ESTALLIDOS XIII Madrid - **2022**

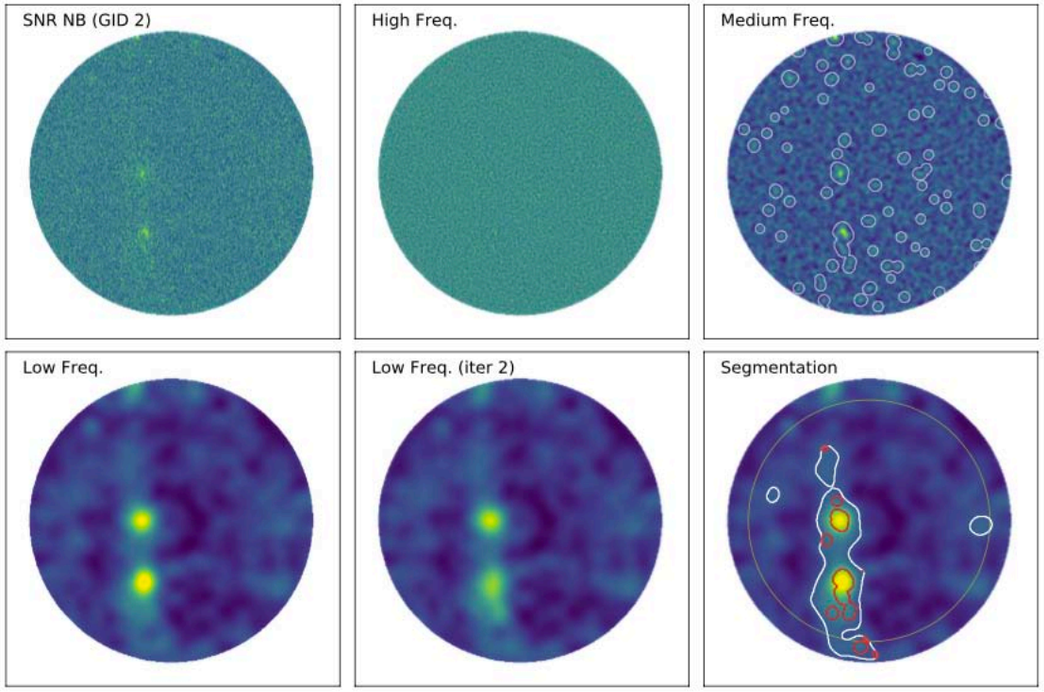
Searching for Hα emission in the outskirts of galaxies

João Calhau
@astro_calhau
astrocalhau.wordpress.com

Collaborators: **Jorge Sanchez Almeida**, Ana Luísa González-Moran
Casiana Muñoz-Tuñon, José Rodriguez Espinosa

Image Credit: ESO/Mario Nonino, Piero Rosat and the ESO
GOODS Team - http://www.eso.org/public/images/eso0839a/

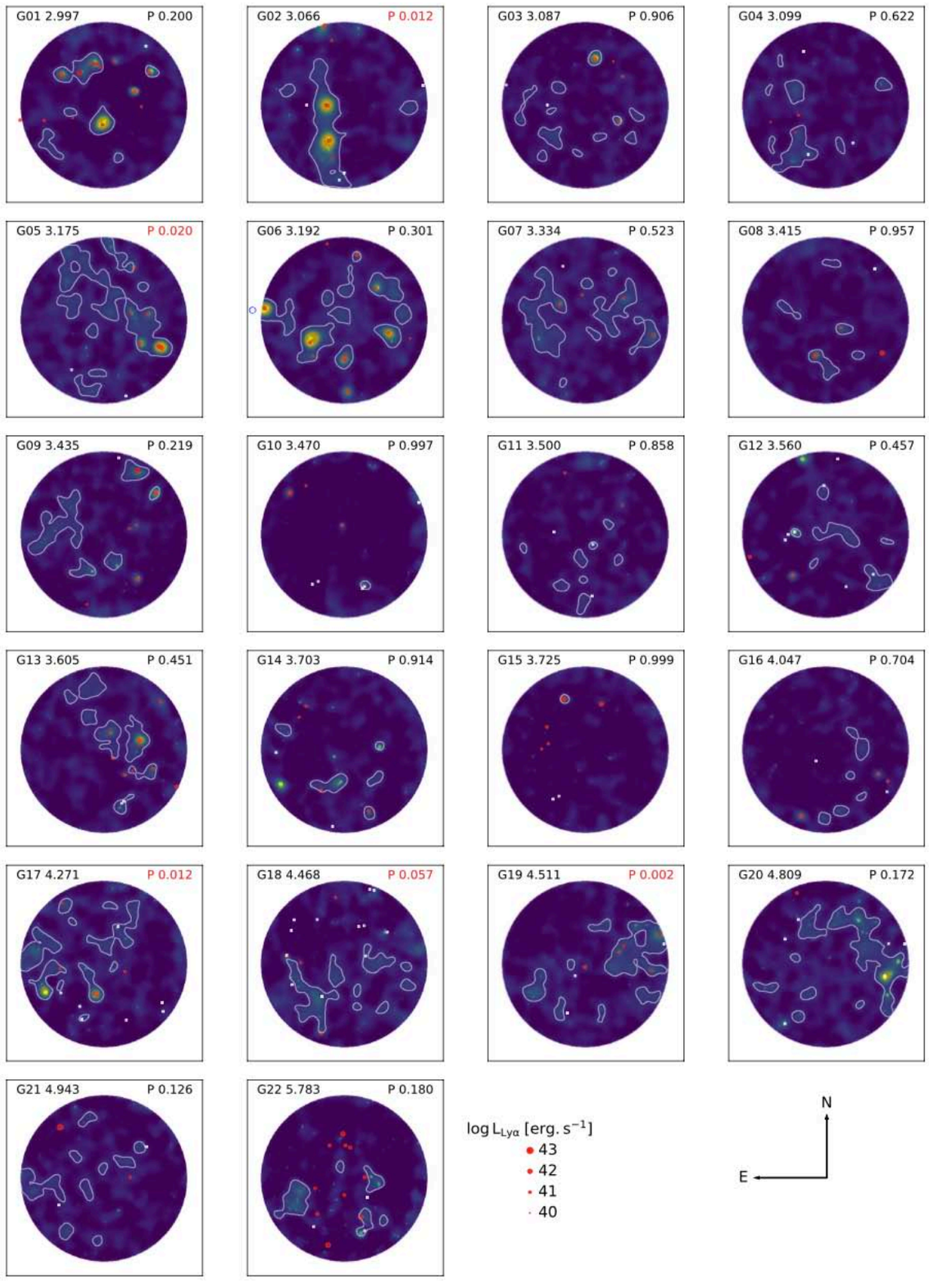
THE PRESENCE OF GAS IN CIRCUMGALACTIC MEDIA



