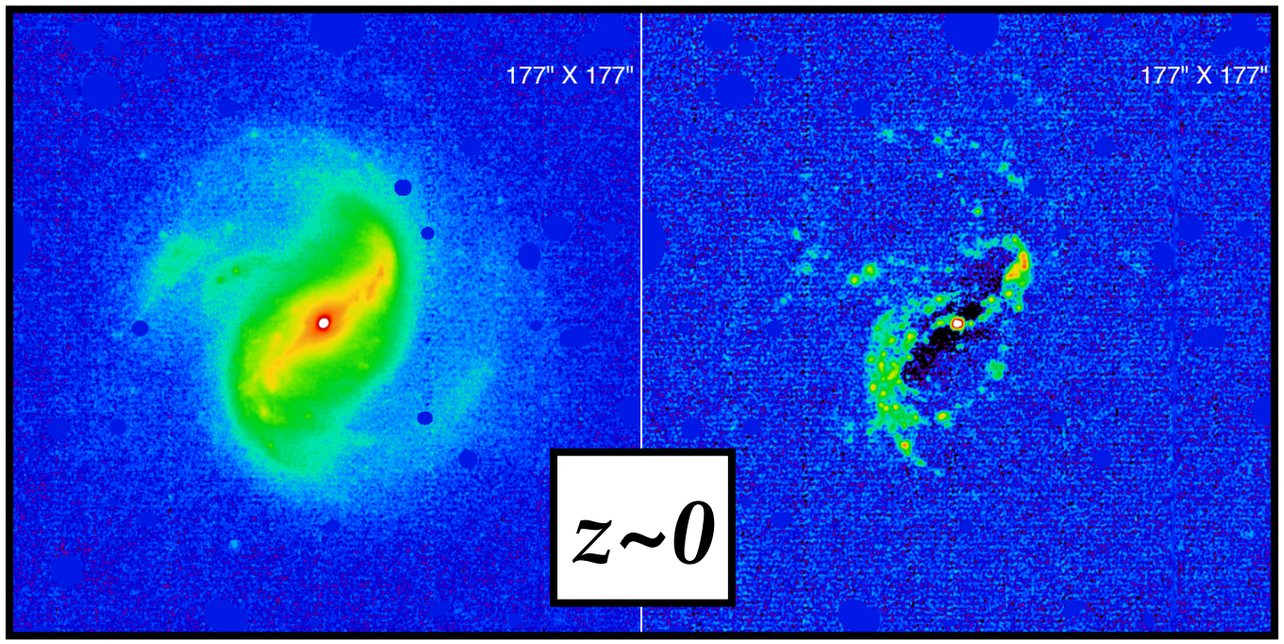
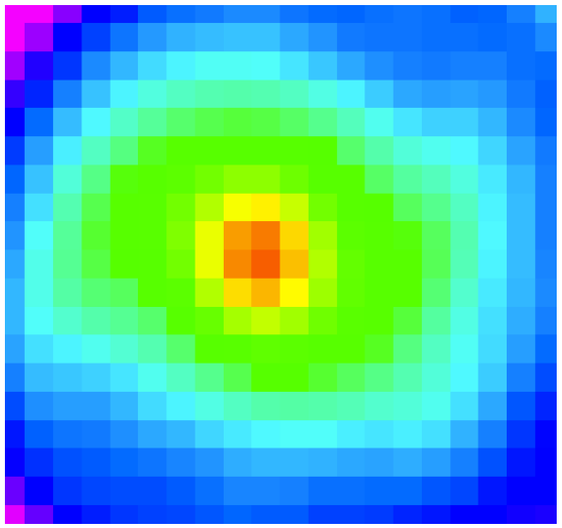
Tracing the Inside-out Growth & Outside-In Quenching of Disks over ~85% of cosmic time

Dave Wilman

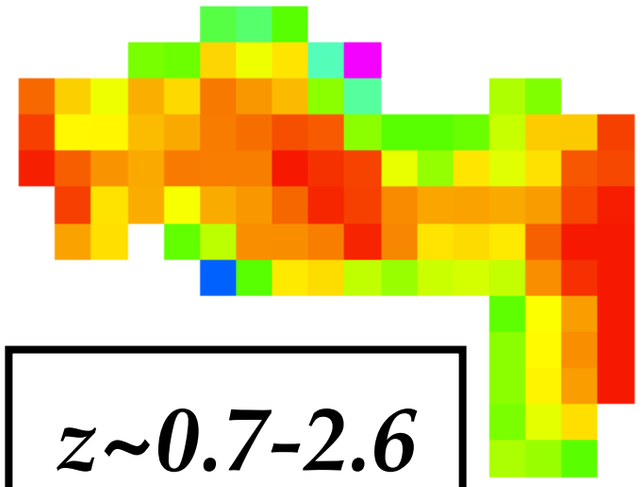
with Matteo Fossati, Sandesh Kulkarni , KMOS^{3D} and HAGGIS Teams



HAGGIS



KMOS^{3D}

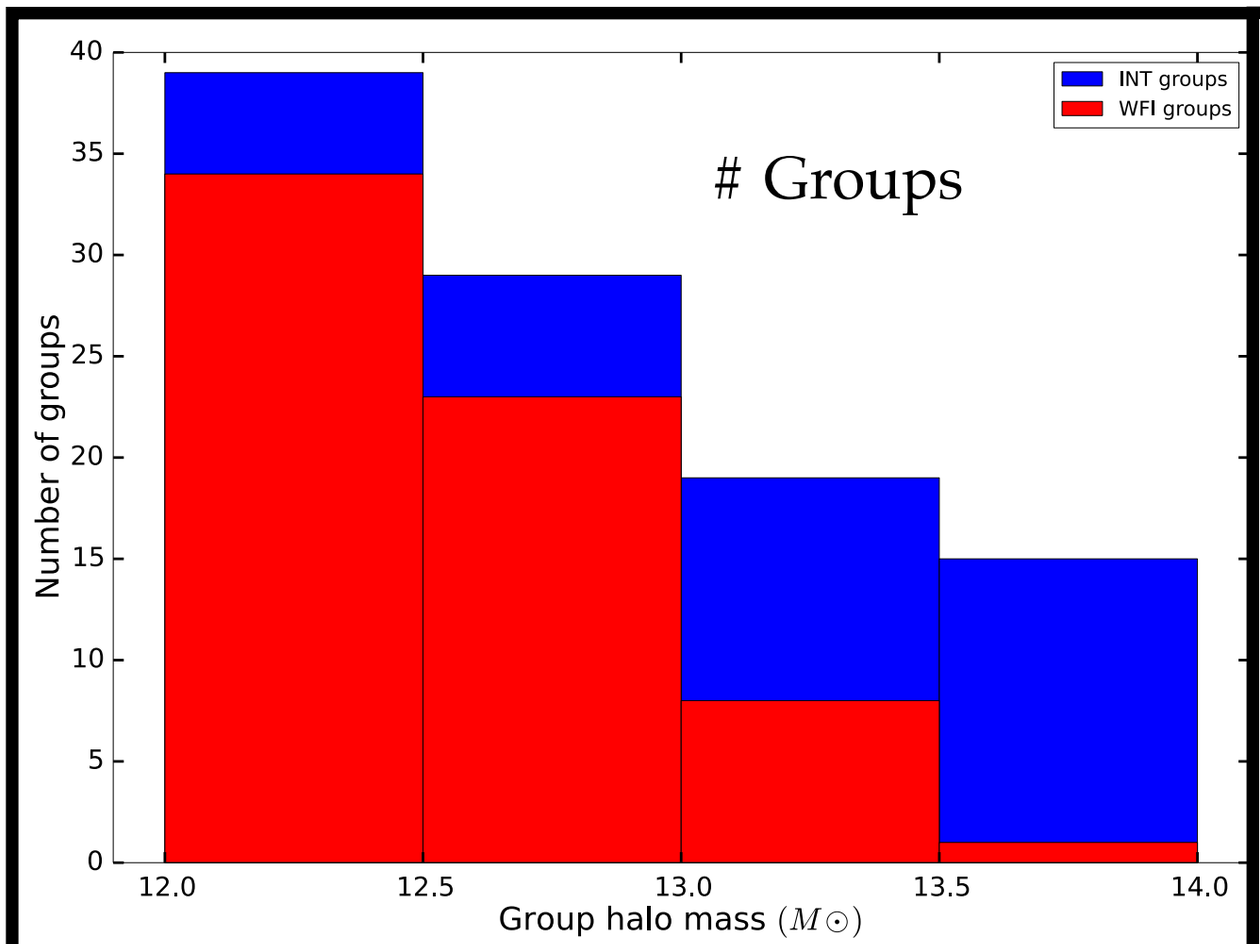


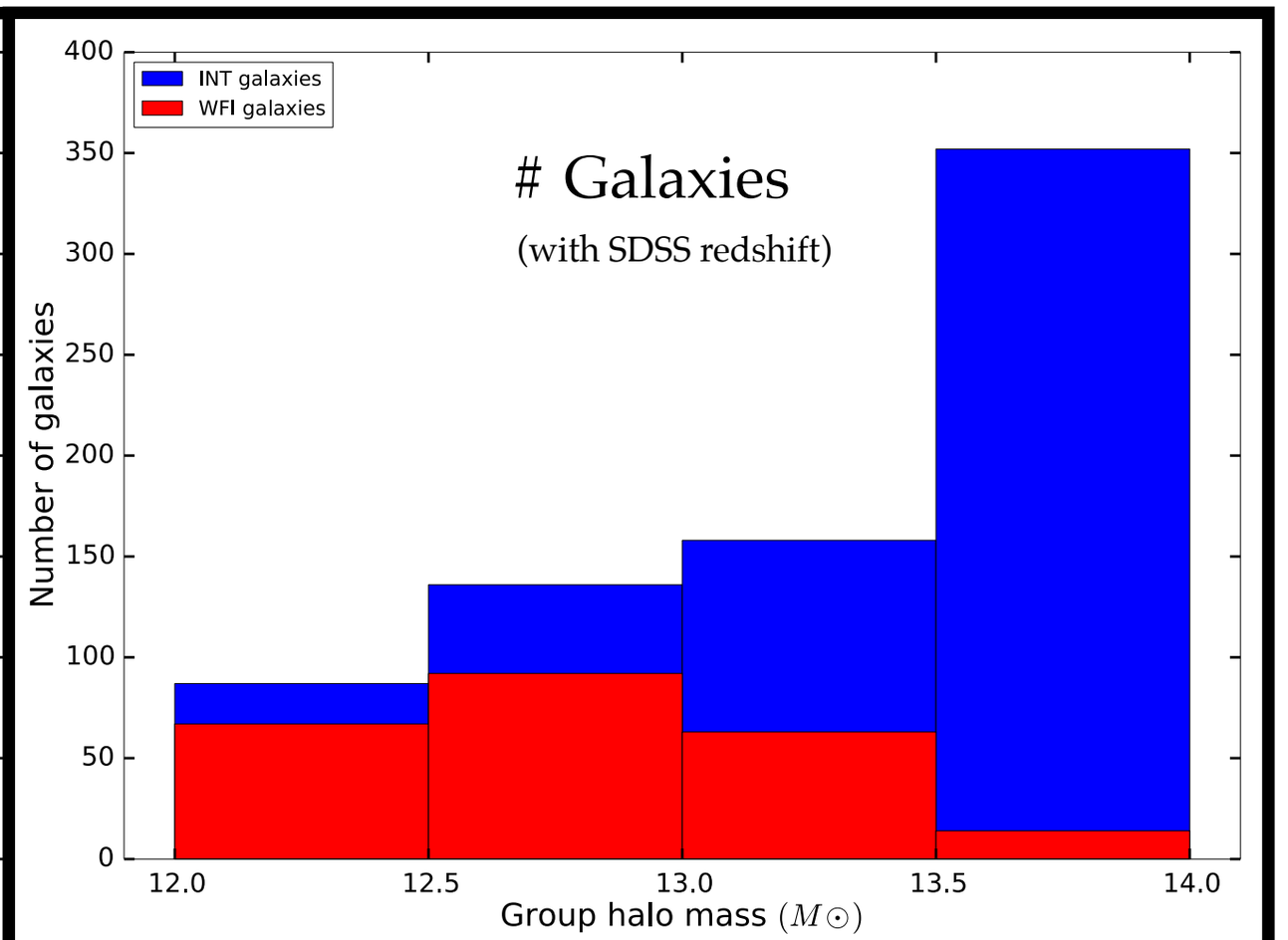
z~0.7-2.6

HAGGIS sample

A ***Group*** sample @ z~0.01 - 0.04

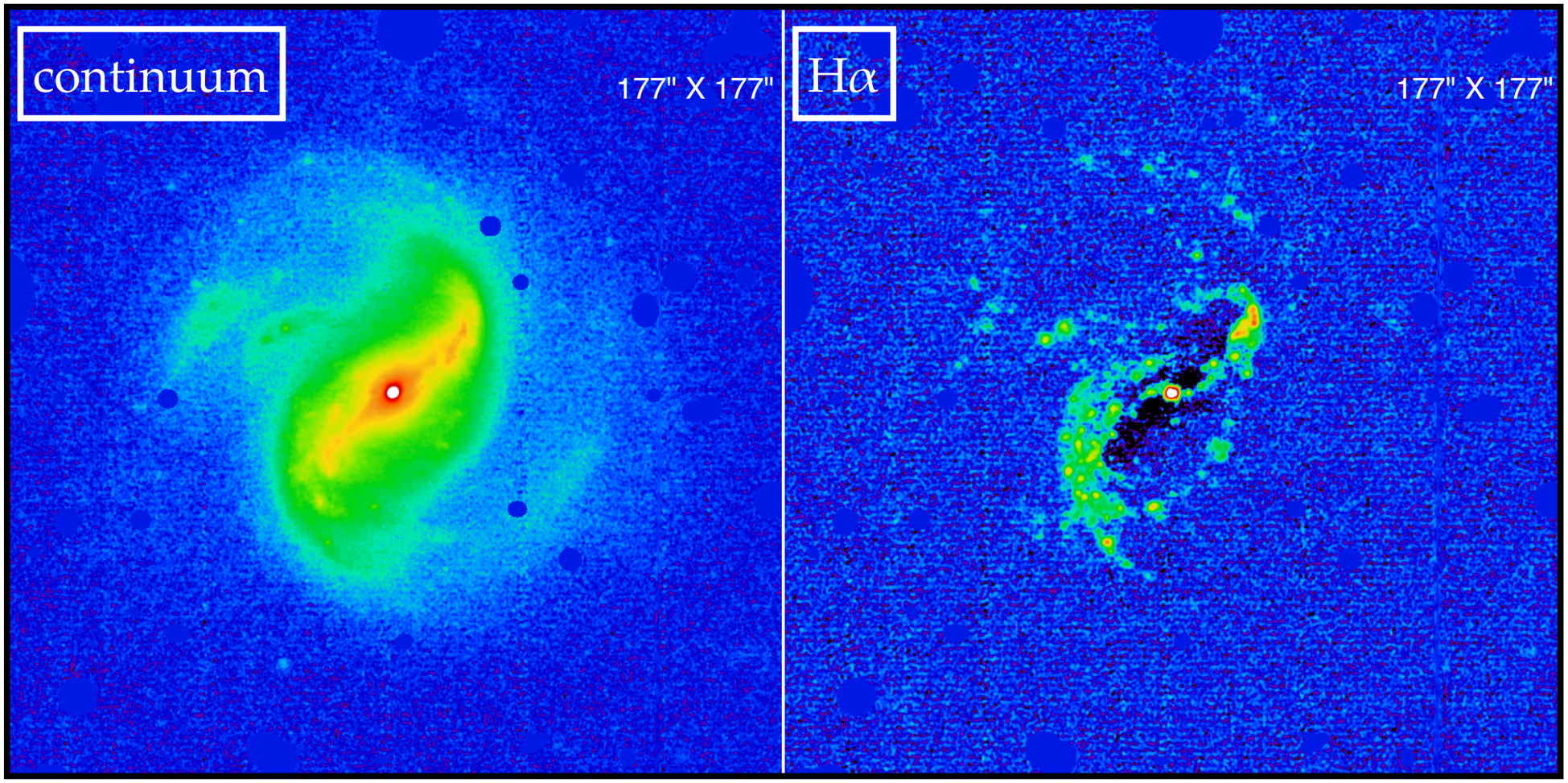
(Yang et al DR7 halo masses)



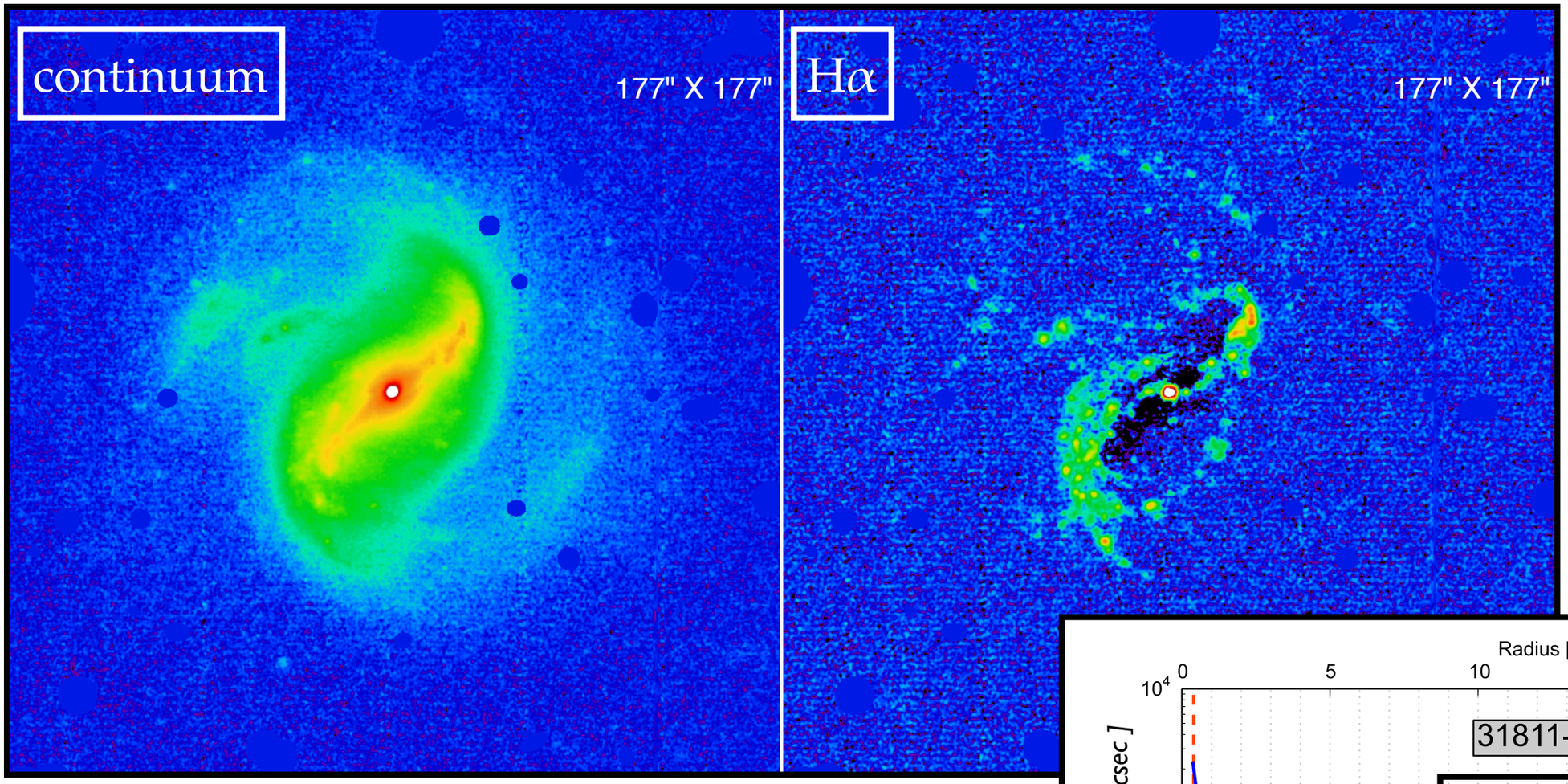


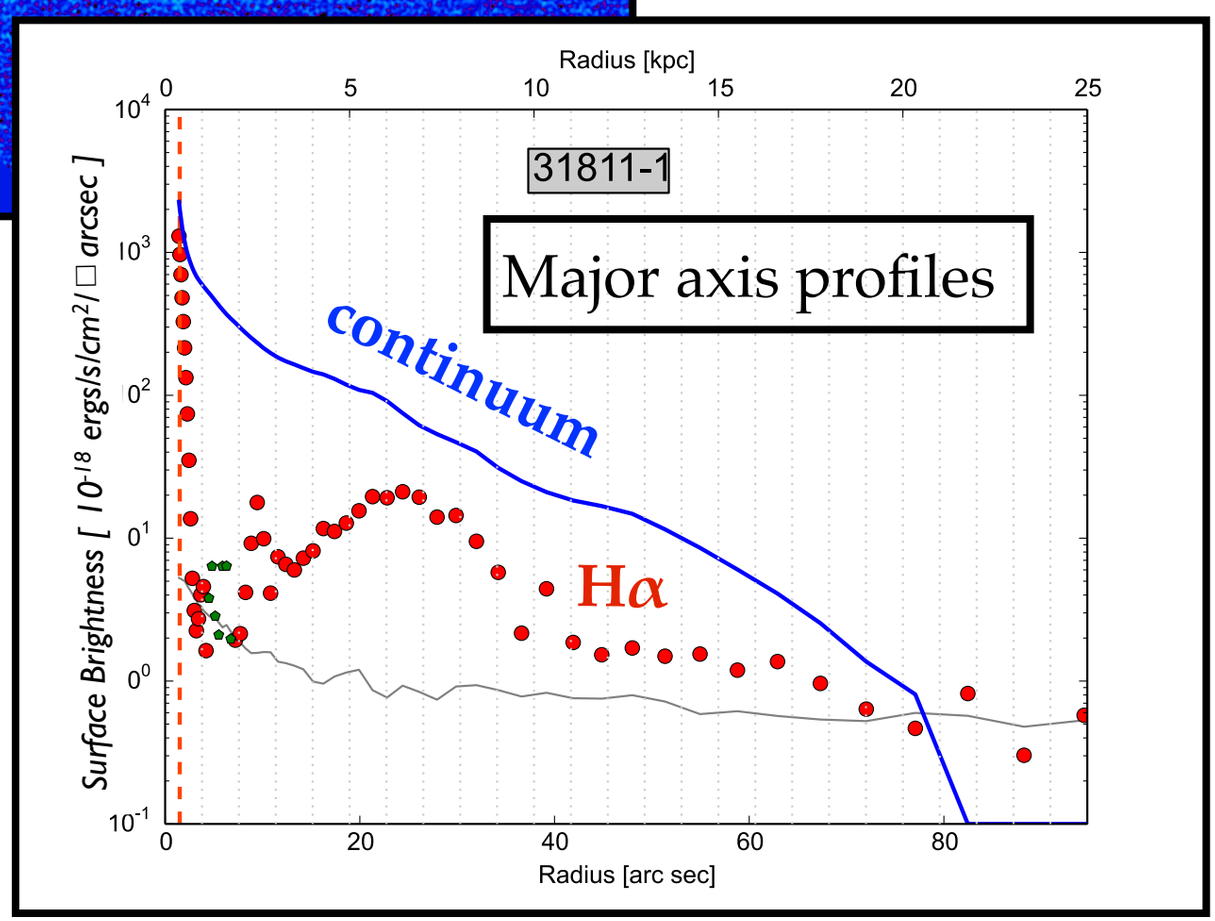
with DW, Peter Erwin, John Beckman, Leonel Guiterrez, Roberto Saglia

