The Environments of z = 2.2 Radio Galaxies as Traced by Hα Emitters

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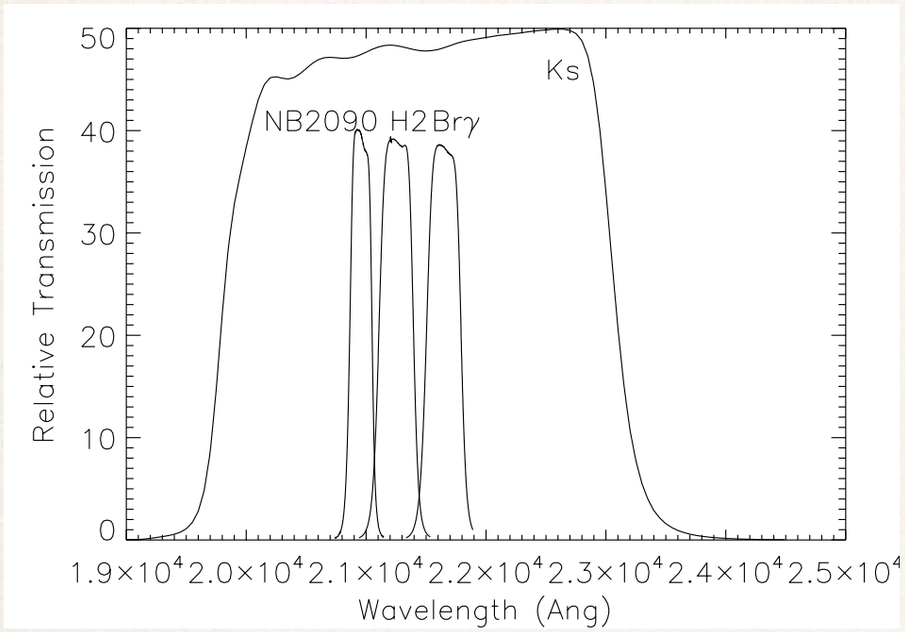
Radio Galaxies as Protocluster Tracers

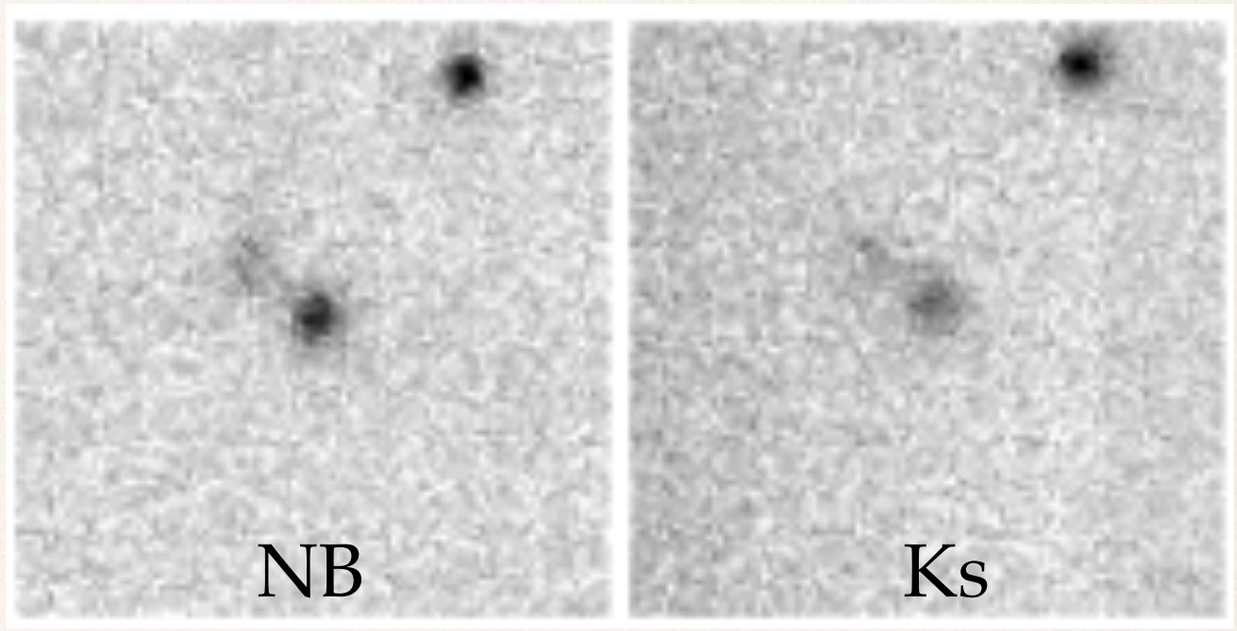
- Massive radio galaxies are known to lie in overdensities at $2 < z < 5$ but do *all* radio galaxies lie in overdensities?

- Do galaxies in overdensities form earlier or have different formation histories?

- Does the radio galaxy affect the galaxies in its nearby environment?

