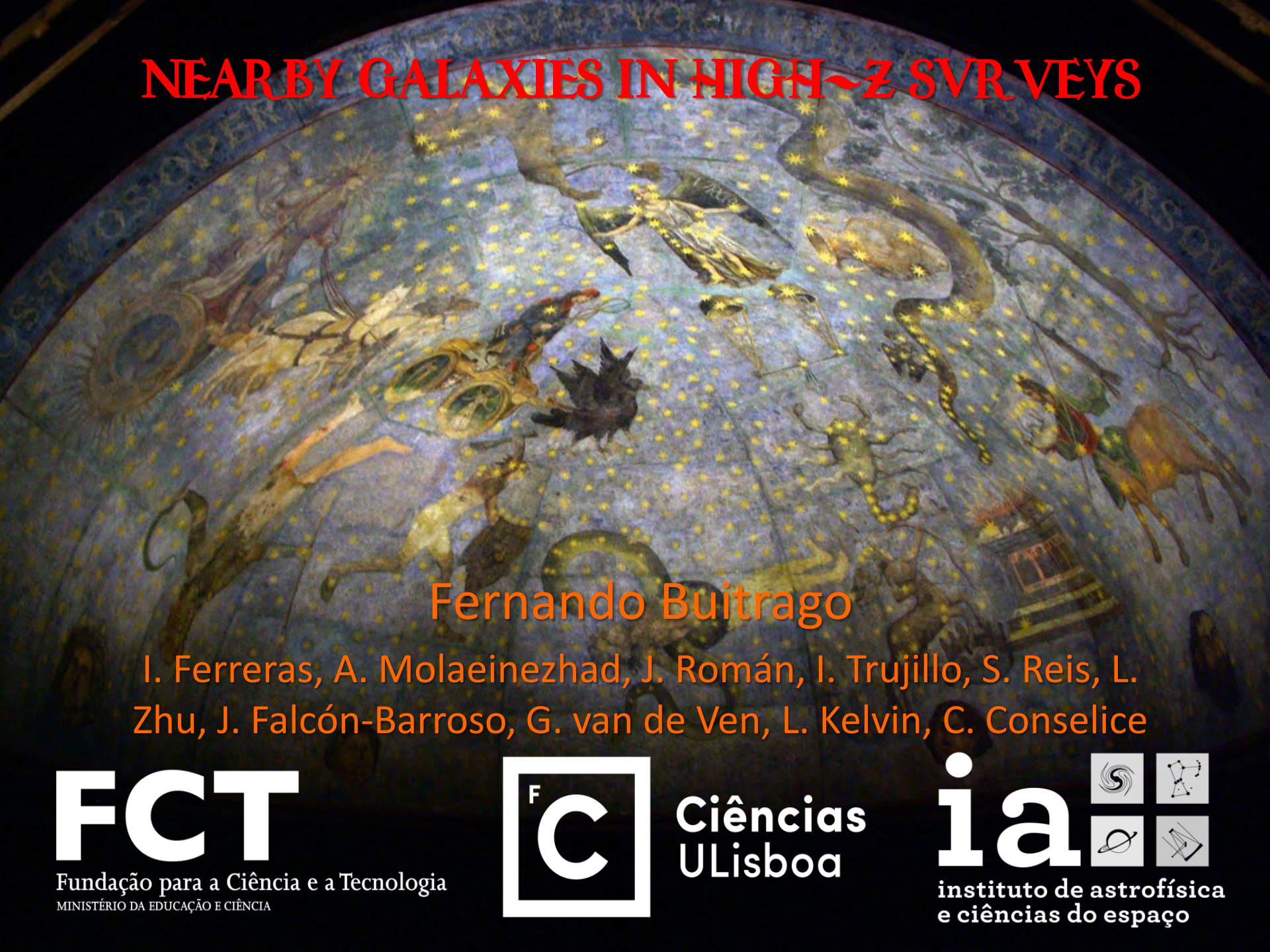
NEARBY GALAXIES IN HIGH-z SURVEYS



Fernando Buitrago

I. Ferreras, A. Molaeinezhad, J. Román, I. Trujillo, S. Reis, L. Zhu, J. Falcón-Barroso, G. van de Ven, L. Kelvin, C. Conselice

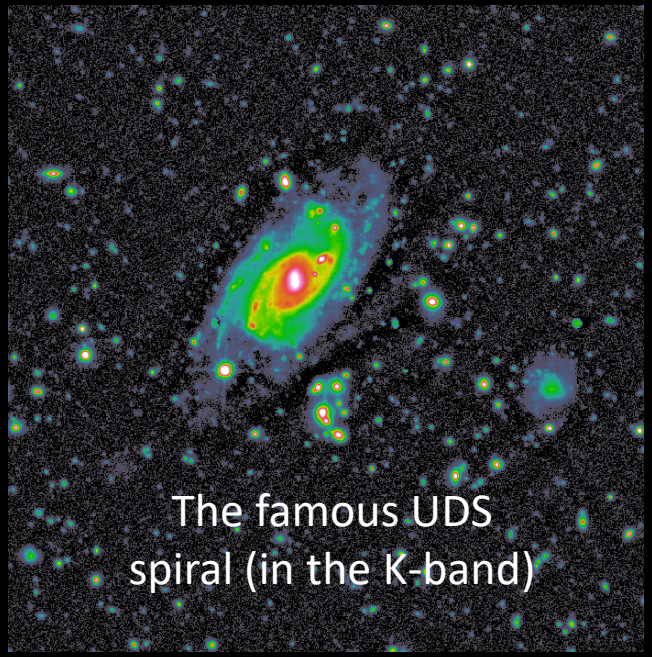
FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

Ciências ULisboa

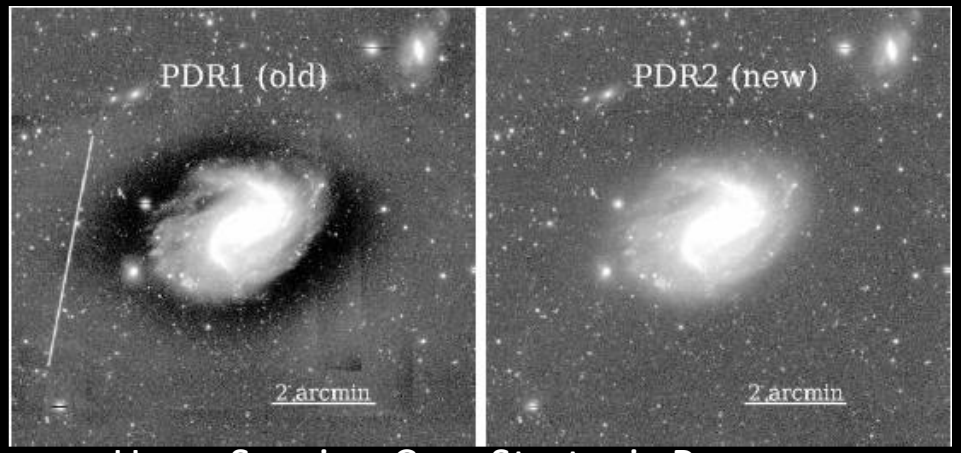
ia instituto de astrofísica e ciências do espaço


