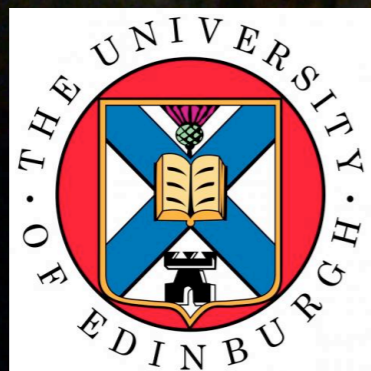


EVOLUTION OF MASSIVE GALAXIES IN THE ERA OF LARGE AREA SURVEYS



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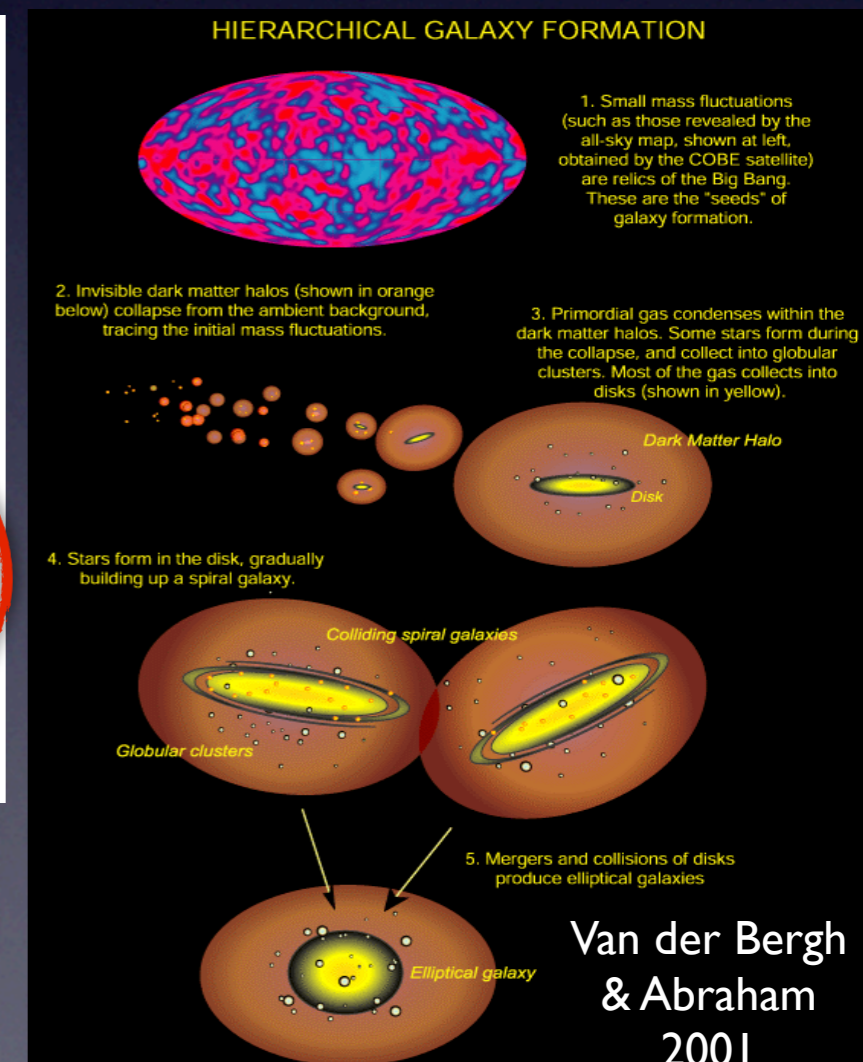
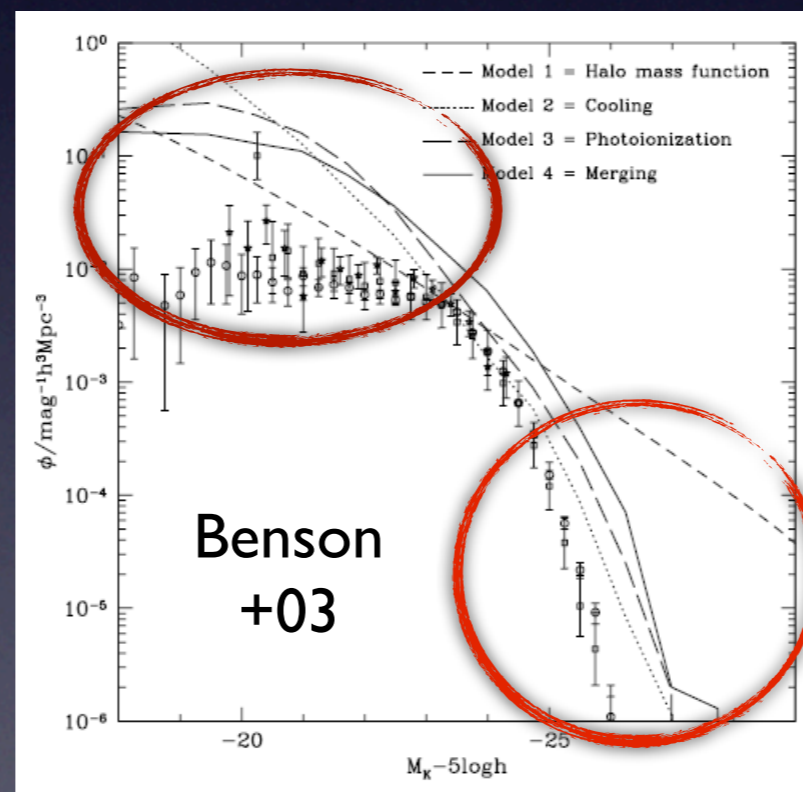
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- Massive galaxies in a Λ CDM Universe
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- 3D spectroscopy confirmation
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MASSIVE GALAXIES IN A Λ CDM UNIVERSE

