Cosmic evolution of radio-AGN: insights from LOFAR and prospects with SKAO

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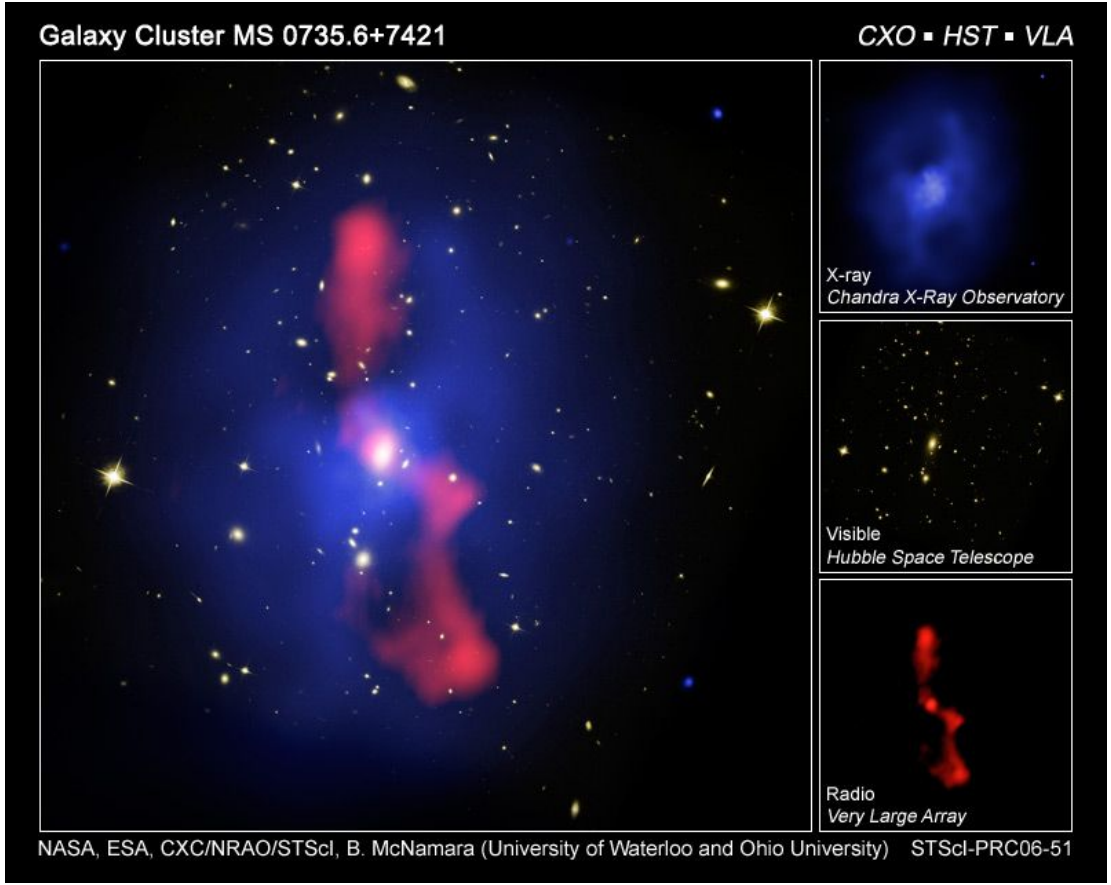
AGN Feedback in Action

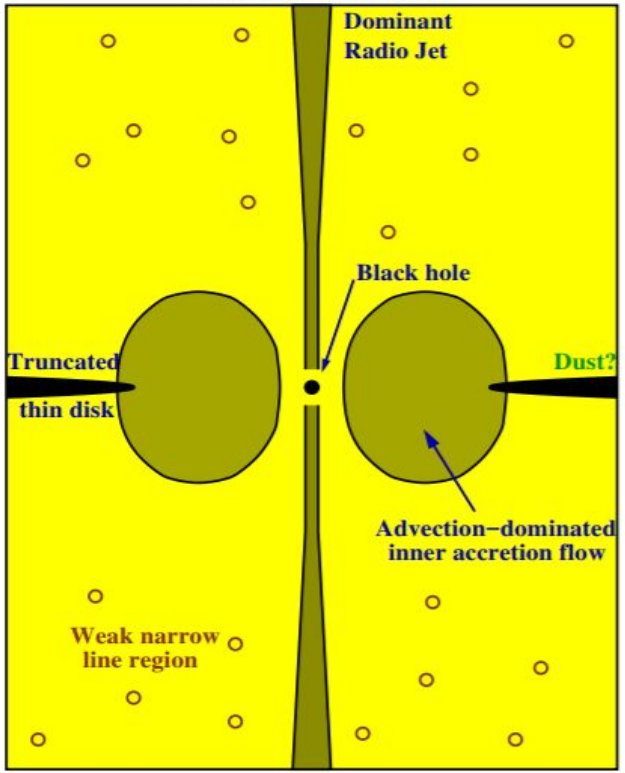


Low-excitation radio galaxies (LERGs)

