ASSEMBLYING STELLAR HALOES IN MASSIVE ETGS AT z~0.65 IN HVDF OR HOW TO VSE HVDF FOR "LOCAL" VNIVERSE STVDIES

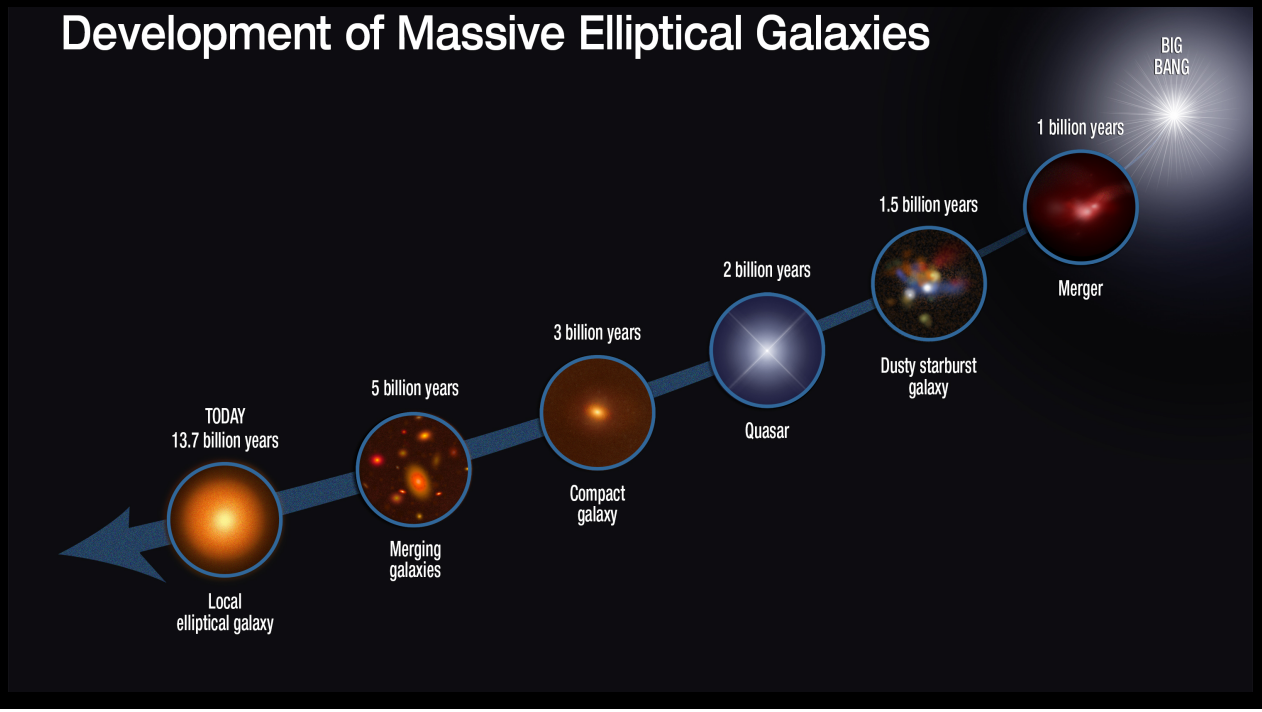
Fernando Buitrago and Ignacio Trujillo

ASTRODEEP

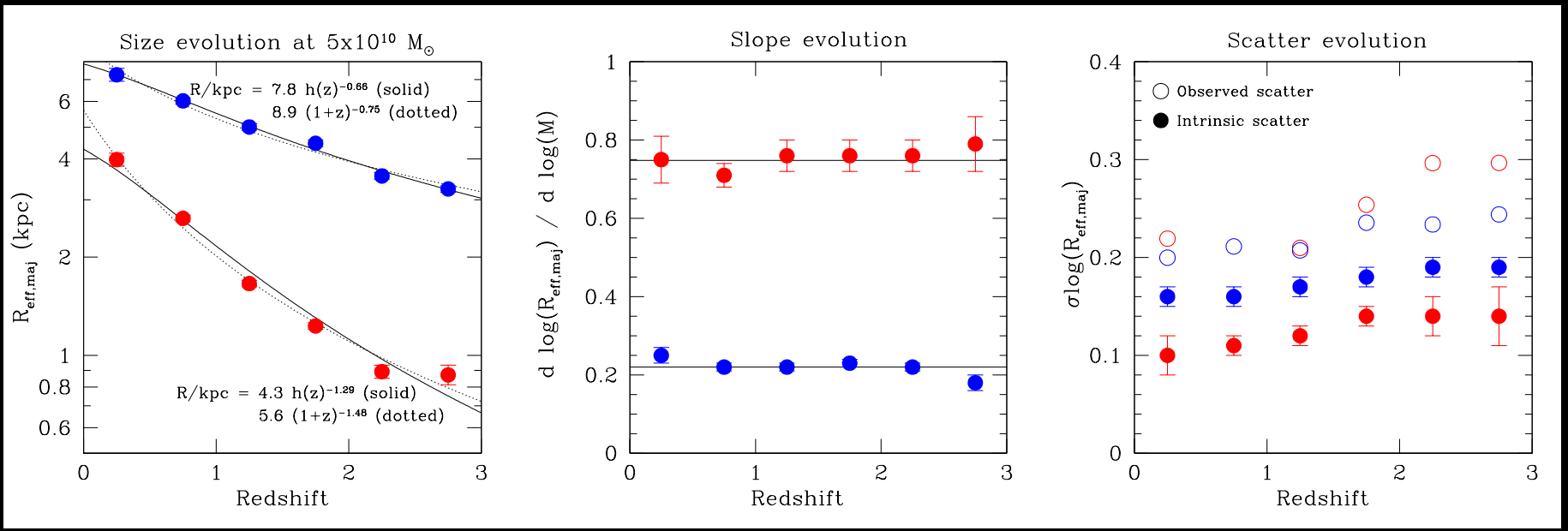
THE UNIVERSITY OF EDINBURGH

ia instituto de astrofísica e ciências do espaço

CENTRO DE ASTRONOMIA E ASTROFÍSICA DA UNIVERSIDADE DE LISBOA CAAUL



