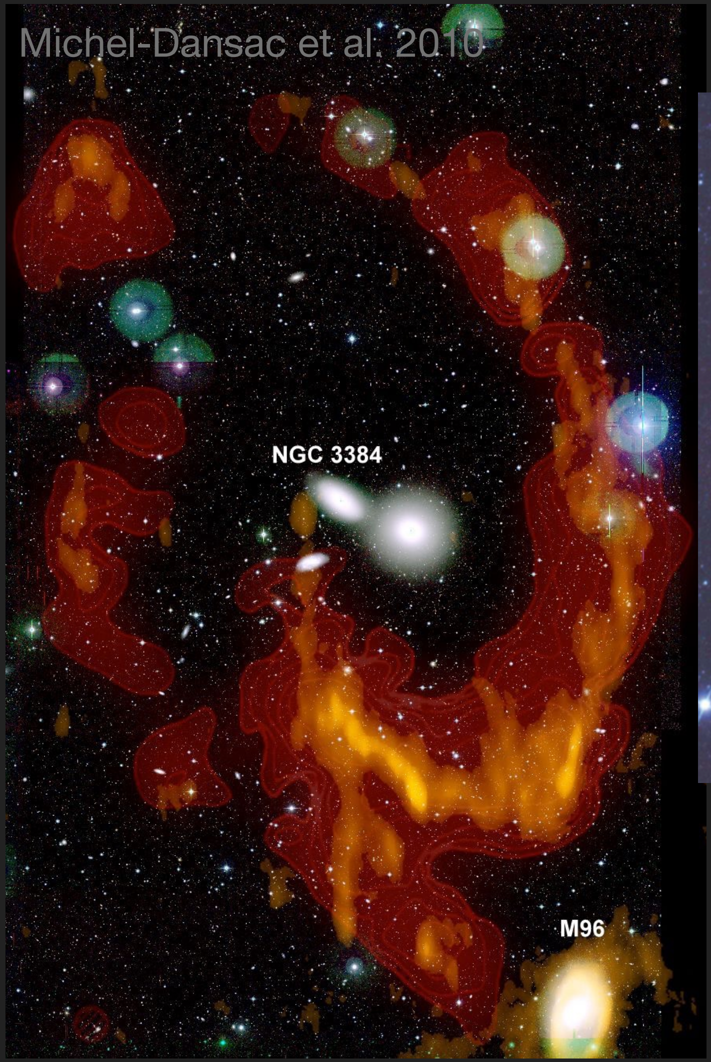
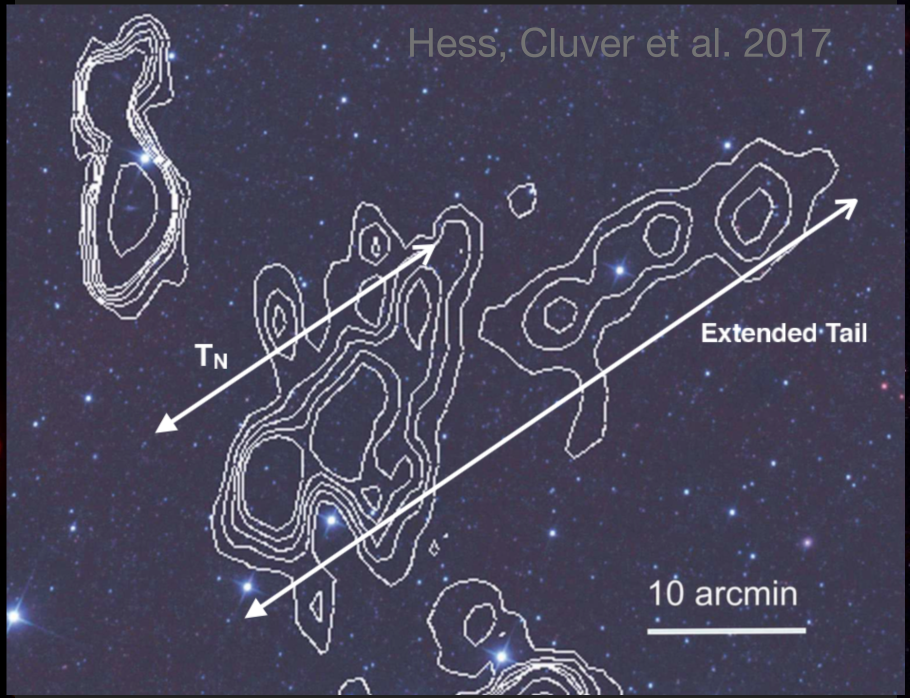
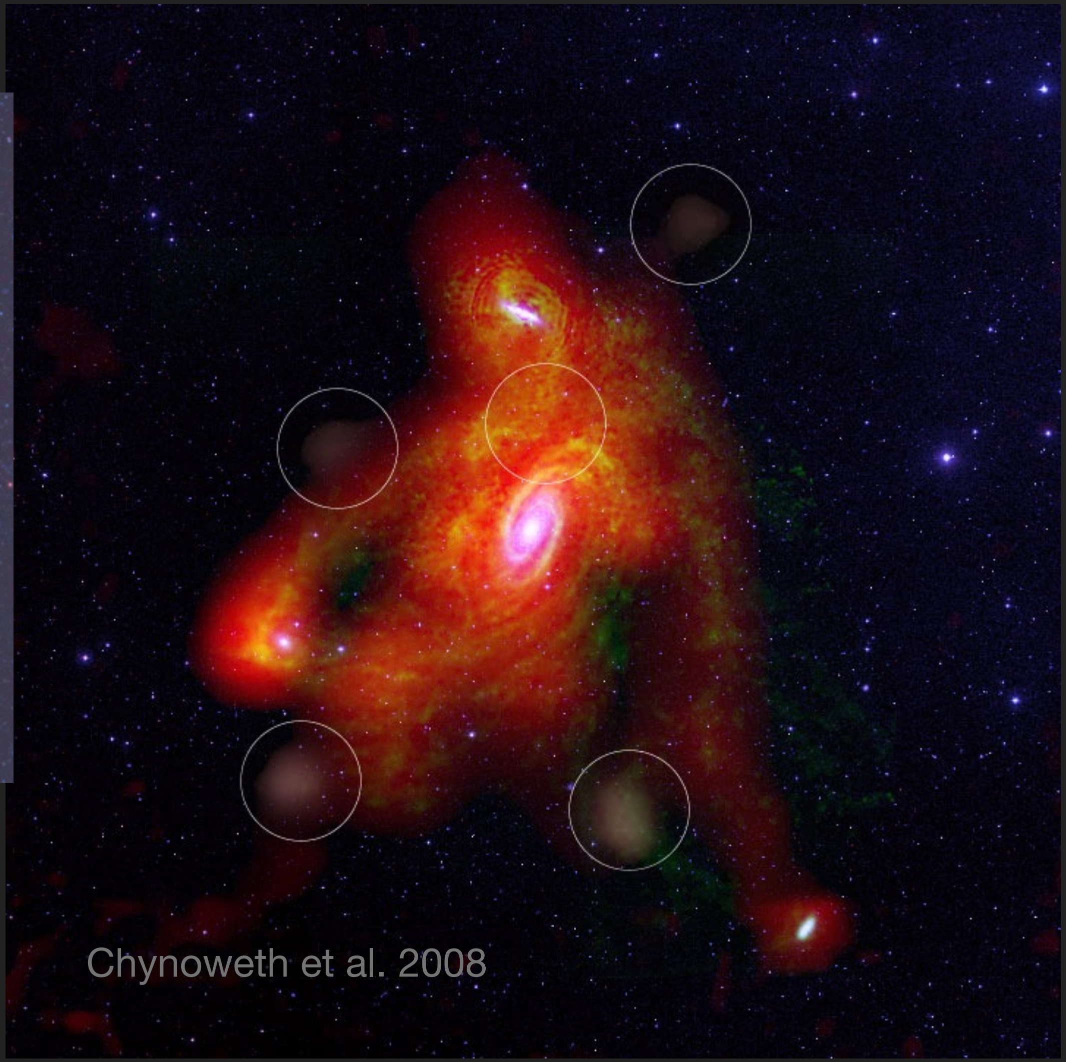
HI/dden Cool and Close Encounters





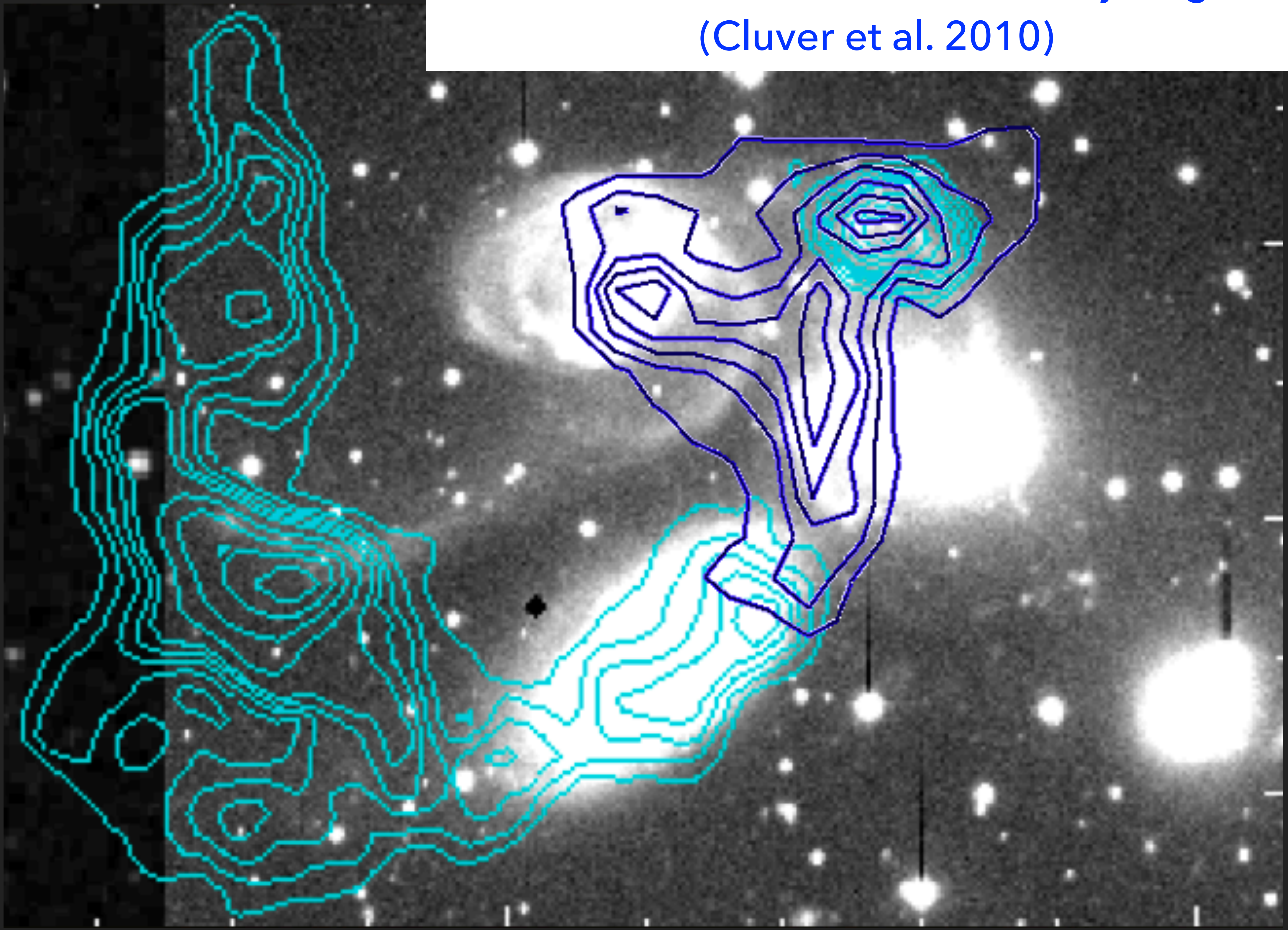


SWINBURNE CENTRE FOR ASTROPHYSICS AND SUPERCOMPUTING

Dr Michelle Cluver

ARC Future Fellow mcluver@swin.edu.au

TIDAL HI DEBRIS CONVERTED TO H_2



Blue: Shock-excited molecular hydrogen (Cluver et al. 2010)

Cyan: HI from VLA (courtesy of L. Verdes-Montenegro)

COLD INTRAGROUP GAS

- Many examples of tidal filaments/streams detected in nearby systems (Mpc vs z) –see “HI Rogues” Gallery (Hibbard et al. 2001)
- Tidal tails and diffuse HI in Hickson Compact Groups (Verdes-Montenegro et al. 2001, Borthakur, Yun & Verdes-Montenegro et al. 2010, Serra et al. 2013, Hess, Cluver et al. 2017)
- And even loose groups like IC 1459 (Oosterloo et al. 2018)

R.I.P. KAT-7

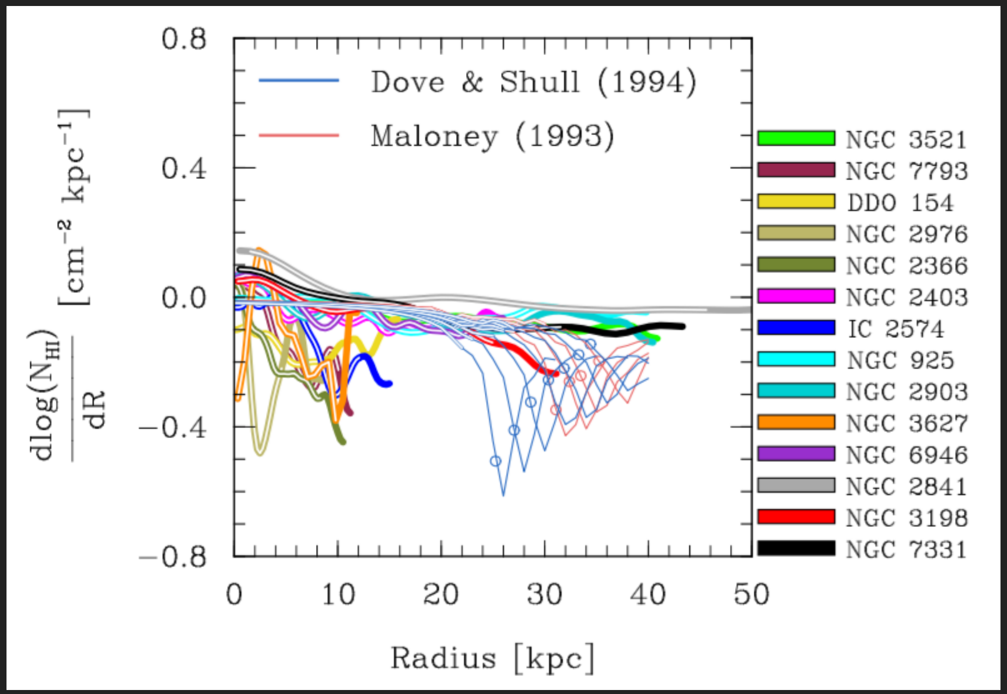
TAKEN FROM US FAR TOO SOON (LITERALLY)

- Hess et al. (2017) and Oosterloo et al. (2018)
- HI tails can survive ~ 0.5-1-2 Gyr
- reduced evaporation or copious intragroup gas initially?

Image credit: SKA-SA

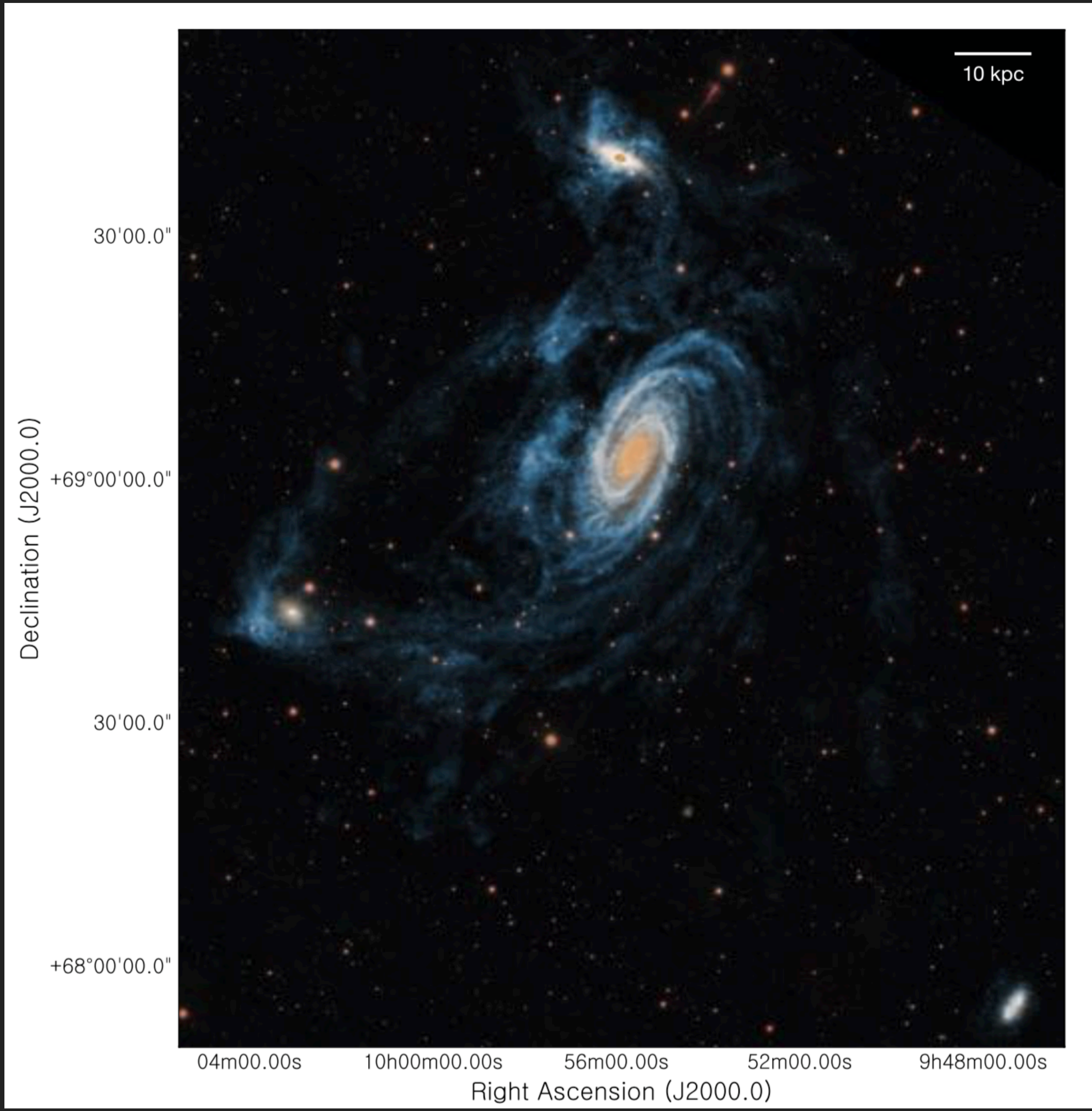
LOW COLUMN DENSITY GAS: 10^{18} – 10^{20} CM^{-2} REGIME

- QSO sightlines relatively insensitive in this "Lyman-Limit" regime due to HI self-shielding
- photoionization and radiative transfer models predict that HI cannot survive at column densities of $< 5 \times 10^{19}$ cm^{-2} (Dove & Shull 1994) due to the lack of self-shielding against extragalactic ionizing photons
- Ianjamasimanana et al. (2018)
- MeerKAT is particularly suited to probe this question



DE BLOK ET AL. (2018)

- "This indicates that the low-column density filaments seen in the GBT data are not simply the VLA HI clouds observed at low resolution, but that they consist of substantial amounts of low-column density HI in which clouds are embedded."