Observations

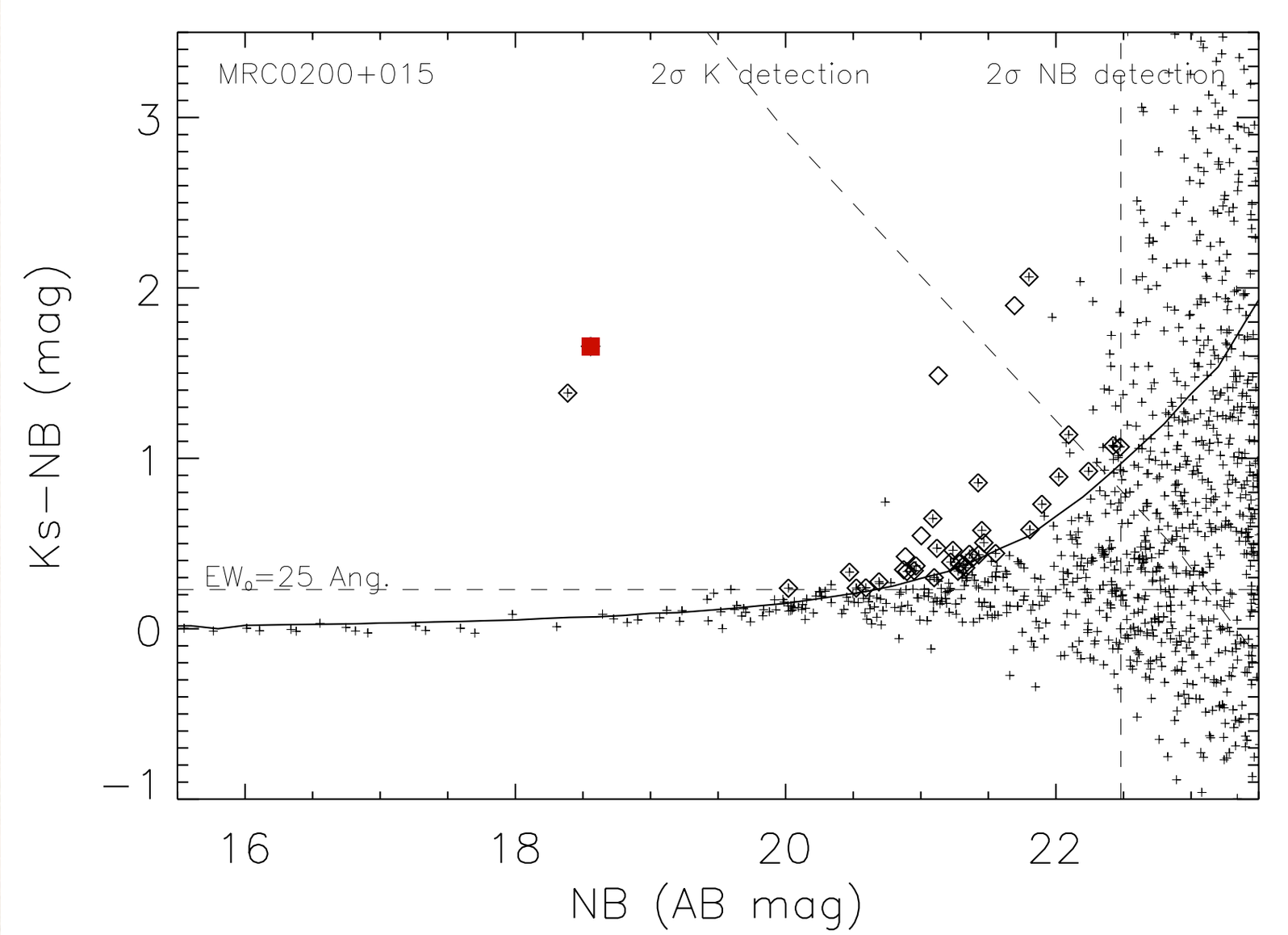




- HAWKI imaging of 7 radio galaxies between $2.19 < z < 2.30$ in a J, Ks and narrow-band centered on Hα at the radio galaxy redshift.
- HAWKI field of view ~12 x 12 co-moving Mpc^2 at this redshift.
- Average 2σ AB depth = 22.9, 23.0 and 22.4 for J, Ks and NB.

Hα Emitter Selection

- Selection:
  - K-NB > 3x average error
  - NB < 2σ lim
  - EW_{ob} > 25 A



Contamination

- Contaminants include:
  - Emission line galaxies at other redshifts e.g. [OIII] emitters at z~3 (rare) or Pa series emitters at lower redshifts (likely <10%)
  - AGN (<10% by comparison of survey fields to X-ray surveys).
- Low probability of contaminants to align with radio galaxy but may have more AGN in clustered environments.

