

**A Wide and Deep Exploration of Radio-detected
Active Galactic Nuclei with Subaru HSC (WERGS).
High-z Radio Quasar candidates from HSC-VLASS
over $\sim 1200 \text{ deg}^2$**

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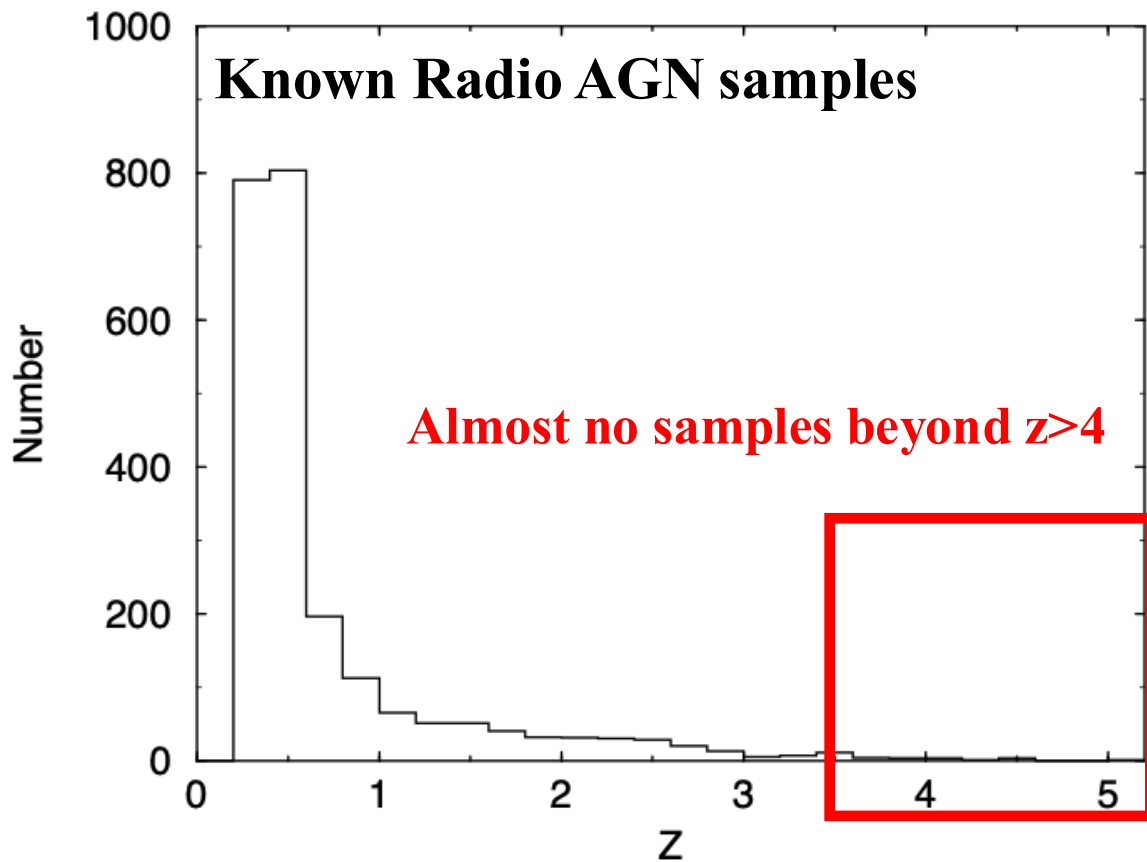
Collaborators: Kohei Ichikawa, Yuxing Zhong, Xiaoyang Chen
(Tohoku U.), Hisakazu Uchiyama (Hosei U.), Kotaro Kohno (U.Tokyo),
and WERGS Team

Search for Radio AGNs beyond the cosmic noon

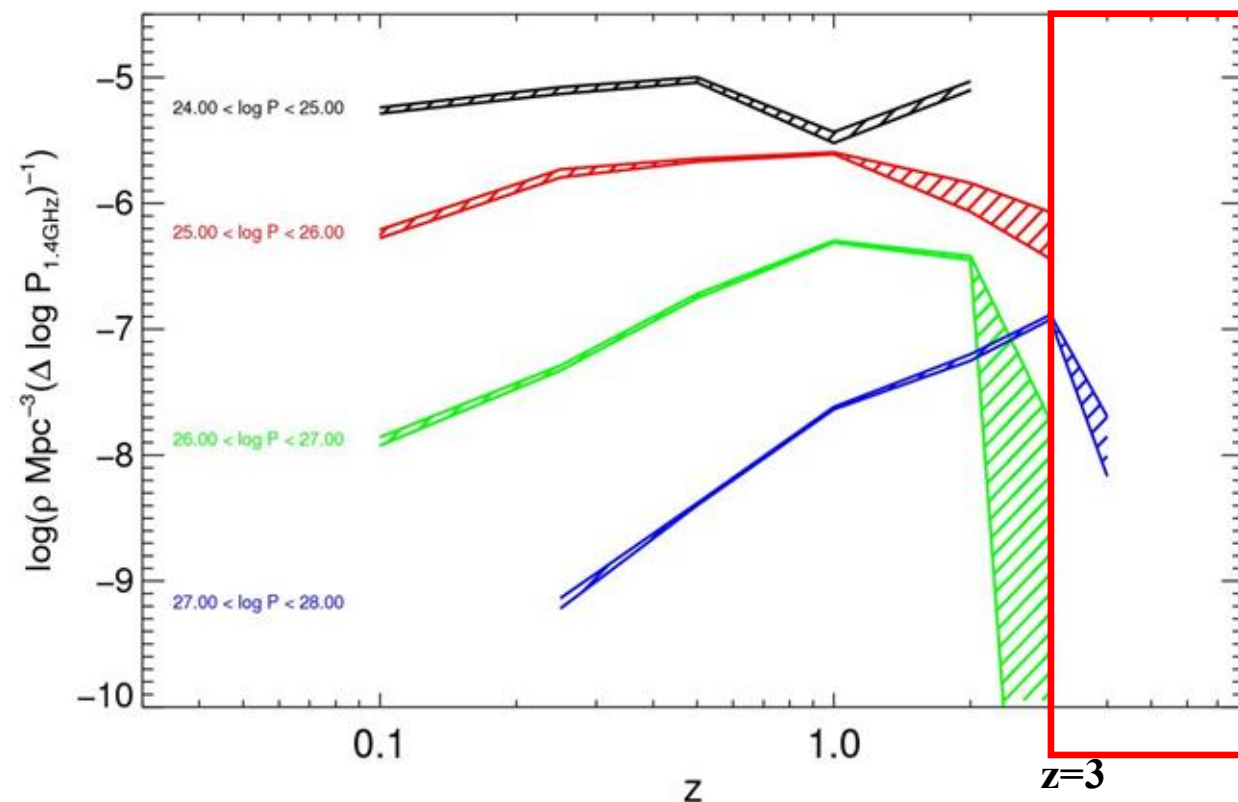
Radio Active Galactic Nuclei (AGN): Makes up $\sim 10\%$ of the AGN population