HAGGIS profiles

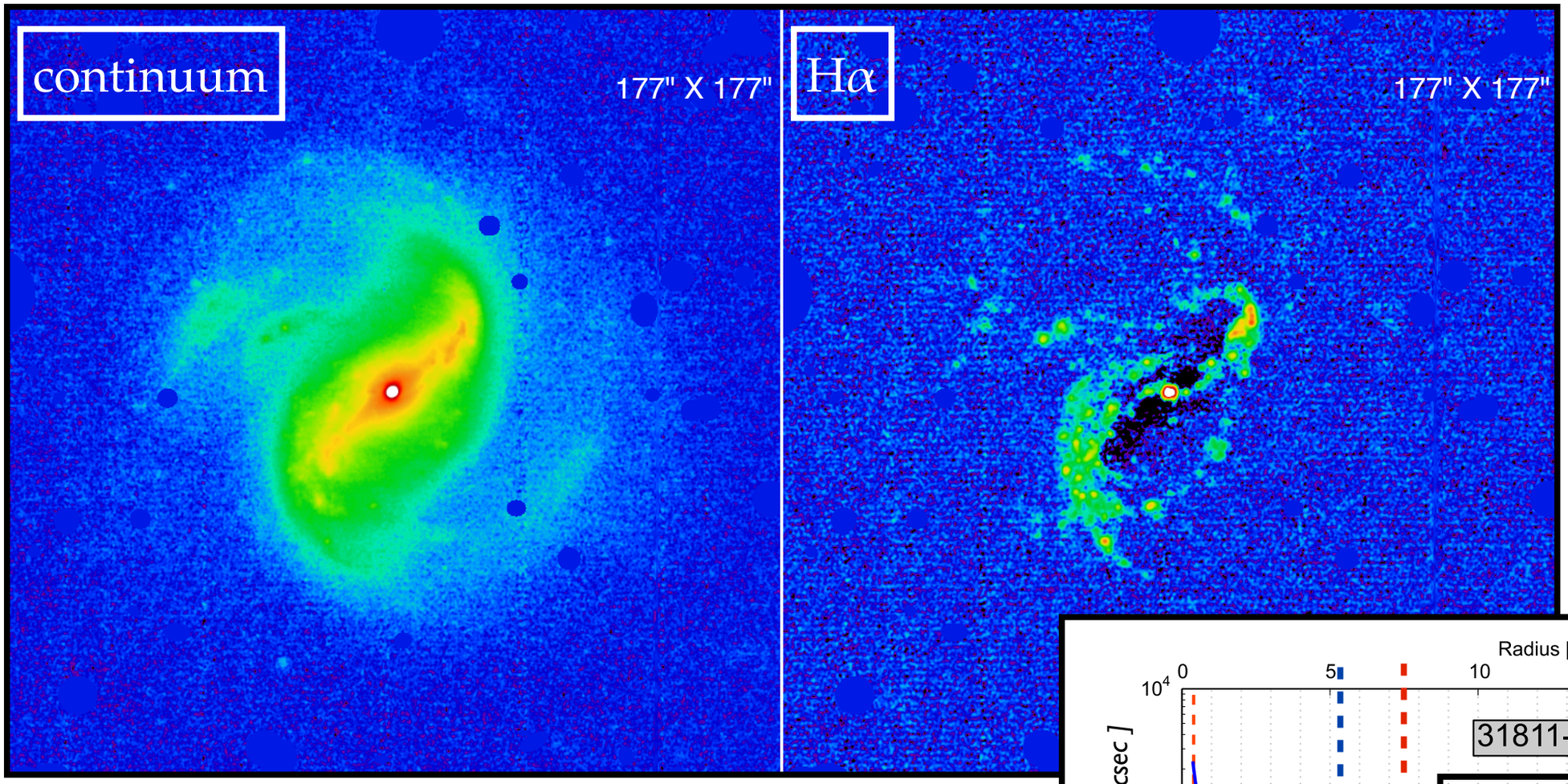


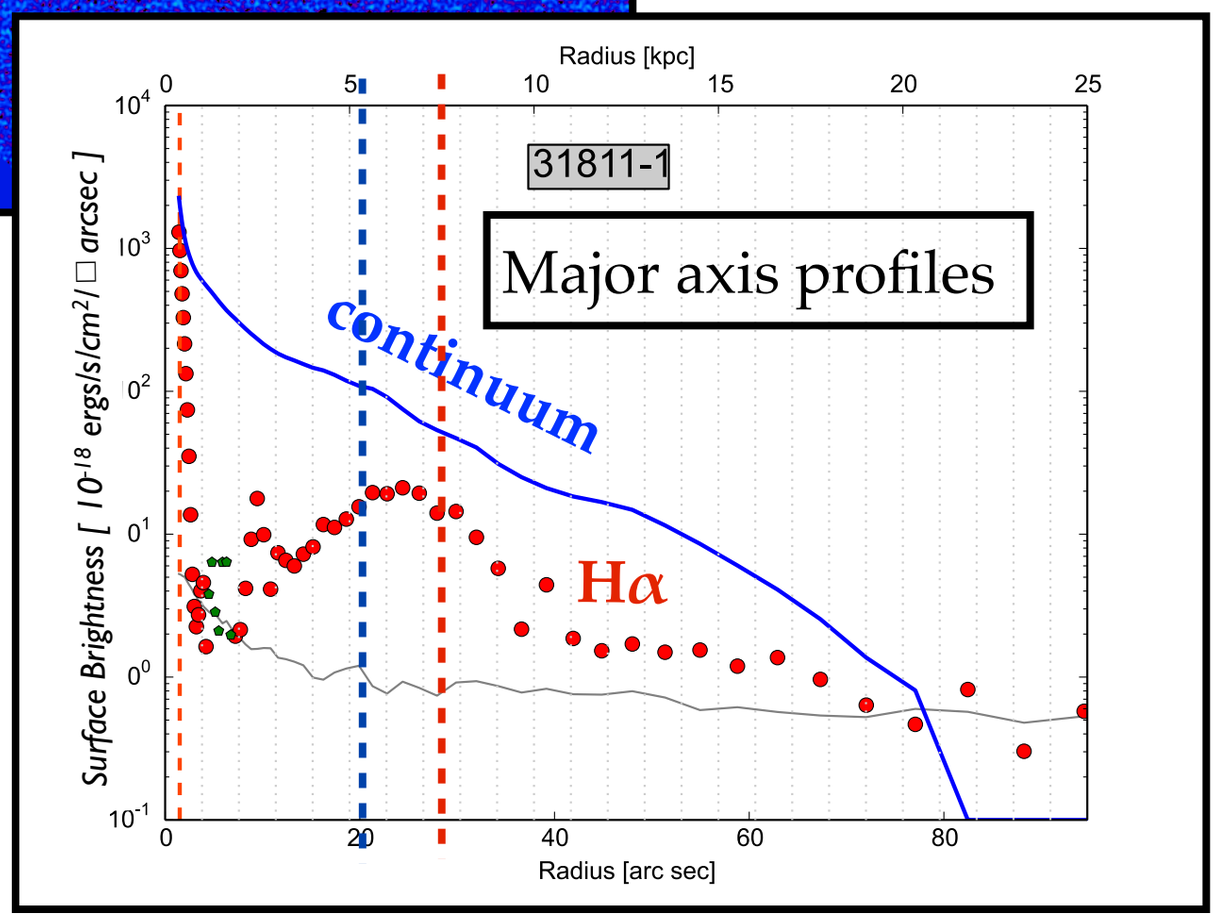
HAGGIS profiles





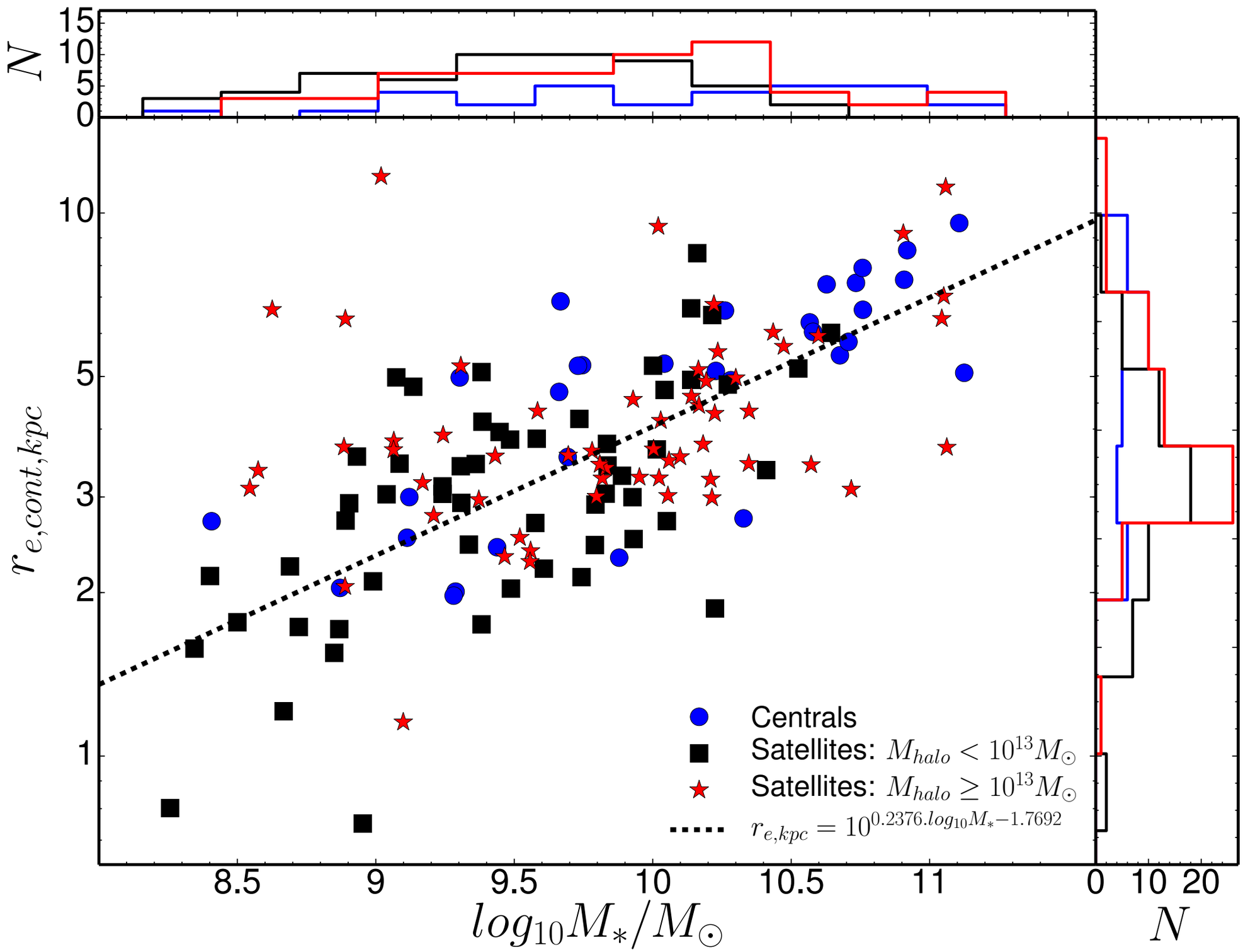
HAGGIS profiles



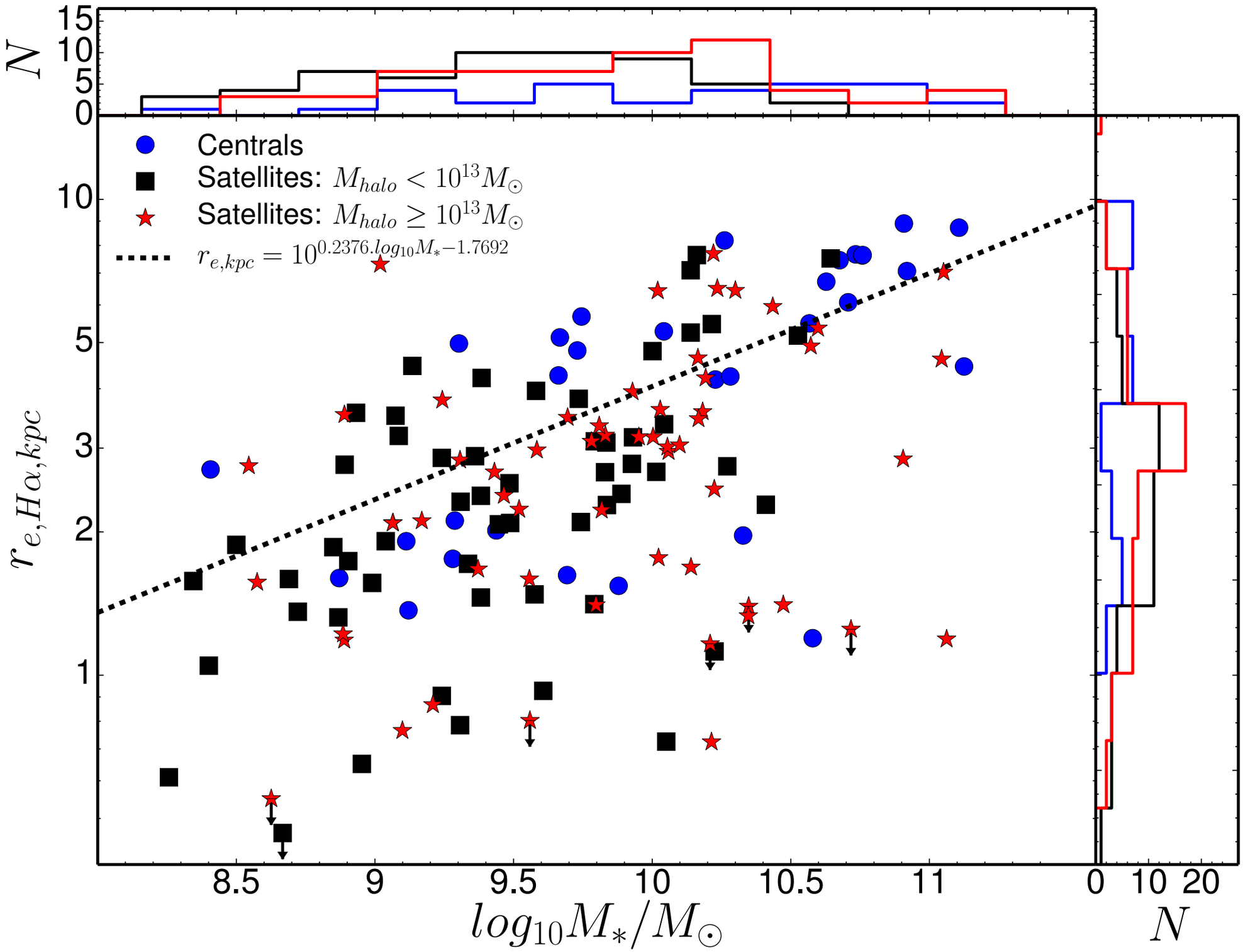


Mass - Continuum Size Relation

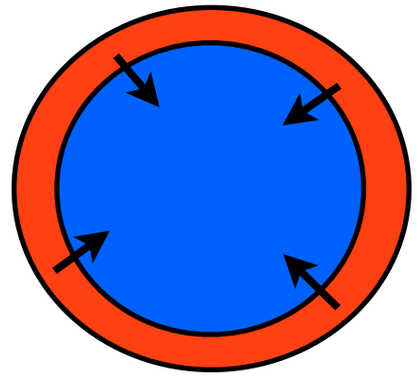
- Only galaxies with Hα emission: (Passive galaxies are more compact)
- Excluding AGN

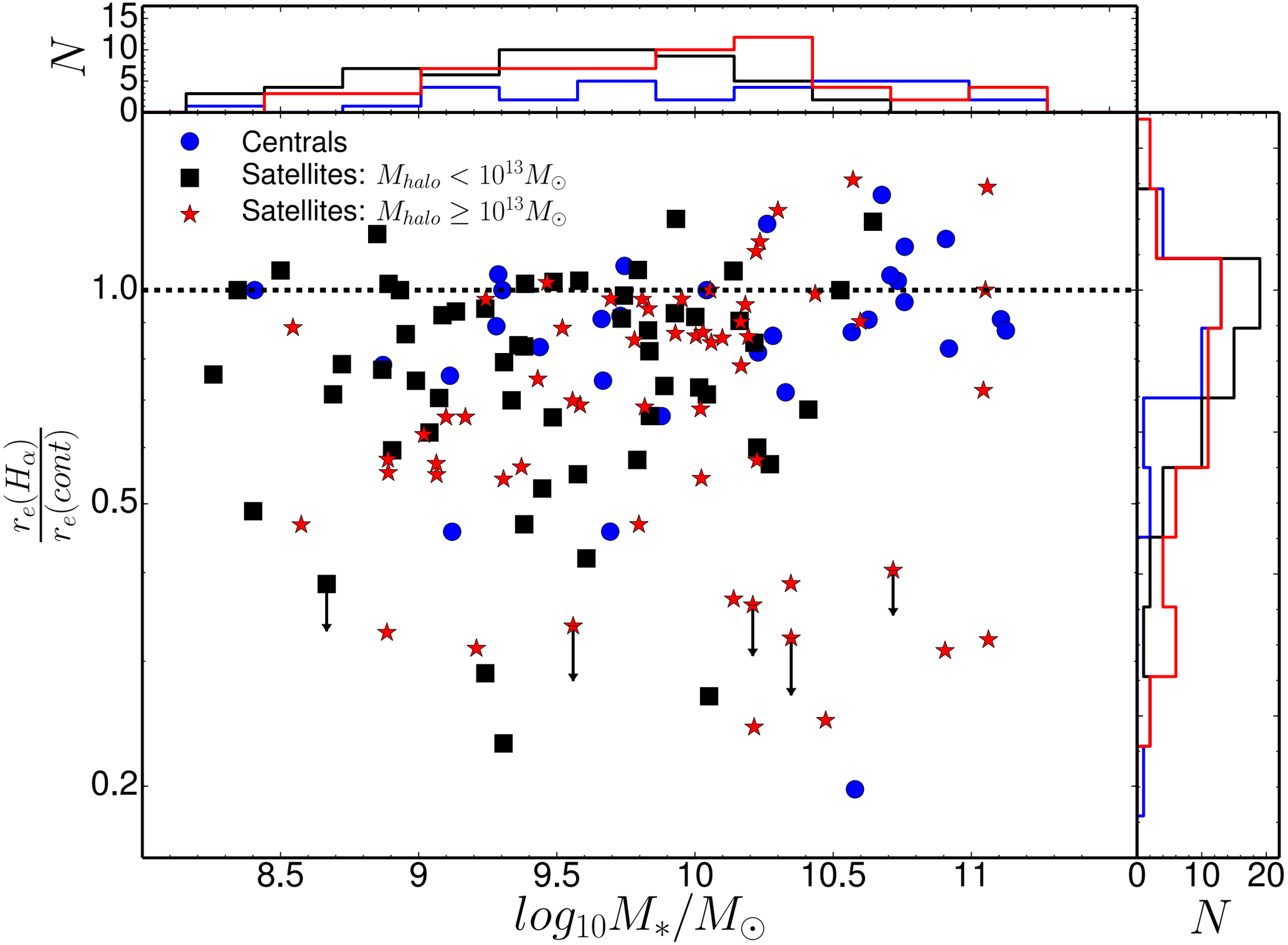


Mass - Hα Size Relation



Mass - Hα to Continuum Size Ratio Relation





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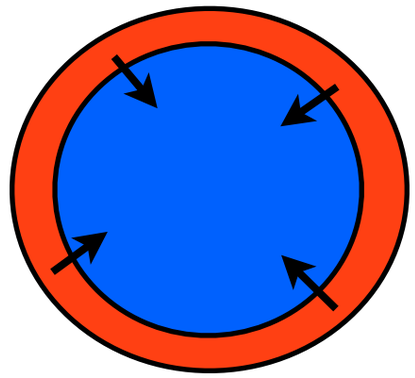
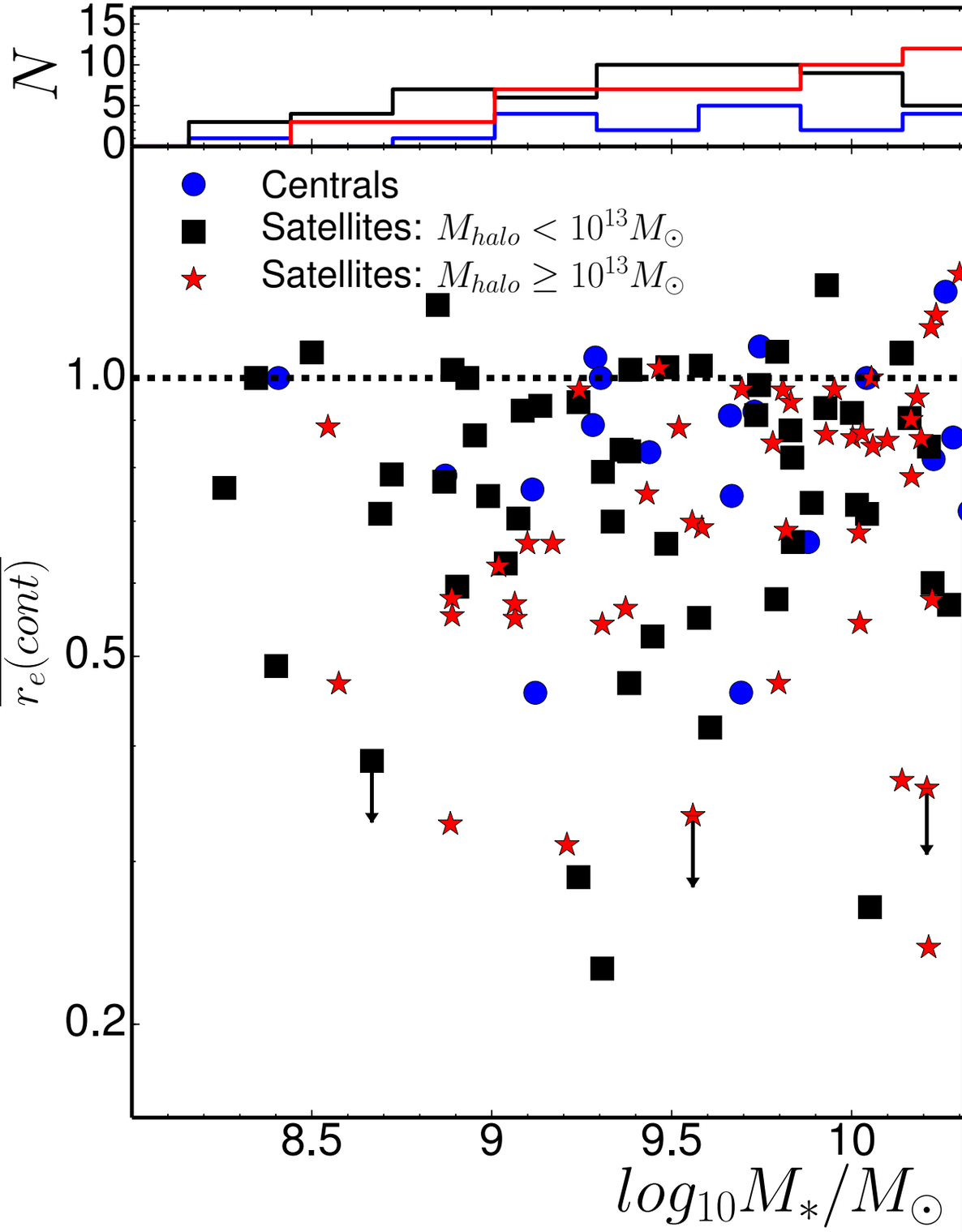
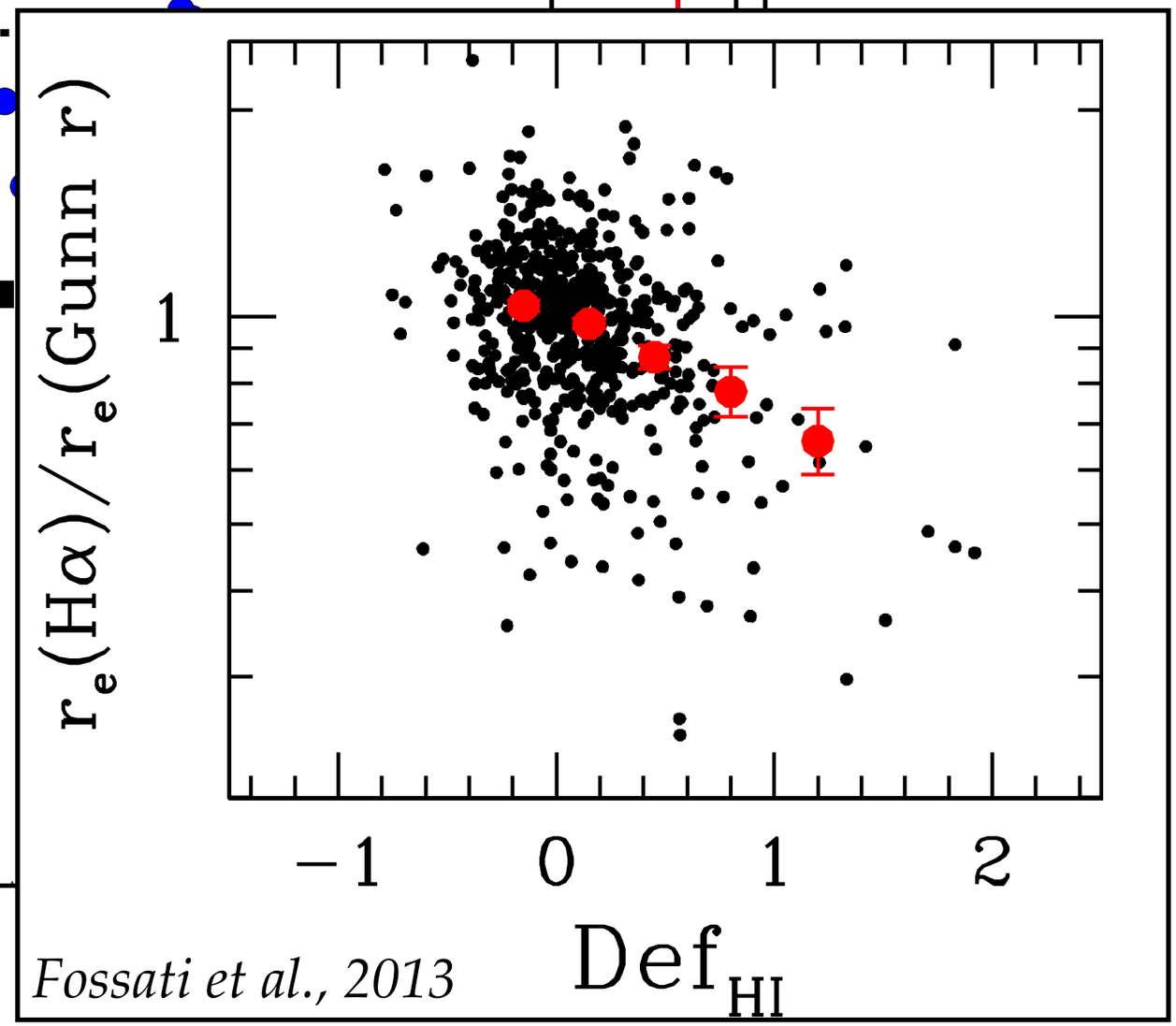
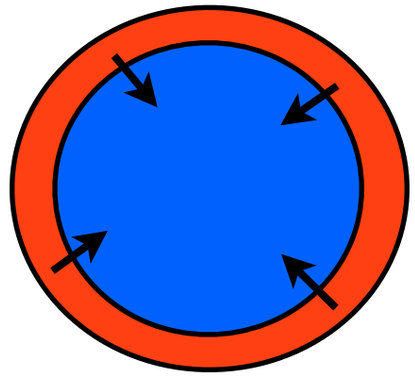