mu(V) < 21.5
Mihos etal 2005

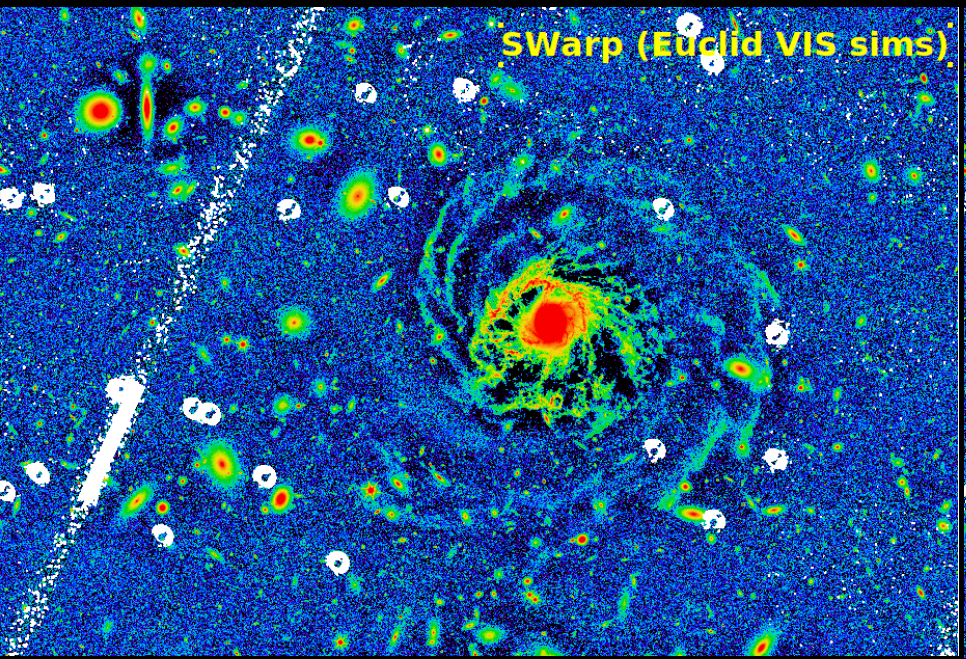
DATA REDUCTION MATTERS

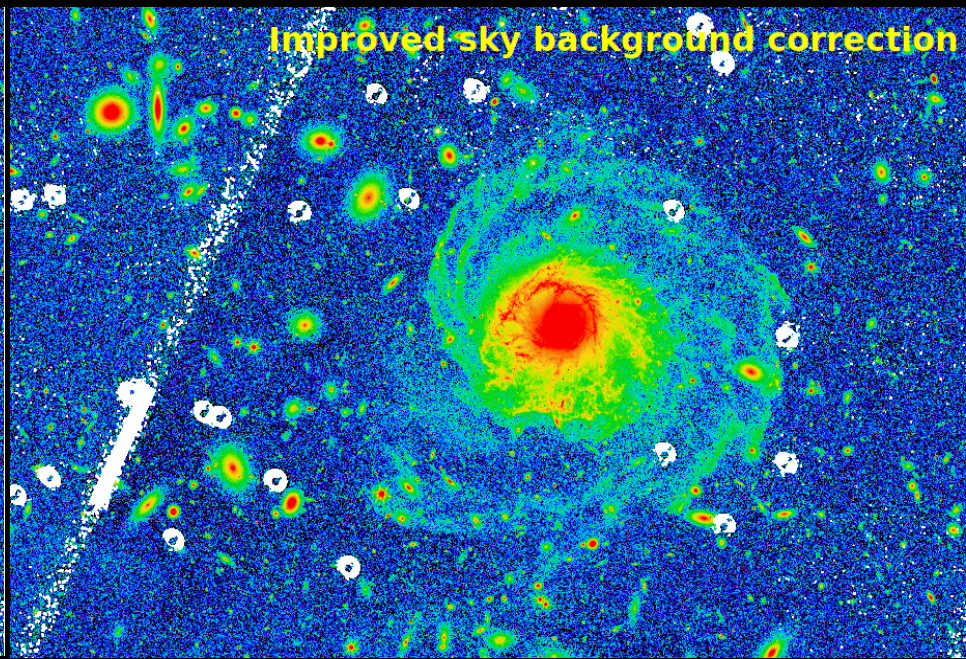


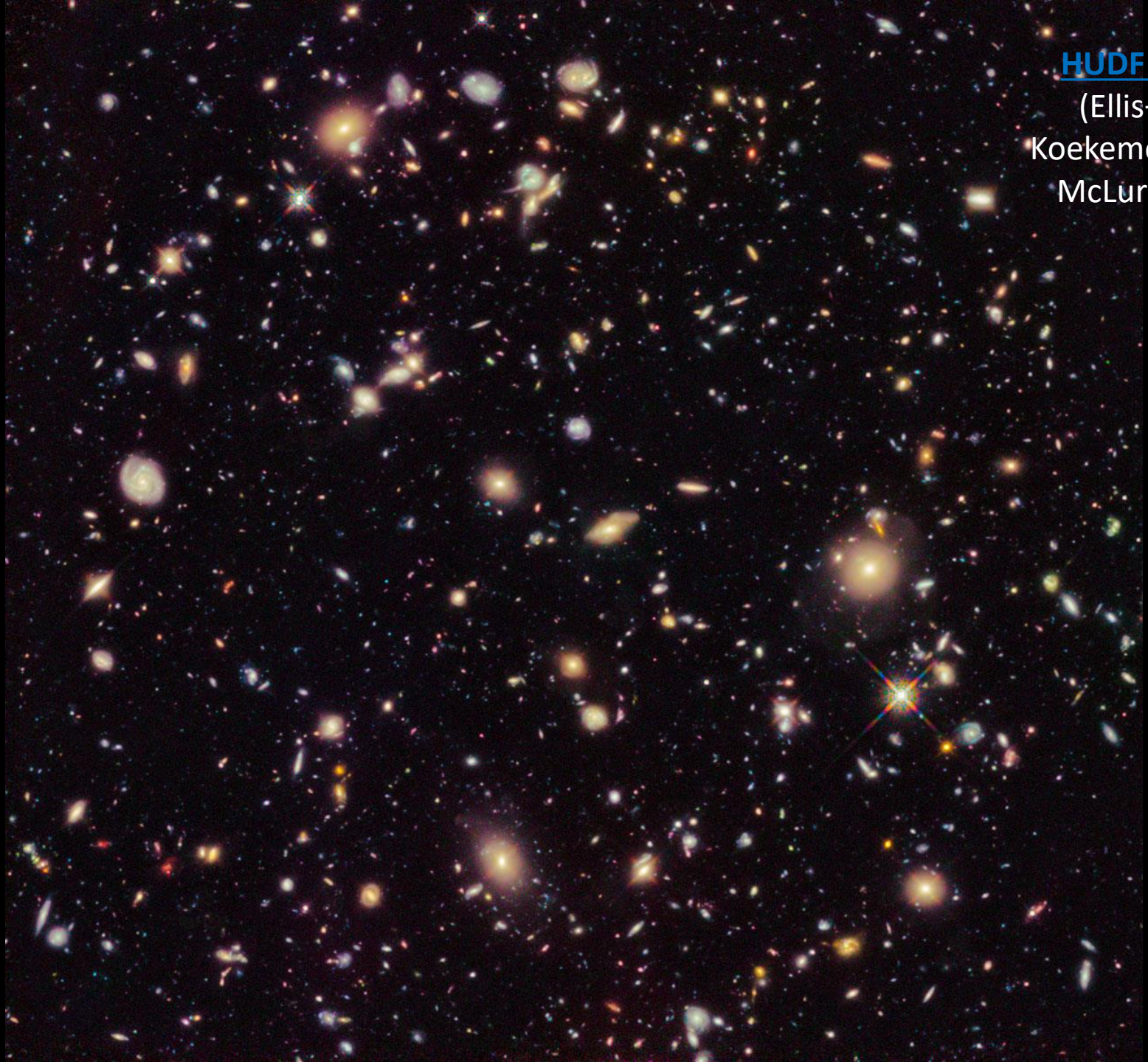
The famous UDS
spiral (in the K-band)



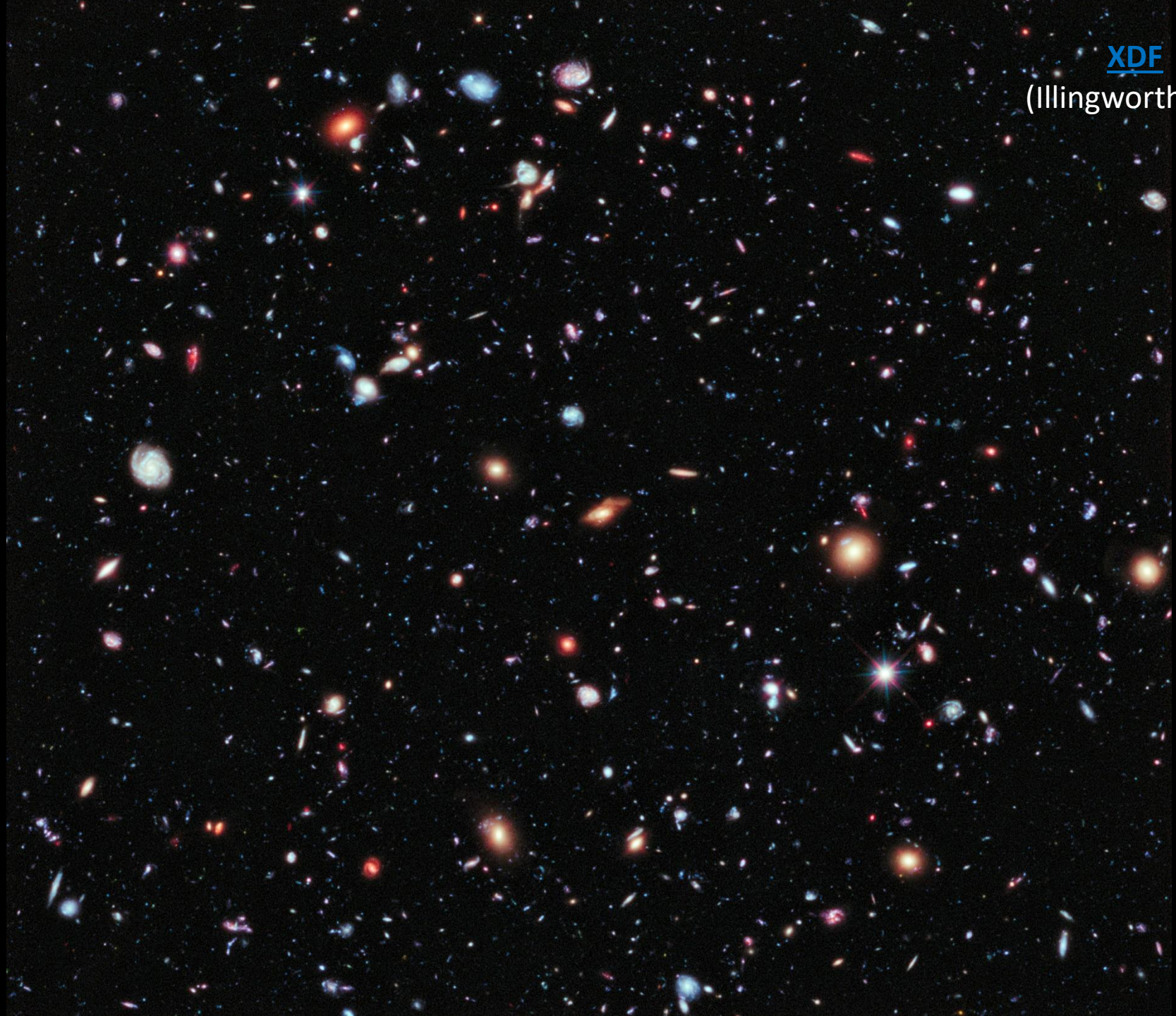
HyperSuprimeCam Strategic Programme
DR2 i-band data (Aihara+2019)

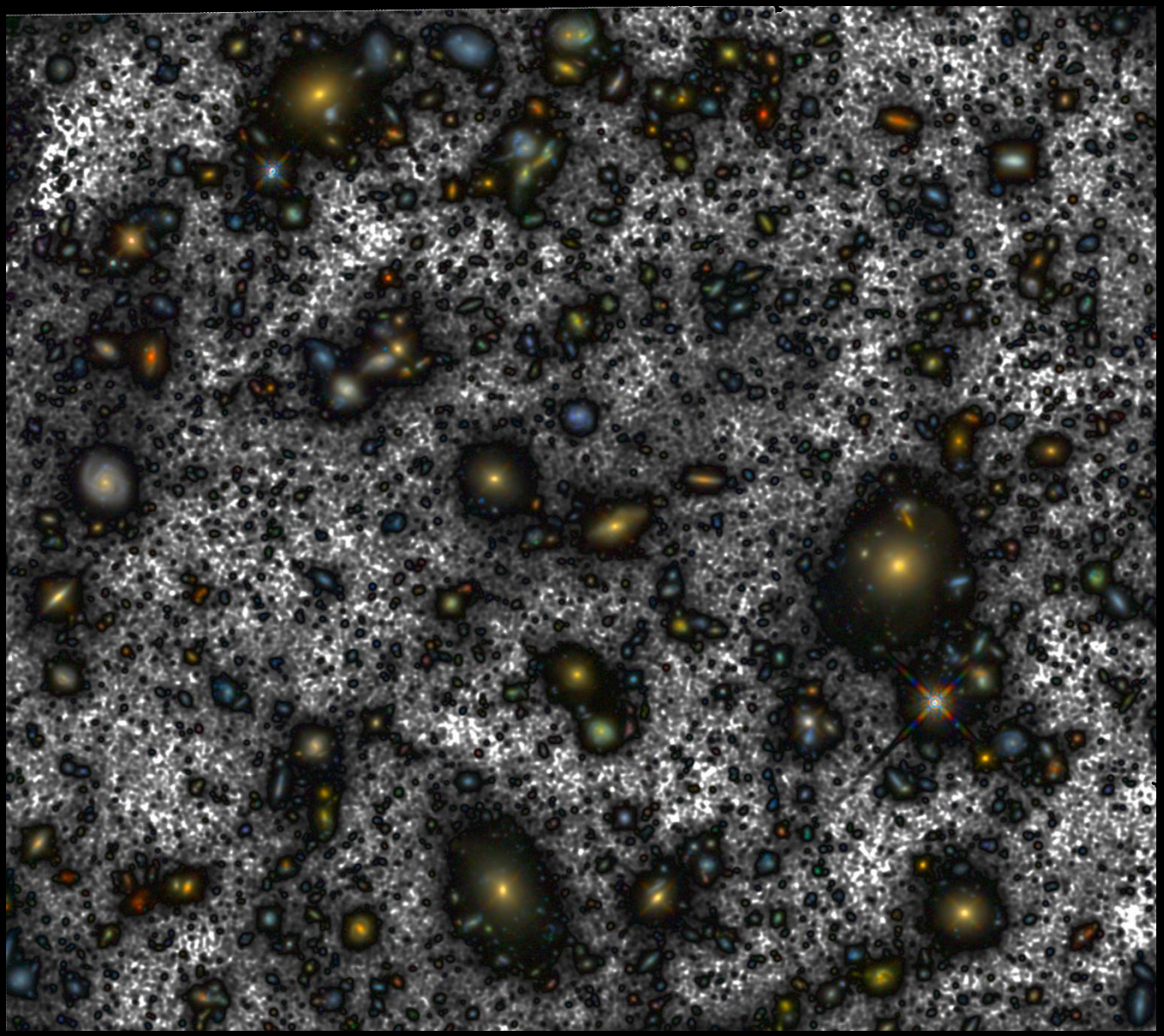






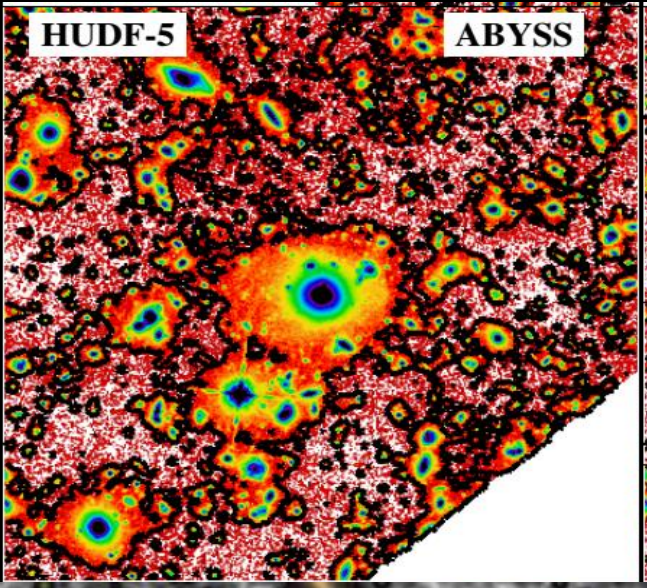
HUDF 2012
(Ellis+13,
Koekemoer+13,
McLure+13)