MeerKAT is ideally suited to detect low-column density HI

MEERKAT

- 64 x 15m dishes: compact core containing 70% of the dishes
- Better receivers (Gifford-McMahon (GM) cryogenic cooling)
- Offset Gregorian dish configuration
- Excellent column density sensitivity in L-band
- Better UV coverage at short baselines (compared to VLA) to recover diffuse emission
- Longest baseline – 8 km, shortest – 29m
- eVLA B, C, D array simultaneously
- Field of View – 1 degree

IS INTRAGROUP HI IMPORTANT FOR GALAXY EVOLUTION STUDIES?

- How does it interact with the CGM –accretion, shock heating, (viscous, cold ram pressure) stripping, formation of H2?
- Formation of tidal dwarfs?
- Hot vs cool intragroup medium? Dispersal vs evaporation vs longevity?
- Do we know enough about group evolution to understand the role of intragroup/spatially-resolved HI?

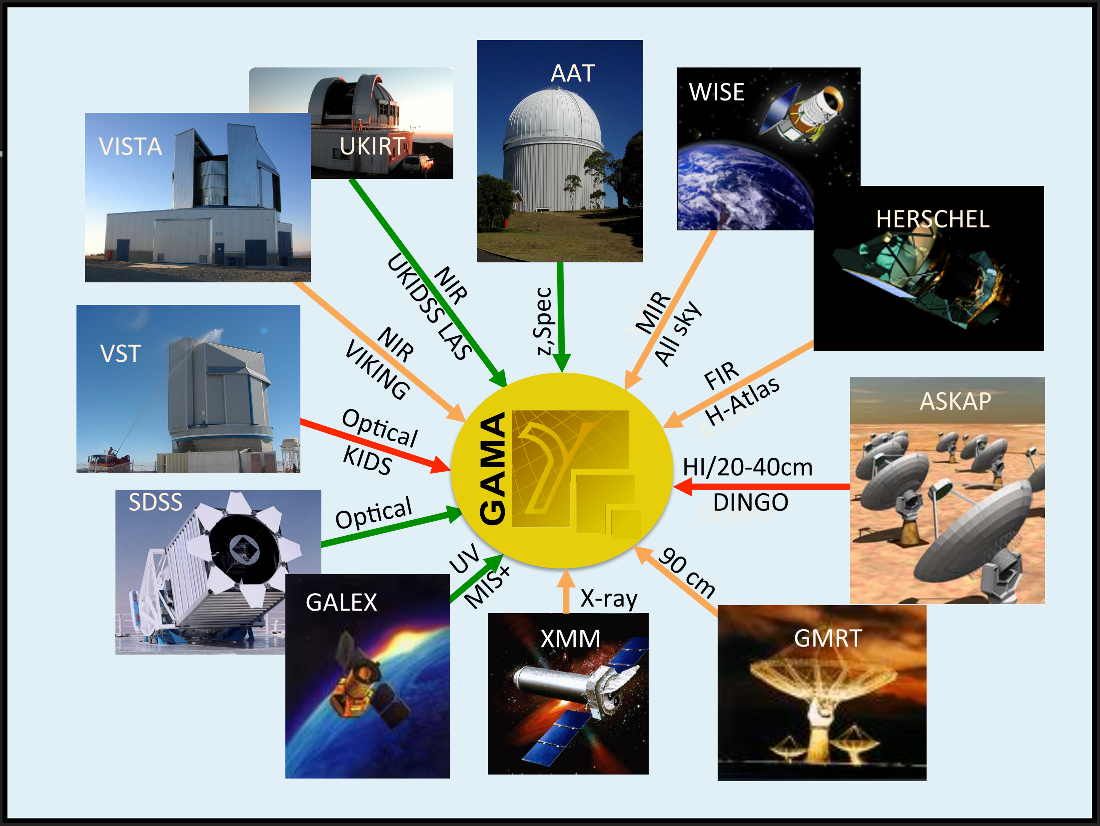
GROUP GALAXIES IN GAMA: MOTIVATION

- G3C Catalogue (Robotham et al. 2011) is currently unique due to the high spectroscopic completeness of GAMA (DESI BGS will sweep up SDSS incompleteness and overtake it)
- No assumption that groups should be treated like clusters
- Where do compact groups fall within the context of a spectrum of group properties?

GROUP GALAXIES IN GAMA: DETAILS

~ 200 000 galaxies,
z<0.5, z~0.3, r < 19.8mag

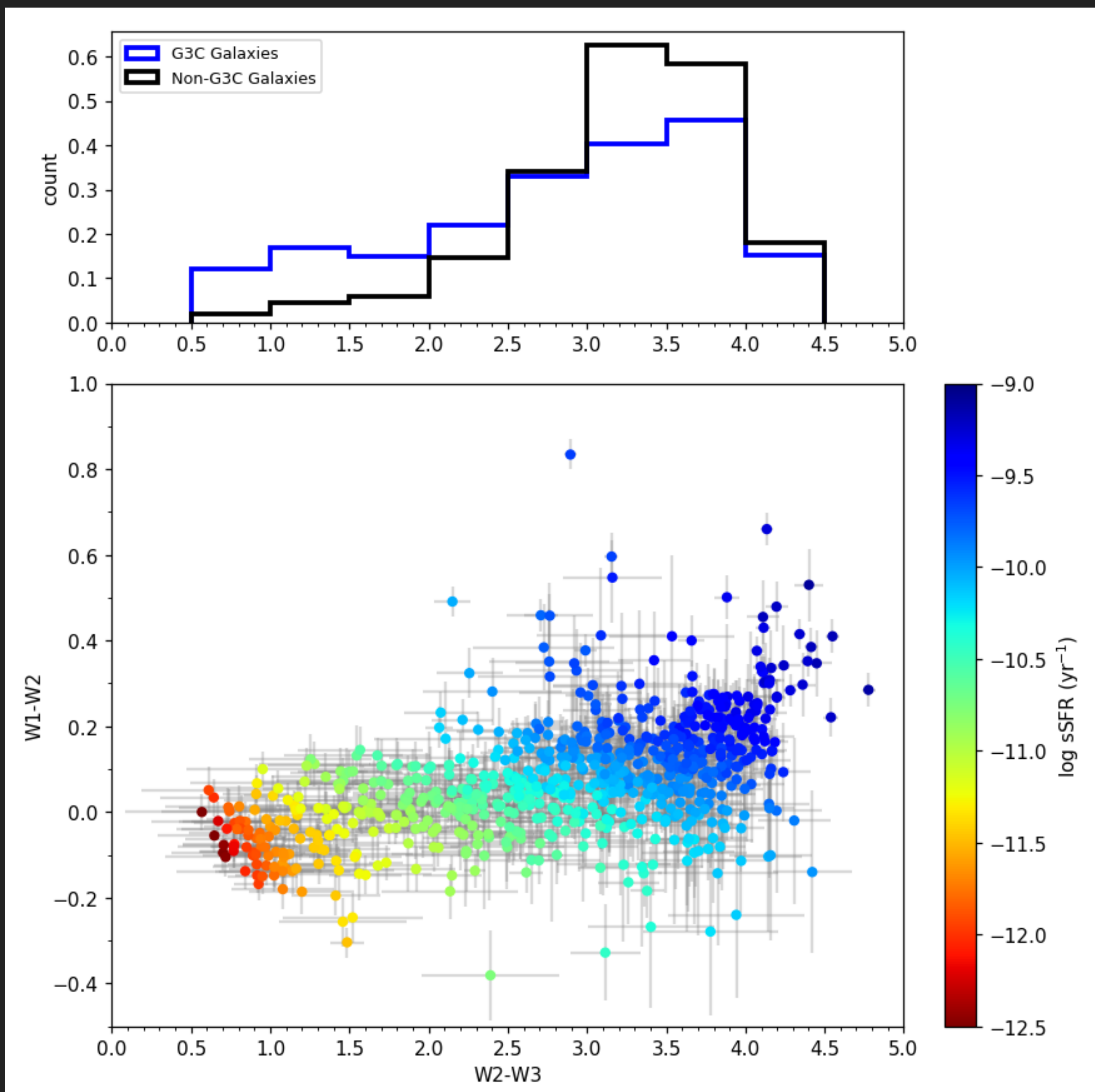
3×12×5 deg² equatorial fields



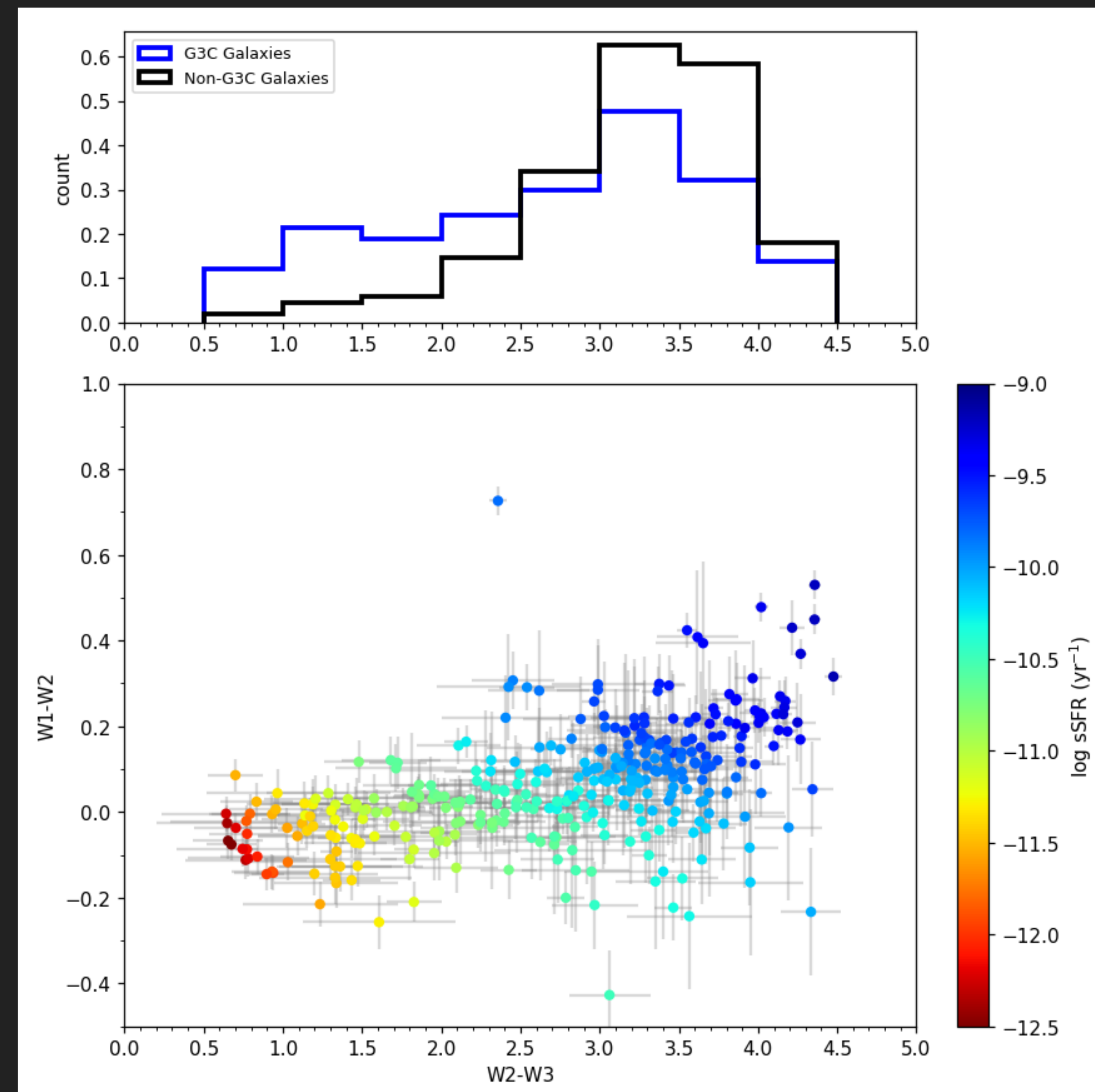
- z<0.1 = 498 groups with 4-20 members (3195 galaxies)
- WISE mid-infrared as tracer of stellar mass (Cluver et al. 2014) and star formation (Cluver et al. 2017)

