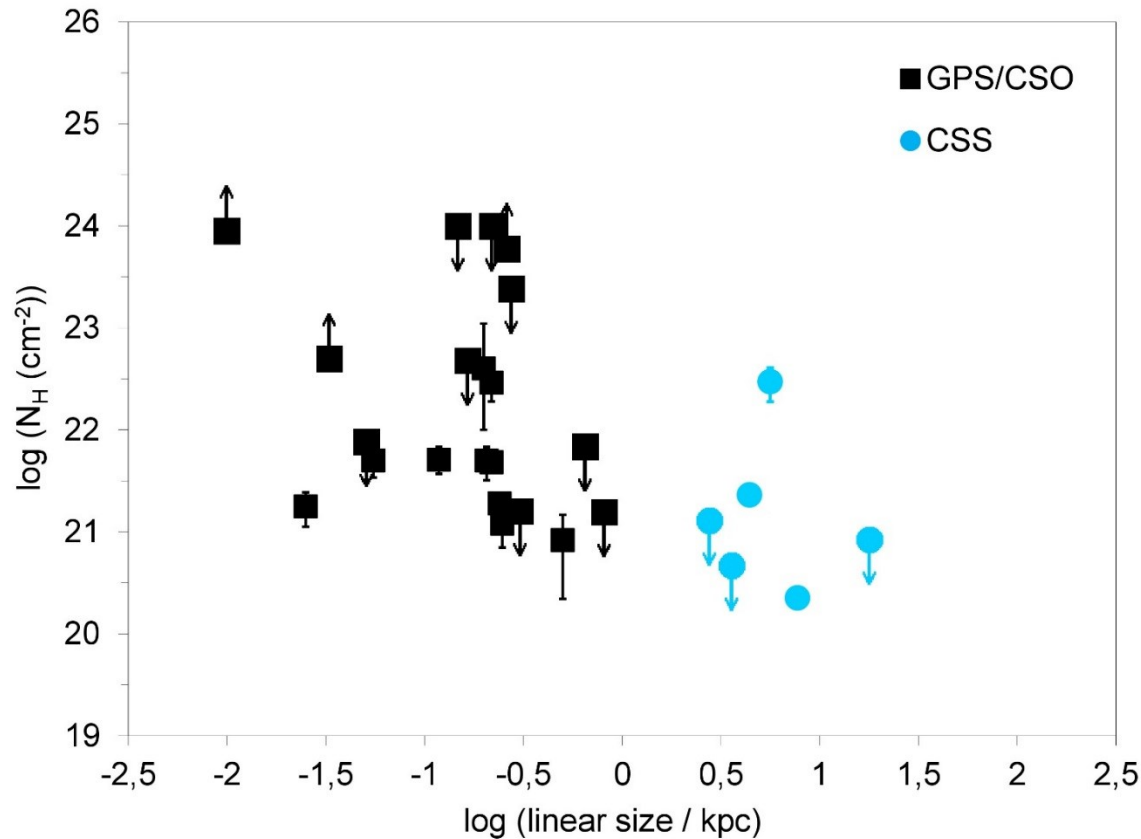
i) in the base of relativistic jet (FRIs) $\square$

ii) in the accretion disk (FRIIs) $\circ$

is already present among the younger compact AGNs.