Massive galaxies: $M_{\text{stellar}} > 10^{11} M_{\odot}$

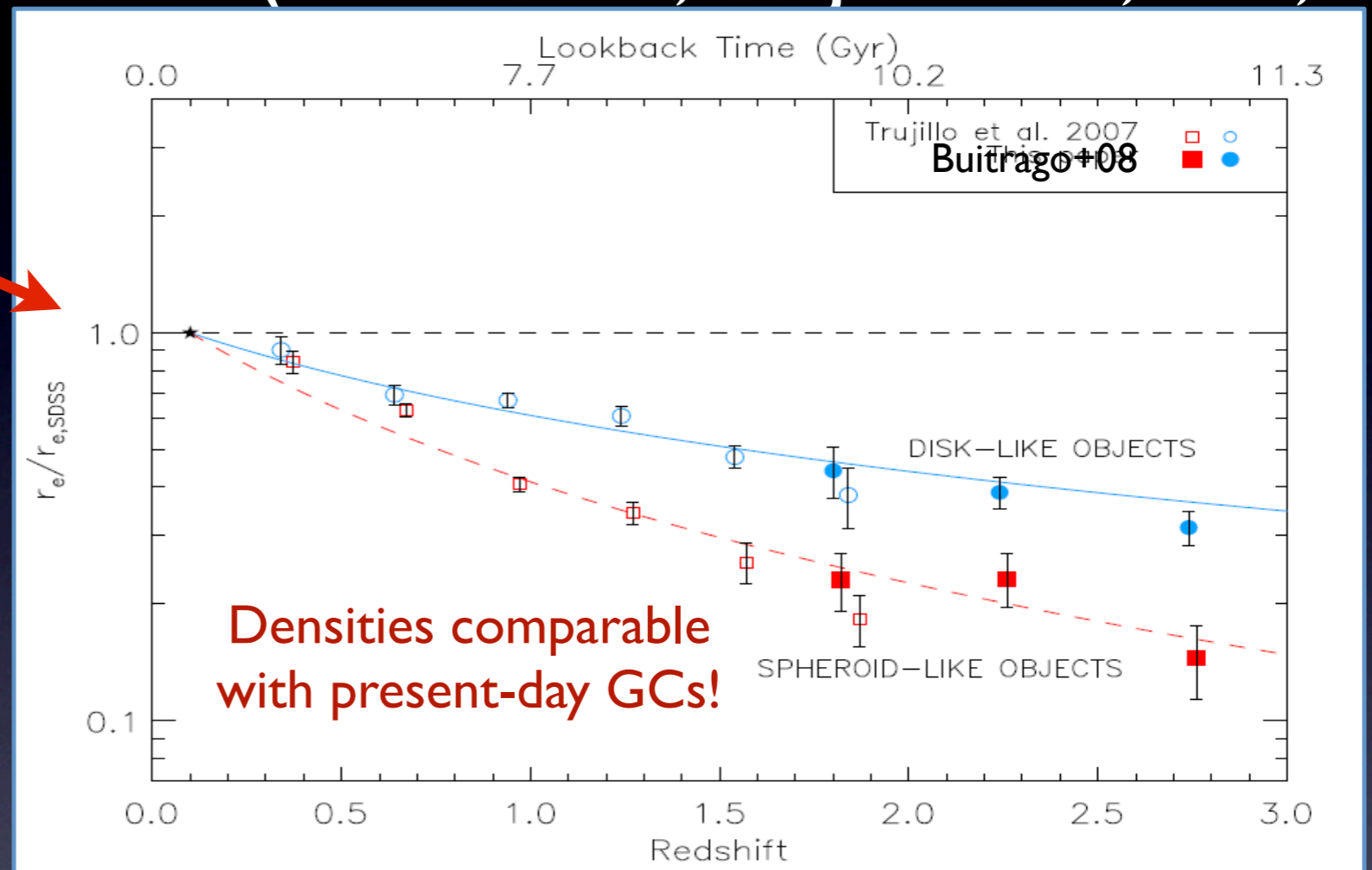
- Scarcity
- Drivers of the environment (semi-analytical models)
- Smaller number densities than predicted by galaxy formation models



- Hard to reconcile with Λ CDM?

OBSERVATIONAL PROPERTIES

- Extreme size evolution (Daddi+05, Trujillo+06,+07, Buitrago+08,...)



Likely origin: very dissipative merging (Ricciardelli+09, Targett+11, Swinbank+11)

- Not so quiescent as previously thought (Cava+10, Viero+11)
- Cores of present-day BCGs (Bezanson+09, Hopkins+09), but see Trujillo+09,+12 in prep.

GOODS NICMOS SURVEY

180 orbits HST program
NICMOS 3 camera F160W (H) band
P.I. Christopher J. Conselice (Nottingham)
60 pointings, 45 arcmin², > 8000 galaxies in total
Pixel scale 0.1", PSF ~ 0.3", Limiting mag. H = 26.8 (5 σ)
Details in Conselice+11 (+FB)
or visit <http://www.nottingham.ac.uk/astronomy/gns/>



80 galaxies $\geq 10^{11} M_{\odot}$ at $1.7 \leq z \leq 3$

BzK galaxies (Daddi et al. 2007)

IRAC-selected Extremely Red Objects, IEROs (Yan et al. 2004)

Distant Red Galaxies, DRGs (Papovich et al. 2006)

... and now waiting for CANDELS to come (Bruce+12 in prep.)

Many works focussed specially in massive galaxy evolution:

Merging (Bluck+09,+11a)

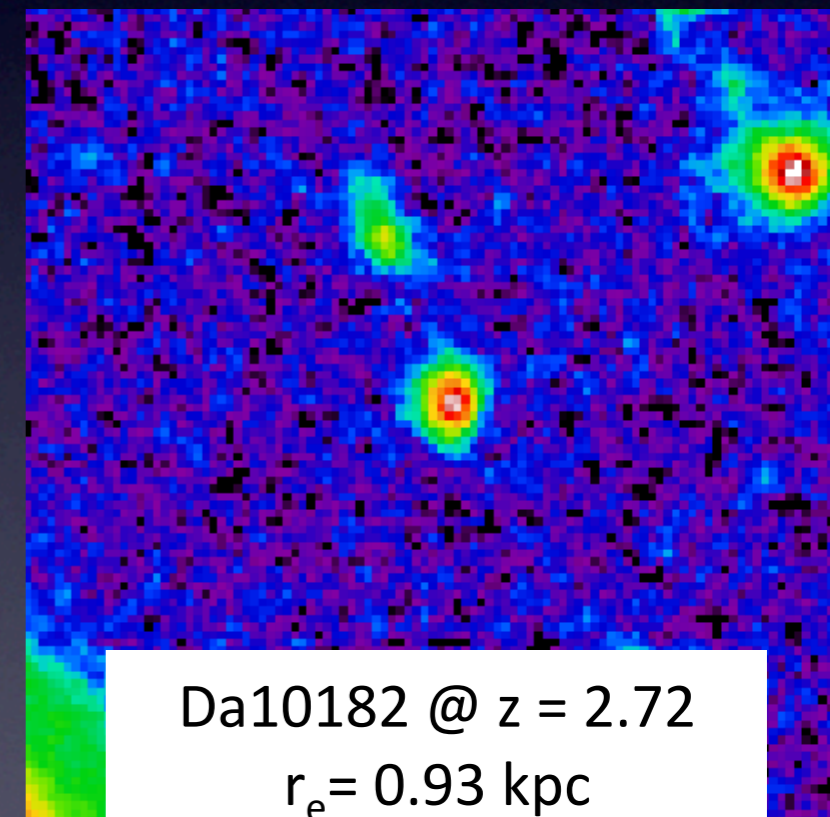
SMBHs (Bluck+11b)

SFR (Bauer+10)

Environments (Grützbauch+10)