WISE-WISE COLOUR SPACE

4<= Nfof <=8



9<= Nfof <=20

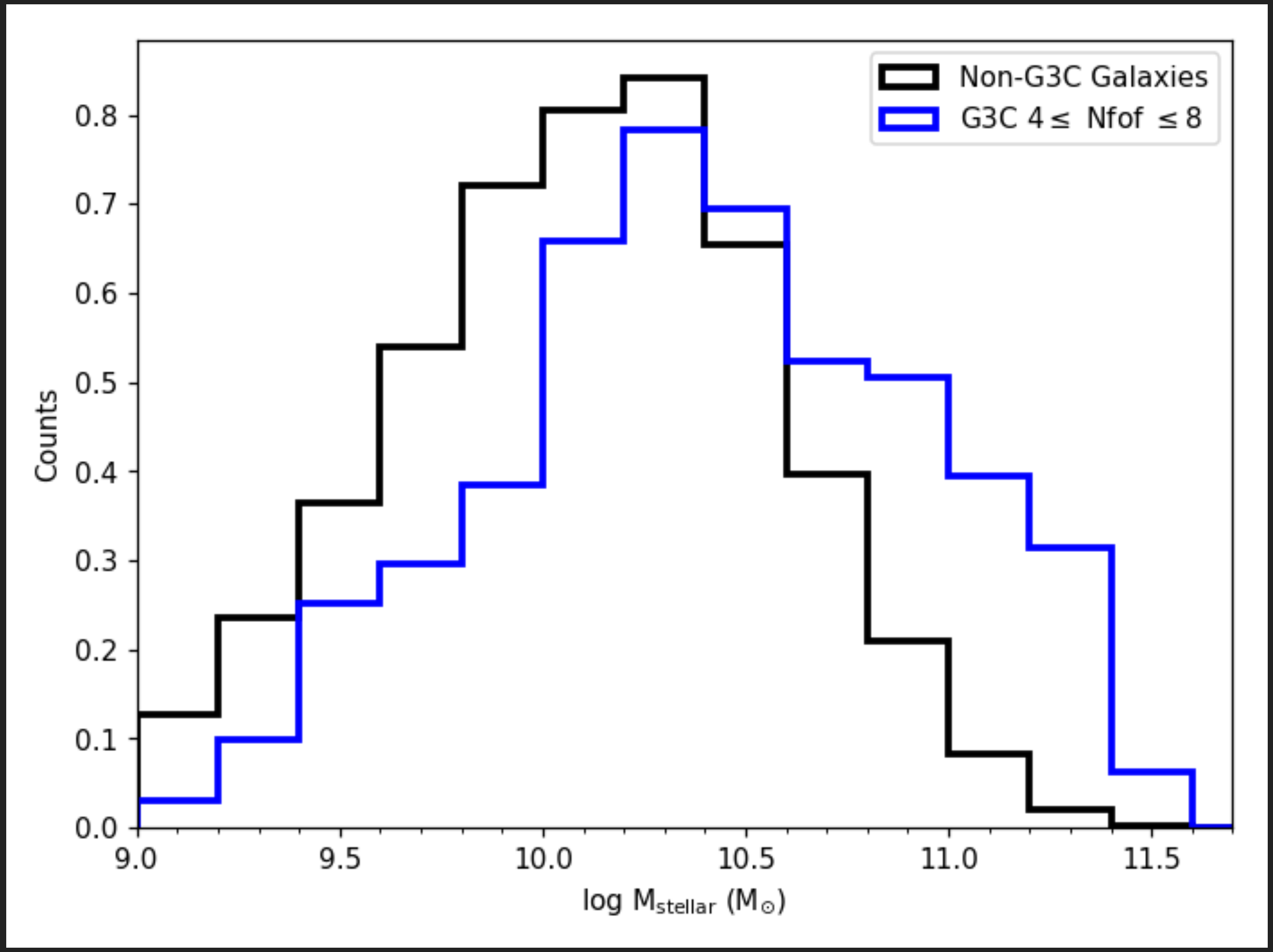


S/N cuts in WISE colour,
stellar mass cut log $M_{stellar} > 9$

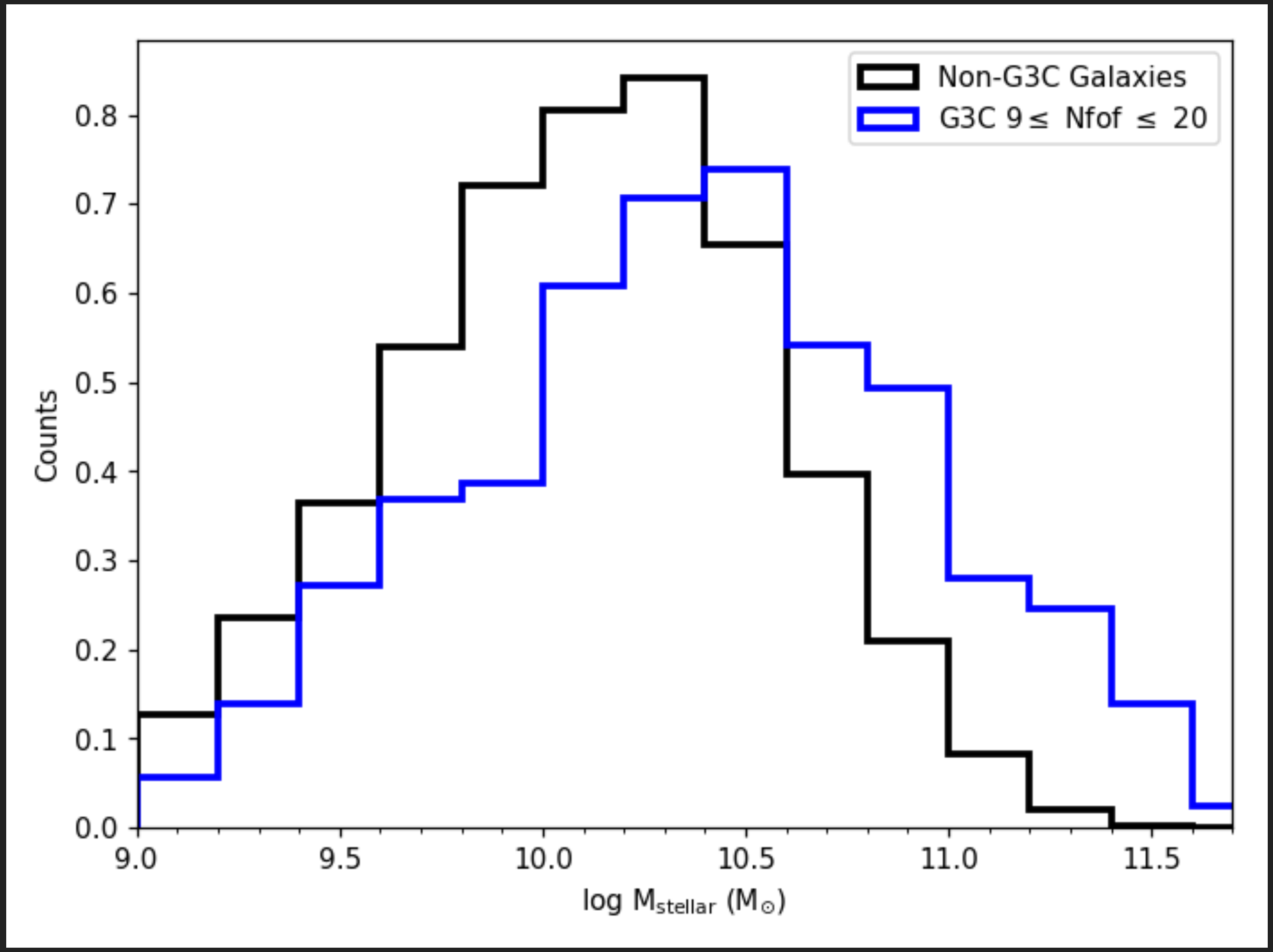
Cluver et al. (in prep.)

HOW DO GROUPS BUILD THEIR STELLAR MASS?

4<= Nfof <=8

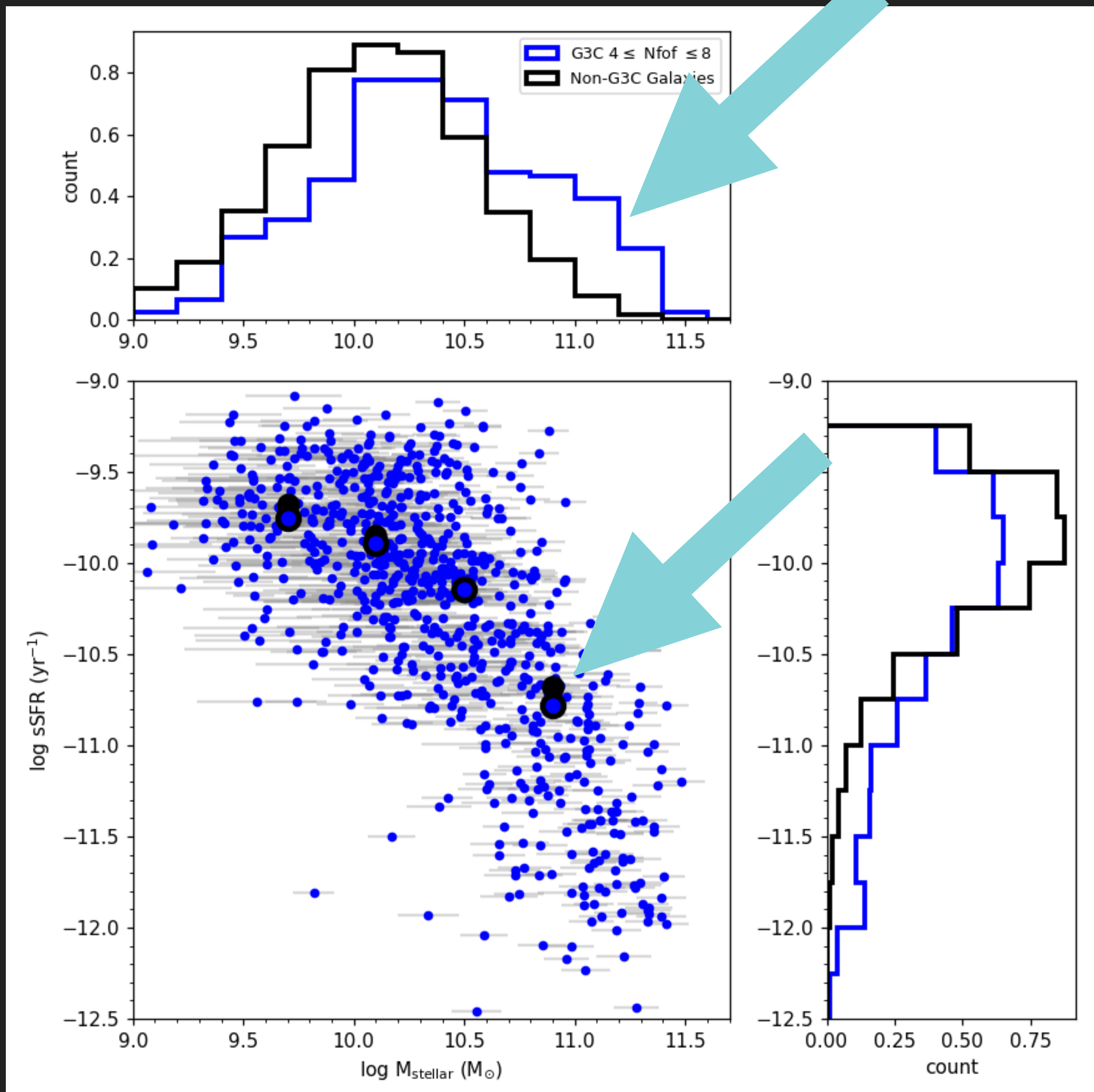


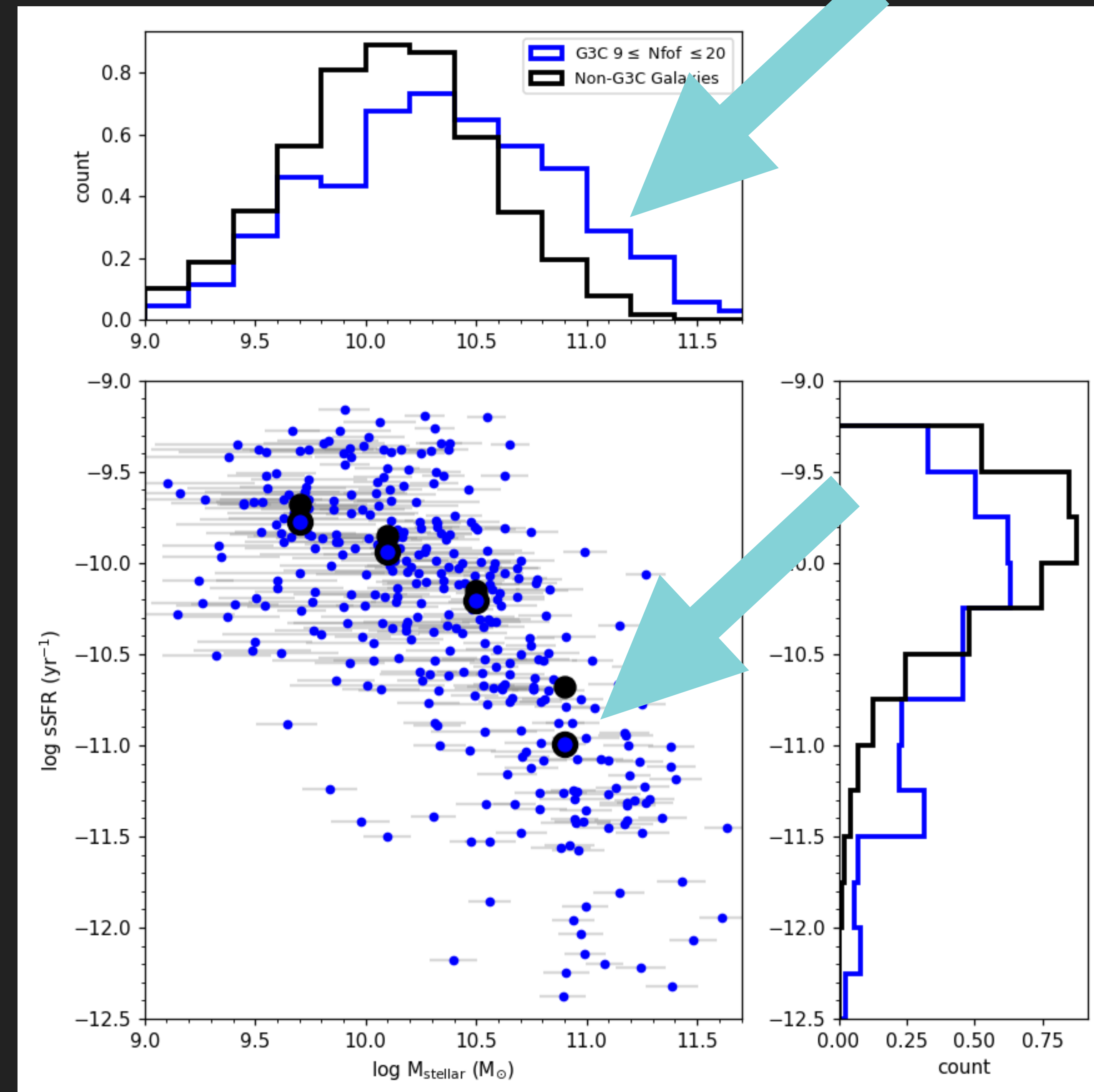
9<= Nfof <=20



Cluver et al. (in prep.)

ALSO WHEN LOOKING AT SSFR, 4<= NFOF <=8 GROUPS SHOW RELATIVELY MORE GALAXIES AT HIGHER STELLAR MASS



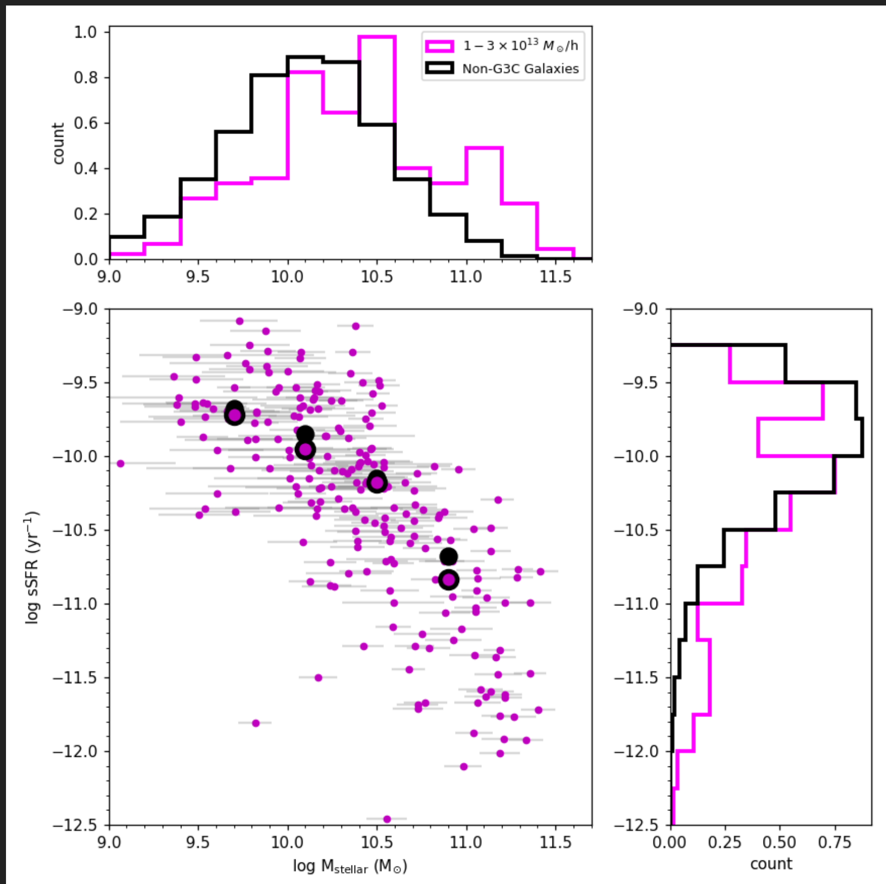


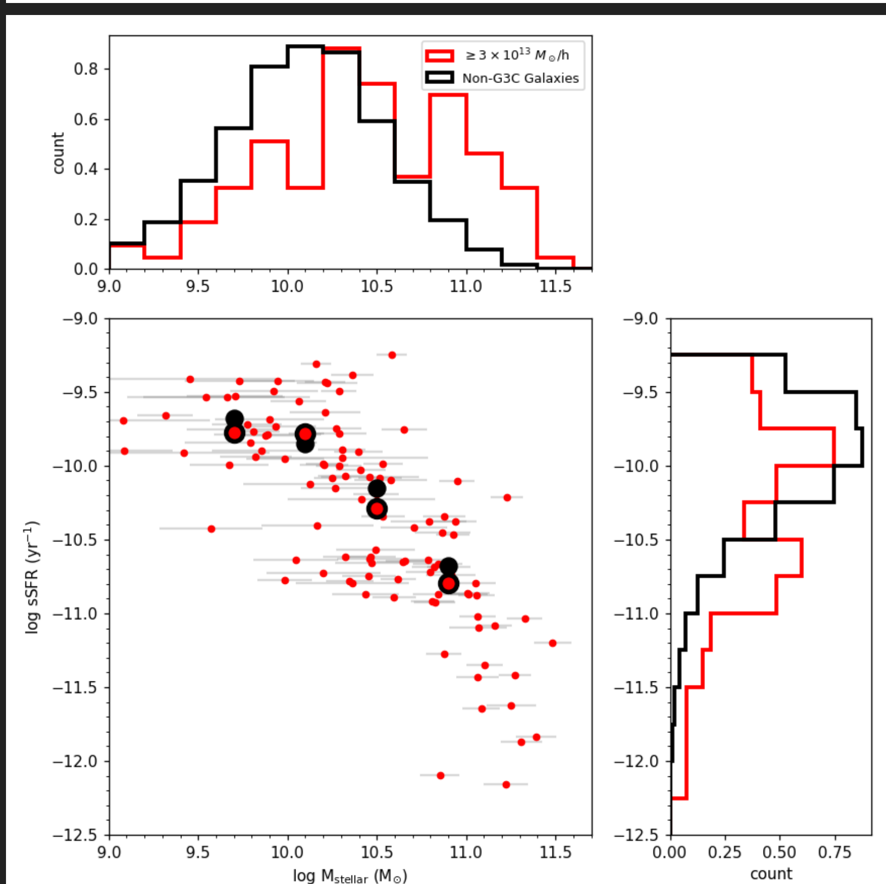
WHEN LOOKING AT SSFR, 9<= NFOF <=20 GROUPS SHOW RELATIVELY MORE QUENCHING AT HIGH STELLAR MASS (SEEN IN ALL HALO MASS BINS)

Cluver et al. (in prep.)