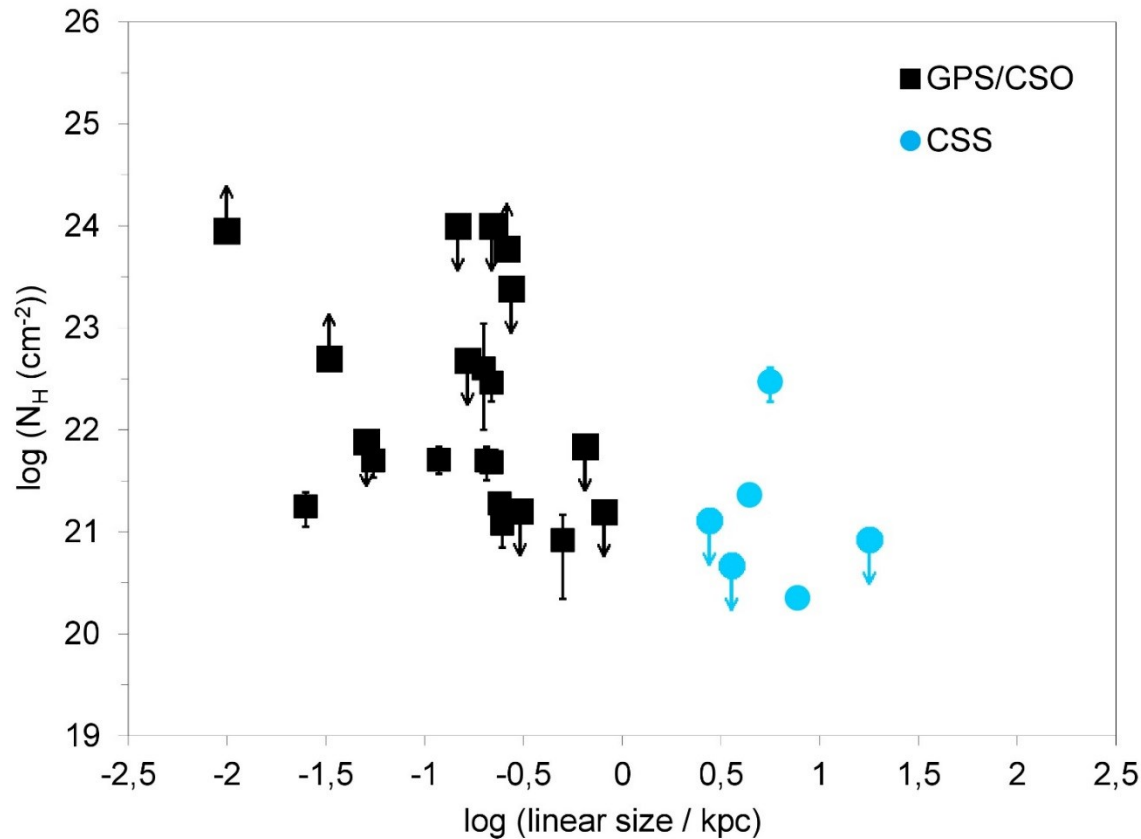
Kunert-Bajraszewska+2014

CHANDRA X-ray observations



Kunert-Bajraszewska+2014

CHANDRA X-ray observations

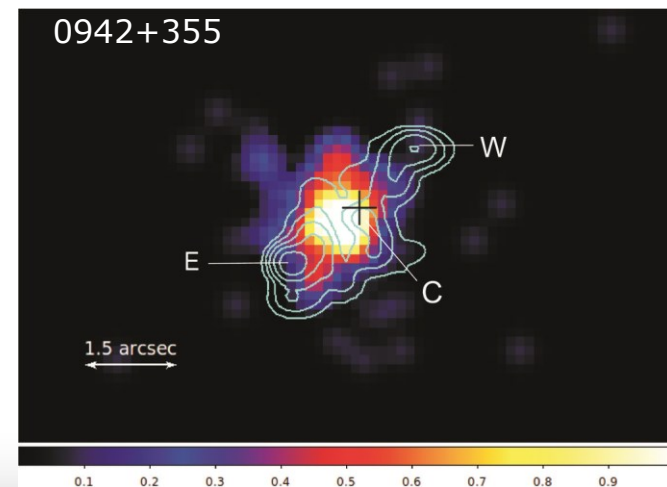
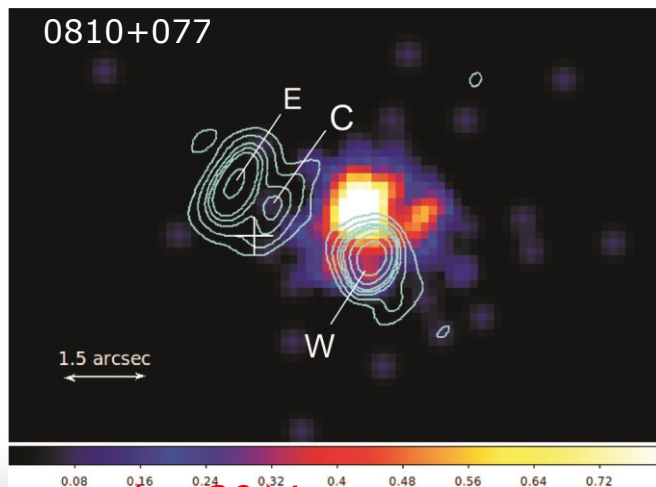


CSS sources are less obscured than the more compact GPSs

Kunert-Bajraszewska+2014

CHANDRA X-ray observations

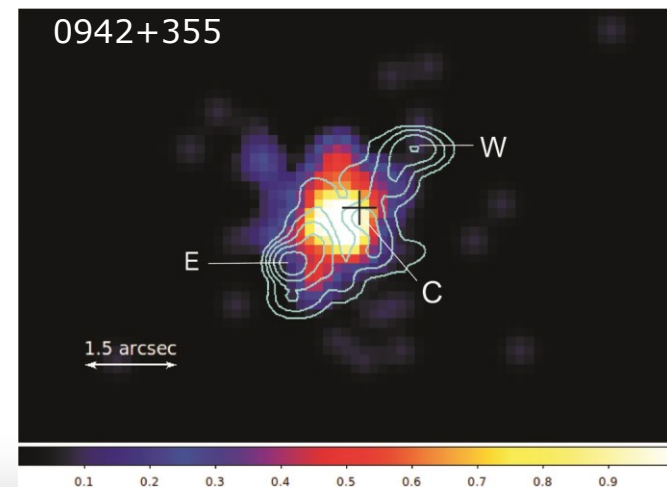
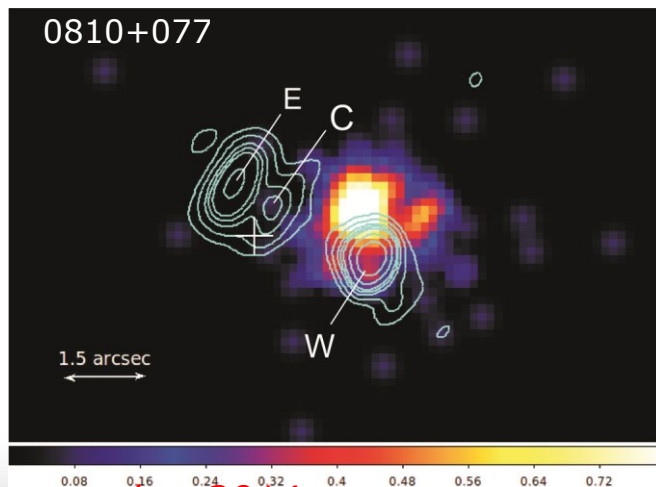
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Kunert-Bajraszewska+2014