However, they are not well studied in high redshifts

- Lack of samples beyond $z \sim 4$, majority is missing.
- Incomplete samples make it difficult to determine the evolution of their number density.

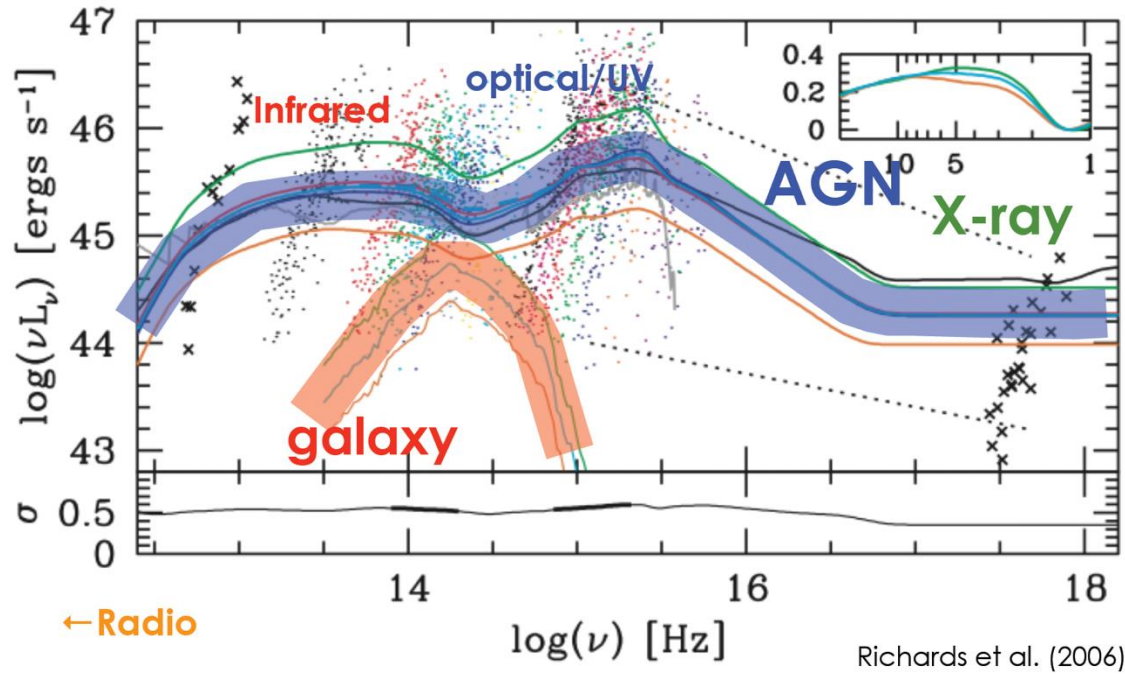


Khabibullina & Verkhodanova 2009

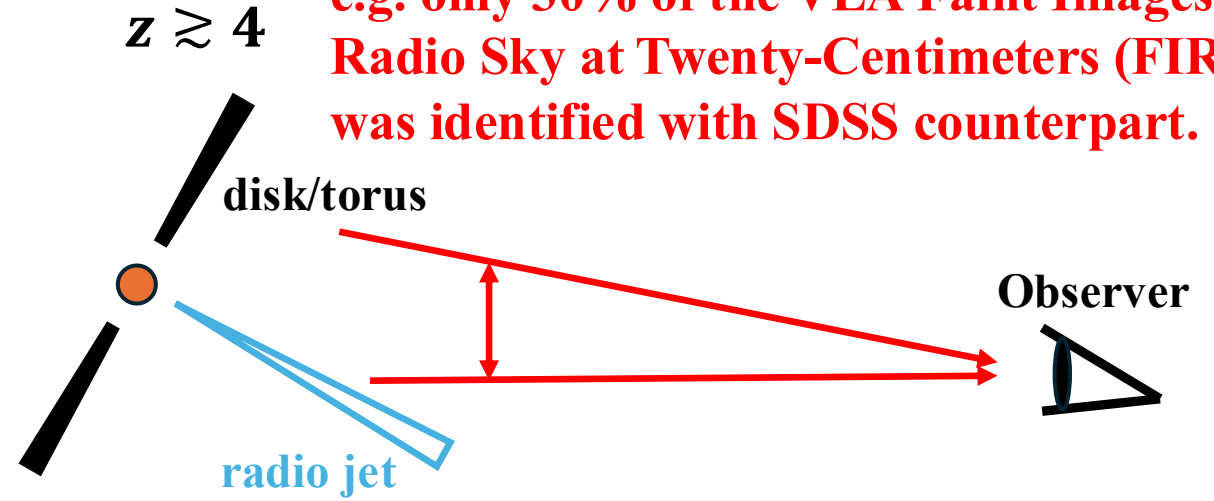


Optical identification of radio AGNs

An effective way to find radio AGNs, BUT, limited survey depth leaves most of the radio sources without optical counterpart!



e.g. only 30% of the VLA Faint Images of the Radio Sky at Twenty-Centimeters (FIRST) was identified with SDSS counterpart.