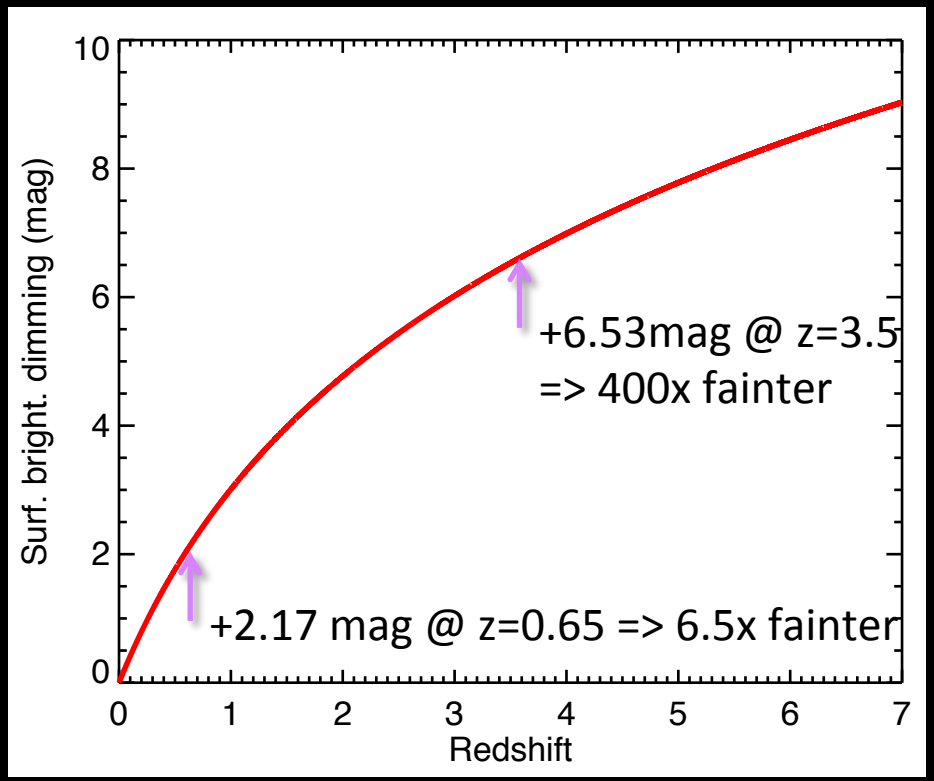
"Inside-out" growth

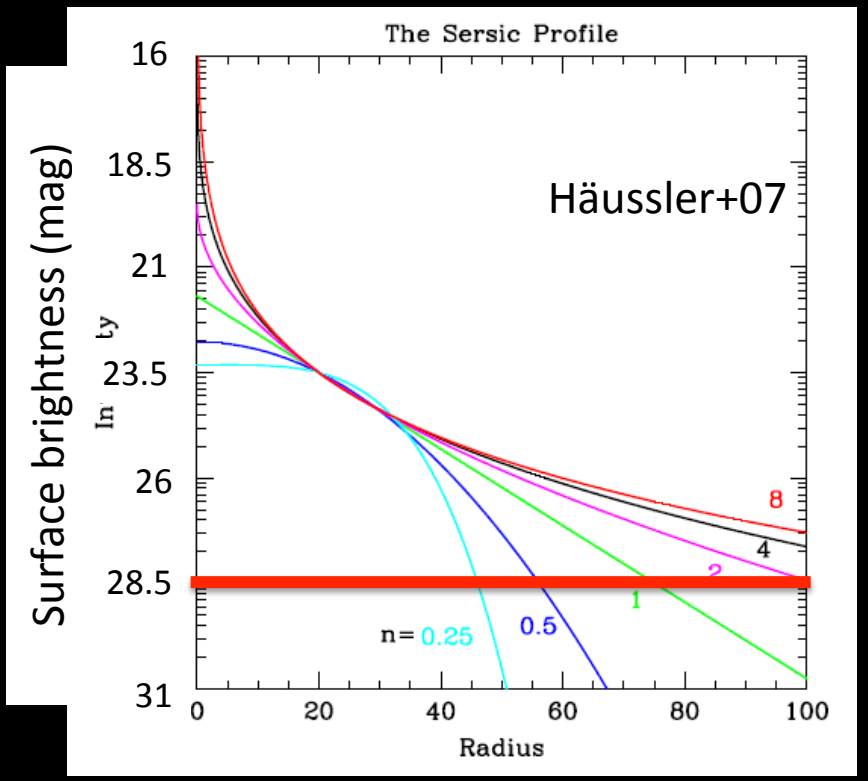


From Van der Wel et al. (2014)

OBSERVATIONAL PROBLEMS

- Surface brightness dimming at high-z
  - The factor $(1+z)^{-4}$ => +10 log (1+z)



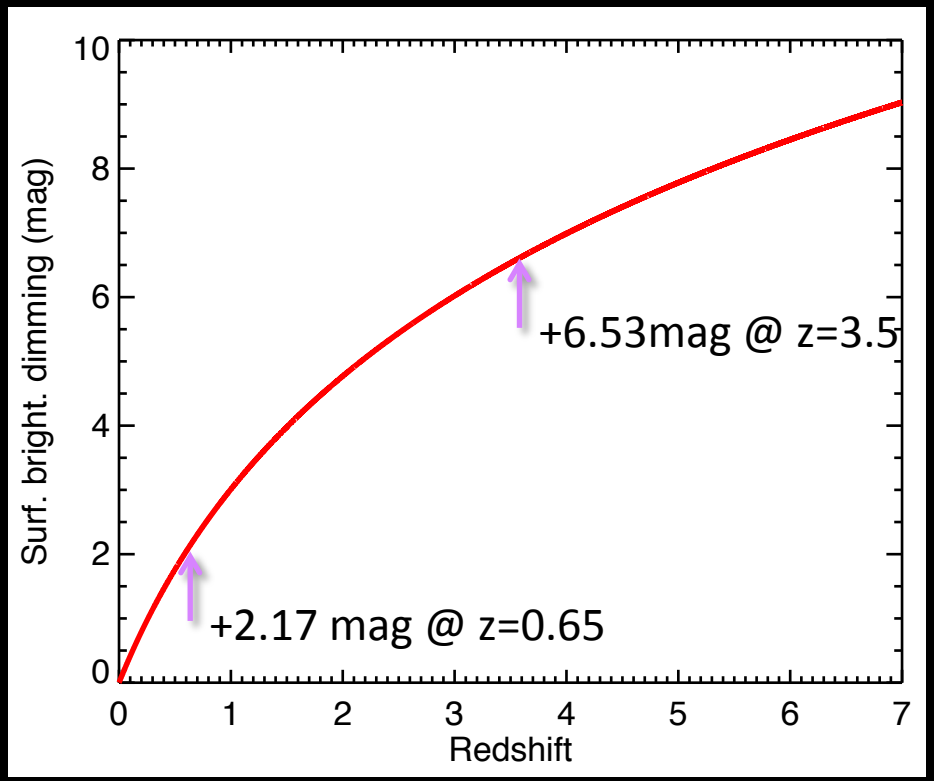


- Early Type Galaxies (ETGs) have very concentrated profiles: wings quickly buried beneath bckg noise