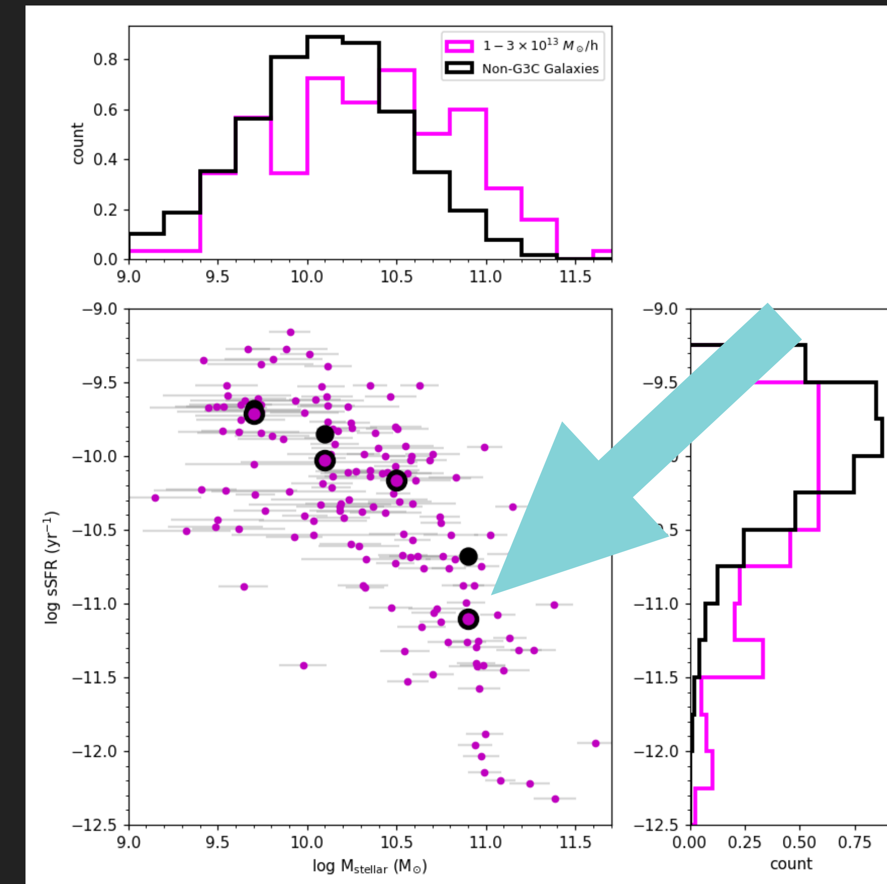
HALO MASS

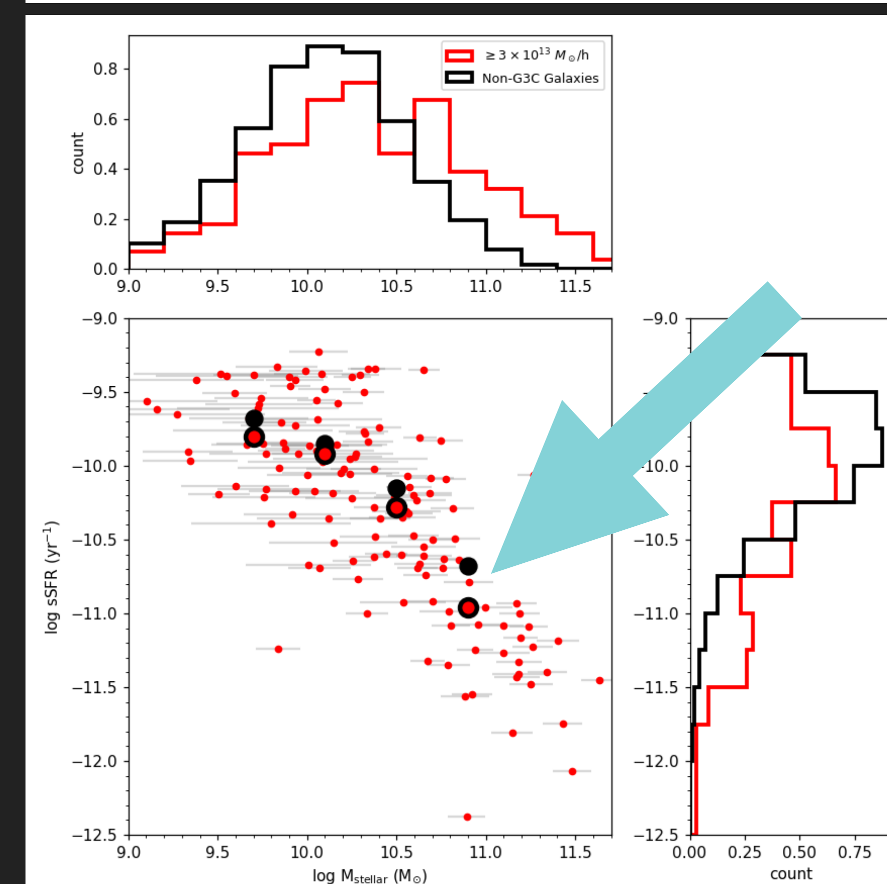
4<= Nfof <=8





9<= Nfof <=20

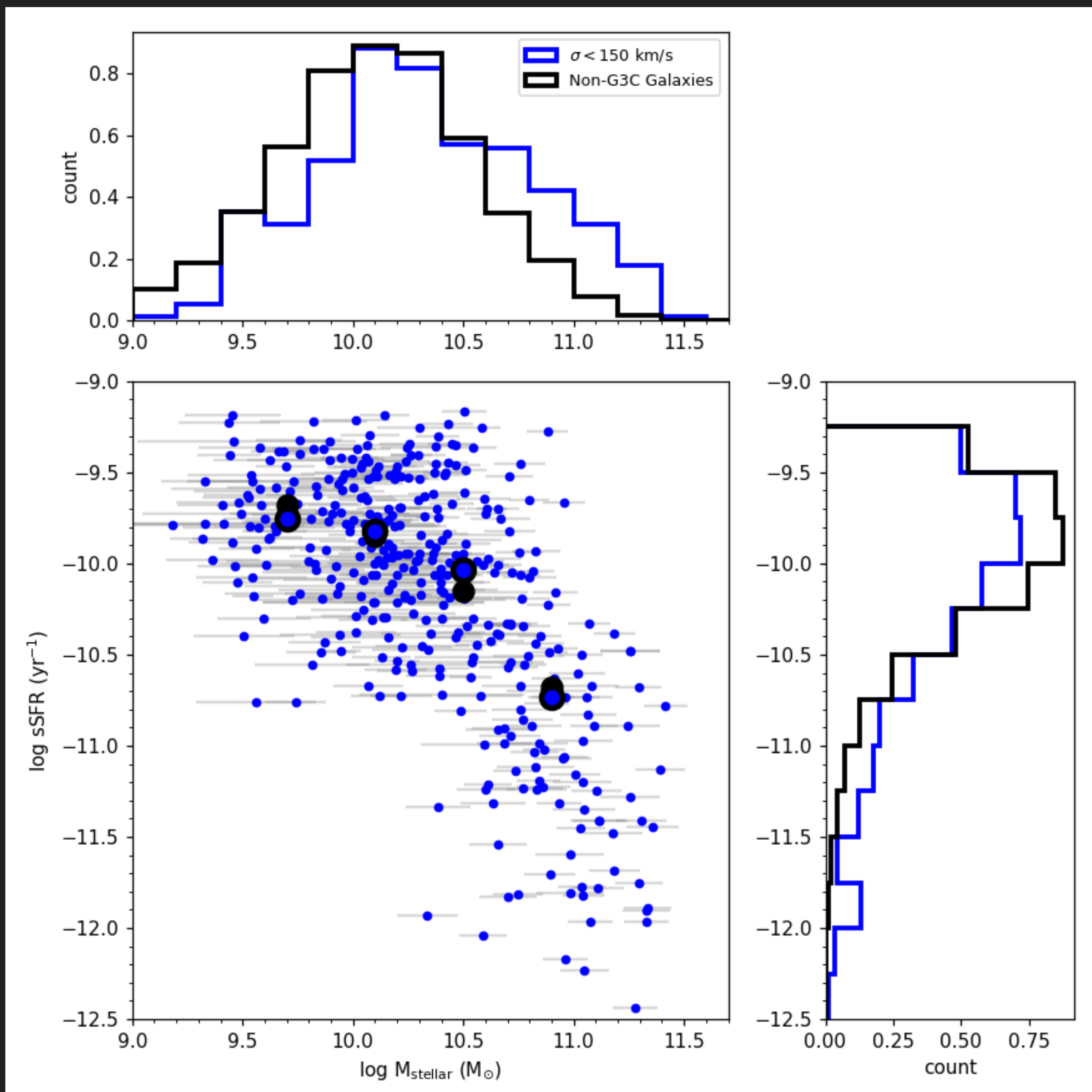




9<= NFOF <=20 GROUPS SHOW MORE QUENCHING AT HIGH STELLAR MASS (INDEPENDENT OF HALO MASS BIN)