- Very small offset ($\lesssim 1$ arcsec) between radio and optical emission at high redshift
- Predominantly compact radio morphology (within survey resolution of $2''.5$)
- Optical component likely unresolved
- single counterpart

Radio (MHz-GHz)

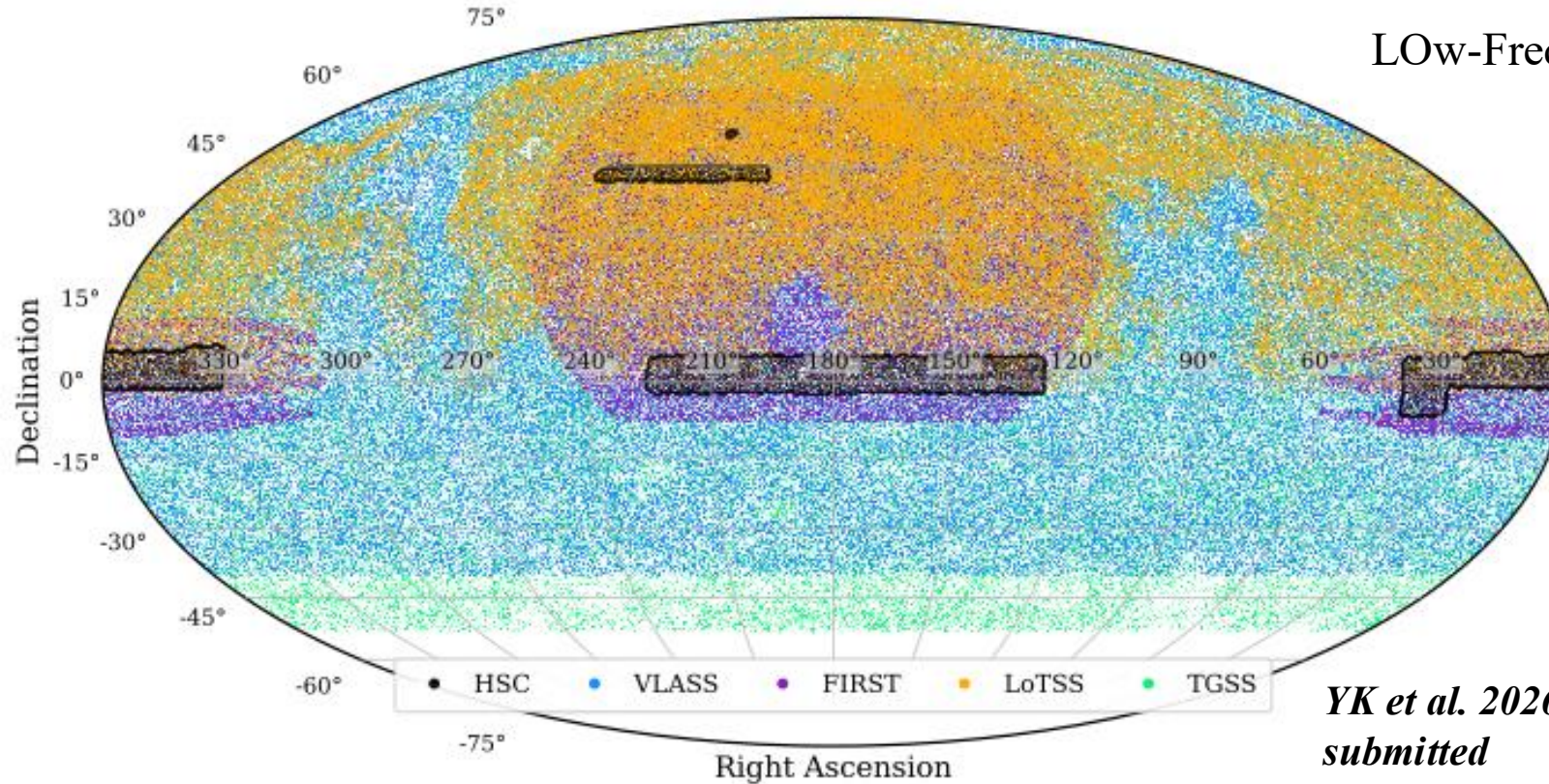
- Mainly trace the radio core (and jet/lobe)
- In some cases, may also probe compact nuclear emission associated with the corona, correlated with X-rays

Optical-NIR

- Trace the accretion disk

WERGS: A Wide and Deep Exploration of Radio-detected Active Galactic Nuclei with Subaru HSC

HSC-SSP x Multiple Radio Surveys



YK et al. 2026 submitted

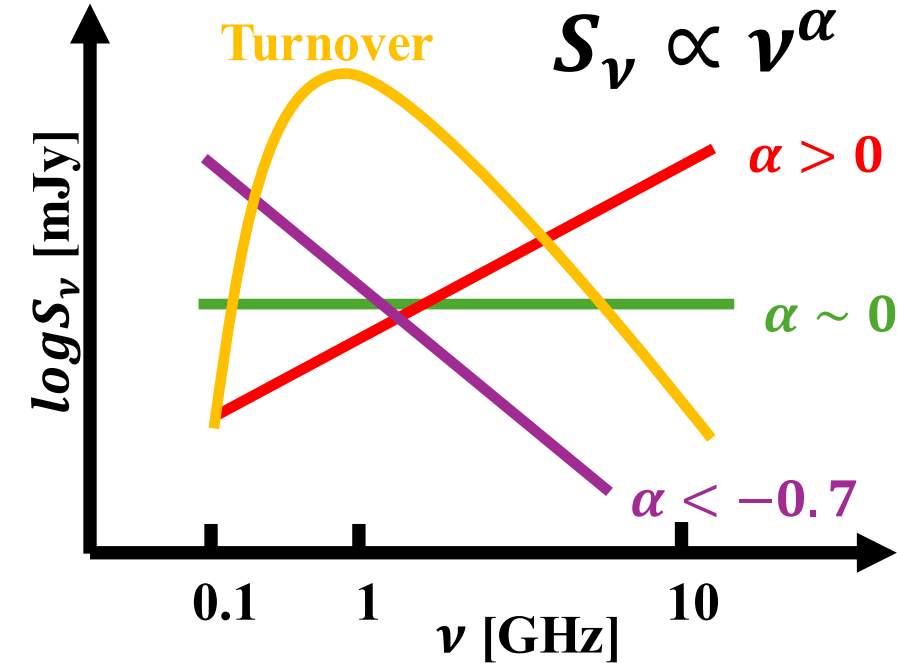
Multifrequency Radio Fluxes

VLA Sky Survey (VLASS) @ 3GHz (main catalog)

VLA/FIRST @ 1.4GHz

LOW-Frequency ARray Two-metre Sky Survey @ 144MHz

And more...



