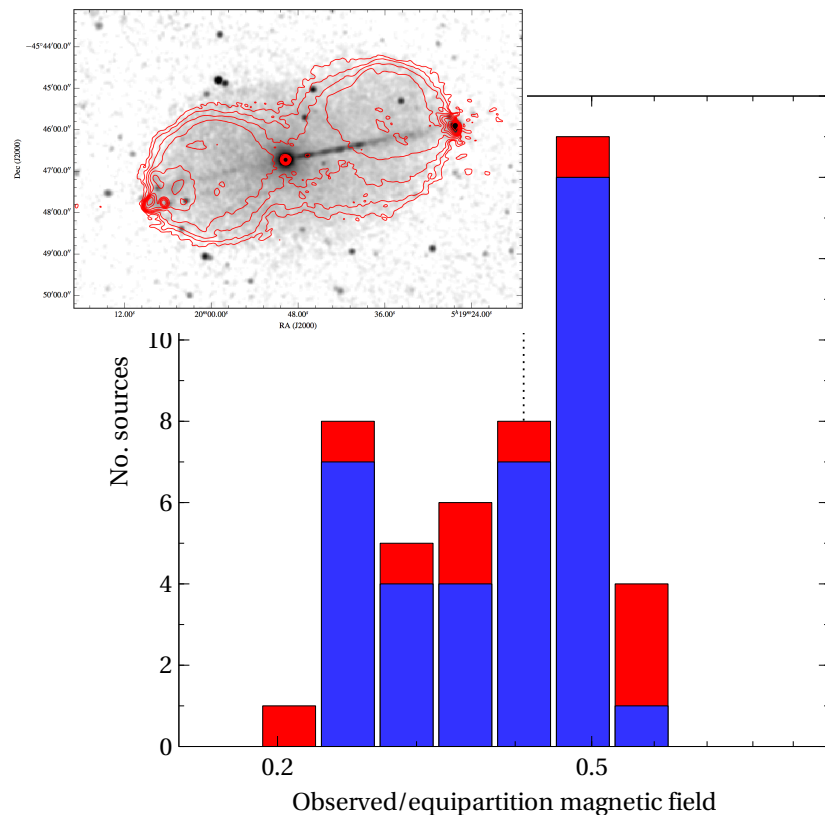
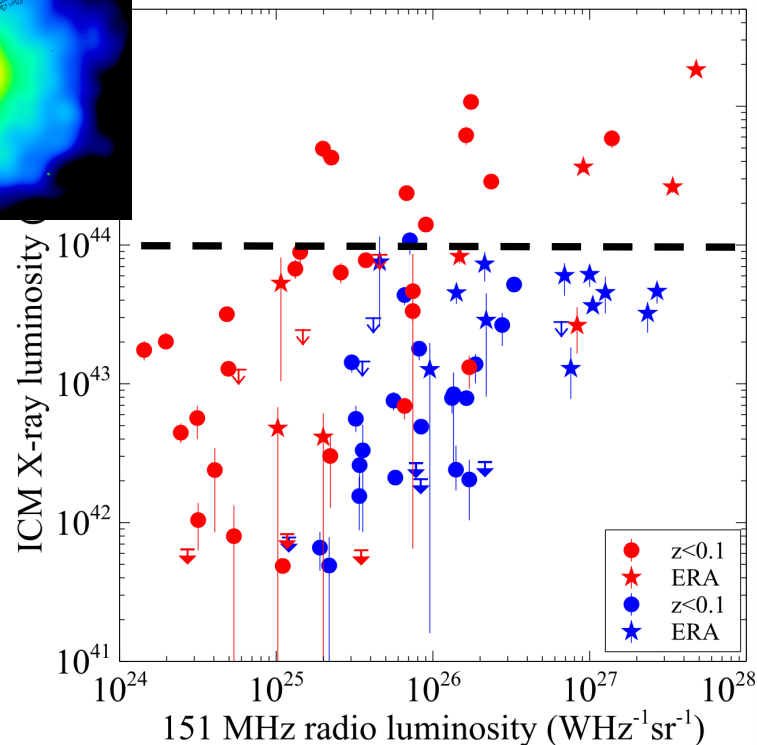
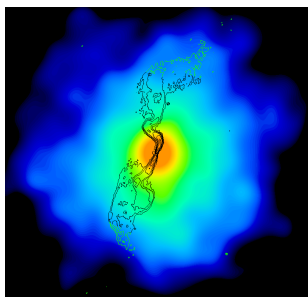