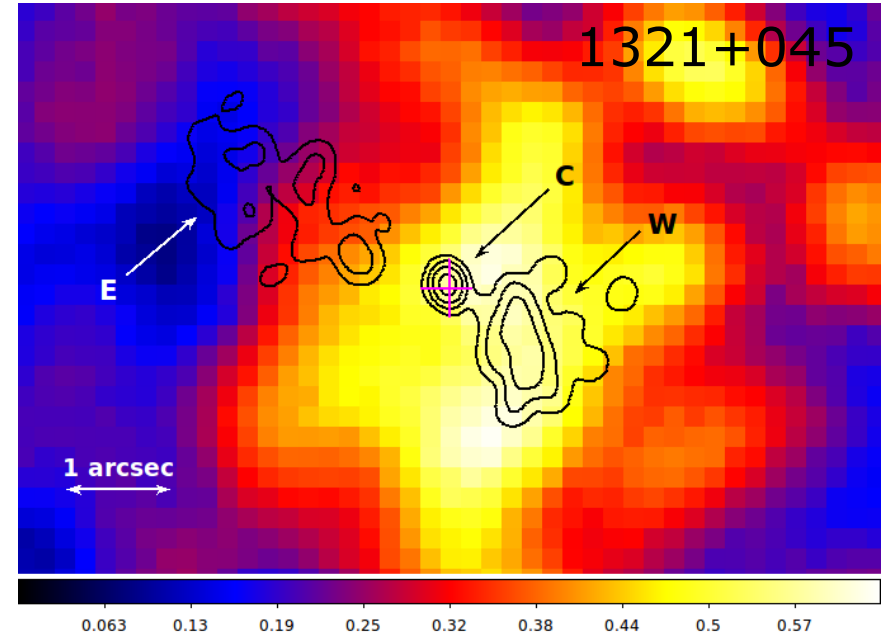
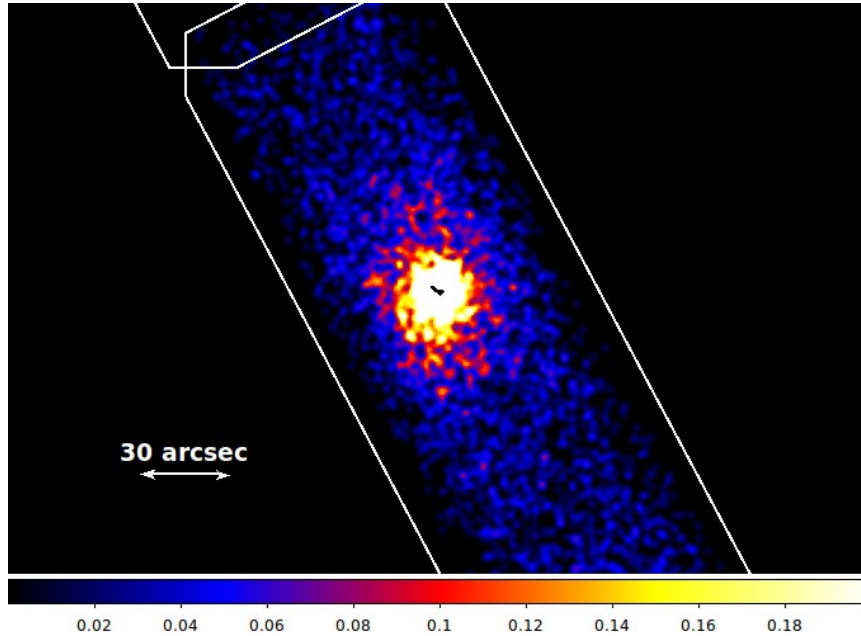
CHANDRA X-ray observations

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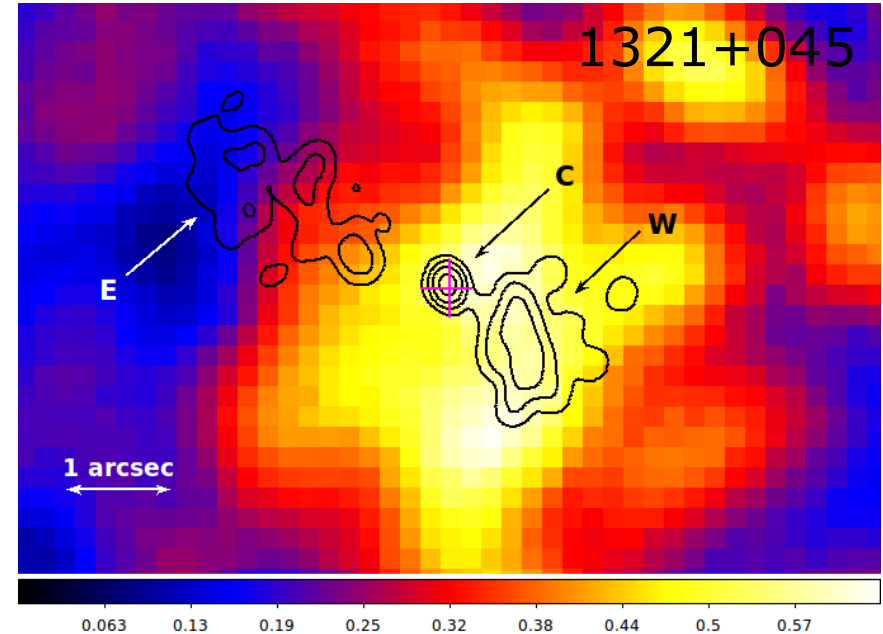
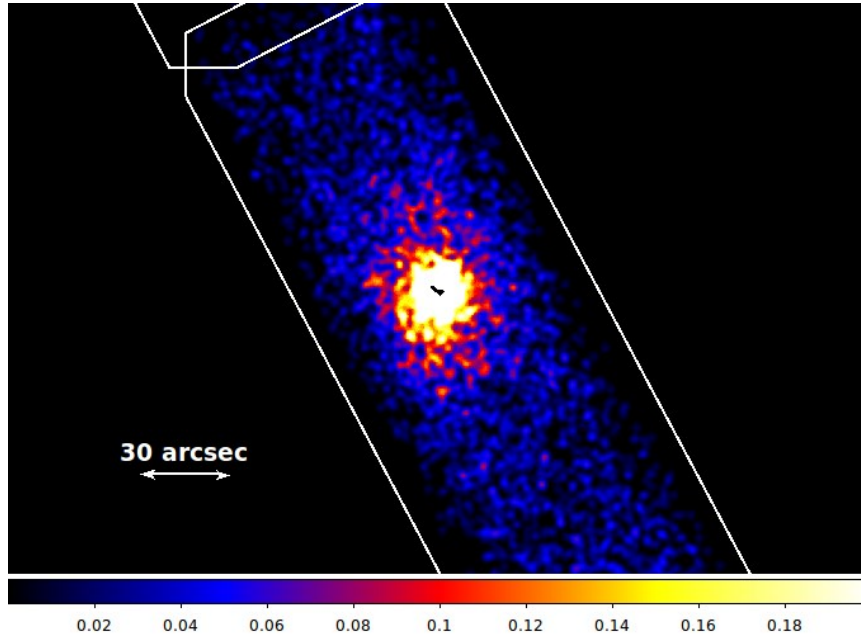
Kunert-Bajraszewska+2014