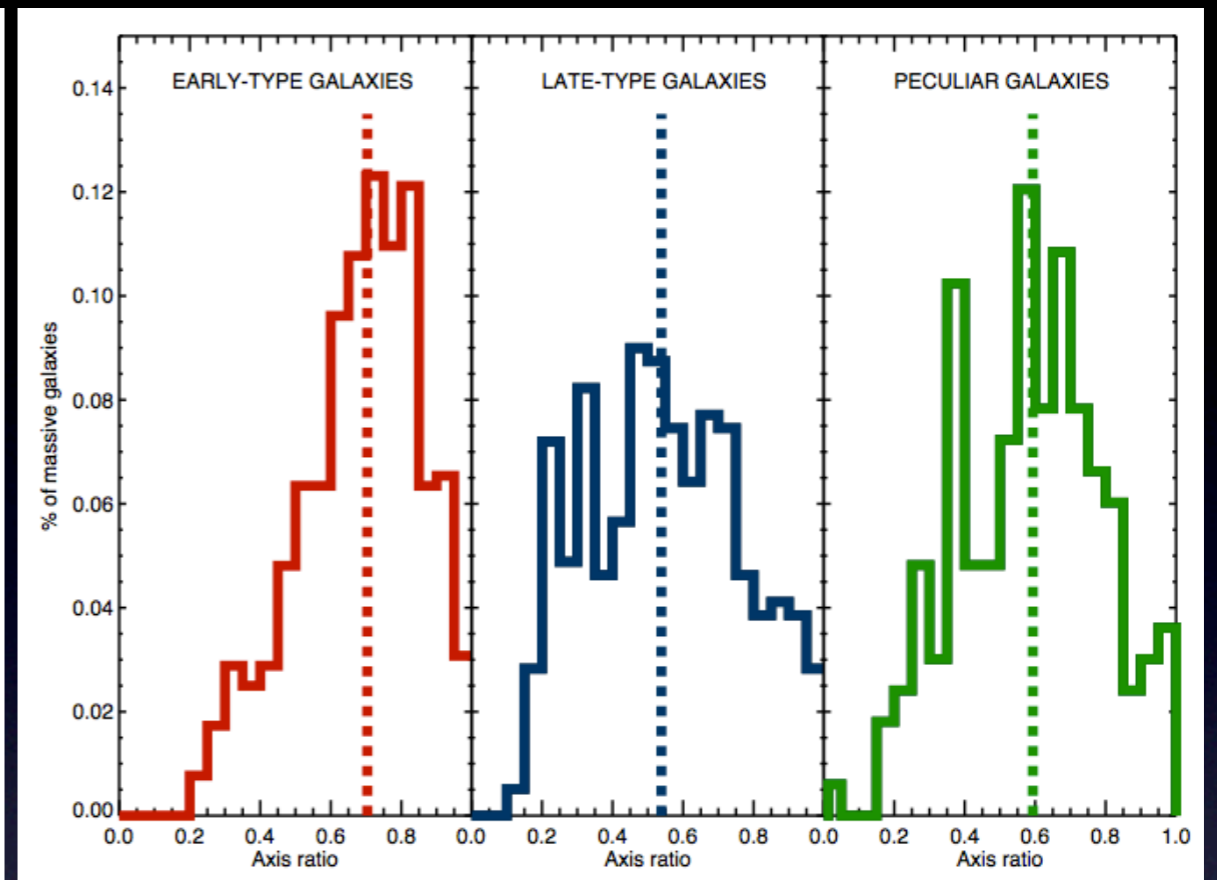
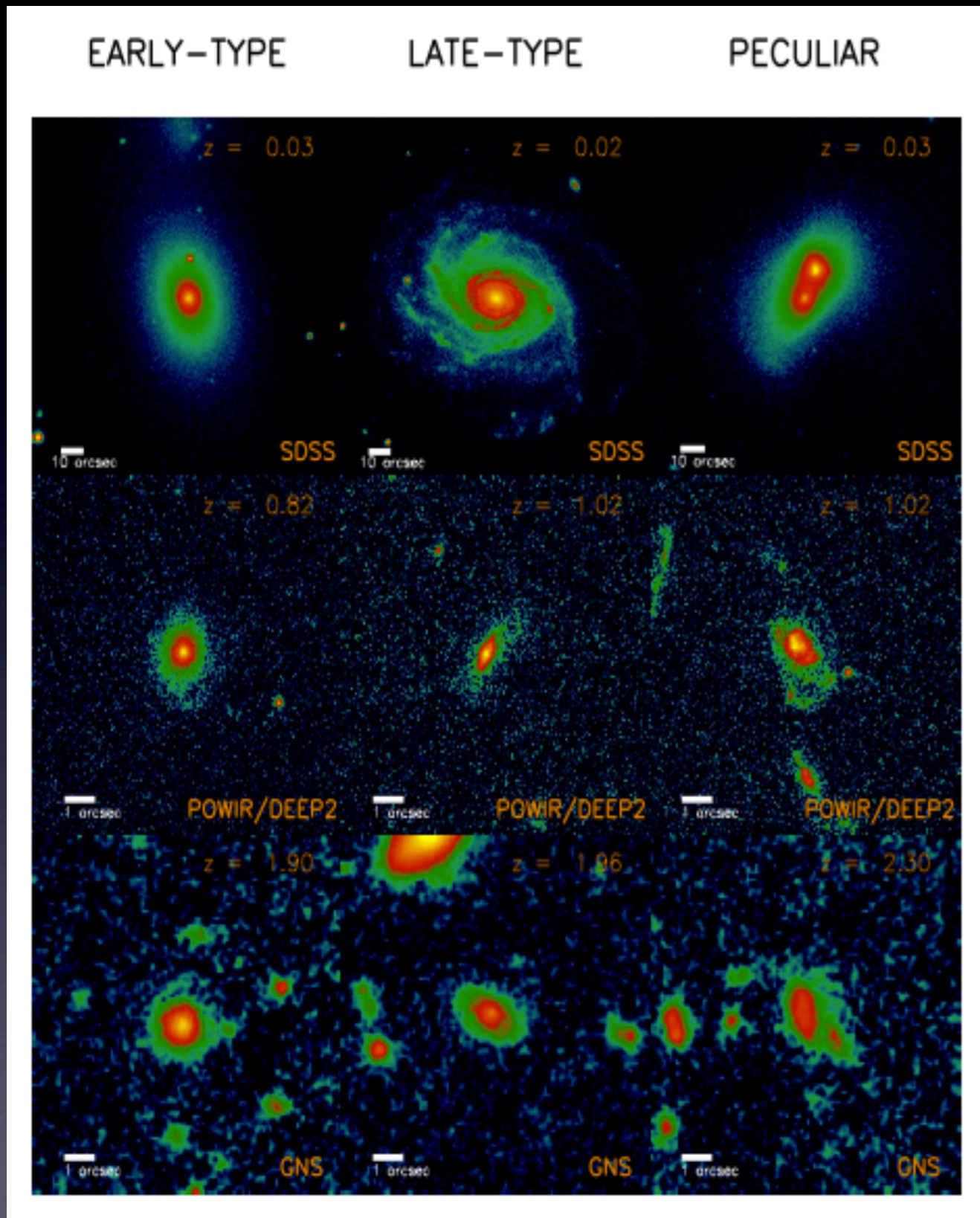
Mass functions (Mortlock+11)

Luminosity profiles (Onsworth+12 in prep.)