Powerful bi-polar radio jets

Radiatively-inefficient accretion

Lack stable accretion disk



Massive galaxies

Red/quiescent population

Rich group/cluster environments

Heckman & Best (2014)

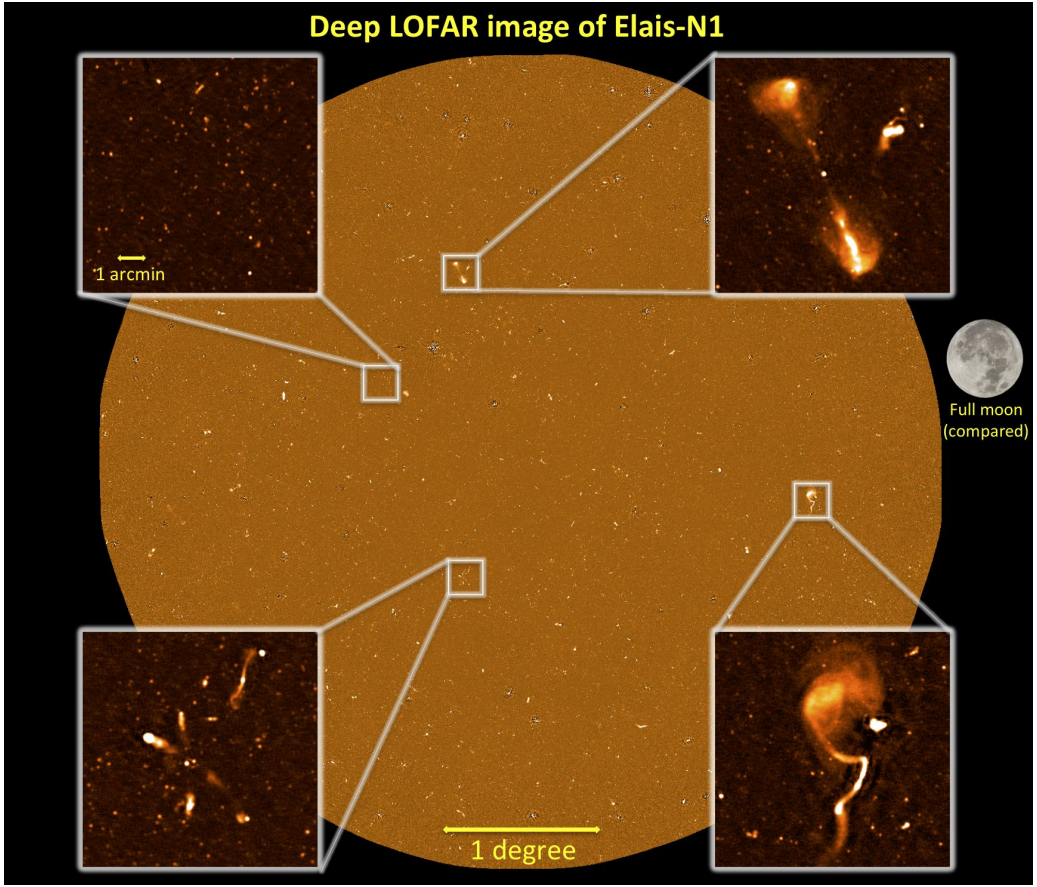
How do LERGs evolve across cosmic time?