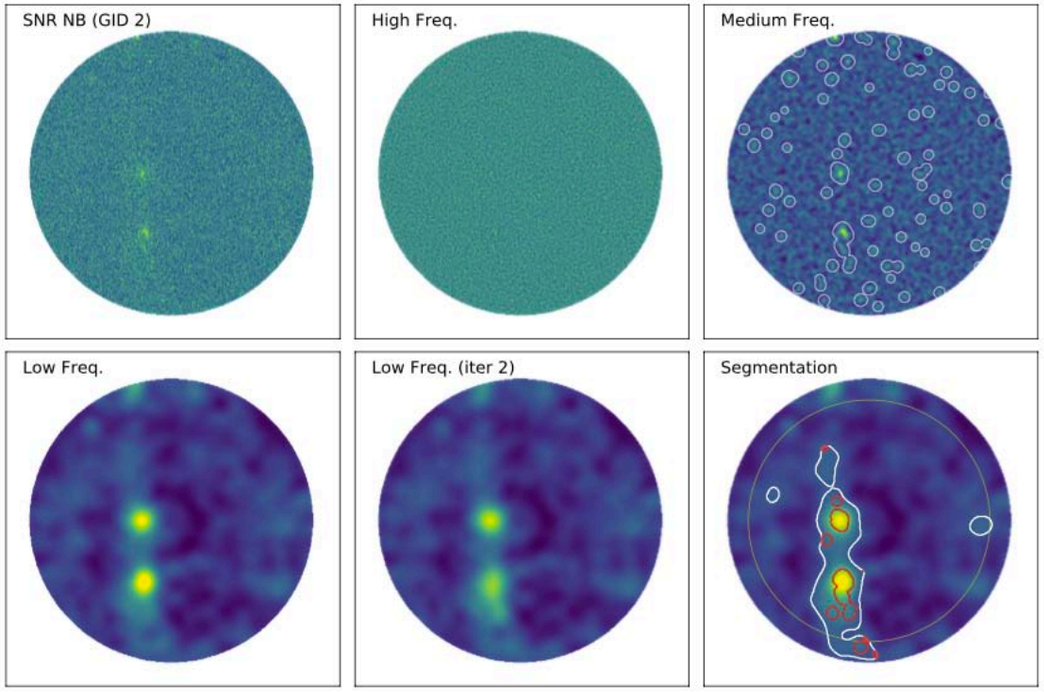
Bacon et al. 2021

Galaxies are expected to be surrounded by large reservoirs of gas, mostly hydrogen.

- Inflows from the intergalactic medium
- Outflows due to galactic winds (e.g. Bond et al. 1996, Bacon et al. al. 2021).



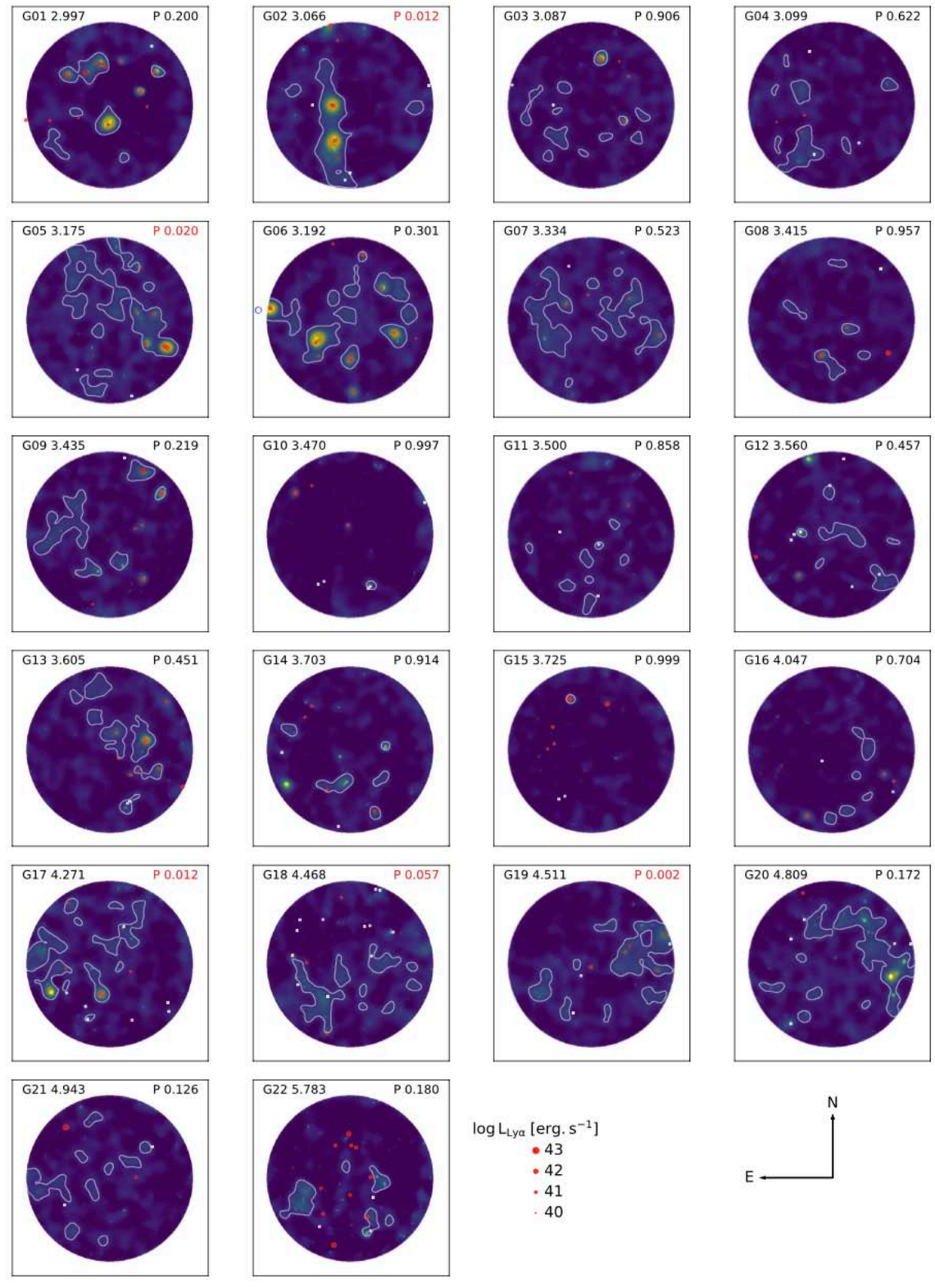
THE PRESENCE OF GAS IN CIRCUMGALACTIC MEDIA