A deep enough optical survey with $i \sim 26$ mag compared to ~ 22 mag from SDSS
Footprint covering $\sim 1200 \text{ deg}^2$ for the final data release S23B (PDR 4)

→ Construction of high purity sample of radio AGN candidates

Optical identification over VLASS : WERGS DR2 (Uchiyama+2026, ApJS accepted)

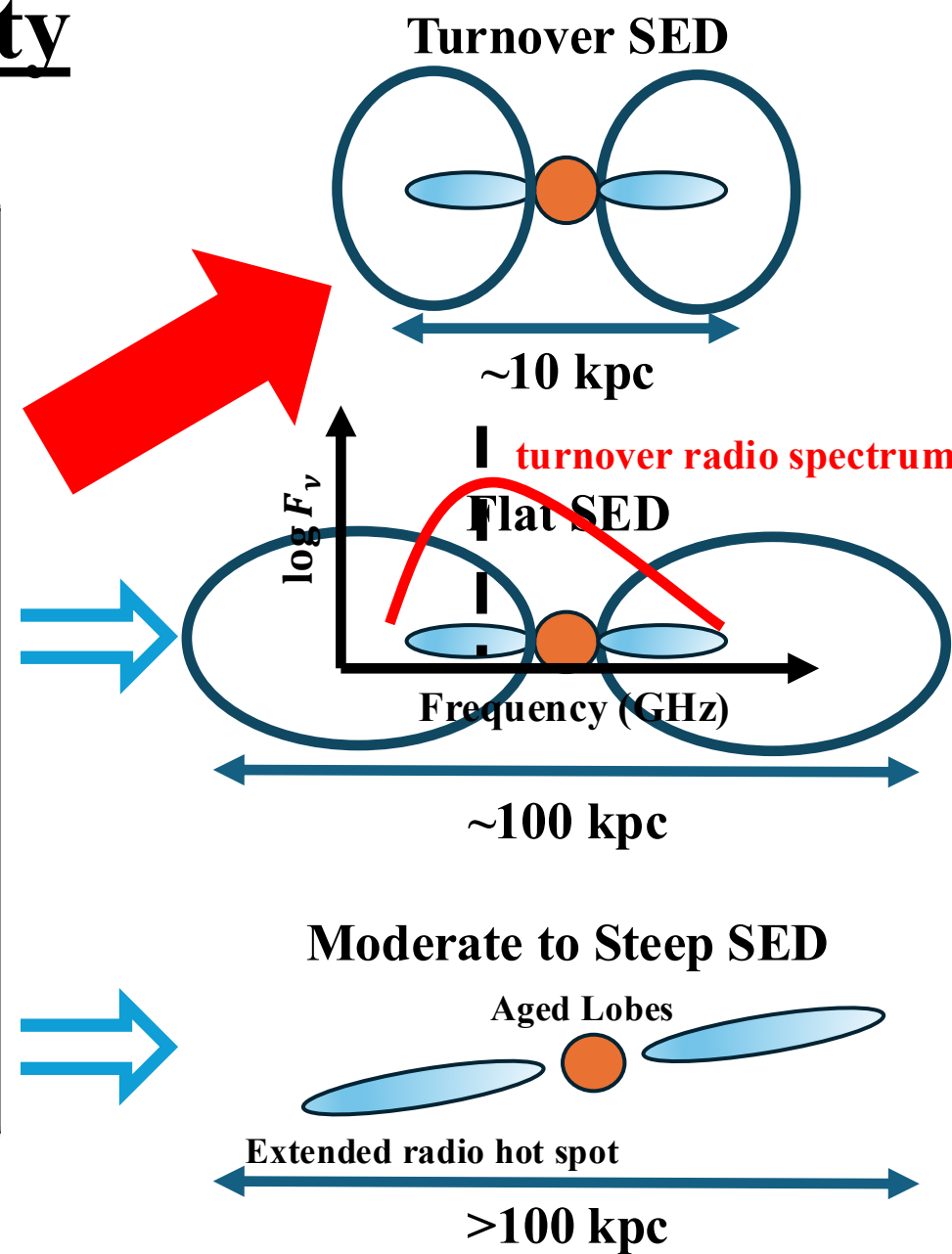
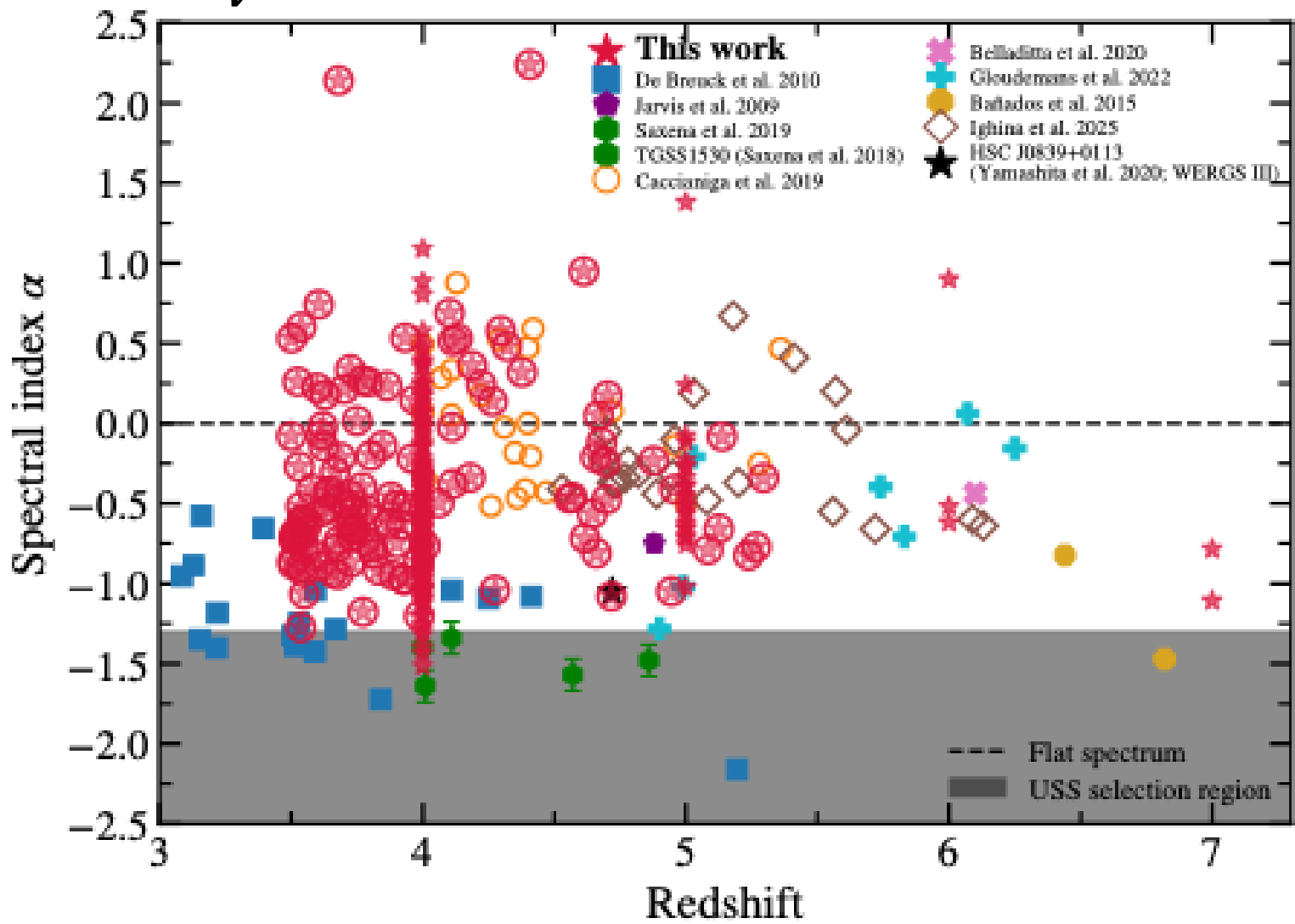
This work: high-z candidates selected from dropout