→ Deep, wide-area radio continuum surveys crucial

LOFAR Two-meter Sky Survey: Deep Fields

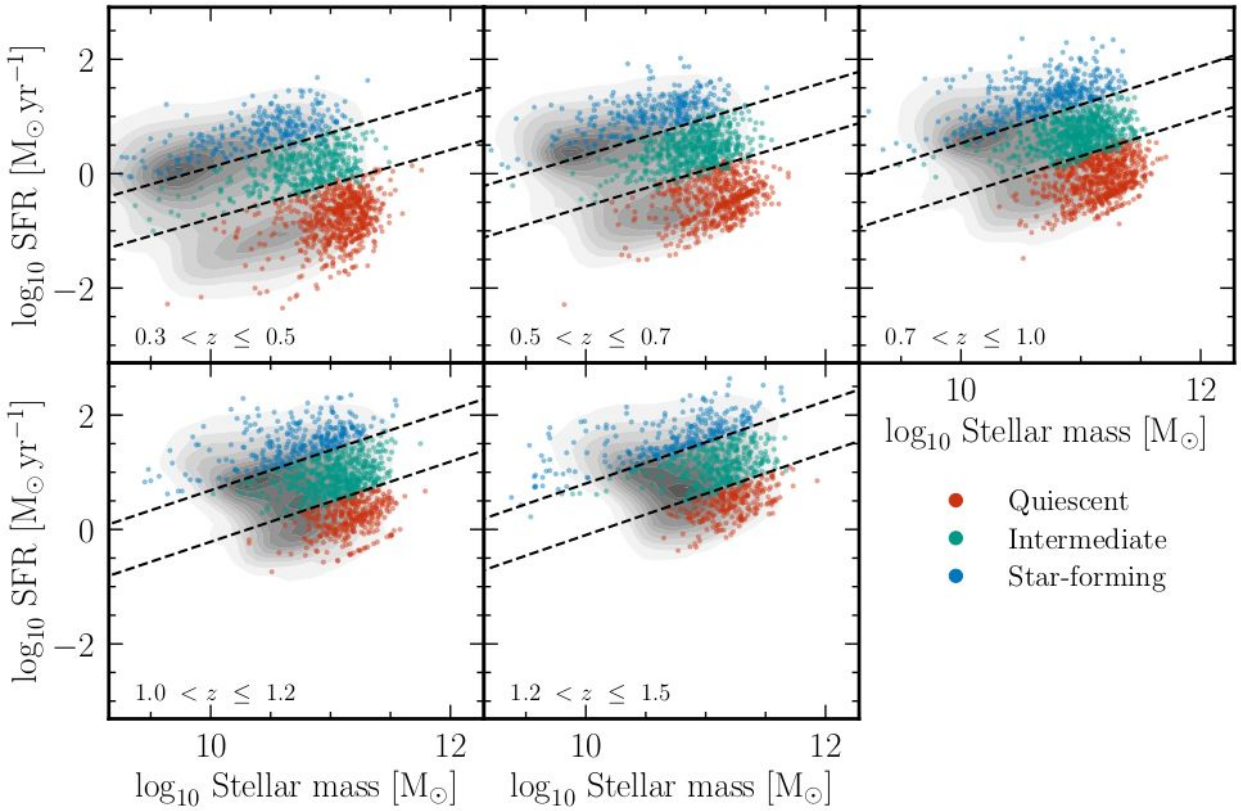
Deepest wide-field radio continuum survey to date at low frequencies

100s hrs of radio imaging **over 25 sq. deg.**



Tasse et al. 2021; Sabater et al. 2021
Kondapally et al. 2021; Duncan et al. 2021
Best et al. 2023, Shimwell et al. 2025