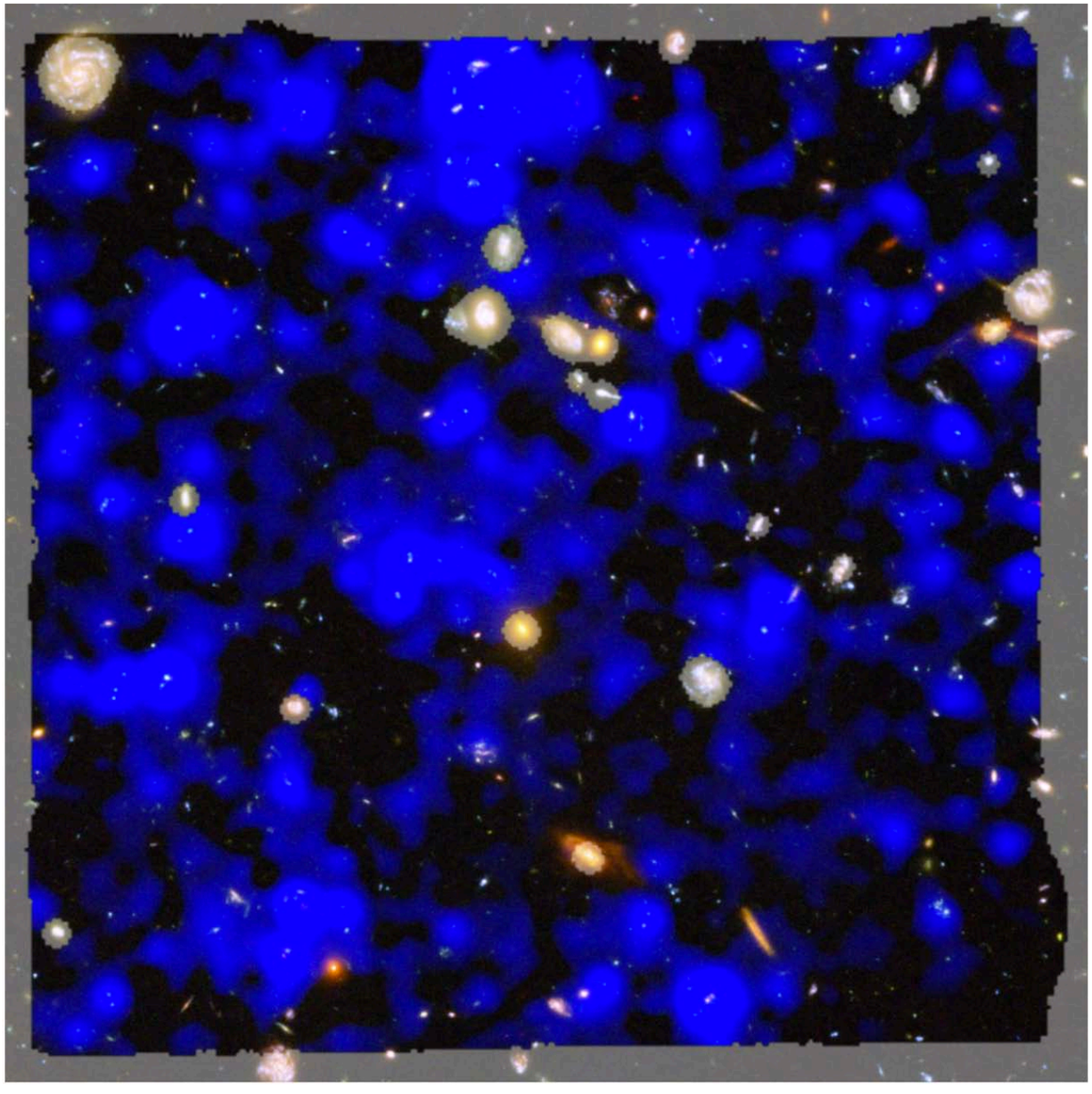
Bacon et al. 2021

Key role in the evolution of galaxies and star formation.

- Stellar mass relations with SFR, metallicity (e.g. Sanchez Almeida et al. 2018, Davé et al. 2012).



THE PRESENCE OF GAS IN CIRCUMGALACTIC MEDIA



Wisotzki et al. 2018

At high redshifts, Lyman-alpha (Lyα) emission has been detected in cosmic web filaments (Wisotzki et al. 2016, Arrigoni Battaia et al. 2019).

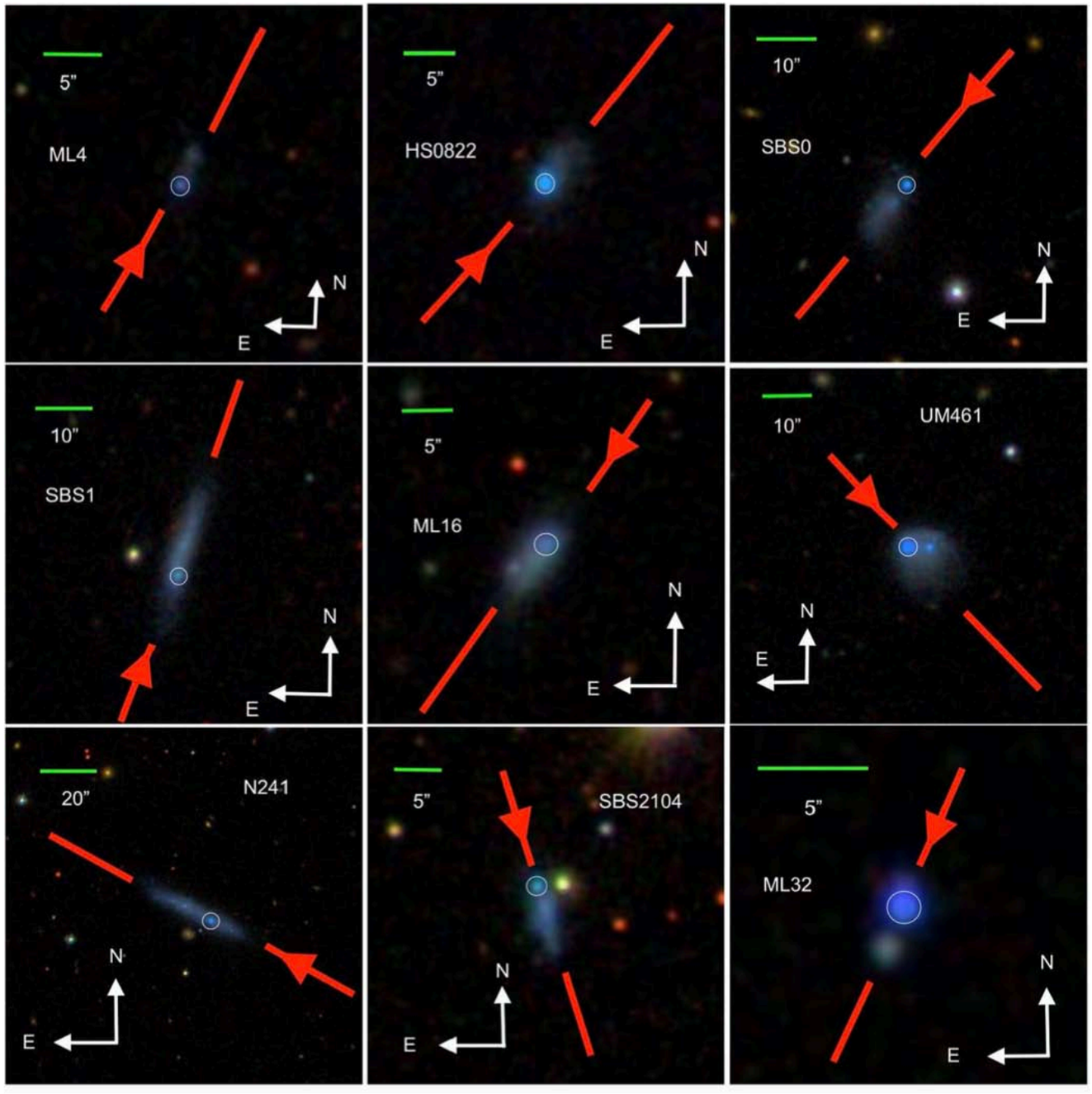
BUT

Detection complicated by the near <u>omnipresence</u> of Lyα emission in the high redshift sky

THE QUESTION

At low redshift, Lyα is unavailable to observers - Ultraviolet.

