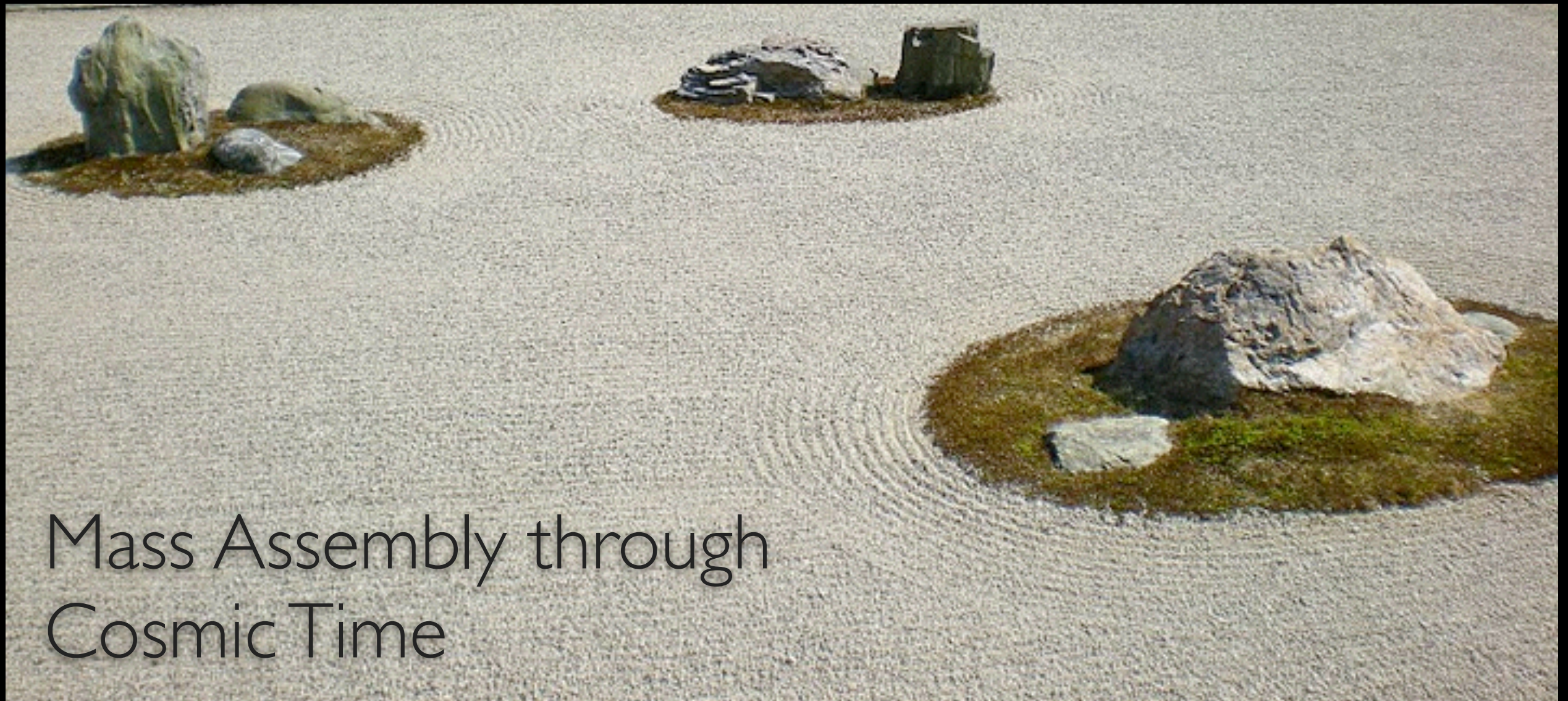


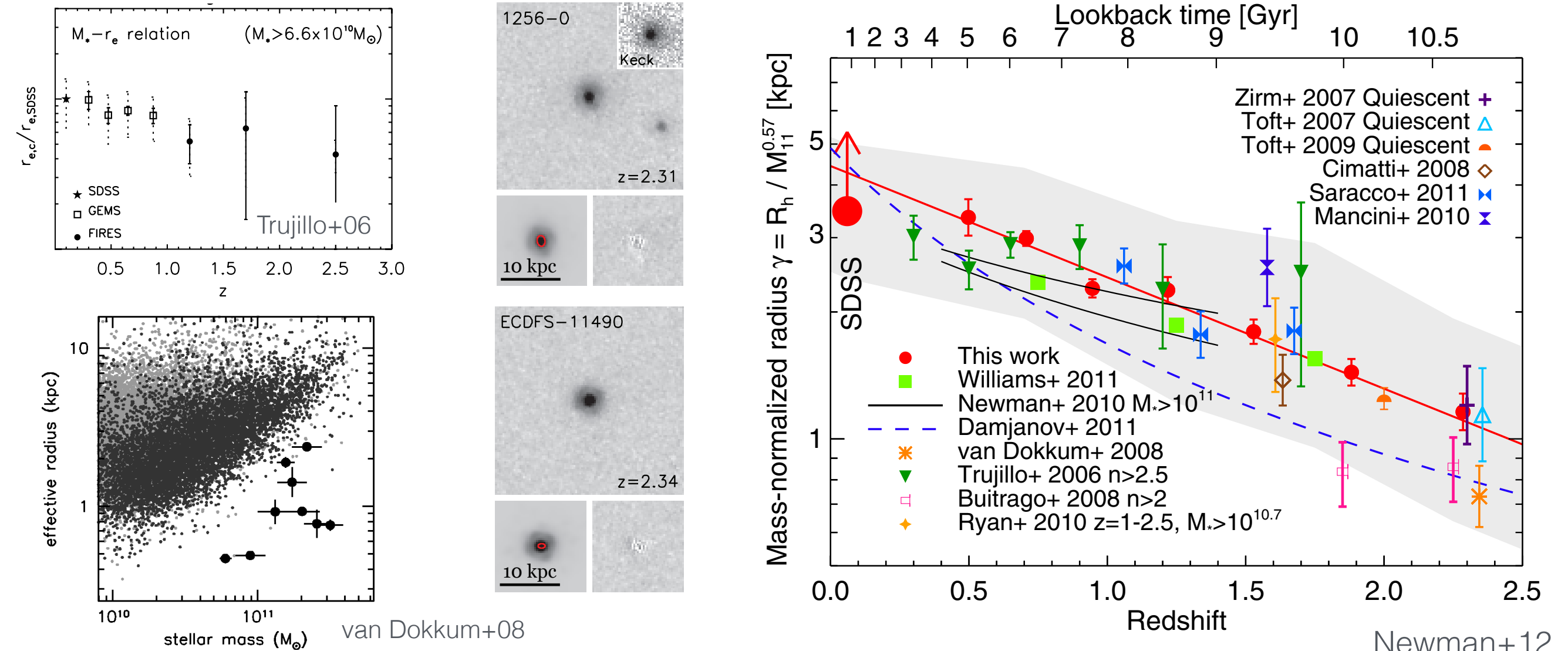


Mass Assembly through Cosmic Time

Kevin Bundy
(Kavli IPMU, U. of Tokyo)