LERGs found across the galaxy population

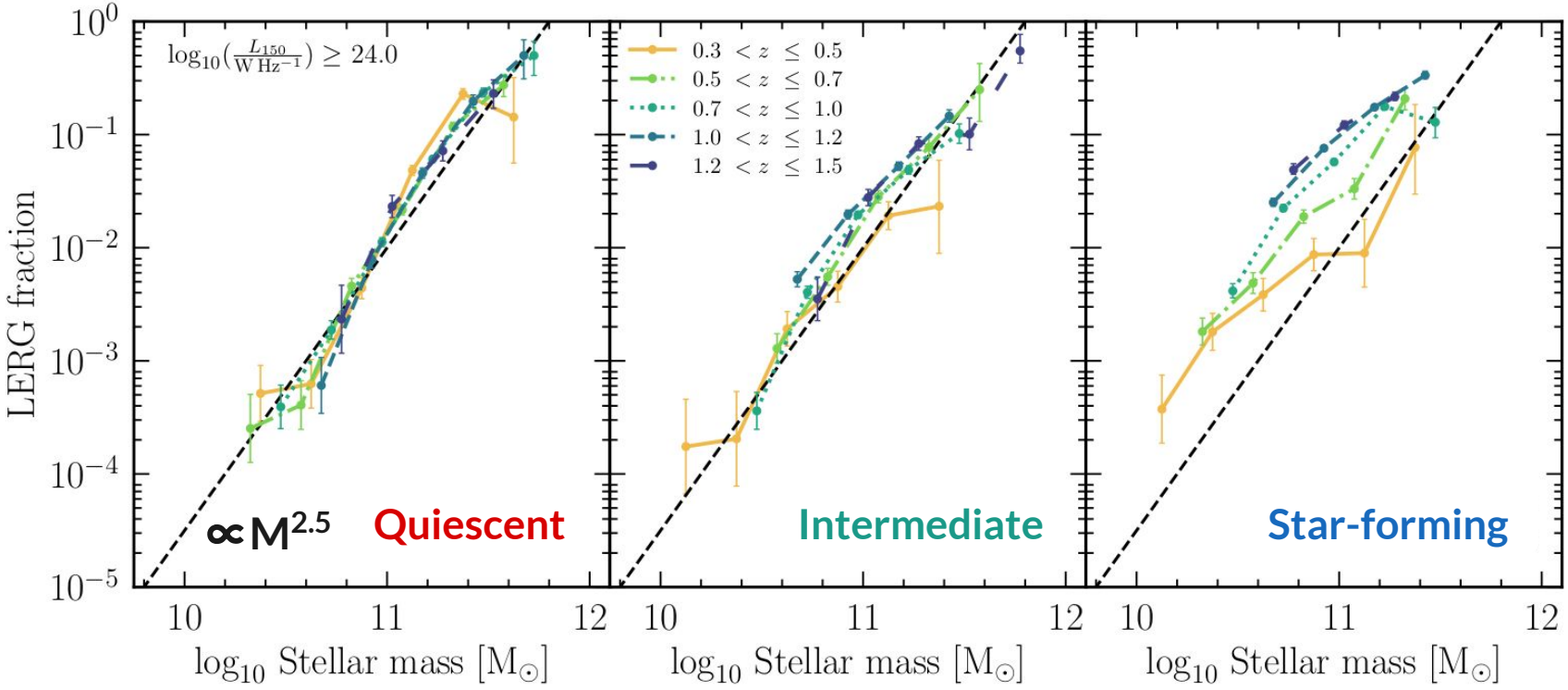


Using the LOFAR-Deep survey

Find significant population of LERGs within star-forming galaxies at earlier times

Kondapally et al. (2022, 2025)

Incidence of LERGs across the main sequence



Q-LERGs: LERG fraction ~ $M^{2.5}$
→ Fuelling from hot gas since z~1.5; consistent with local Universe

SF-LERGs: Flatter mass dependence
→ Additional fuelling mechanism, cold gas?

Kondapally et al. (2022, 2025)