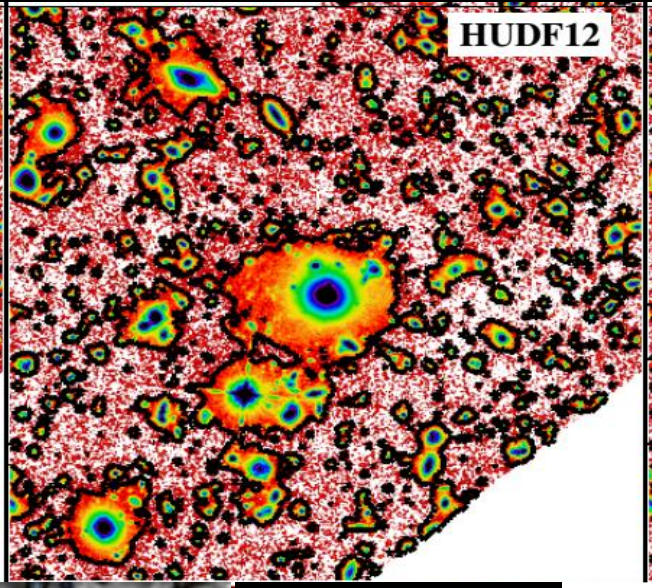

XDF
(Illingworth+13)

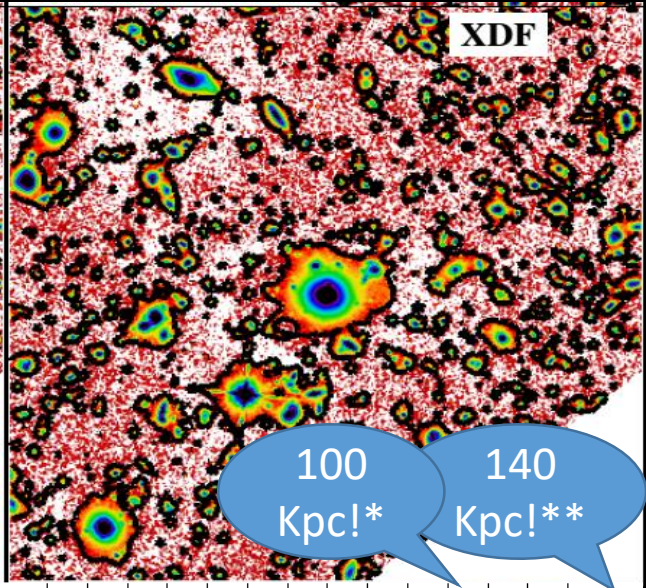


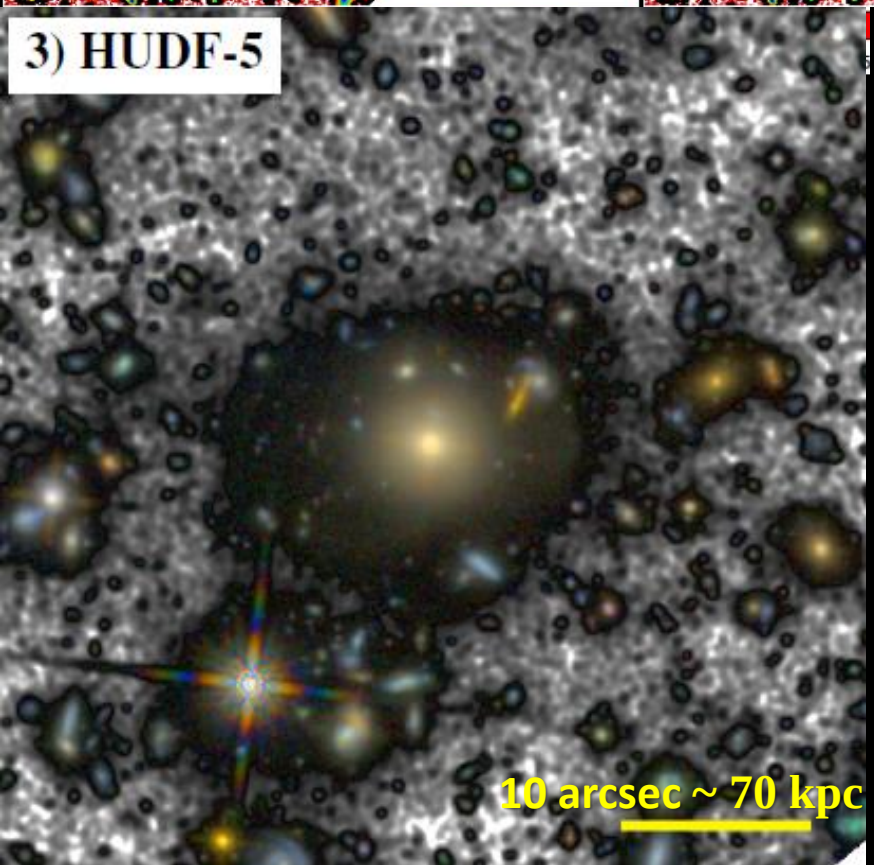
ABYSS
(Borlaff+19)