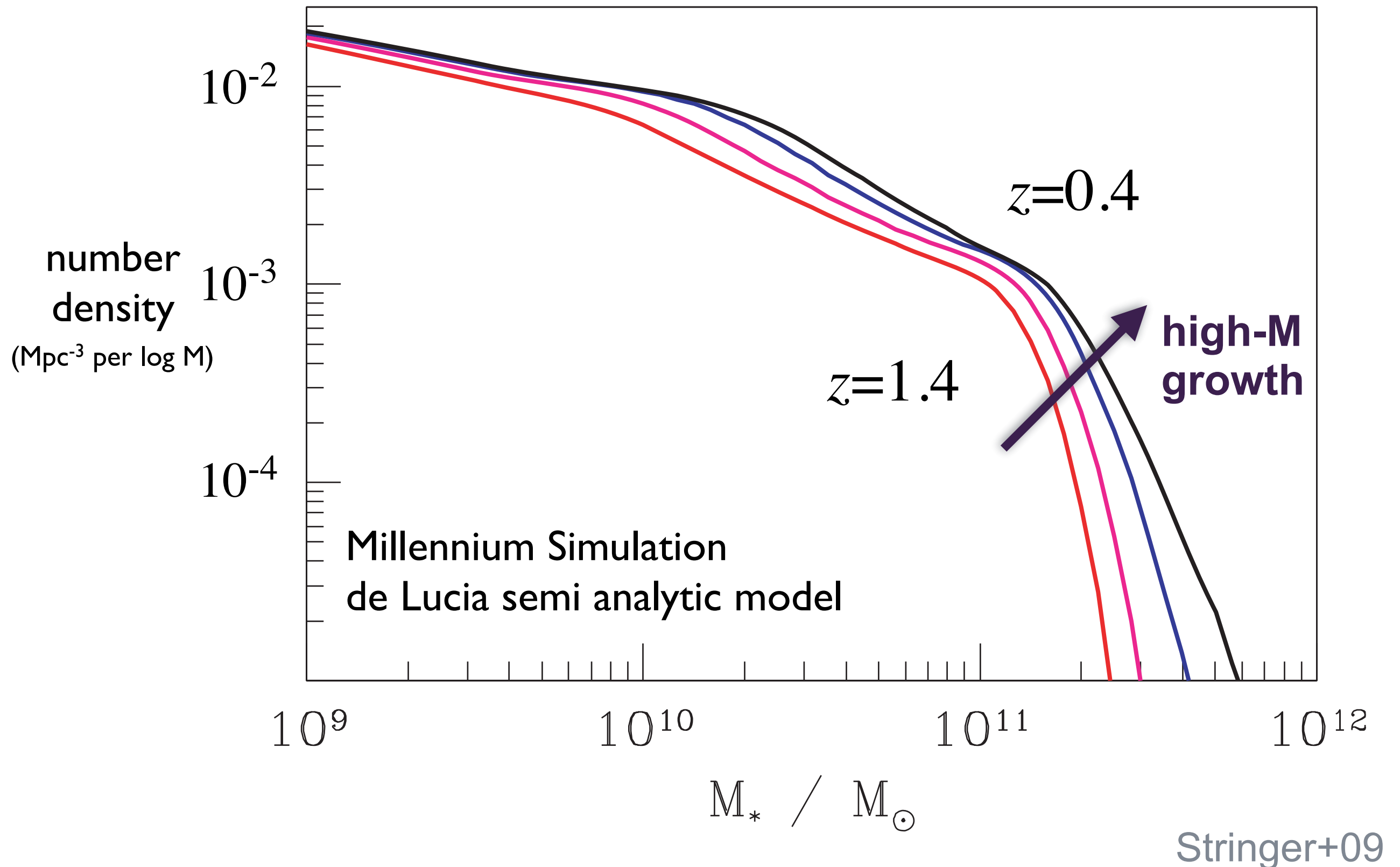
Cozumel April 2016

Observed: Massive galaxies grow in size



The remarkable compact “nuggets”