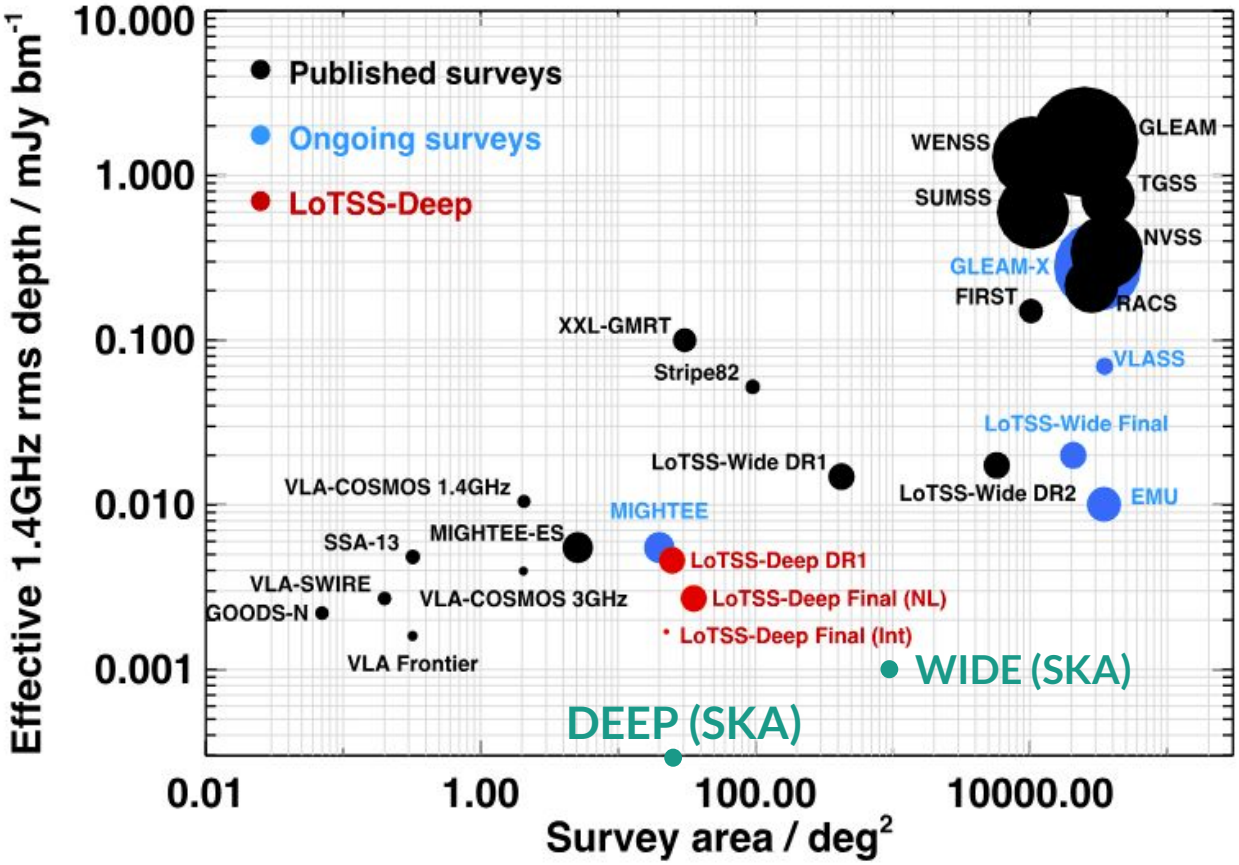
An (assumed) SKAO radio-continuum survey

Wide: ~1uJy/beam, ~1000 deg^2

Deep: 0.2uJy/beam, ~20 deg^2

(Following Prandoni & Seymour 2015)