OBSERVATIONAL PROBLEMS

- Surface brightness dimming at high-z
  - The factor $(1+z)^4$ => +10 log (1+z)

z = 0.65



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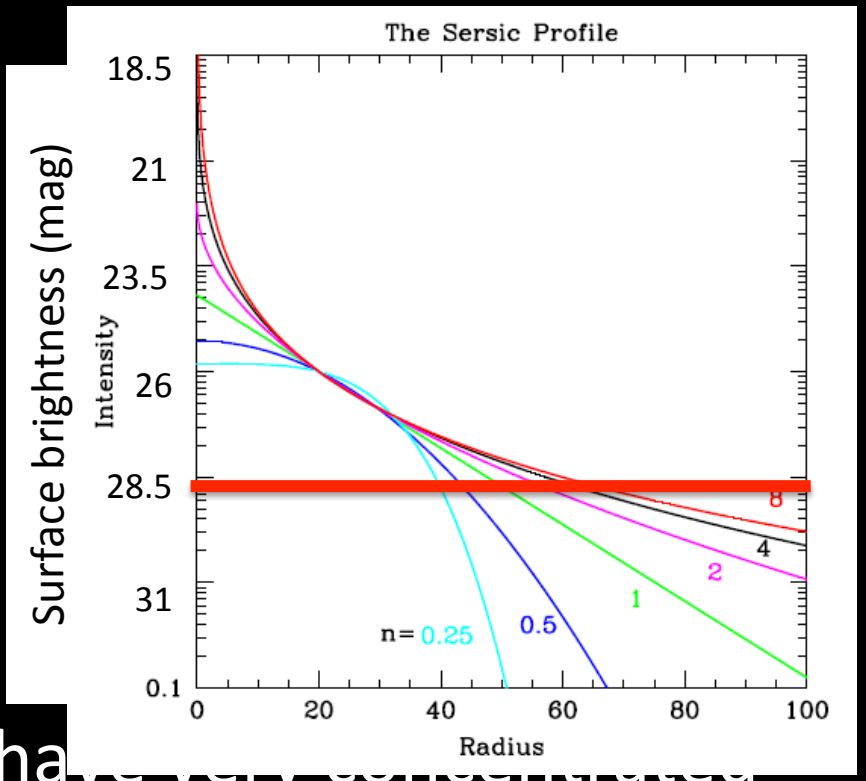


- Early Type Galaxies (ETGs) have very concentrated profiles: wings quickly buried beneath bckg noise

SOLUTIONS AT LOW-Z

- STACKING (Zibetti+04, Tal & Van Dokkum 2009, La Barbera +12)
- DEEP PHOTOMETRY (Zibetti & Ferguson 2004, Van Dokkum 2005, Atkinson+13, Trujillo & Bakos 2013, Duc+15)
- DEEP SPECTROSCOPY (Coccato+10)
- STELLAR COUNTS (Crnojevic+13, Rejkuba+14)

WHAT DO WE KNOW?

- ~70% of nearby ETGs are tidally disrupted
- The observed features are red and extended
- Assembled via red and dry merger
- Very large number of potential satellites

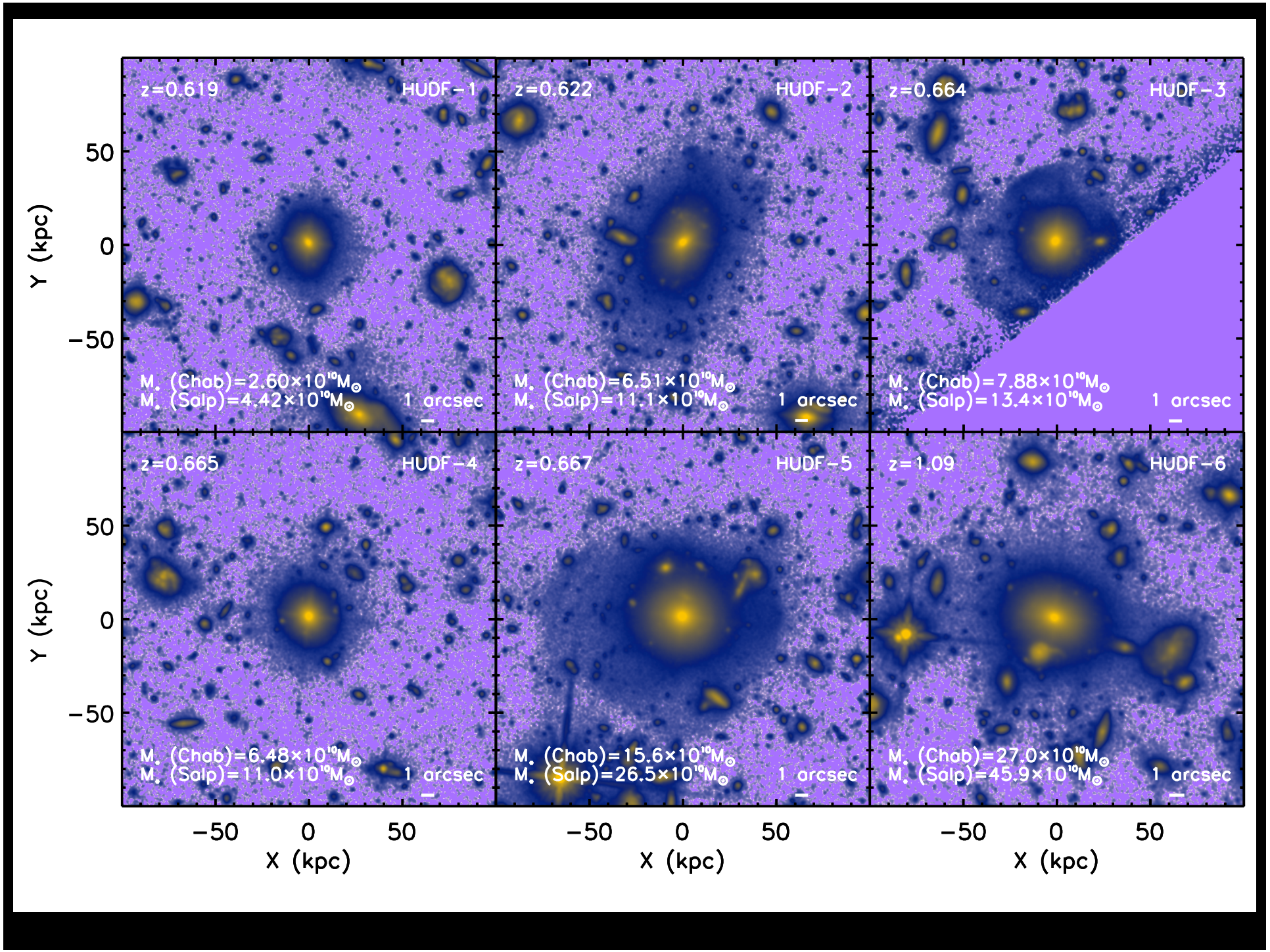
HUDF12
(PI Ellis &
McLure)
Ellis et al.
2012
Koekemoer
et al. 2012