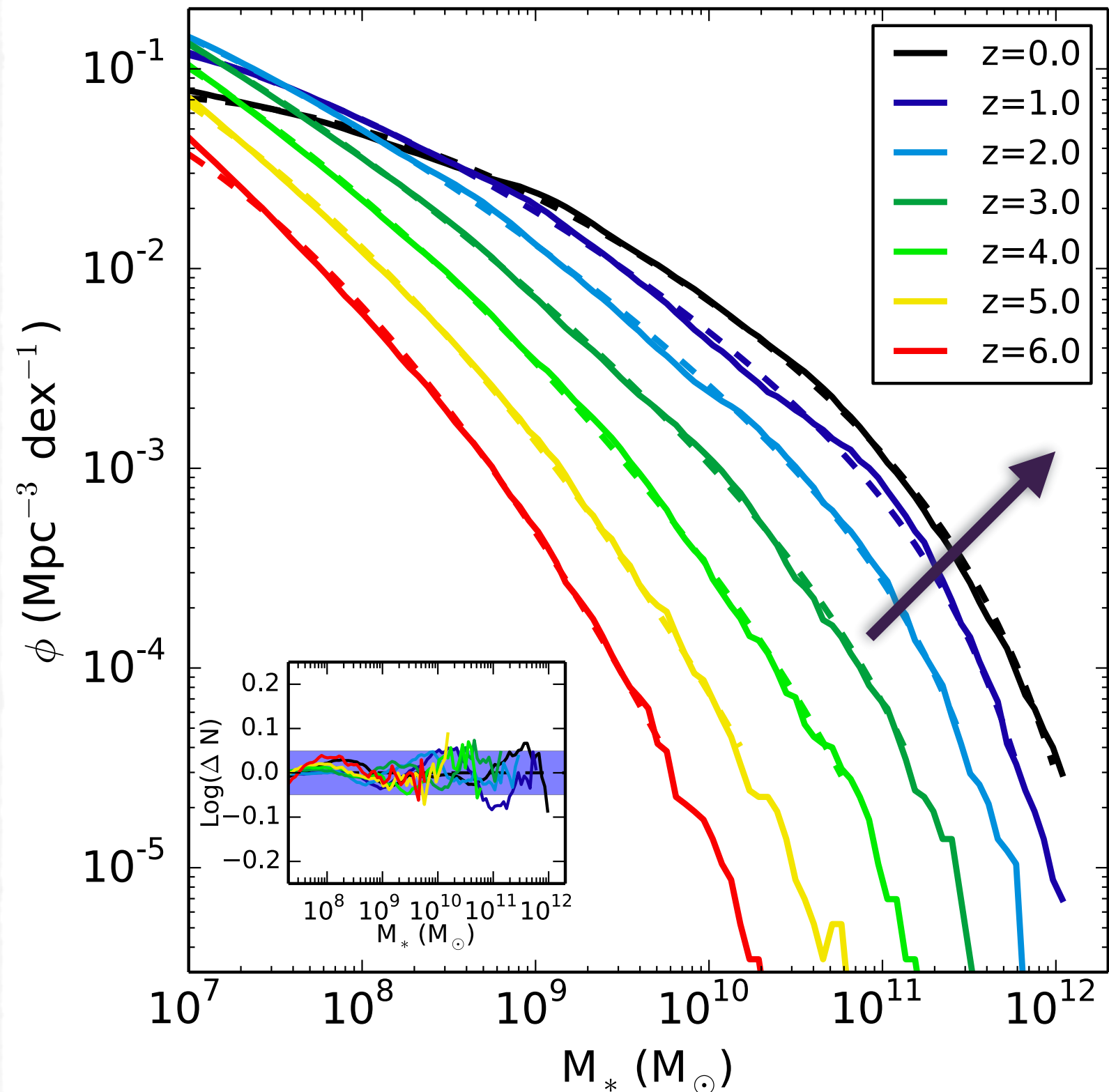
Predicted: Growth in the stellar mass function



Predicted: Growth in the stellar mass function

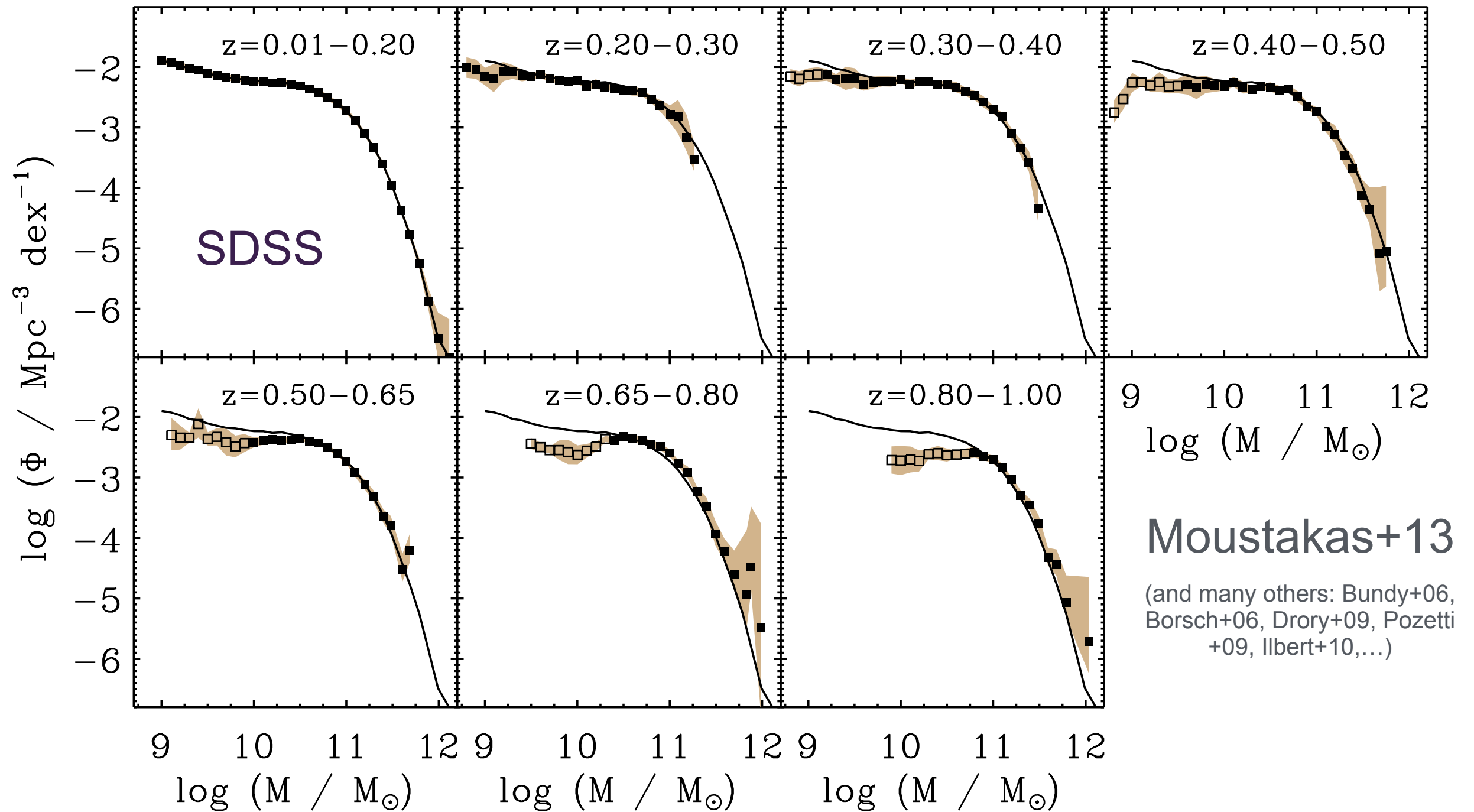
number
density
(Mpc^{-3} per $\log M$)