HiZELS/ Control Fields

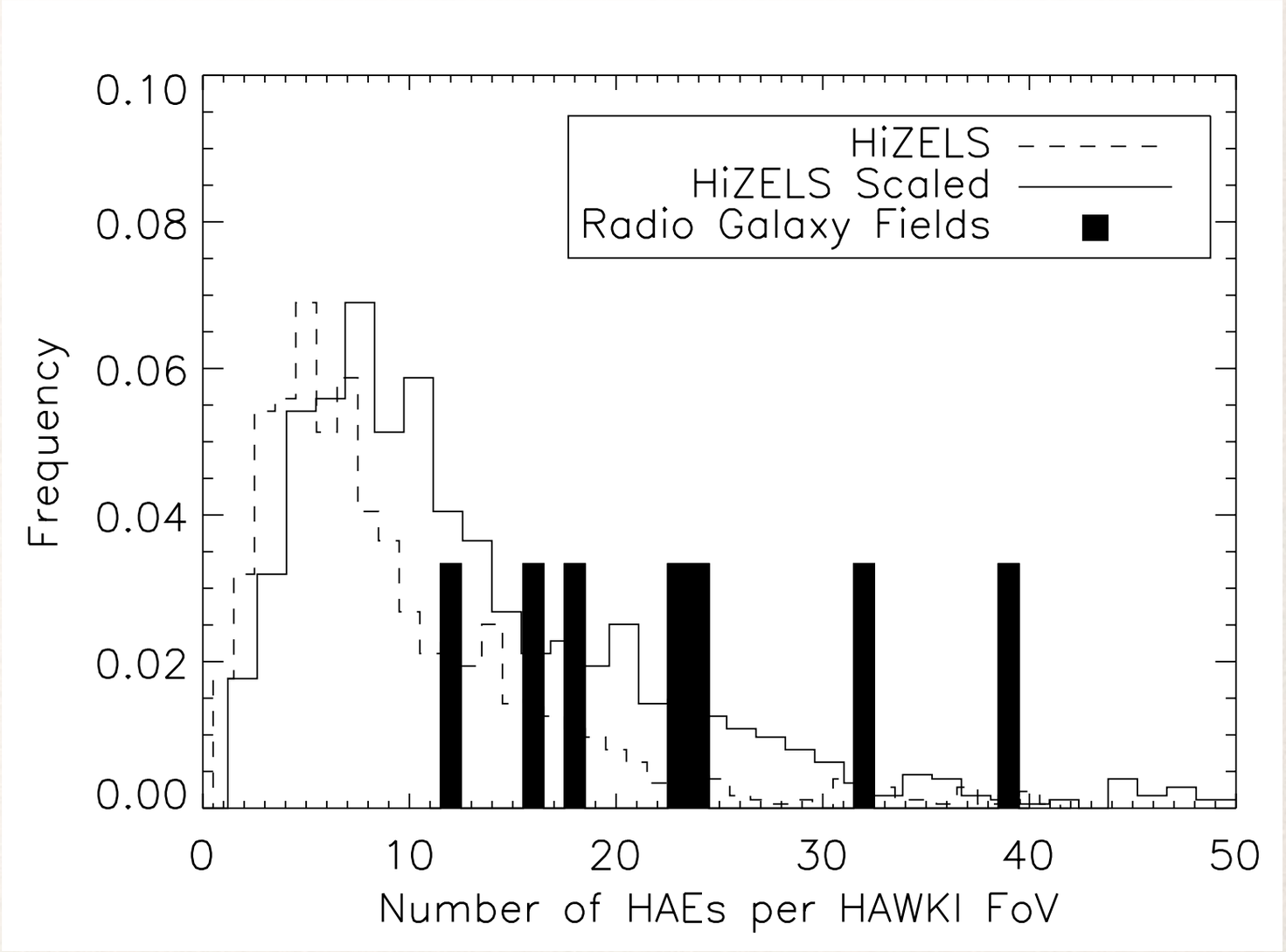
- COSMOS (as part of HiZELS; e.g. Sobral+12) and GOODS-S (Hayes +10) imaged with HAWKI in Ks and narrow band.

- Re-reduced this data and applied our HAE selection to it = control sample.

- Survey data is deeper than radio galaxy fields so reduced a fraction of the data to get comparison images with the same length exposure as the radio galaxy fields.