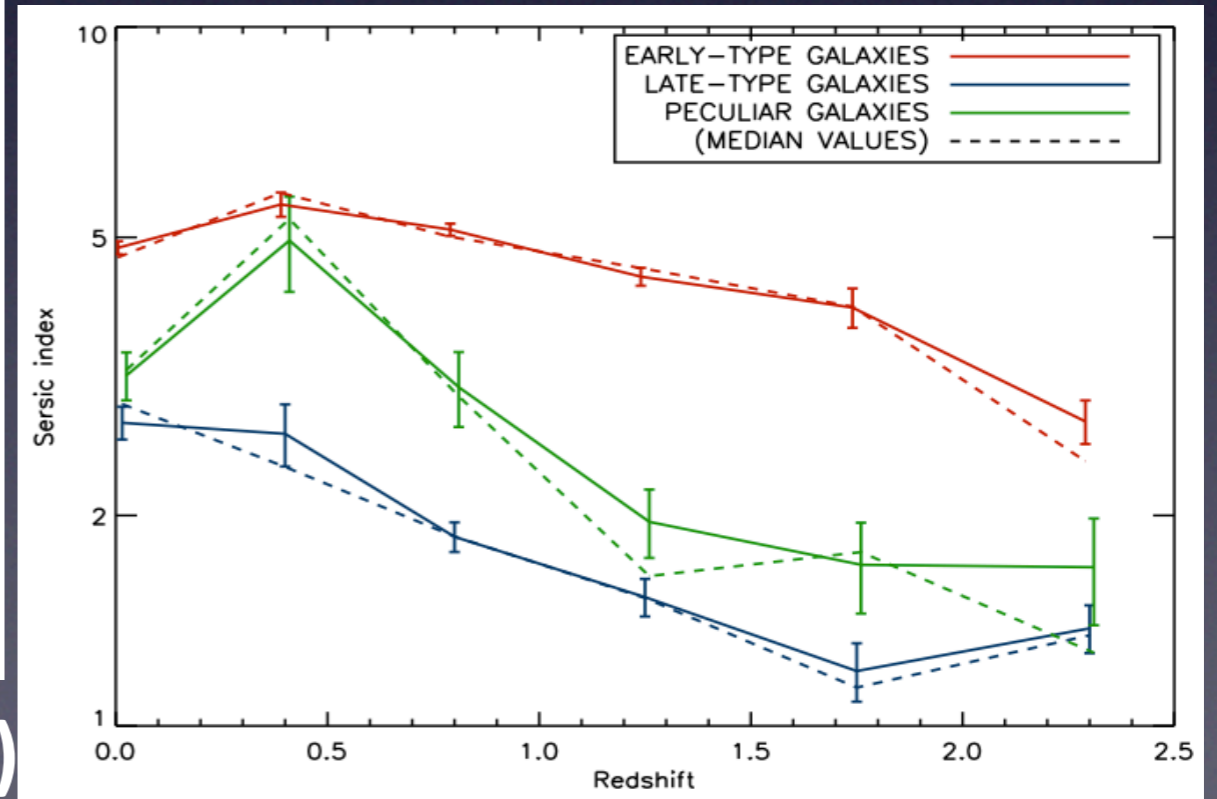


Da10182 @ $z = 2.72$
 $r_e = 0.93$ kpc
Mass = $1.91 \times 