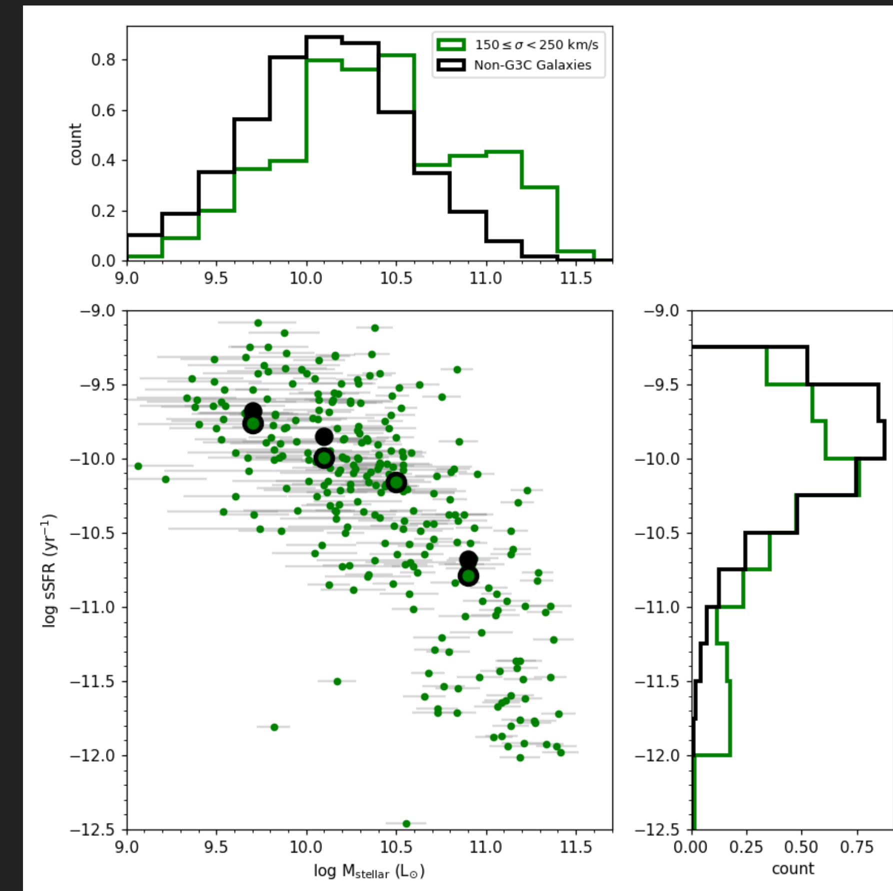
VELOCITY DISPERSION

4<= Nfof <=8

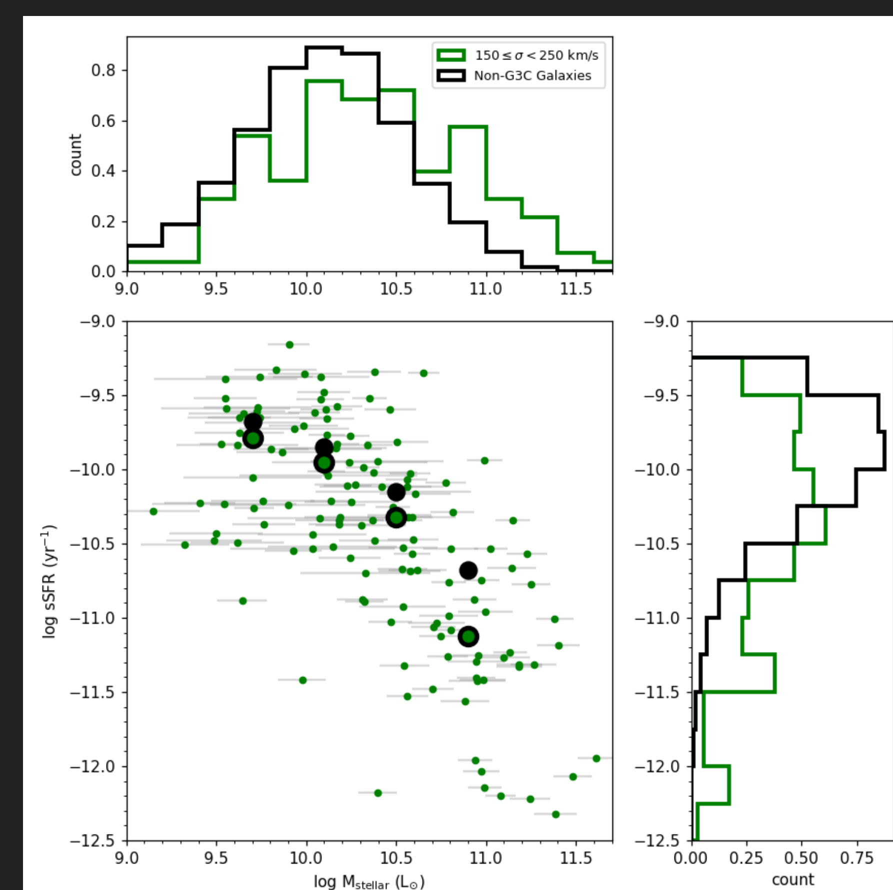


LOW VELOCITY DISPERSION GROUPS SHOW LITTLE DIFFERENCE COMPARED TO LEAST-GROUPED

4<= Nfof <=8



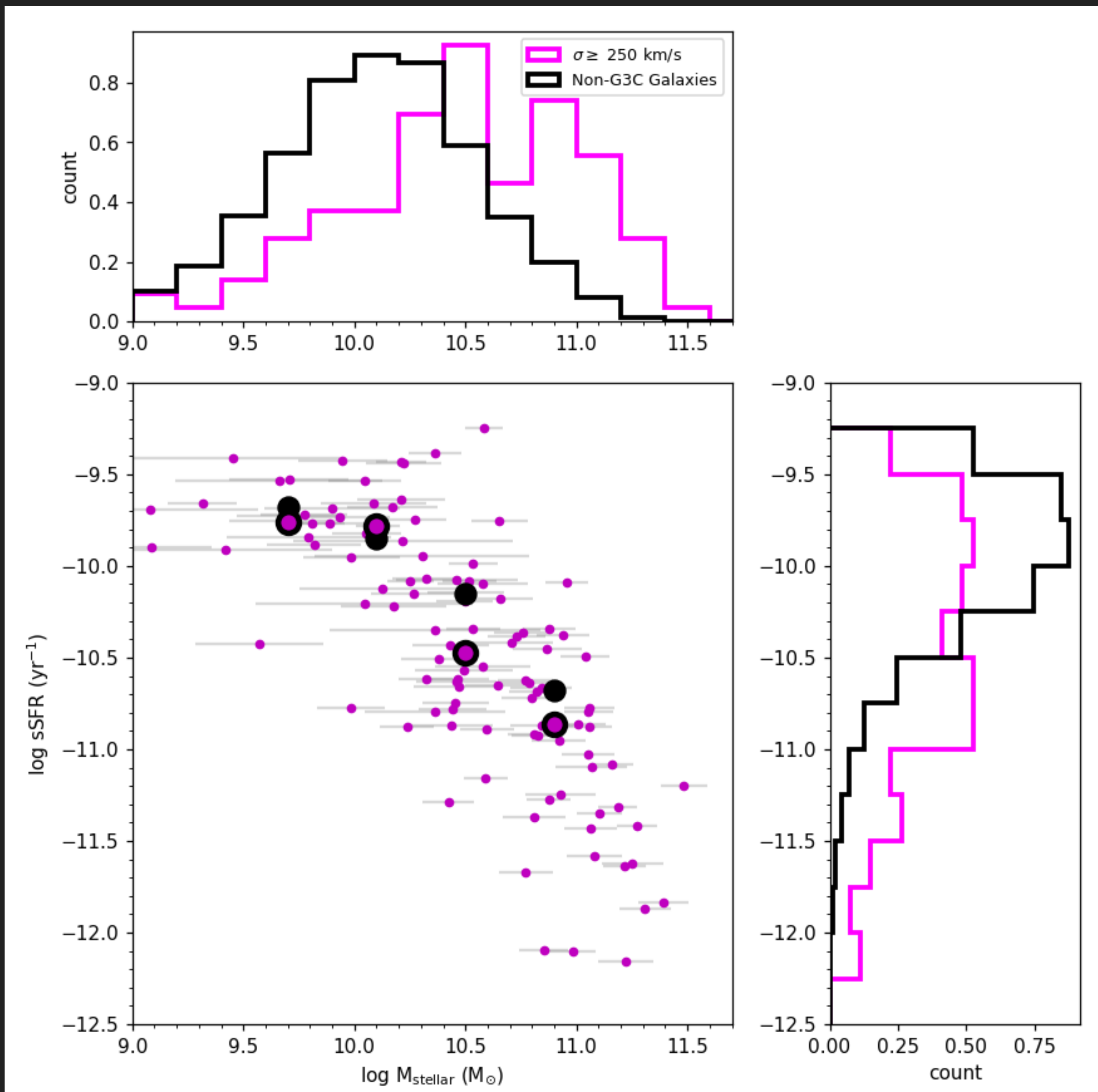
9<= Nfof <=20

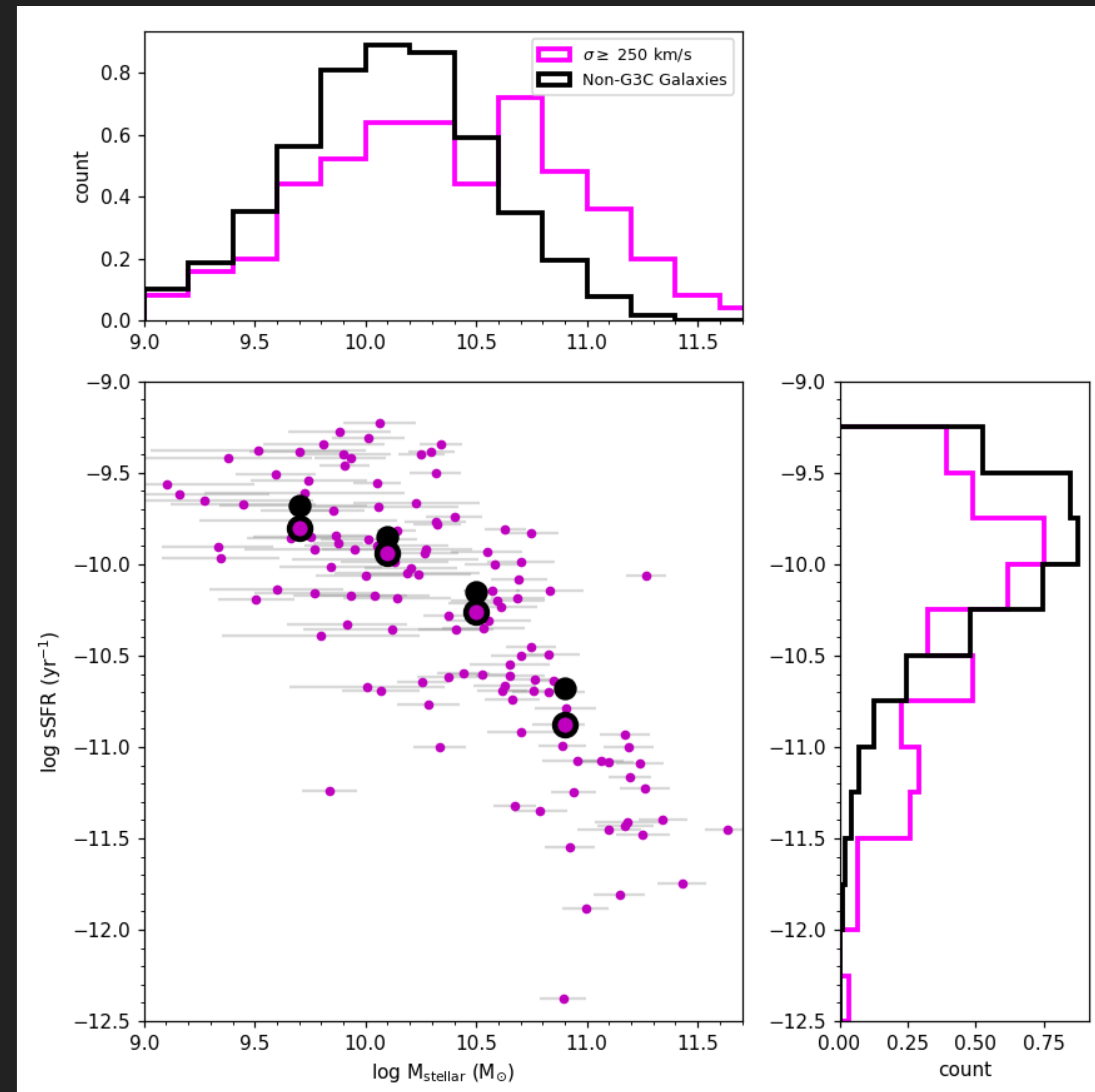


HIGH VELOCITY DISPERSION

4<= NFOF <=8 SHOW AN EXTREME DIFFERENCE TO LEAST-GROUPED

still a lot more to be done at z<0.1





9<= NFOF <=20 SHOW OVERALL QUENCHING PATTERN (ALSO SEEN AT HIGH HALO MASS)

USING MEERKAT TO PROBE HI AND ENVIRONMENT

- Fornax Cluster Survey (P.I. Serra)
- MIGHTEE and LADUMA, but not main science driver
- MeerKAT Open Time?
- Targeted (typical/loose/compact) groups?
- Large(r) area survey?

MEERKIDDENS

SHAMELESS MERCHANDISING COMING SOON

MeerKAT observations in KiDS-S studying the evolutionary impact of galaxy Density

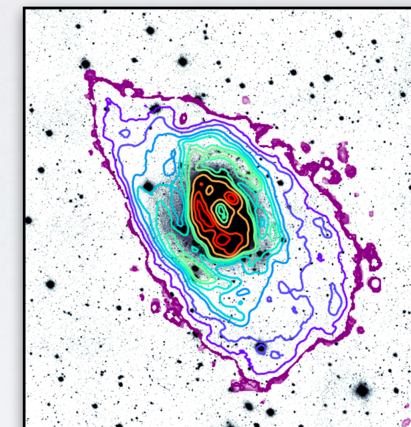
- ~100 square degrees, ~15″ resolution, ~0.5 mJy/beam (achievable in 1 hour)
- Herschel (far-IR)+ KiDS (optical) + VST-Atlas (optical) + VIKING (near-IR) and WISE (mid-IR)
- Redshifts from the Taipan Galaxy Survey (a SDSS-like redshift survey, but with higher completeness) in Early Science
- Falls within WAVES (on VISTA) footprint.

Image Credit: Adrian Mann

PostDoctoral Position
IAA-CSIC, Granada, Spain

Lourdes Verdes-Montenegro
lourdes@iaa.es

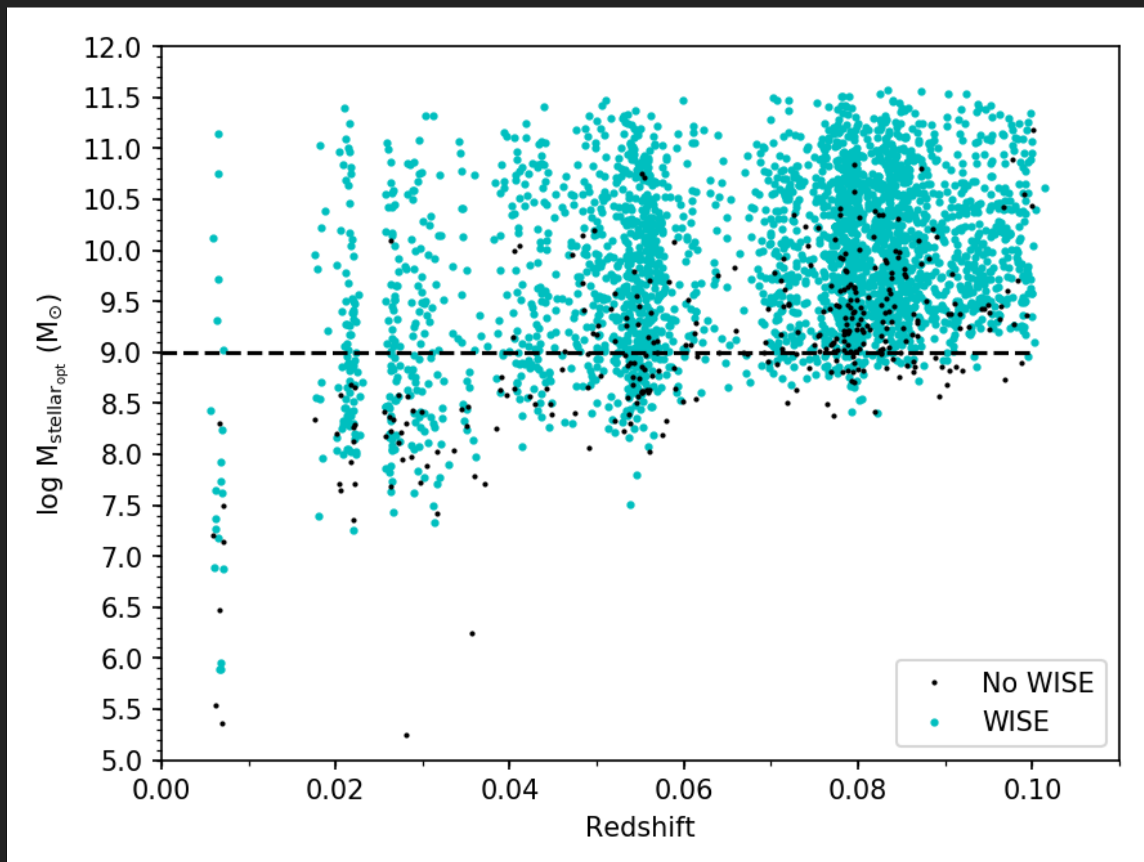
Origin of asymmetries in isolated galaxies: study of their outskirts with deep optical images and HI interferometric data

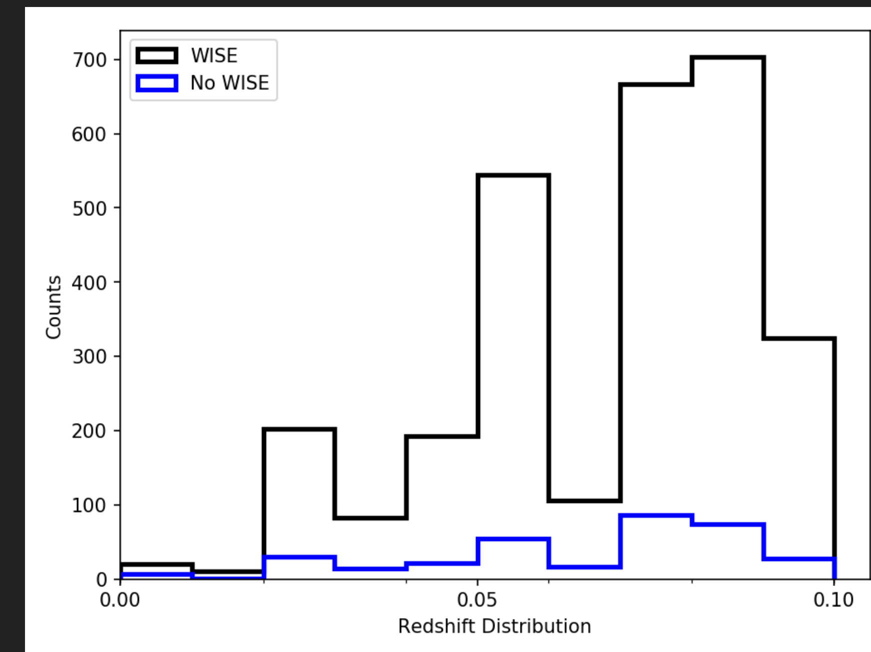


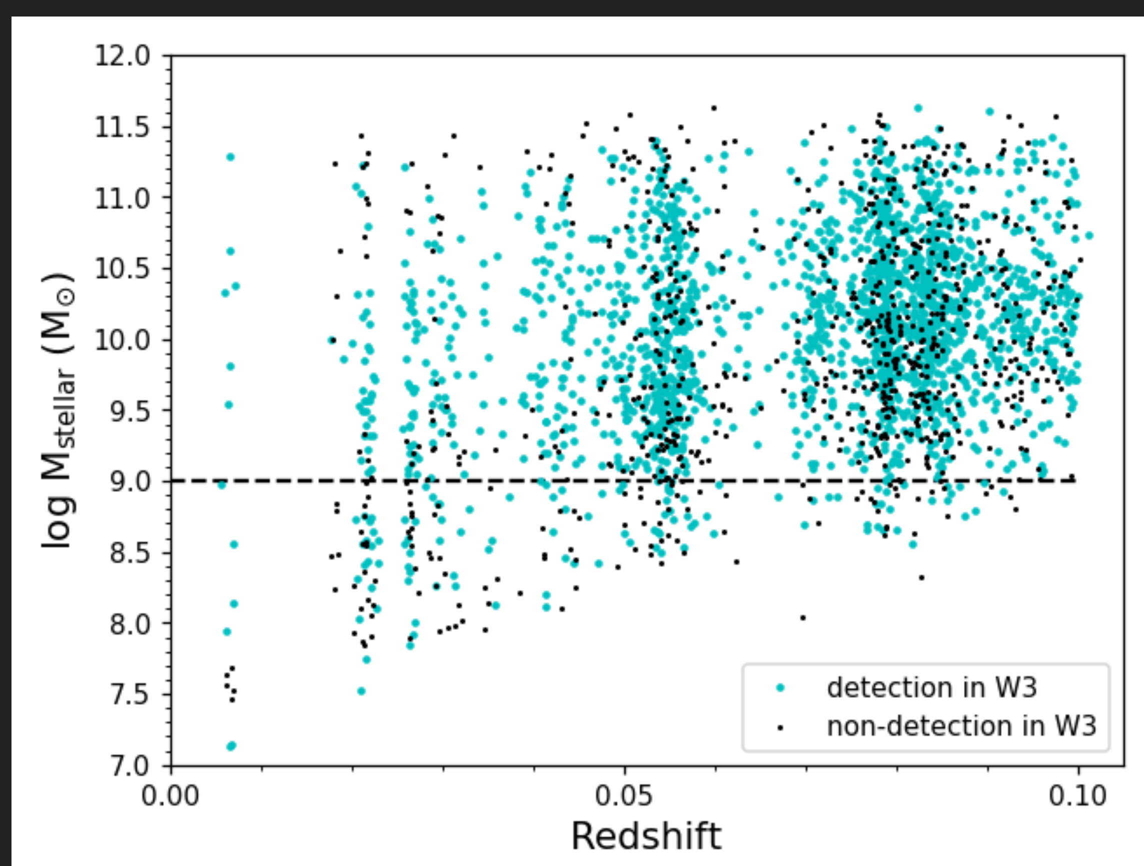
- Job conditions
  - To start as soon as possible
  - Duration: till 31/12/2019, with good chances to extend it further.
- Candidates
  - Expertise in reducing deep optical images and/or HI interferometric data is required
- Work environment
  - AMIGA group (Analysis of the interstellar Medium of Isolated GAlaxies, amiga.iaa.es)
  - AMIGA PI: coordinator of the Spanish participation in the SKA & co-Chair of the SKA HI SWG
  - The IAA-CSIC has recently obtained the Center of Excellence Severo Ochoa distinction and AMIGA team leads the development of a prototype of an SKA Regional Centre fully engaged with Open Science