Illustris
Torrey+16



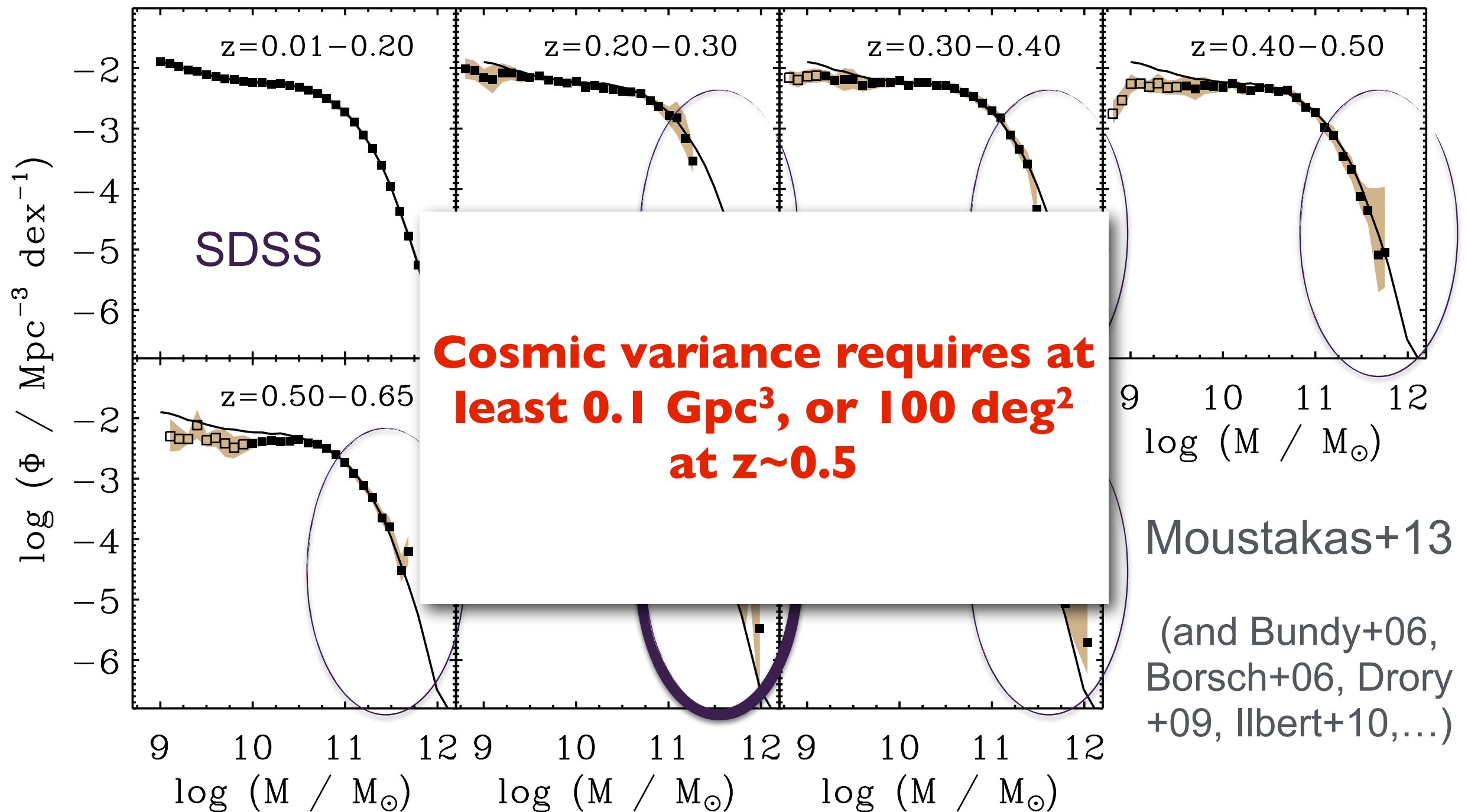
Observed: No growth in stellar mass

PRIMUS Survey: 5.5 deg²



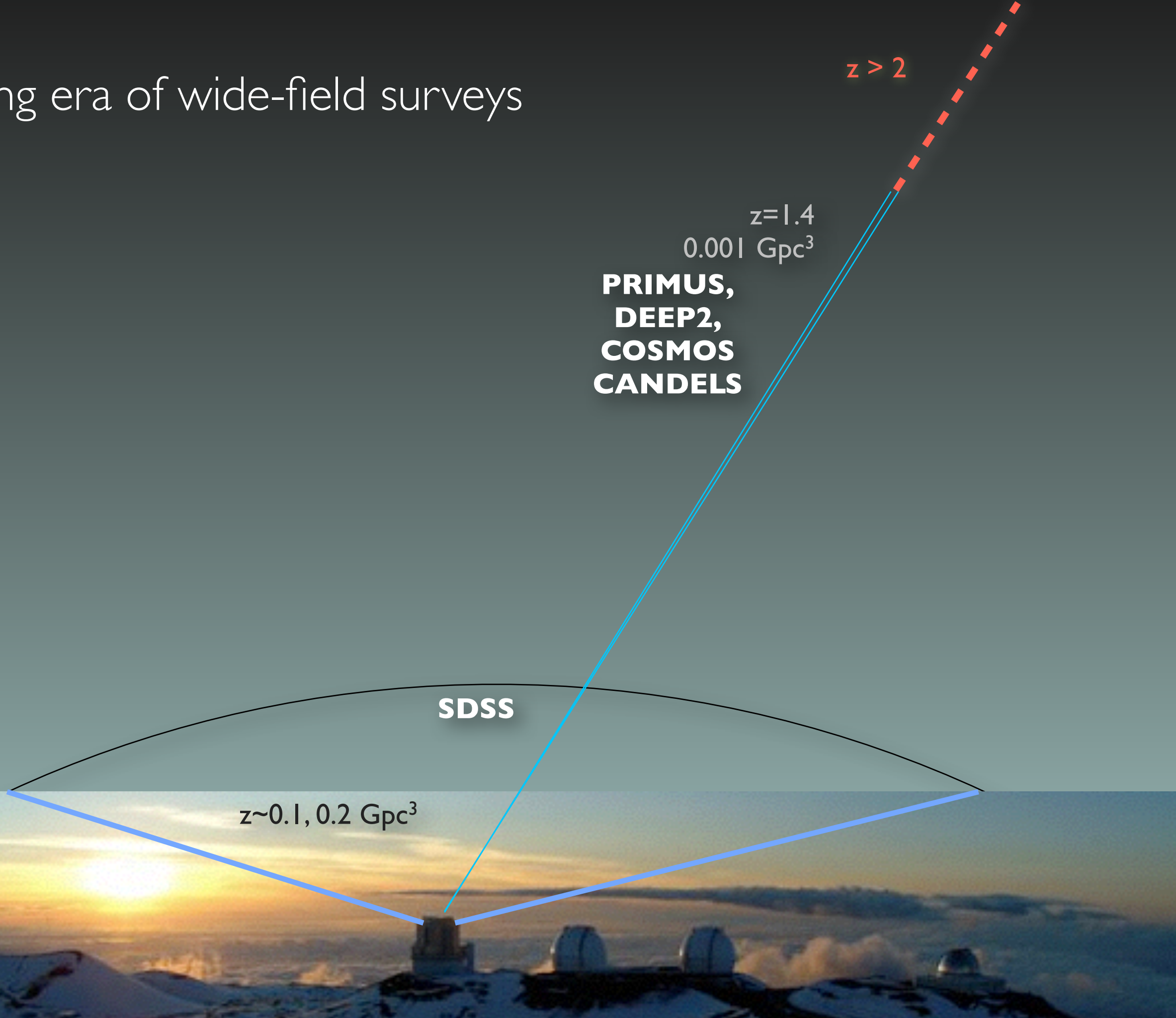
Observed: No growth in stellar mass

PRIMUS Survey: 5.5 deg²