10^{11} M_{\odot}$

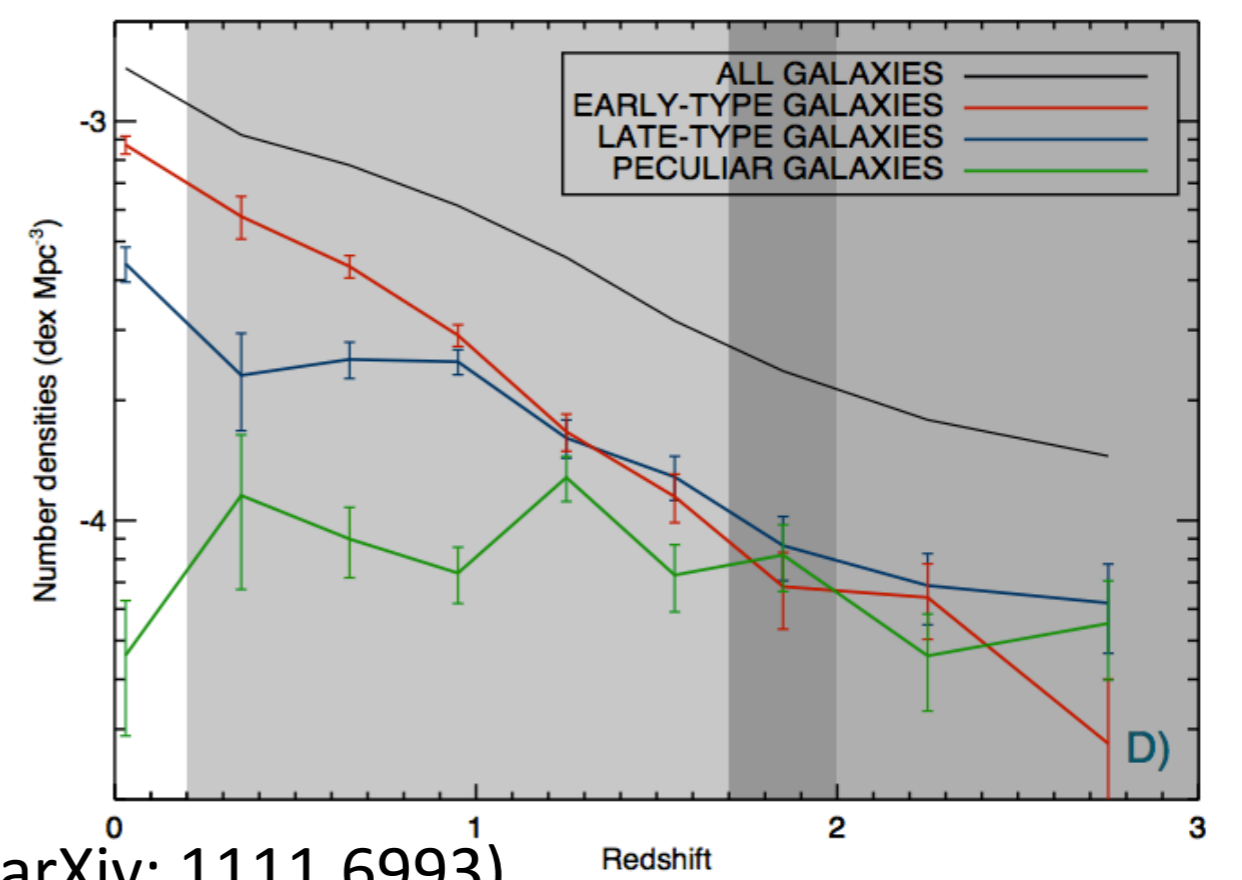
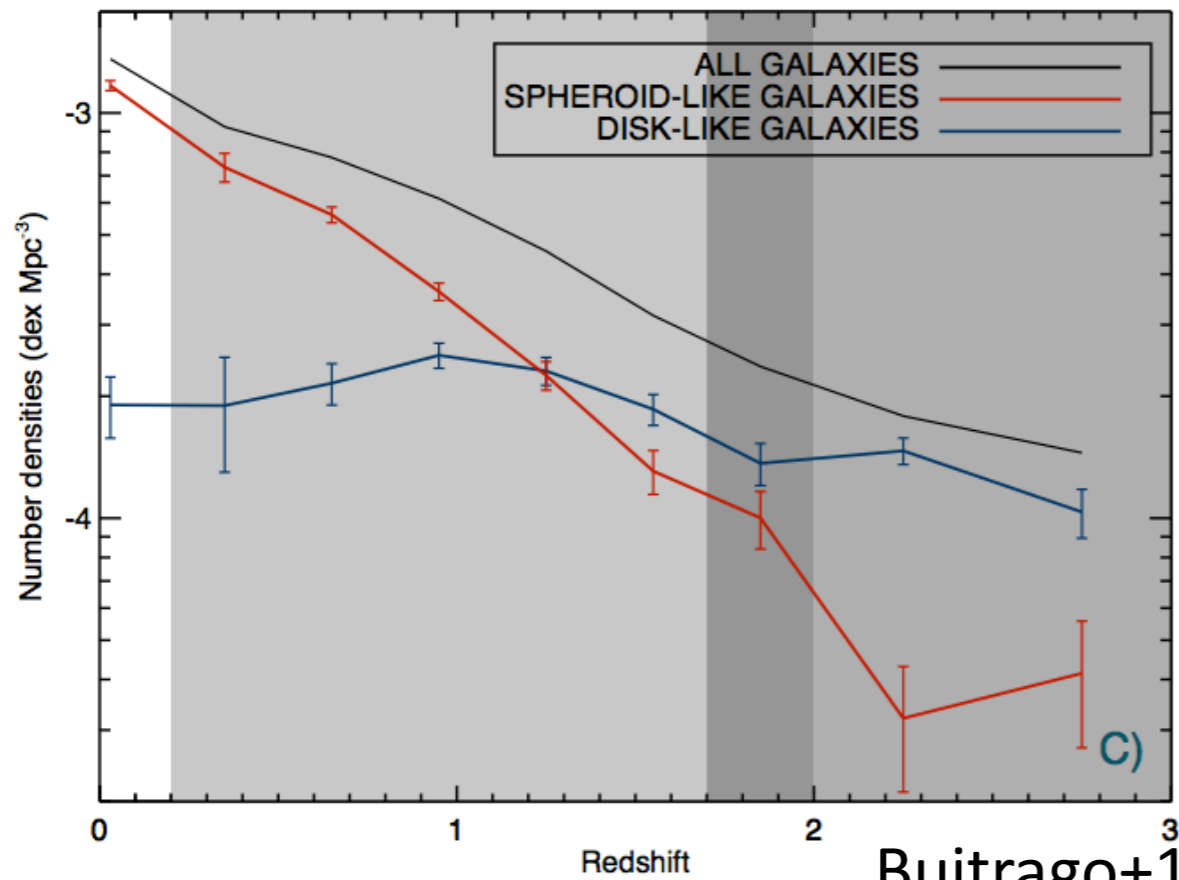