Reflection of :

- different physical conditions
- possible evolutionary stages.

Expanding the population and diversity

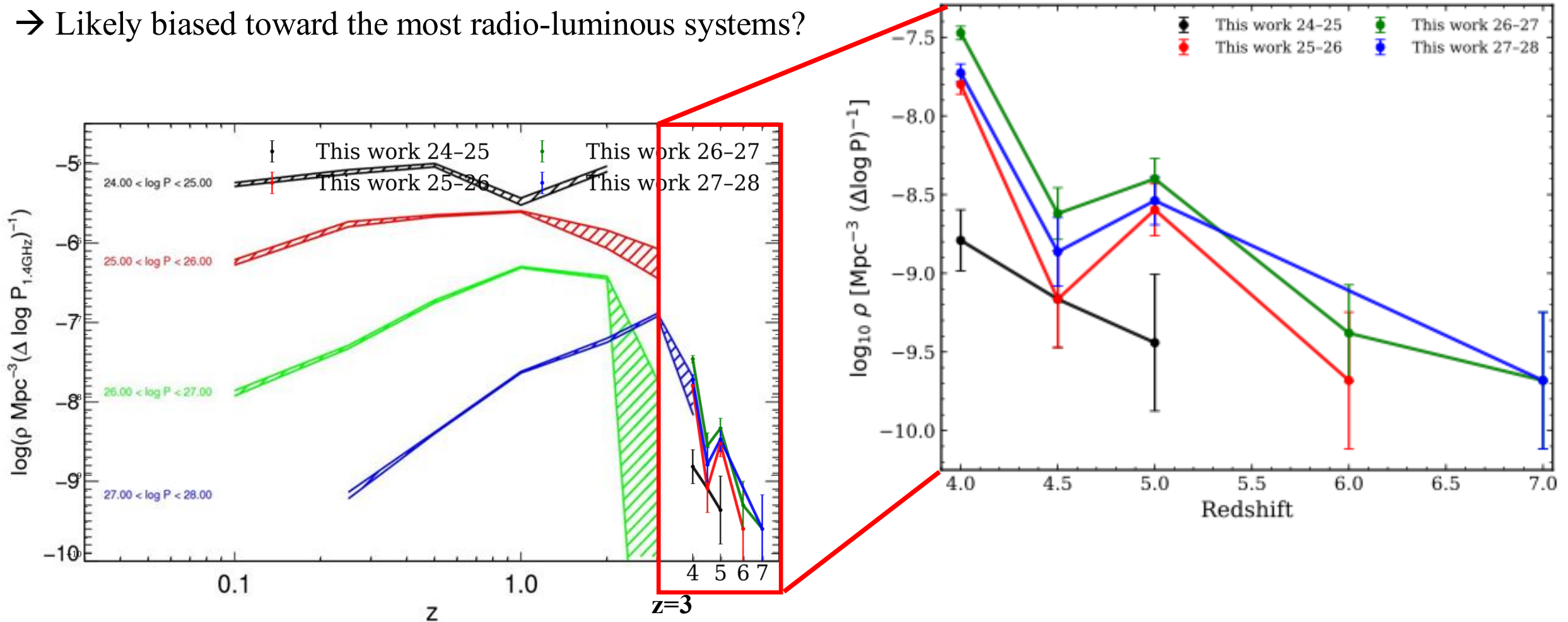