But it should still be possible to identify gas in the circumgalactic medium by making use of Hα emission (Olmo-Garcia, et al. 2019).



Olmo-Garcia et al. 2019

We aim to find these low-redshift analogues using Hα

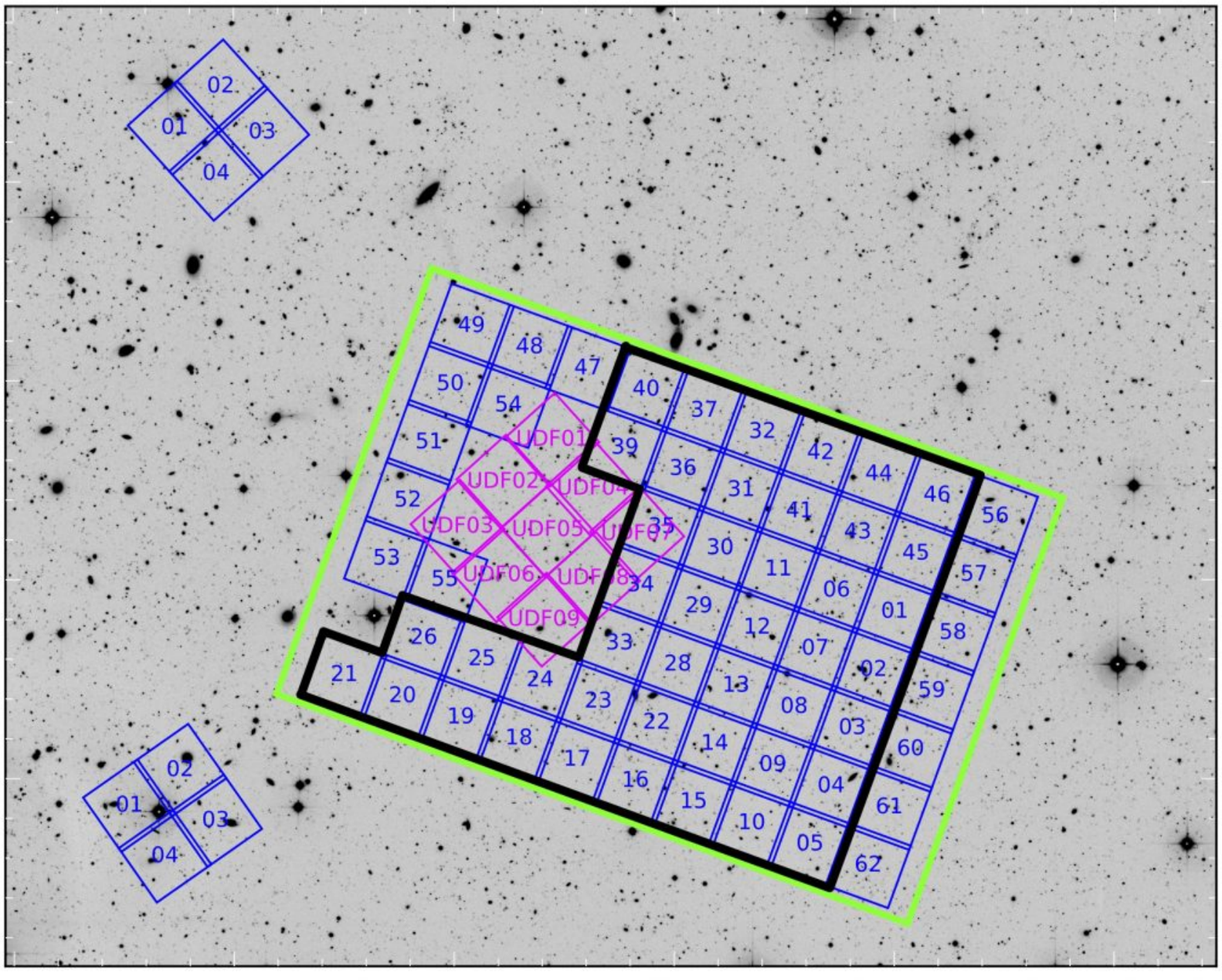
Hα

BLOBS

THE MUSE-WIDE DATASET

Blind spectroscopic survey encompassing the CANDELS/GOODS-S and CANDELS/COSMOS regions.

Urrutia et al. 2019



Integration time of 1 hour

100 x 1 arcmin2

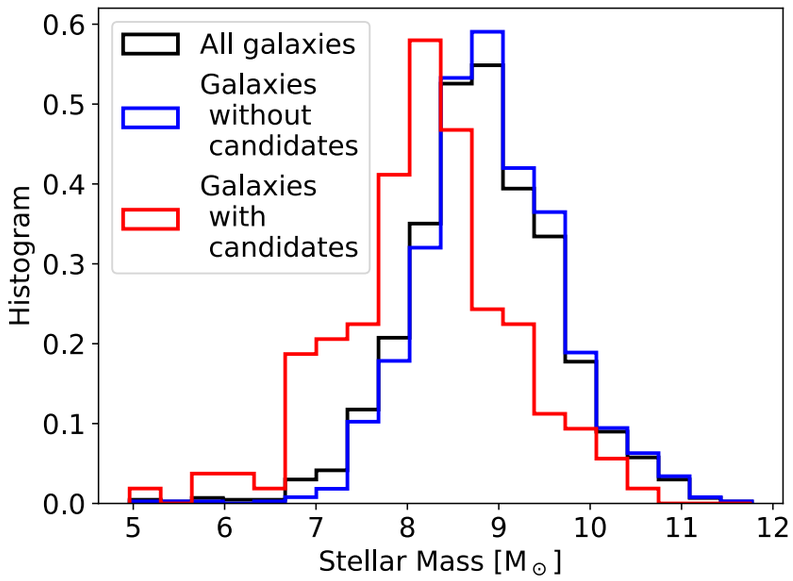
44 fields (currently)

wavelength range of 4750 - 9350Å

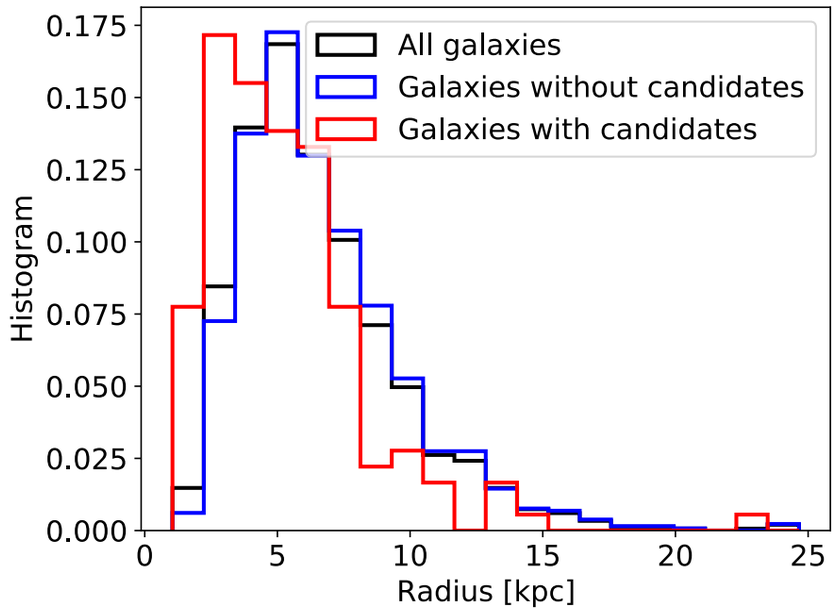
spatial resolution of 0.2'' x 0.2''