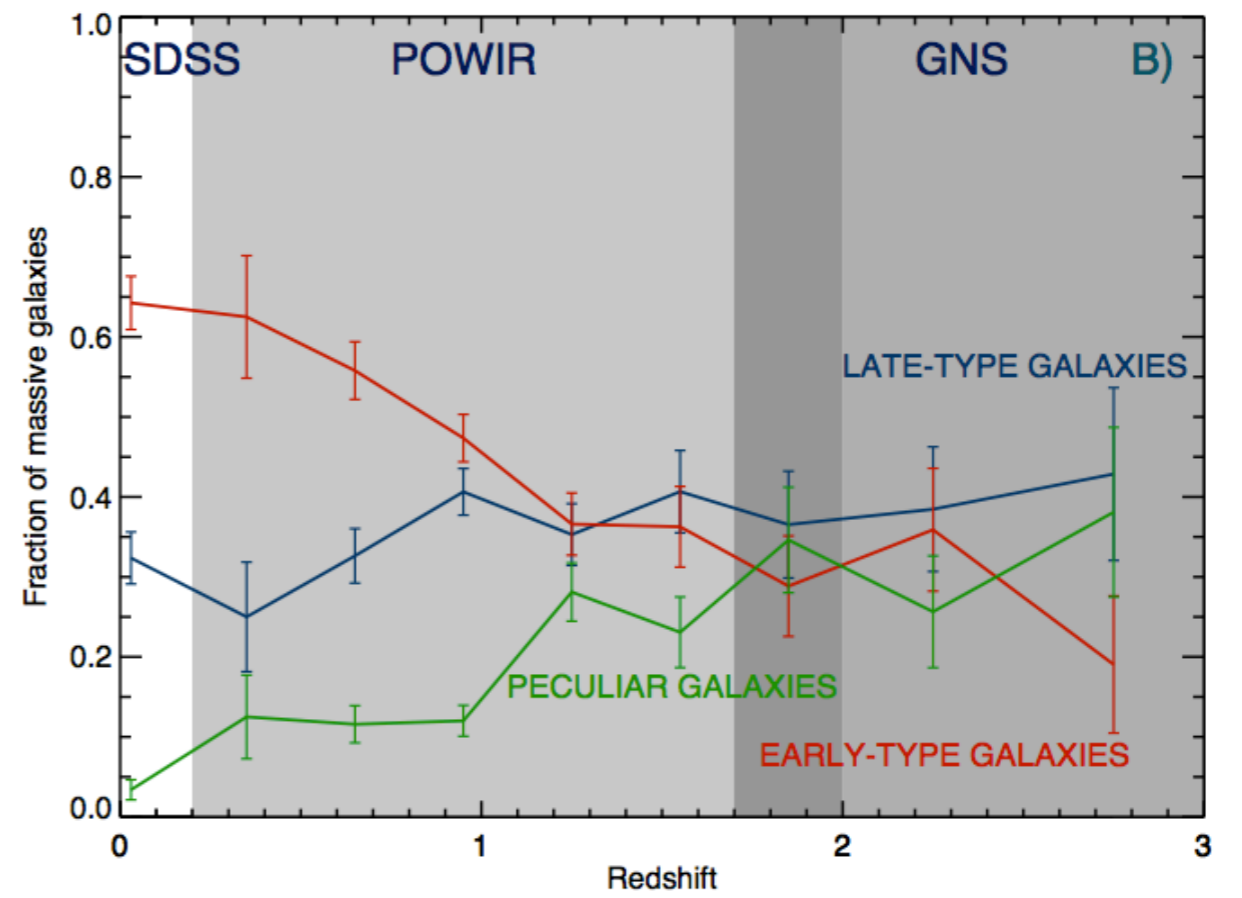
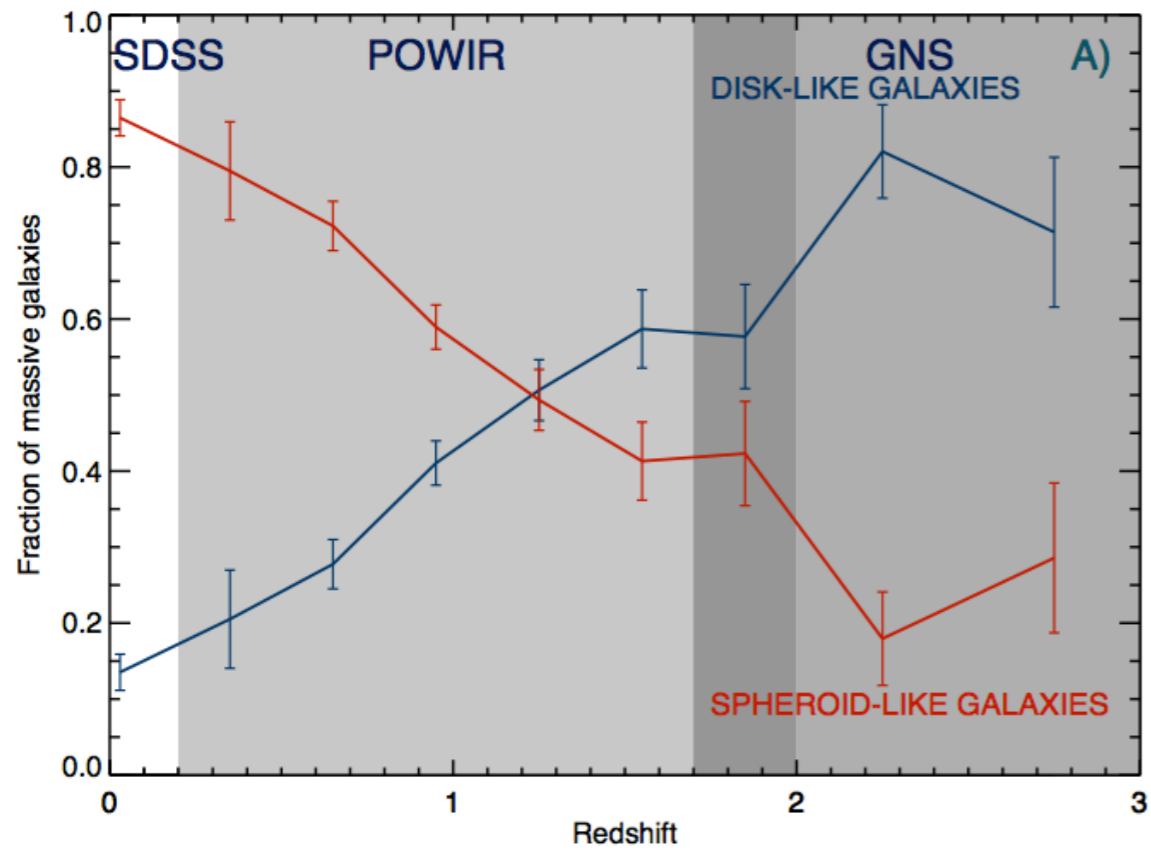
MORPHOLOGICAL TRANSFORMATION