CSS galaxy associated with an X-ray cluster



Kunert-Bajraszewska, Siemiginowska, Labiano, 2013, ApJL, 772, 7

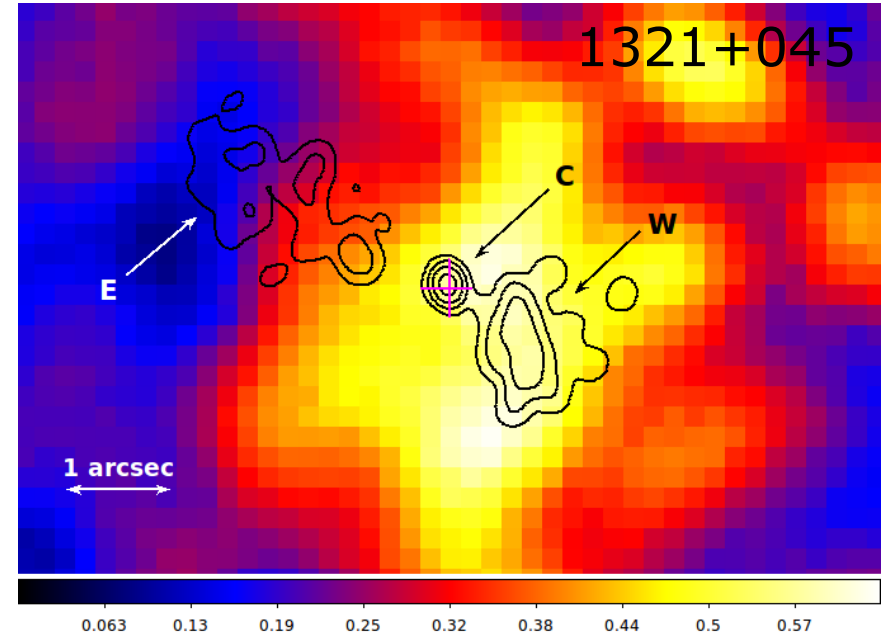
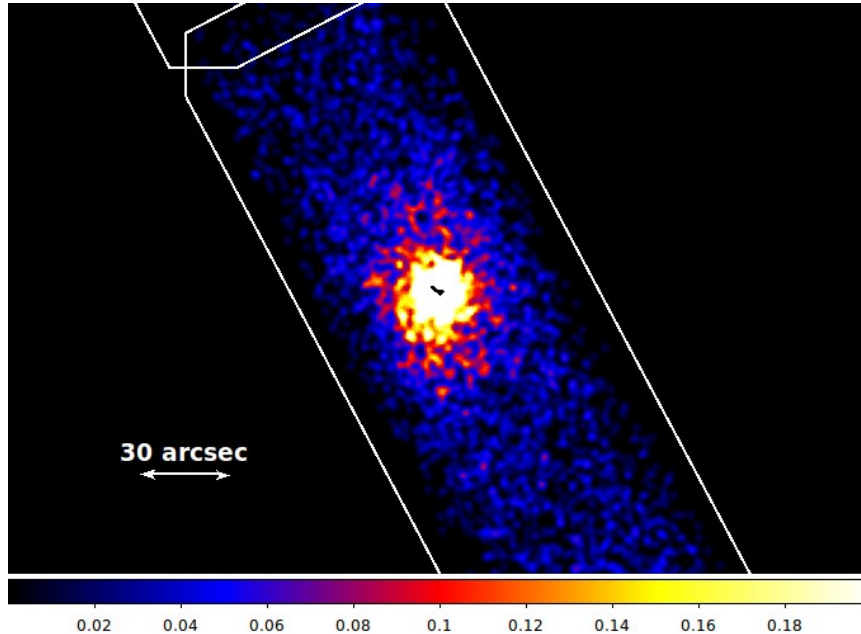
CSS galaxy associated with an X-ray cluster



- Classified as LEG;