The LOFAR (and X-ray) view of extragalactic jet populations

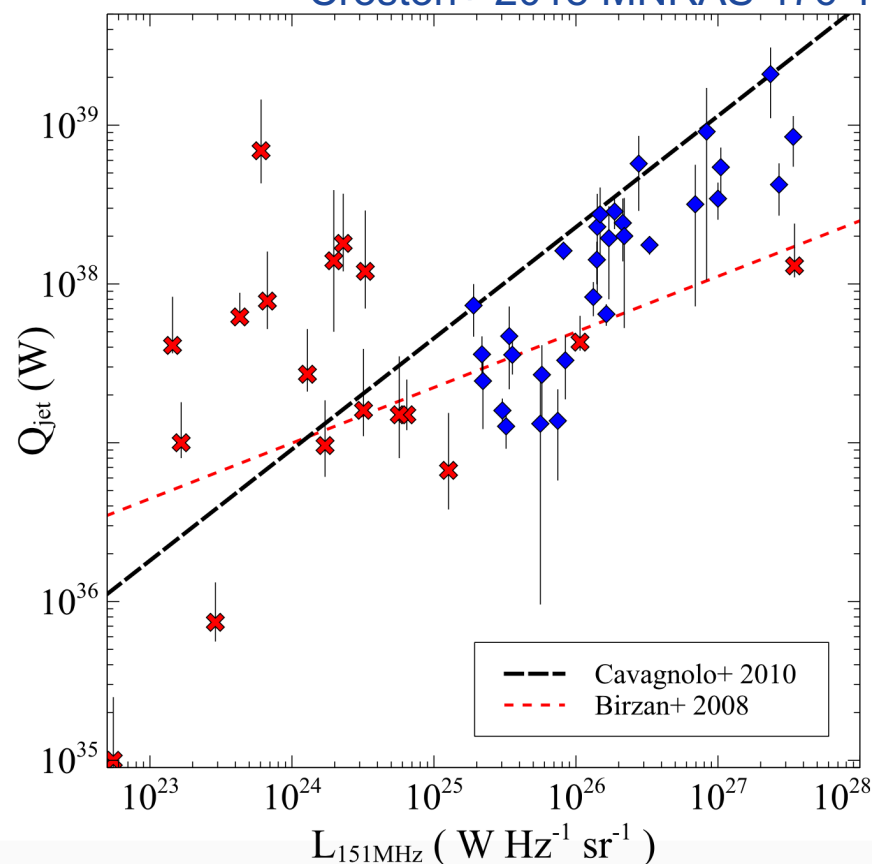
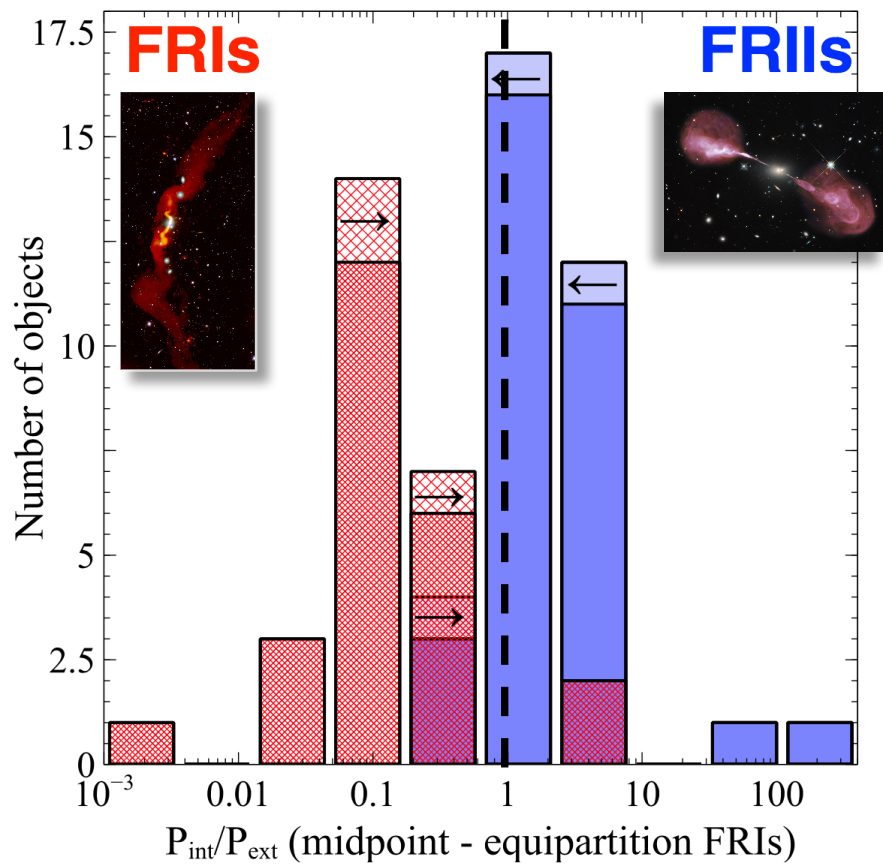
Judith Croston

Thanks to Beatriz Mingo, Judith Ineson, Brendan Webster,
Bonny Barkus + LOFAR surveys team