See also Van der Wel+11



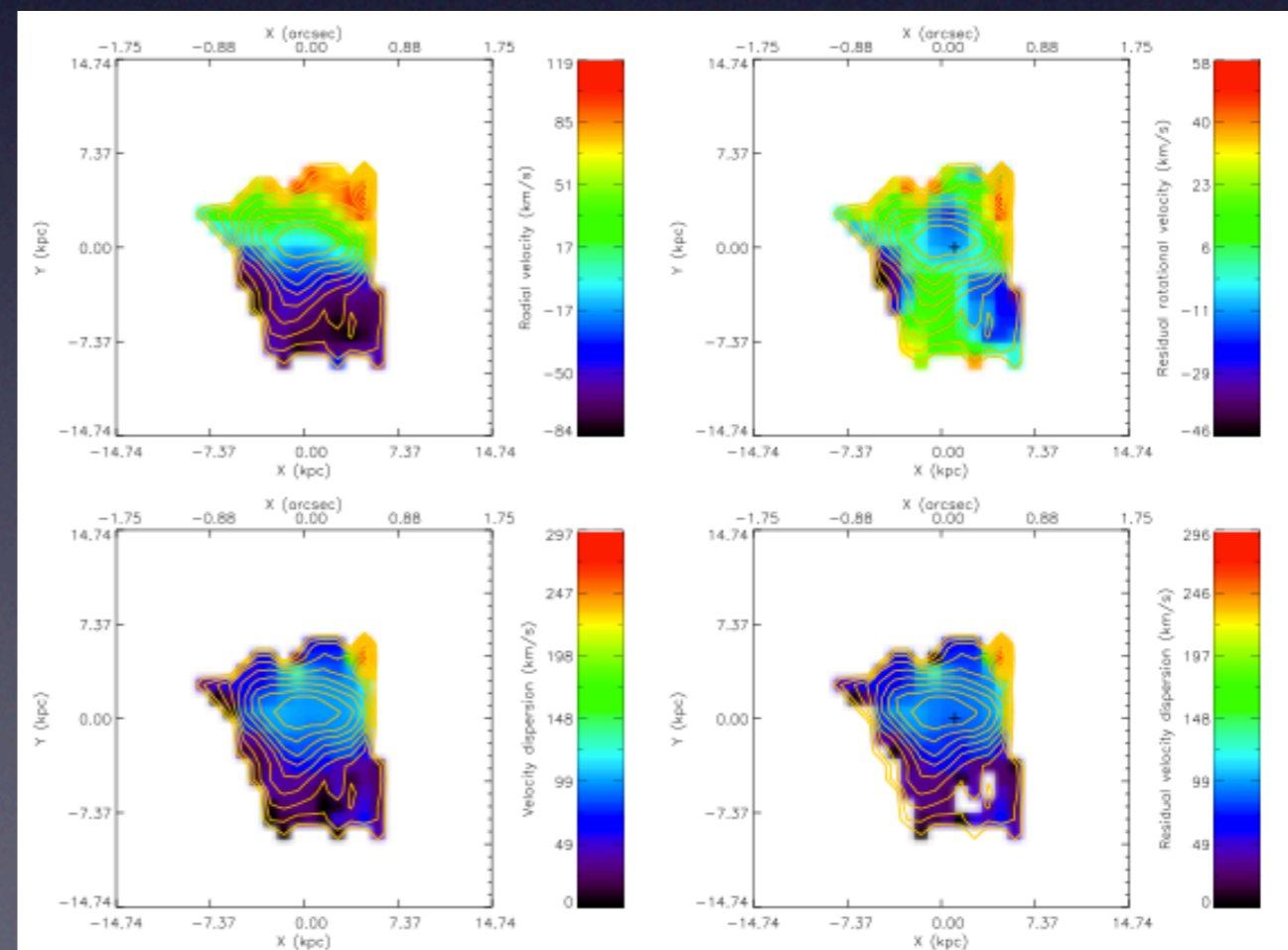
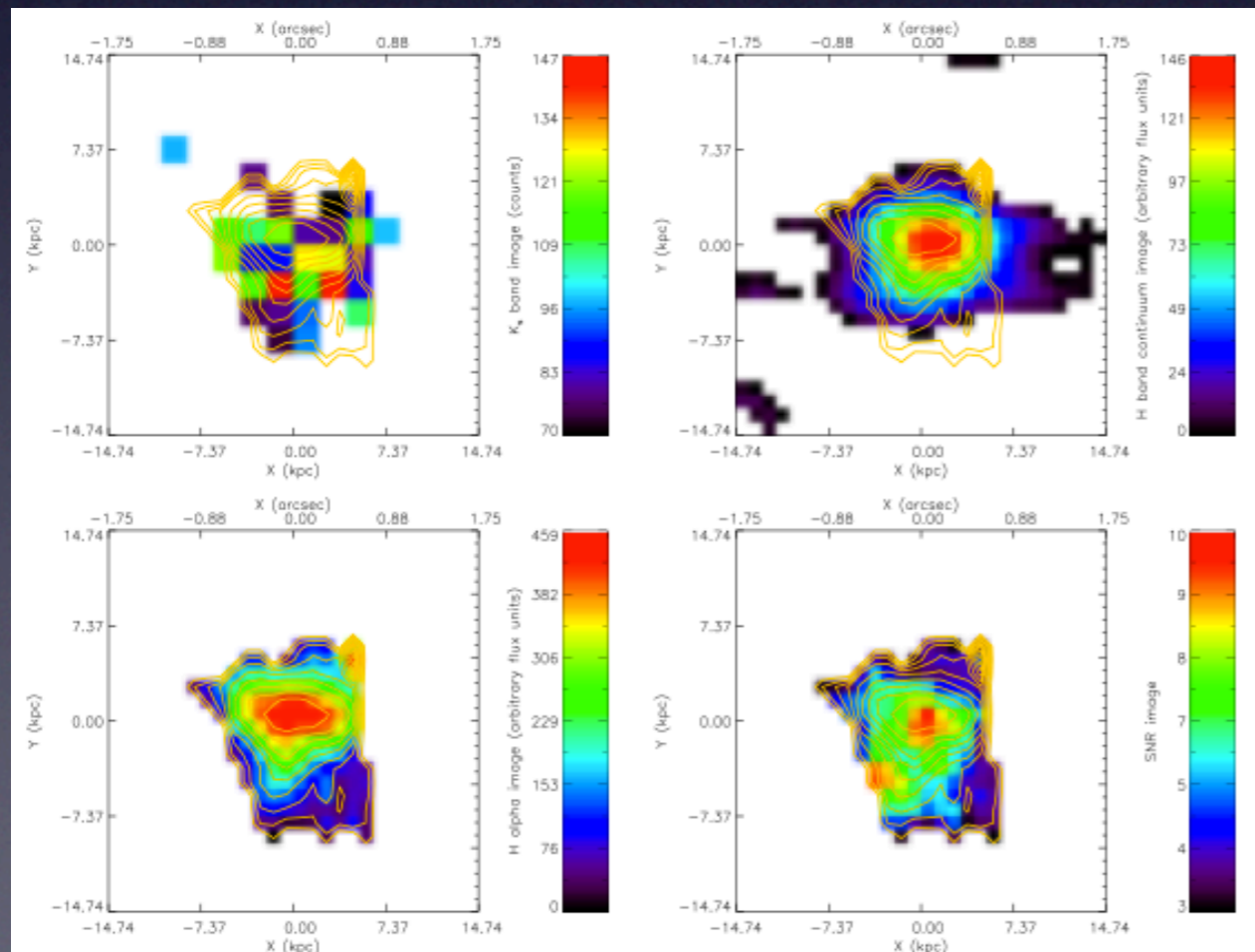
From Buitrago+11 (arXiv: 1111.6993)