$$S_\nu \propto \nu^\alpha$$



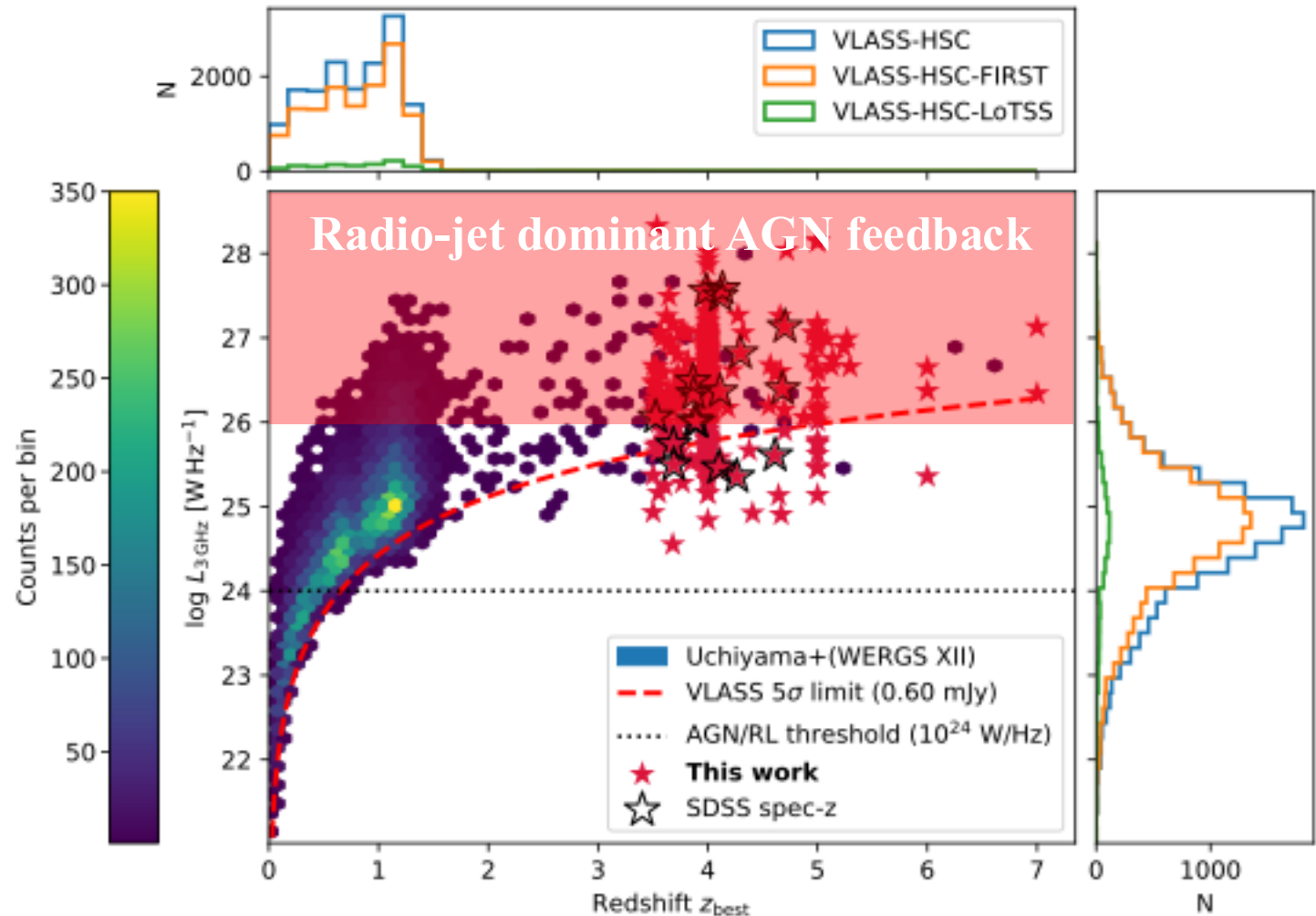
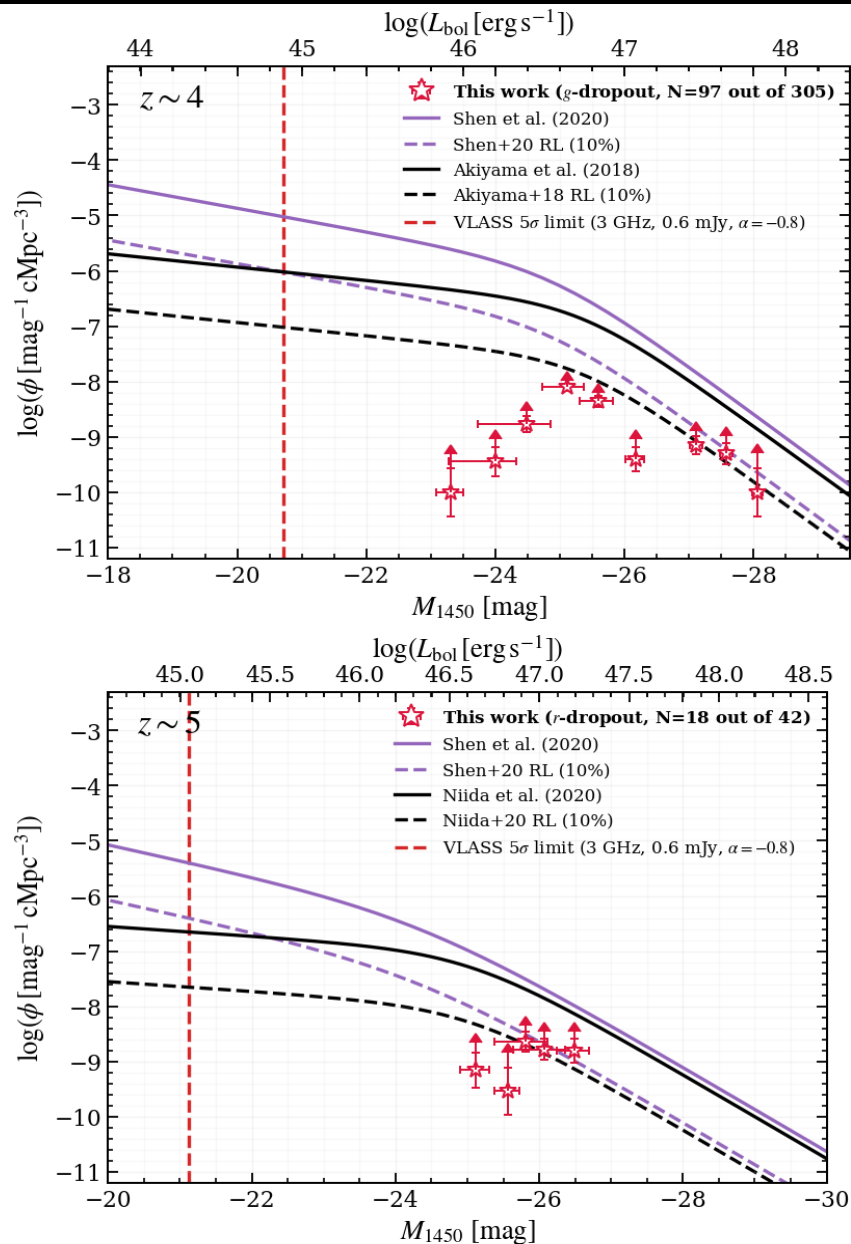
Successfully recovered up to $z \sim 7$