Internal conditions and environments from X-rays



Morphology and internal conditions



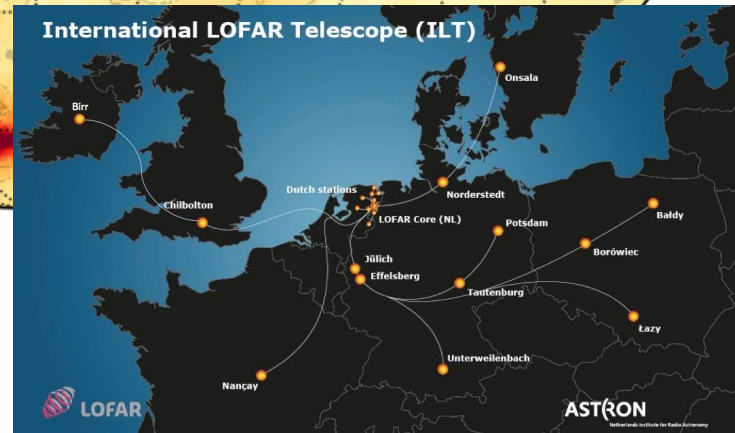
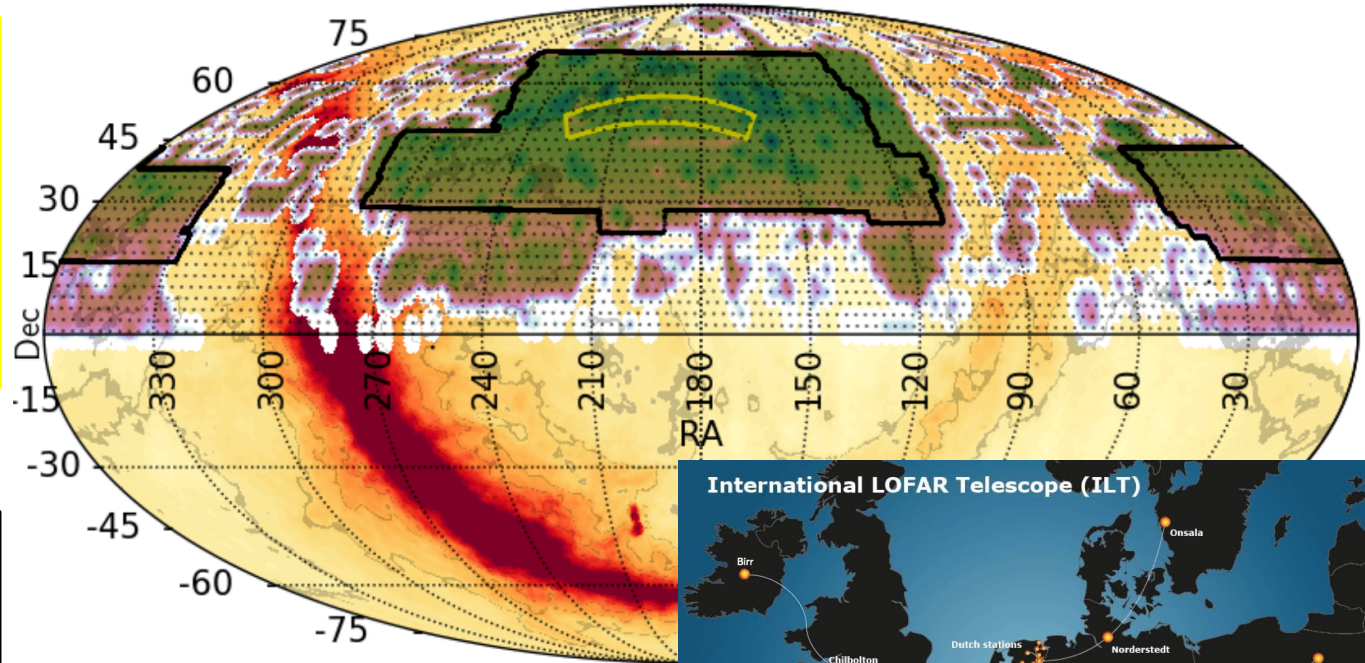
LOFAR extragalactic surveys