wavelength sampling of 1.25Å

THE HOSTS



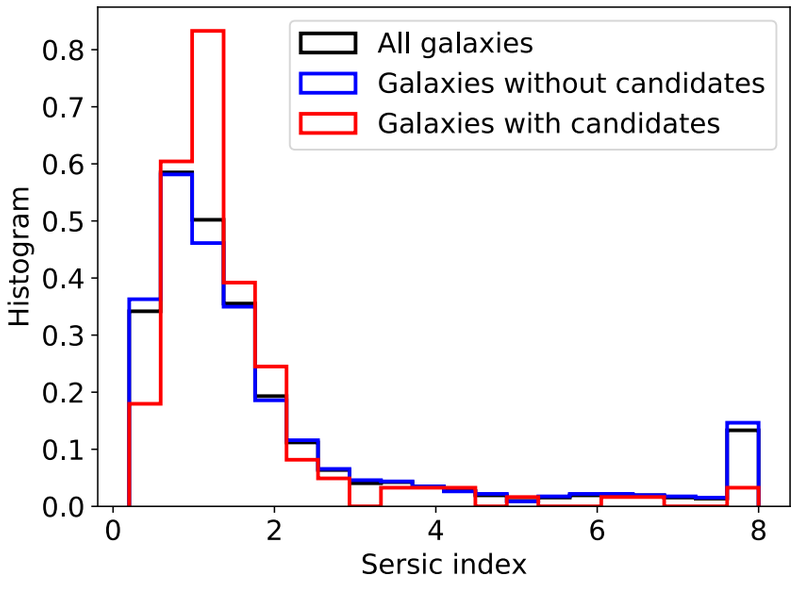
164 galaxies in the MUSE-WIDE field (average z~0.29 +/- 0.08).



log(M⊙) ~ 8.2 +/- 0.9

Sersic index ~ 1.5 +/- 1.2

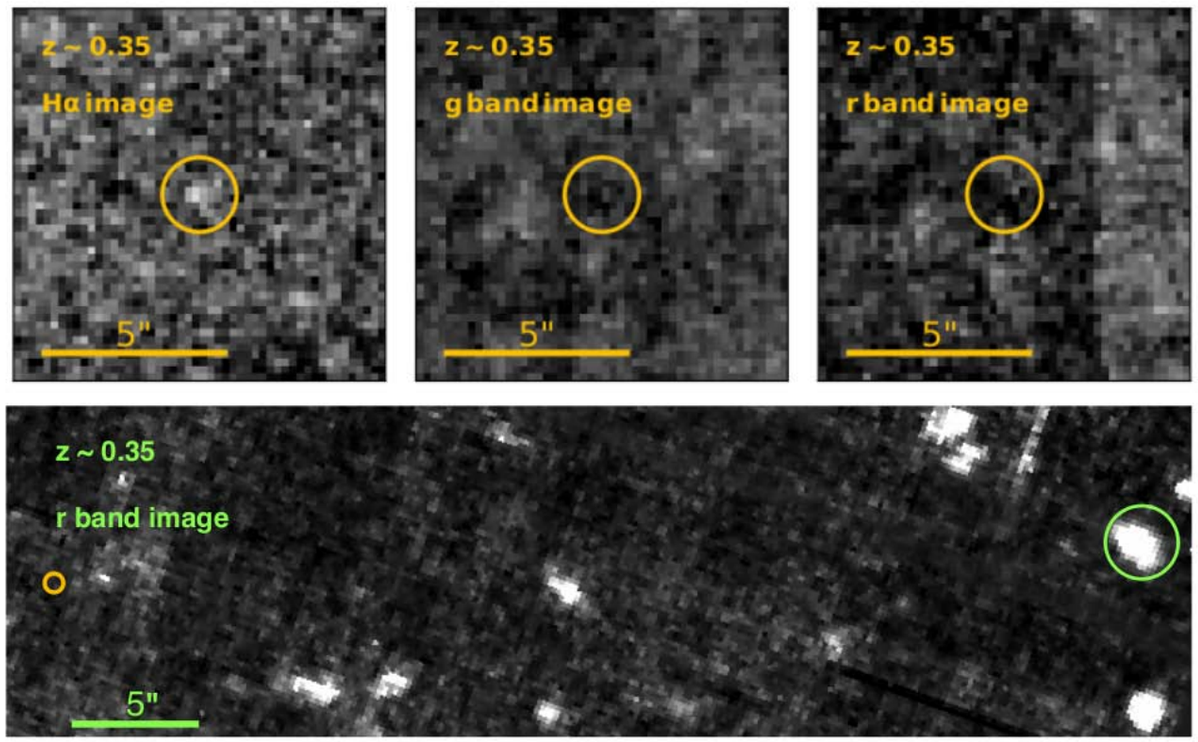
Radius(kpc) ~ 5 +/- 3



Sanchez Almeida, J., Calhau, J. et al. (submitted)

Consistent with smaller spirals and dwarf galaxies.

SEARCHING FOR Hα EMISSION IN THE OUTSKIRTS OF GALAXIES



Lack of continuum

↕

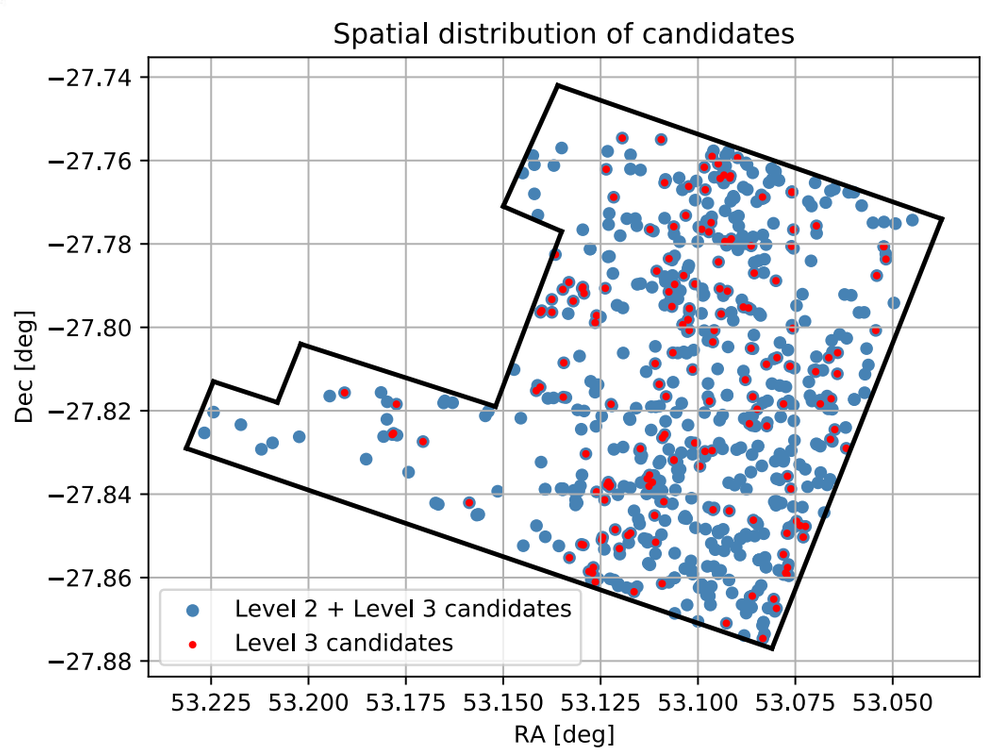
exclusion of stars, unresolved background galaxies.