Samples from this work have comparable number density with previous work in the high radio luminosity end.

→ Likely biased toward the most radio-luminous systems?



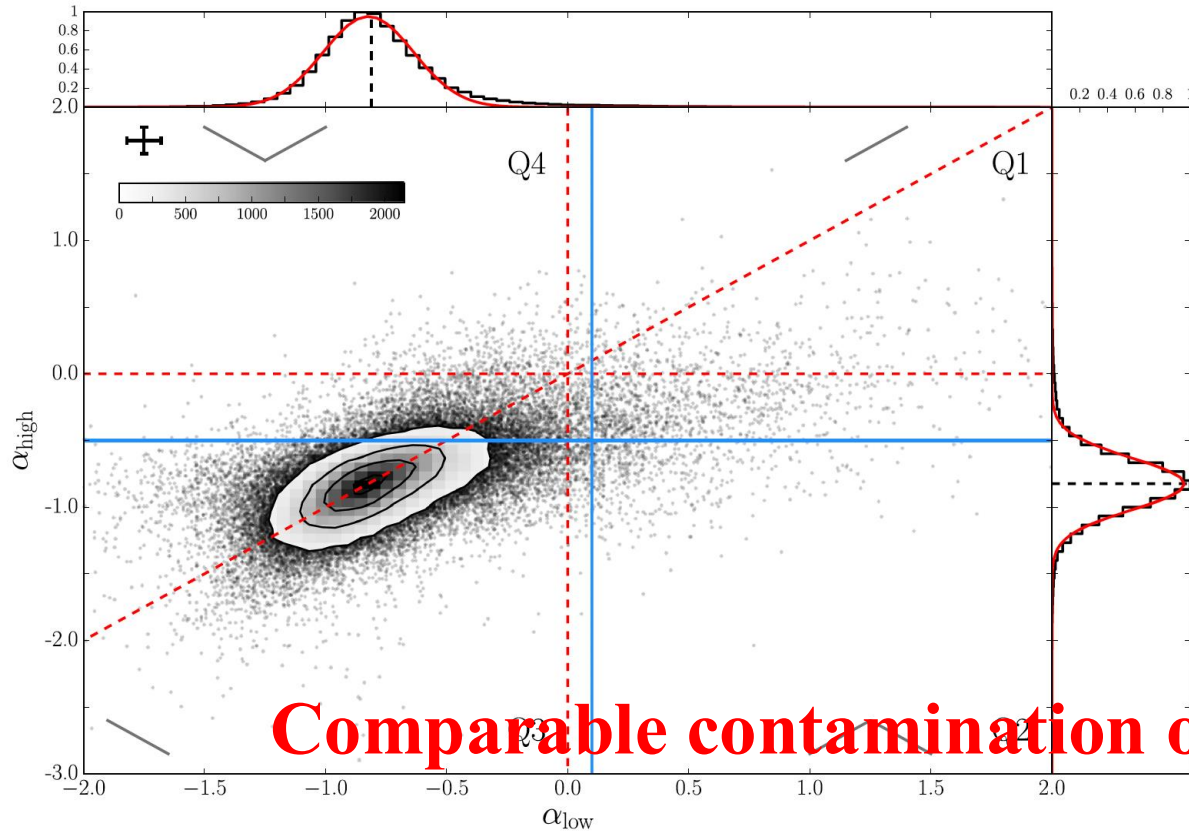
Underestimated number density for luminous AGNs?



Uchiyama, YK et al. submitted
YK, et al. submitted

- Strong radio-mode AGN feedback
- dominating the luminous end of quasar luminosity function.