Kunert-Bajraszewska, Siemiginowska, Labiano, 2013, ApJL, 772, 7

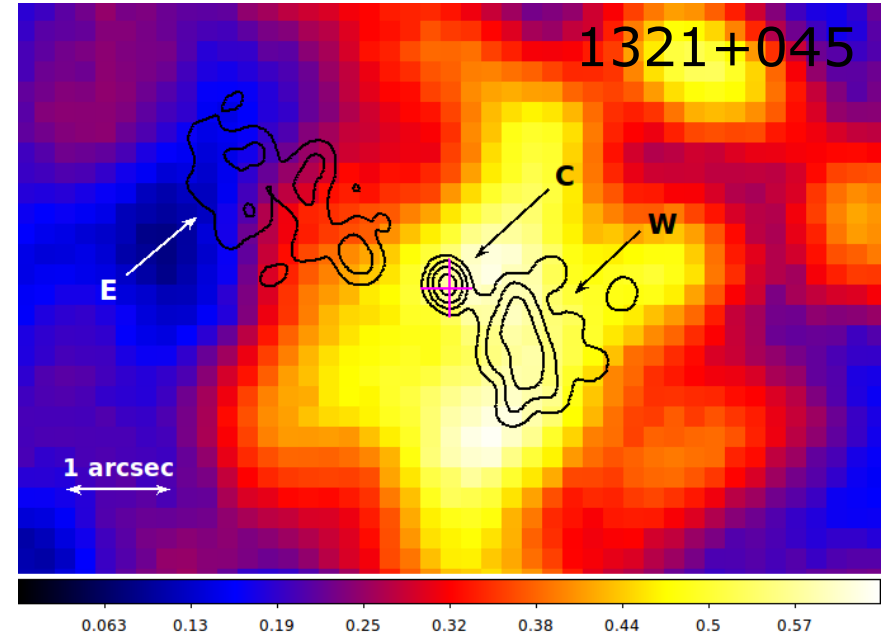
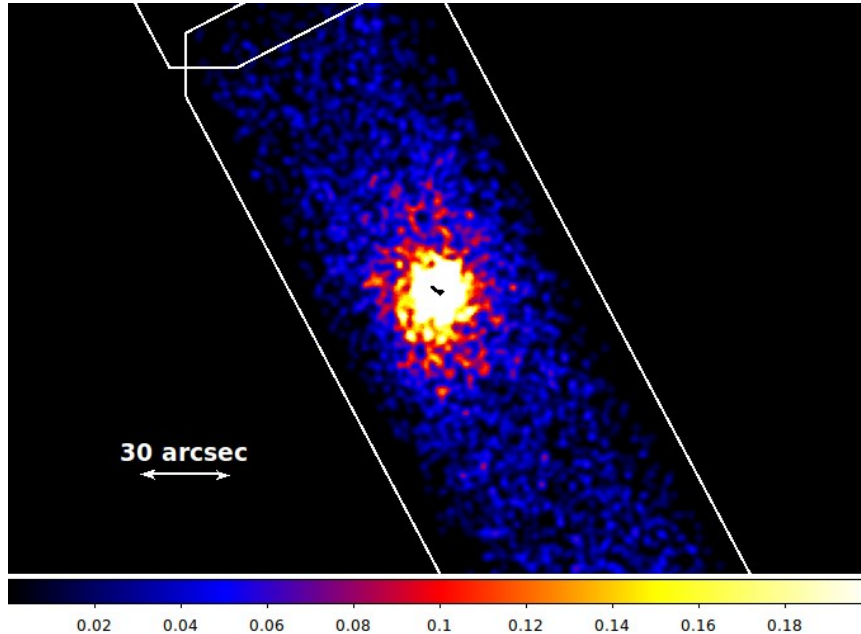
CSS galaxy associated with an X-ray cluster



- Classified as LEG;
- Radio luminosity $\sim 10^{25}$ W/Hz places it in the FRI-FRII transition region;

Kunert-Bajraszewska, Siemiginowska, Labiano, 2013, ApJL, 772, 7

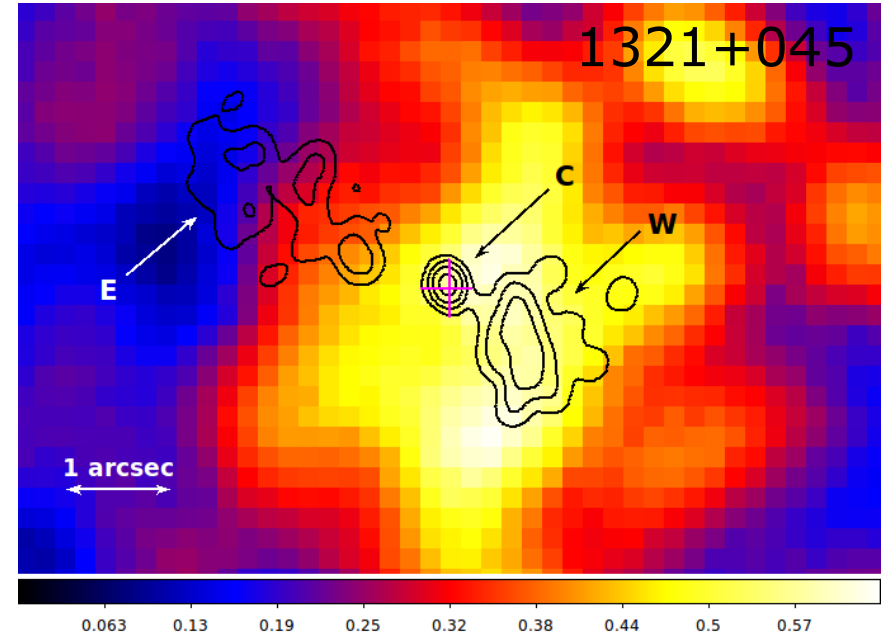
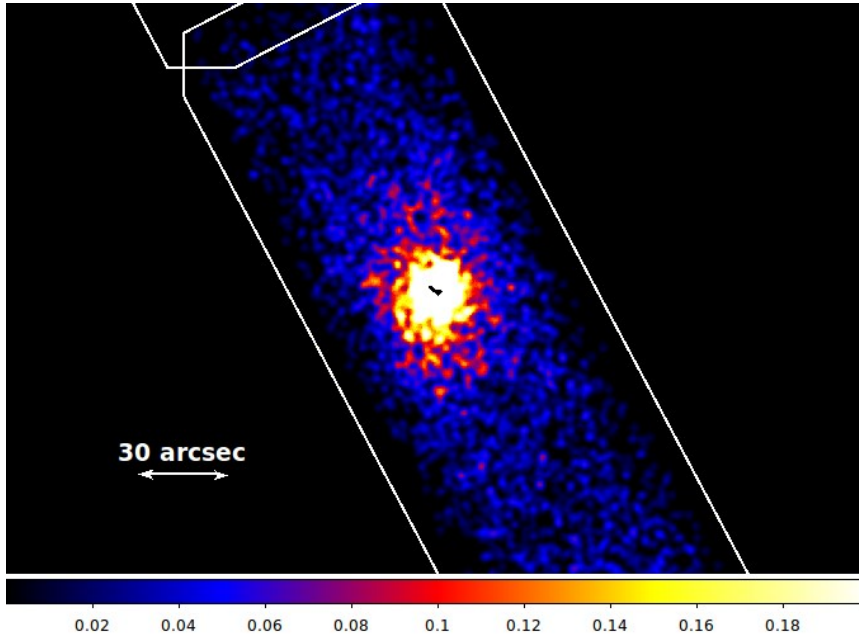
CSS galaxy associated with an X-ray cluster



- Classified as LEG;
- Radio luminosity $\sim 10^{25}$ W/Hz places it in the FRI-FRII transition region;
- X-ray emission is uniform;