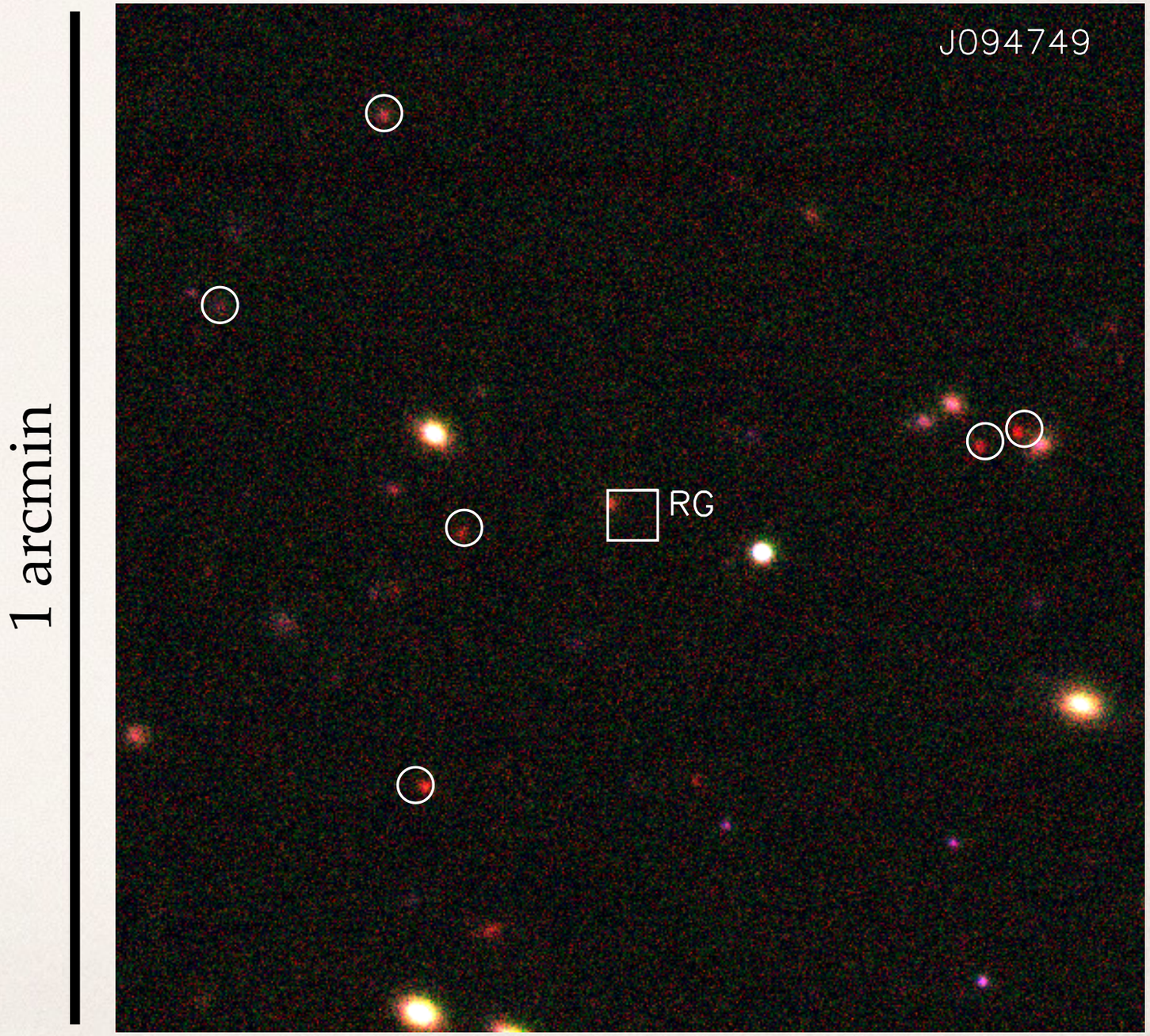
Environment

- 4/7 overdense compared to control fields (similar to Venemans+07) but large variation.
- Can also compare to 2 deg² of HiZELS.
- 2 fields contain more HAEs per HAWKI FoV than 95% of the regions in HiZELS.