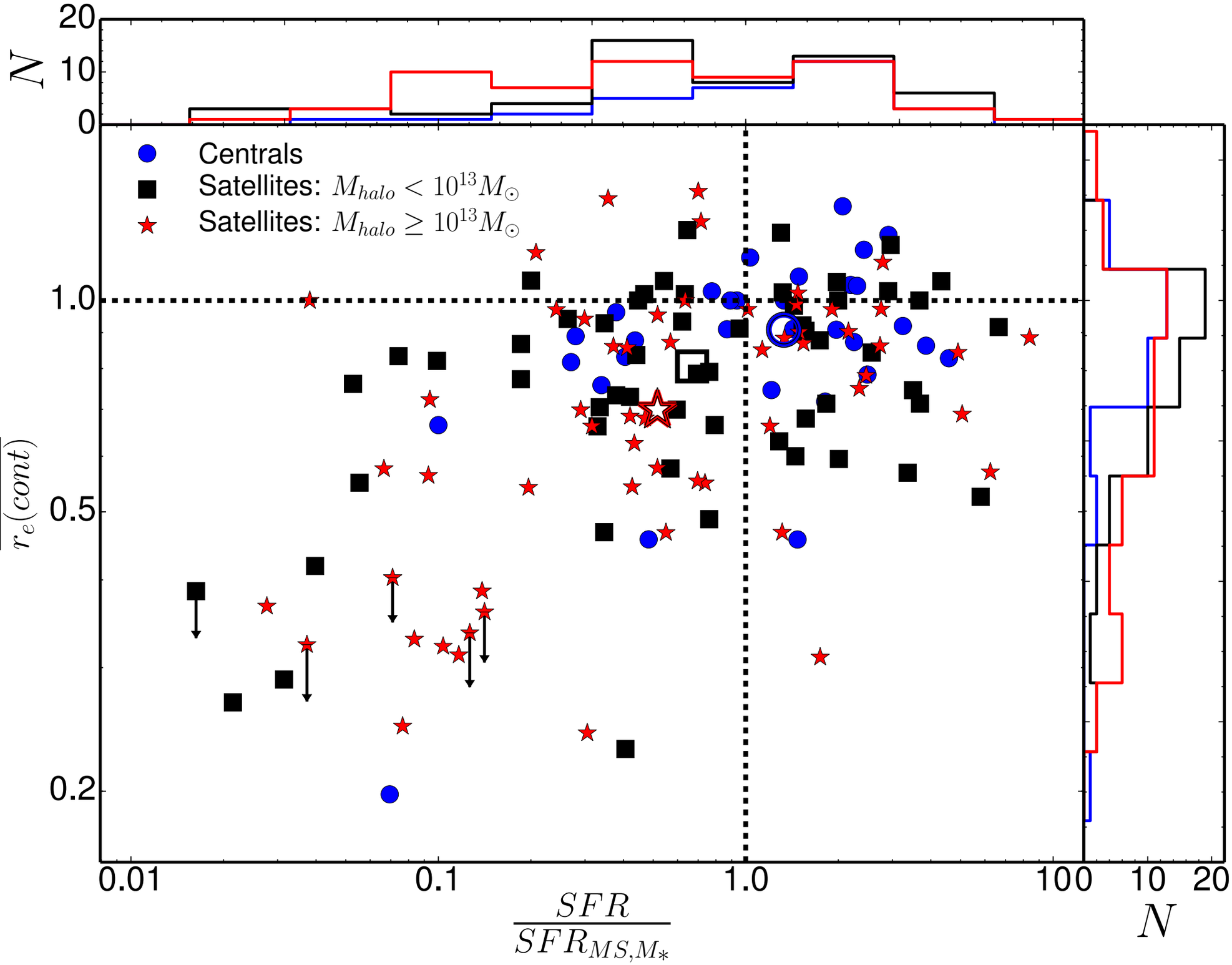




Fossati et al., 2013

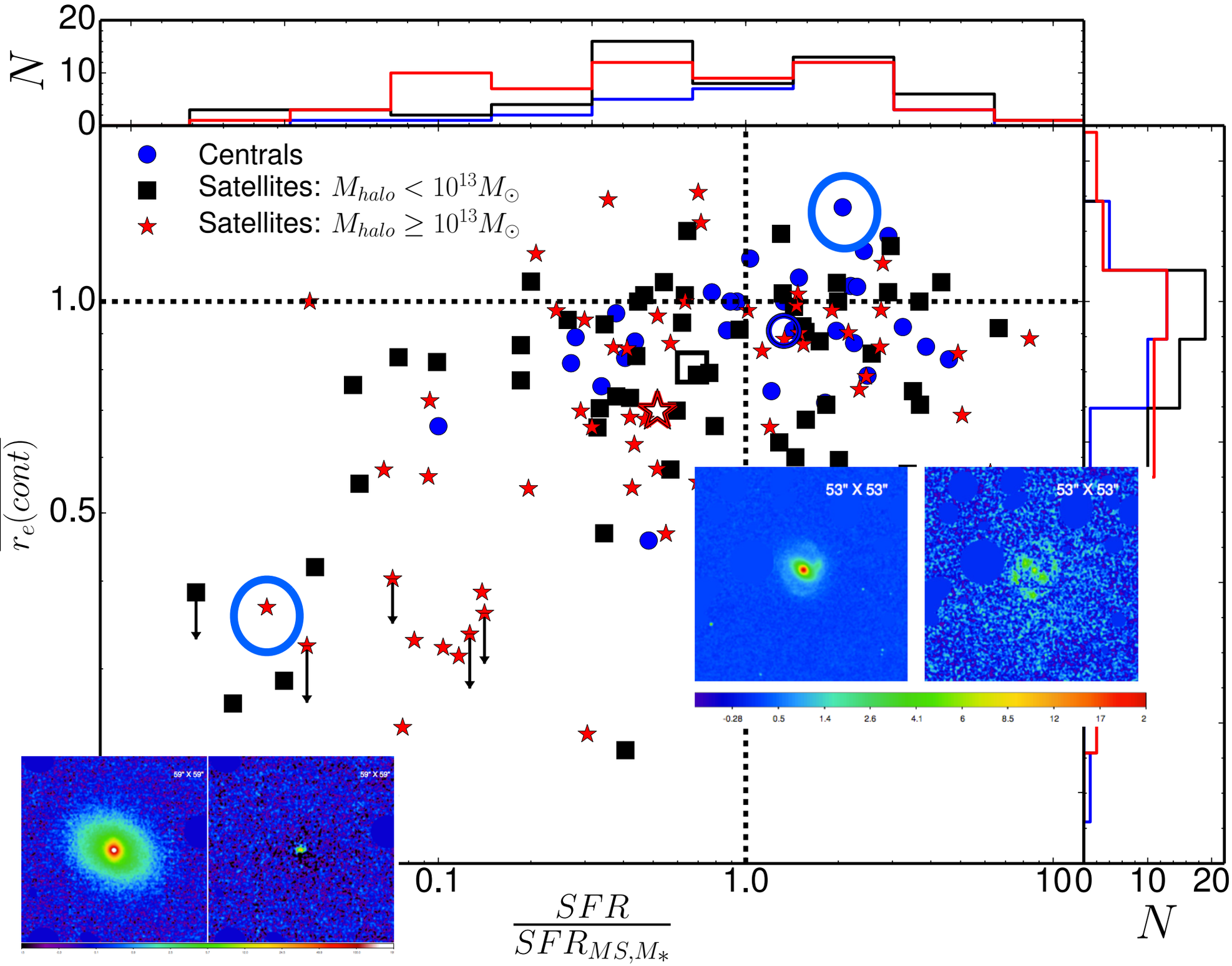
Size Ratio vs Offset from Main Sequence (SFR)



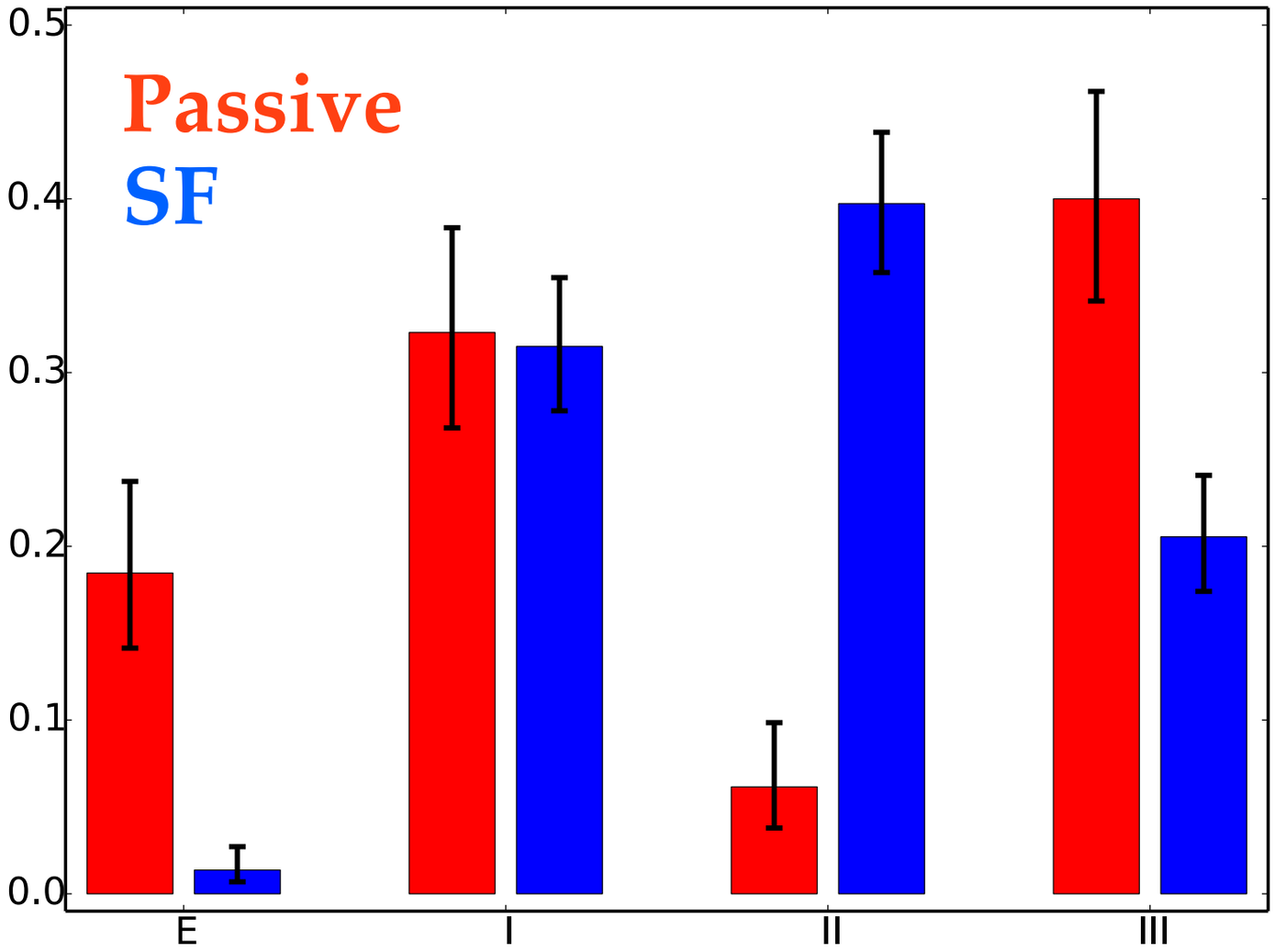


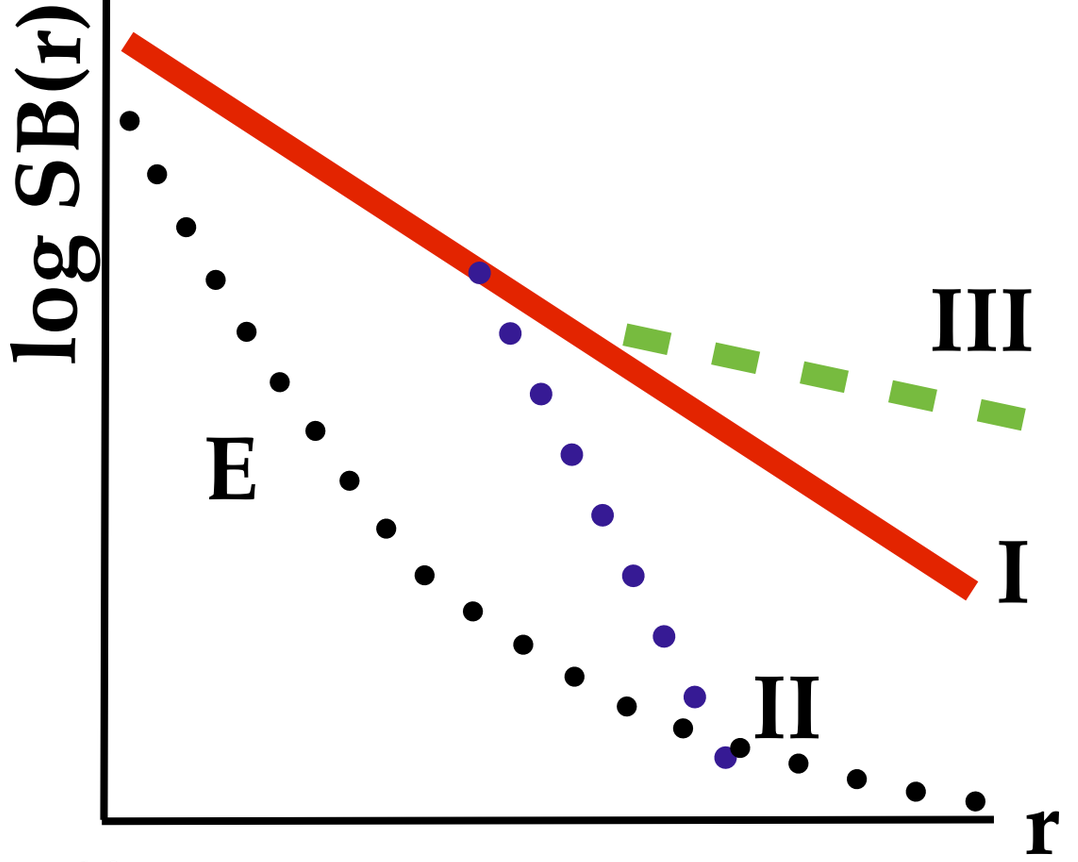
K-S Test:
1% chance that distribution of satellites on either axis consistent with that of the centrals

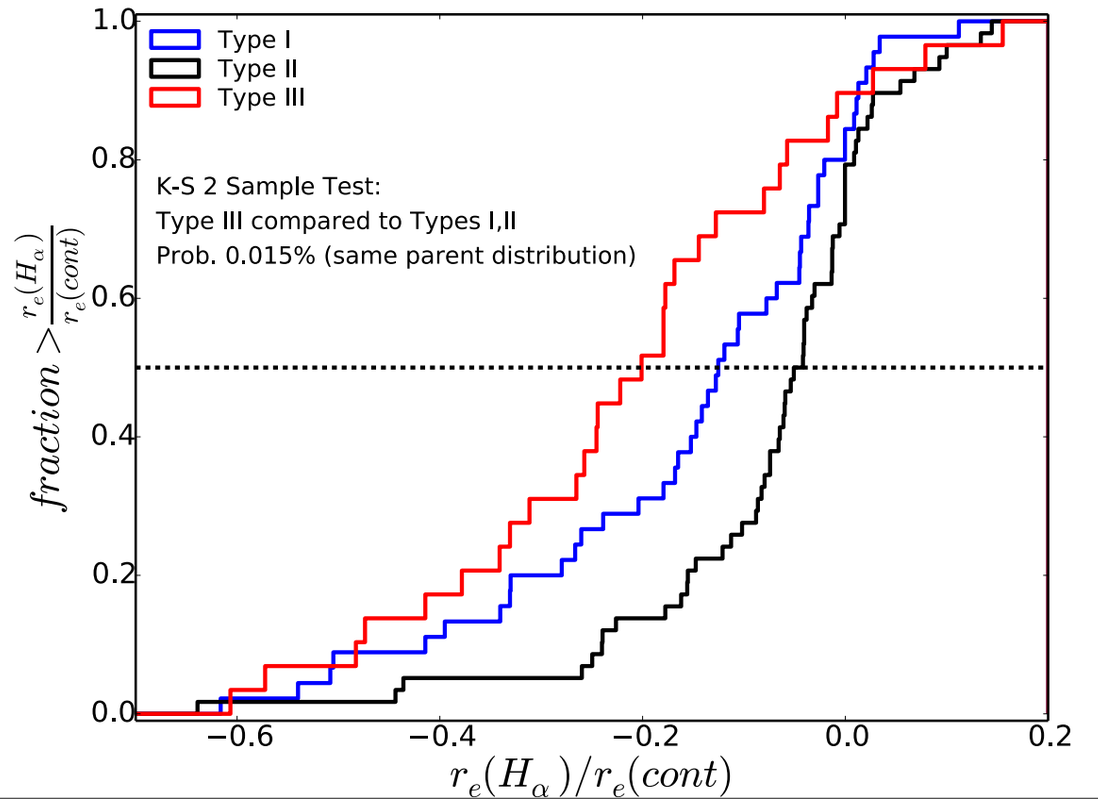
Size Ratio vs Offset from Main Sequence (SFR)



Signature of Gravitational Interactions



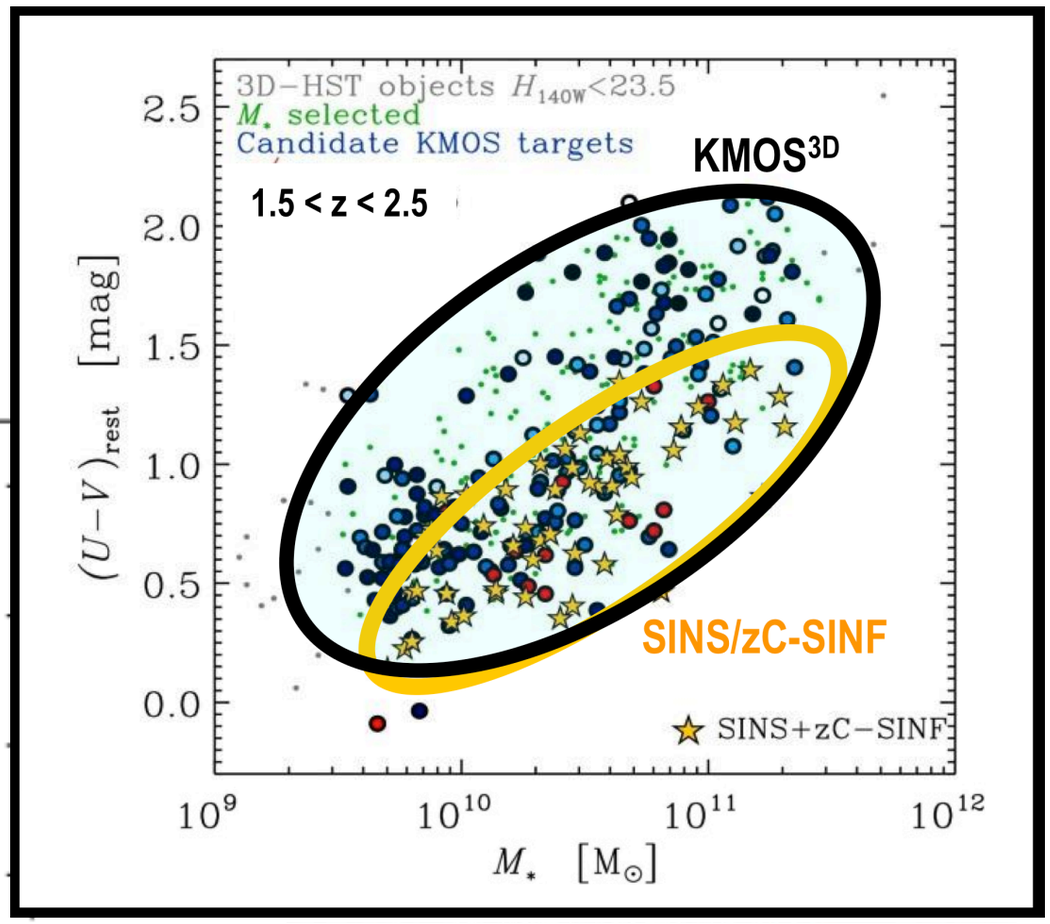


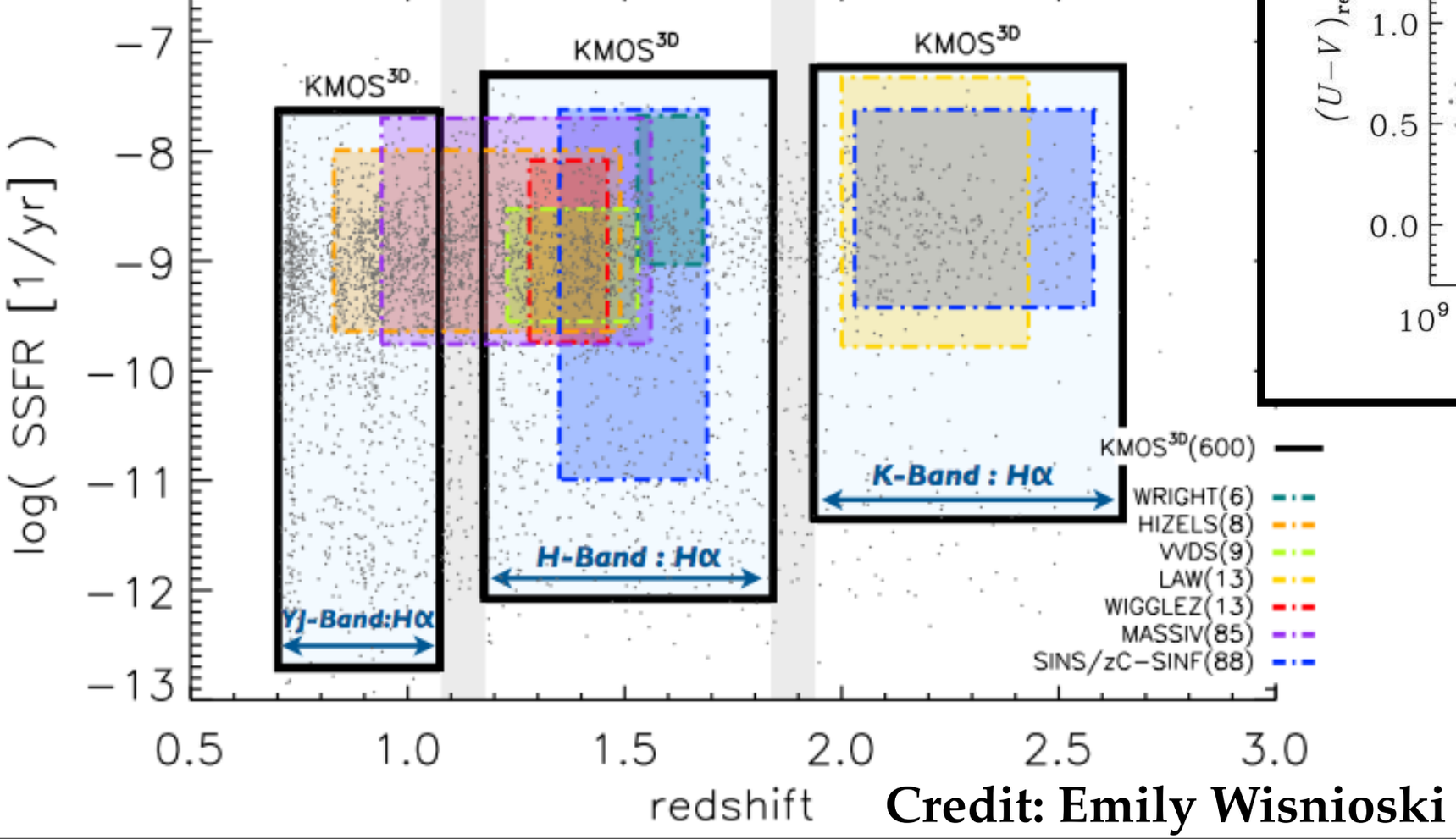


KMOS^{3D}

Science Team: *N.M. Förster Schreiber, D. Wilman, E. Wisnioski, R. Bender, R. Genzel, K. Bandara, A. Beifiori, G. Brammer, J. Chan, R. Davies, M. Fossati, A. Galametz, S. Kulkarni, P. Lang, D. Lutz, J.T. Mendel, I. Momcheva, E. Nelson , D. Rosario, R. Saglia, S. Seitz, L.J. Tacconi, P. van Dokkum, E. Wuyts, S. Wuyts, et al.*

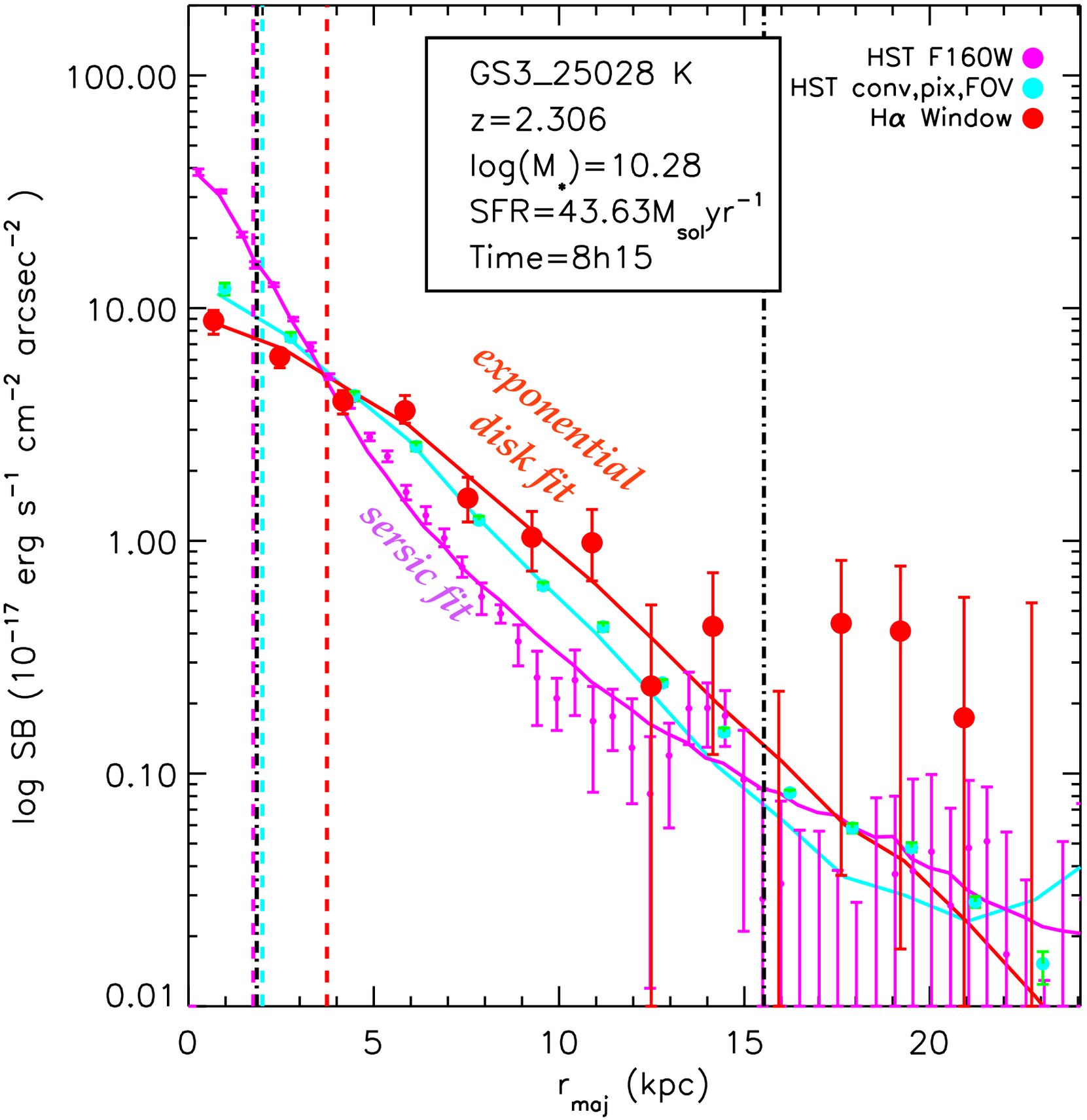
- Mapping Hα+[NII] kinematics for a mass-limited sample of galaxies selected from the 3DHST survey @ z=0.7-2.8
- Largest GTO Program: 75 nights
- YJ, H and K-bands with R~3400-3800