Kunert-Bajraszewska, Siemiginowska, Labiano, 2013, ApJL, 772, 7

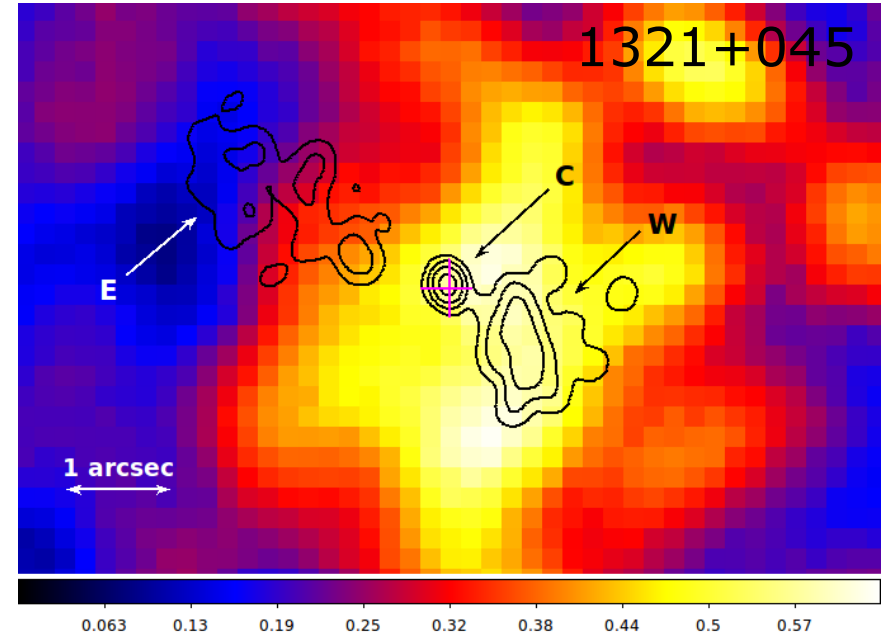
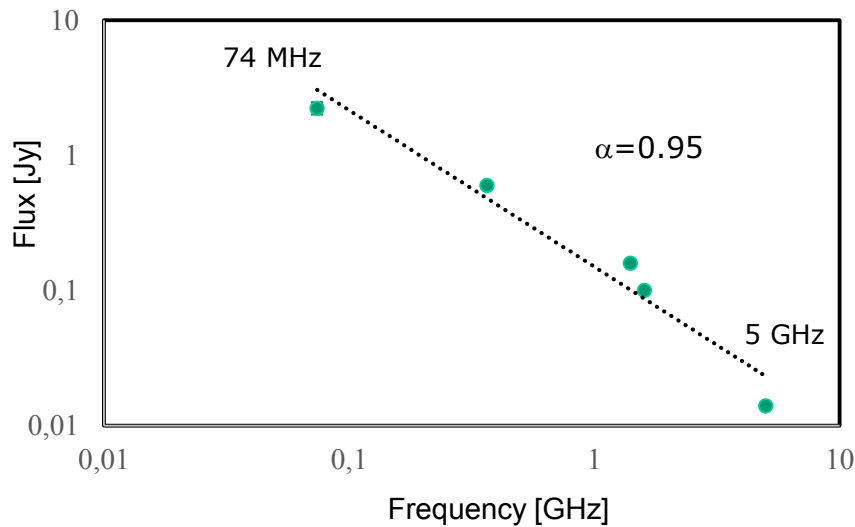
CSS galaxy associated with an X-ray cluster



- Classified as LEG;
- Radio luminosity $\sim 10^{25}$ W/Hz places it in the FRI-FRII transition region;
- X-ray emission is uniform;
- Magnetic pressure $\cong$ central thermal pressure; the cluster environment can limit the growth of this source;

Kunert-Bajraszewska, Siemiginowska, Labiano, 2013, ApJL, 772, 7

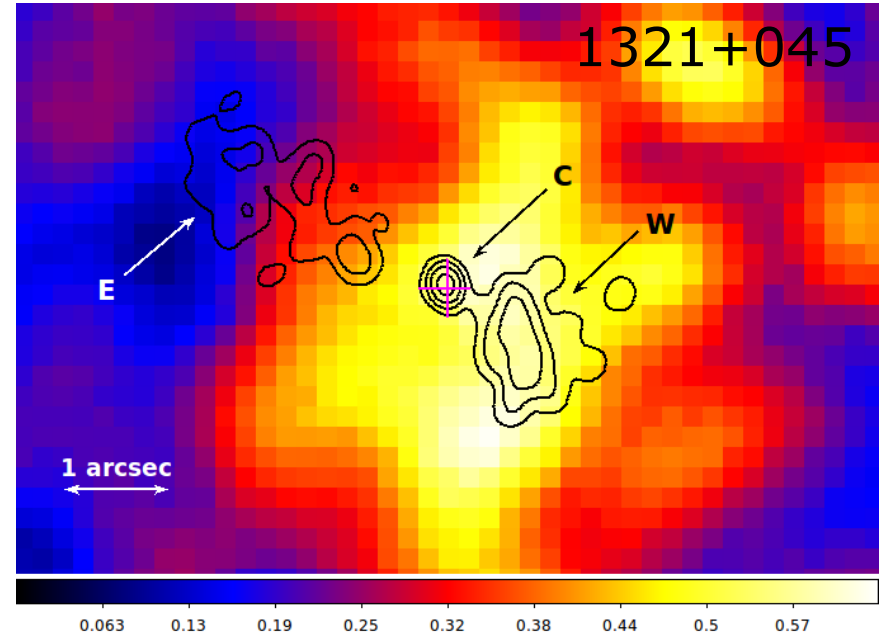
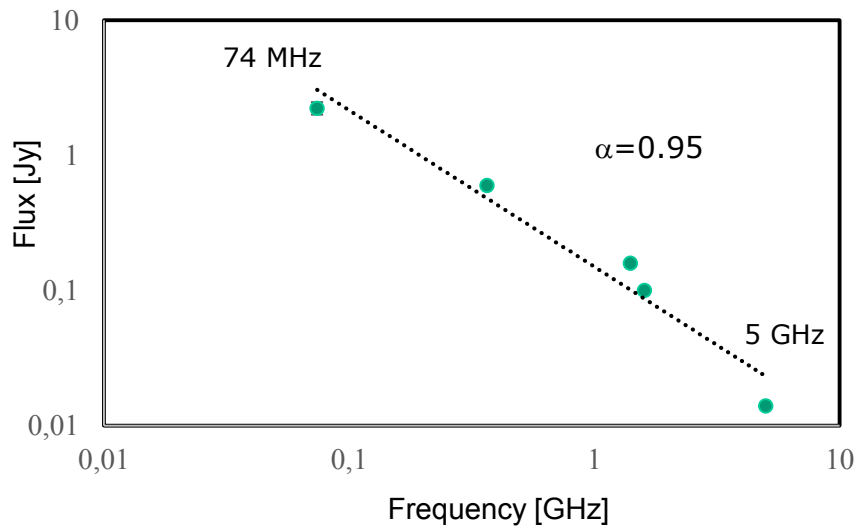
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Kunert-Bajraszewska, Siemiginowska, Labiano, 2013, ApJL, 772, 7