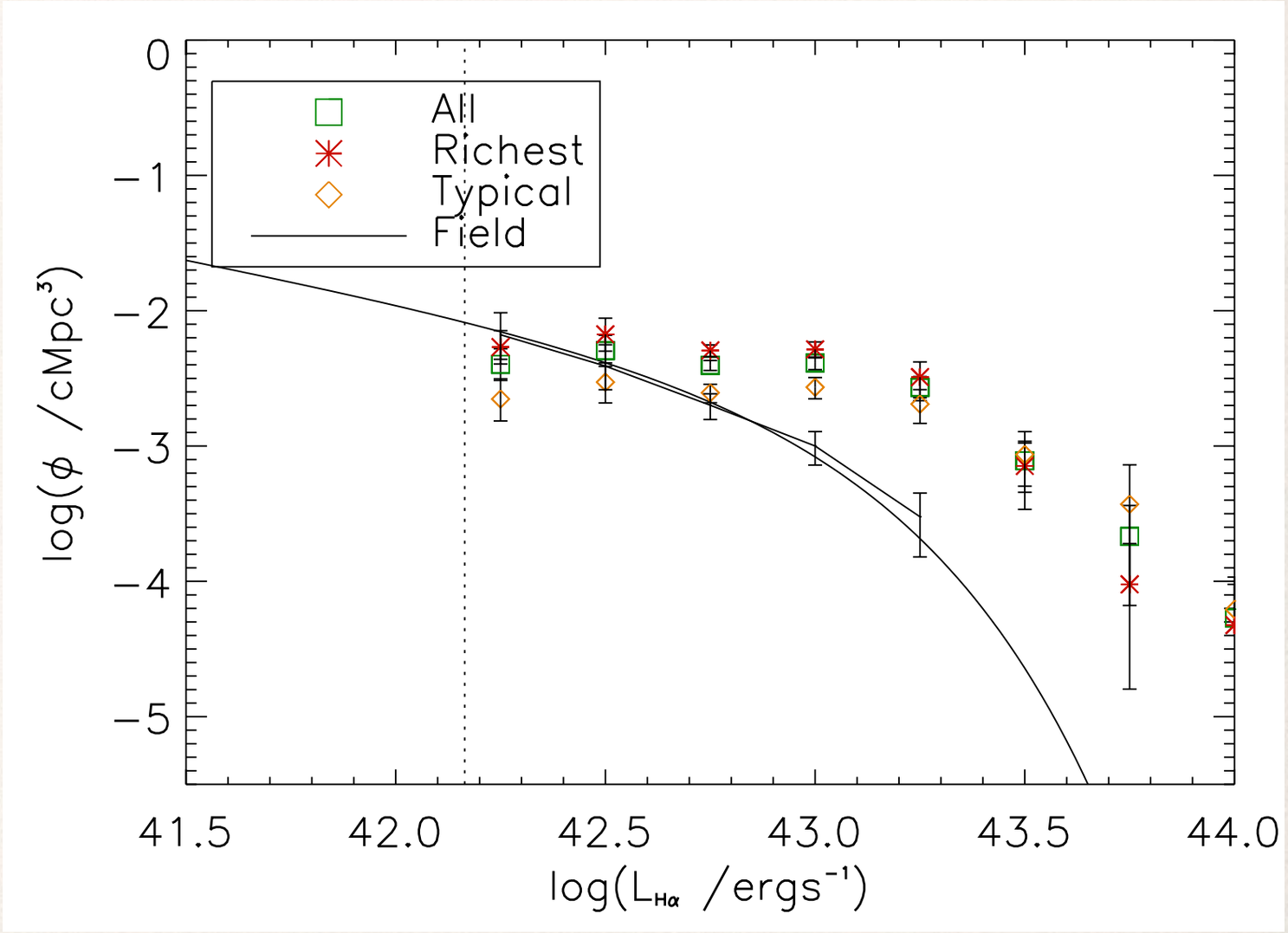
Protocluster Candidate NVSS J094748

- Average number density of HAEs is 1.6x field (at same depth).
- 5 HAEs + central radio galaxy when expect ~0.27 HAEs in 1 arcmin^2 - 19x overdensity.