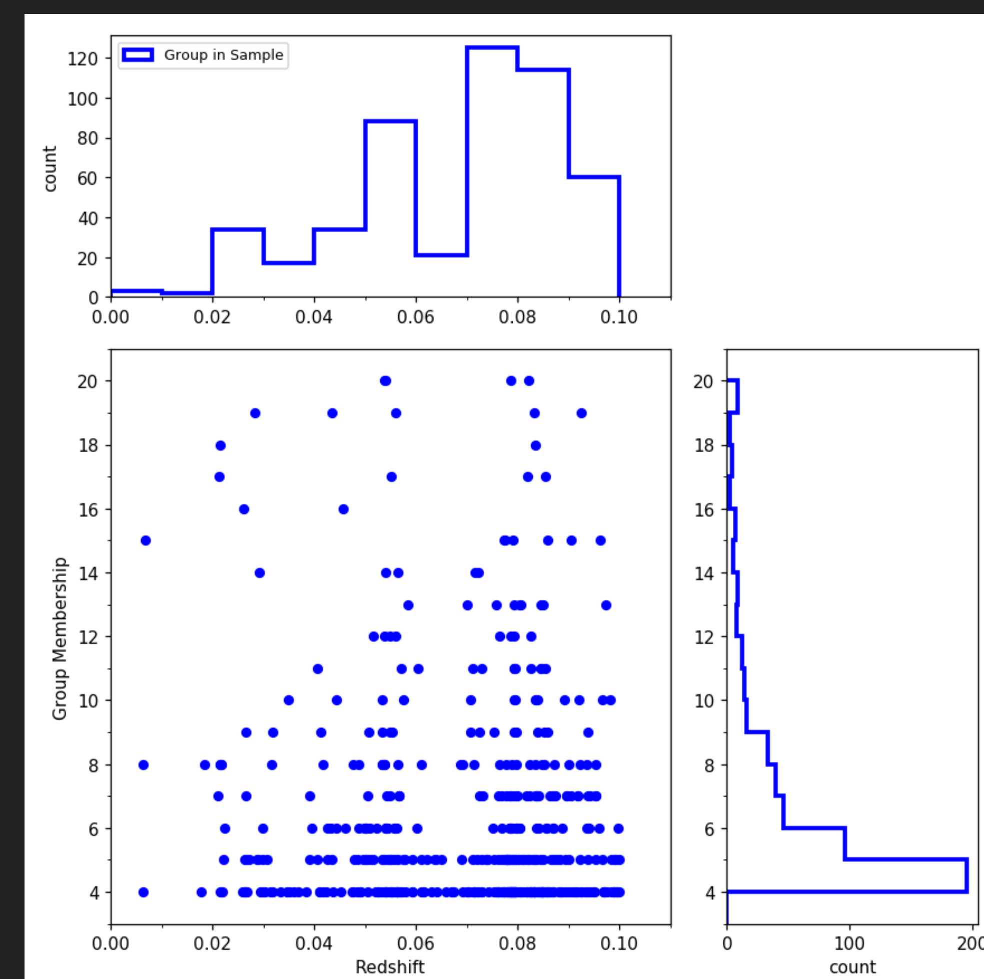
EXTRA SLIDES

GROUP GALAXIES IN WISE

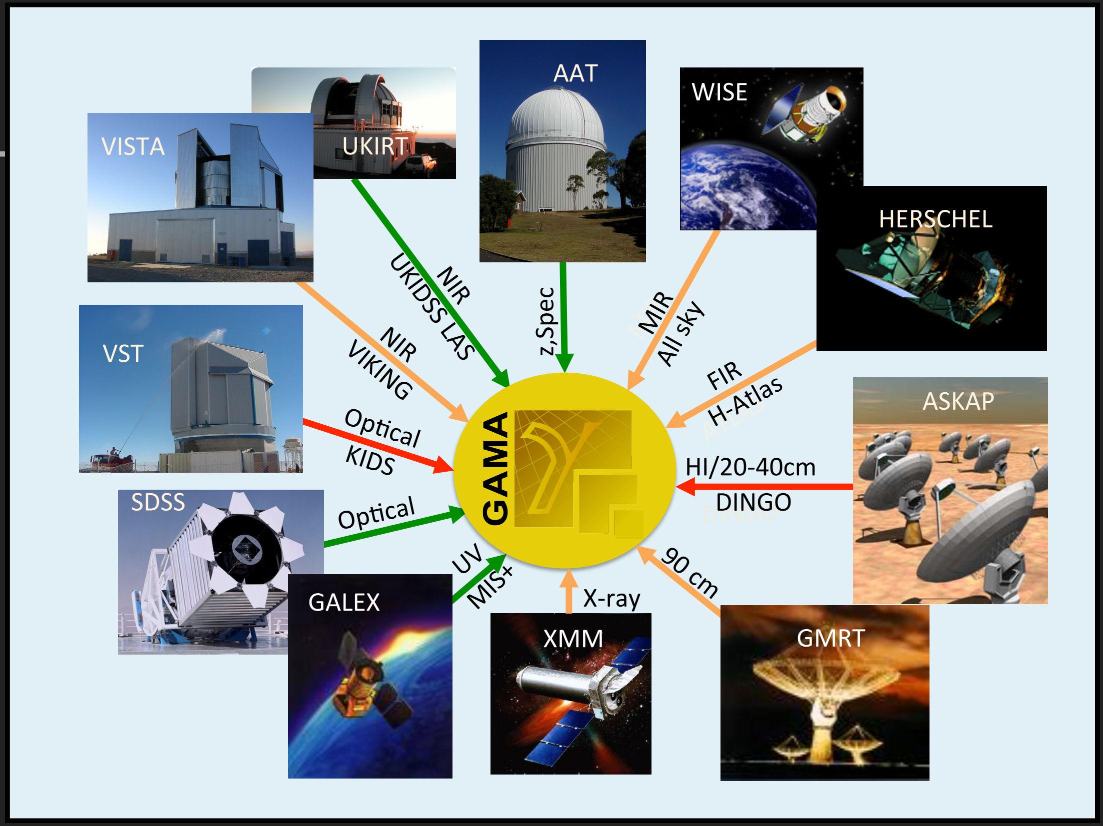








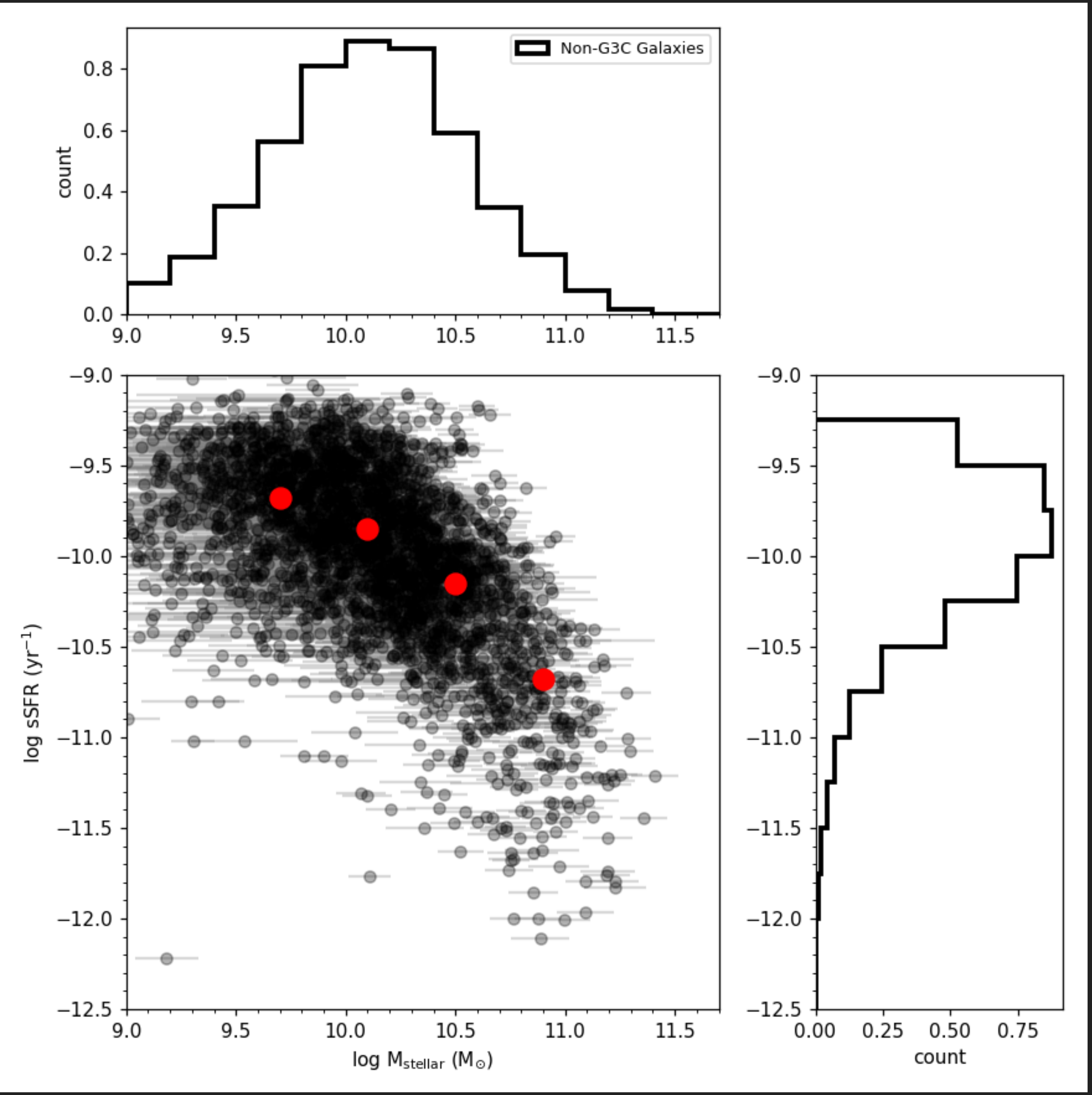
GROUP GALAXIES IN GAMA: DETAILS



~ 200 000 galaxies,
z<0.5, z~0.3, r < 19.8mag

3×12×5 deg² equatorial fields

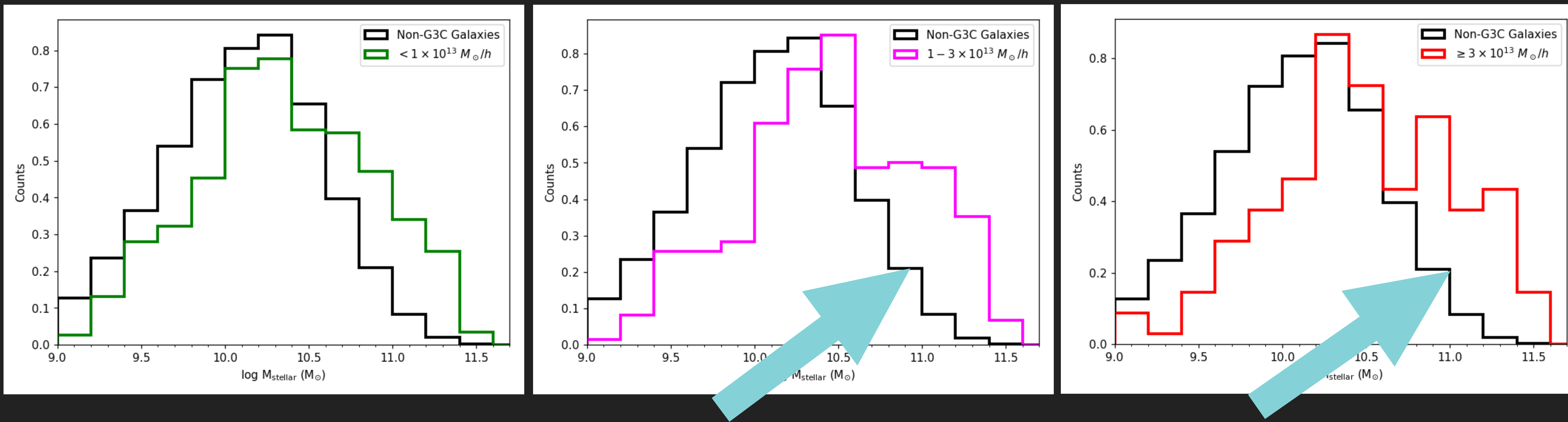
- z<0.1 = 498 groups with 4-20 members (3195 galaxies)
- WISE x-match: group galaxies – 2861/3195 (90%) , non-group (least grouped) – 9360/11228 (83%)
- WISE mid-infrared as tracer of stellar mass (Cluver et al. 2014) and star formation (Cluver et al. 2017)
- S/N cuts in WISE colour, stellar mass cut log $M_{stellar}$ >9



Non-G3C Galaxies
count
0.0
0.2
0.4
0.6
0.8
9.0
9.5
10.0
10.5
11.0
11.5
log sSFR (yr^{-1})
−9.0
−9.5
−10.0
−10.5
−11.0
−11.5
−12.0
−12.5
log $M_{stellar}$ ($M_\odot$)
0.00
0.25
0.50
0.75
count

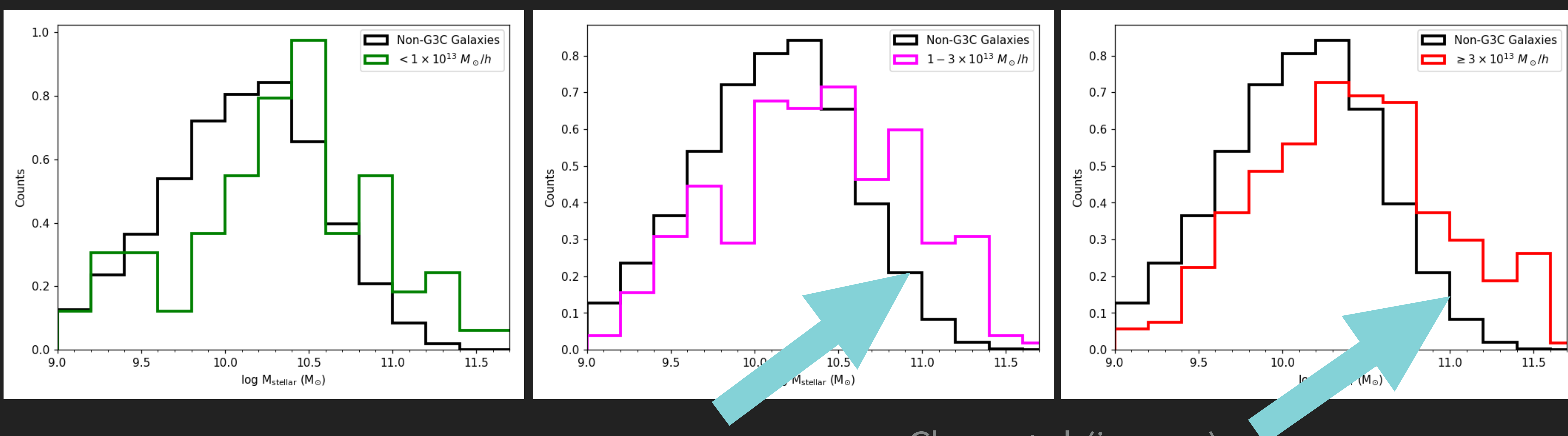
HALO MASS

4<= Nfof <=8



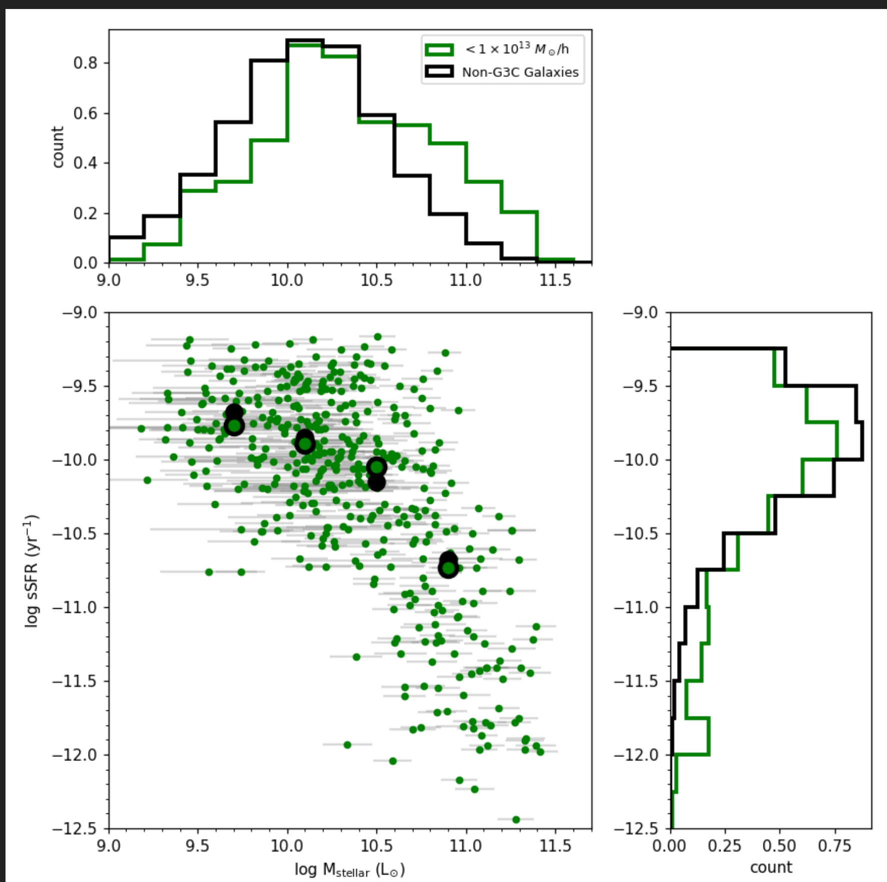
IS 4<= NFOF <=8 RELATIVELY MORE EFFICIENT AT BUILDING STELLAR MASS?