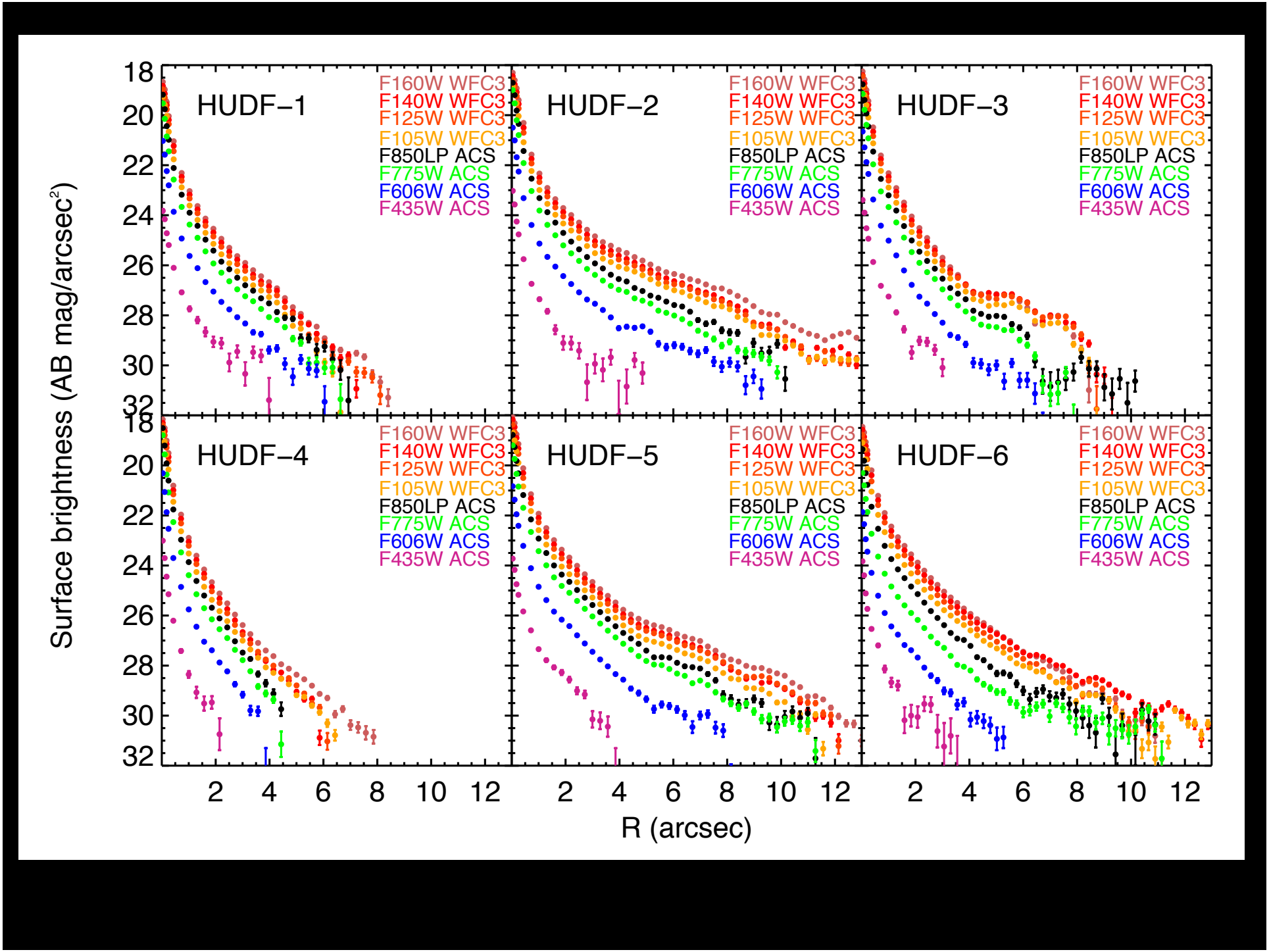
x2 in WFC3,
x4 in Y_{105},
first time J_{140}

