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# WHAT IS A HALO?



# WHAT ABOUT AN ETG?

It's just a big halo (1<sup>st</sup> order approx)



But the strong size evolution of massive galaxies implies they should create an envelope of accreted material





#### OBSERVATIONAL PROBLEMS → 3 for CCDs (Giavalisco+96)

Surface brightness dimming at high-z

- The factor  $(1+z)^{+} => +10 \log (1+z)$ 



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

# **OBSERVATIONAL PROBLEMS**

z = 0.65

Surface brightness dimming at high-z
The factor (1+z)<sup>3</sup> => +7.5 log (1+z)



#### • PSF!!

- You should take a PSF size of x1.5 the galaxy apparent size (Sandin 2014, 2015)
- Otherwise, you will suffer the spurious red halo problem (La Barbera+12)





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

x2 in WFC3, x4 in Y<sub>105</sub>, first time J<sub>140</sub>

+ ACS optical coverage

653 orbits 5σ~30 mag"<sup>2</sup>



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





Up to 12 arcsec – 100 kpc at those redshifts – 25 effective radii  $\rightarrow$  Same as for local Universe galaxies!







## MASS AND LIGHT CUMULATIVE DISTRIBUTIONS



## **STELLAR MASS PROFILES**



#### Accreted mass in sims → the importance of the stellar halo Comparing with Cooper+13 simulations



# AMOUNT OF MASS IN ONGOING MERGING

Close pairs expectations

– Van Dokkum 2005

– Ferreras+14

Galaxy % light in residuals Mass in residuals (1)% galaxy's mass (2) Mass in residuals (2) $M/L_{galaxy}$  $M/L_{residuals}$ Mo Mo  $2.50 \times 10^{8}$  $1.24 \times 10^{9}$ HUDF-1 0.96 0.290.354.76  $2.93 \times 10^{9}$  $1.97 \times 10^{9}$ HUDF-2 3.02 0.280.274.49 $1.41 \times 10^9$  $1.41 \times 10^9$ HUDF-3 1.790.320.301.79HUDF-4 0.35 $2.29 \times 10^{8}$ 0.68  $4.37 \times 10^{8}$ 0.290.17HUDF-5  $2.20 \times 10^{9}$  $5.78 \times 10^9$ 1.41 0.410.503.70HUDF-6  $9.31 \times 10^8$  $5.51 \times 10^8$ 0.340.38 0.110.20  $1.17 \times 10^{9}$  $2.06 \times 10^9$ Mean values 1.31 2.60\_ \_

 $\frac{\Delta M/M}{M} = 0.08 \pm 0.02 \ Gyr^{-1}$ 

 $\frac{\Delta M/M}{M} = 0.09 \pm 0.04 \quad Gyr^{-1}$ 

How long these red features last? 150 Myr (Bell+06), 0.4-1 Gyr (Conselice+06,09, Lotz+08)

=>Consistent with an evolution solely driven by merging



# CONCLUSIONS

- ACDM predicts minor and major merging ubiquous, specially for massive galaxies
  - Haloes must be there, especially considering ETGs should grow inside-out
- Stellar haloes in ETGs... at <z> = 0.65!!
- Smooth surface brightness profiles up to 31 mag arcsec<sup>-2</sup> (up to 100 kpc, 25 r<sub>e</sub>)
- 10-20% mass at 10 < R < 50 kpc, as opposed with late-types (<10%)</li>
- Evolution solely driven by mergers STAY TUNED FOR BUITRAGO ET AL. 2016