https://www.iac.es/proyecto/abyss/



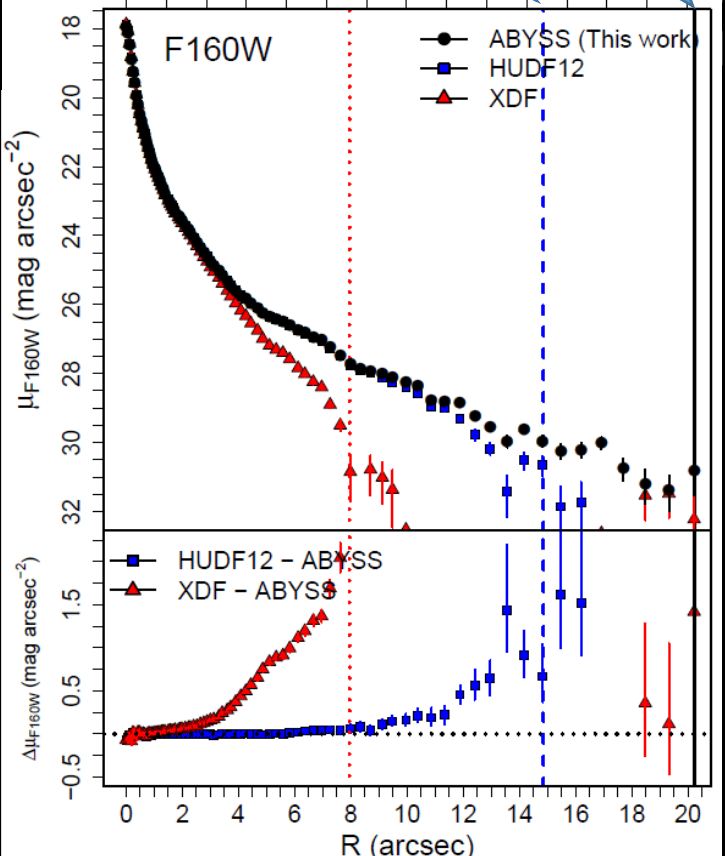


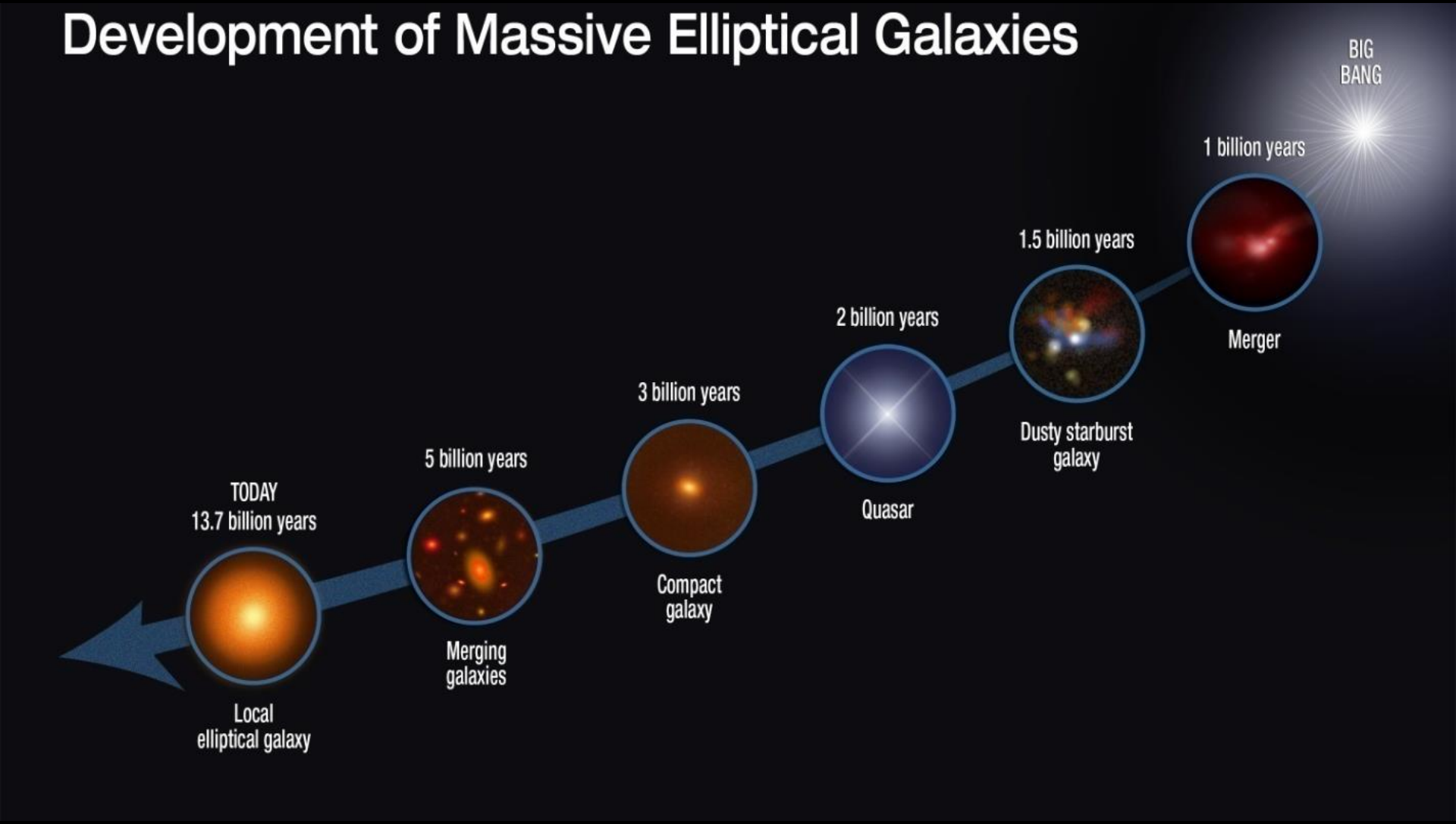


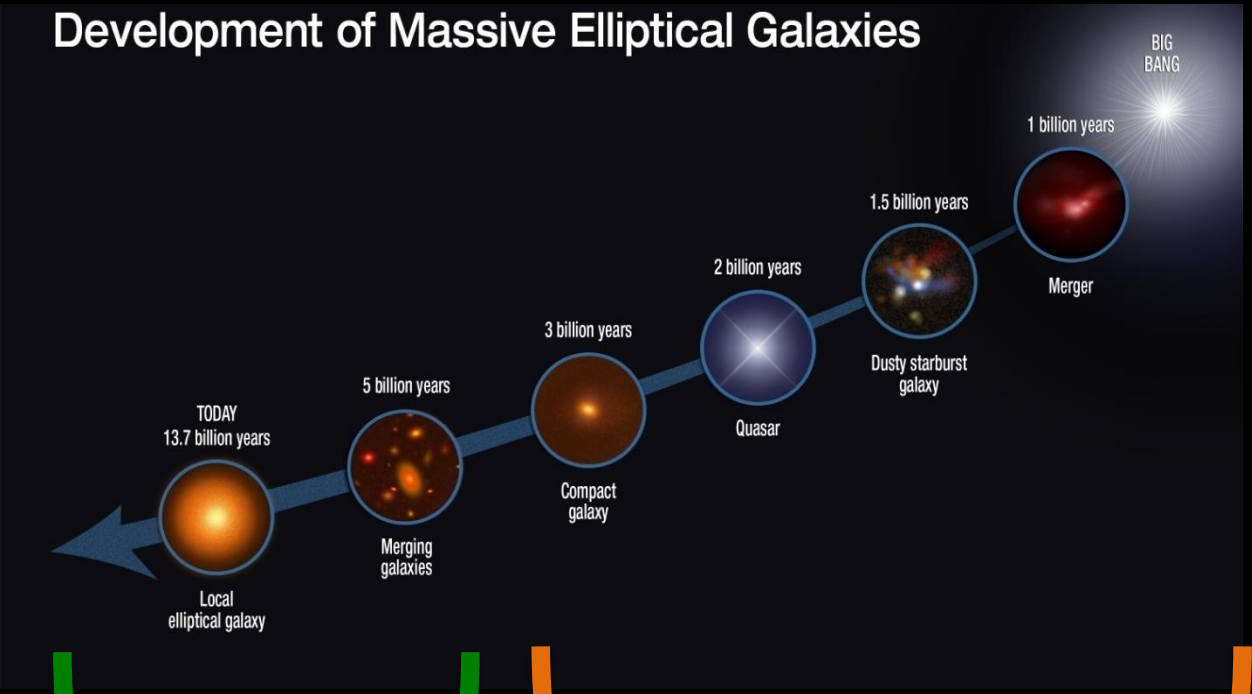


*Buitrago+17

**Borlaff+19




Development of Massive Elliptical Galaxies
BIG BANG
1 billion years
Merger
1.5 billion years
Dusty starburst galaxy
2 billion years
Quasar
3 billion years
Compact galaxy
5 billion years
Merging galaxies
TODAY
13.7 billion years
Local elliptical galaxy



Accreted component

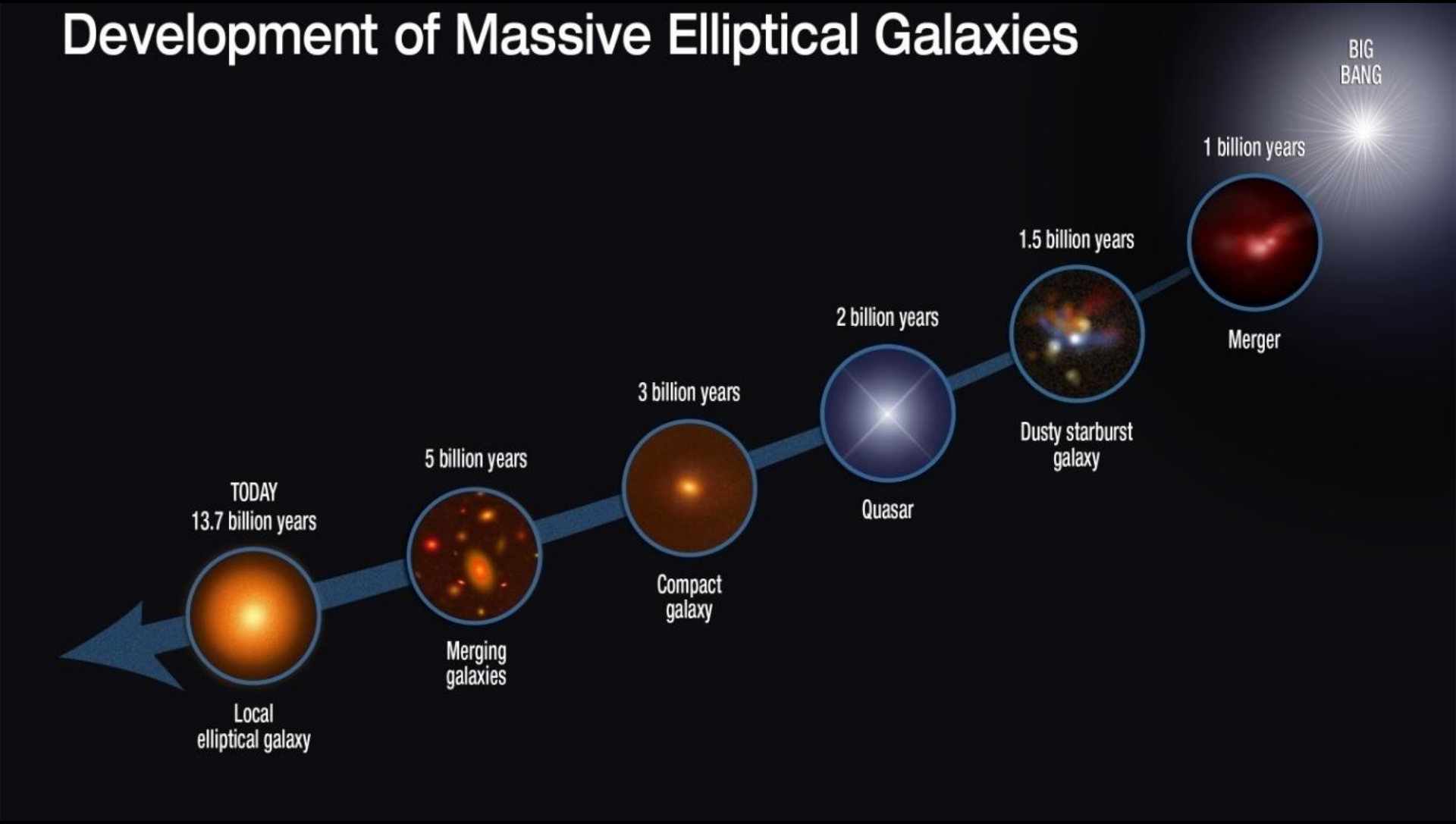
vs

In-situ component

Two phase formation scenario: inside-out growth

Great work by simulations: Hopkins+09, Oser+10, Hilz+13, Cooper+13, Zolotov+15, Wellons+16, etc; plenty of observational evidence: Bezanson+09, Van Dokkum+10, Trujillo+11, Huertas-Company+13, FB+14, Williams+14, Ferreras+14, and so many others

➔ Massive ETGs should grow an extended stellar envelope across cosmic time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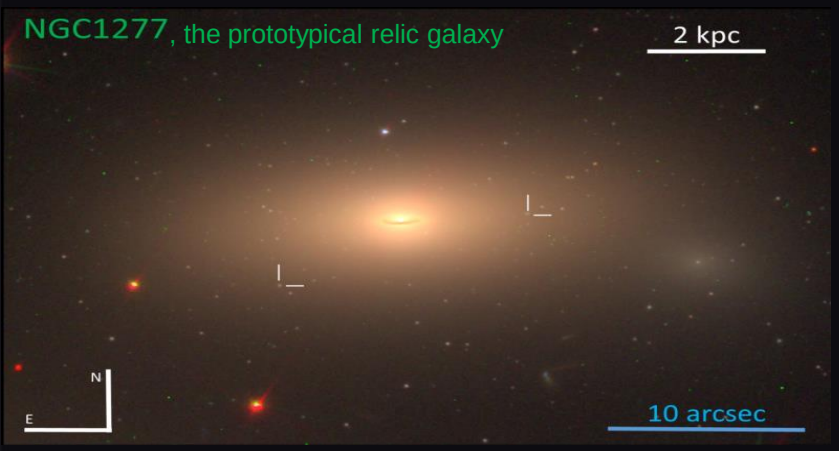
Development of Massive Elliptical Galaxies



BIG BANG

1 billion years

Merger

1.5 billion years

Dusty starburst galaxy

2 billion years

Quasar

3 billion years

5 billion years

Merging galaxies

TODAY
13.7 billion years

Local elliptical galaxy

Massive Ultracompact Galaxy

Ultramassive galaxies

Red nuggets

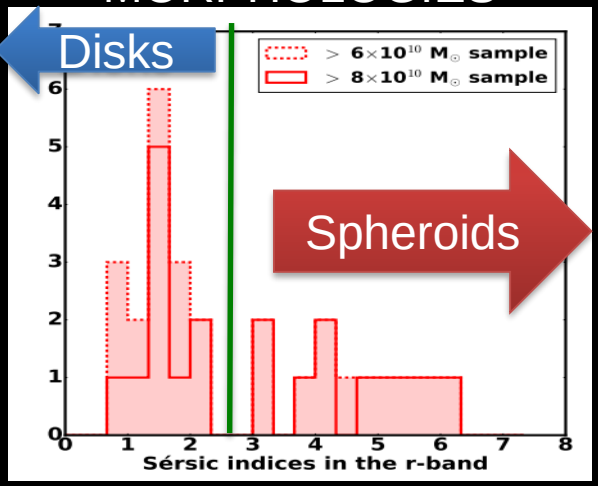
Relic in a high-density environment

Relic in a low-density environment

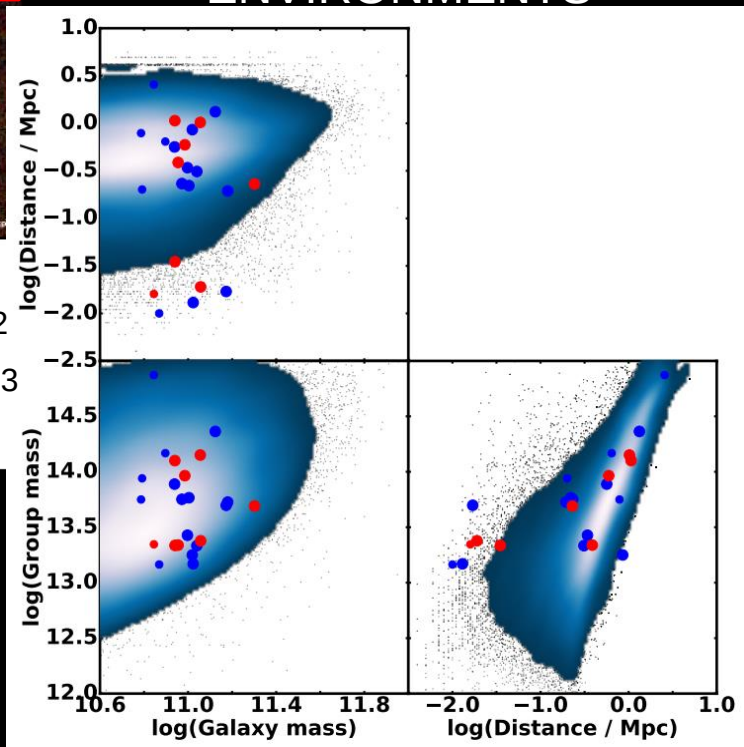
Perseus cluster

Buitrago et al. +18

MORPHOLOGIES



ENVIRONMENTS



Area in GAMA survey: 180 deg^2
No. density (0<z<0.3): 10^{-6} Mpc^{-3}

Incredible properties: übermassive black holes (Van den Bosch+12), bottom-heavy IMF at all radii (Martín-Navarro+15), uni-modal GC population (Beasley+18)