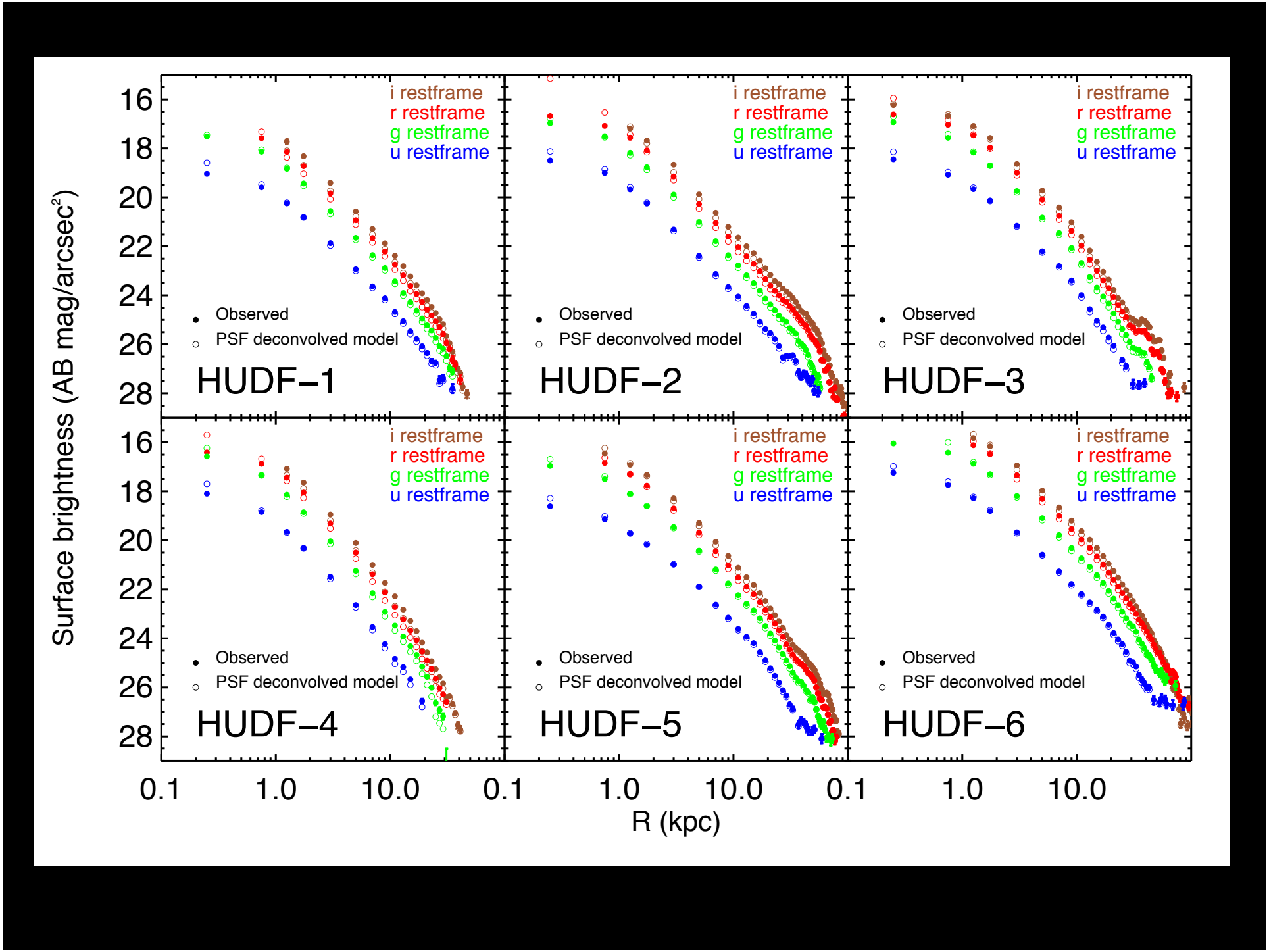
+ ACS optical
coverage

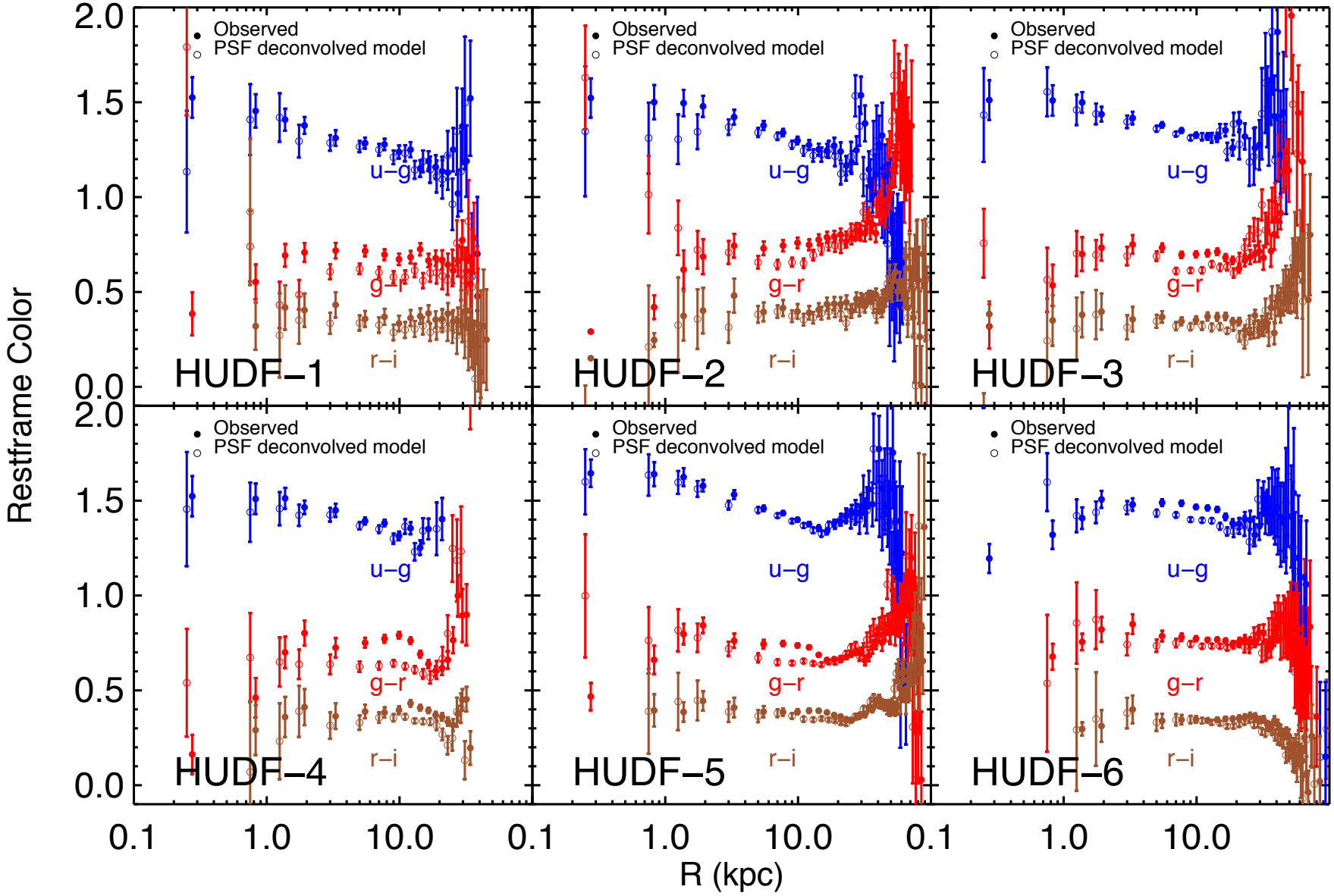
653 orbits
5σ~30 mag”^{2}

CAUTION :
Providing the right data reduction, our deep high-z extragalactic deep & wide surveys could be key to understand the low-z Universe