9<= Nfof <=20

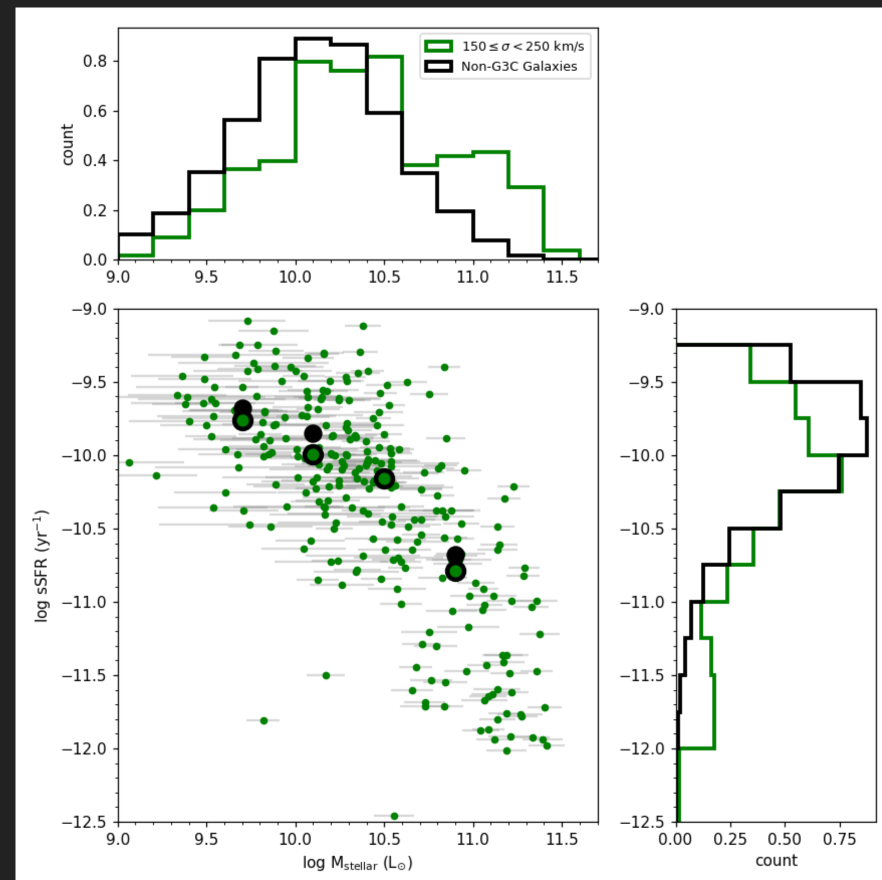


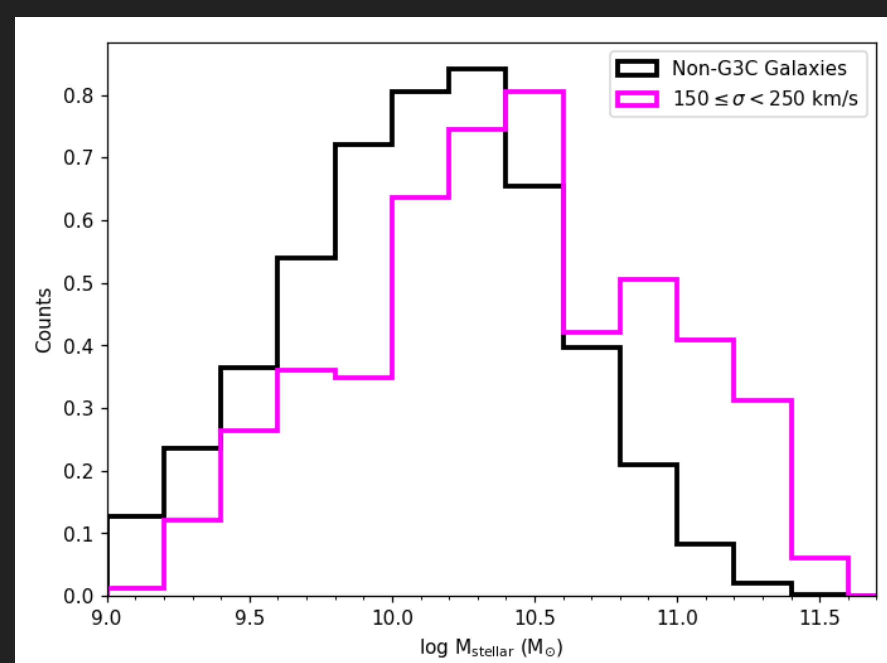
Cluver et al. (in prep.)