Credit: Emily Wisnioski

KMOS^{3D} 2D-Fitting and Major axis Profiles



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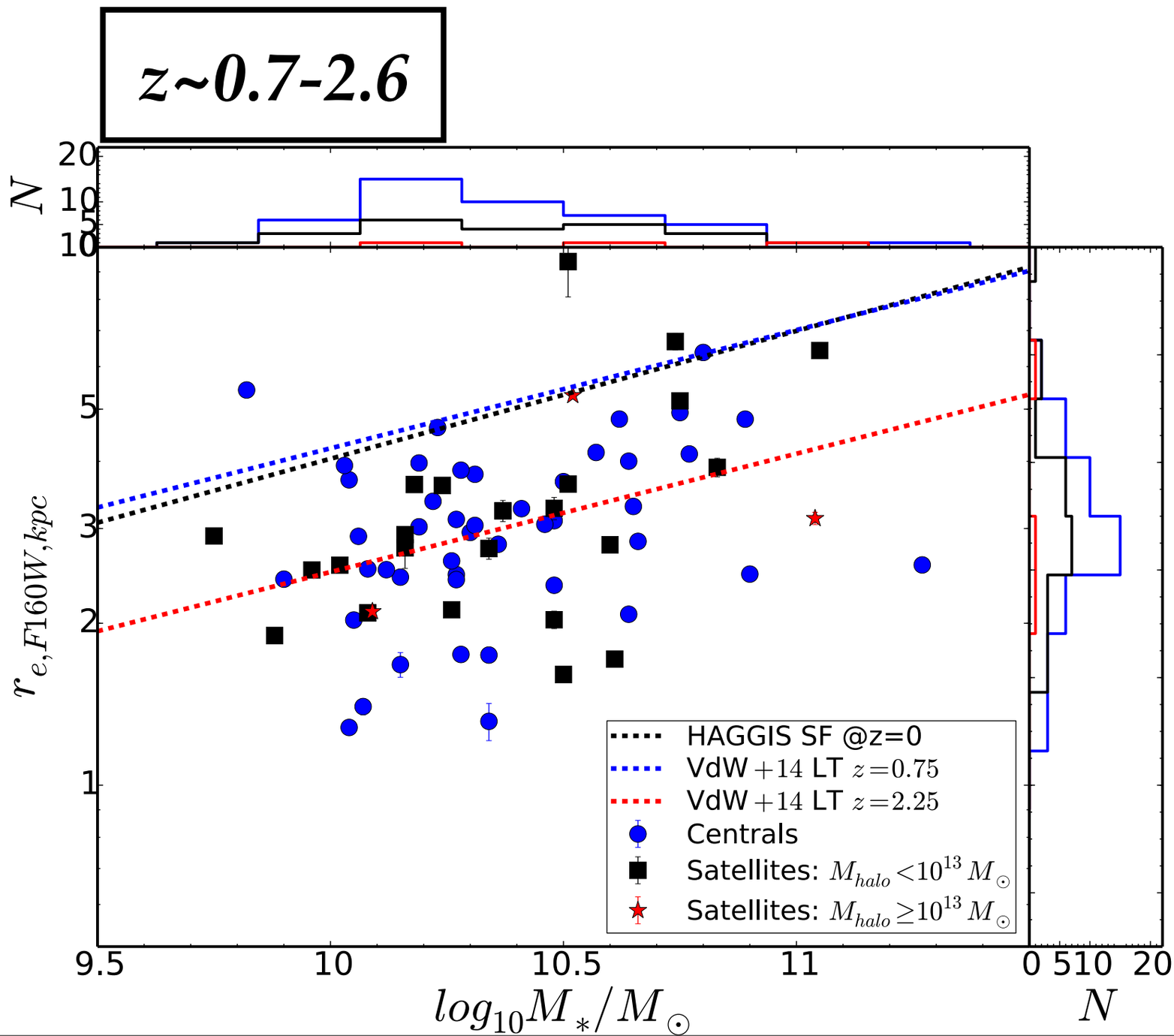
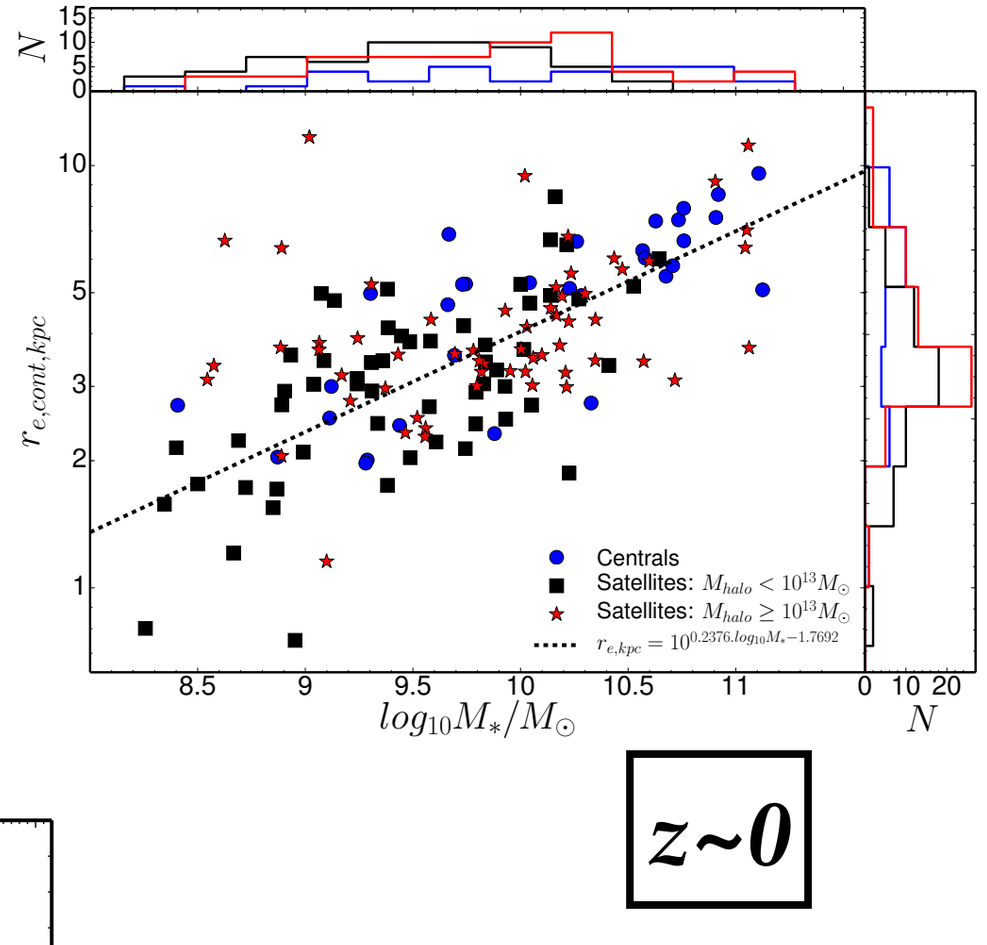
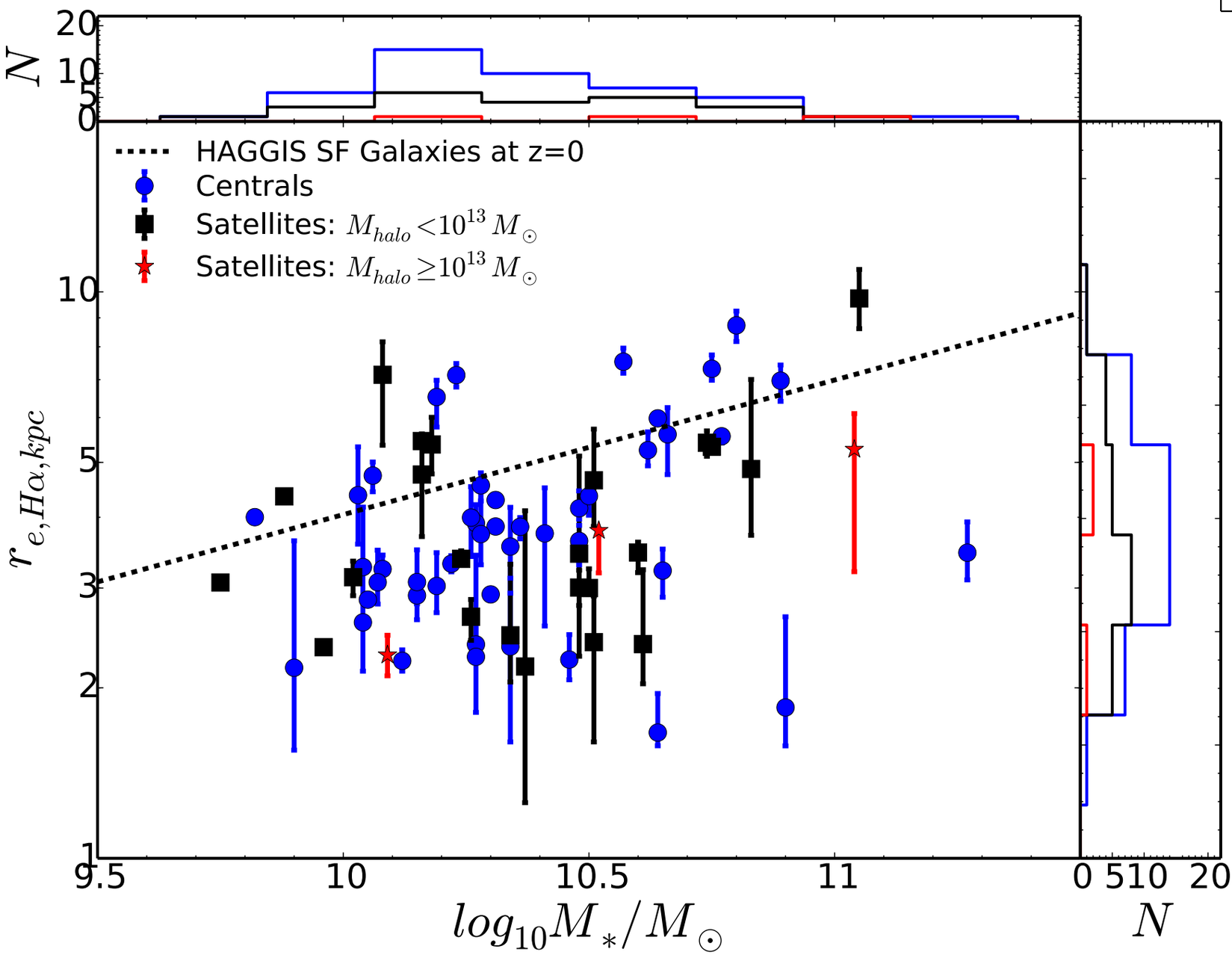




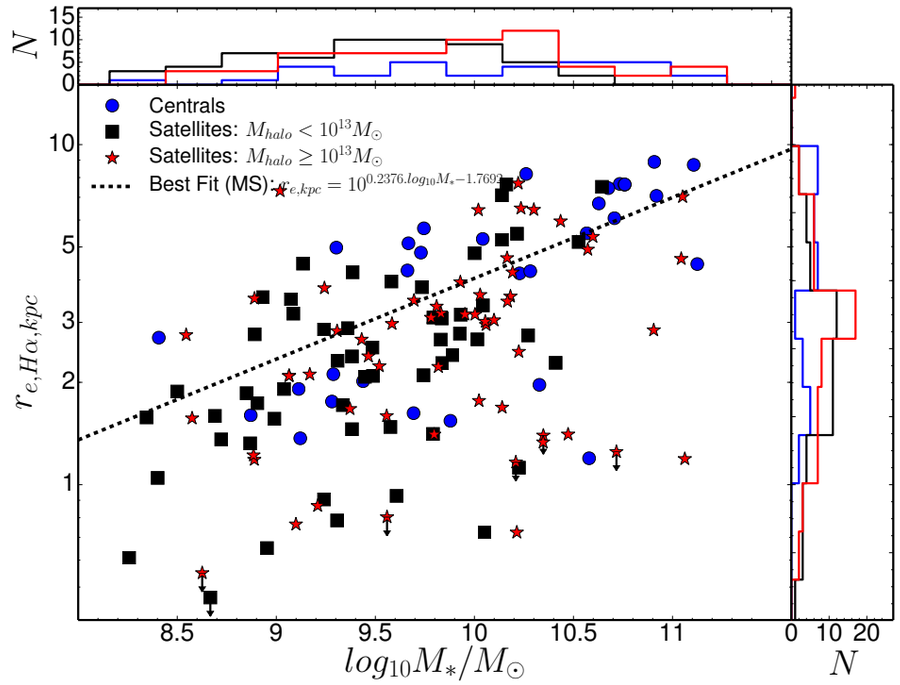
z~0

Mass - Hα Size Relation

z~0.7-2.6



z~0



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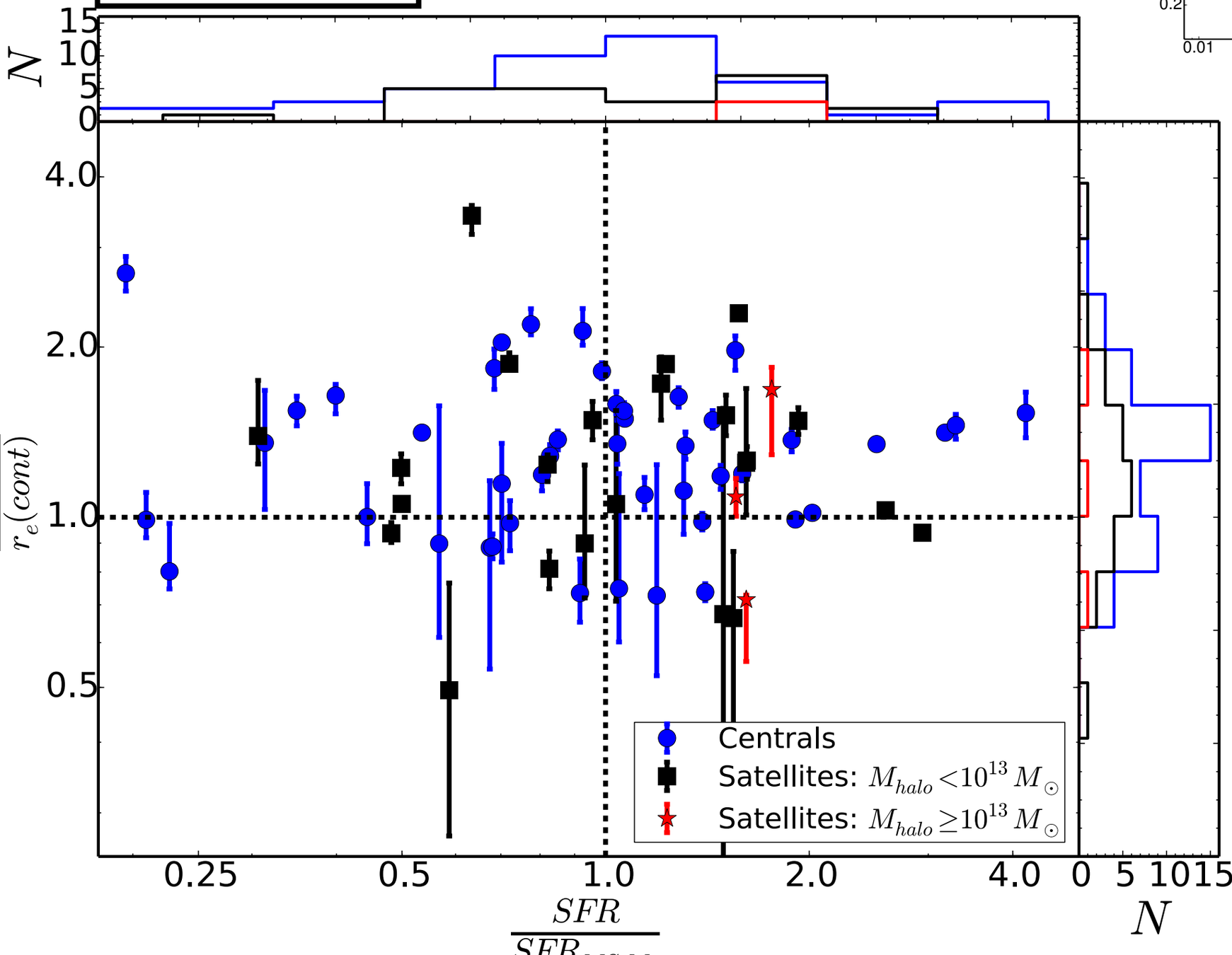

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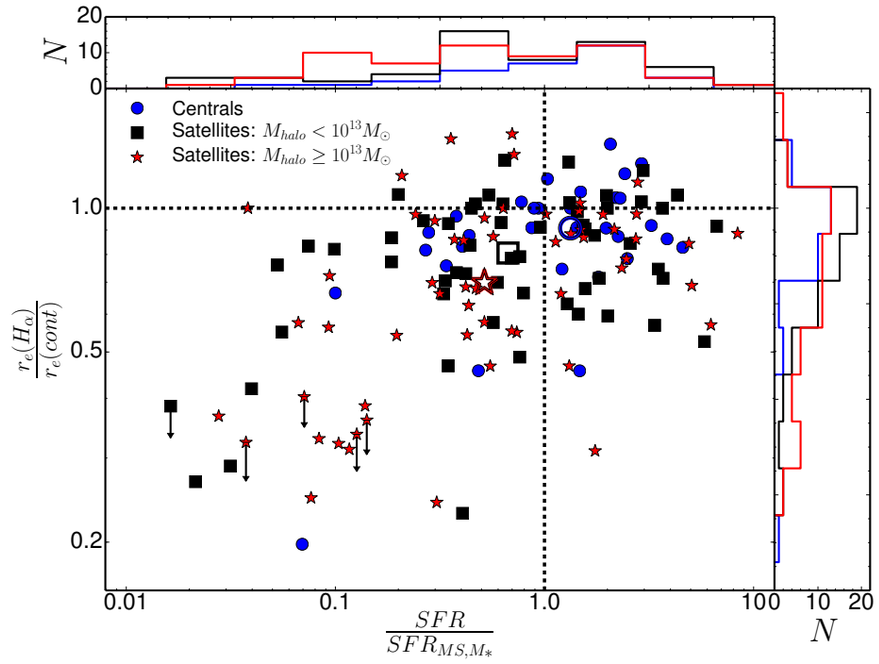
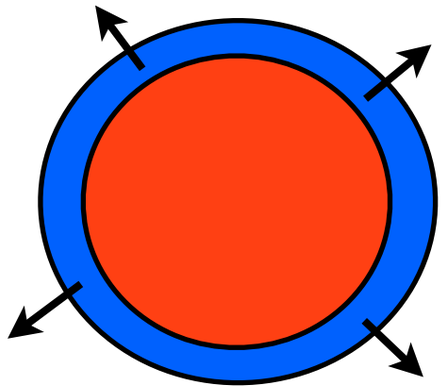
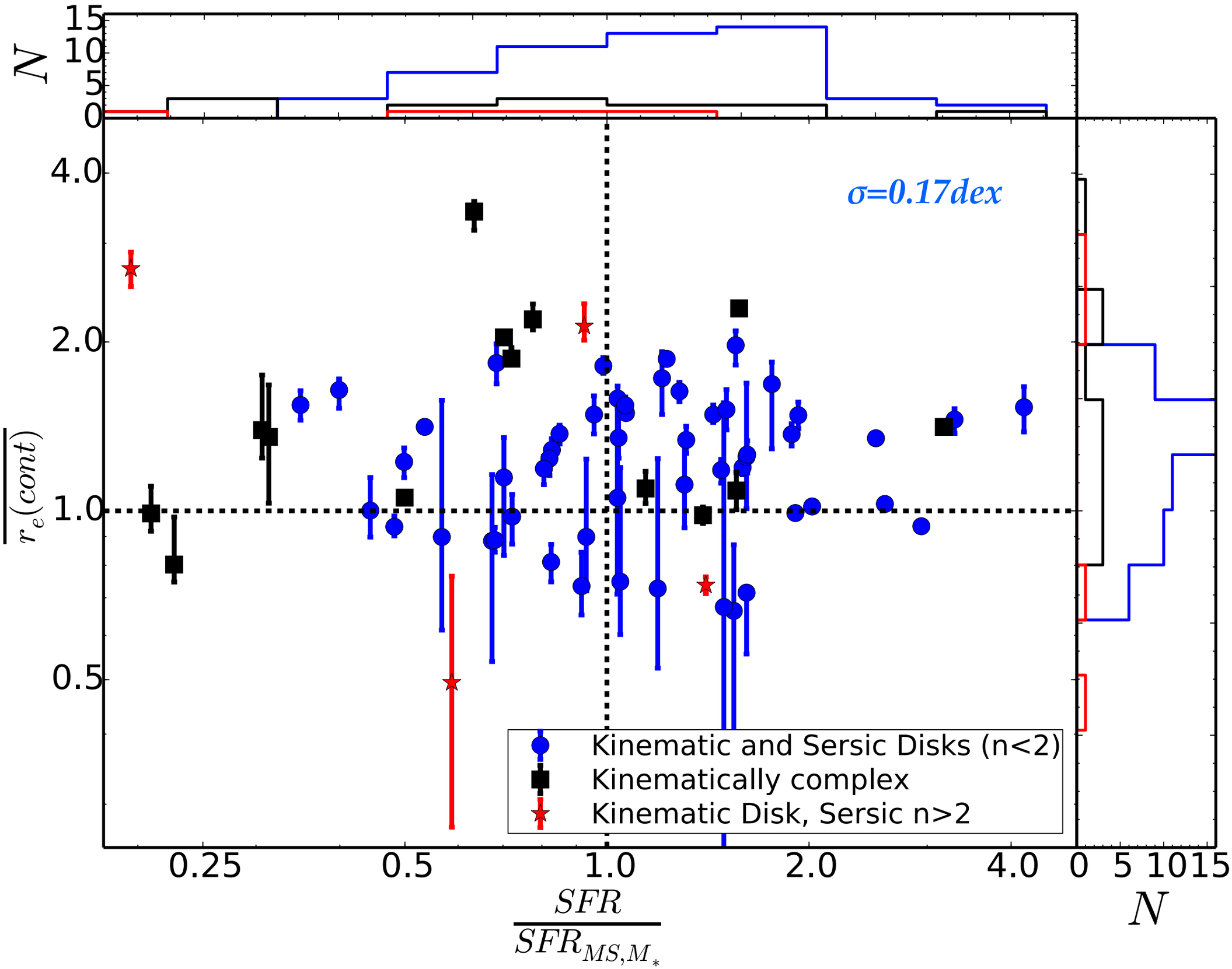




Embrace the scatter



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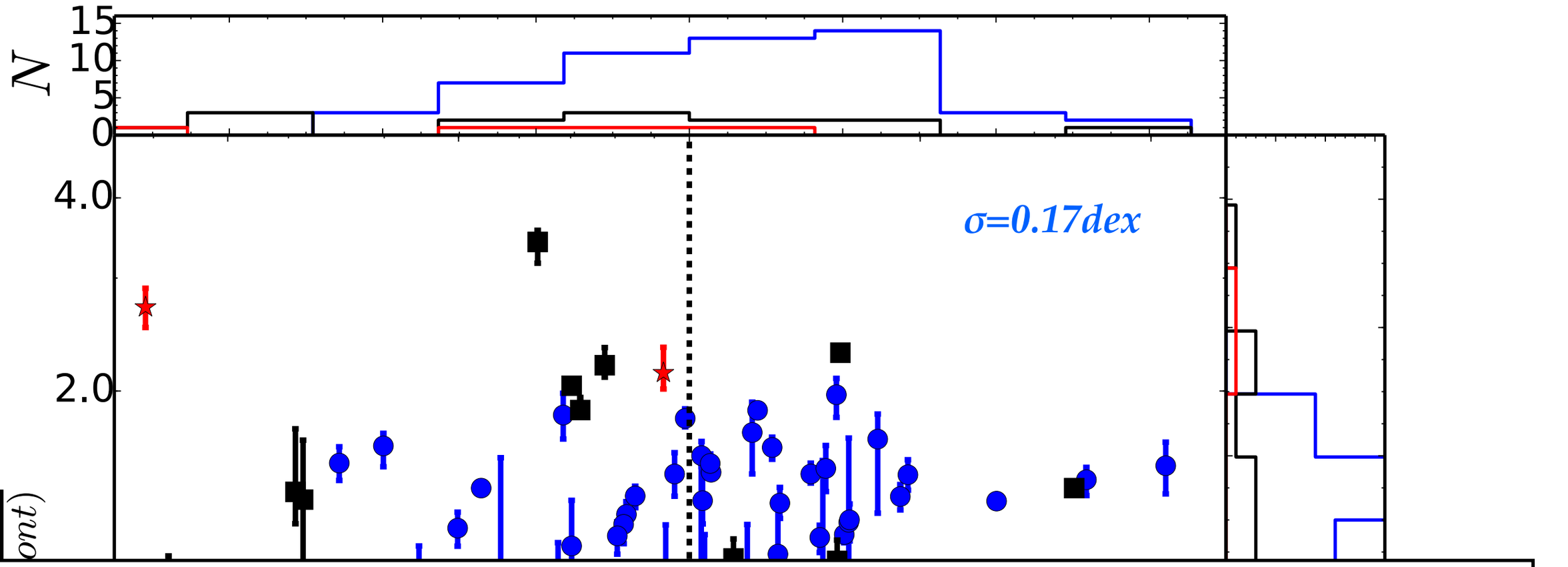
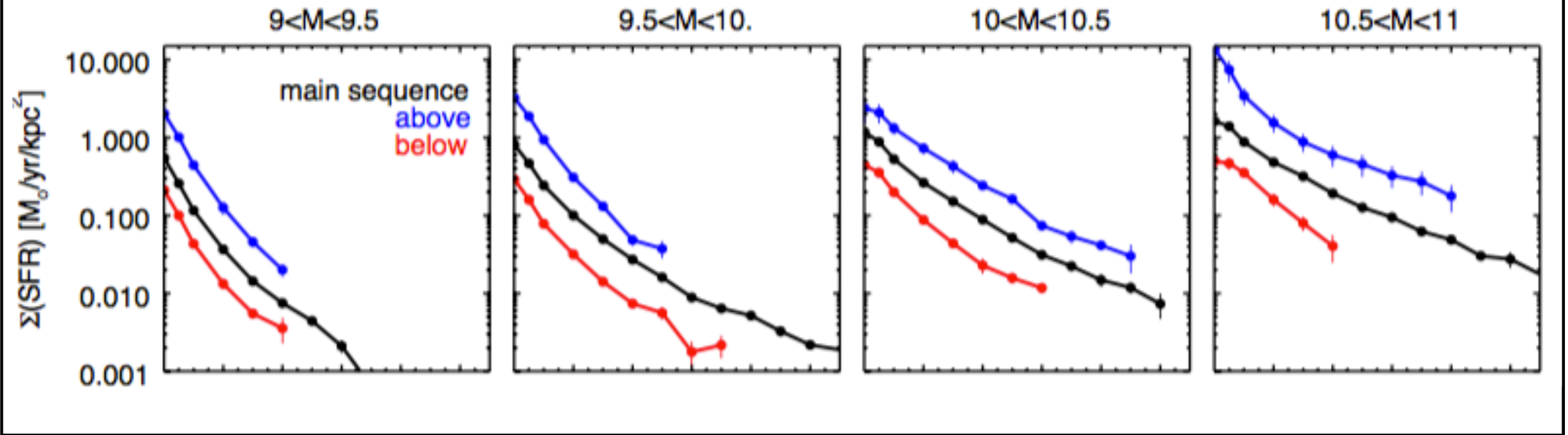


Nelson et al., 2015 ***3D-HST stacks***



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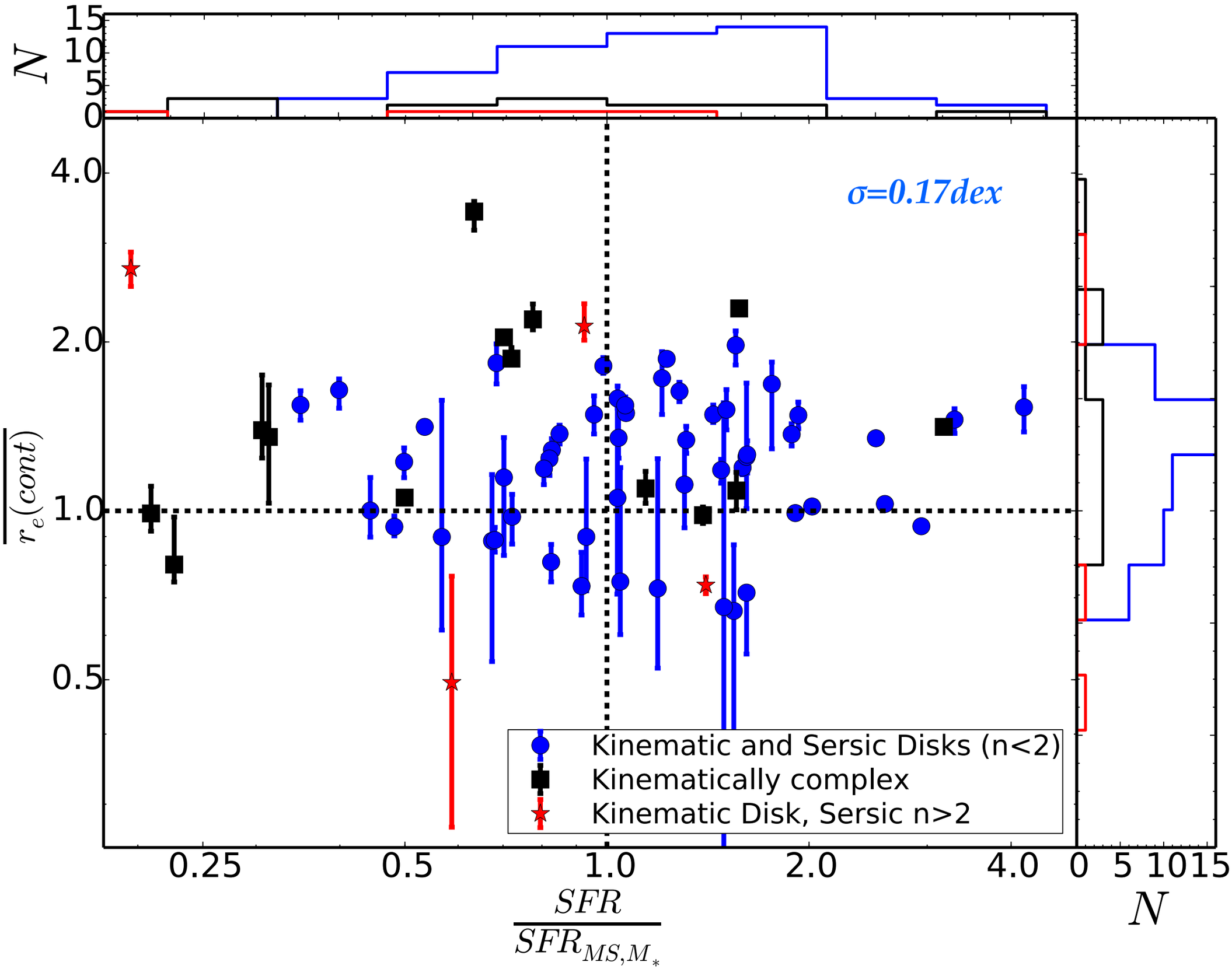