>600 preliminary candidates in 164 galaxies at 0.076 < z < 0.42 → 3-6 per galaxy.

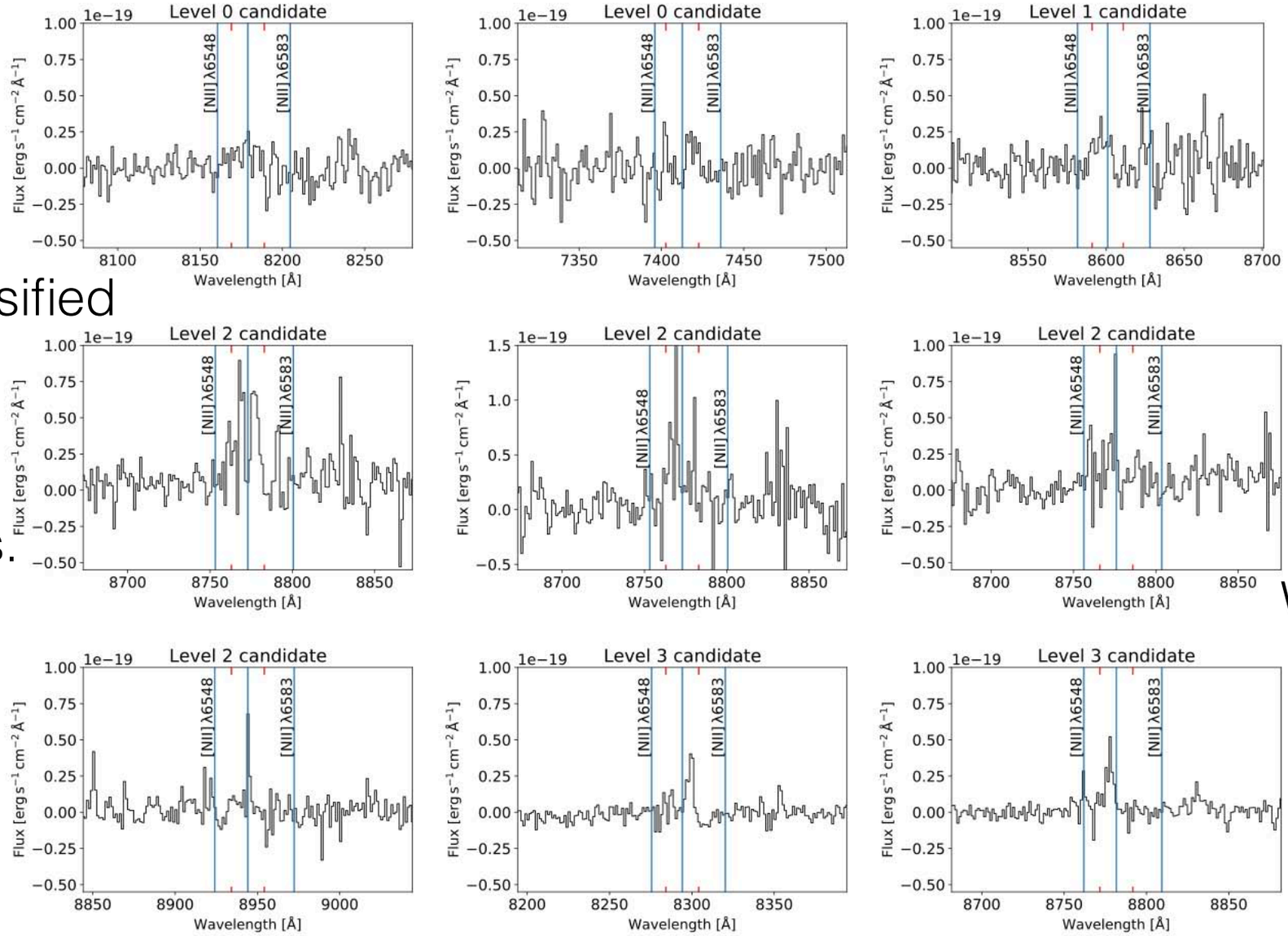
Candidates must have emission in the Hα band and NO emission in the "broad filters".

Search radius as large as ~100x host galaxy radius.

Sanchez Almeida, J., Calhau, J. et al. (submitted)



SEARCHING FOR Hα EMISSION IN THE OUTSKIRTS OF GALAXIES



Candidates classified from “level 0” to “level 3” based on their spectral features.

We look for:

- Hα line
- Hβ line
- O[III] lines
- Any others

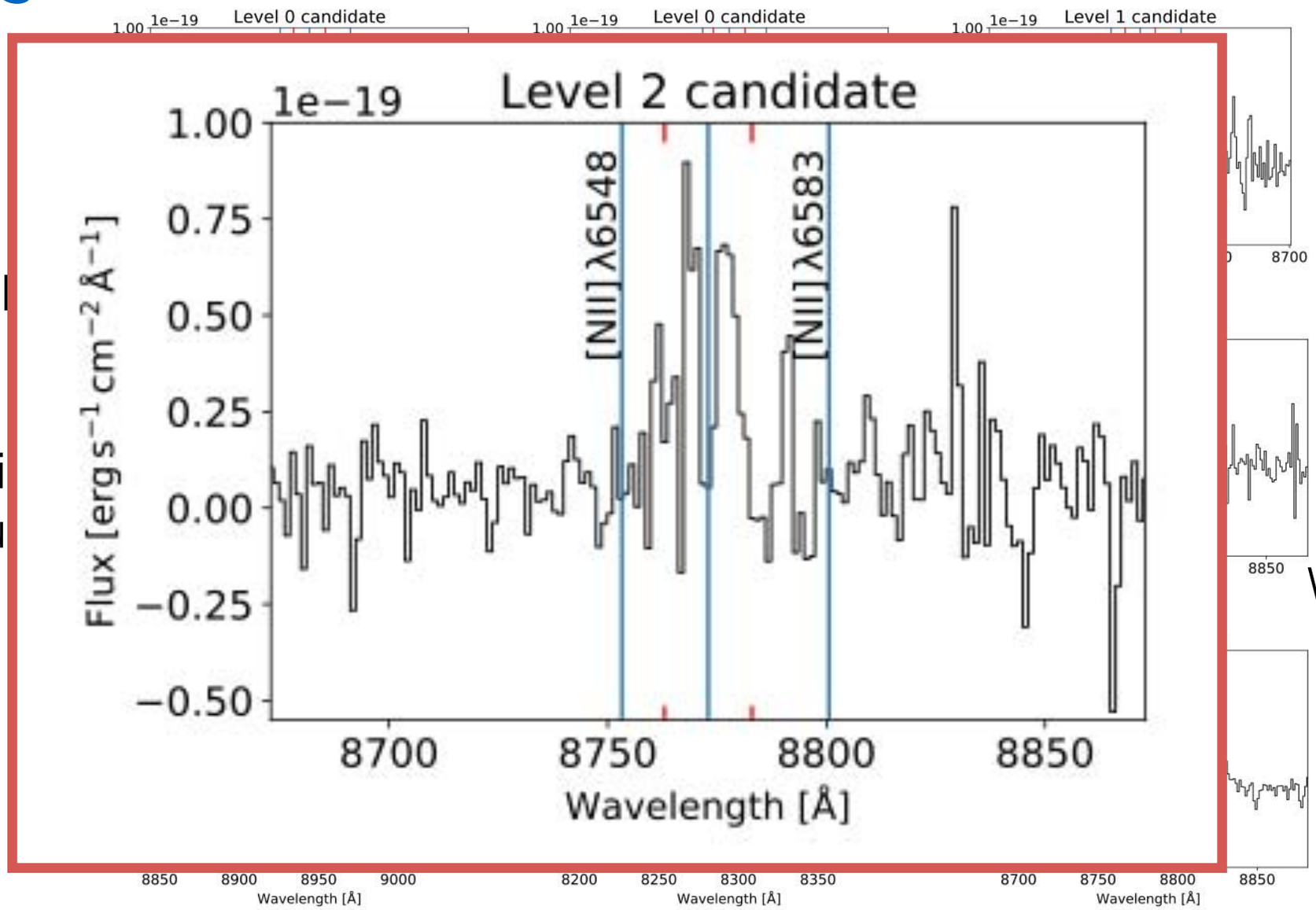
Lack of Hα line in the 1D spectra is grounds for “level 0” designation and immediate **termination**

Sanchez Almeida, J., Calhau, J. et al. (submitted)

Level 2-3 candidates are selected for further studies.

SEARCHING FOR Hα EMISSION IN THE OUTSKIRTS OF GALAXIES

Candidates cl
from “level 0”
to “level 3”
based on thei
spectral featu



We look for:

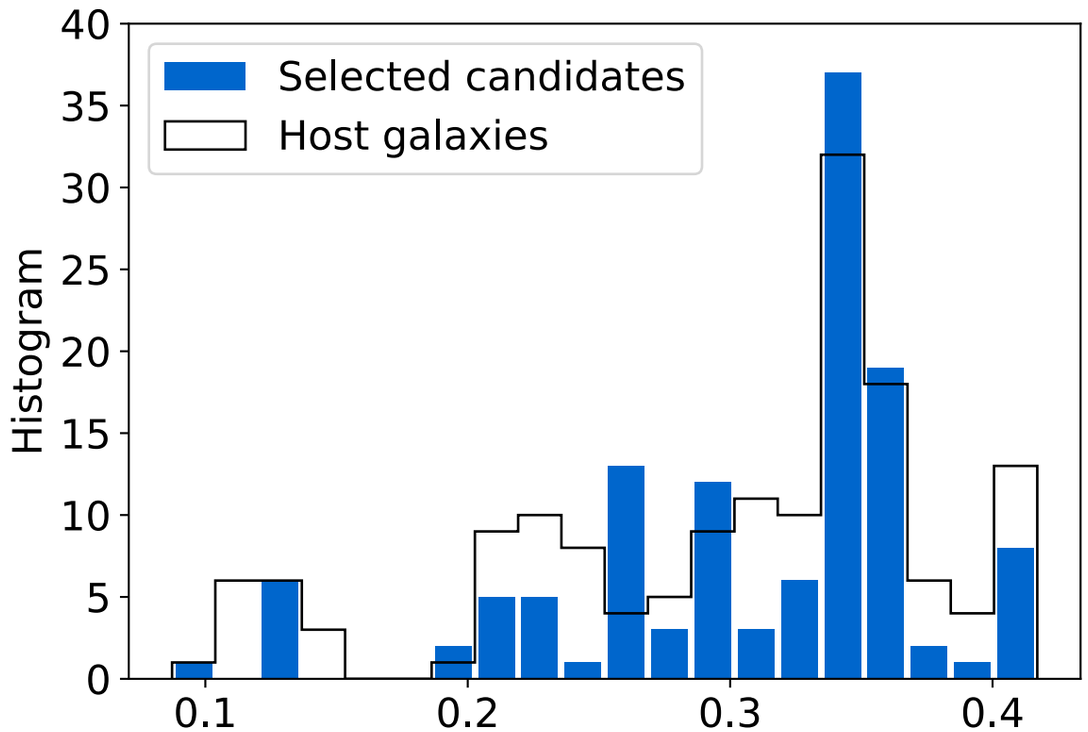
- Hα line
- Hβ line
- O[III] lines
- Any others

Lack of Hα line in the 1D spectra is grounds for “level 0” designation and immediate **termination**

Sanchez Almeida, J., Calhau, J. et al. (submitted)

Level 2-3 candidates are selected for further studies.

SEARCHING FOR Hα EMISSION IN THE OUTSKIRTS OF GALAXIES



Final selection yields ~120 candidates

Average redshift = 0.31 +/- 0.07

Average projected size = 0.9” +/- 0.4”

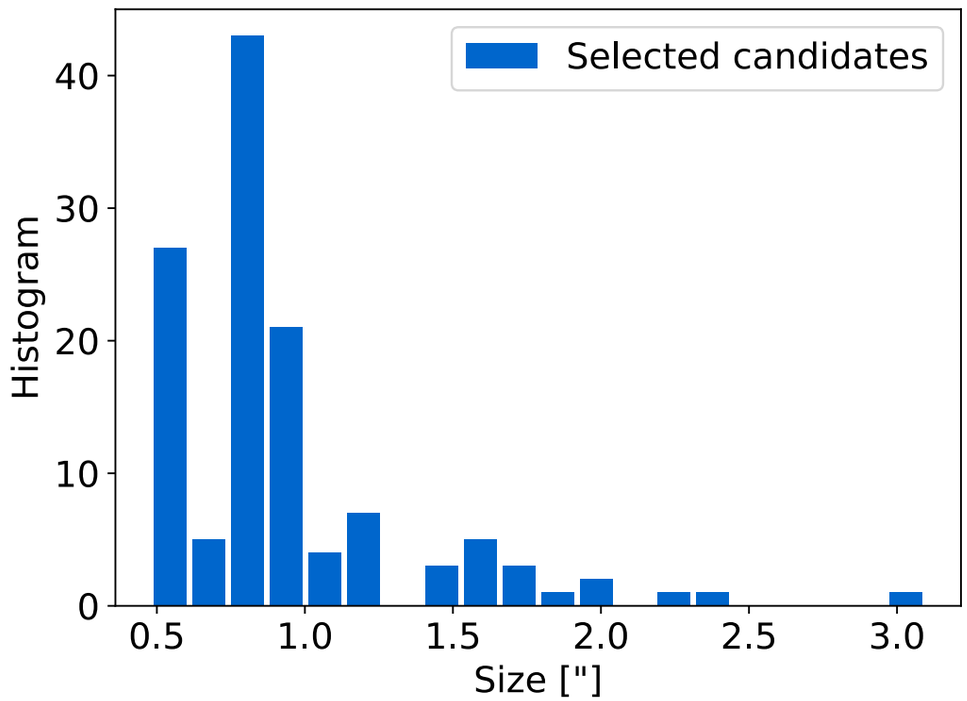
log(Average flux) = 17.3 +/- 0.3 erg/cm2/s