DR1
Shimwell+ 2019
A&A 622 1

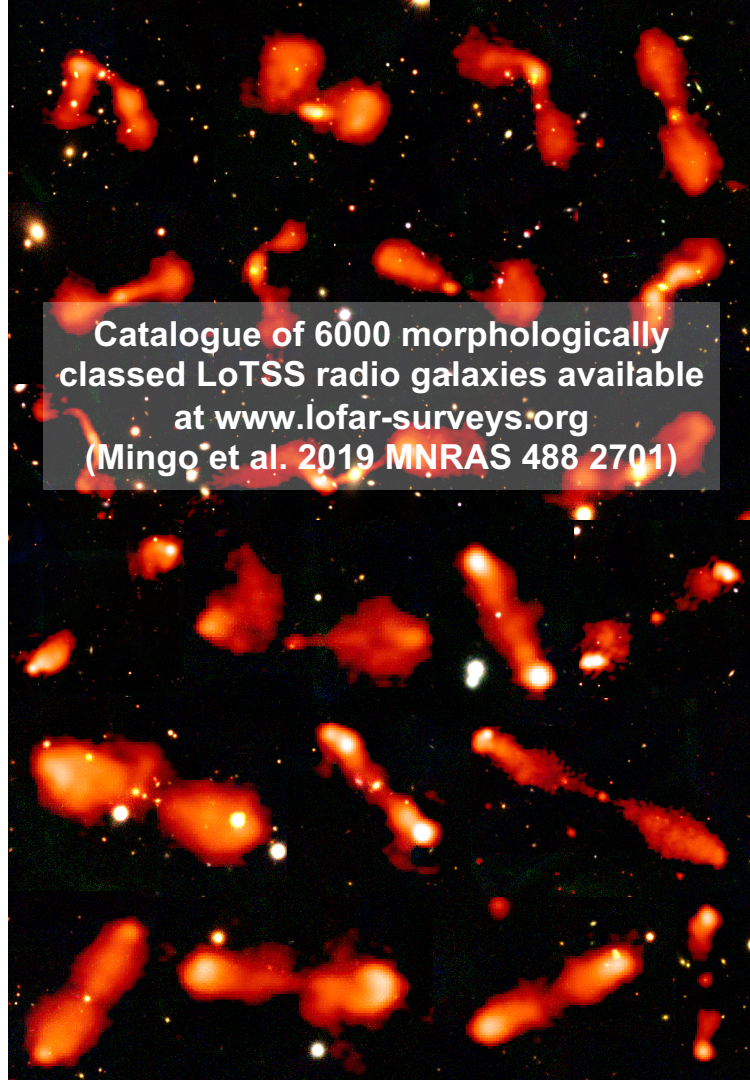
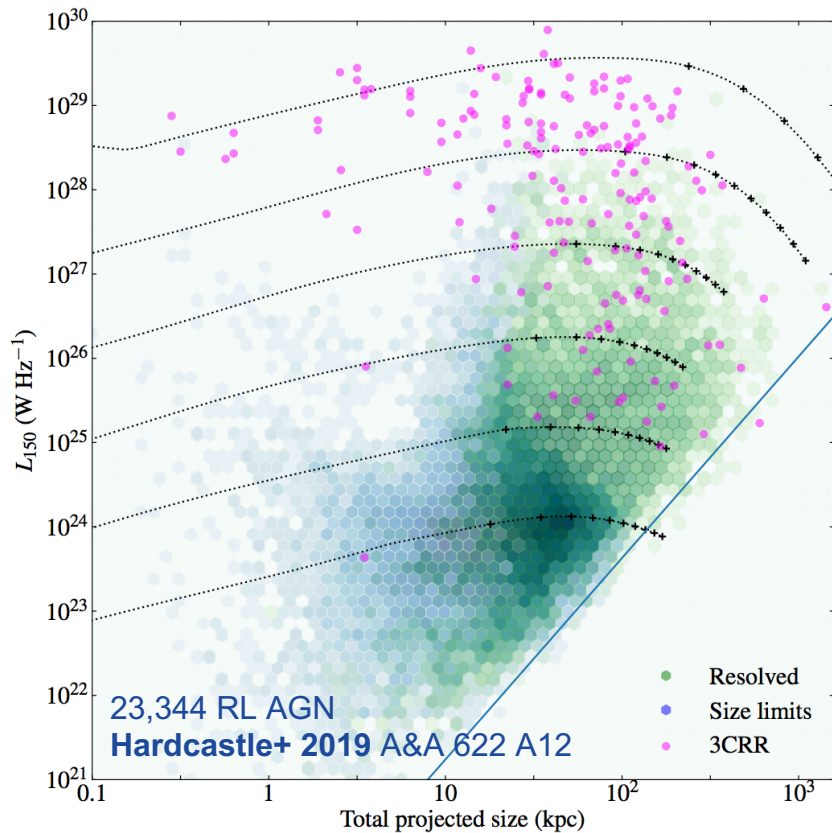
424 deg²
300,000 sources
51% with redshifts