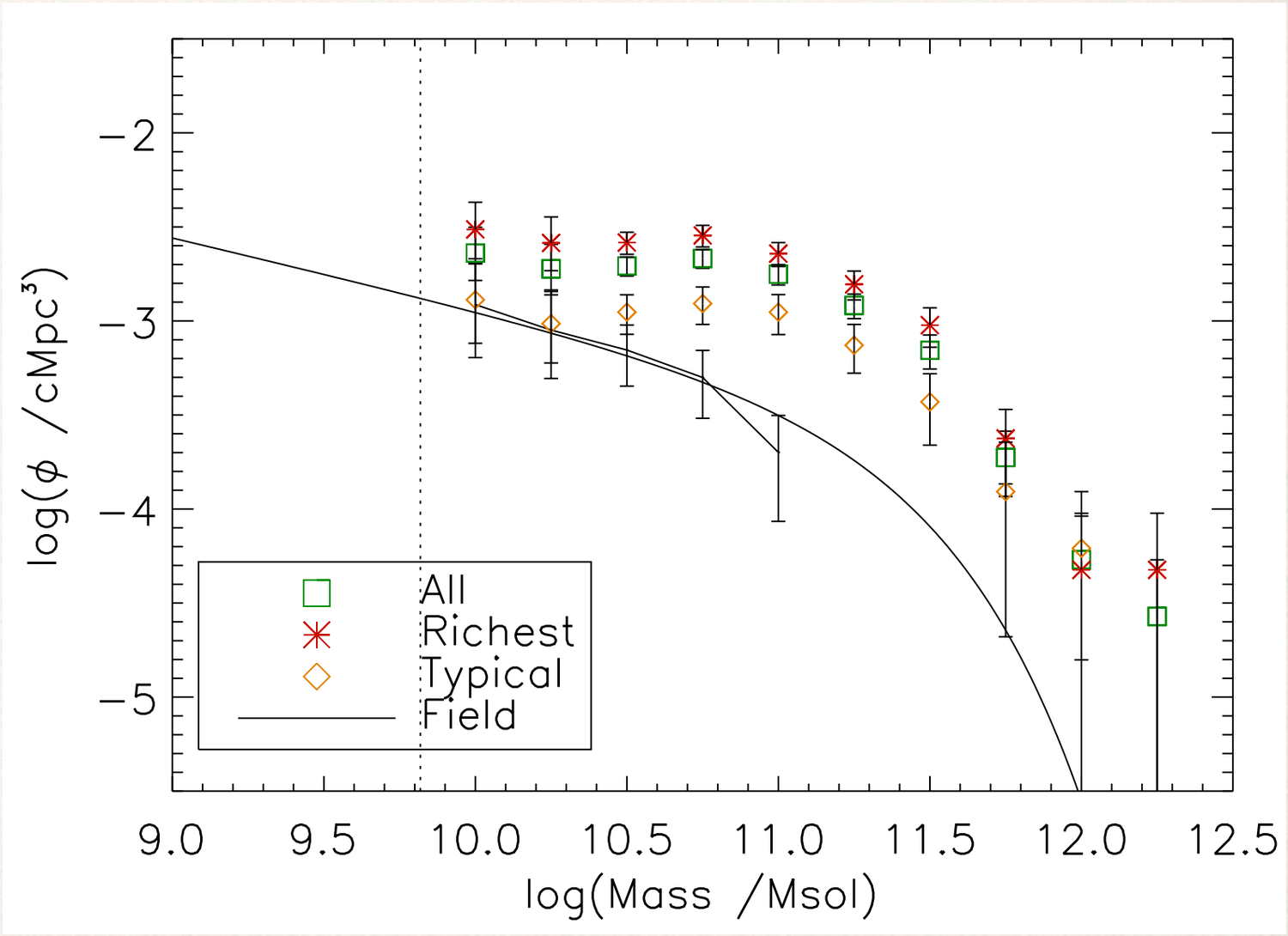
Luminosity Function

- NII corrected, 1 mag dust extinction, completeness corrected to Sobral+13 relation.
- Excess of bright, high star formation galaxies.
- Little difference between four richest radio galaxy fields and the more typical ones.