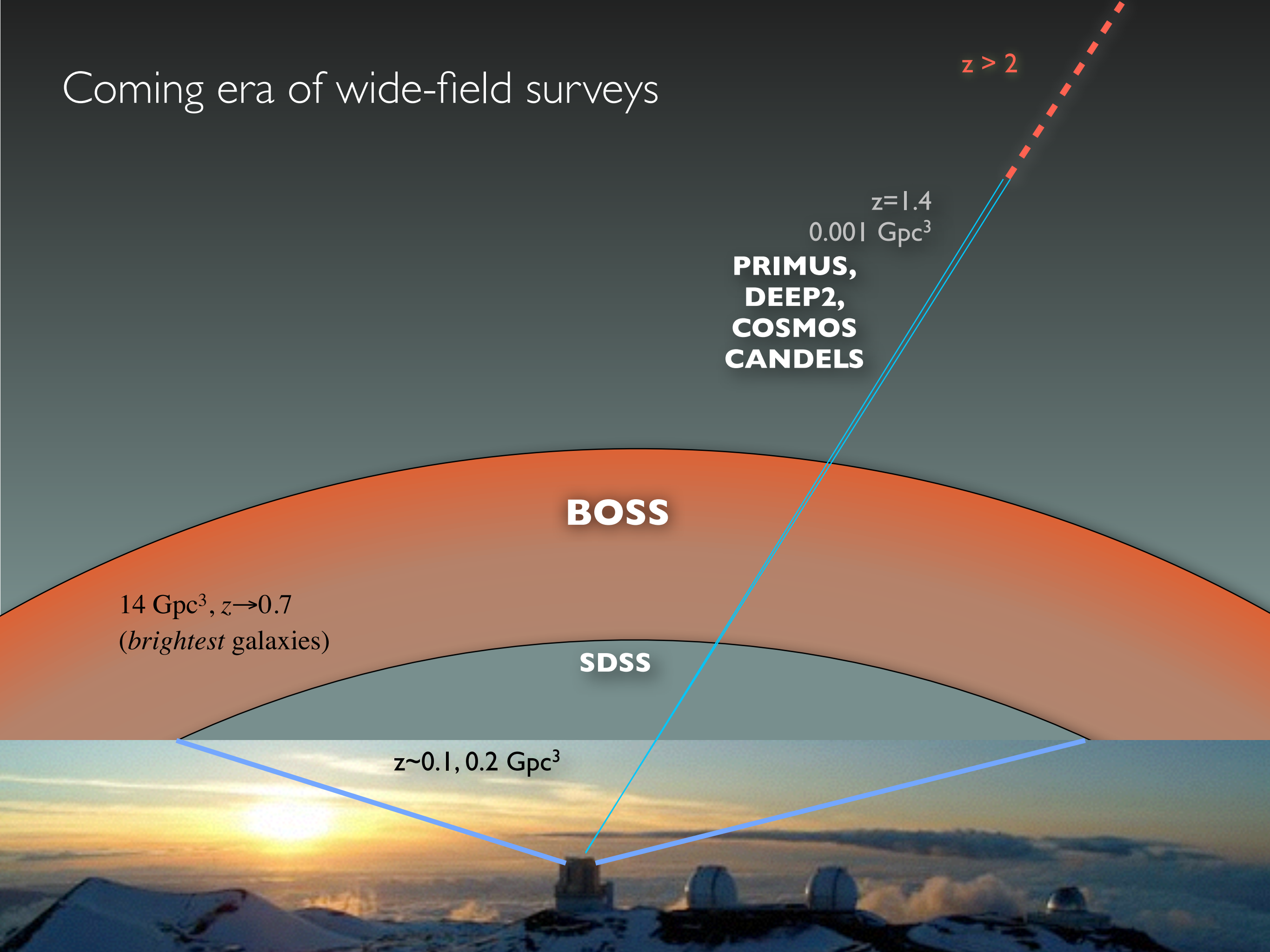


But, large errors at the high-mass end

Coming era of wide-field surveys



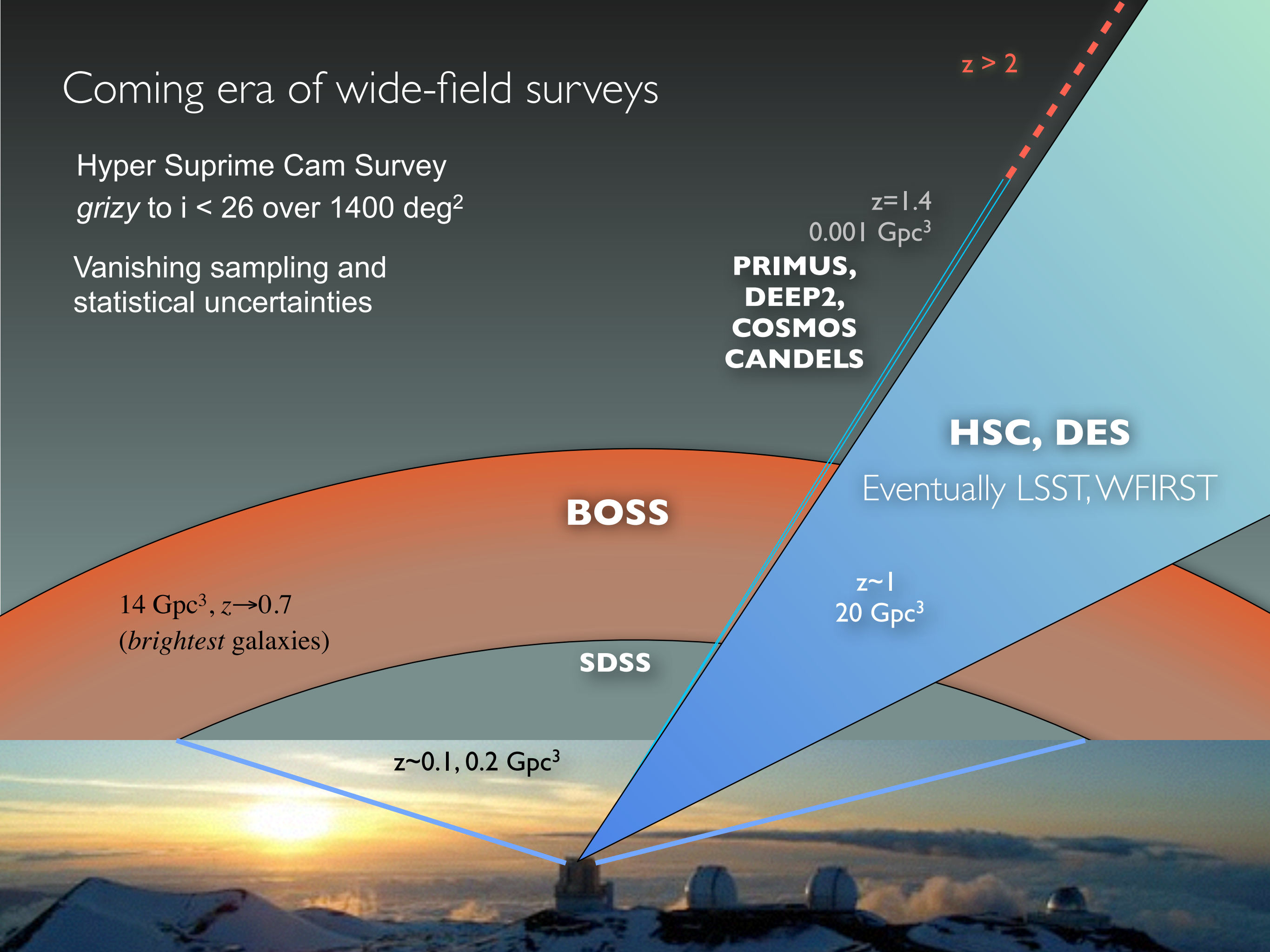
Coming era of wide-field surveys