DR2
Shimwell+ in prep

5635 deg²
4.4 million sources



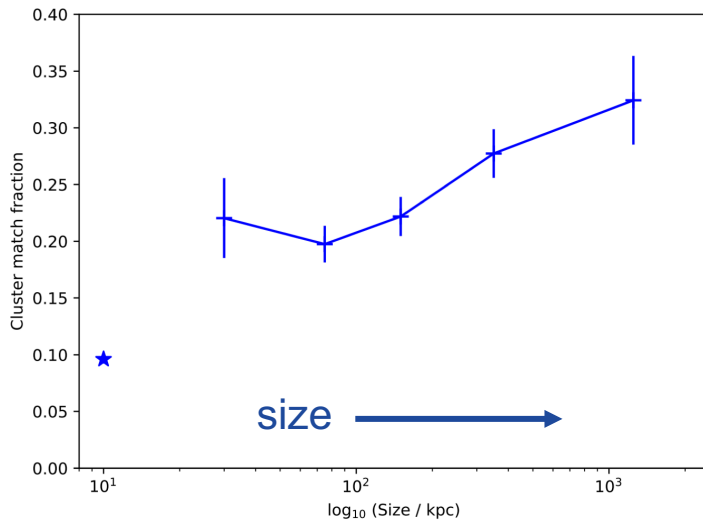
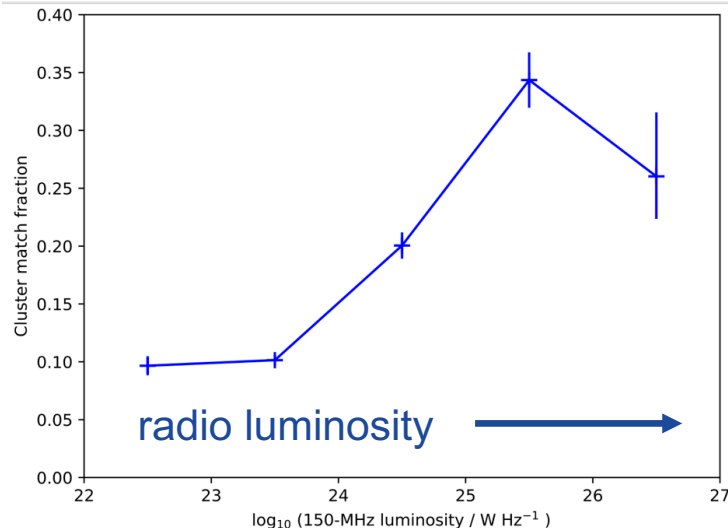
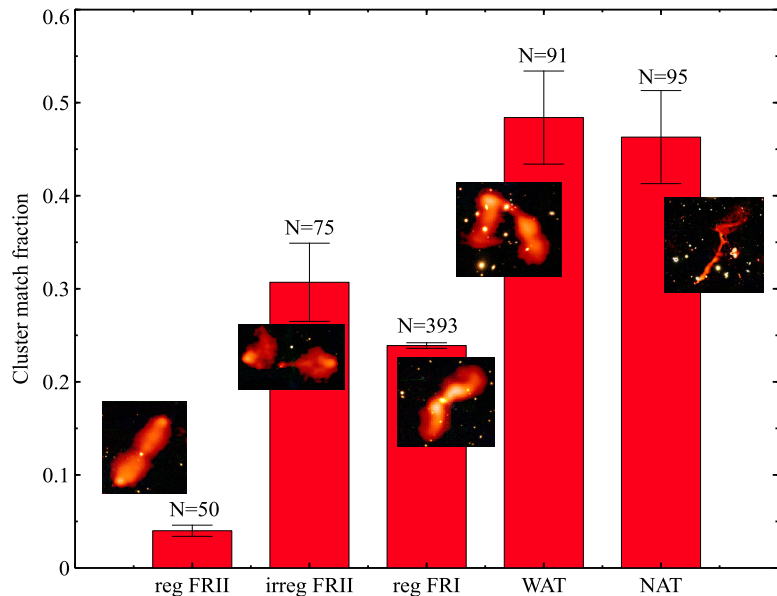
Resolved jet structures in LoTSS



Catalogue of 6000 morphologically
classed LoTSS radio galaxies available
at www.lofar-surveys.org
(Mingo et al. 2019 MNRAS 488 2701)