Buitrago+17

Based on the seminal work of Trujillo & Bakos 2013

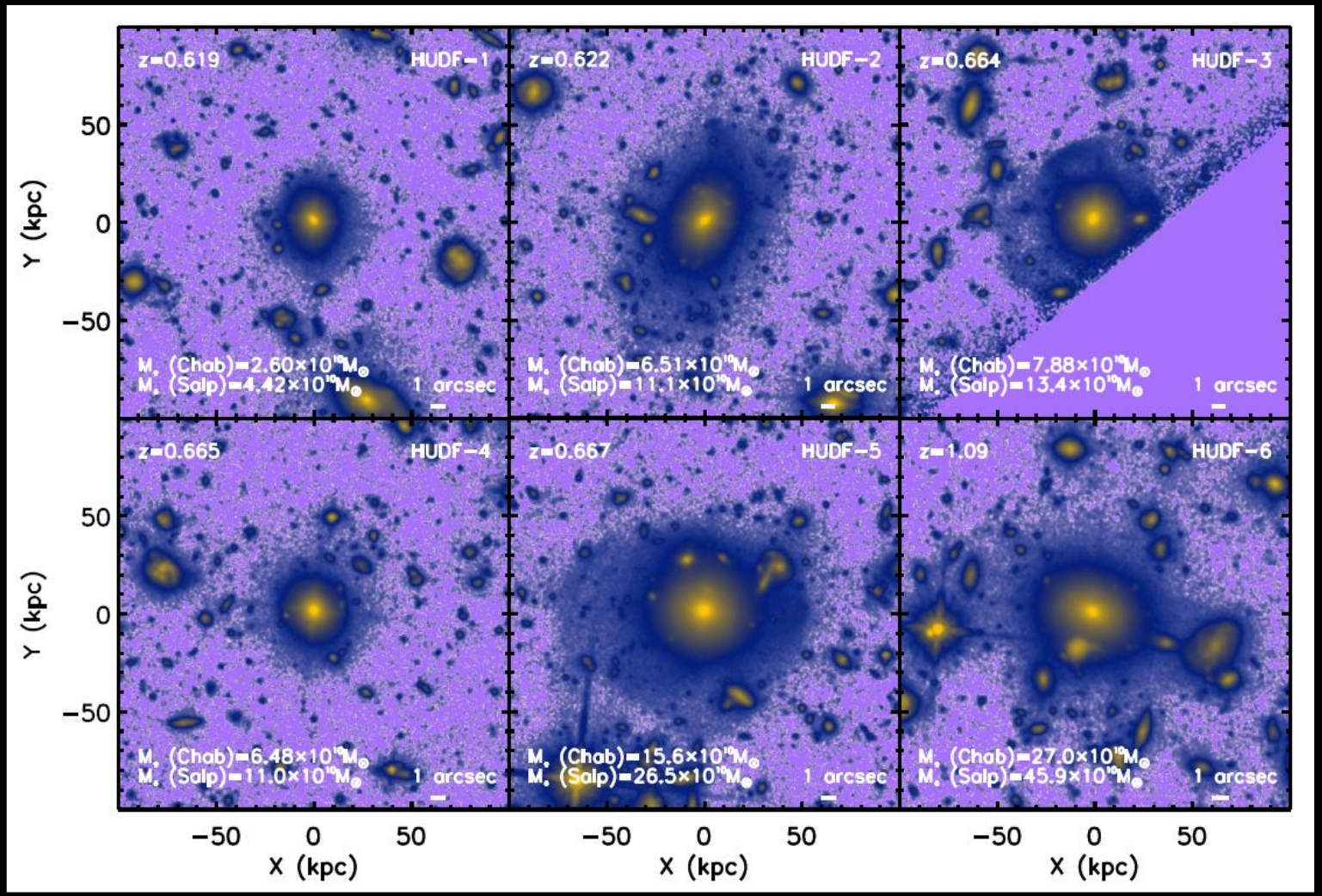
Galaxies are affected by surface brightness dimming

Selection criteria:

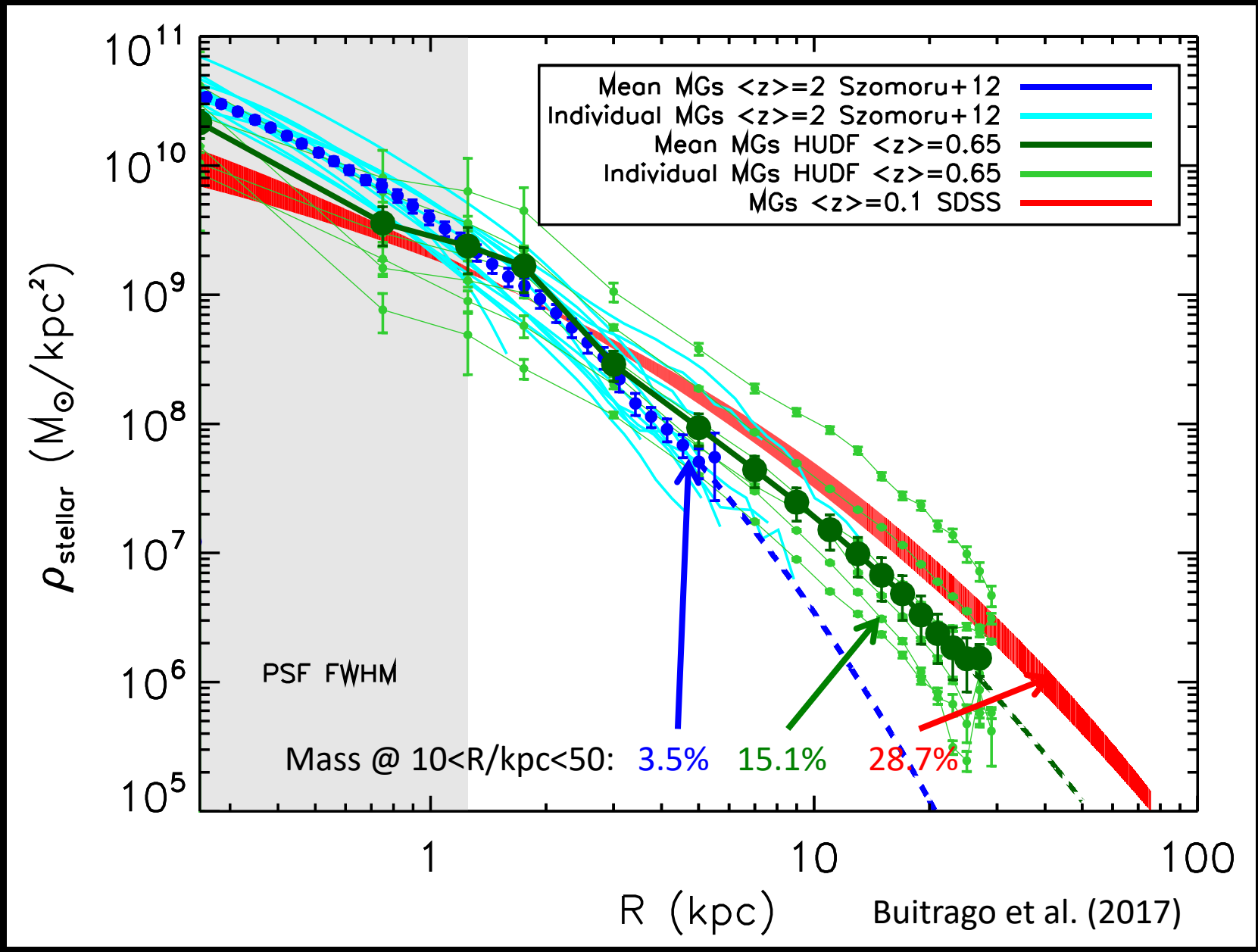
-> Stellar mass > 5×10^{10} $M_\odot$

-> $z_{spec} < 1$

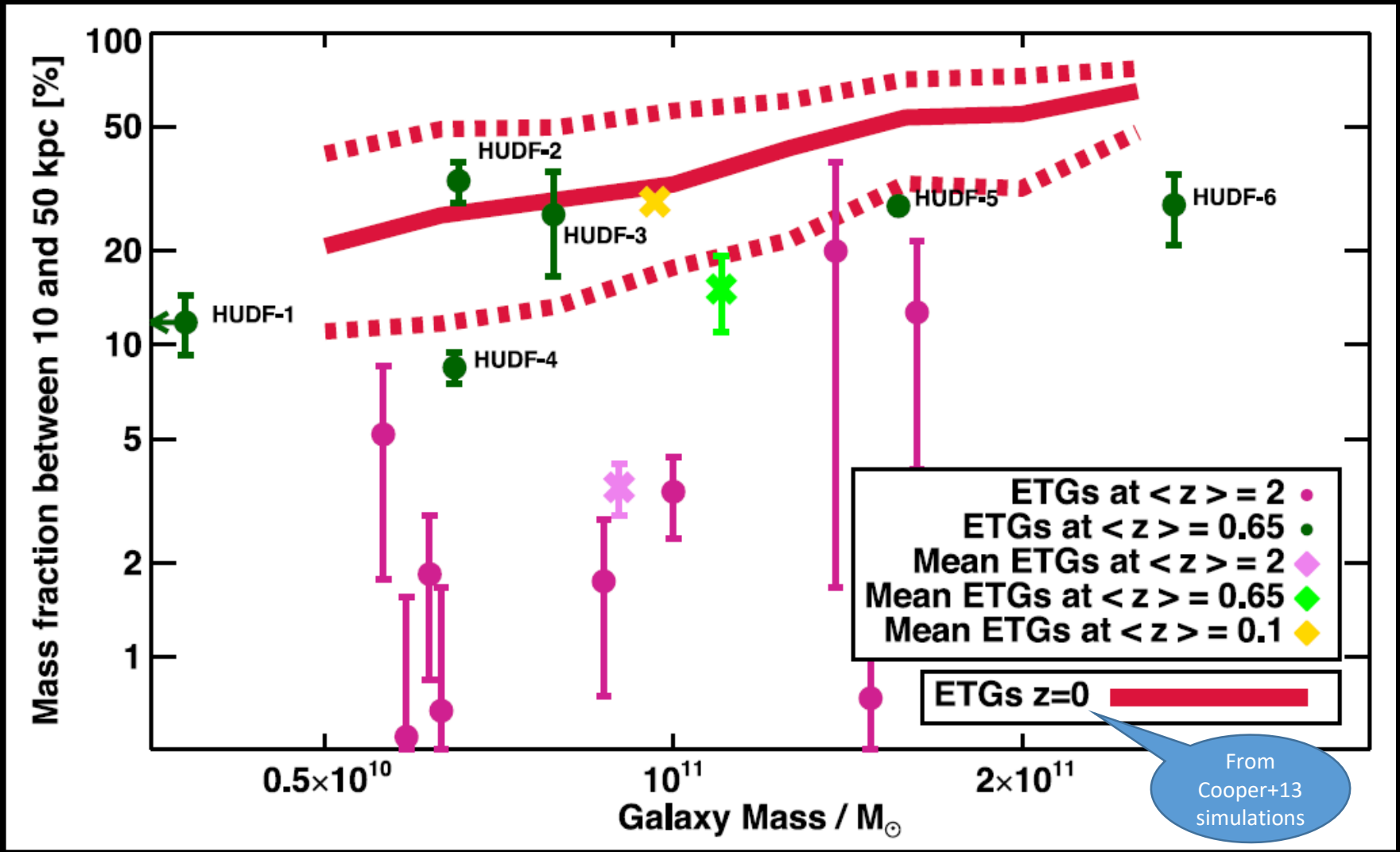
=> Early-type galaxies down to 29 mag arcsec^{-2} restframe at median redshift z = 0.65!!!