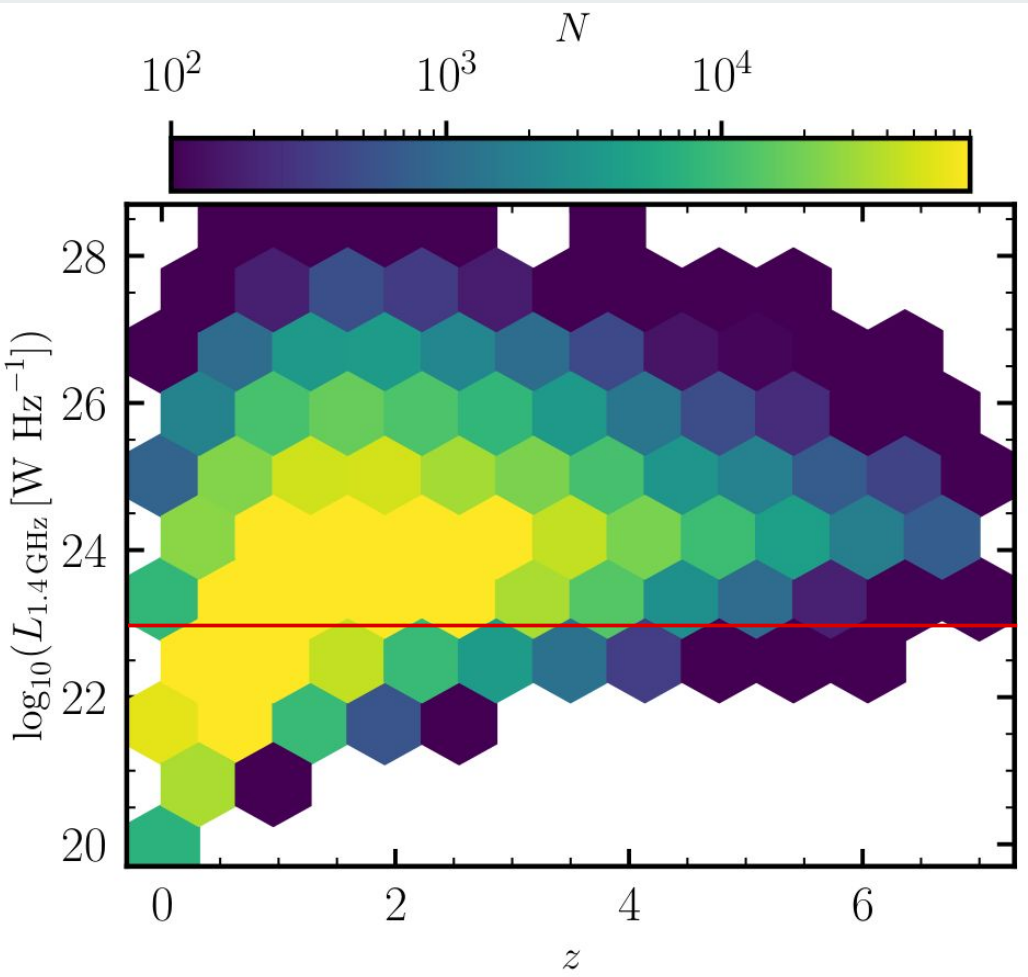
* Survey details TBD



Adapted from Best et al. 2023

Using T-RECS for source population predictions

SKAO reference surveys may detect > 2.5 million radio-AGN!

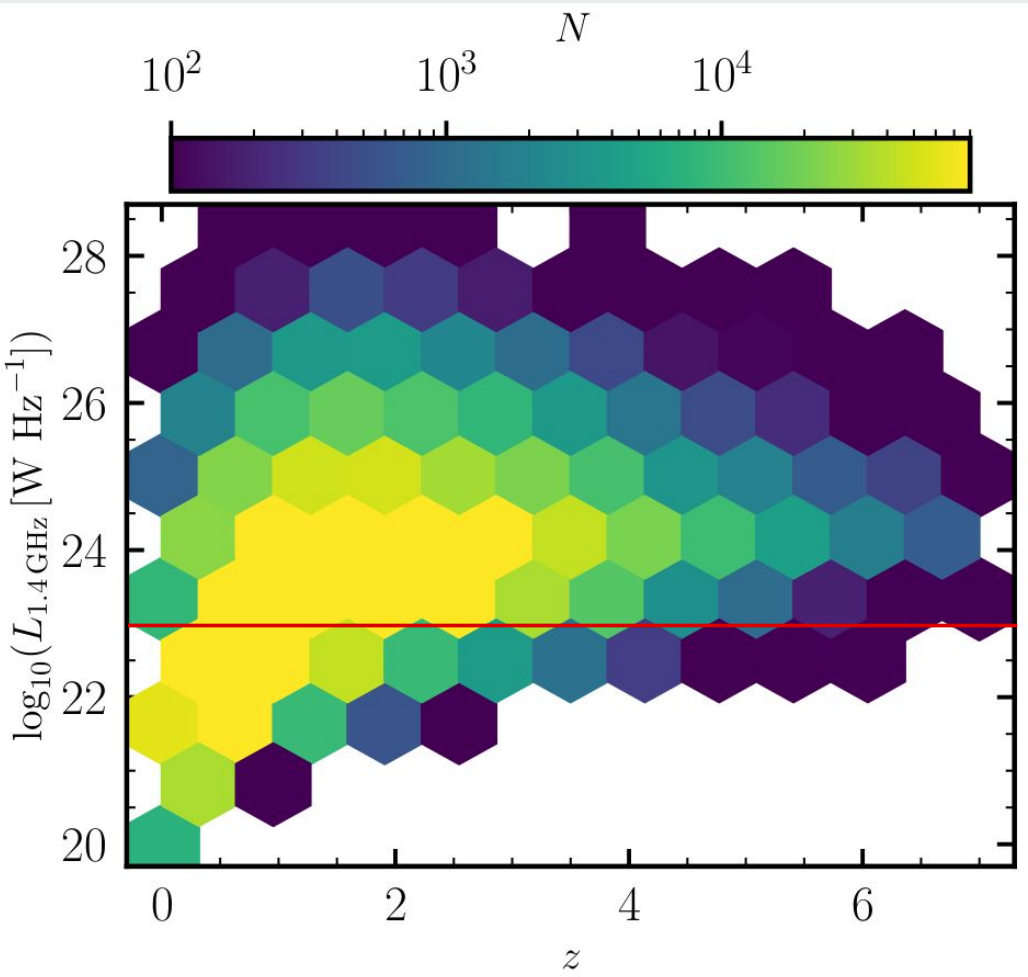


Using T-RECS for source population predictions

SKAO reference surveys may detect > 2.5 million radio-AGN!