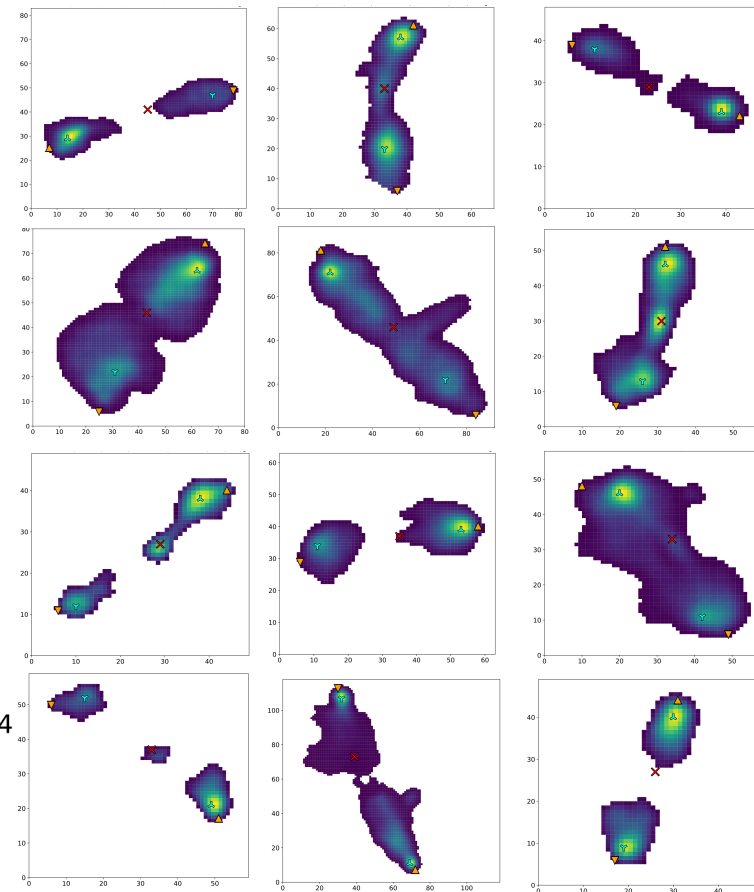
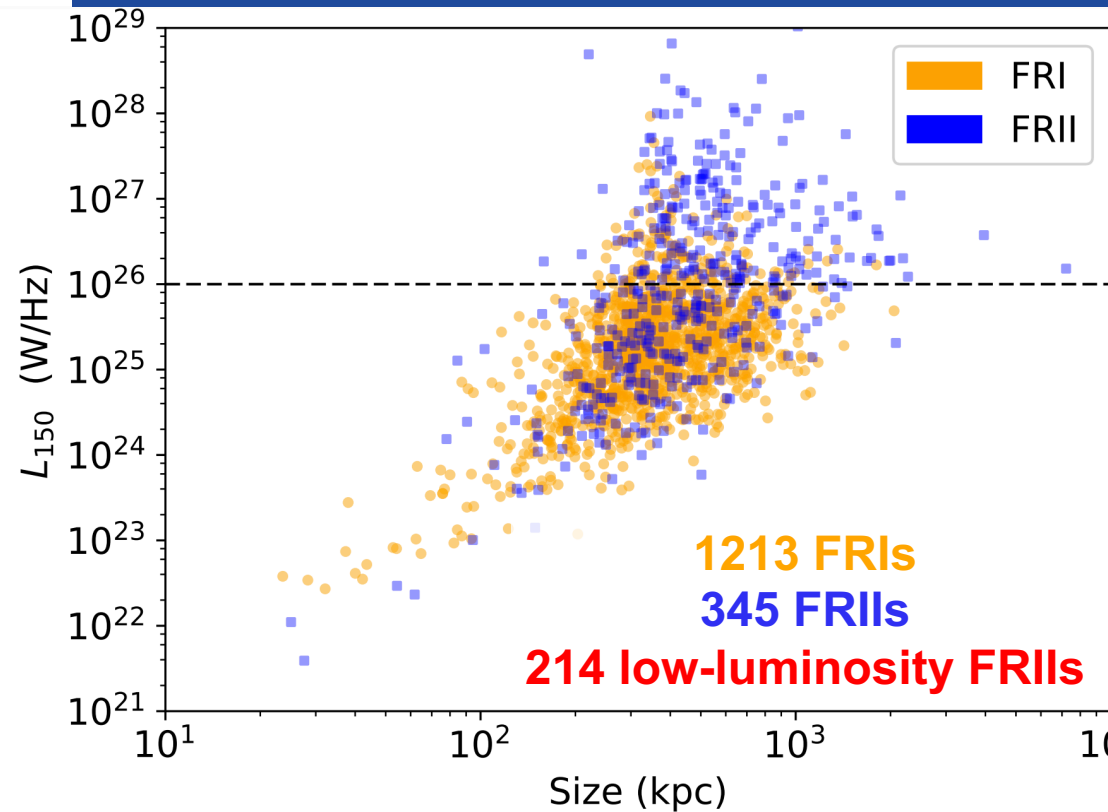
Group/cluster environments

8475 RL AGN matched with SDSS groups/clusters
= 900 jet/cluster associations



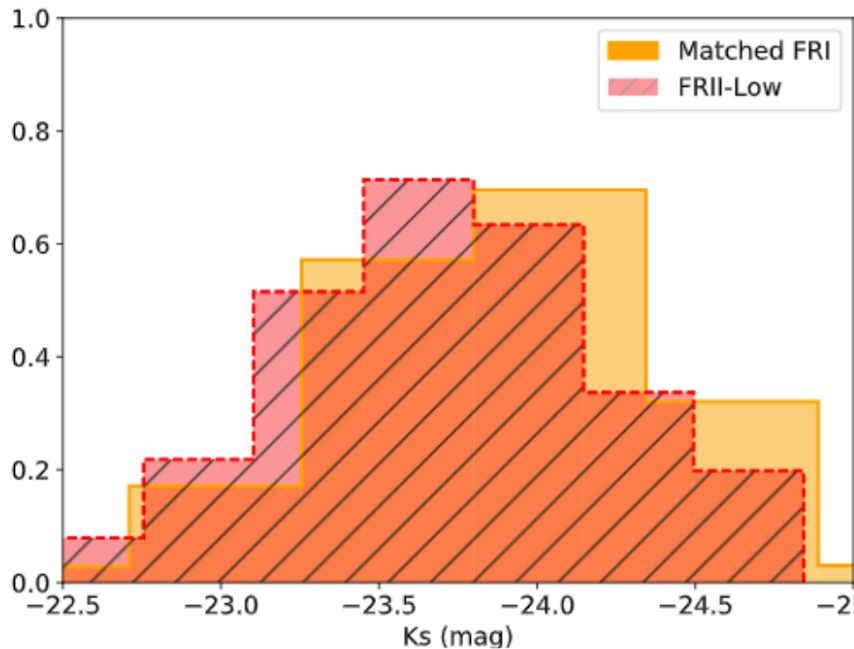
Croston et al. 2019 A&A 622 A10 and
Hardcastle & Croston 2020 NewRevAst, 88 (arXiv:2003.06137)
See also Ineson+ 2015 MNRAS for comprehensive X-ray view