4<= Nfof <=8

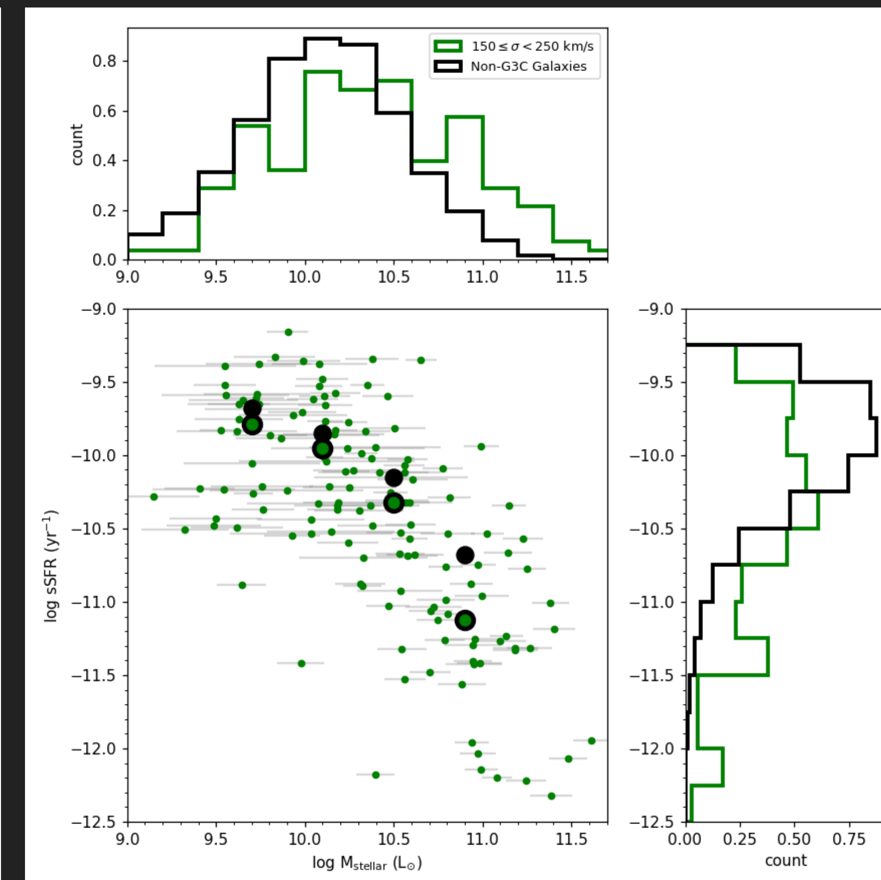


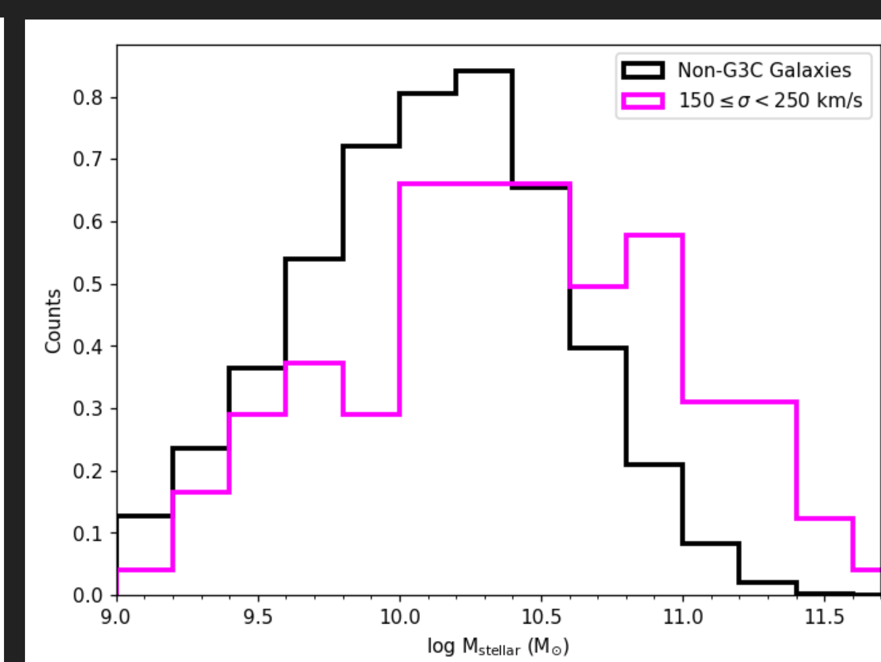
4<= Nfof <=8





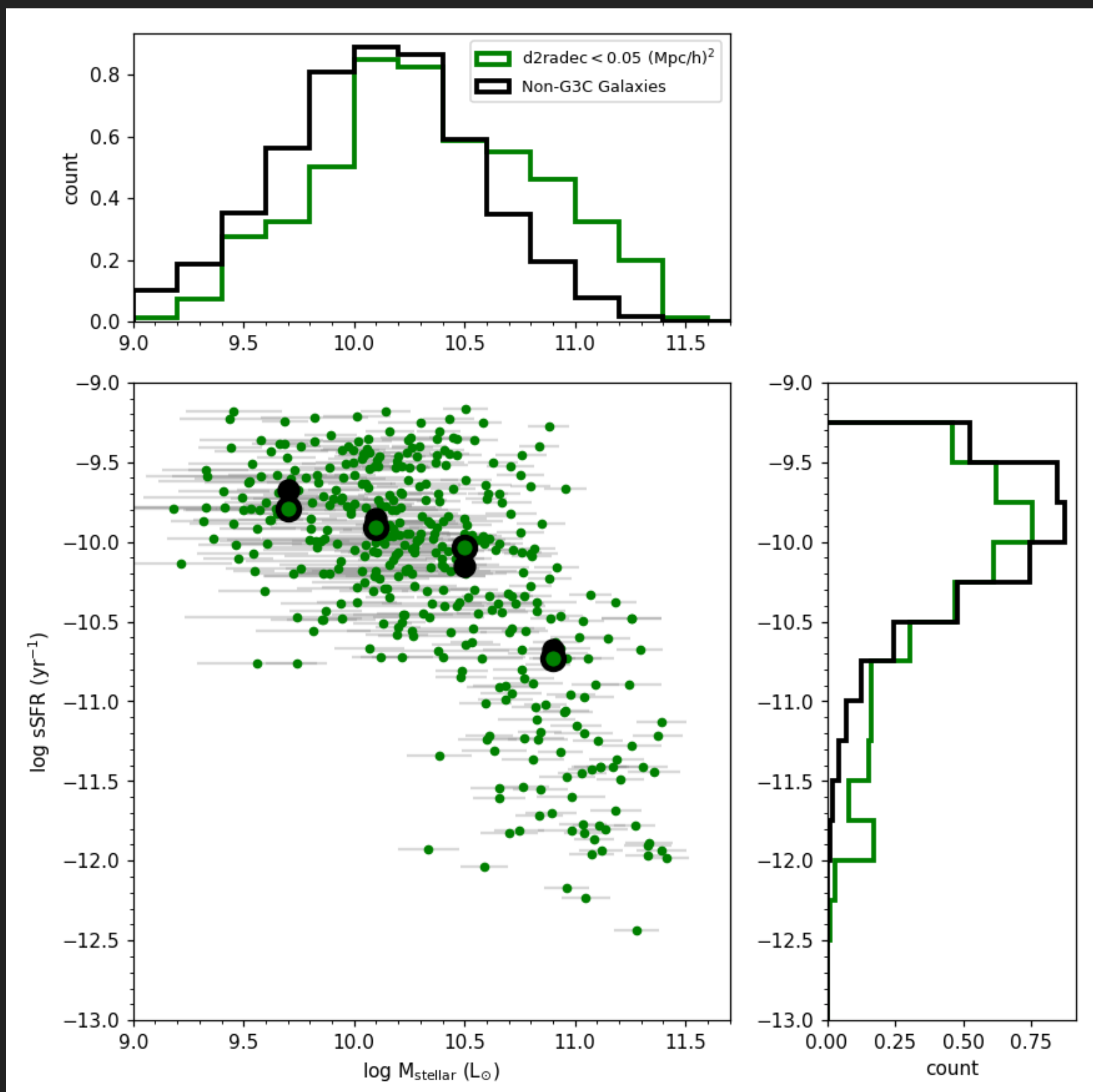
9<= Nfof <=20



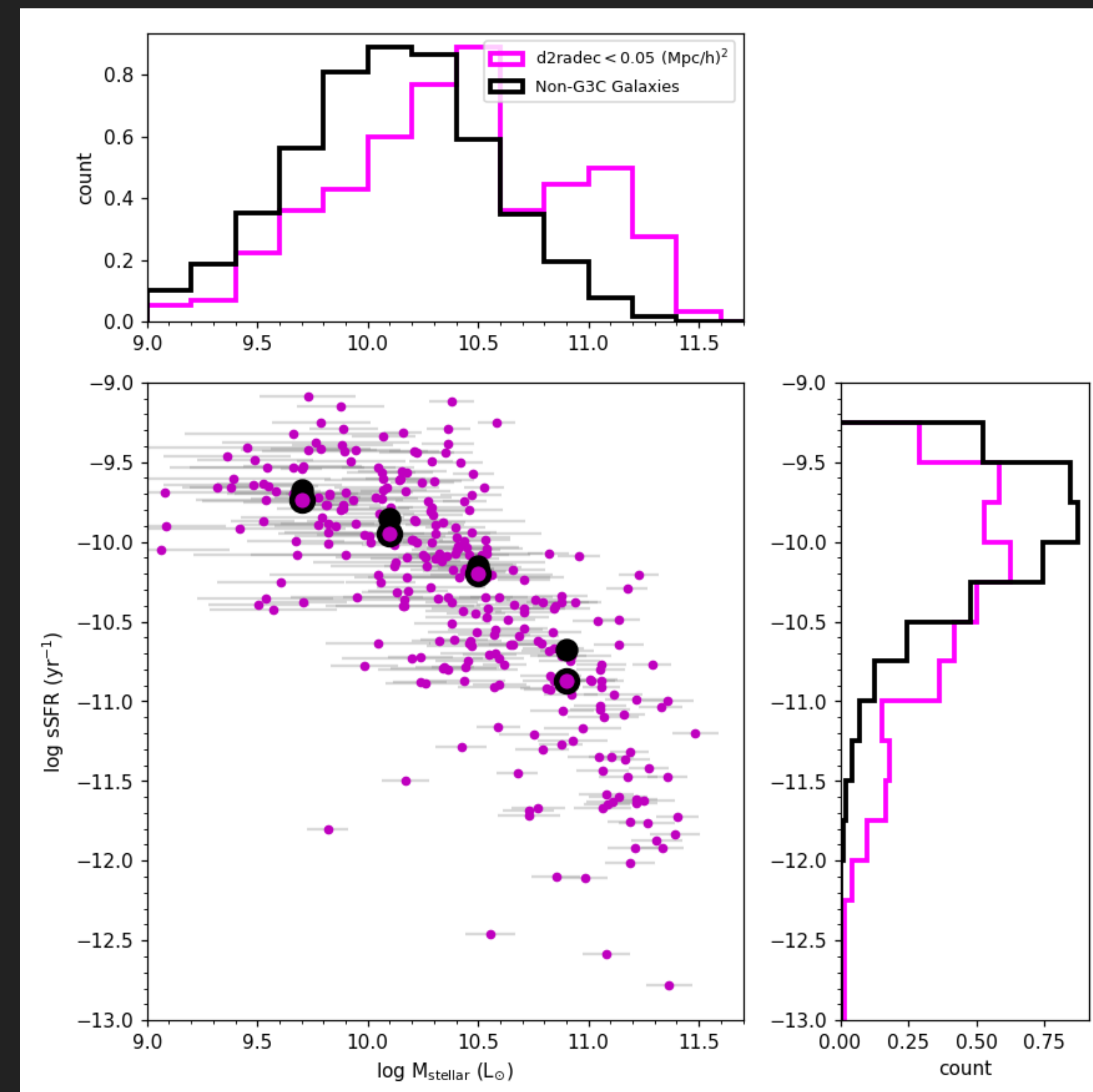


4<= Nfof <=8

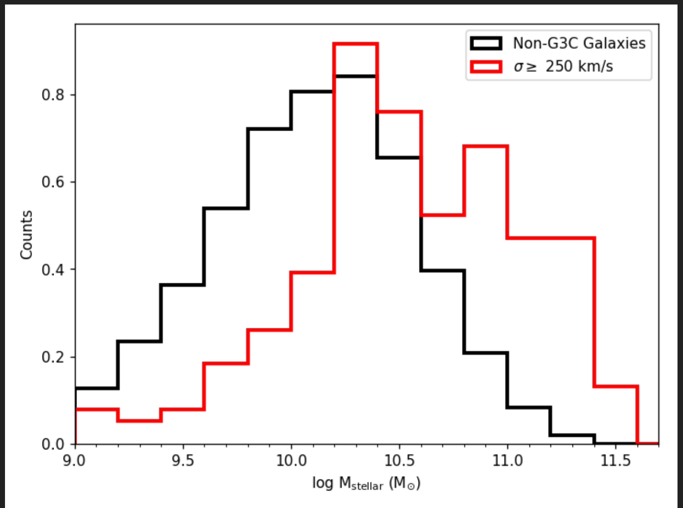
Mass < 1e13



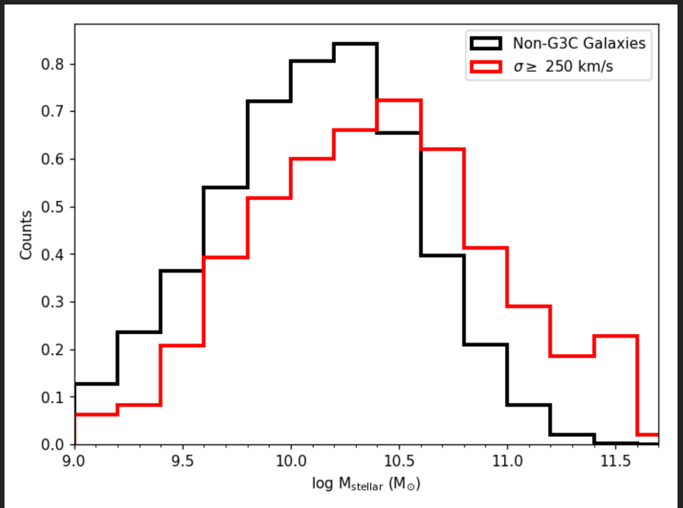
Mass > 1e13

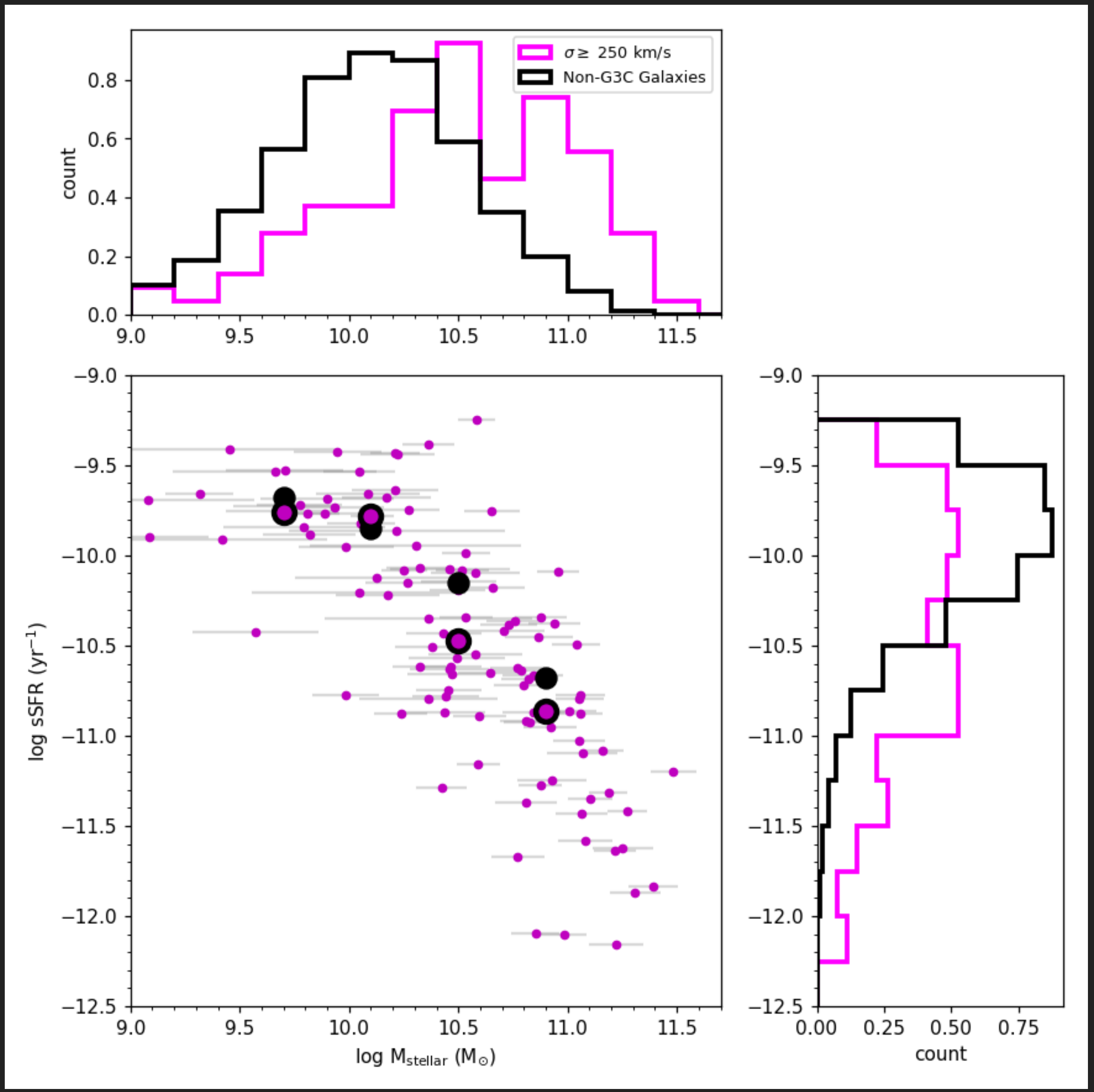


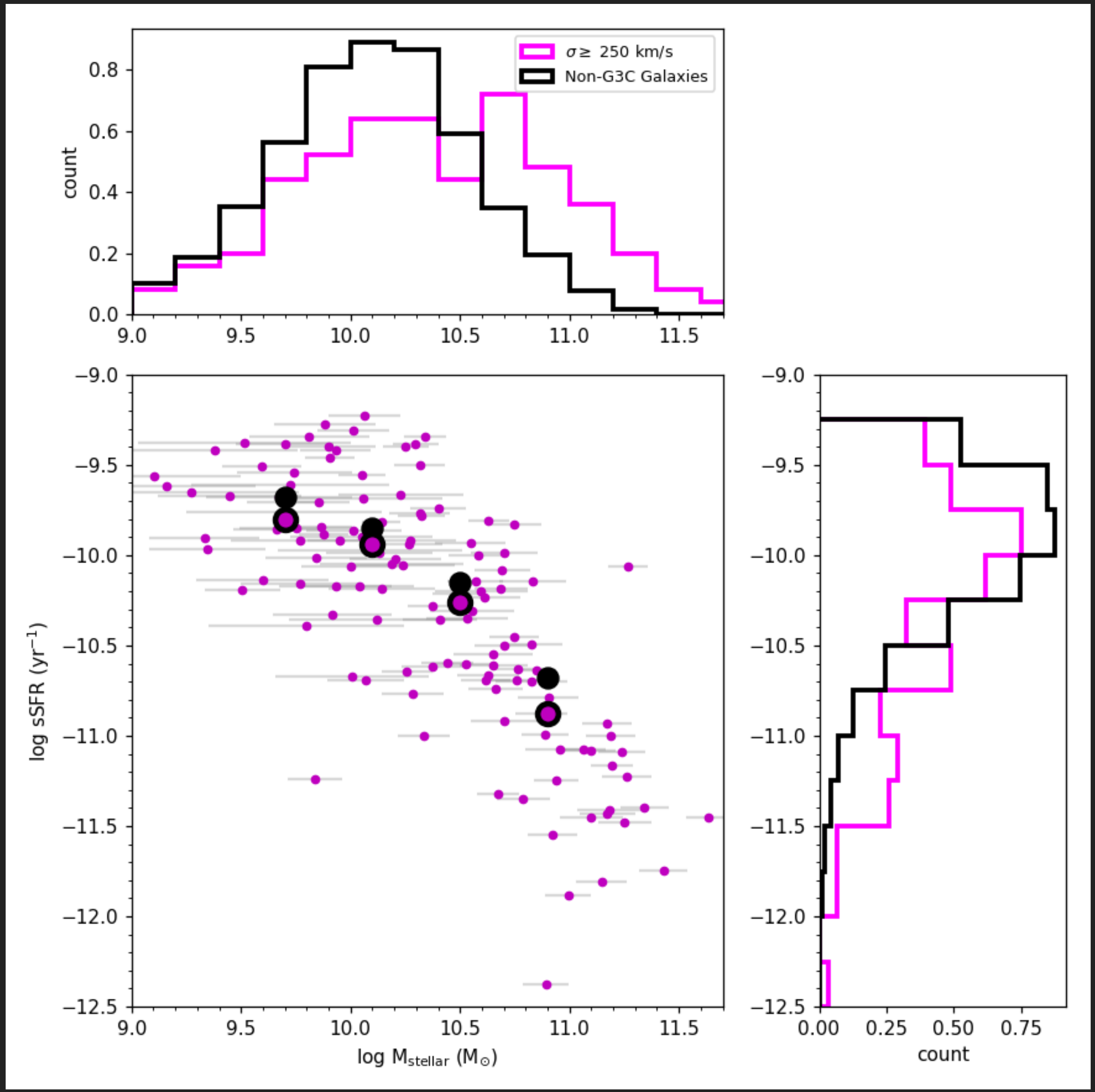
HIGH VELOCITY DISPERSION



4<= NFOF <=8 SHOW AN EXTREME DIFFERENCE TO LEAST-GROUPED

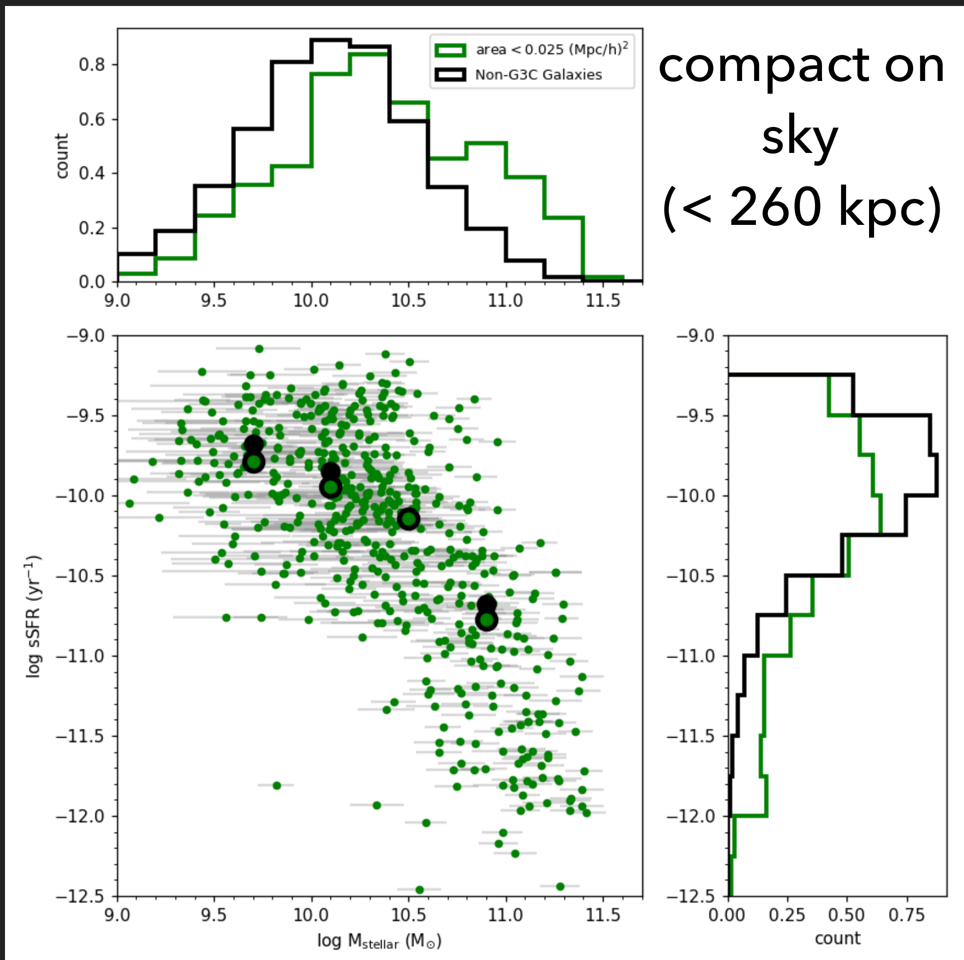


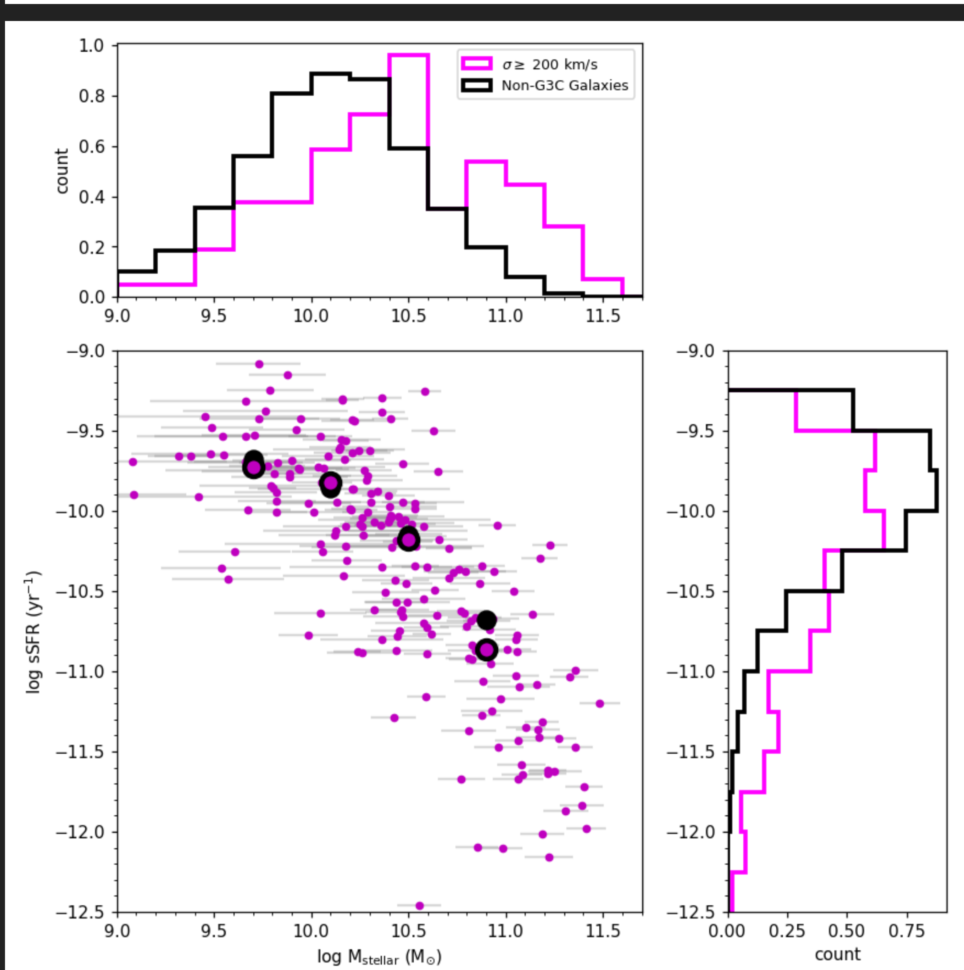


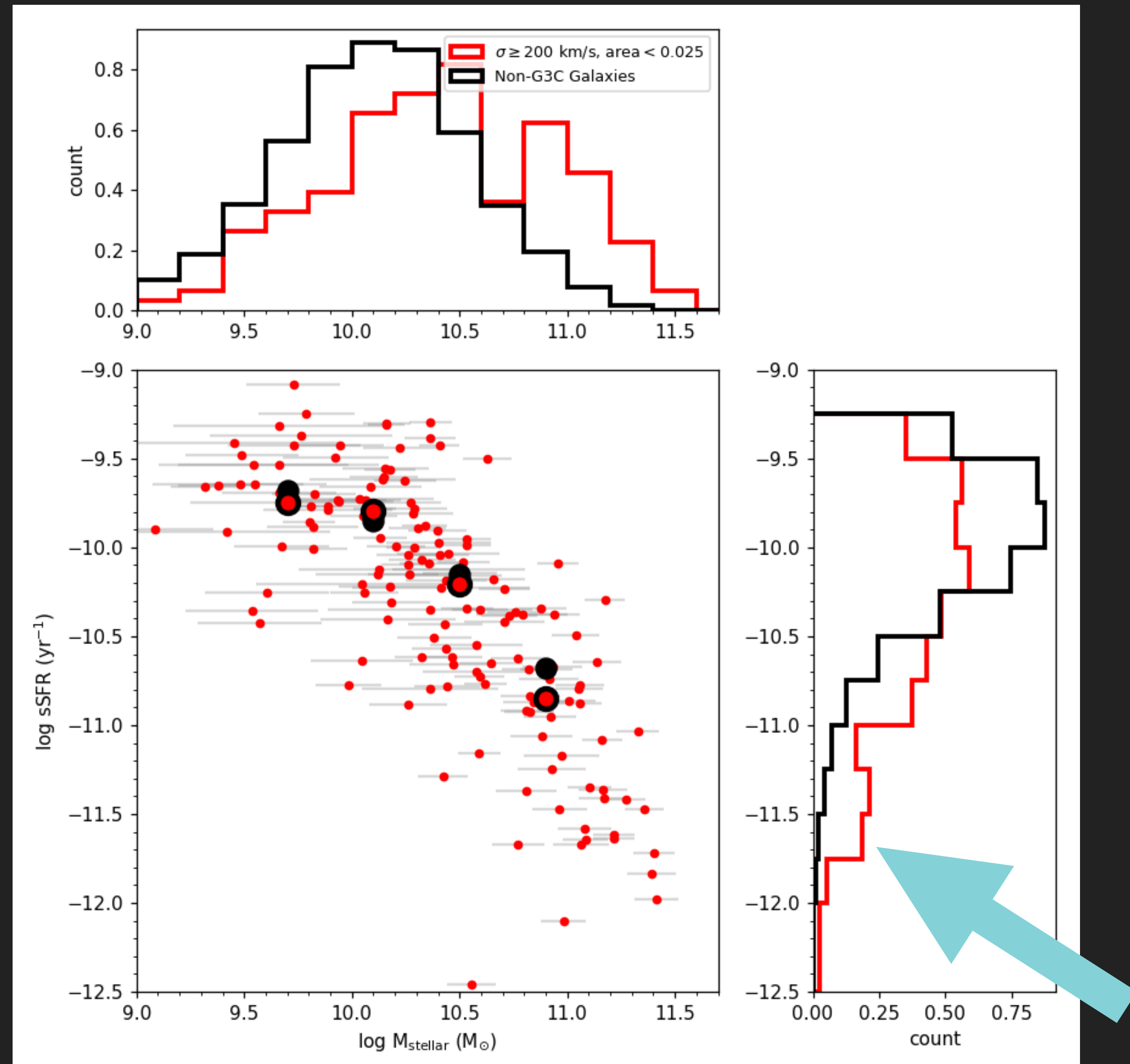


9<= NFOF <=20 SHOW OVERALL QUENCHING PATTERN (ALSO SEEN AT HIGH HALO MASS)

4<= Nfof <=8







VELOCITY DISPERSION PROFILE DOMINATES, LOW SSFR GALAXIES ARE BOOSTED

MEERKAT IS IDEALLY SUITED TO DETECT LOW-COLUMN DENSITY HI

- Column density sensitivity (a 12 hour integration on the 64 dish array will achieve a column density sensitivity of ~5×10^{18} cm^{-2} in 30″ beam
    - Locating faint HI is crucial to understanding HI "cycle" and lifetime of tidally stripped material
- Better UV coverage at short baselines (compared to VLA) to recover diffuse emission
- Larger Field of View (compared to VLA: 1° vs 32′)

(Cluver et al. 2018, arXiv1802.03807)