Coming era of wide-field surveys

Hyper Suprime Cam Survey
grizy to $i < 26$ over 1400 deg^2

Vanishing sampling and
statistical uncertainties



The BOSS Stripe 82 Massive Galaxy Catalog

Bundy et al. 2015b
MassiveGalaxies.com

Dec = +1.5 deg

170 deg²

Dec = -1.5 deg

RA = -30 deg

RA = 46 deg

Stripe 82 Coadds: 50-80 epochs, $i_{AB} < 23.5$, ~2 mag deeper than SDSS

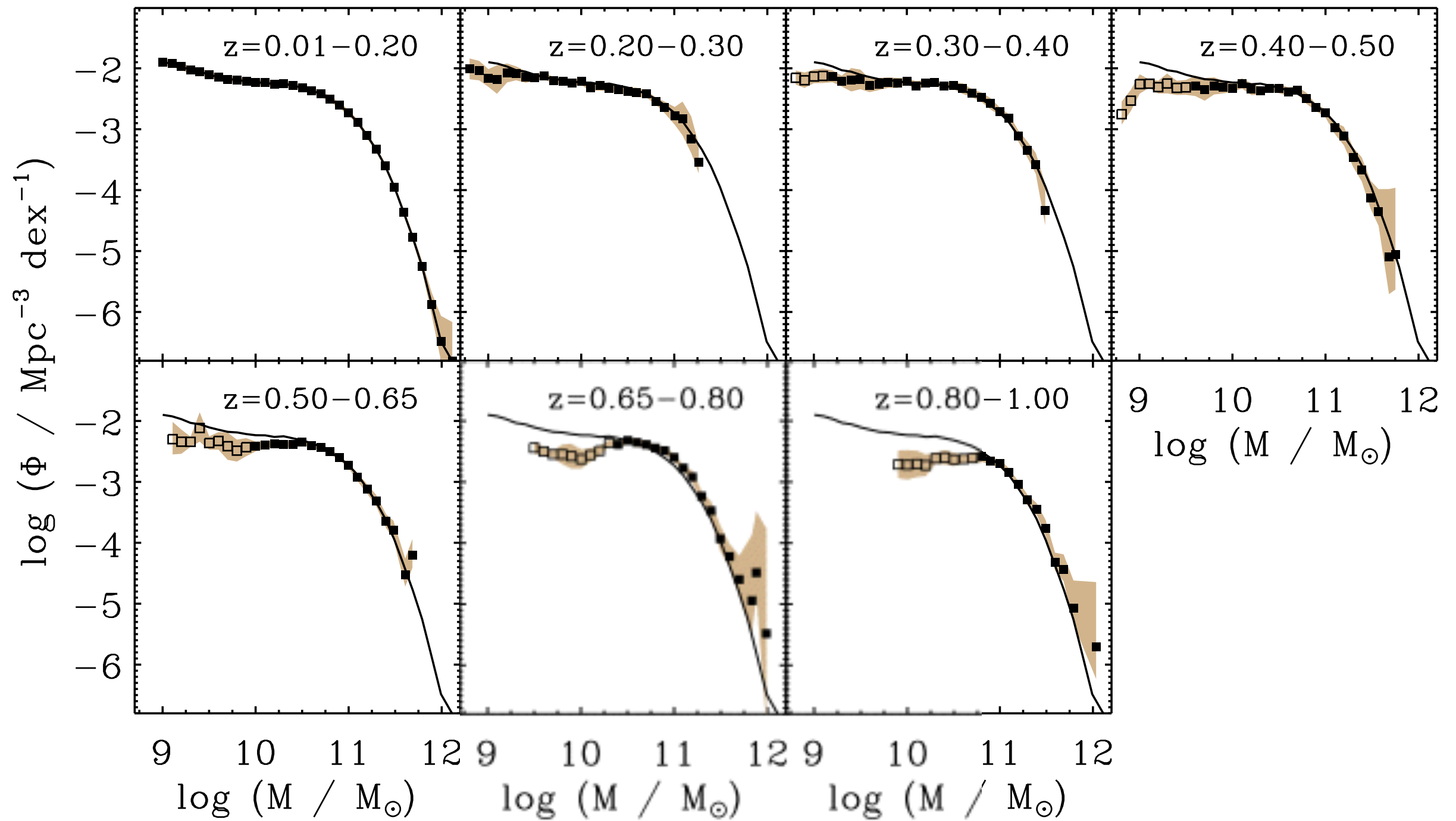
Synthetic Aperture Magnitudes (SynMags)