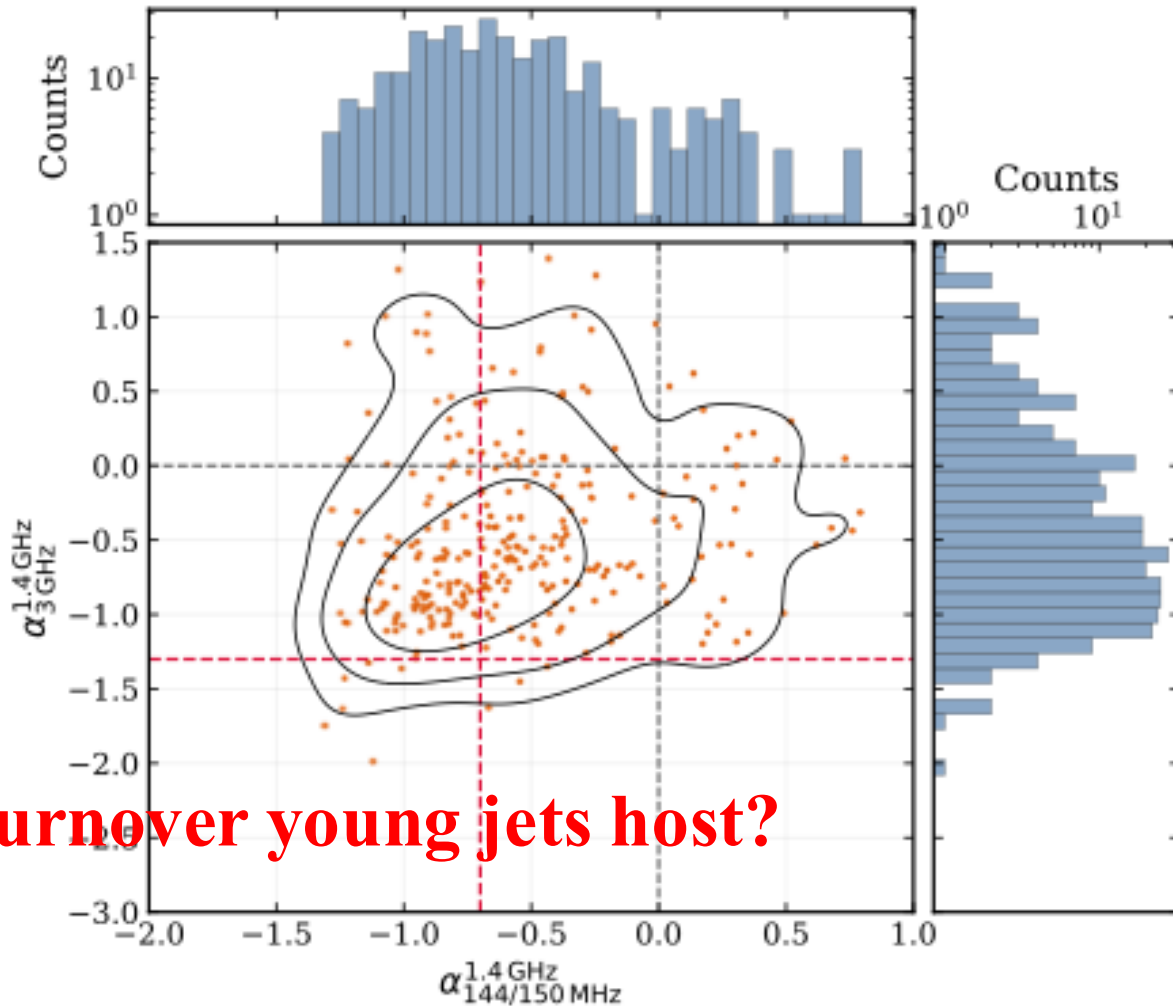
Our sample comparable to the known lower-z population?



Comparable contamination of turnover young jets host?

Callingham+2017:

96,628 GLEAM sources focusing on Gigahertz peaked/Compact Steep Spectrum sources.



This Work:

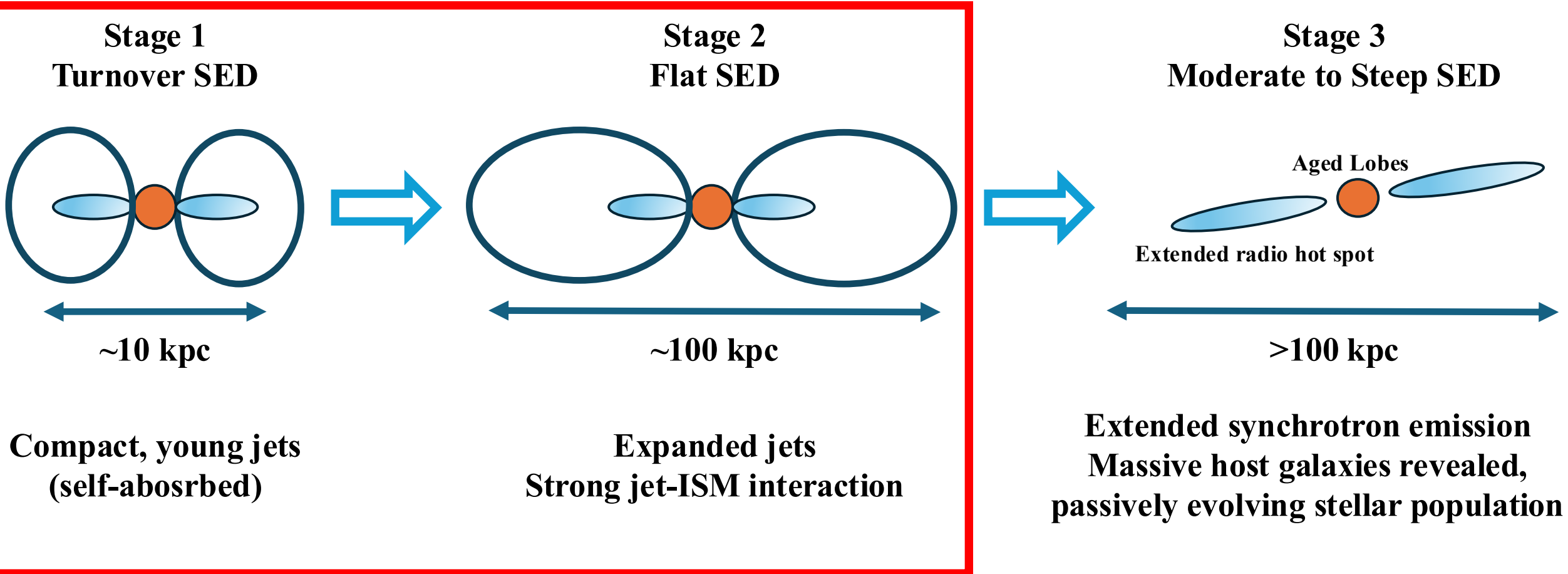
No bias selection regarding spectra shape

Results Implication

Nature of this selection

- Compact radio sources within a beamsize of $2''.5$
- ~ 30 kpc physical scale at maximum

This work



An increased contribution of compact / early-stage radio AGN candidates at $z = 4-6$?

Future prospect

- **PFS-SSP:** currently undergoing, will eventually cover HSC Wide. Providing robust spec-z confirmation over the lower-z samples (WERGS DR2 focused)
- **Missing counterparts beyond y -band:** shallow and limited coverage of VIKING/UKIDSS and WISE, possible future follow-up for broadband photometry (maybe ULTIMATE?)
- **Faint high-z target confirmation:** individual follow-ups by FOCAS, MOIRCS...