Complete AGN samples across redshift **down to 10^{23}W/Hz (@1.4Ghz)**

→ Can do studies at z~4 that are possible now at z < 1



Conclusions

Considerable population of LERGs hosted by star-forming galaxies in the early Universe

→ These may be fuelled differently (via cold gas) compared to LERGs in quiescent galaxies

SKAO reference surveys will detect millions of radio-loud AGN

- Complete AGN samples down to 10^{23}W/Hz out to z~4
- Including > 10,000 AGN at z~4 → enables detailed statistical studies of AGN properties

Working on "Cosmic evolution of radio-AGN with SKAO" for updated SKAO Science Book

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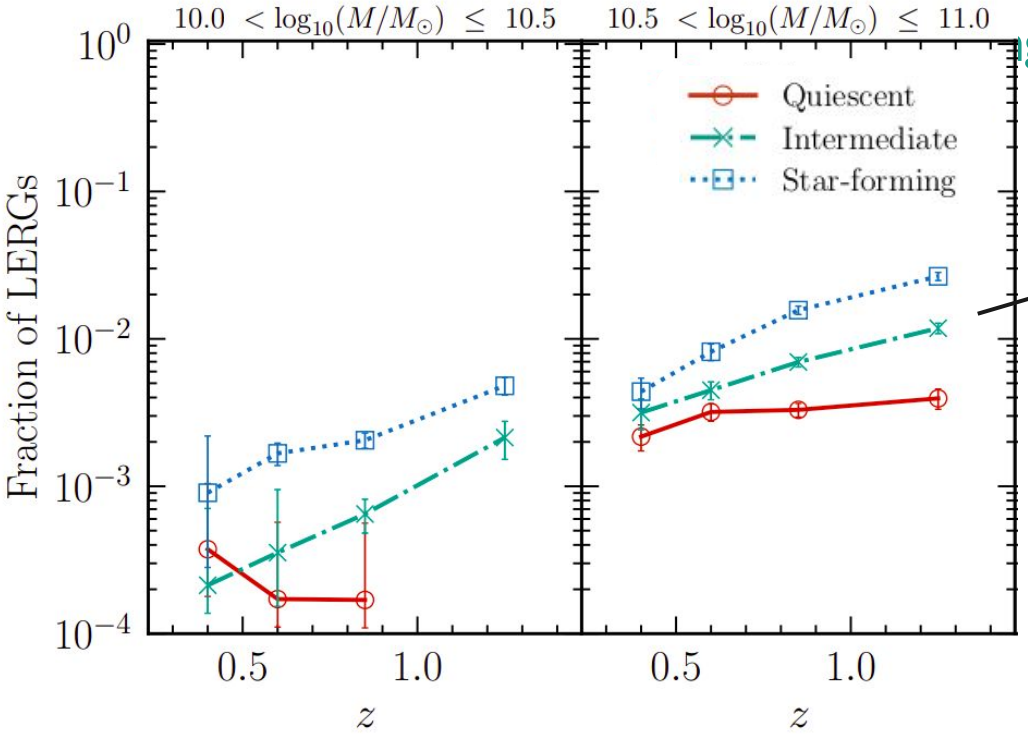
https://rohitk-10.github.io/