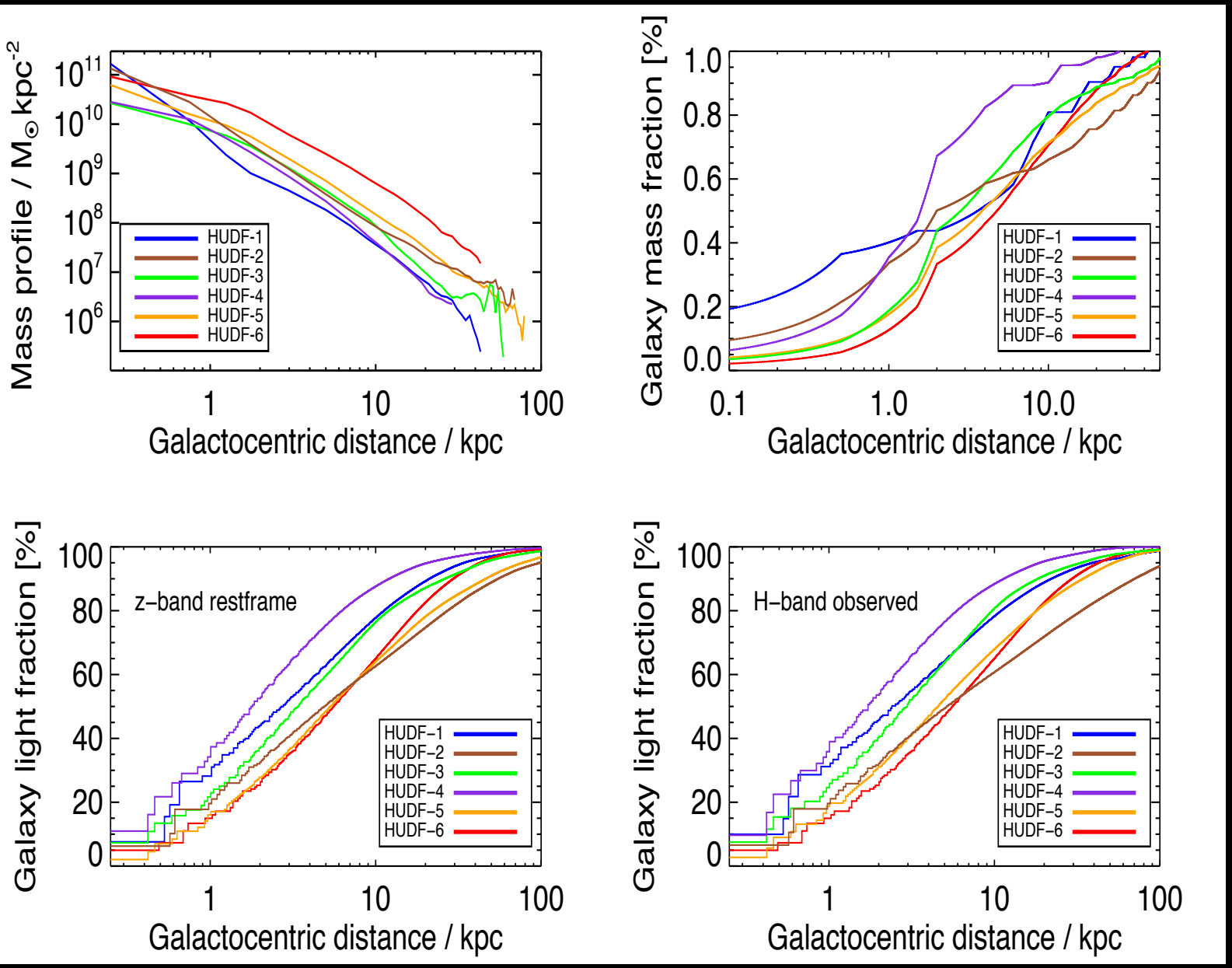

z=0.619
HUDF−1
M* (Chab)=2.60×10¹⁰M⊙
M* (Salp)=4.42×10¹⁰M⊙
1 arcsec
z=0.622
HUDF−2
M* (Chab)=6.51×10¹⁰M⊙
M* (Salp)=11.1×10¹⁰M⊙
1 arcsec
z=0.664
HUDF−3
M* (Chab)=7.88×10¹⁰M⊙
M* (Salp)=13.4×10¹⁰M⊙
1 arcsec
z=0.665
HUDF−4
M* (Chab)=6.48×10¹⁰M⊙
M* (Salp)=11.0×10¹⁰M⊙
1 arcsec
z=0.667
HUDF−5
M* (Chab)=15.6×10¹⁰M⊙
M* (Salp)=26.5×10¹⁰M⊙
1 arcsec
z=1.09
HUDF−6
M* (Chab)=27.0×10¹⁰M⊙
M* (Salp)=45.9×10¹⁰M⊙
1 arcsec
Y (kpc)
50
0
−50
X (kpc)
−50
0
50


HUDF−1
HUDF−2
HUDF−3
HUDF−4
HUDF−5
HUDF−6
F160W WFC3
F140W WFC3
F125W WFC3
F105W WFC3
F850LP ACS
F775W ACS
F606W ACS
F435W ACS
Surface brightness (AB mag/arcsec²)
R (arcsec)
18
20
22
24
26
28
30
32
2
4
6
8
10
12