Conclusions

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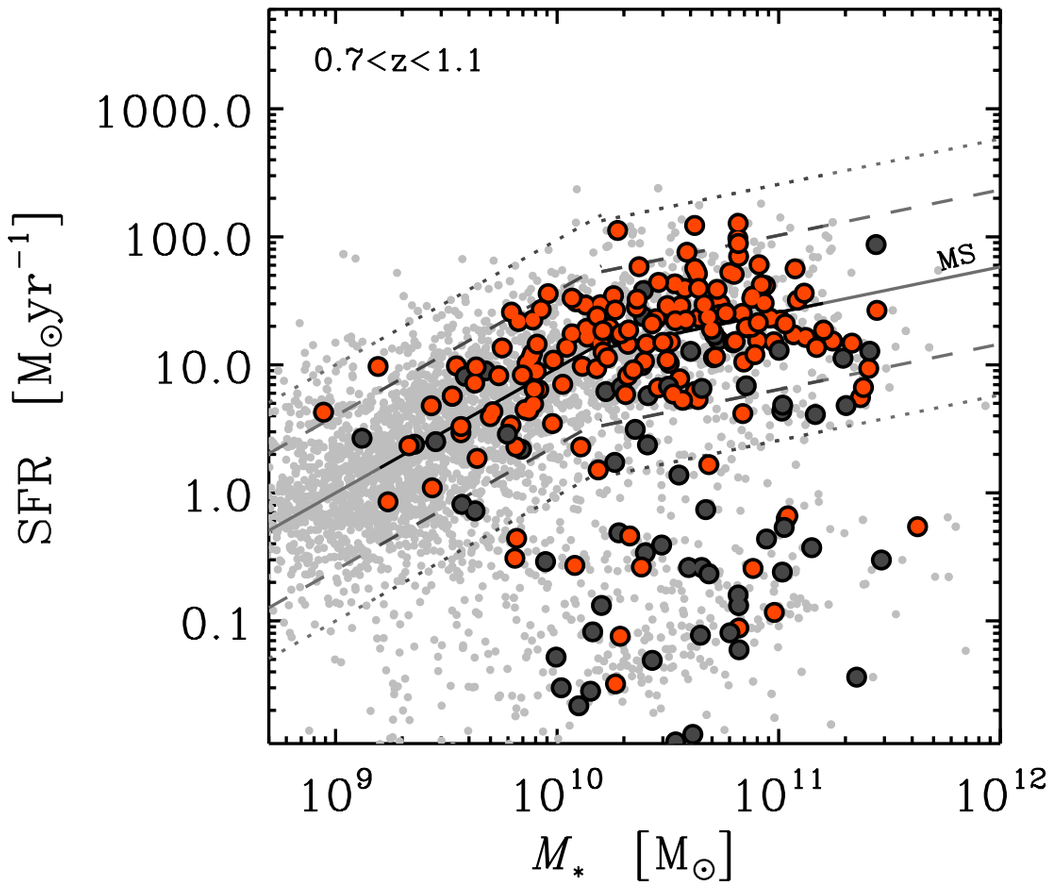
- By z~0 they have mostly stopped growing in size
- At z~0 outer disks can be preferentially quenched, probably due to satellite-specific processes
- But these involve gravitational interactions to generate compact cores and shallow outer disks
- There is a lot more work to be done!

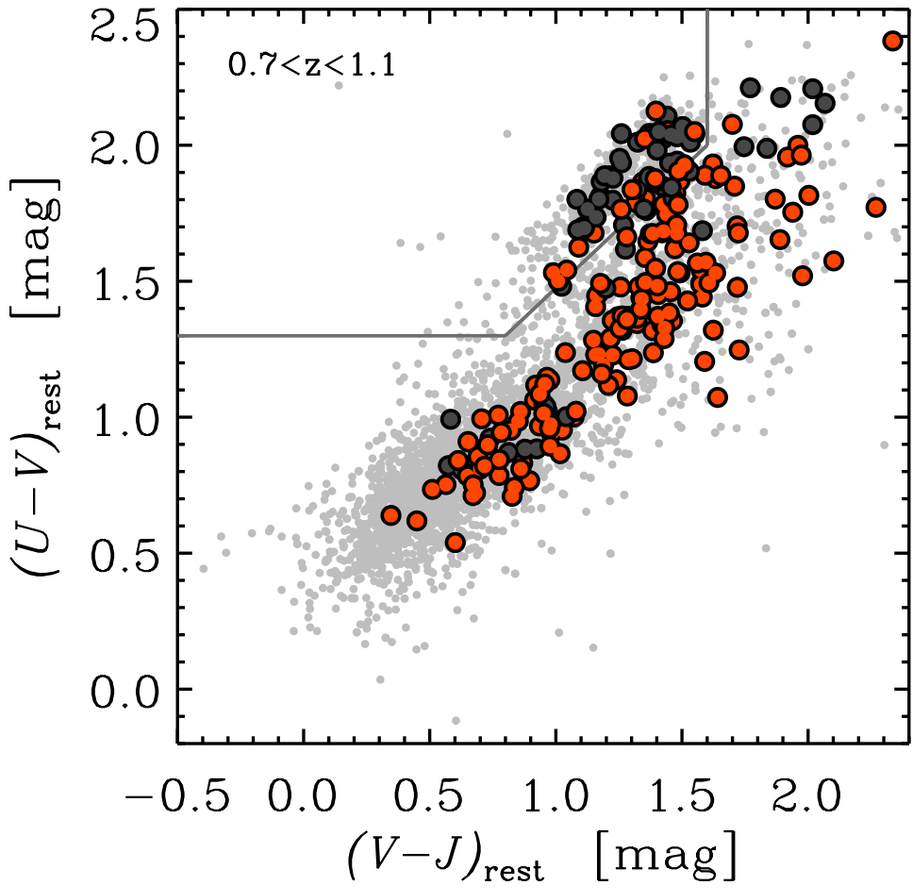
Hα Detections (YJ-Band)

YJ: Median 4.6h on source



Detections:

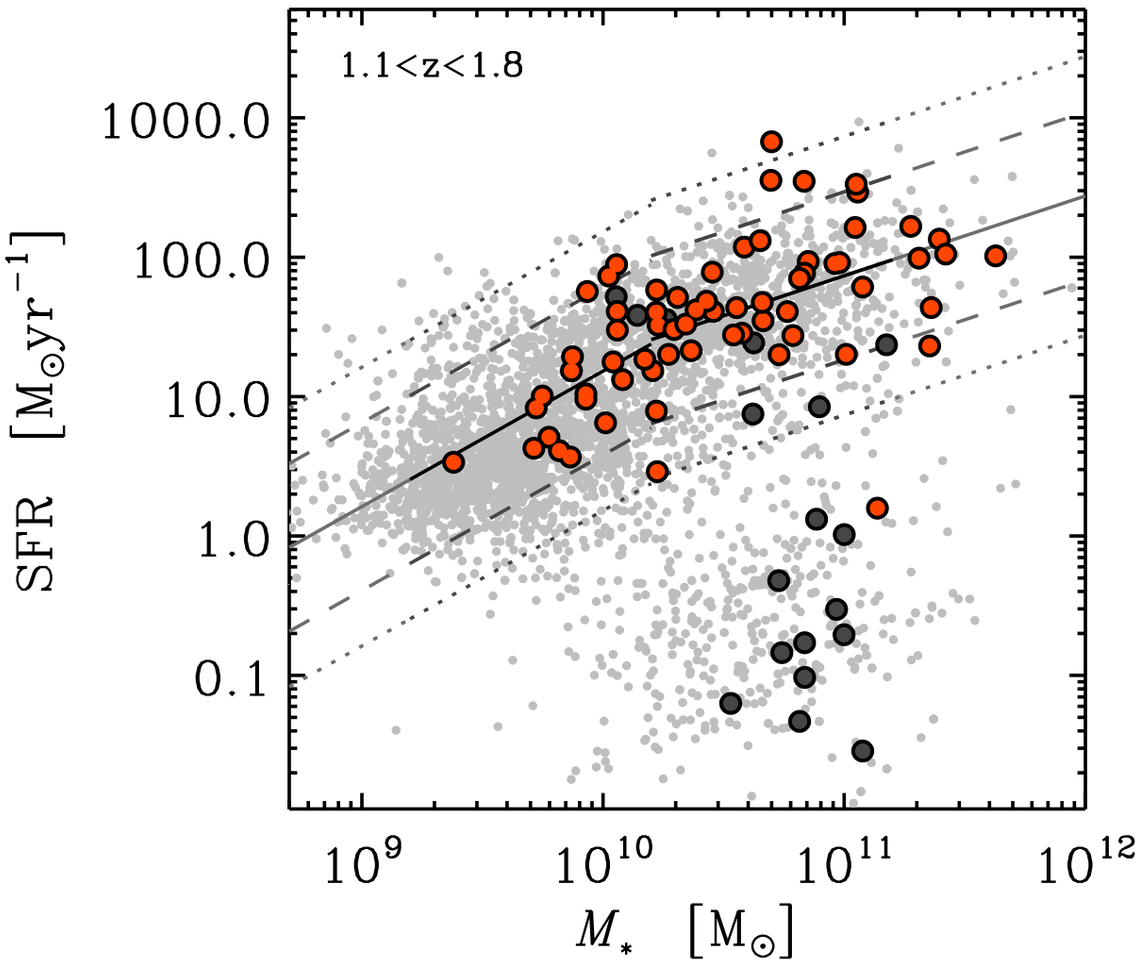
- **72% TOTAL**
- **84% On or Above SF Main Sequence**
- **29% Below SF Main Sequence**



Credit: Emily Wisnioski

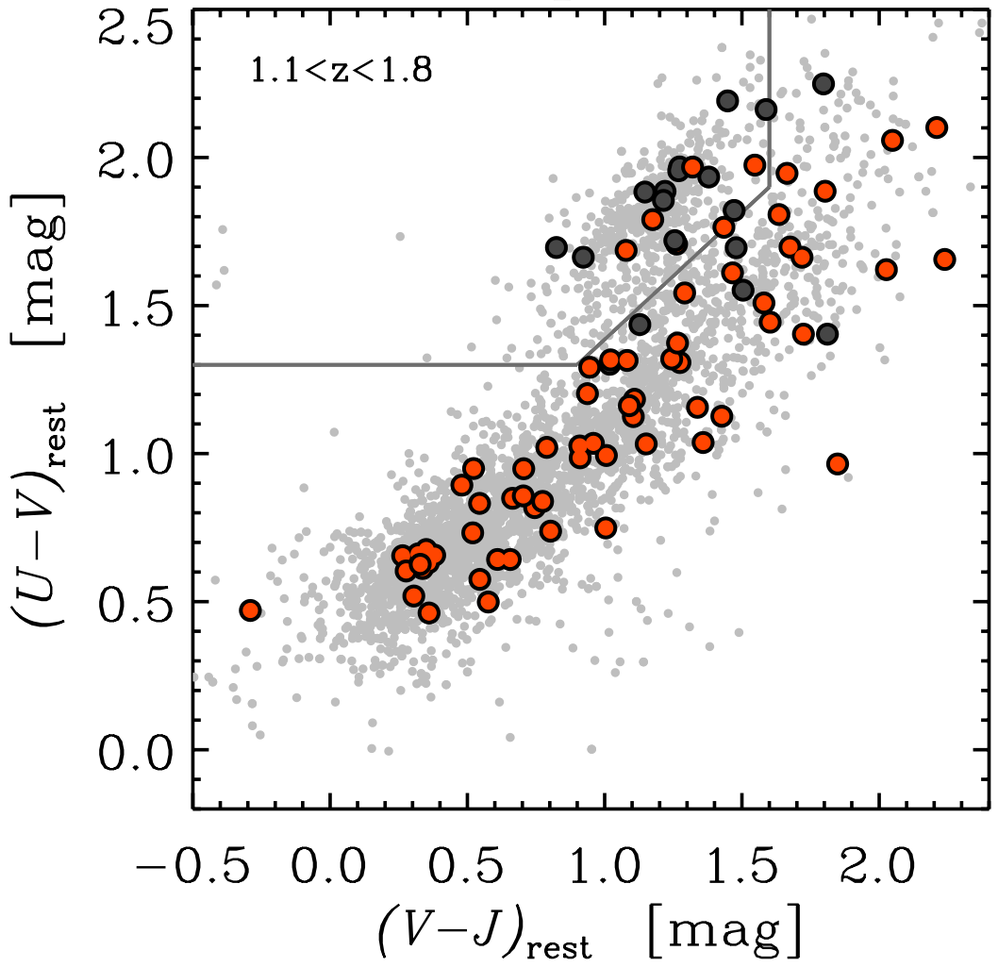
Hα Detections (H-Band)

H: Median 7.25h on source



Detections:

- **80% TOTAL**
- **93% On or Above SF Main Sequence**
- **8% Below SF Main Sequence**



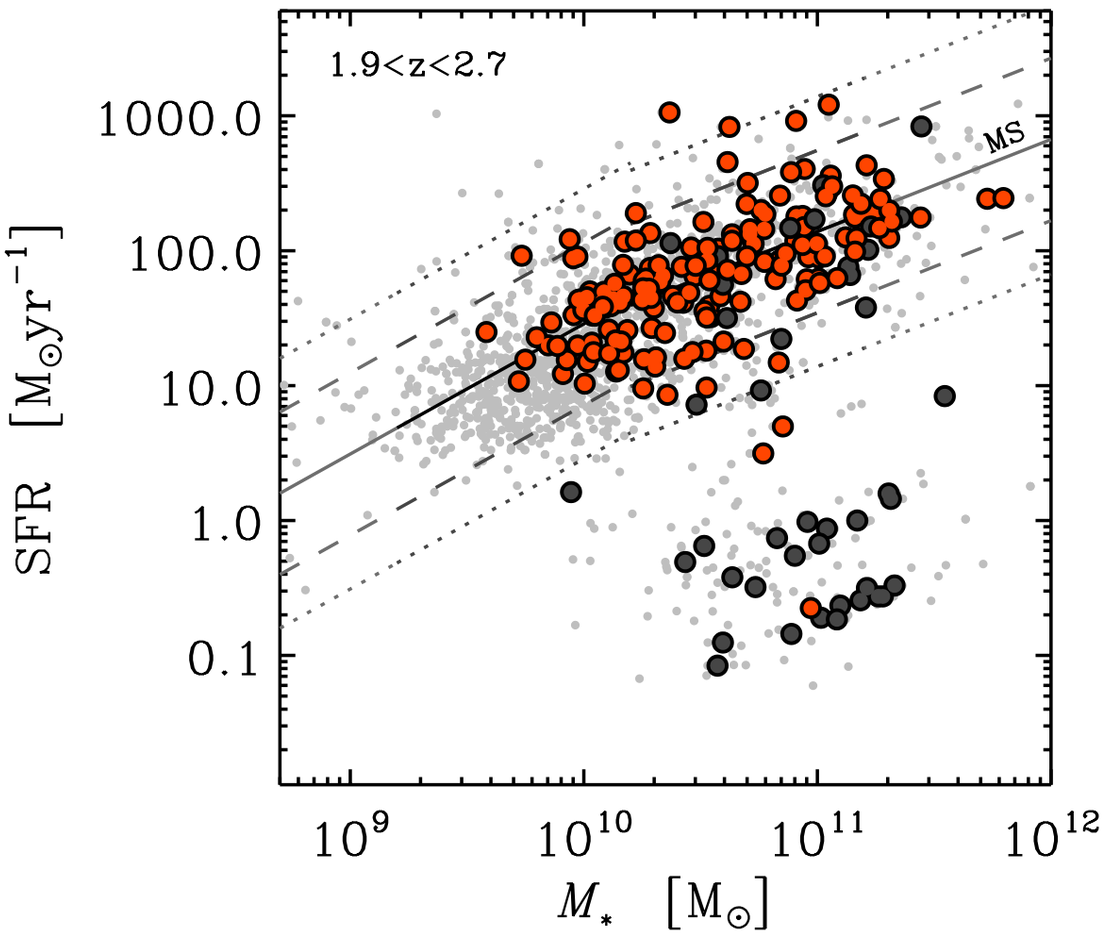
Credit: Emily Wisnioski

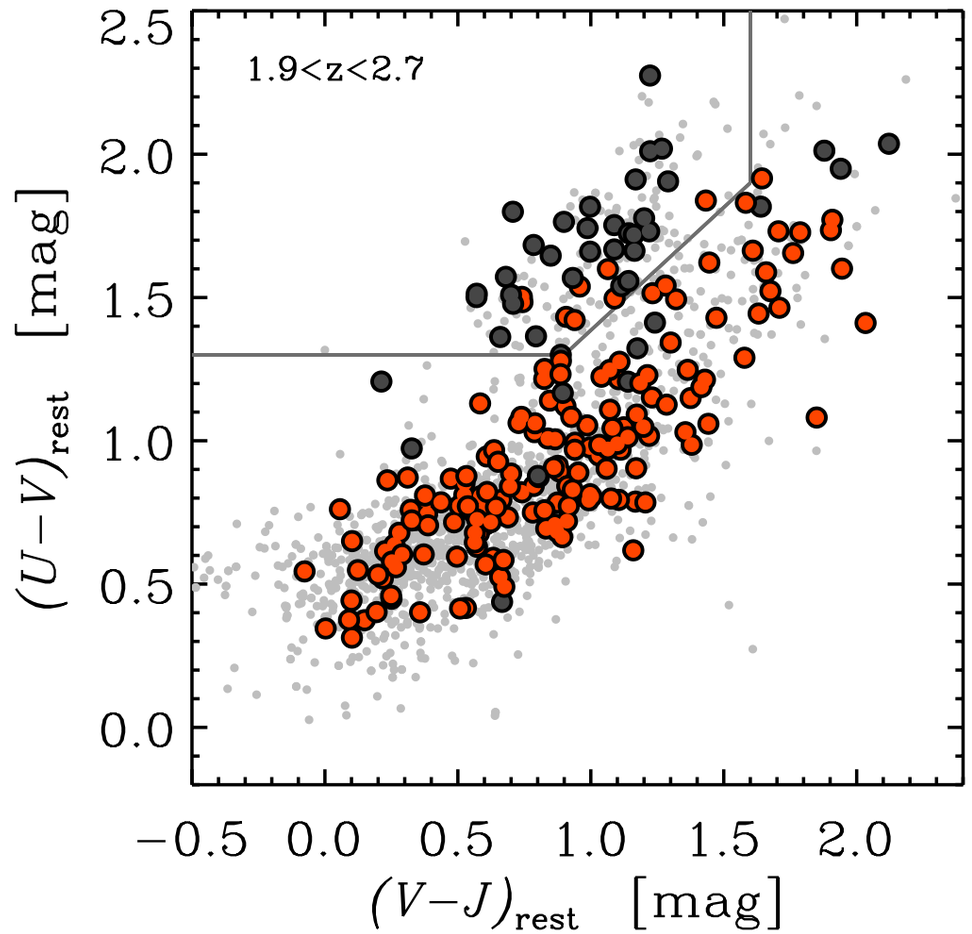
Hα Detections (K-Band)

K: Median 8.25h on source

Detections:

- **79% TOTAL**
- **91% On or Above SF Main Sequence**
- **10% Below SF Main Sequence**



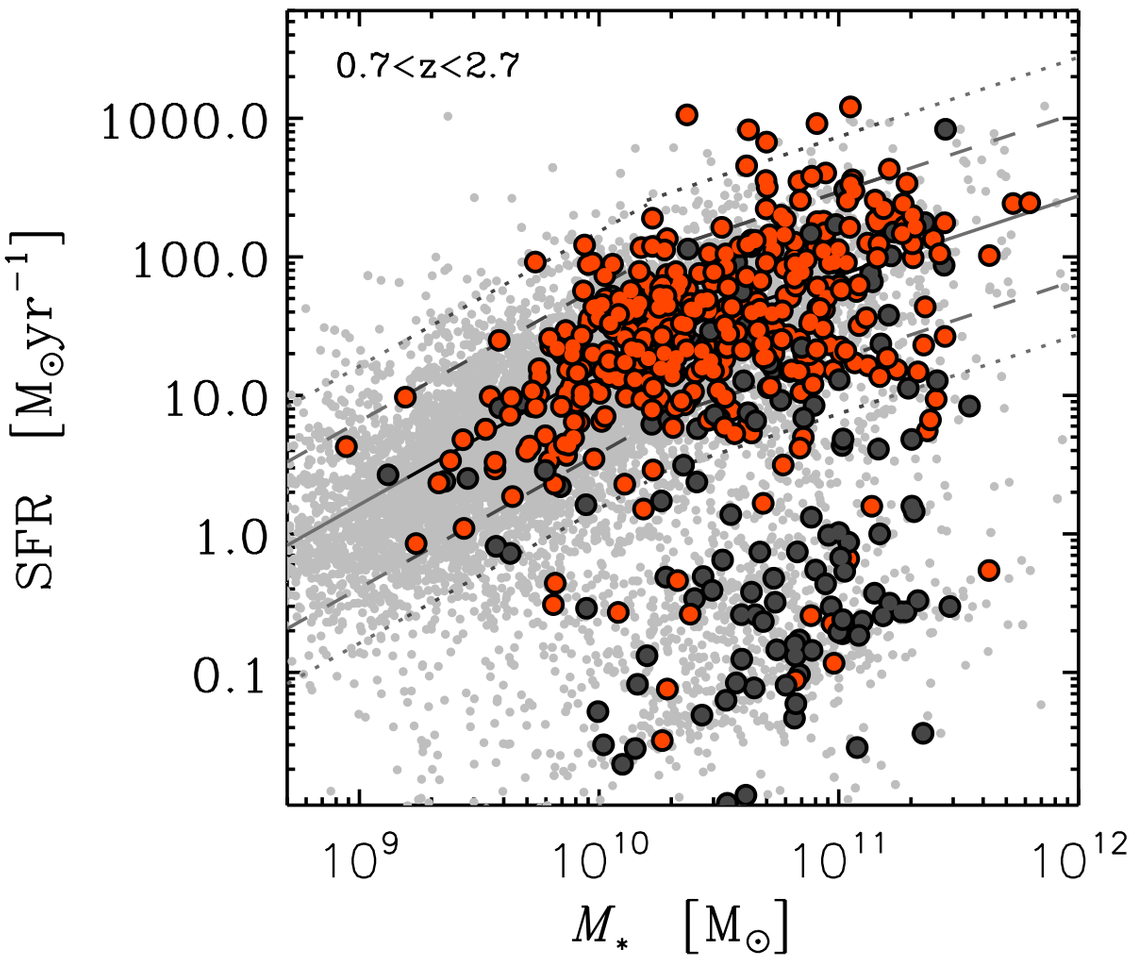


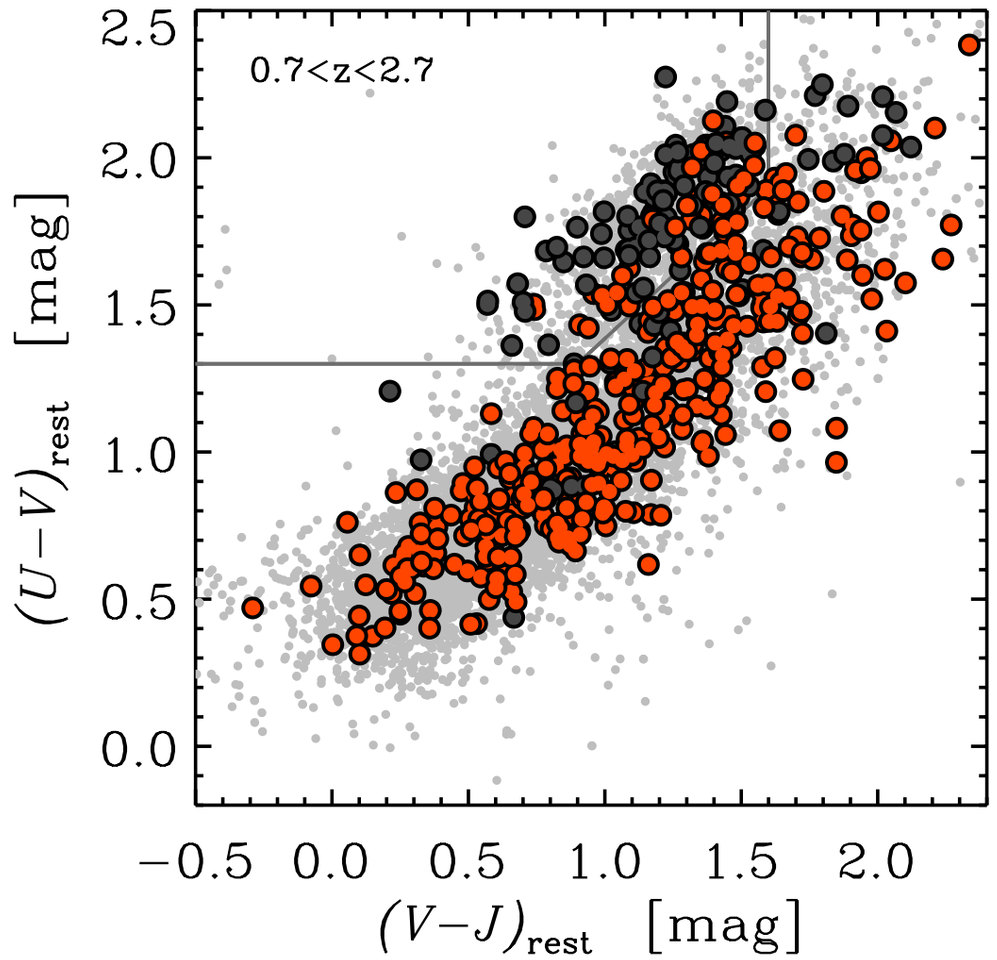
Credit: Emily Wisnioski

Hα Detections (Combined)

Detections:

- **76% TOTAL**
- **88% On or Above SF Main Sequence**
- **19% Below SF Main Sequence**