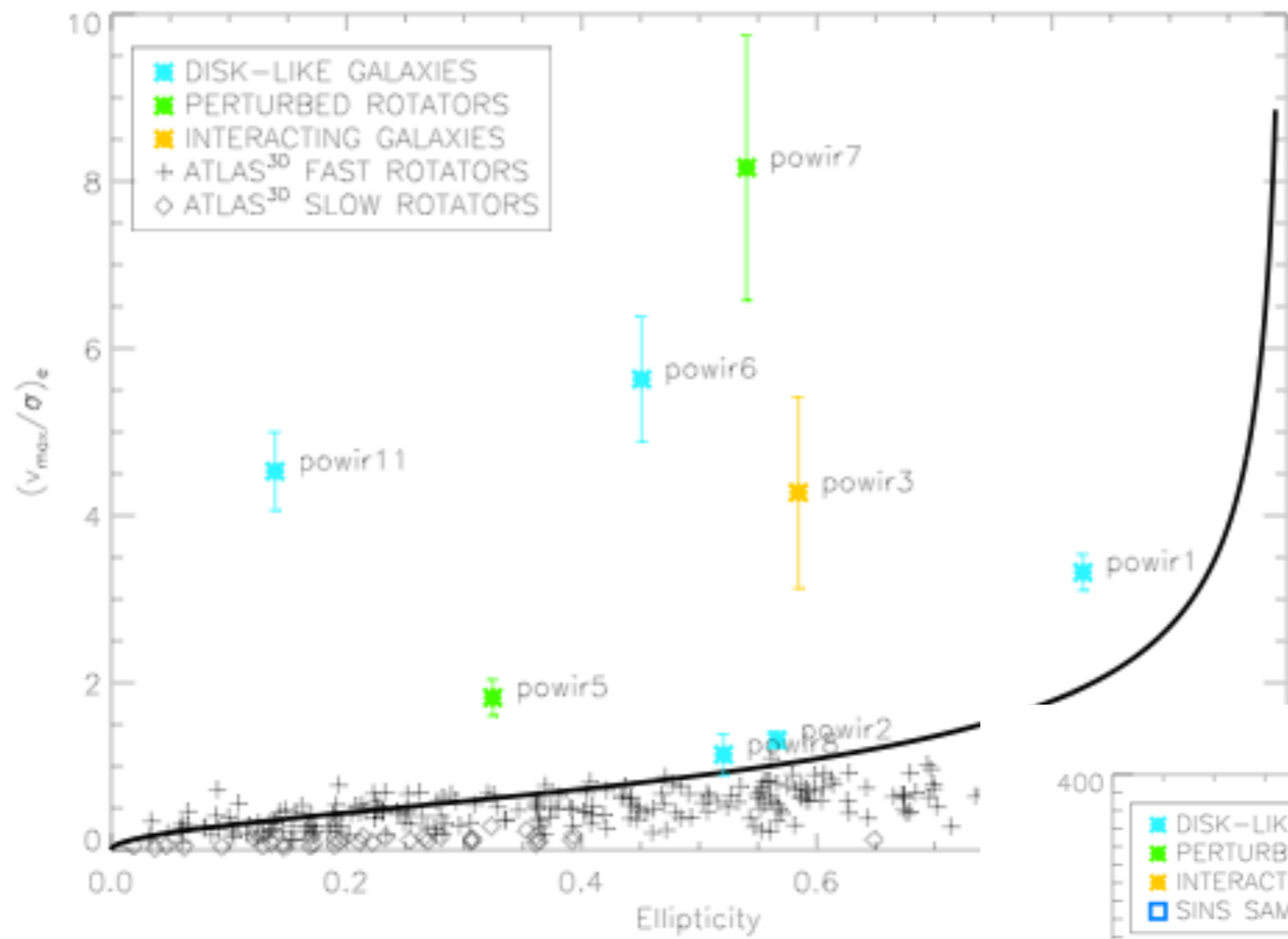


Buitrago+11 (arXiv: 1111.6993)

3D SPECTROSCOPY OF MASSIVE GALAXIES (BUIRAGO ET AL. 2012, IN PREP.)

- Bright future: spectroscopy + photometry (cf. Durham+Edinburgh projects such as KMOS or EAGLE)
- H_α traces the ionized gas
- Insights on the MINOR MERGING, cold flows and dynamical masses
- 1st sample “solely” selected by mass using SINFONI
(cf. POWIR Survey, e.g. Bundy+2006, Conselice+2007)
- 10 objects @ $z=1.36 - 1.41$ and $K_{AB}=17.9 - 18.5$
- Modelling as in Epinat+2010 (see also Epinat +09)

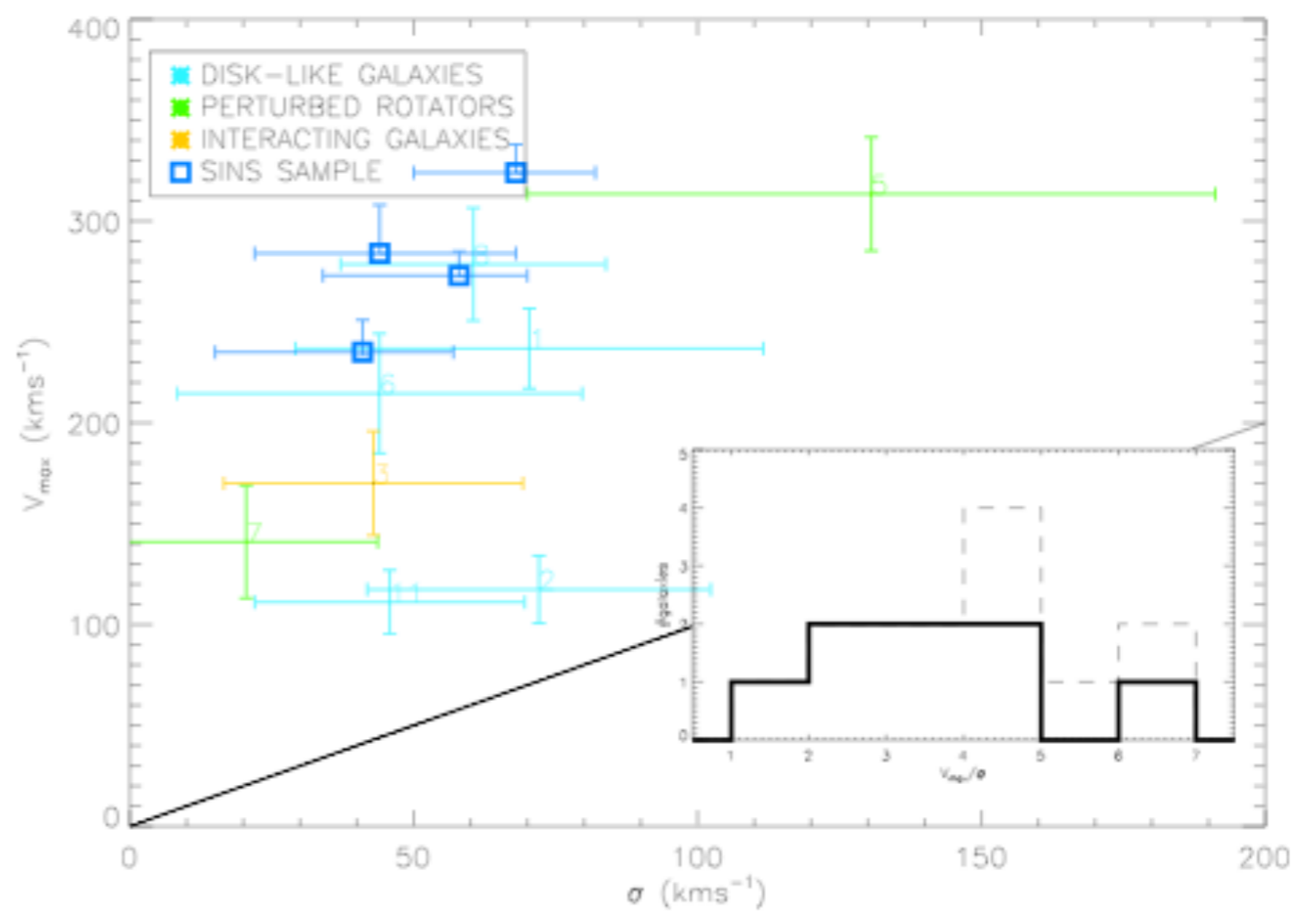




BEFORE:
 → Non circular gas motions increase with z
 → Merging observed but attention is now drawn towards faint features like clumps or cold flows (Forster-Schreiber+11)

Buitrago+12 in prep.

AFTER:
 → Massive galaxies are supported mainly by rotation (vs low- z Univ.)
 → Disks are already stable at high- z , but merging has been observed



LARGE AREA SURVEYS

- To palliate scarcity of massive galaxies
- To witness the end of the galaxy mass function
- EUCLID will provide 10x massive galaxies and 100x spectra for these objects
- To pick other rare objects such as PDGs (Messias+12 in prep. & FB)
- A compromise between depth and surveyed area: UltraVISTA
 - $1 \times 1.5 \text{ deg}^2$; YJHK_s; $H_{AB/5\sigma/\text{lim}} = 26.1$; PI J. Dunlop (RoE)

CONCLUSIONS

Massive galaxies are an exceptional test-bed to check **Λ CDM** framework predictions

Extremely small sizes, lack of local counterparts and a variety of star formations make them a challenging frontier on galaxy formation & evolution

There is a clear trend towards a **switch from spheroids to disk-like morphologies as redshift increases** for massive galaxies.

They seem to be **supported by rotational velocity** at high- z and their evolution is consistent with a **crucial role of minor merging**