PROGRESSIVE DEVELOPMENT FOR ETG STELLAR HALOES OVER REDSHIFT

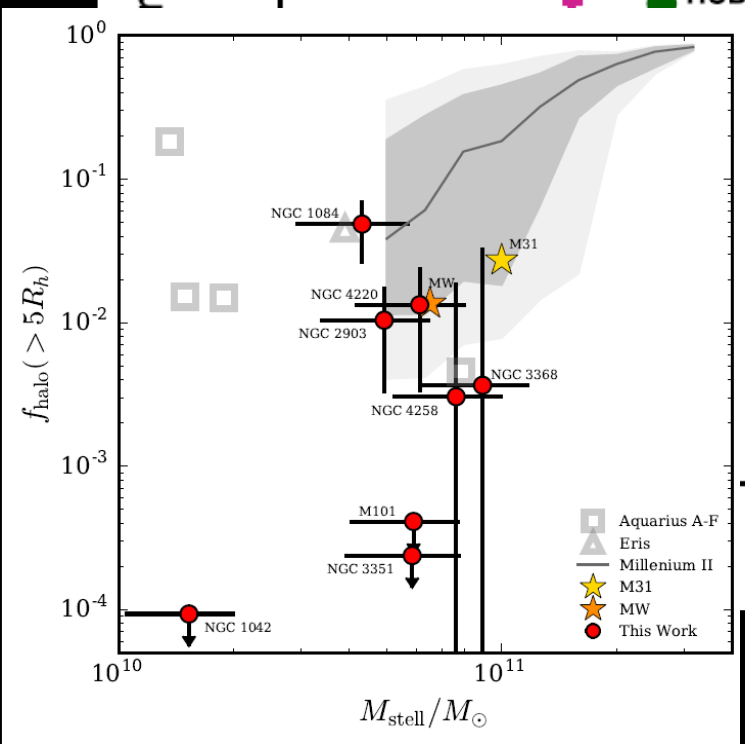


RELATIVE IMPORTANCE OF STELLAR HALOES FOR ETGs OVER REDSHIFT



Buitrago+17

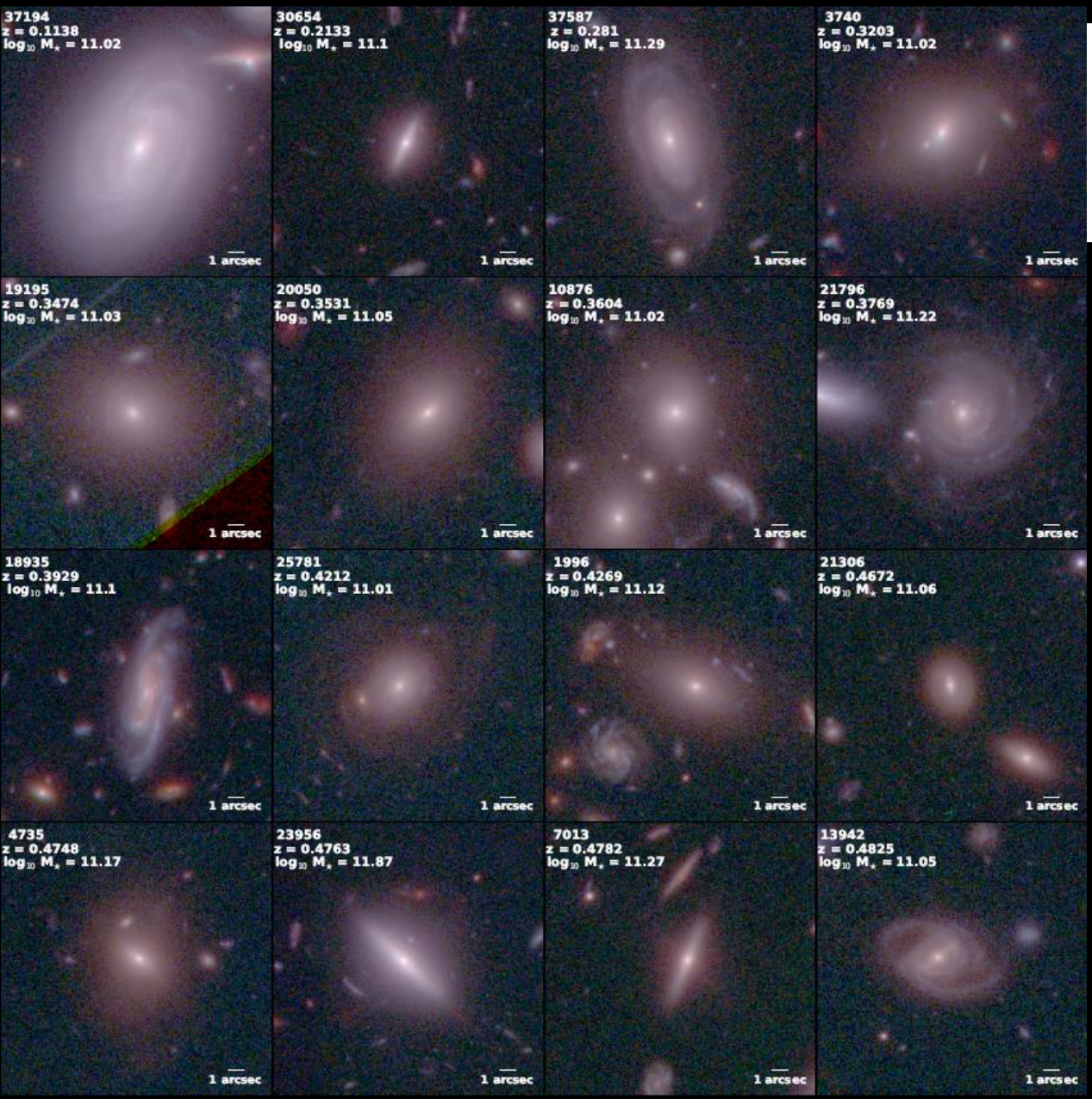
RELATIVE IMPORTANCE OF STELLAR HALOES FOR ETGs OVER REDSHIFT

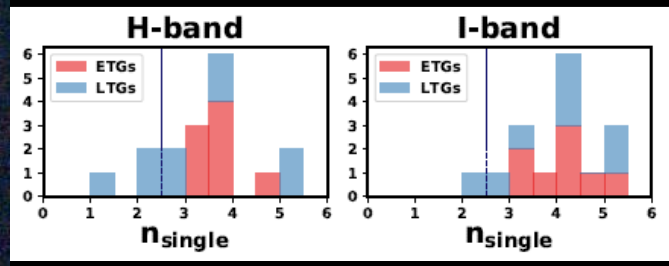


Merritt+2016

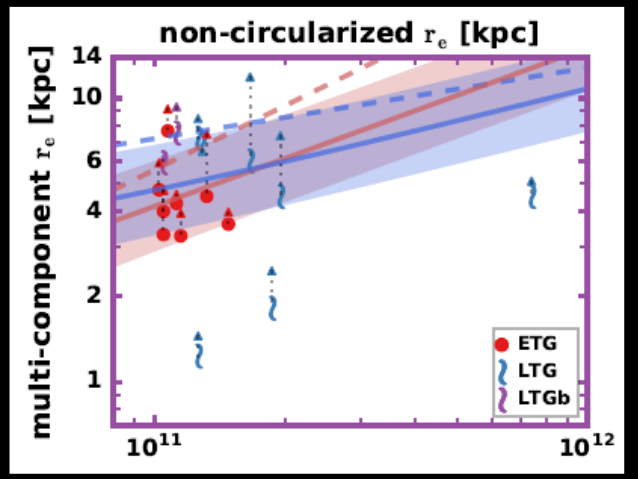
Buitrago+17

MASSIVE GALAXIES IN CANDELS @ Z < 0.5





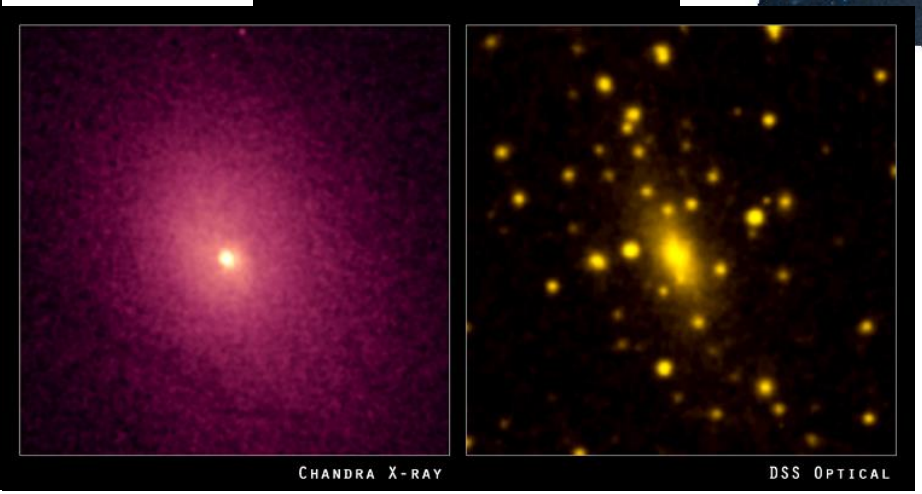
See also Buitrago+13



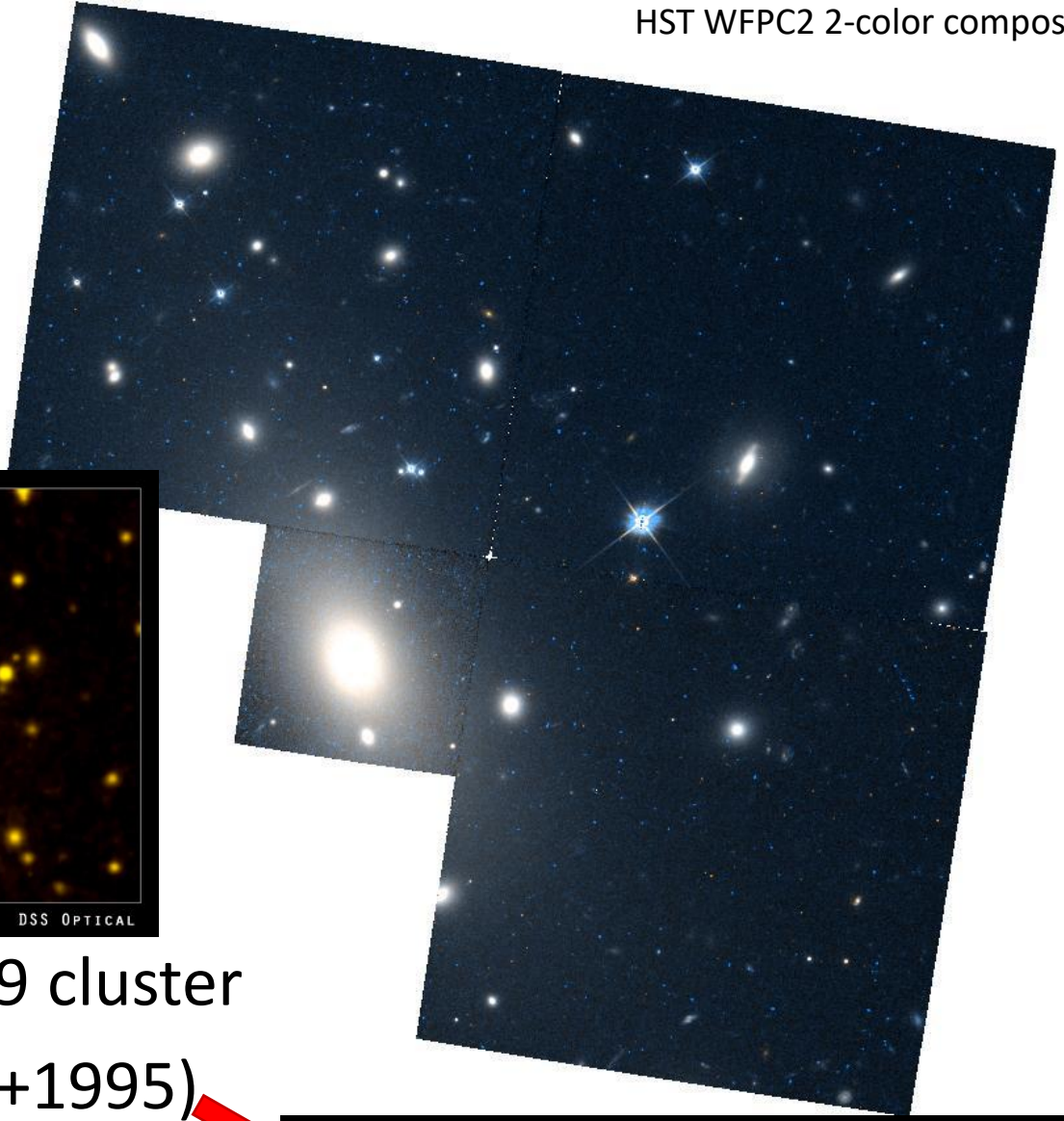
Reis, FB+19
(in press)

Just google this name…

IC1101



HST WFPC2 2-color composite



-Center of the Abell 2029 cluster

-R_e = 64 ± 12 kpc (Fisher+1995)