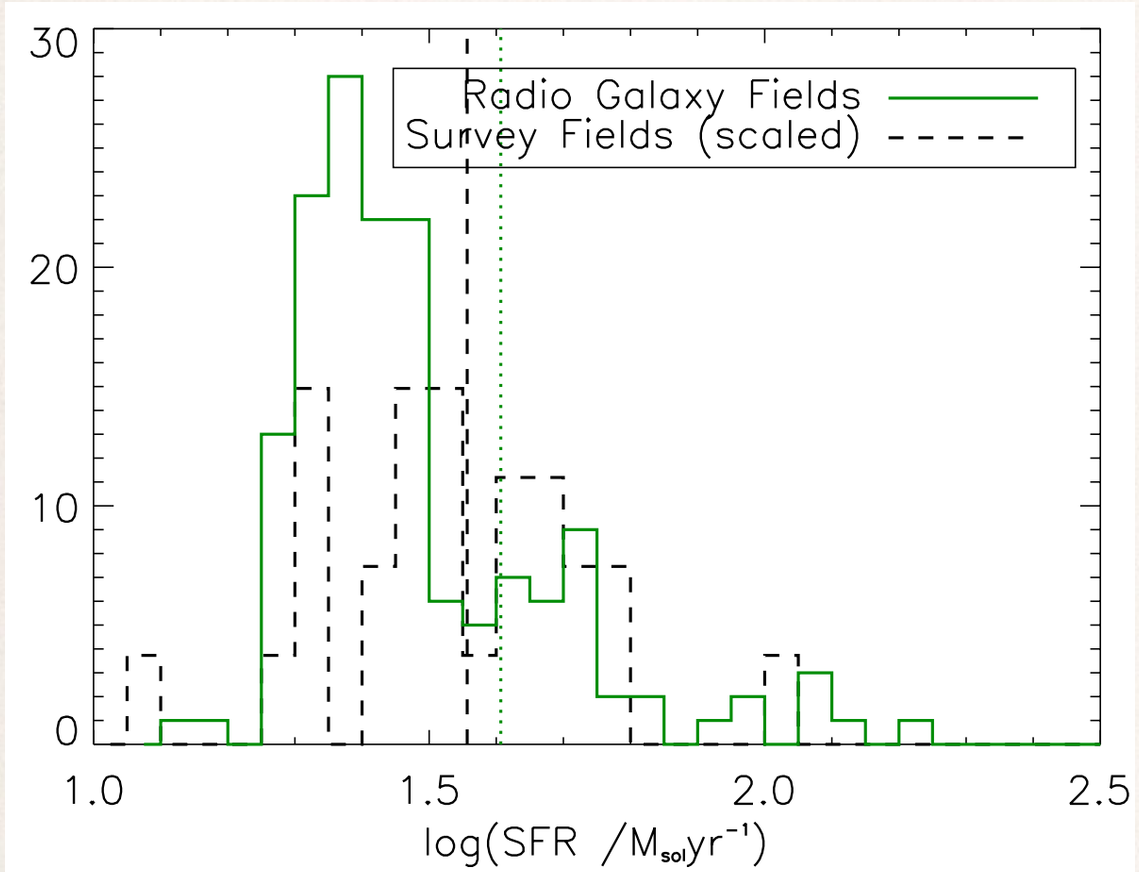


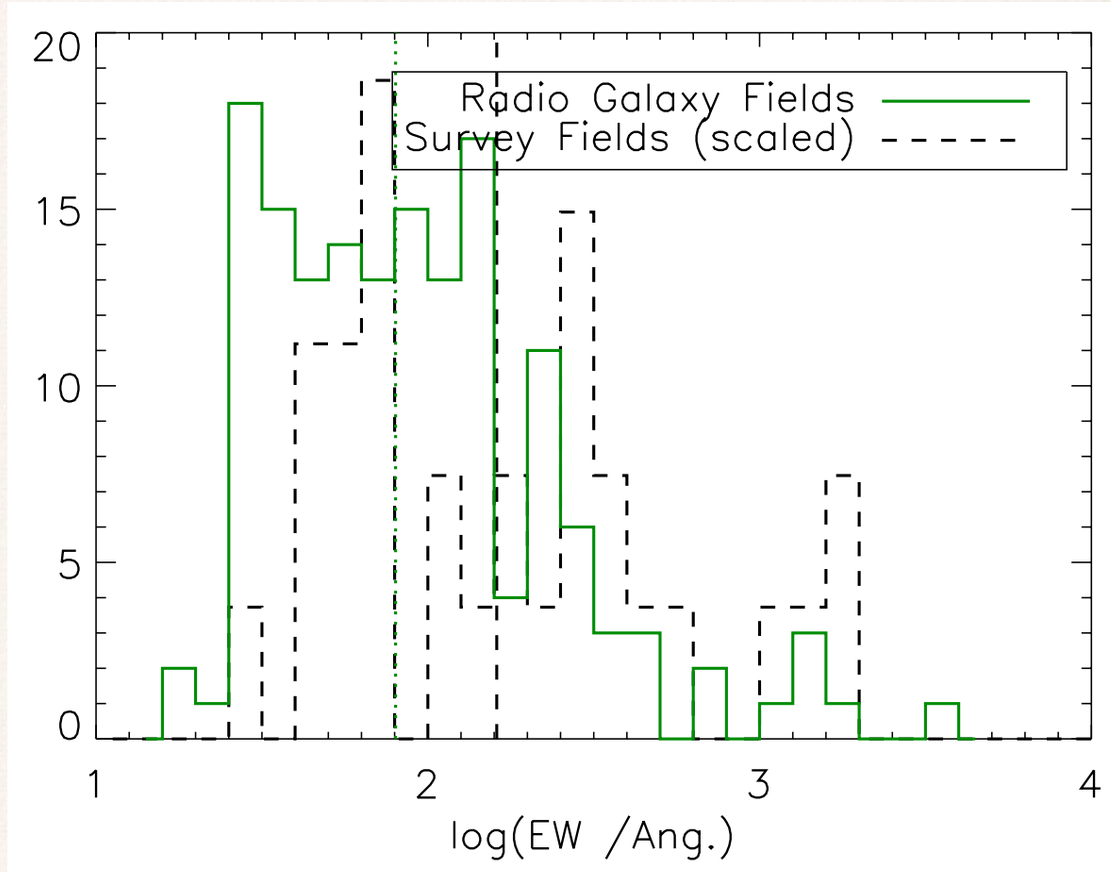
Mass Function

- NII corrected, 1 mag dust extinction, completeness corrected to Sobral+13 relation.
- Excess of galaxies, perhaps the most massive galaxies.
- => These fields have massive, highly star-forming HAEs.