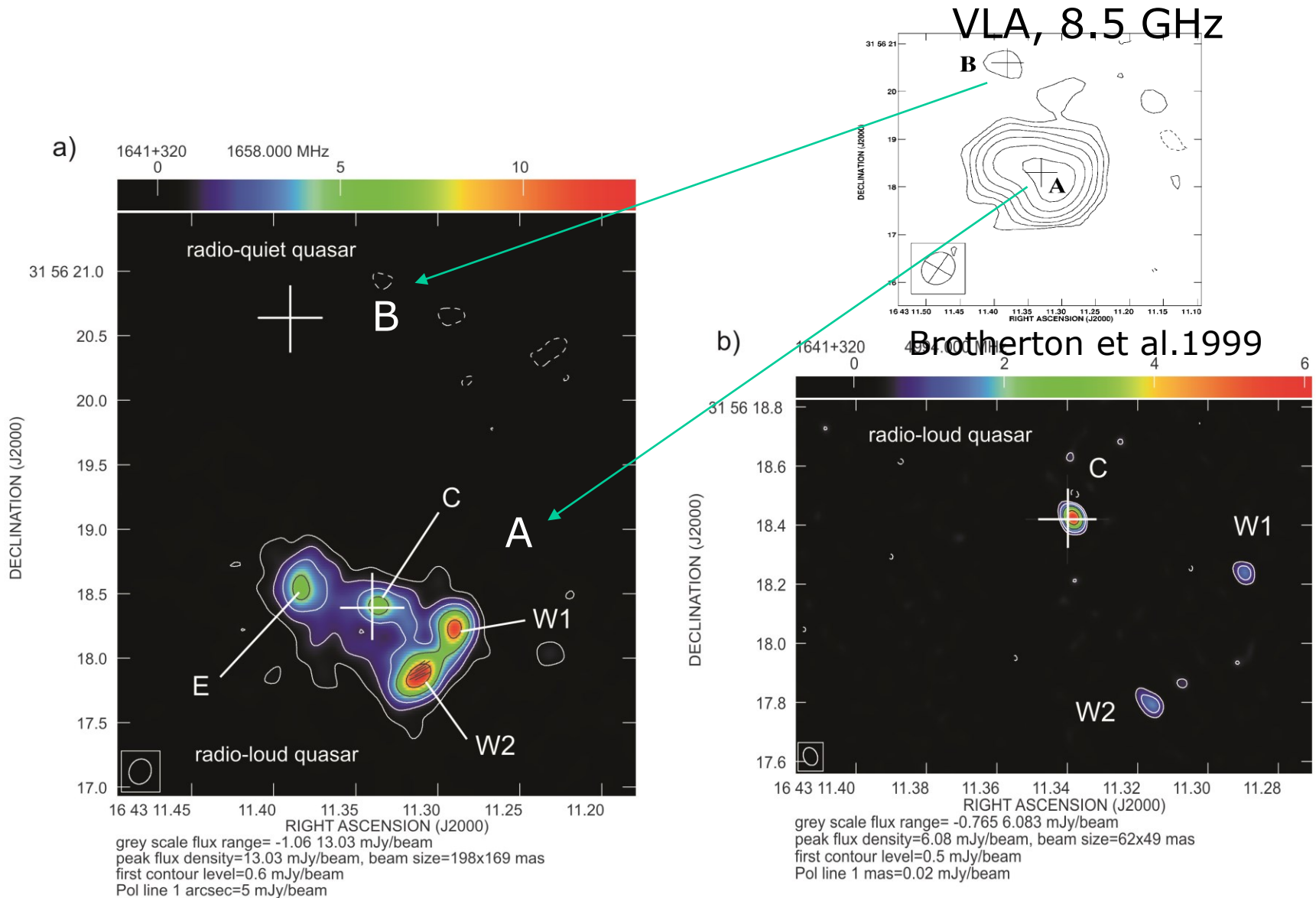
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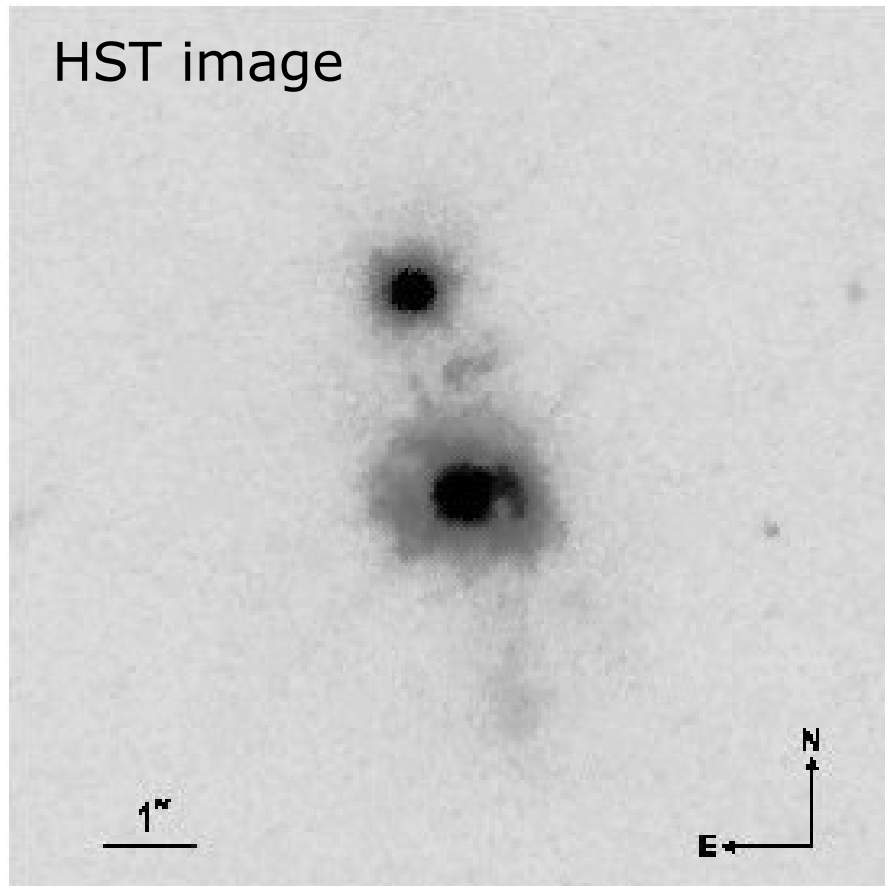
- Classified as LEG;
- Radio luminosity $\sim 10^{25}$ W/Hz places it in the FRI-FRII transition region;
- X-ray emission is uniform;
- Magnetic pressure $\cong$ central thermal pressure; the cluster environment can limit the growth of this source;
- Estimated age $\sim 10^6$ years