-Searching for similar objects in KiDS with C. Tortora | Stellar populations w/ FADO by S. Reis and J.M. Gomes

New r_e = 42±4 kpc (but probably much less)

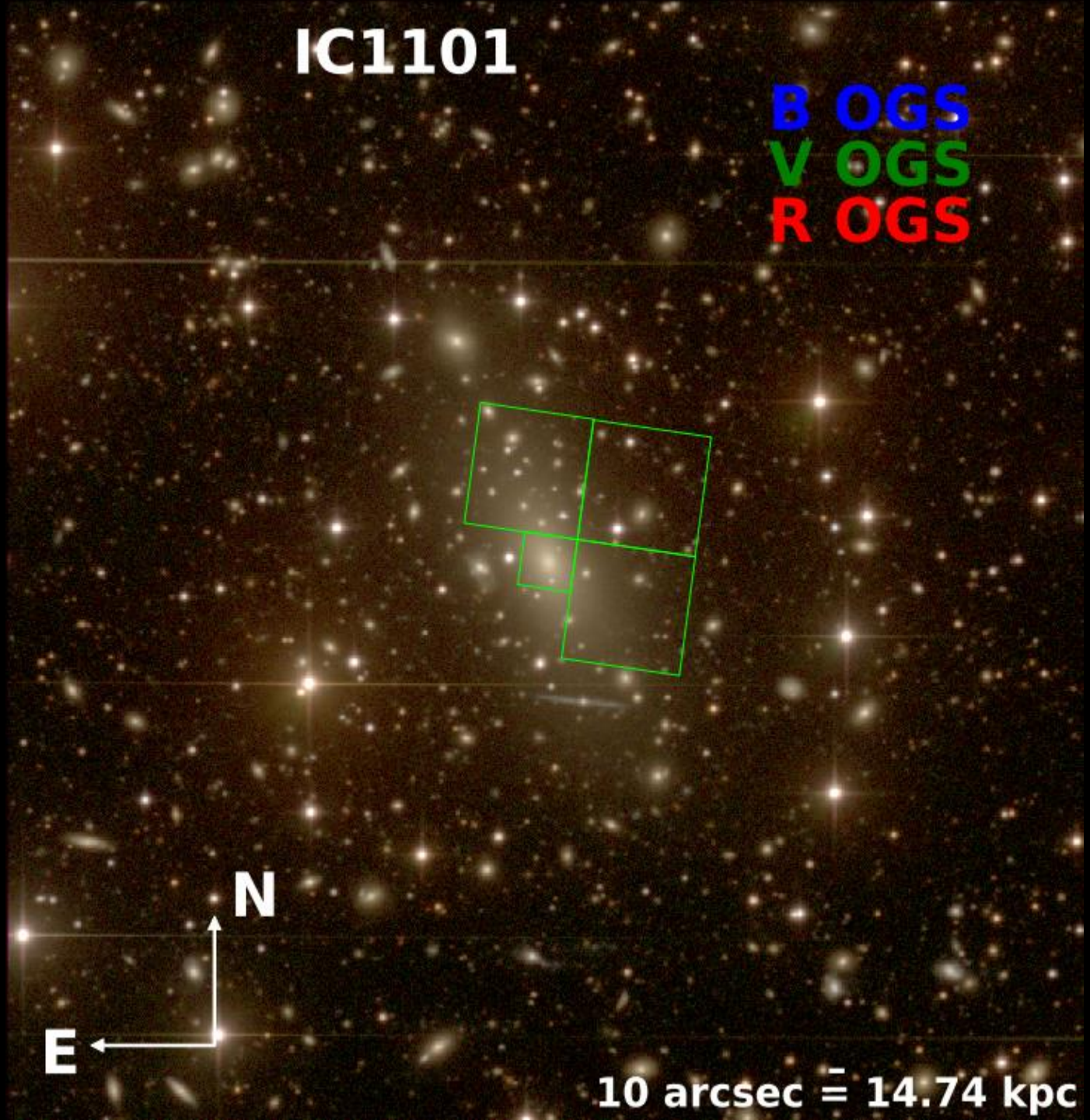
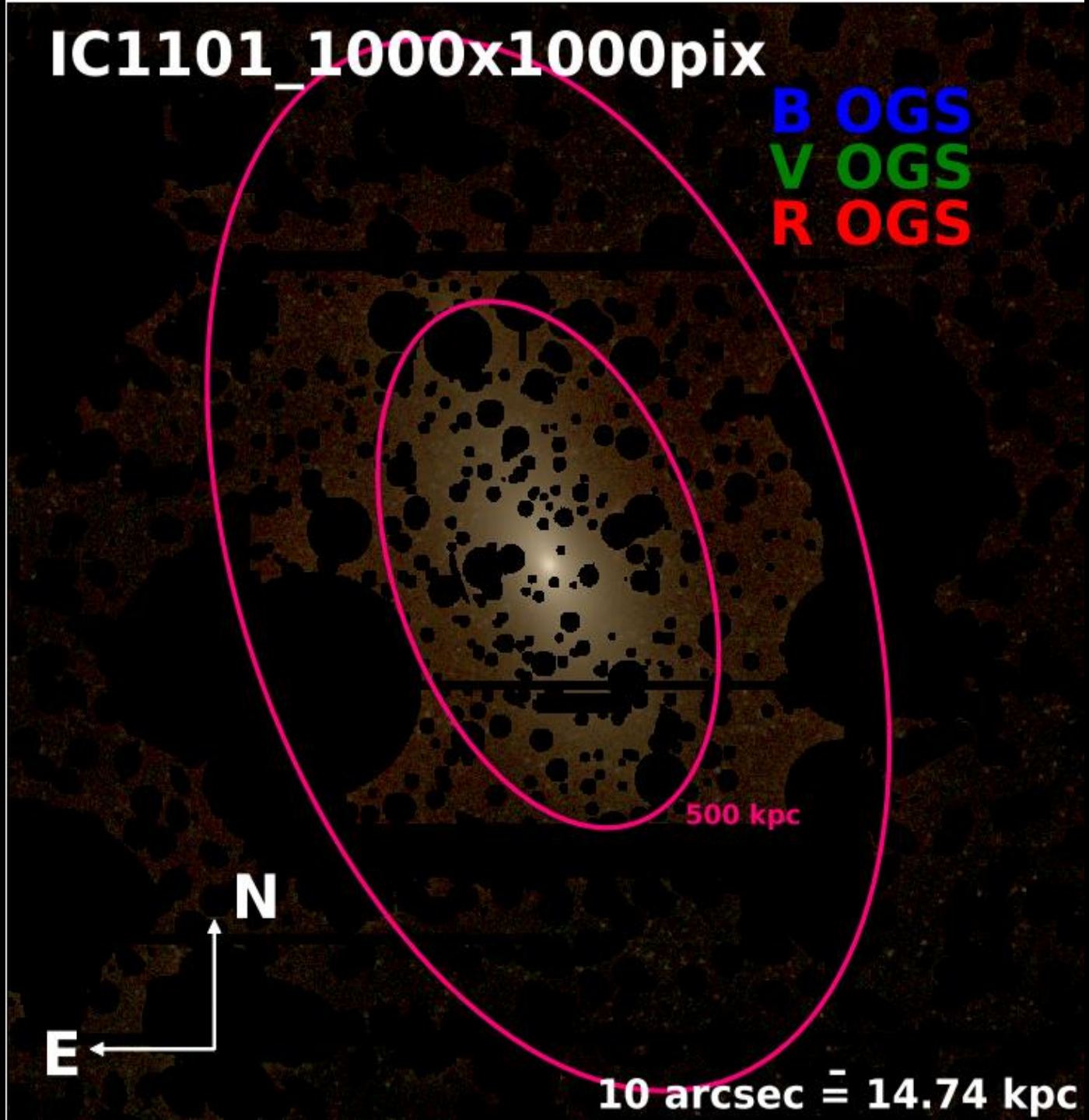


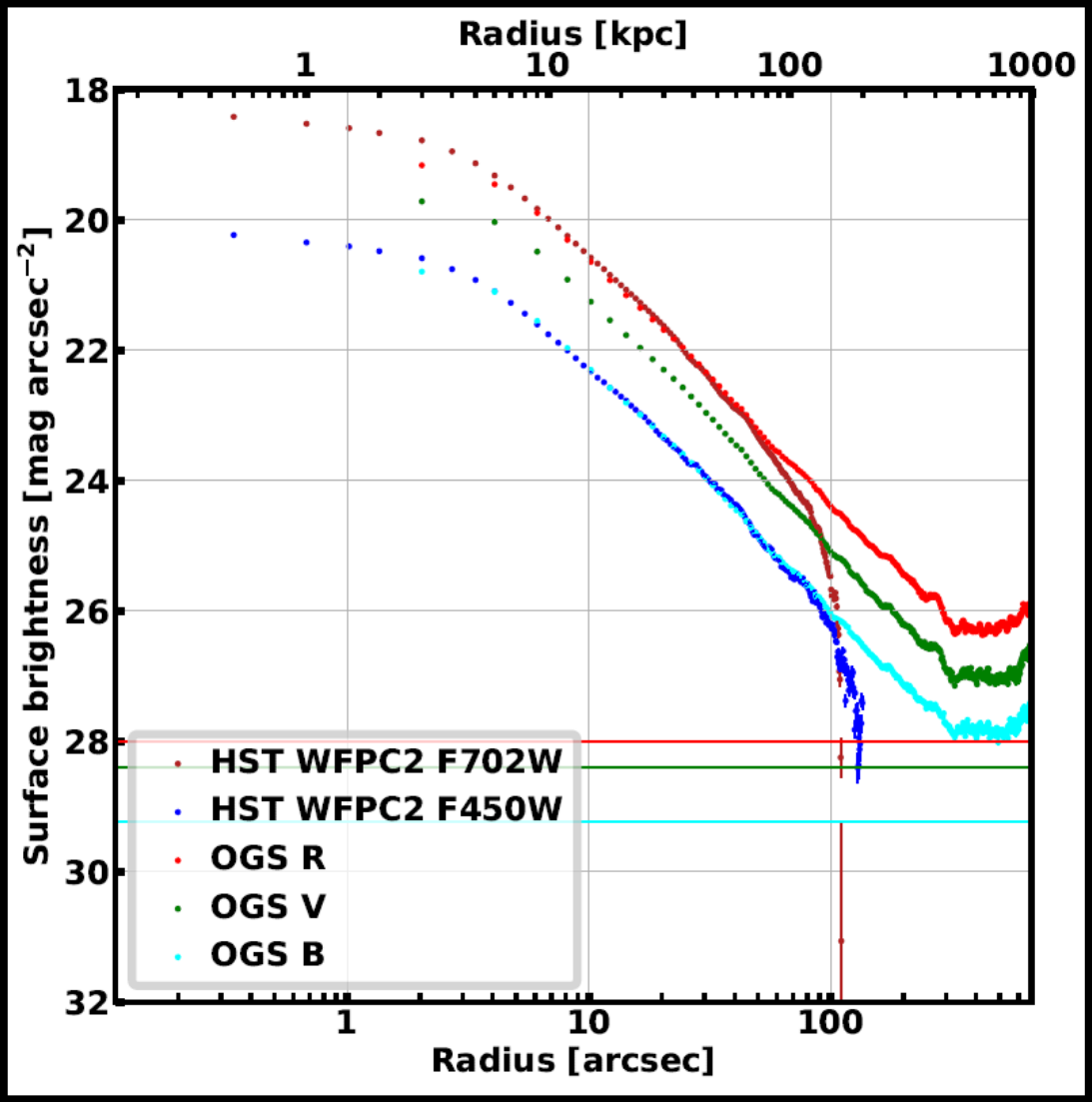
Image by Javier Román

Exposure time 3.83h in the OGS telescope (1m)