Sanchez Almeida, J., Calhau, J. et al. (submitted)

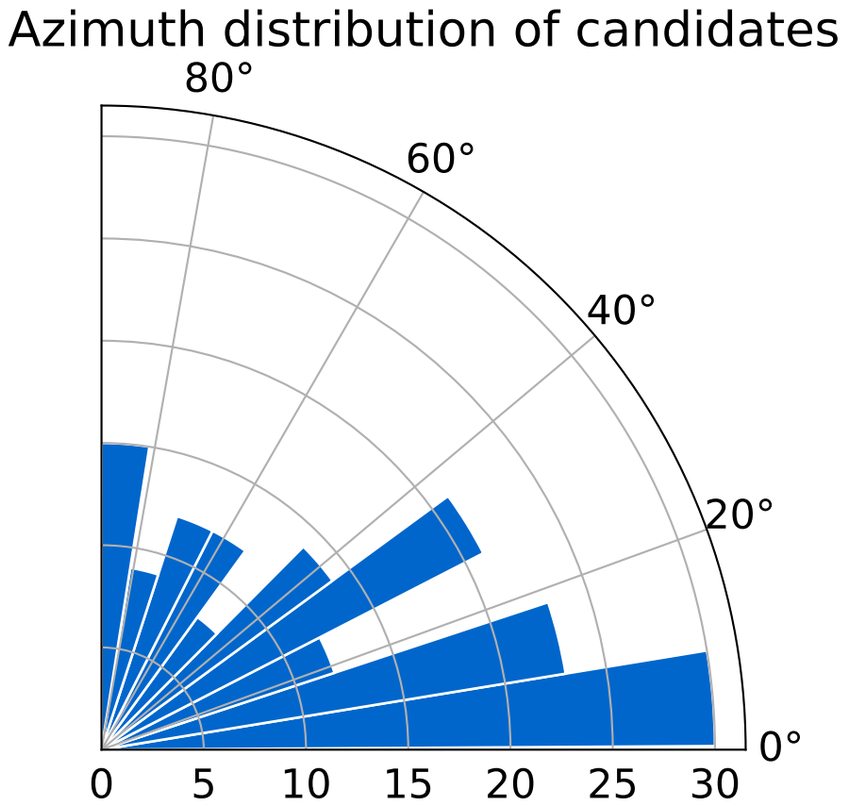
45 (~27%) considered very strong candidates from their spectral profiles.

~0.3 Hα blobs per galaxy

But be sure to check Jorge’s talk right after this one!



SEARCHING FOR Hα EMISSION IN THE OUTSKIRTS OF GALAXIES



Most gas blobs can be found at ~40-50 radii from their host galaxies.

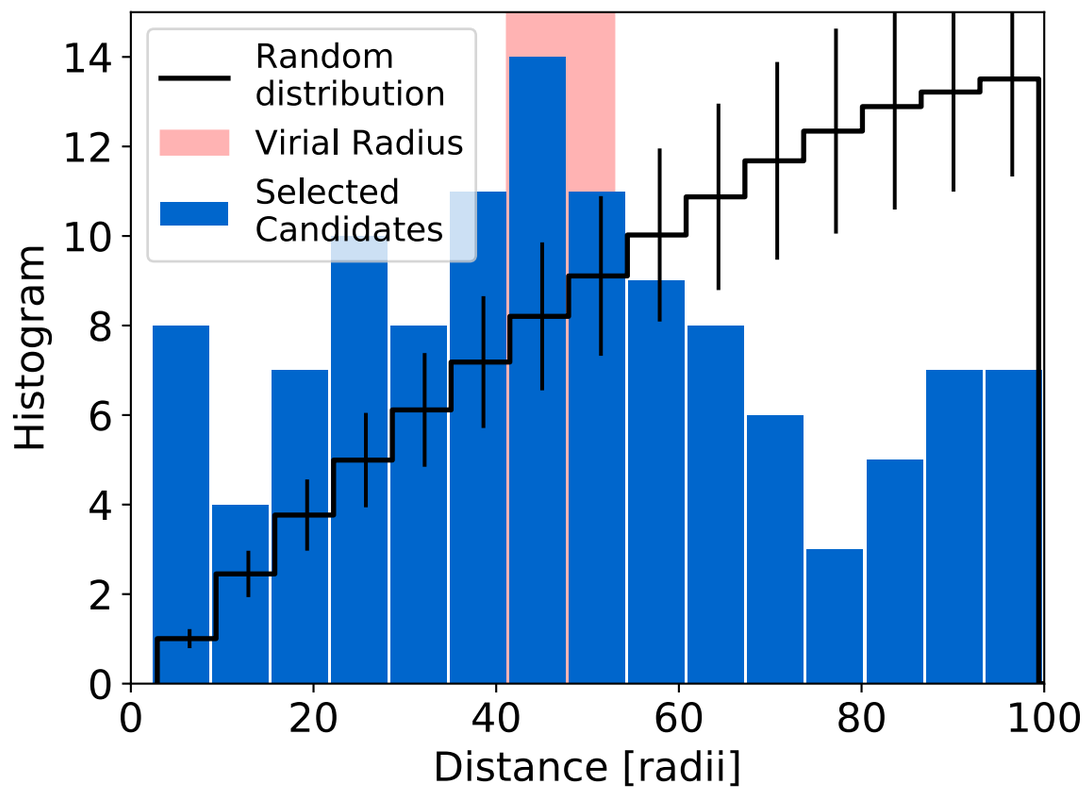
Smaller peaks found at <10 raddii and ~100 radii.

Candidates seem to prefer to align themselves with the galactic plane.

Gas accretion into the galaxy or something else?

But be sure to check Jorge's talk right after this one!

Sanchez Almeida, J., Calhau, J. et al. (submitted)



TAKE-AWAY POINTS AND FUTURE WORK

- Gas structures have been identified in the high redshift Universe through Lya emission but it should be possible to find low redshift counterparts with Ha.

- Using MUSE-Wide data, we find ~120 candidates for Ha gas clumps around host galaxies from $0.07 < z < 0.4$ and extract some preliminary properties of these structures.

- These candidates' signals are faint and often at noise level ⟶ Difficult to separate from contaminating signals.

- **BUT**

- They appear real and represent **possible detection of structures** which, so far have **only** been **found on a theoretical level (simulations)**.

- Current/Future work: Automatisation of search and classification processes.