Kunert-Bajraszewska, Siemiginowska, Labiano, 2013, ApJL, 772, 7

Binary quasar FIRST J164311.3+315618

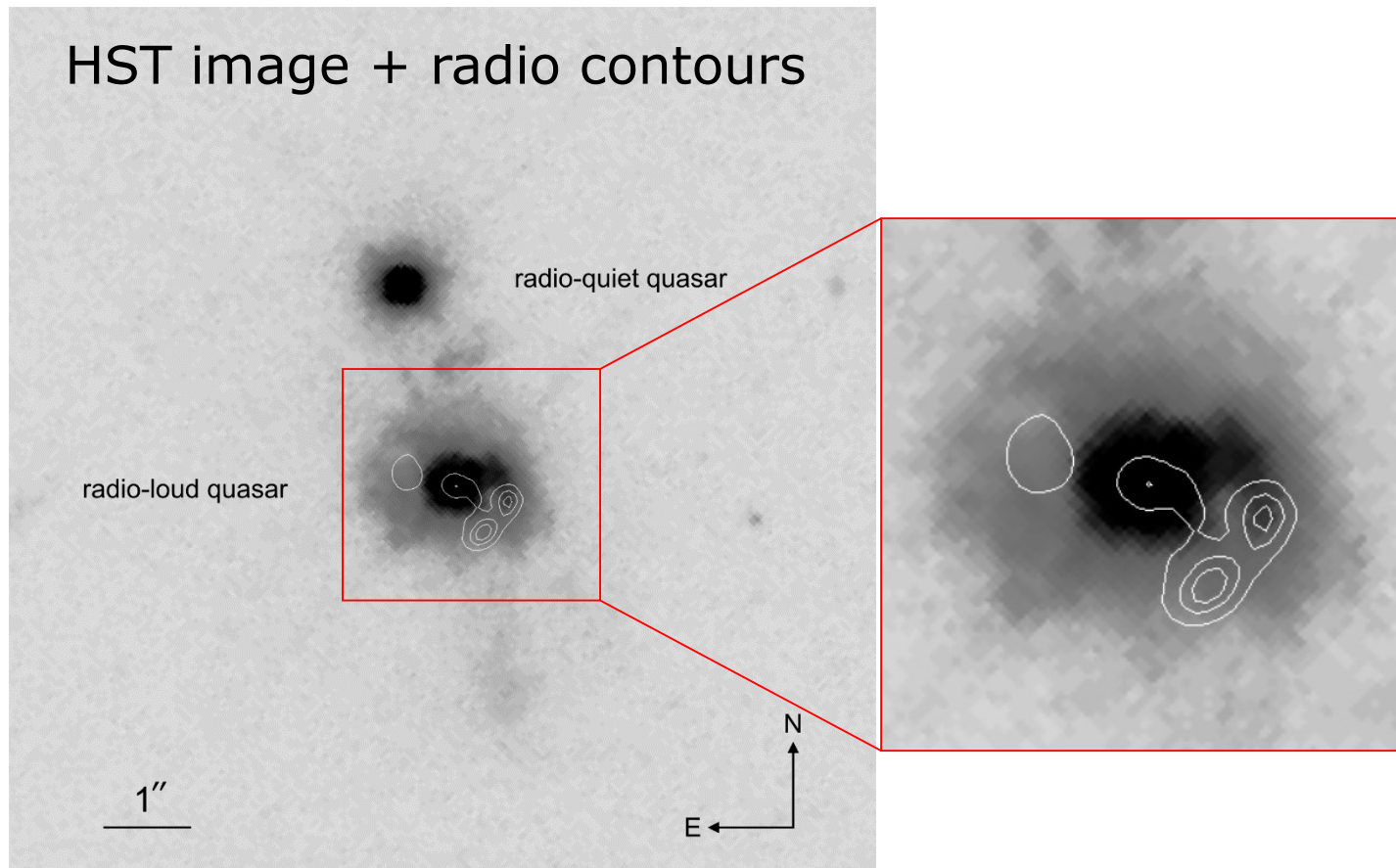


Binary quasar



Martel+2005

Binary quasar



Kunert-Bajraszewska & Janiuk, 2011, ApJ, 736, 125



The End