Revisiting the FR paradigm with LOFAR

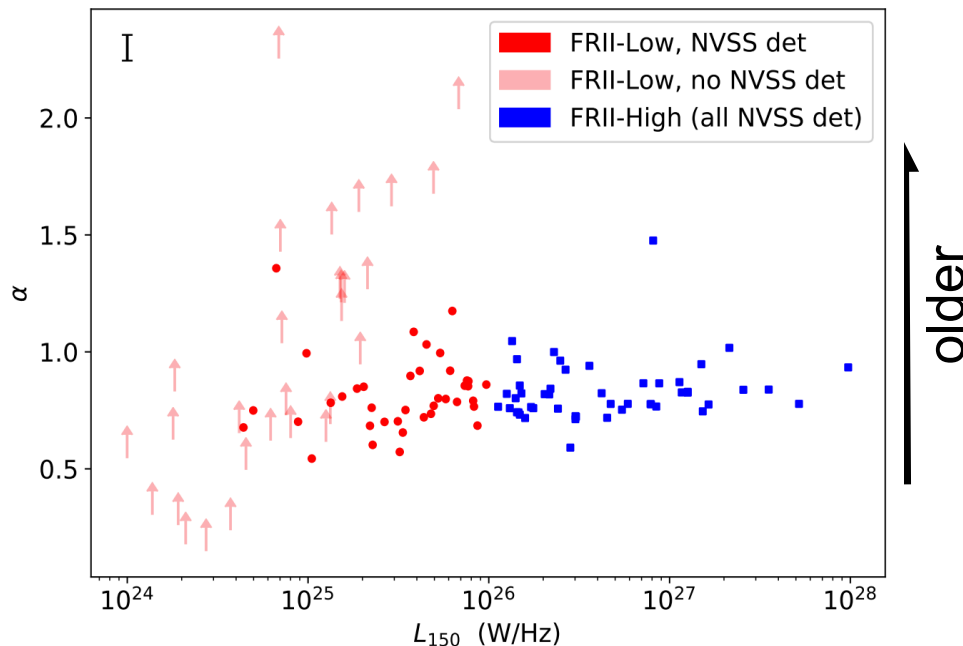


Revisiting the FR paradigm with LOFAR

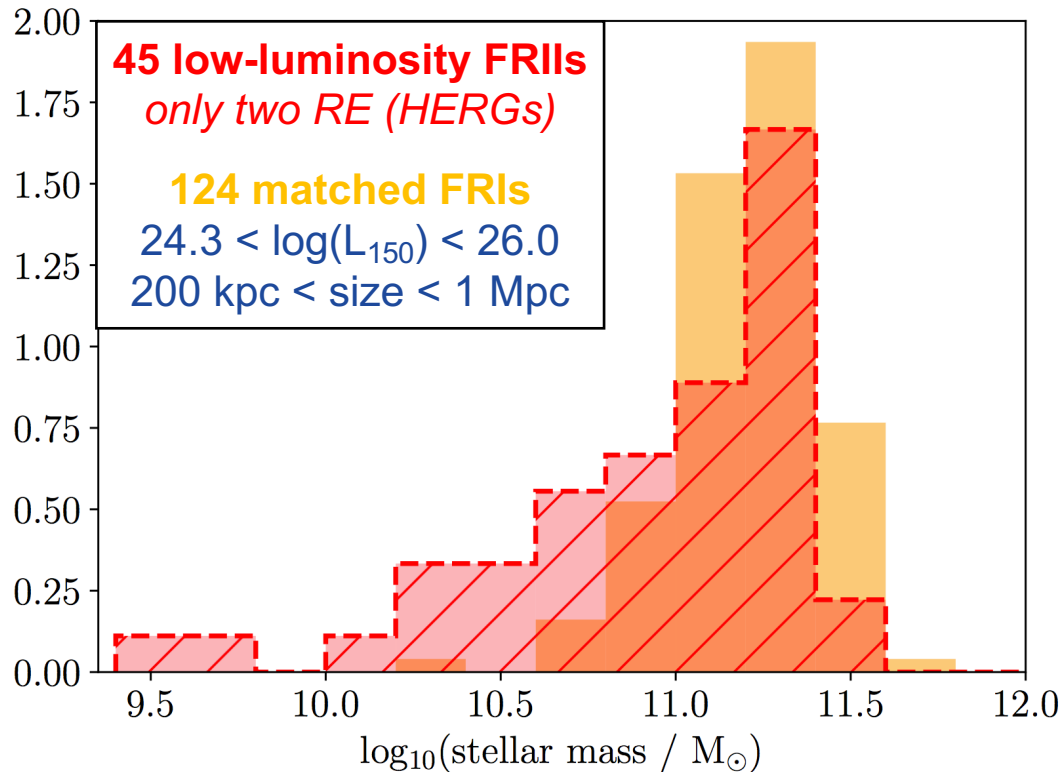
Mingo et al. 2019 MNRAS 488 2701



145 low-luminosity FRIIs
847 matched FRIs



How does environment affect low-power jets?