Incidence of LERGs across SFR and Mass

At low(er) stellar masses



g star-formation of host

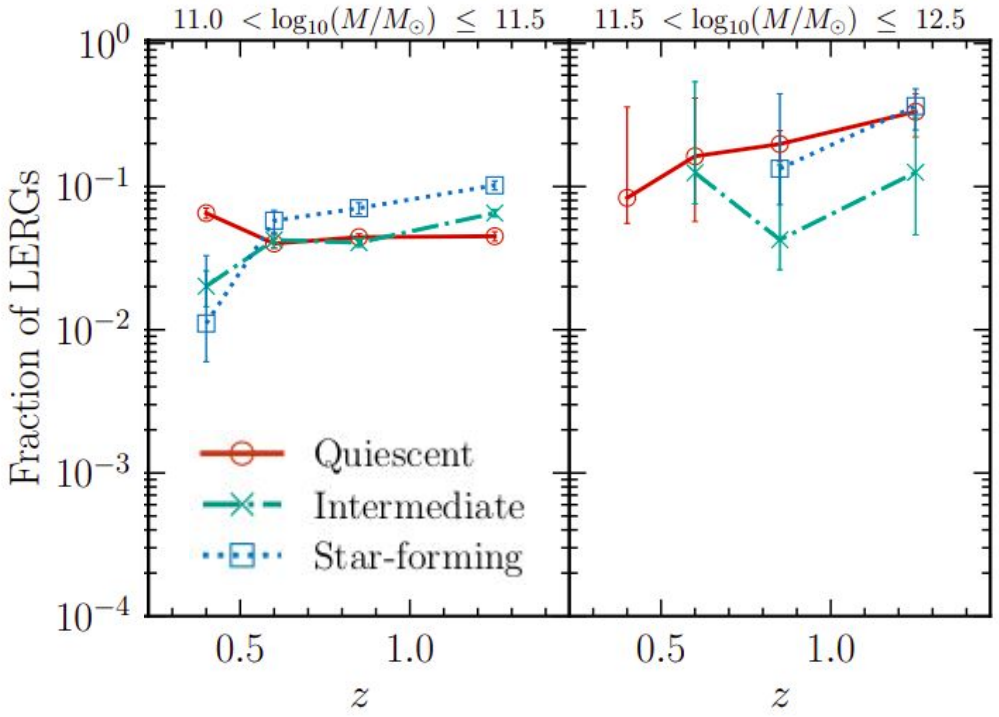
incidence of LERGs across

Kondapally et al. (2025)

Incidence of LERGs across SFR and Mass

At high stellar masses

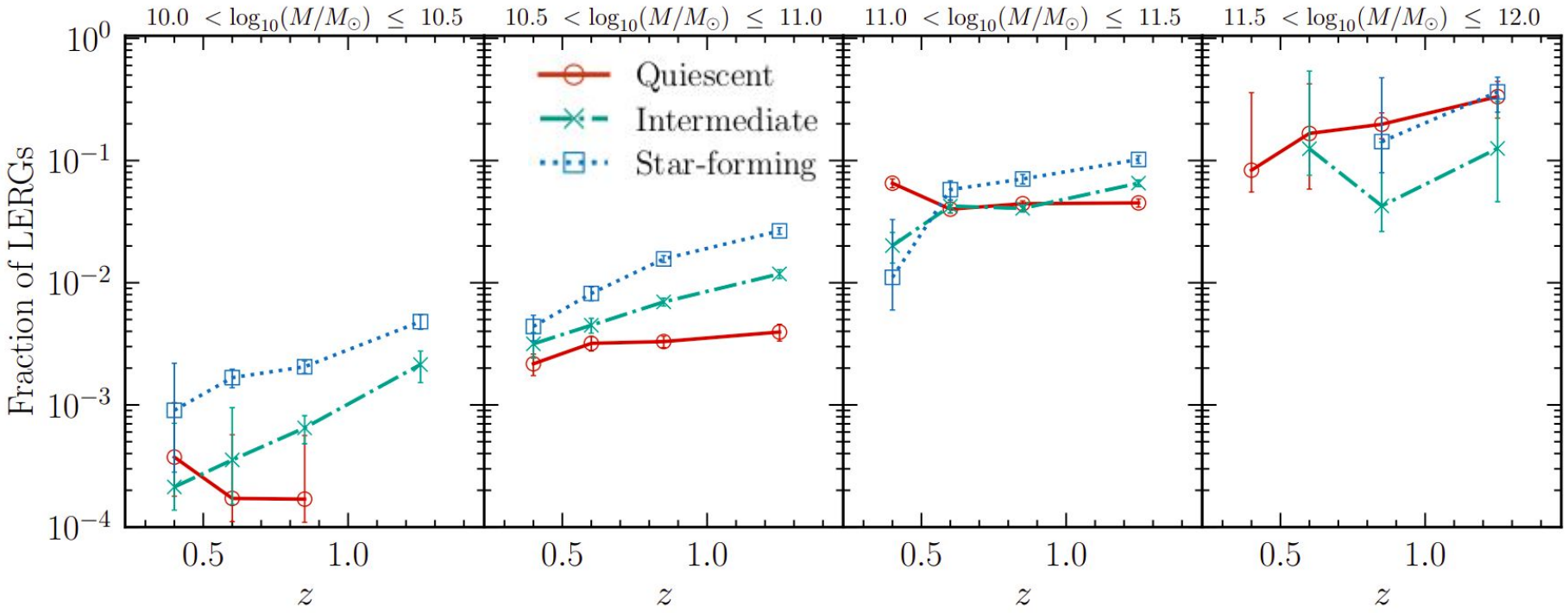
Stellar mass drives the l



Kondapally et al. (2025)

Incidence of LERGs across SFR and Mass

Increasing stellar mass →



Kondapally et al. (2025)