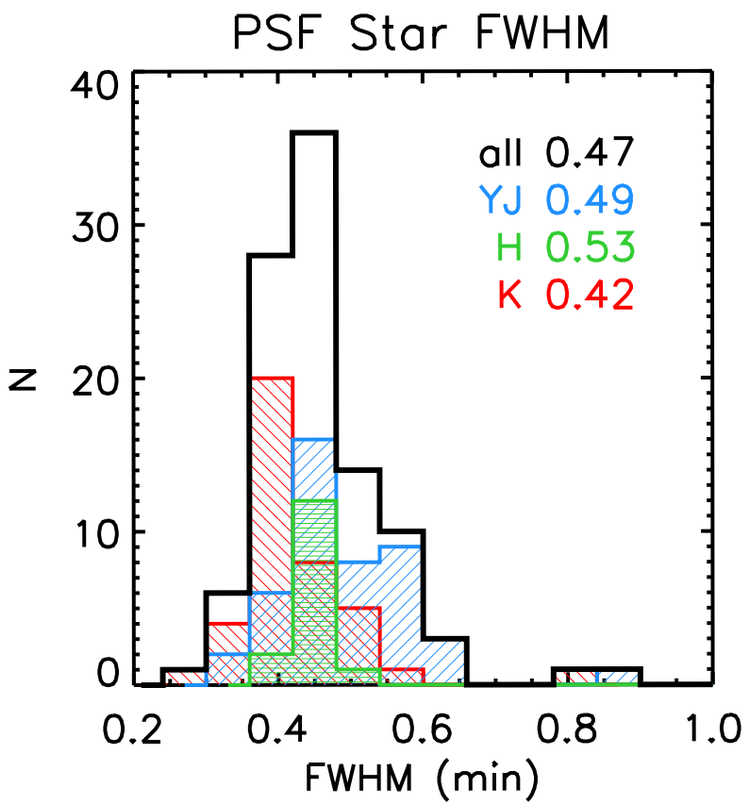


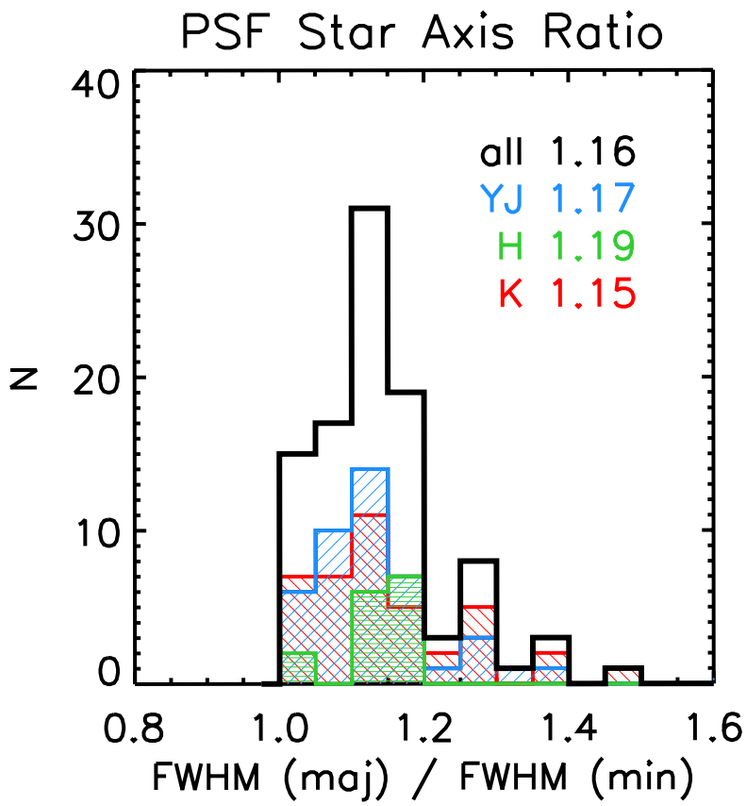


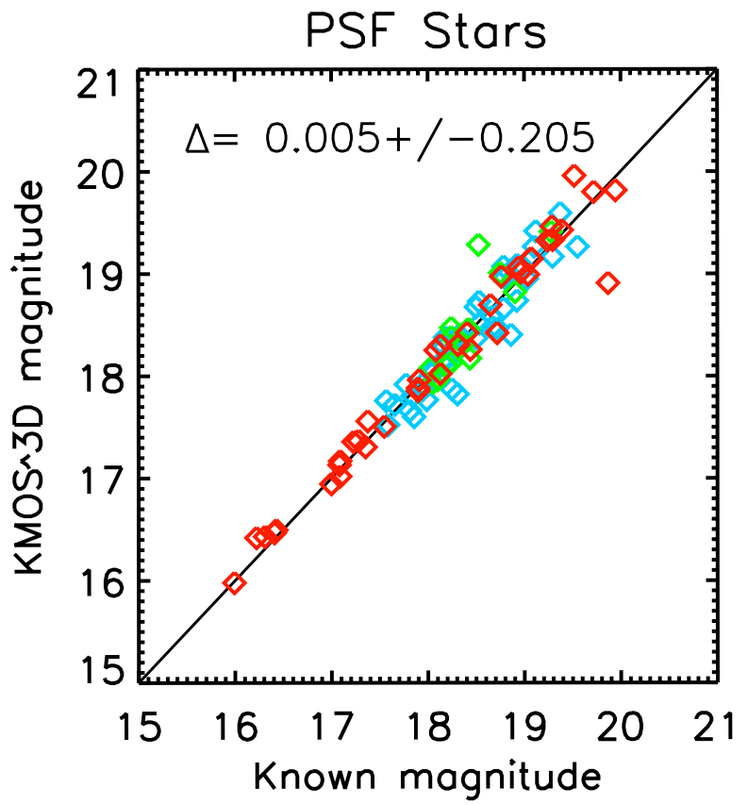
Credit: Emily Wisnioski

“Image” Quality and Flux Calibration

86% of detected galaxies are spatially resolved

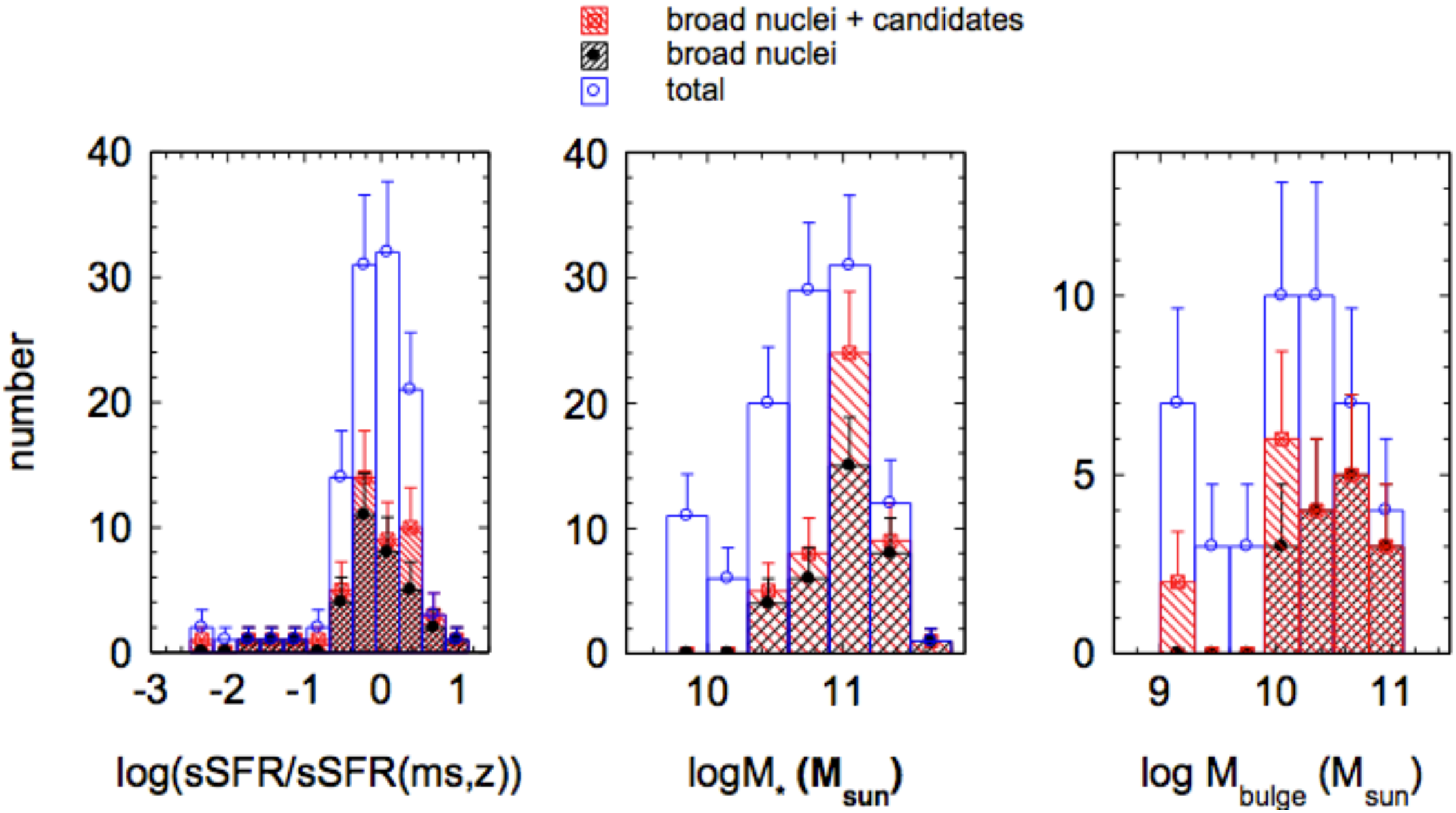






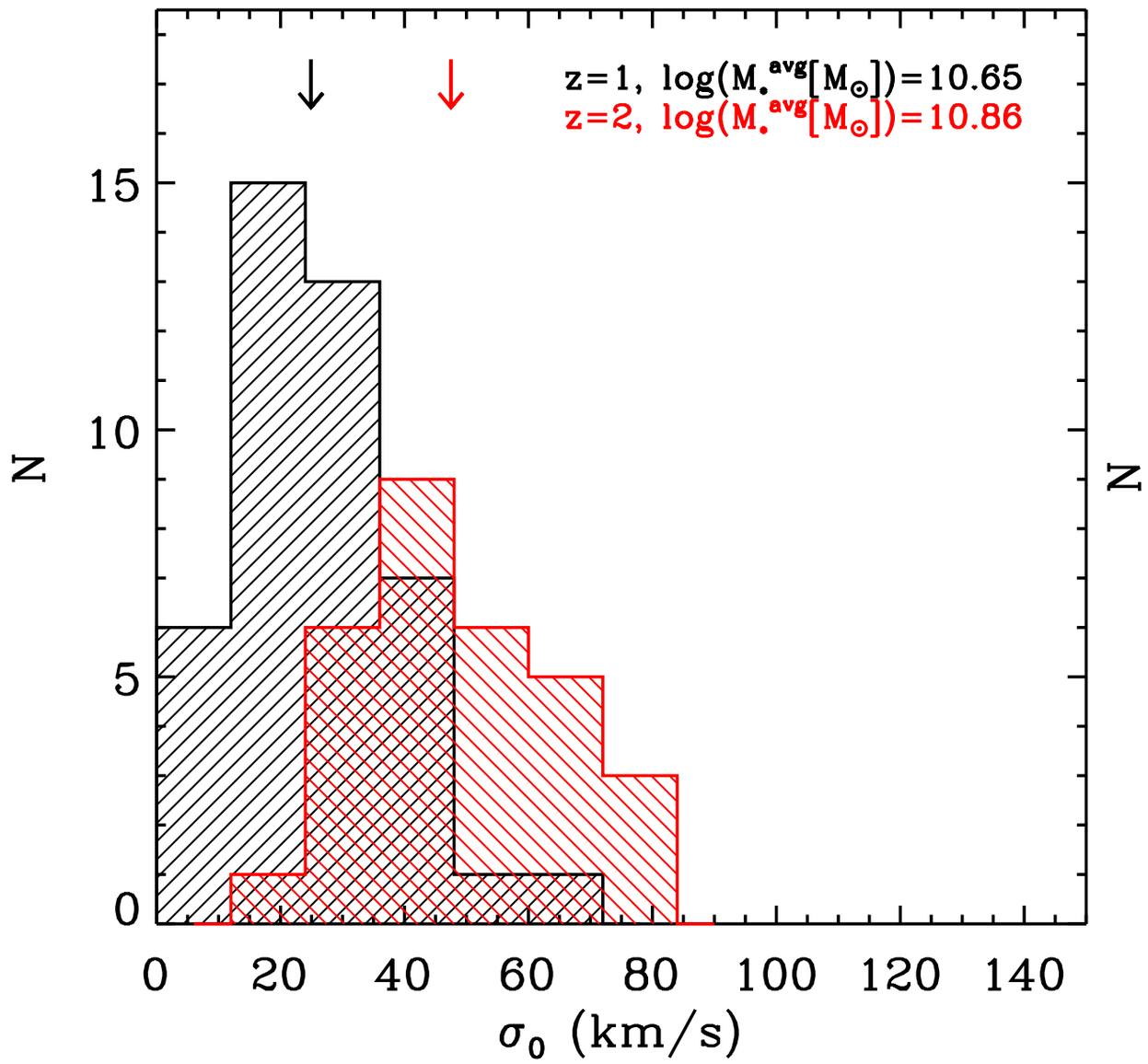
Credit: Emily Wisnioski

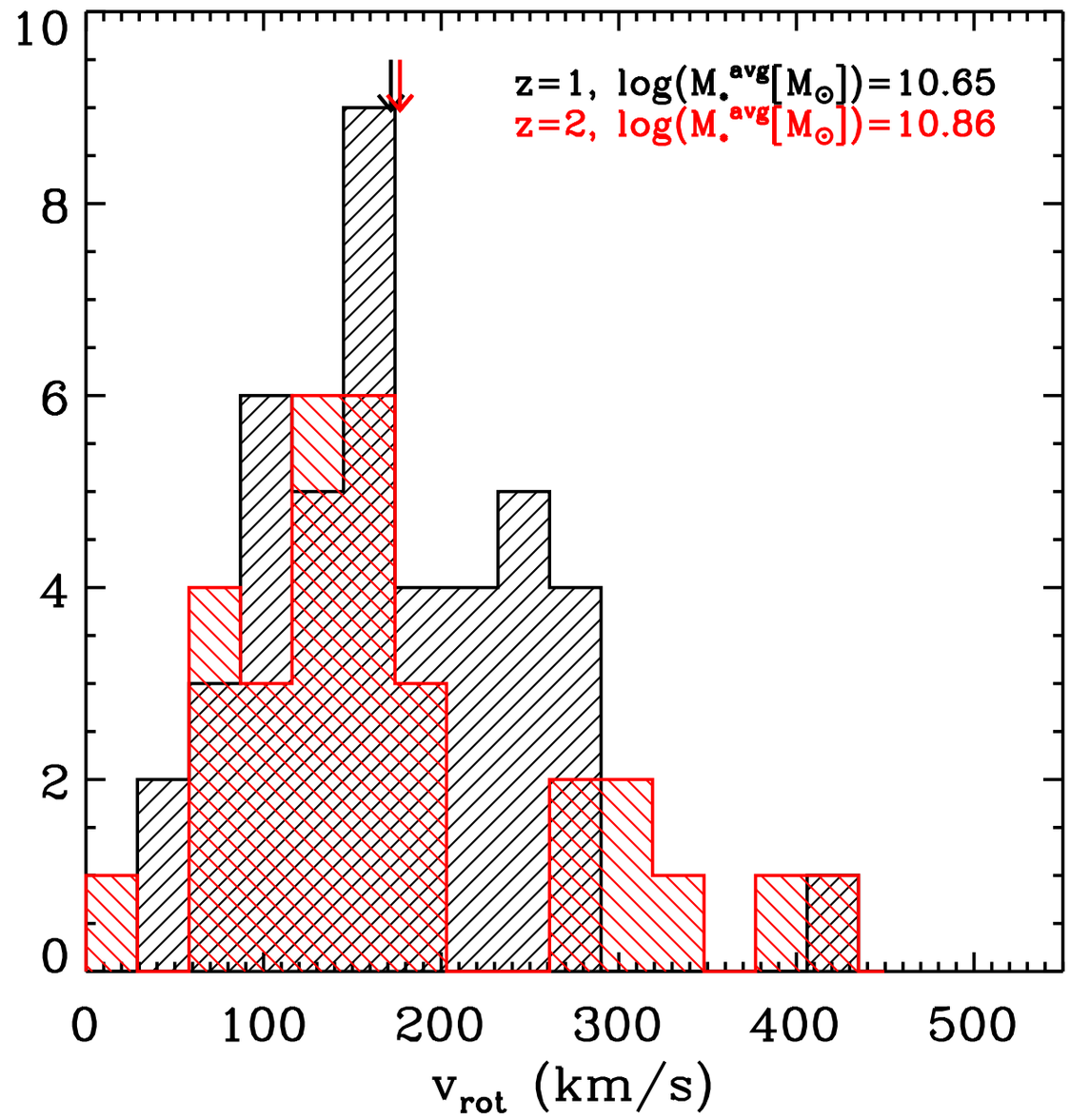
KMOS^{3D} - Nuclear Broad Line Incidence



Genzel et al., 2014

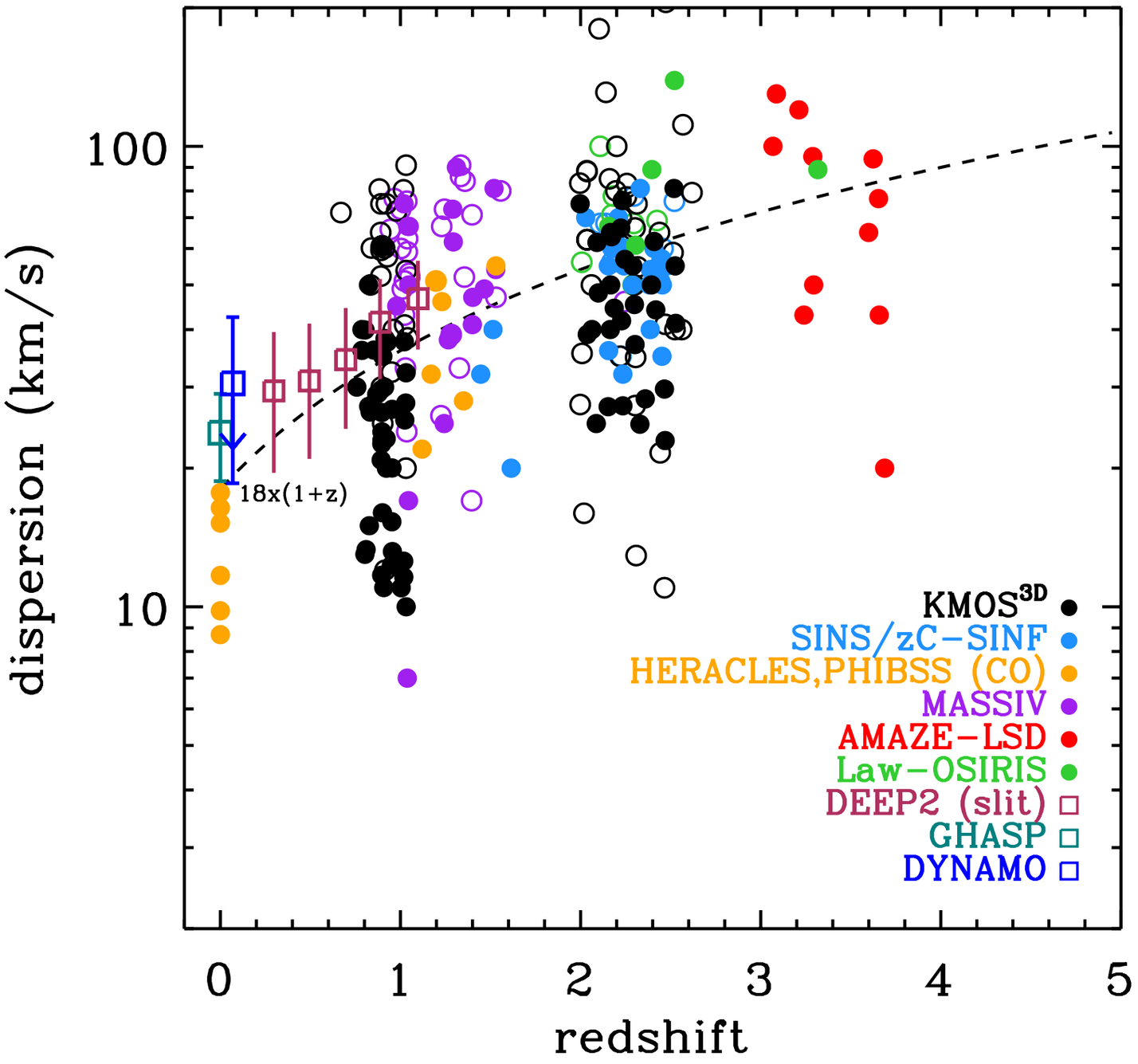
KMOS^{3D} Disk Kinematics - Evolution





Wisnioski et al., 2015

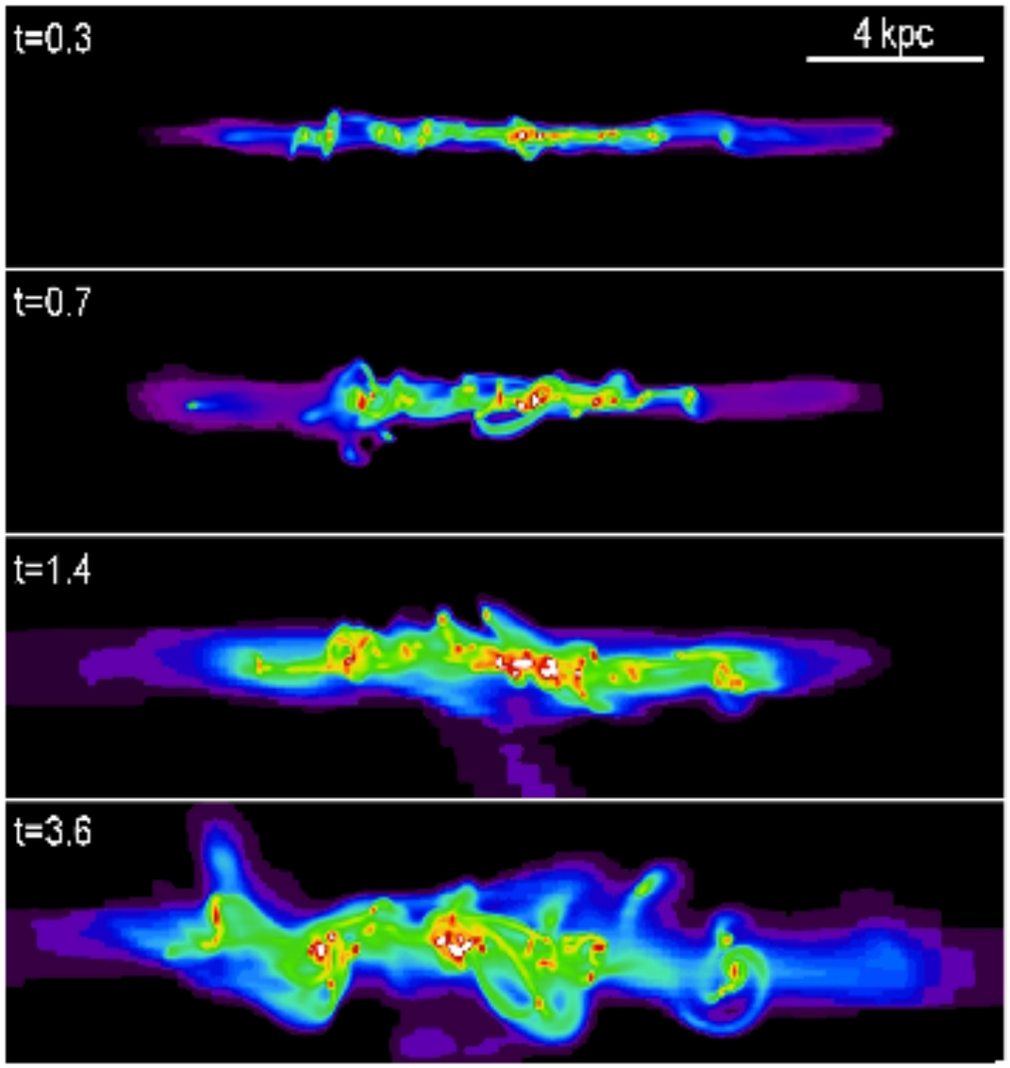
Turbulent Disks



Wisnioski et al., 2015

$$v_{rot}/\sigma_0 = \sqrt{2} \,/\, f_{gas}.Q_{crit}$$

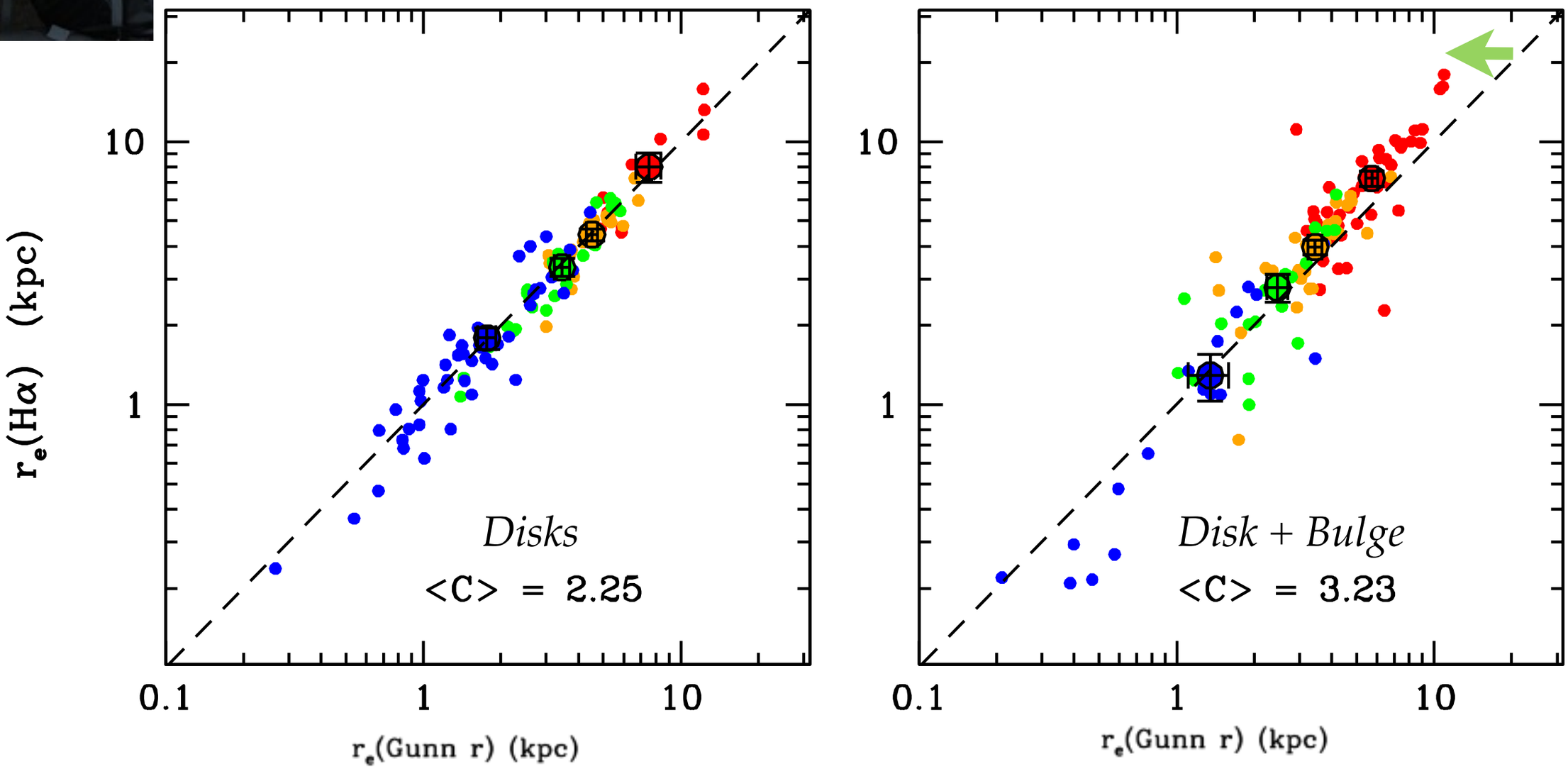
(Toomre 1964)