LOFAR deep fields dataset:

Tasse+ 2021 A&A 648 1

Sabater+ 2021 A&A 648 2

Kondapally+ 2021 A&A 648 2

Duncan+ 2021 A&A 648 4

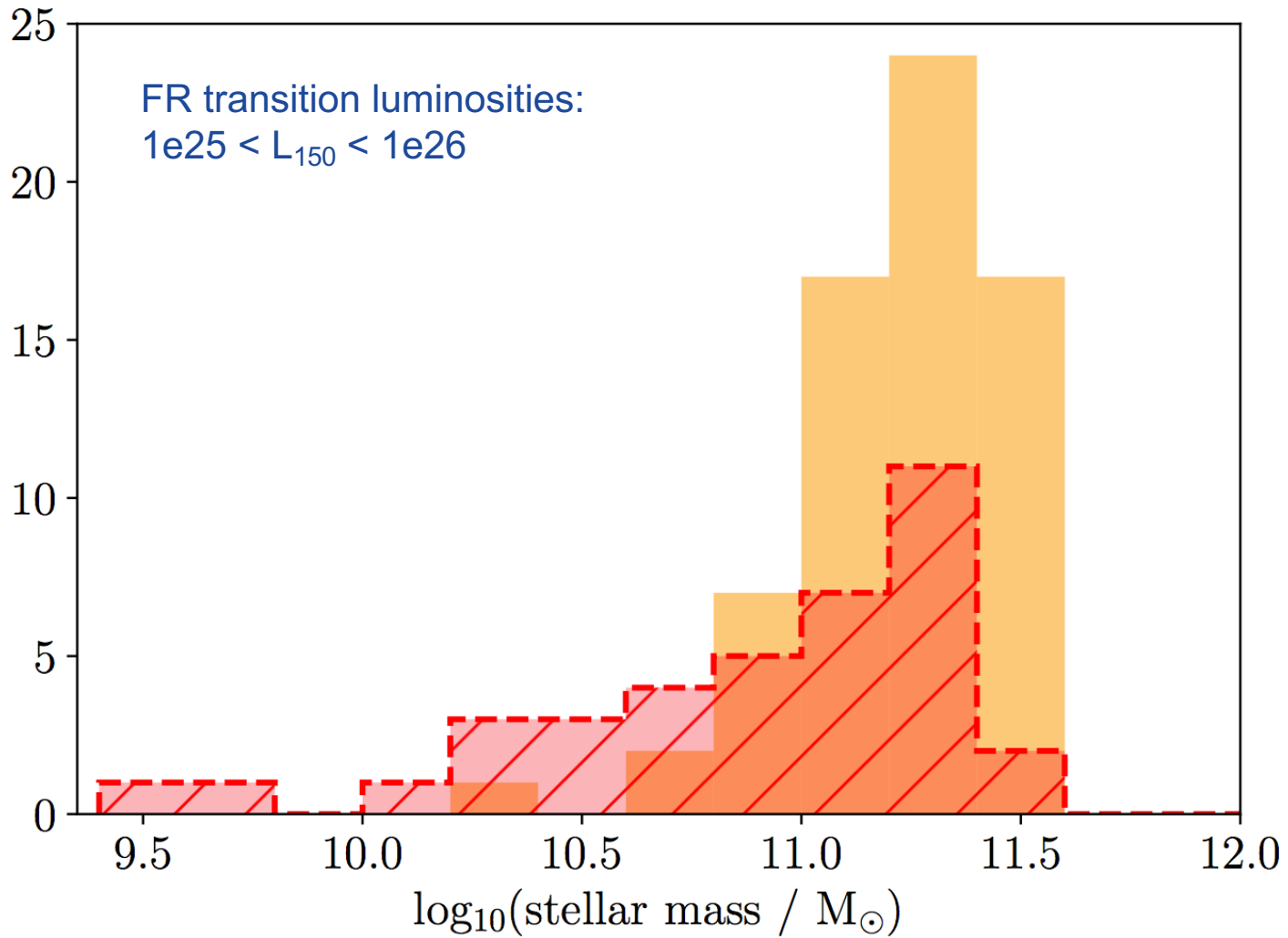
Catalogues and images at

www.lofar-surveys.org/deepfields.html

Low-power jets are 2-3x more likely to be an FRI than an FR2.

But probability of FR2 morphology increases at low stellar mass.

unrelated to accretion mode



Accretion mode and morphology in LOFAR deep fields

	HERG (RE)	LERG (RI)
FR II high	24 (35%)	45 (65%)
FR II low	5 (9%)	52 (91%)
FR II all	29 (24%)	96 (76%)
FRI	7 (4%)	153 (96%)
<i>Small/unresolved RLAGN</i>	1225 (8%)	13,215 (92%)

+ see **Webster, JC+ 2021** MNRAS 500 4921 for more on small jets in LOFAR surveys

Summary

- Deep, representative sample X-ray studies demonstrate a **physical difference in FRI and FRII particle content**, best explained by entrainment in FRIs.
- LOFAR surveys reveal a new population of **low-luminosity FRIIs**
- The evolution of low-power jets (i.e. whether FRI or low-luminosity FRII) linked to **stellar mass** and not accretion mode.
- **Accretion mode** is decoupled from jet and lobe dynamics and appearance: luminous jets can be RI or RE irrespective of morphology, while low-luminosity jets are typically RI.
- LOFAR catalogues and images, including 6000 morphologically classed radio galaxies, and 900 jet/cluster associations, at **www.lofar-surveys.org**