R band:
28.01 mag/arcsec2
V band:
28.39 mag/arcsec2
B band:
29.24 mag/arcsec2

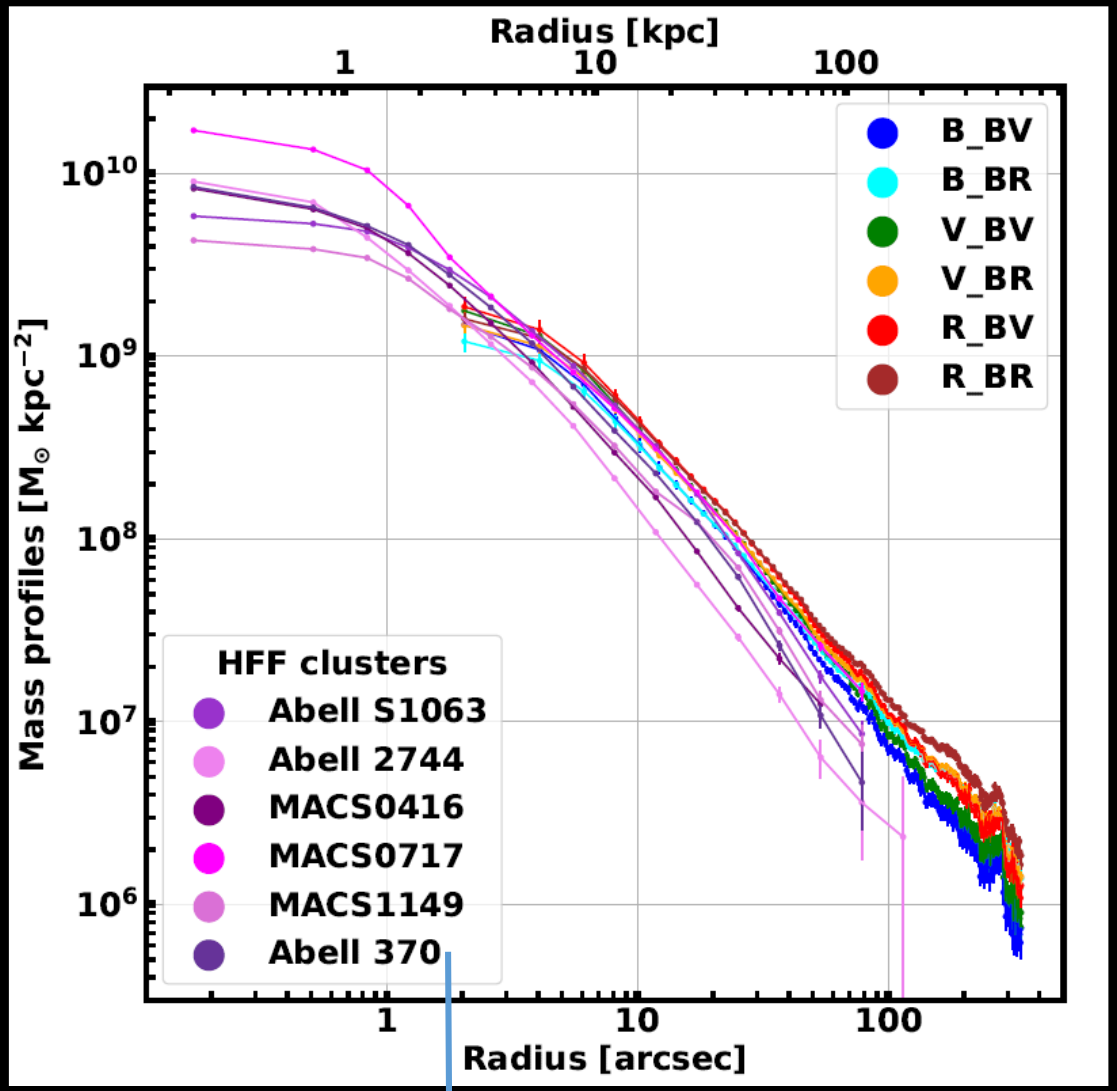
(3σ, 10x10 arcsec)


IC1101_1000x1000pix
B OGS
V OGS
R OGS
500 kpc
N
E
10 arcsec = 14.74 kpc



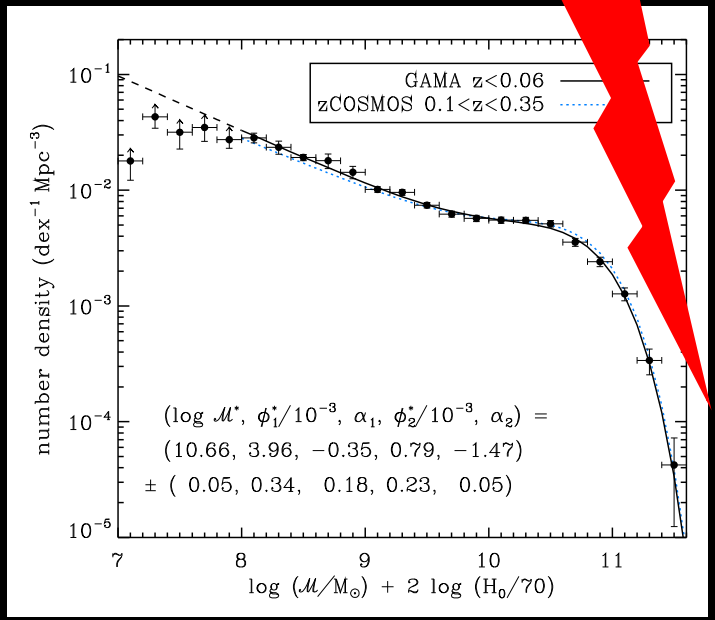
- Work in progress!
- Is this galaxy light or is it ICL?
- Fossil group? Cluster merger?

- Integrated mass $3.4 \pm 0.5 \times 10^{12}\ M_{\odot}$
- If taking the Galaxy mass function at z = 0 (Baldry+2012)…

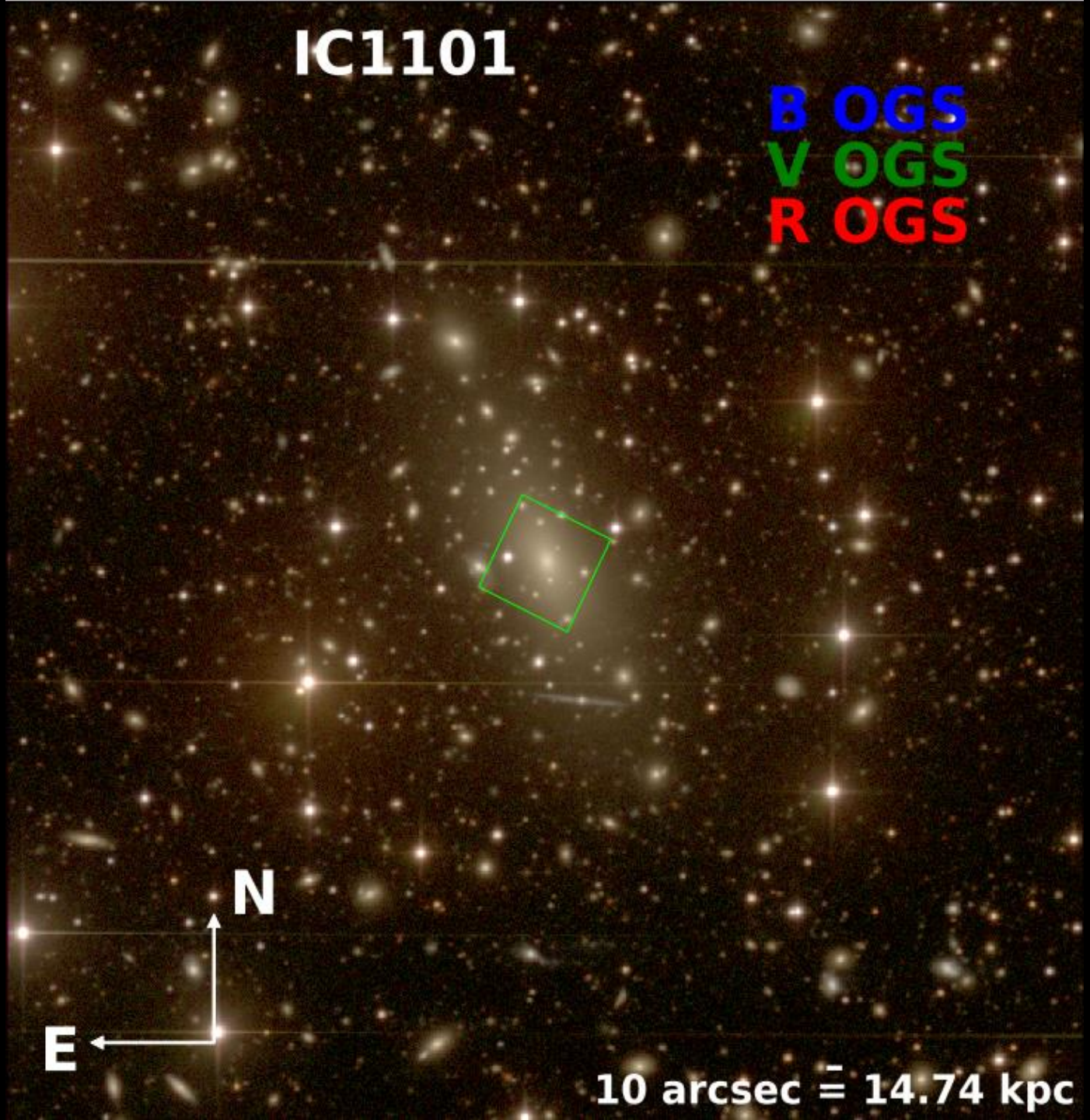


Buitrago+20

Extracted from Montes+18



Is ΛCDM accounting for these objects?

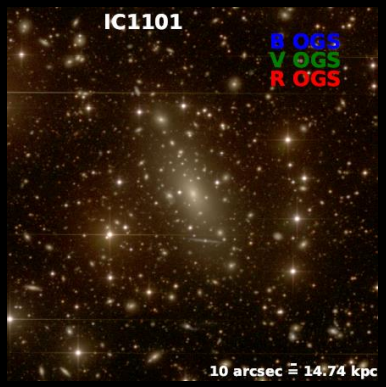


MUSE FoV,
PI Buitrago

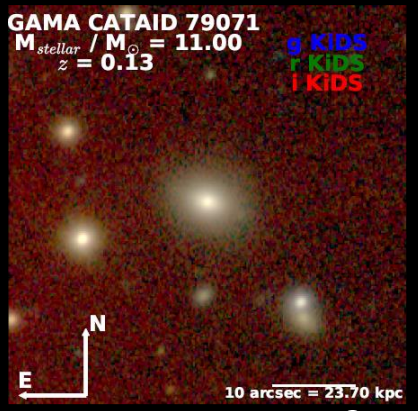
NEW GENERATION TELESCOPES' CAPABILITIES

Provided an adequate data reduction, good observing strategy and good PSF knowledge
Limiting Surface brightness given as 3σ detections in 10x10 arcsec boxes

- JWST
  - ➢30.5 mag arcsec^{-2} (1h) and 31.8 mag arcsec^{-2} (10h)
- Euclid
  - ➢Wide survey: 28.7 mag arcsec^{-2}, Drilling fields: 29.7 mag arcsec^{-2}
- LSST
  - ➢26.5 (15 sec) => SDSS Stripe 82 for 25000 deg^2 each 3d!, 30.5 (3.5h)
- 30-m telescopes
  - ➢31.2 mag arcsec^{-2} (1h) and 32.5 mag arcsec^{-2} (10h)
- MESSIER spacecraft
  - ➢ Whole sky: 34 mag arcsec^{-2}, Drilling fields: 36 mag arcsec^{-2}



SUMMARY



- Massive elliptical galaxies grow stellar haloes to account for their size and mass evolution, and they host 5-20% of the stellar mass (vs < 5% for LTGs)

- Massive galaxies are priviledged testbeds for galaxy evolution and their different flavours imply (and help discerning) different physical mechanisms at play

- Next generation telescopes and surveys will systematically find many low- to intermediate-redshift galaxies, and LSB is key to fully understand galaxies (beware cosmological dimming!)

Fernando Buitrago, fbuitrago@oal.ul.pt – Rome 13-Sep-2019