Delaye et al, conference proceedings

z~0: Star Formation tracks the stellar disk

Fossati et al., 2013

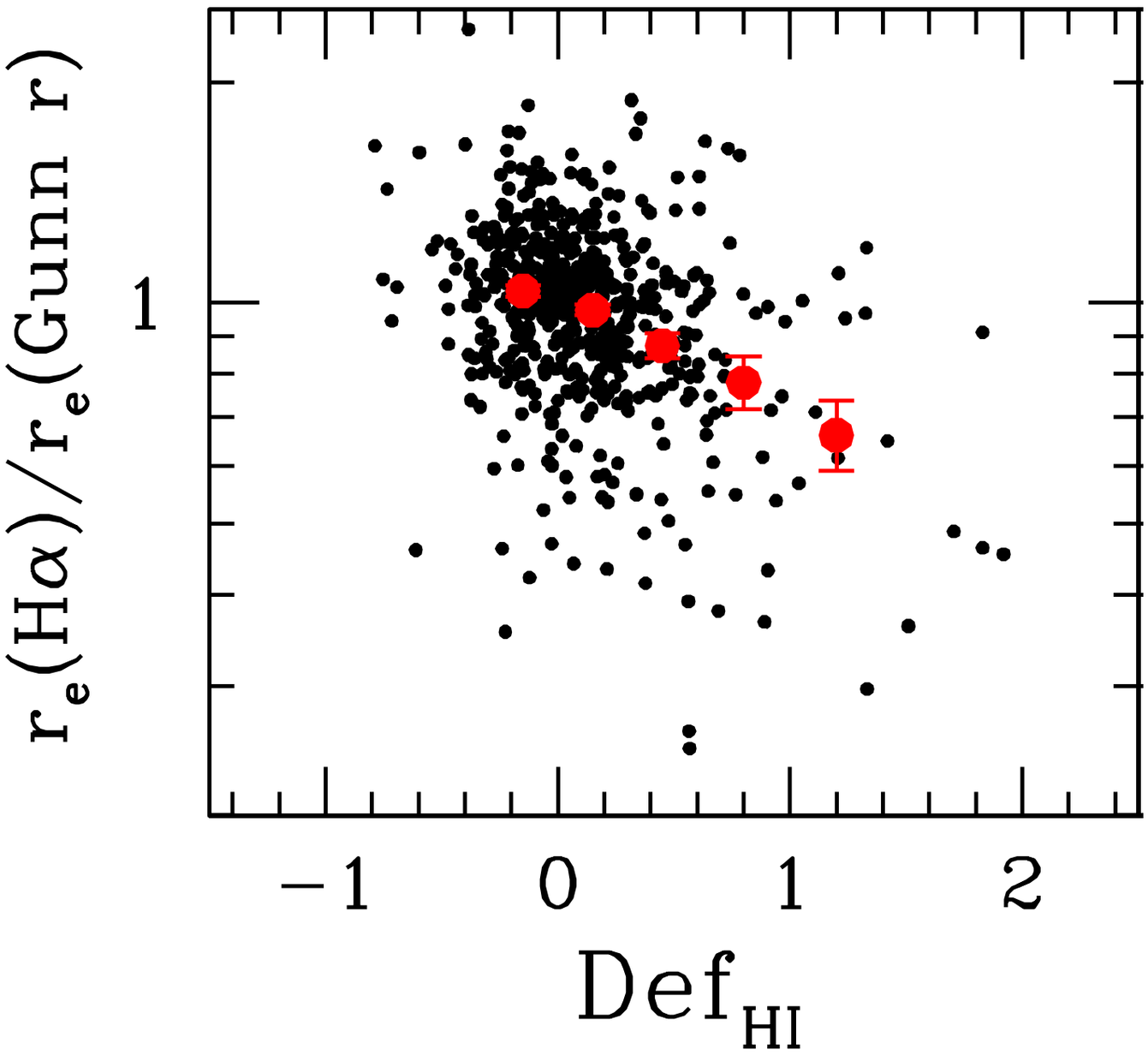


***ALFALFA, Ha3* sample: HI-normal galaxies only**

At z~0 stars dominate local potential

This seems to lead to smaller sizes for the star forming disk...

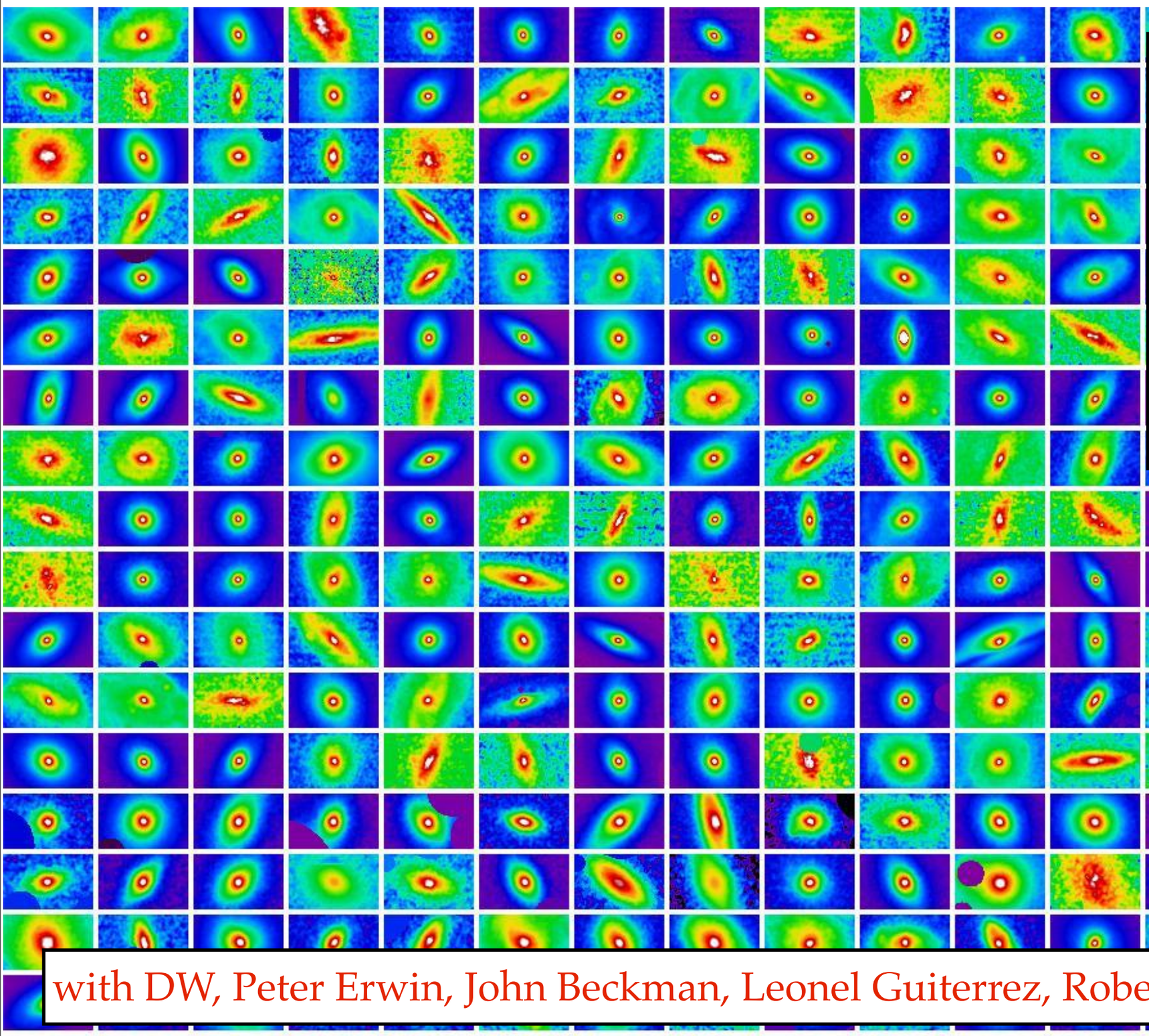
Fossati et al., 2013:
Narrow band image of Local Supercluster

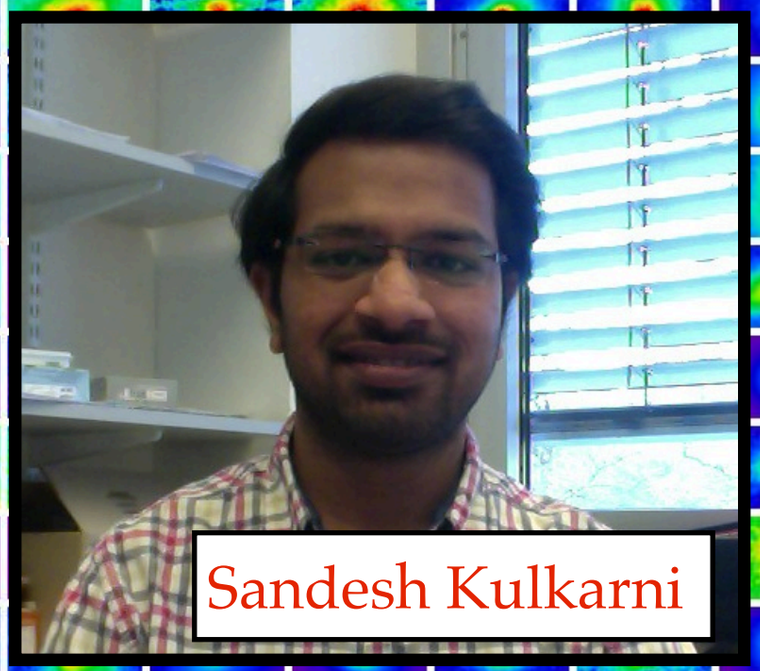


Galaxies deficient in HI are ***SMALLER*** in Hα (and star formation) than in stars.

i.e. Star formation suppressed from the ***outside-in***

H-Alpha Galaxy Groups Imaging Survey

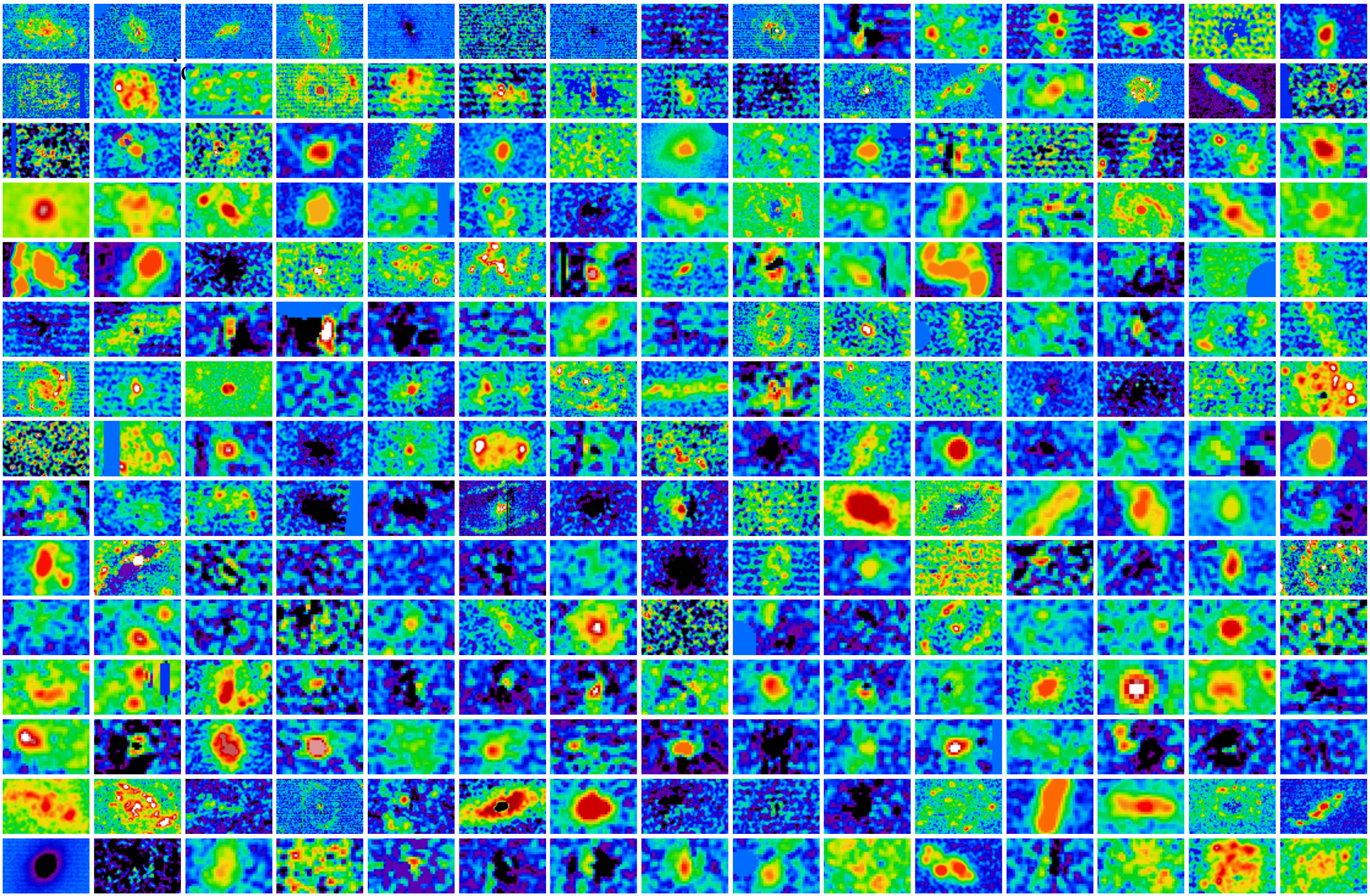




Sandesh Kulkarni

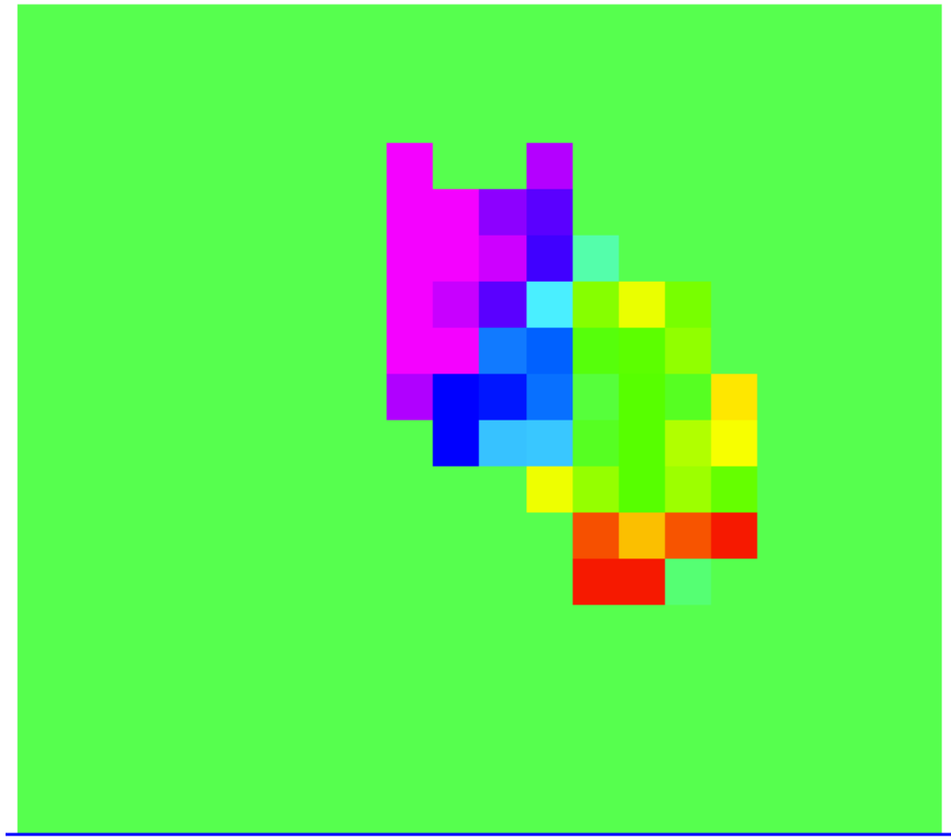
with DW, Peter Erwin, John Beckman, Leonel Guiterrez, Roberto Saglia

H-Alpha Galaxy Groups Imaging Survey

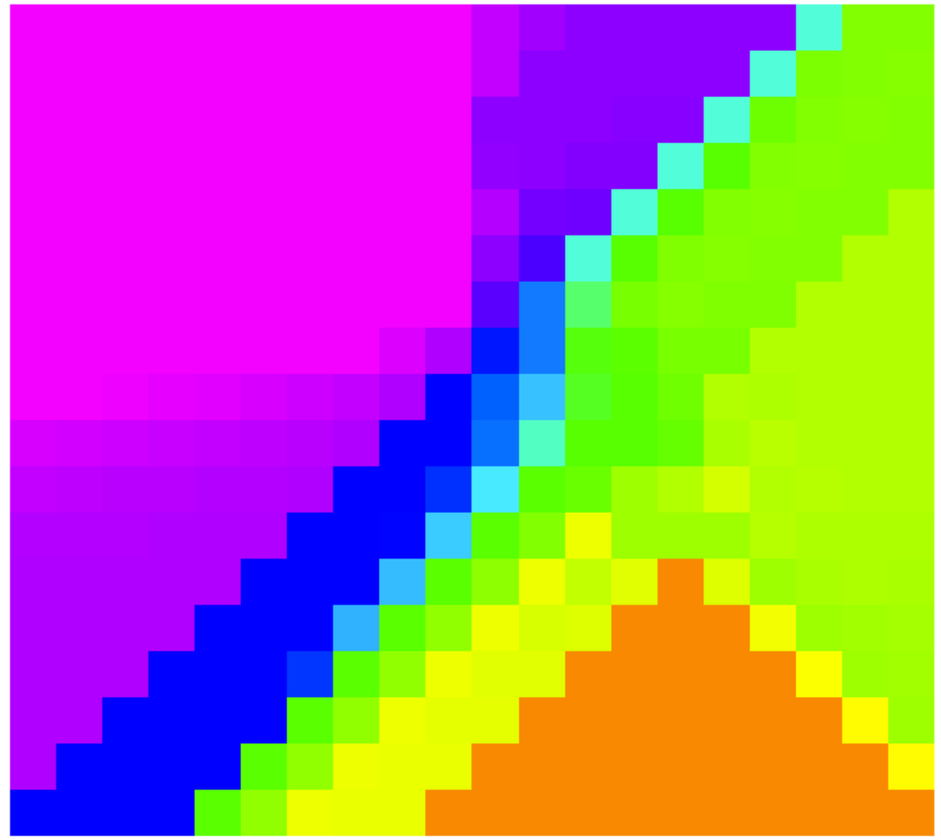


Flux Window

Masked velocity Field



"Grow" to fill FOV

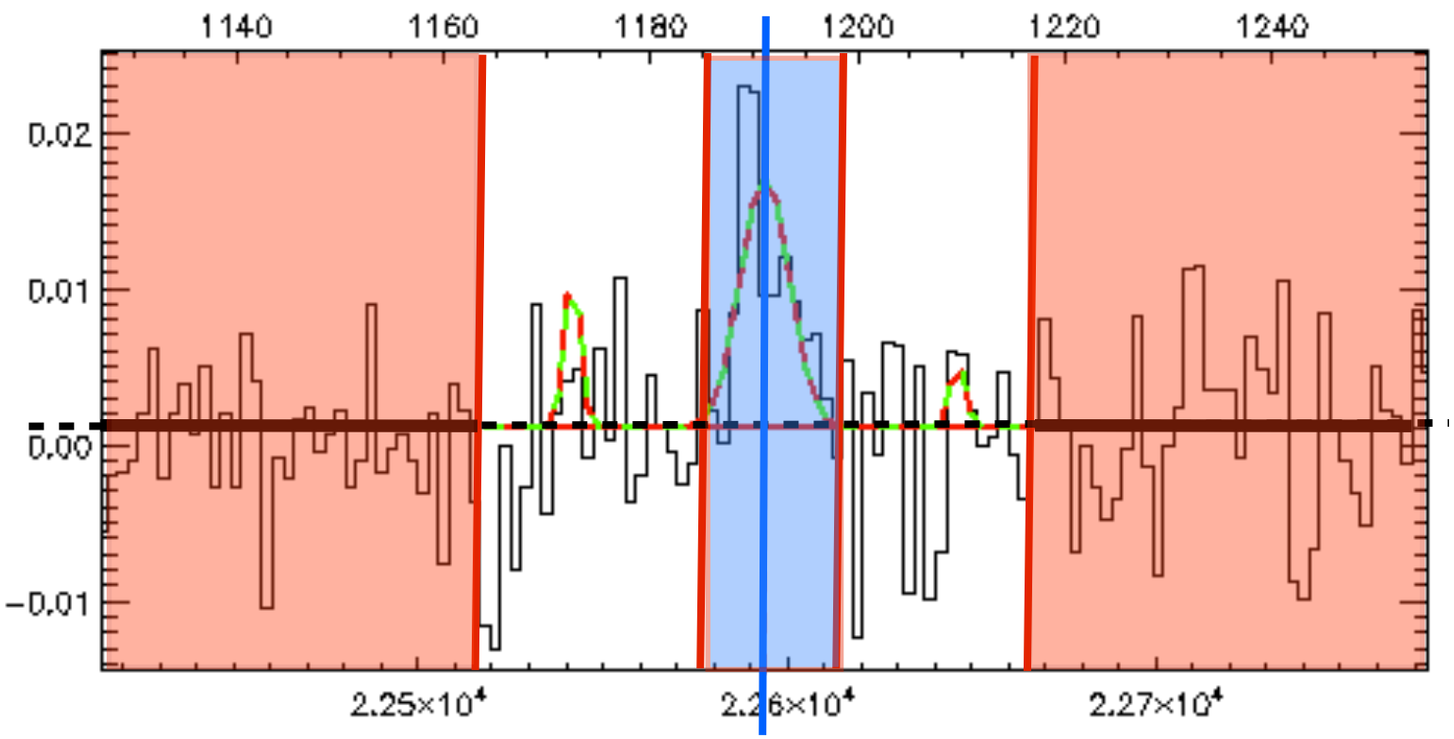


EXAMPLE: GS3_28991

Fit Continuum and Subtract

Integrate flux in ±200km/s window around Hα

Noise estimated from 100 bootstrap cubes individually combined



2D Model Fits

EXAMPLE: GS3_28991

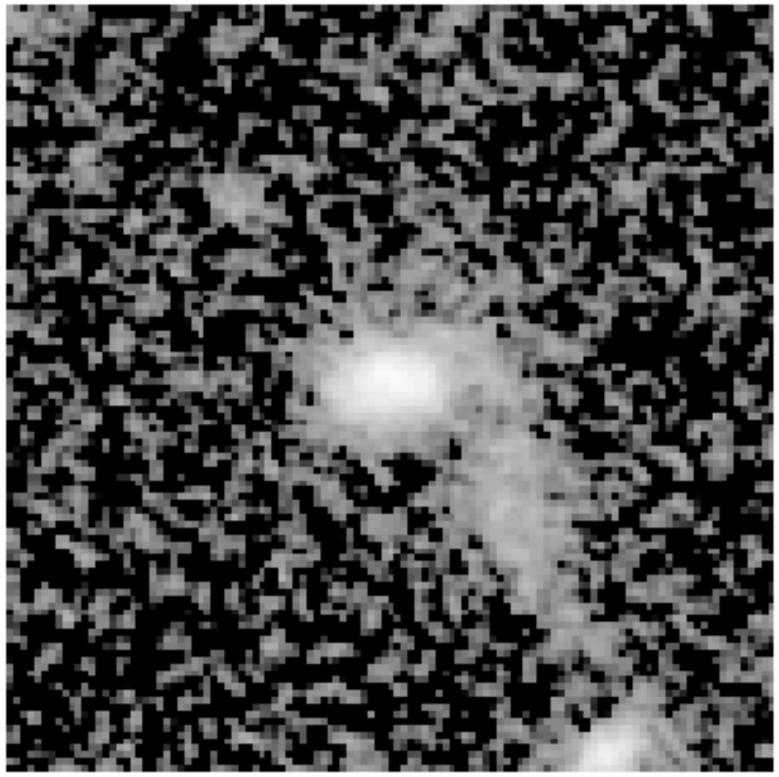
(*imfit, Erwin et al., 2015*)

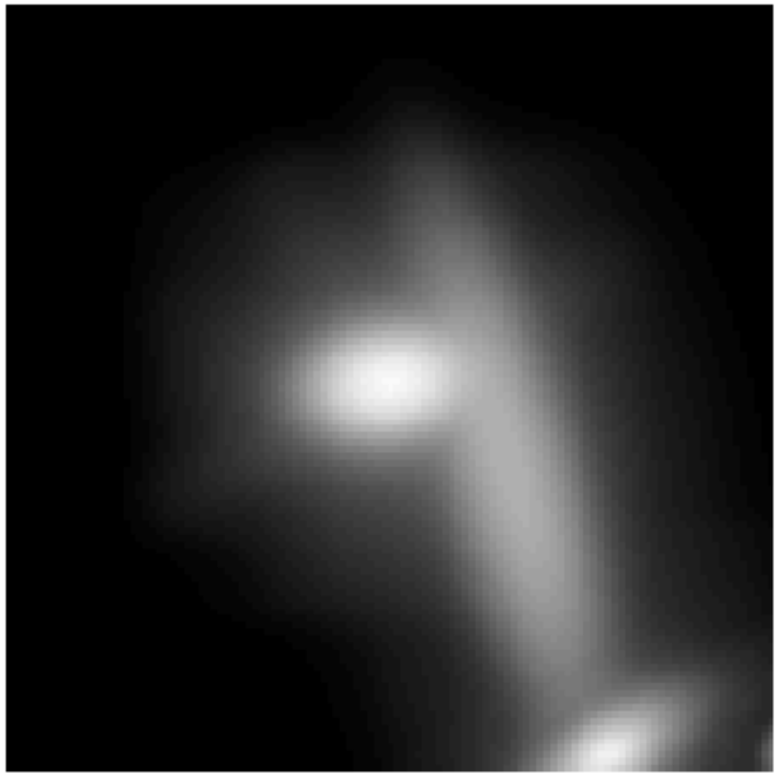
DATA

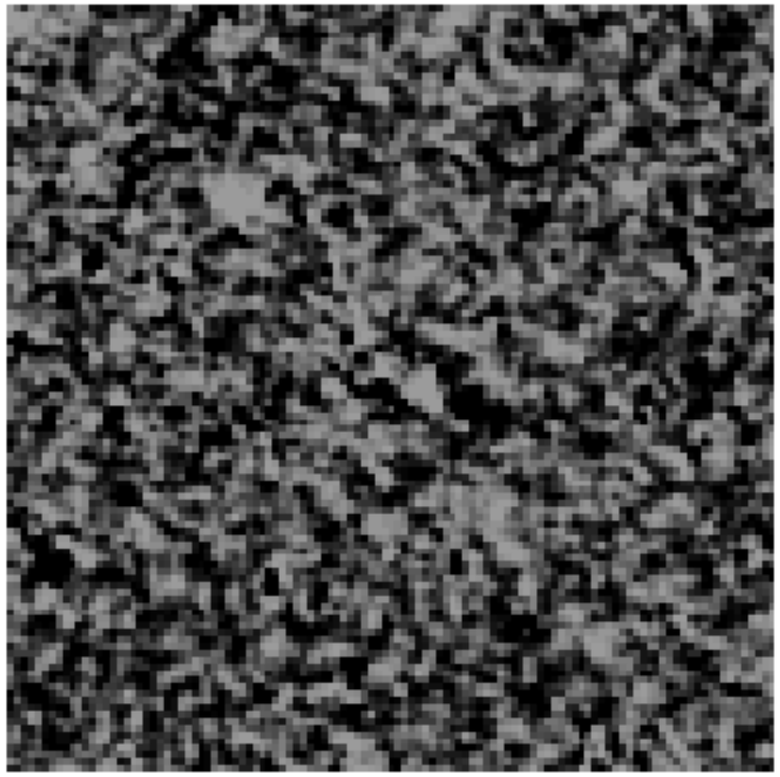
MODEL

RESIDUALS

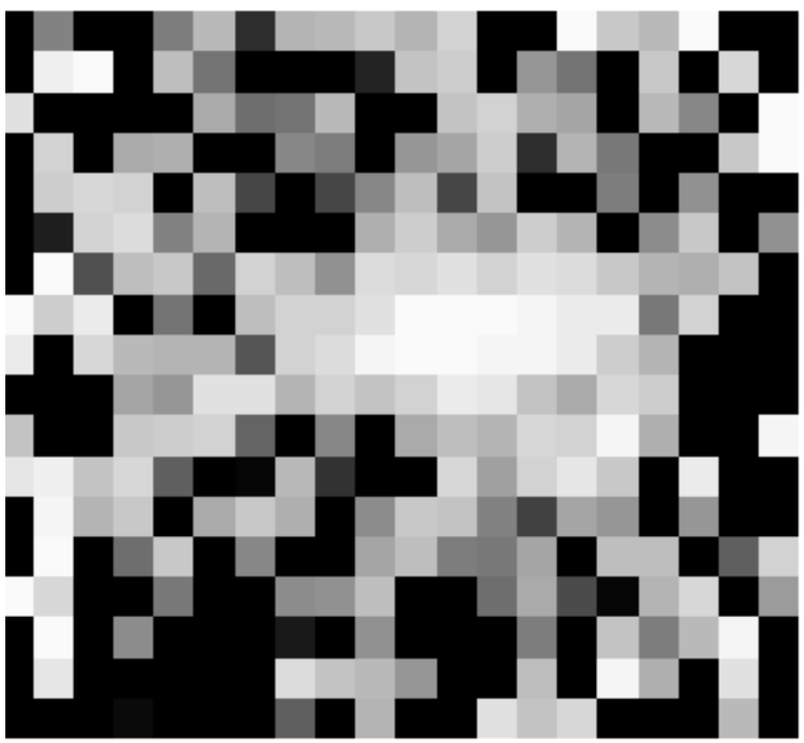
HST F160W (H)