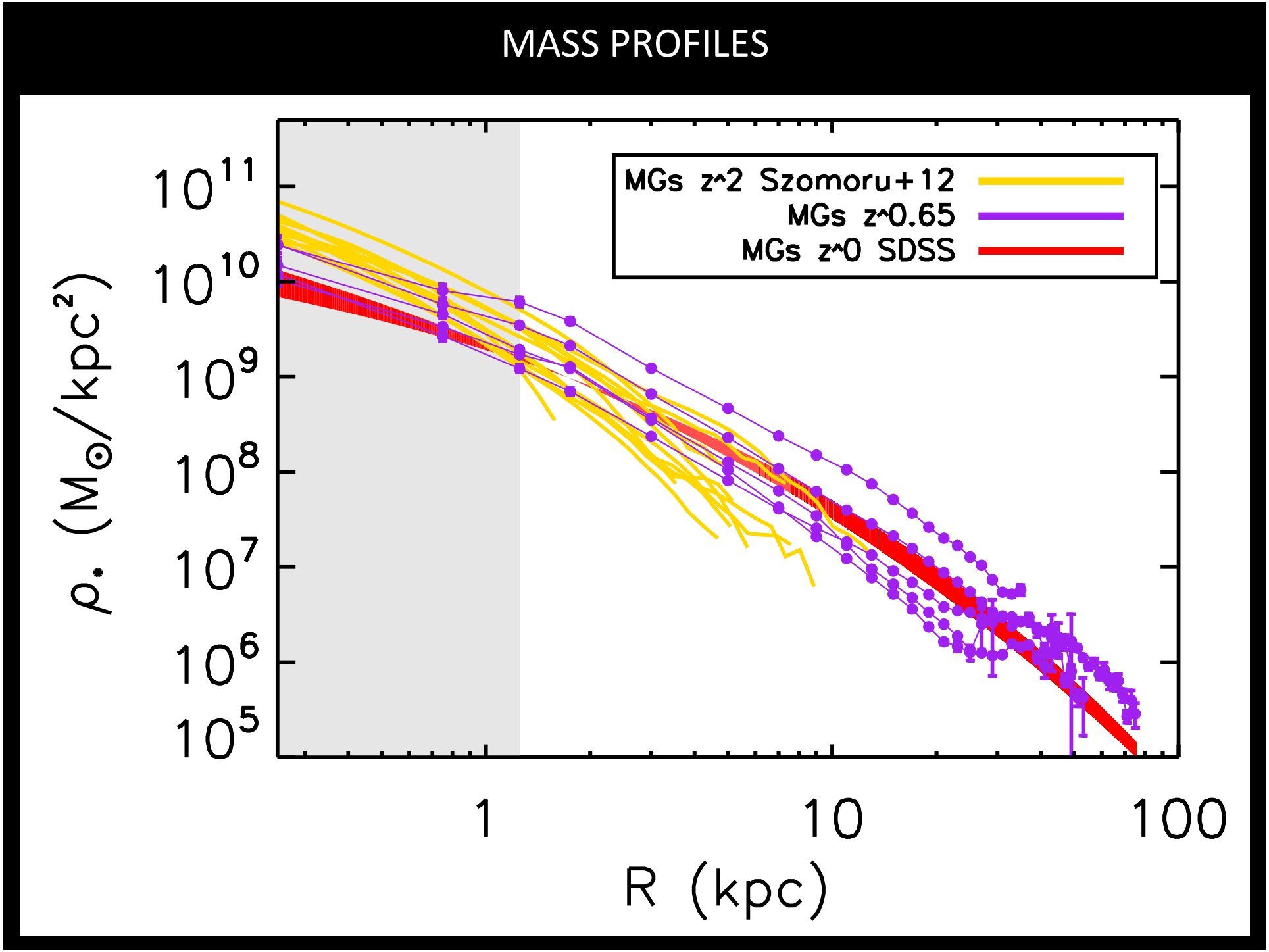

Surface brightness (AB mag/arcsec^2)
R (kpc)
i restframe
r restframe
g restframe
u restframe
Observed
PSF deconvolved model
HUDF–1
HUDF–2
HUDF–3
HUDF–4
HUDF–5
HUDF–6
16
18
20
22
24
26
28
0.1
1.0
10.0


Observed
PSF deconvolved model
u−g
g−r
r−i
HUDF−1
HUDF−2
HUDF−3
HUDF−4
HUDF−5
HUDF−6
Restframe Color
R (kpc)
0.0
0.5
1.0
1.5
2.0
0.1
1.0
10.0