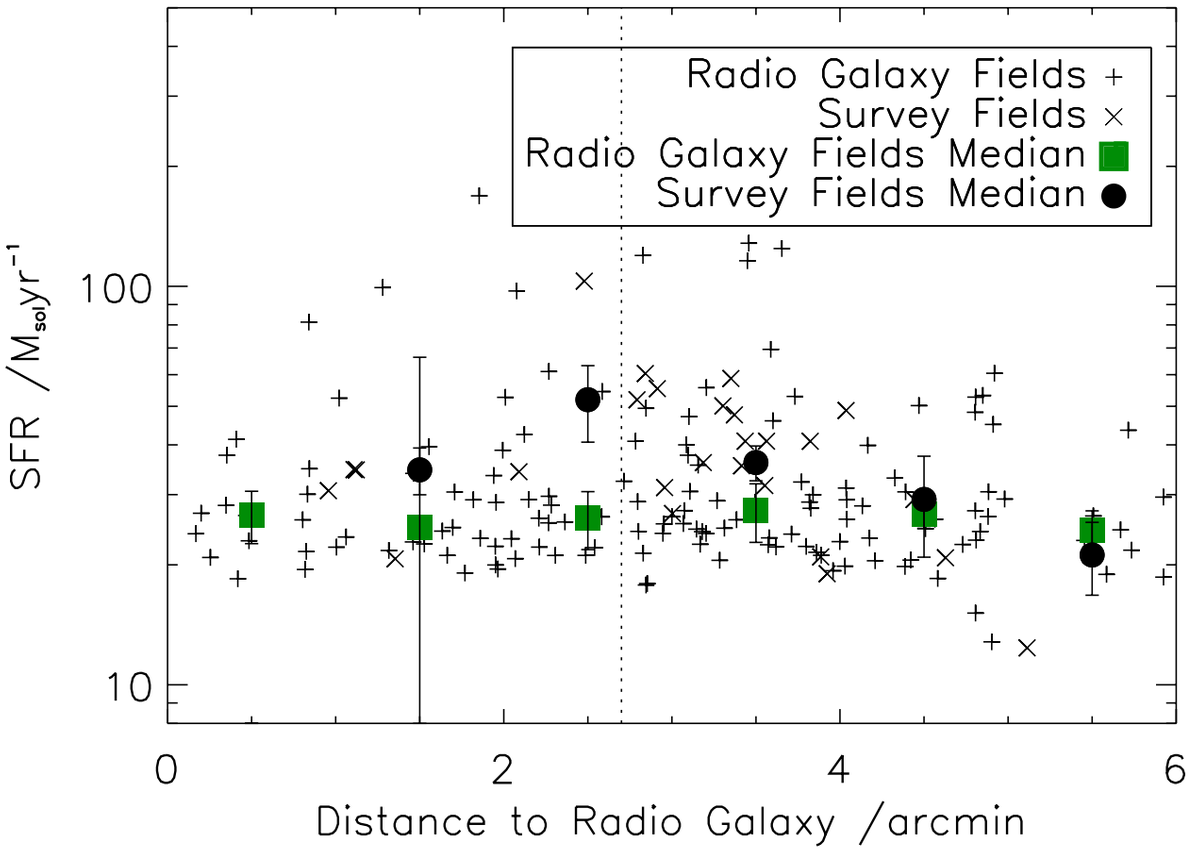
Galaxy Properties

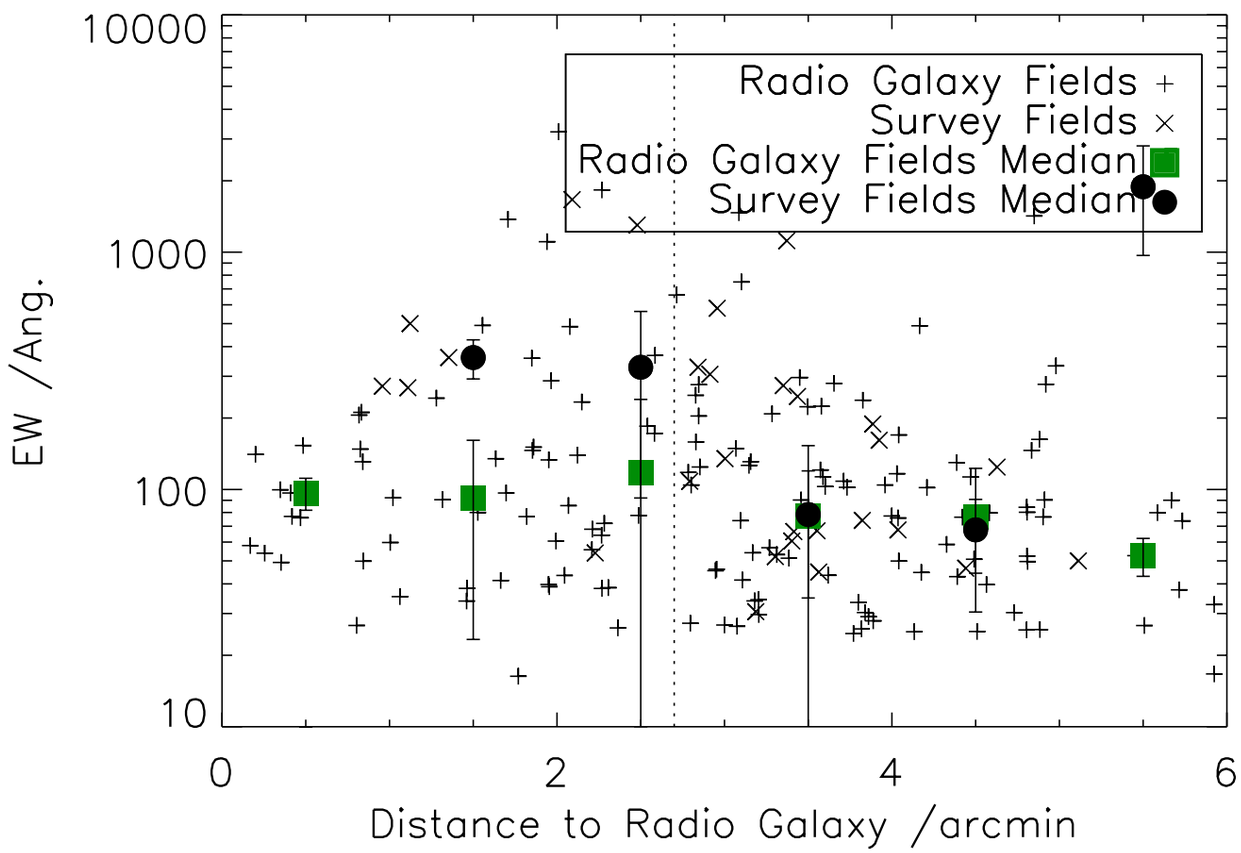




- Radio galaxy fields have higher SFRs but lower sSFRs than the field.
- Perhaps radio galaxy is heating cold gas in its local environment removing the fuel for star formation.

Galaxy Properties





- Although HAEs cluster near radio galaxies there is no variation in properties with distance to central radio galaxy.

- But no spectroscopy here so this is projected distance.

Conclusions

- Most radio galaxies are in denser environments than the field (4/7 overdense), but there is a large variation between fields.

- Two fields extremely dense (denser than 95% of the HAWKI sized regions around galaxies in HiZELS) and will be followed up.

- On average the radio galaxy fields have galaxies that are more massive and more luminous (=> higher SFRs) than the field but average or low sSFRs => cluster HAEs have different formation histories.