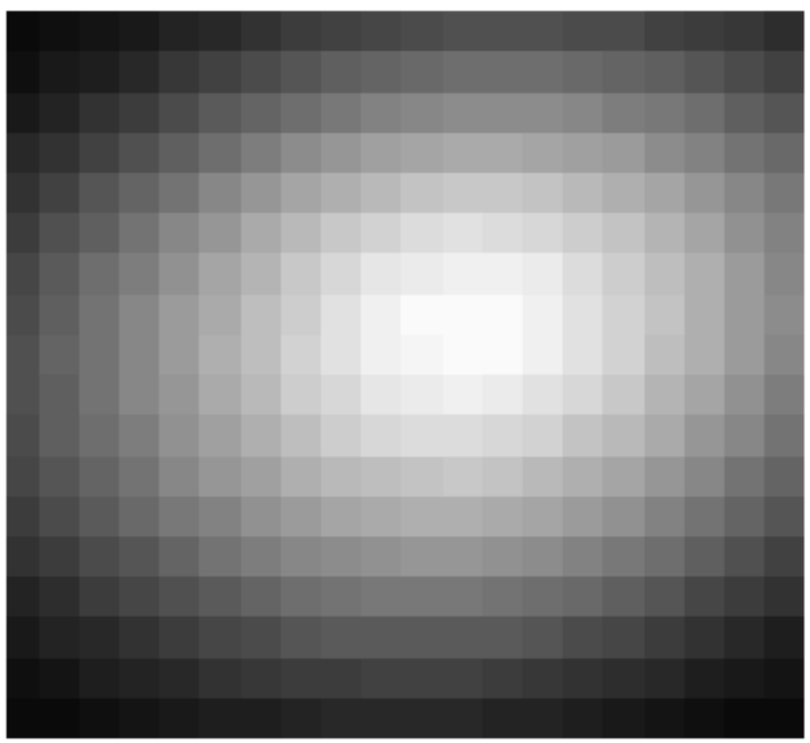


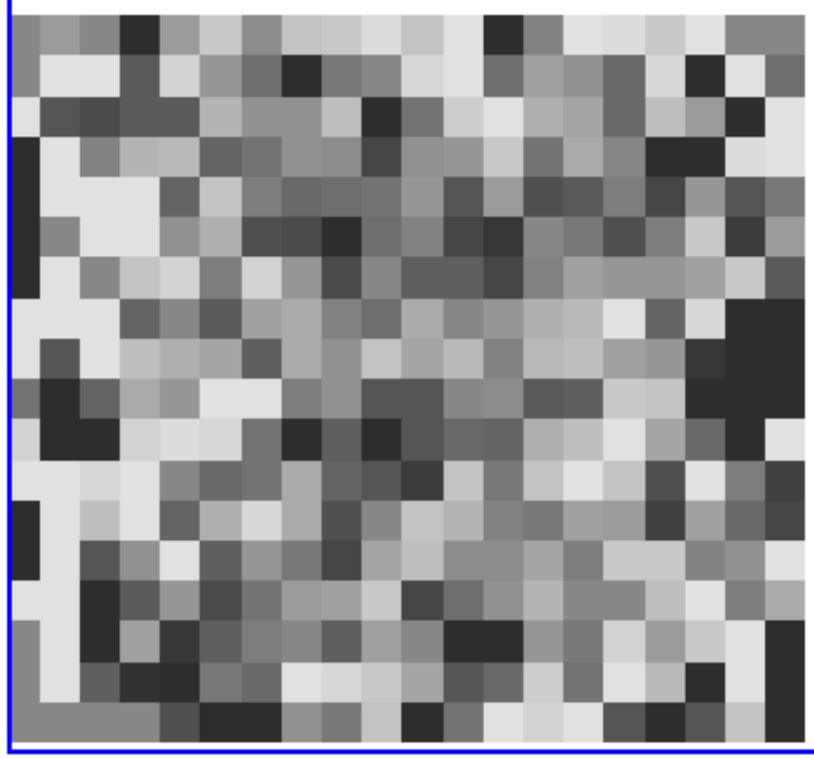




KMOS Hα



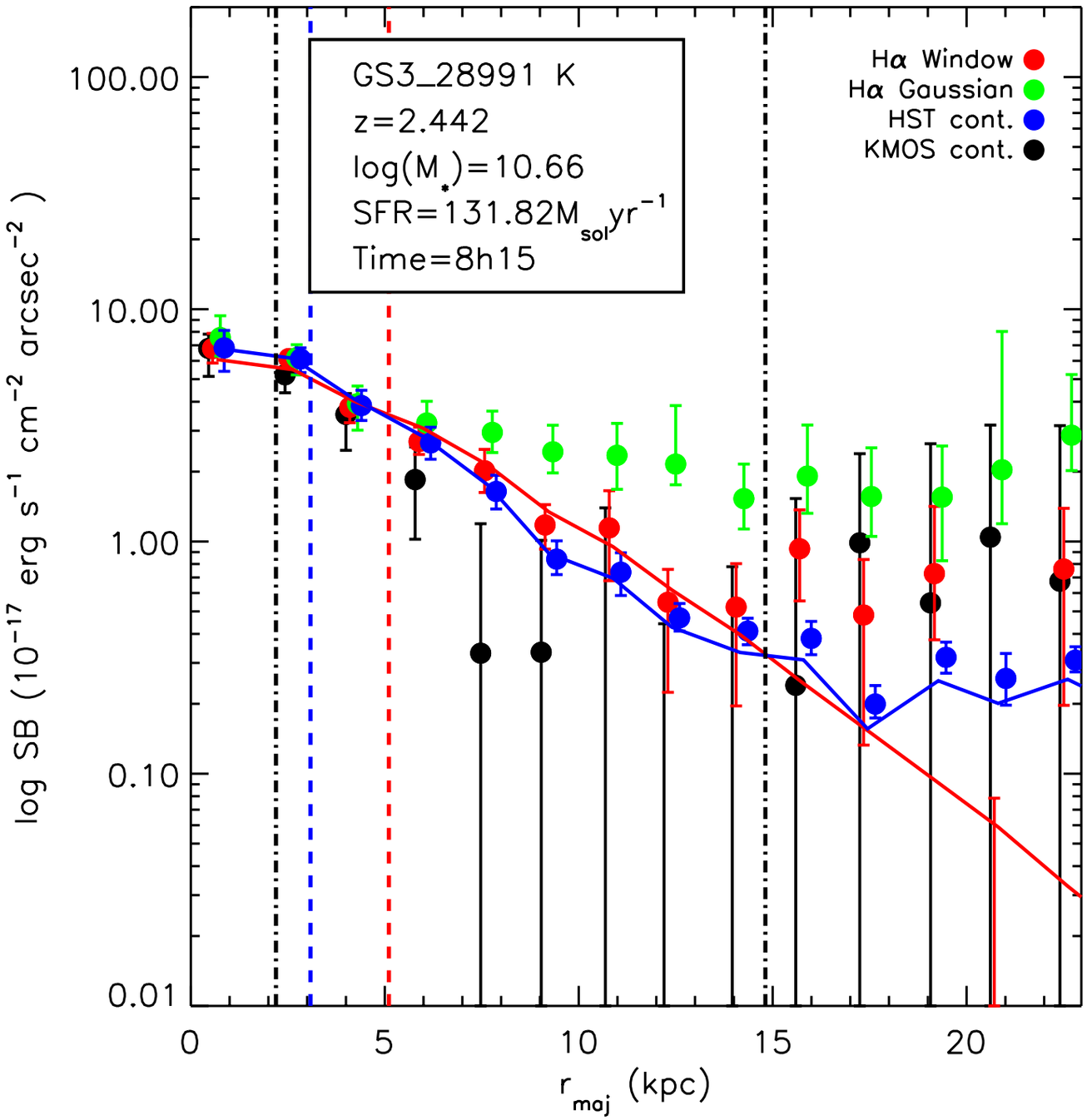




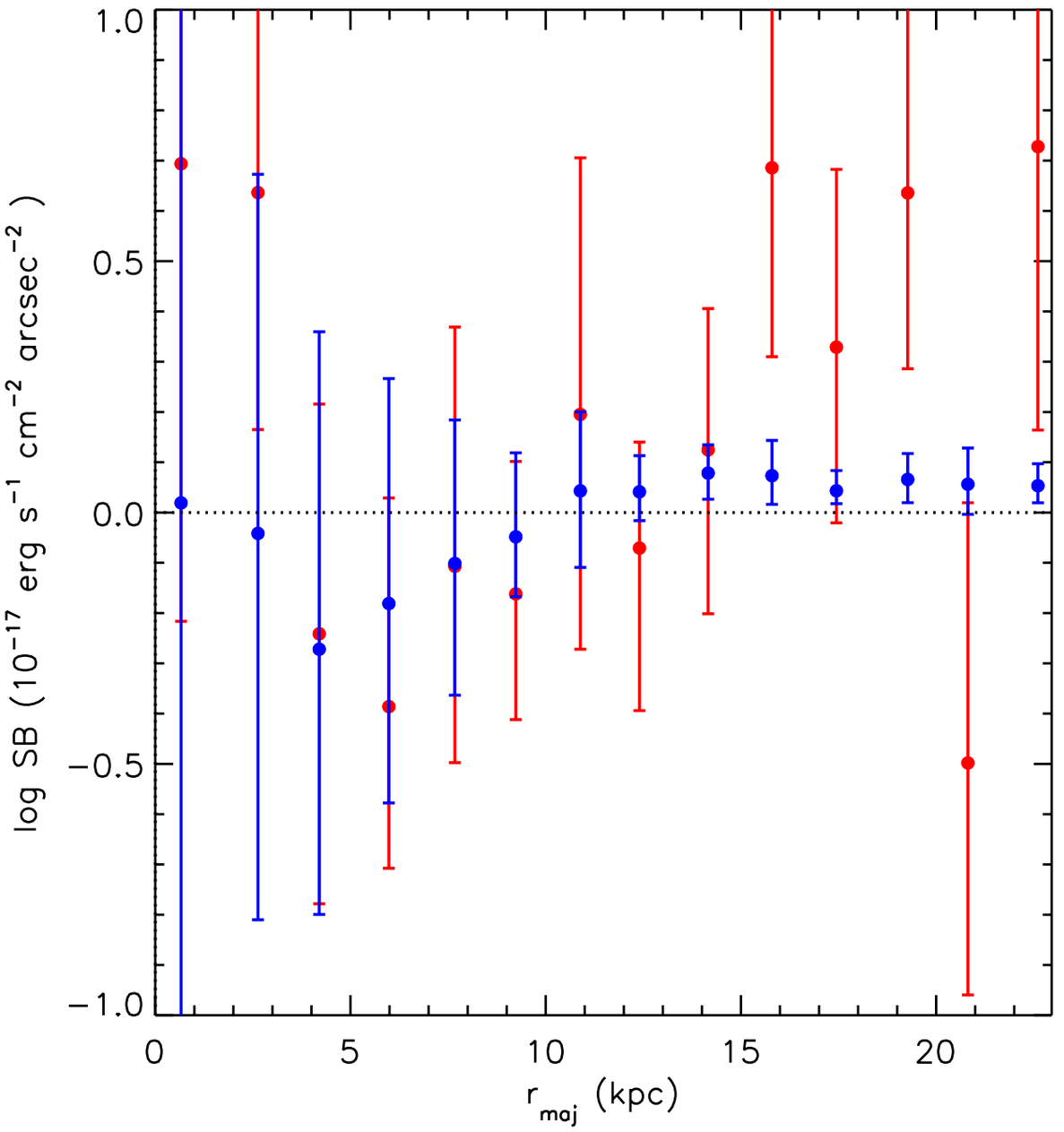
Major Axis Radial Profiles

EXAMPLE: GS3_28991

Profile (data and model):



Profile Residuals



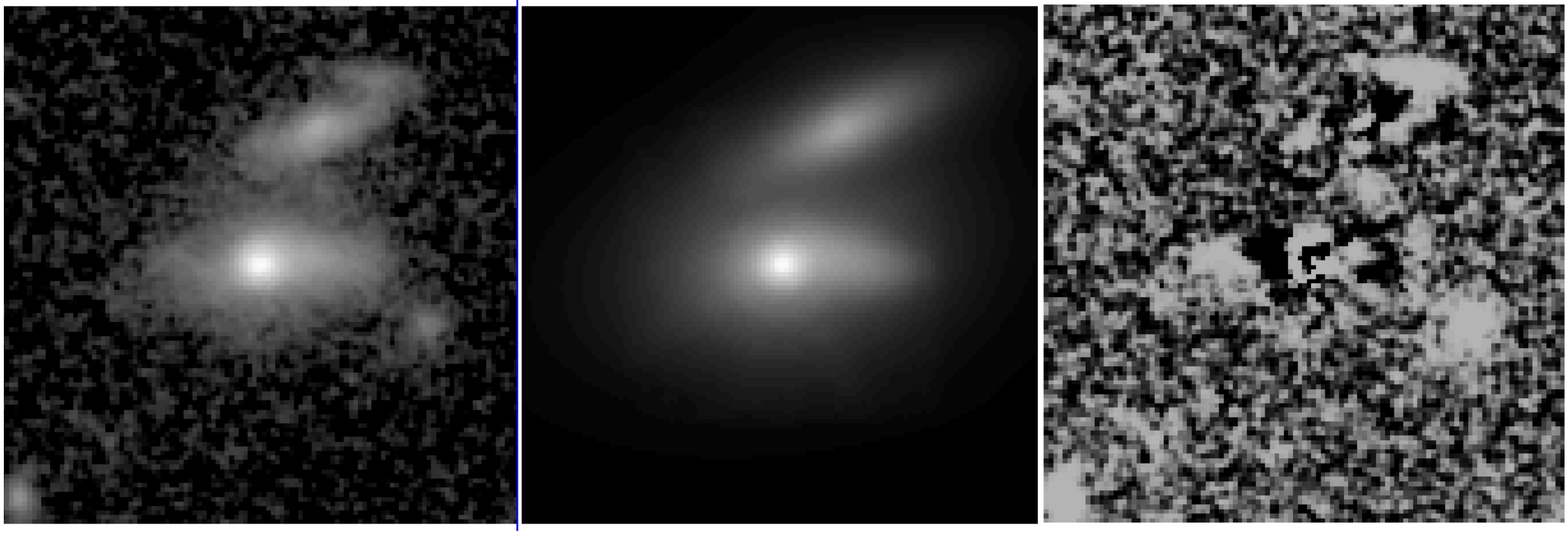
EXAMPLE: GS3_19791

DATA

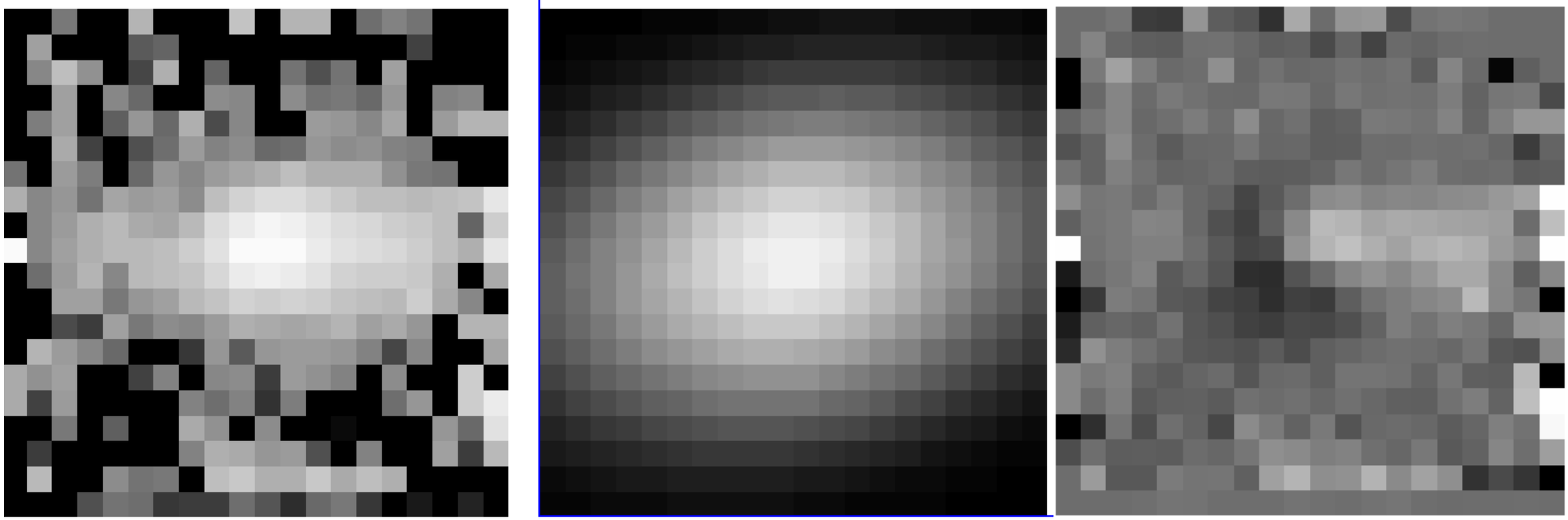
MODEL

RESIDUALS

HST F160W (H)

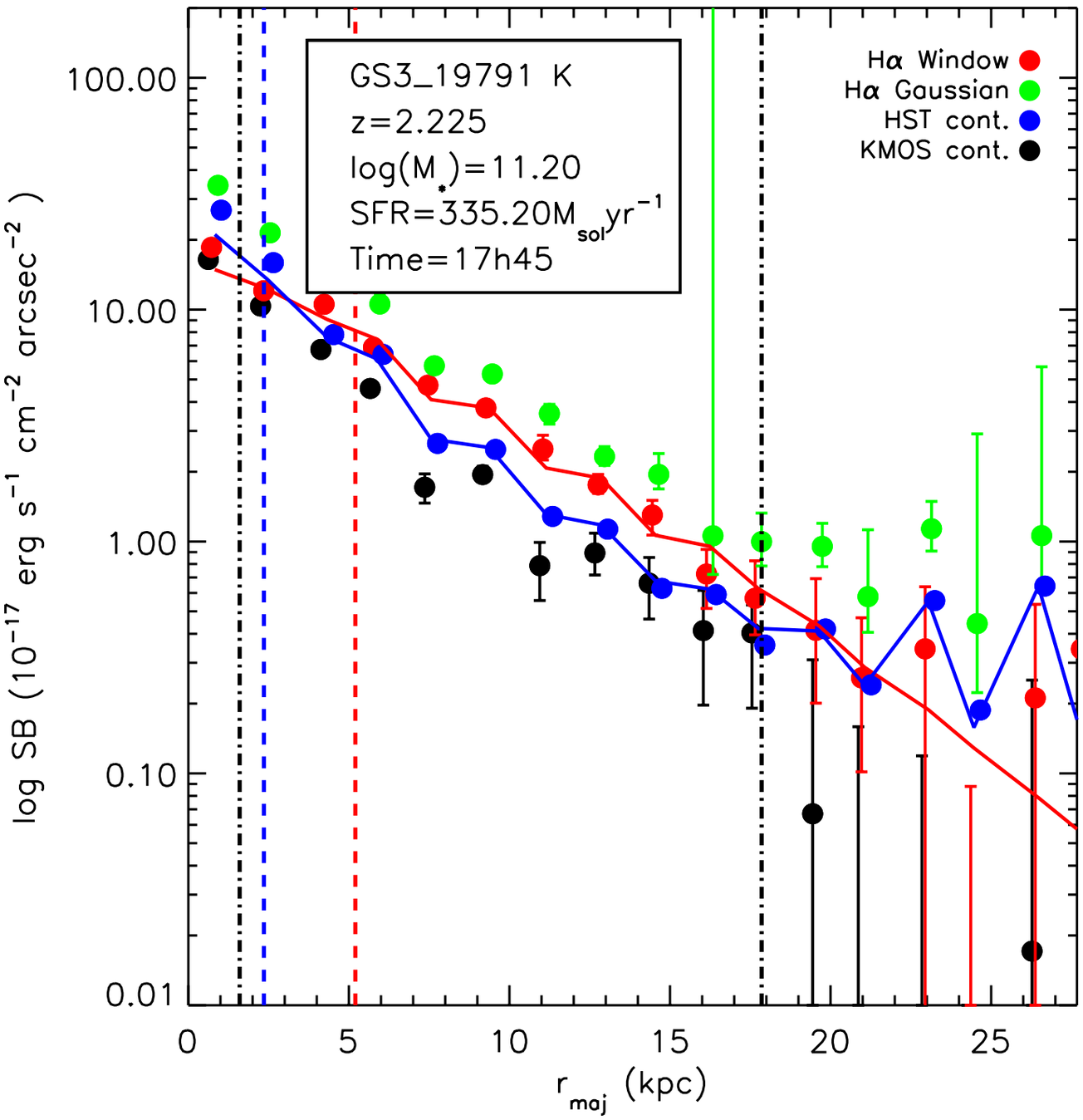


KMOS Hα

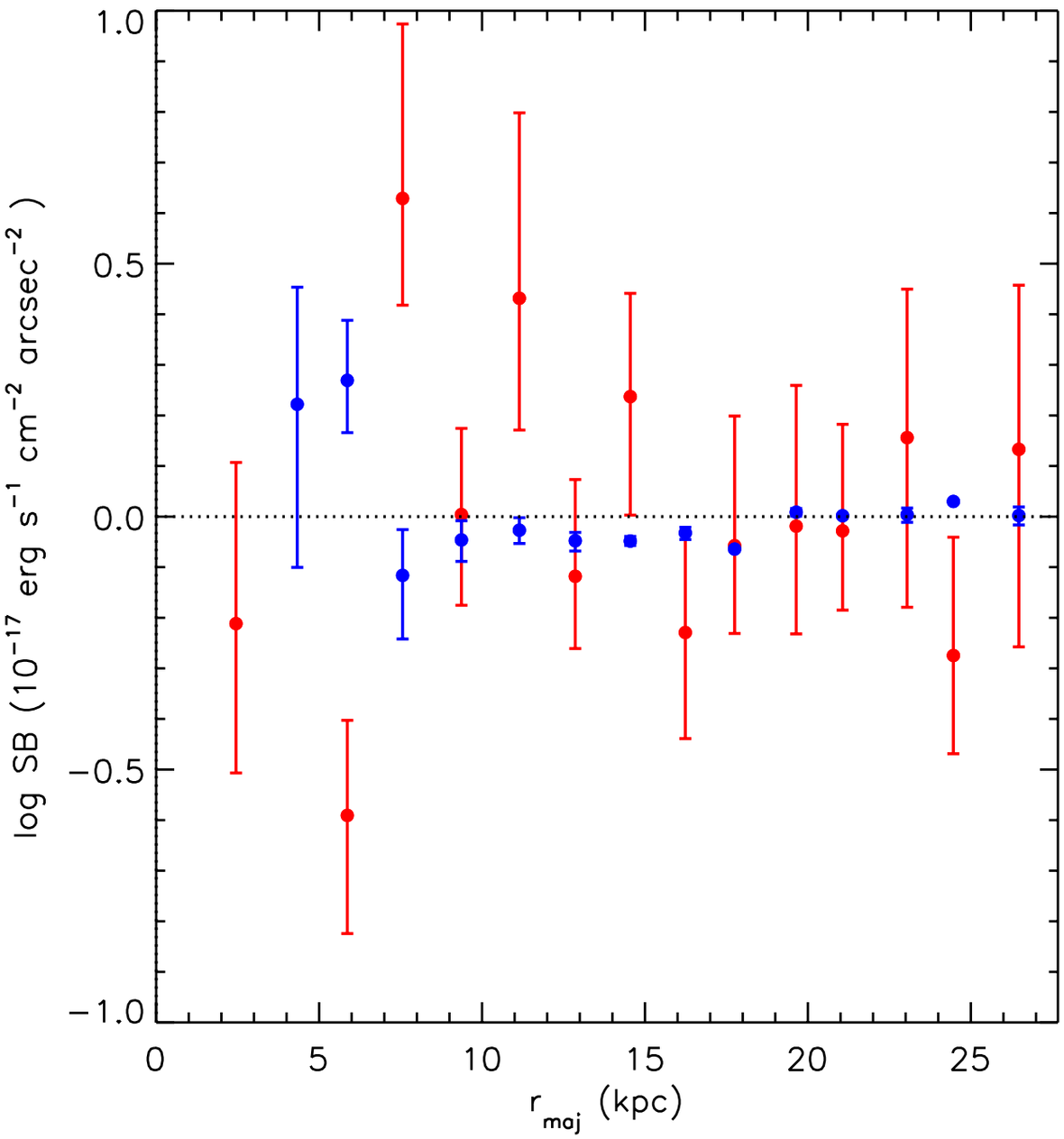


EXAMPLE: GS3_19791

Profile (data and model):



Profile Residuals



Continuum Fits