MASS AND LIGHT CUMULATIVE DISTRIBUTIONS

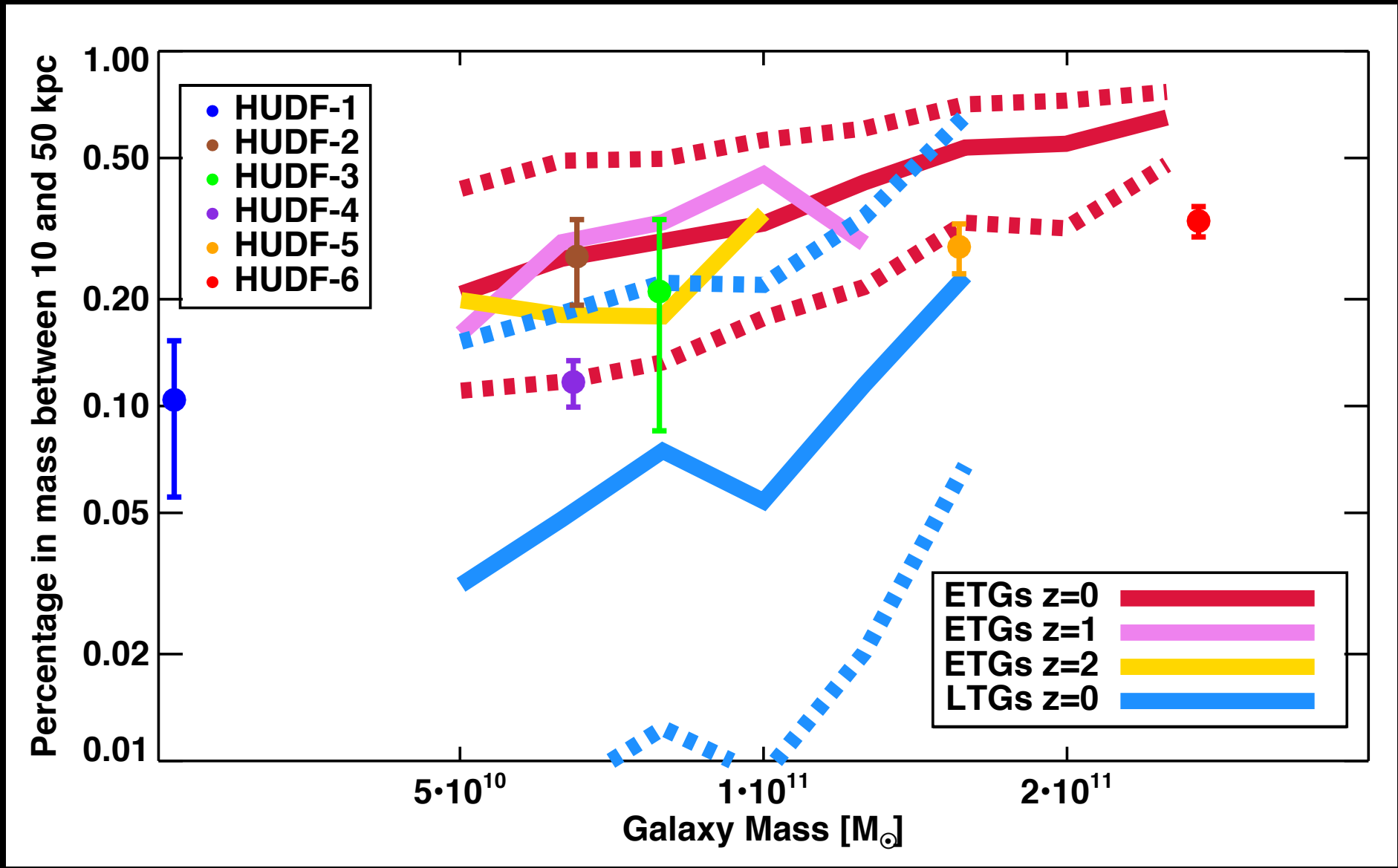


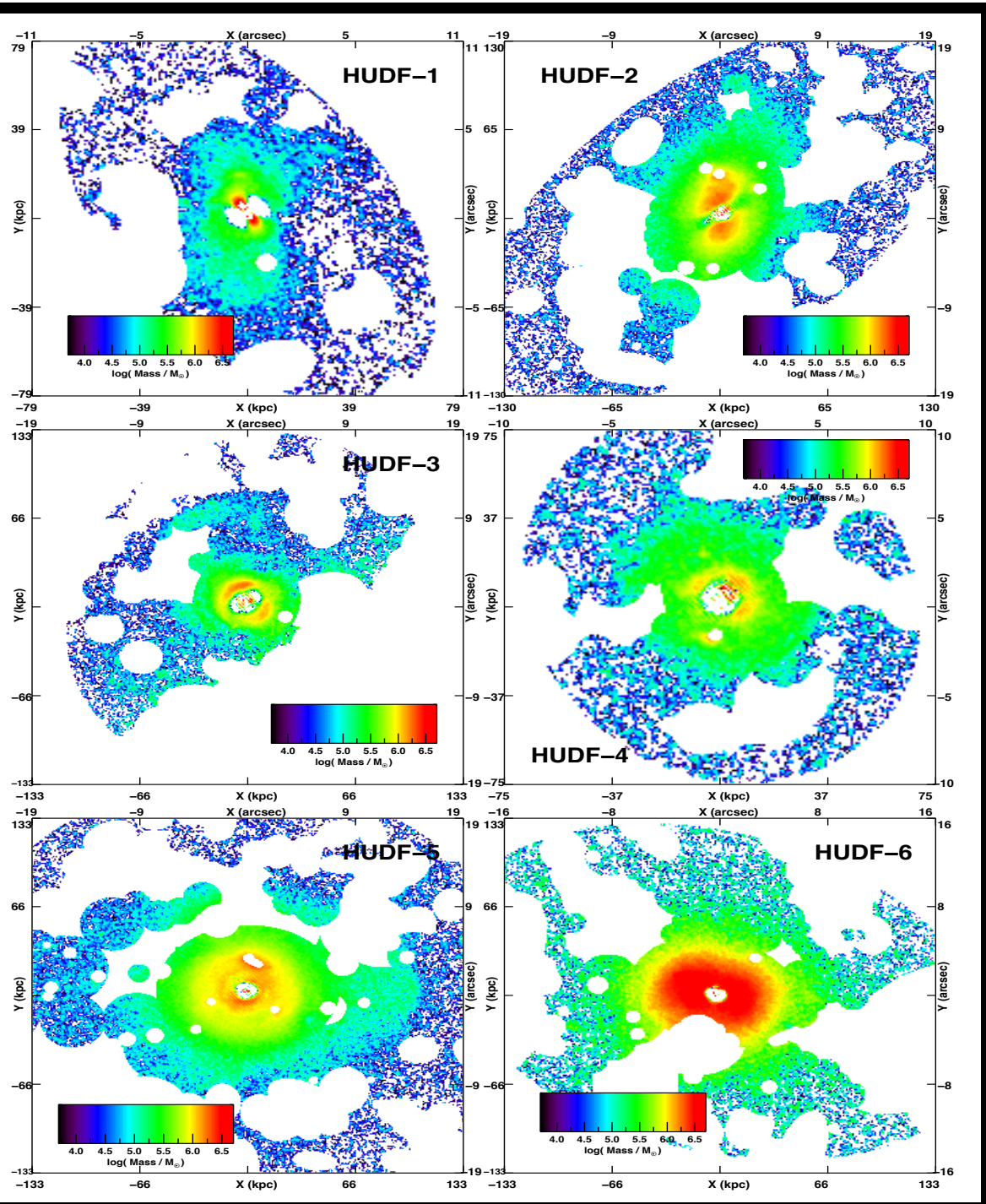
MASS PROFILES



THE IMPORTANCE OF STELLAR HALOES IN SIMULATIONS

Based on Cooper et al. (2013) simulations





AMOUNT OF MASS IN ONGOING MERGING

Galaxy name	Mass in residuals $M_\odot$	% of galaxy's mass
HUDF-1	$9.72\pm0.88\times10^{8}$	3.7 ± 0.3
HUDF-2	$5.57\pm0.29\times10^{9}$	8.5 ± 0.5
HUDF-3	$2.55\pm0.20\times10^{9}$	3.2 ± 0.3
HUDF-4	$1.21\pm0.74\times10^{9}$	1.9 ± 1.1
HUDF-5	$8.82\pm0.33\times10^{9}$	5.6 ± 0.2
HUDF-6	$1.13\pm0.20\times10^{10}$	4.2 ± 0.7
Total	-	4.5 ± 0.3

In agreement with close pairs estimations (see Ferreras et al. 2014)

CONCLUSIONS

- ΛCDM predicts minor and major merging ubiquous, specially for massive galaxies
  - ETGs should grow inside-out
- Stellar haloes in ETGs… at <z> = 0.65!!
- Smooth surface brightness profiles up to 29 mag arcsec^{-2}
- 10-20% mass at 10 < R < 50 kpc, as opposed with late-types (<10%)
- 5% of the galaxy mass in ongoing mergers

STAY TUNED FOR BUITRAGO ET AL. (2015a,b)