Bundy et al. 2012

Catalog-level PSF-matched photometry SDSS+UKIDSS: YJHK to ~19.8 AB

Optical + Near-IR 9-band stellar masses

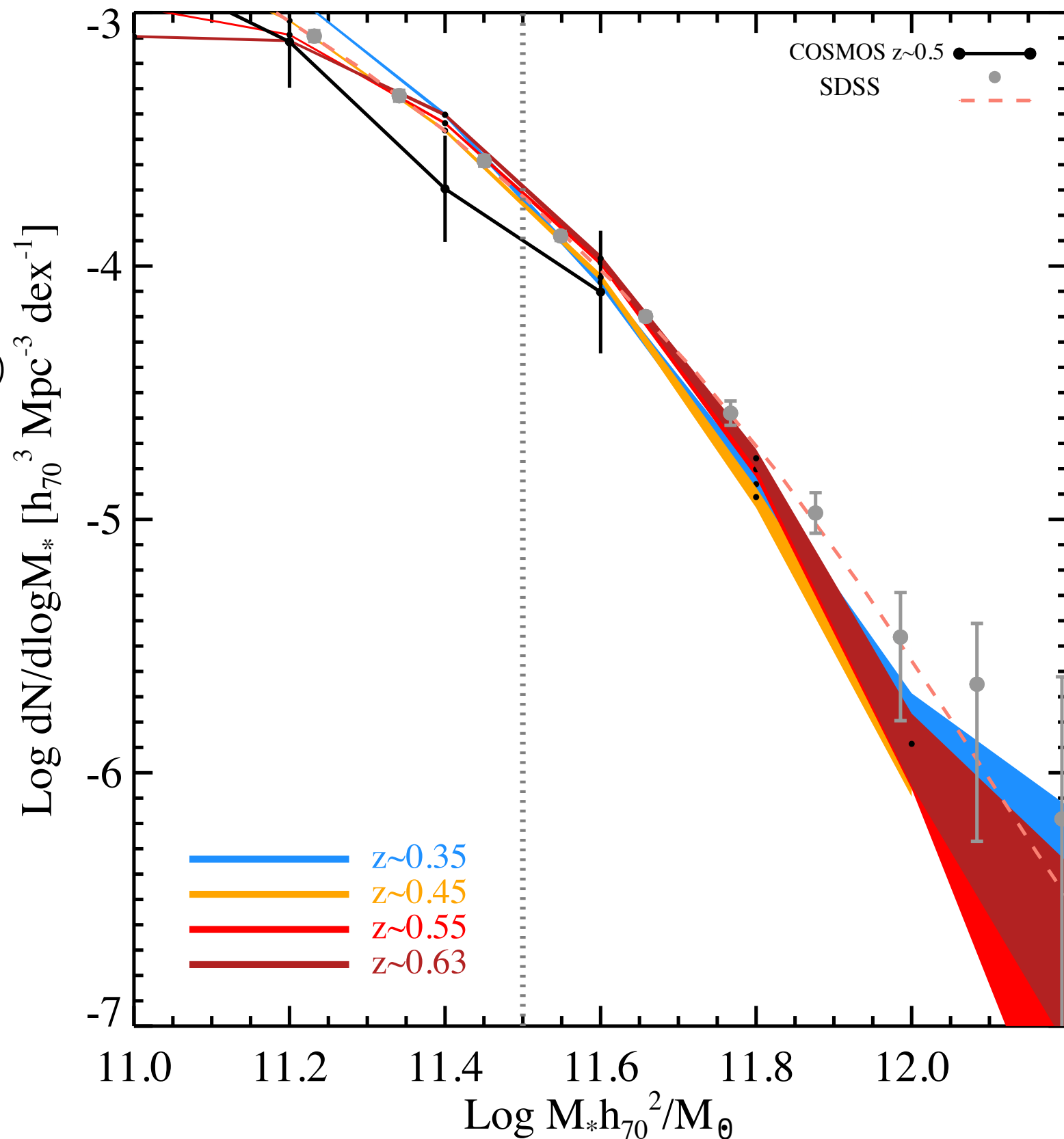
Explore assumptions on priors and synthesis models



Wide-field preview with Stripe 82: BOSS + UKIDSS

170 deg²
~30,000 galaxies
(dominated by BCGs)

Near-IR $M_{\star}$
(+UKIDSS,
see Bundy+12)

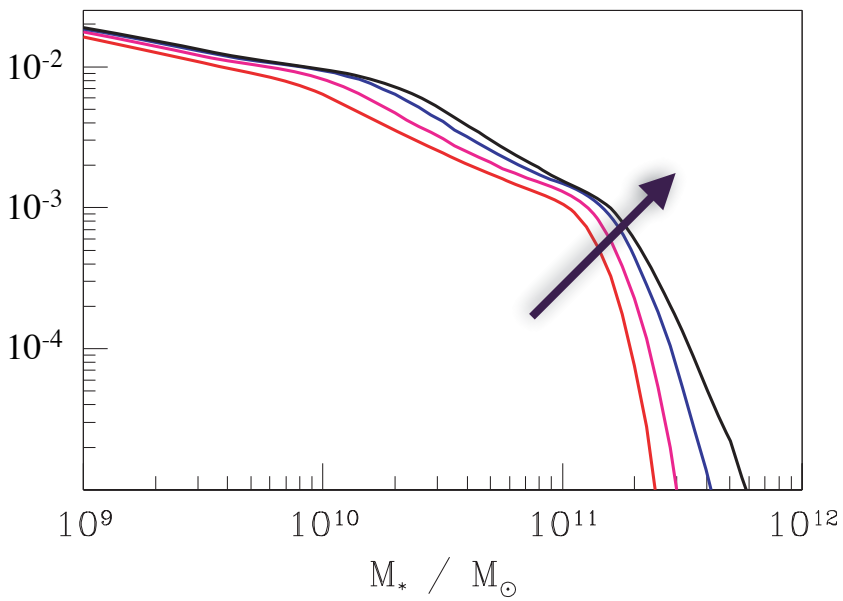


Complete
at high-M
SDSS/BOSS + photoz

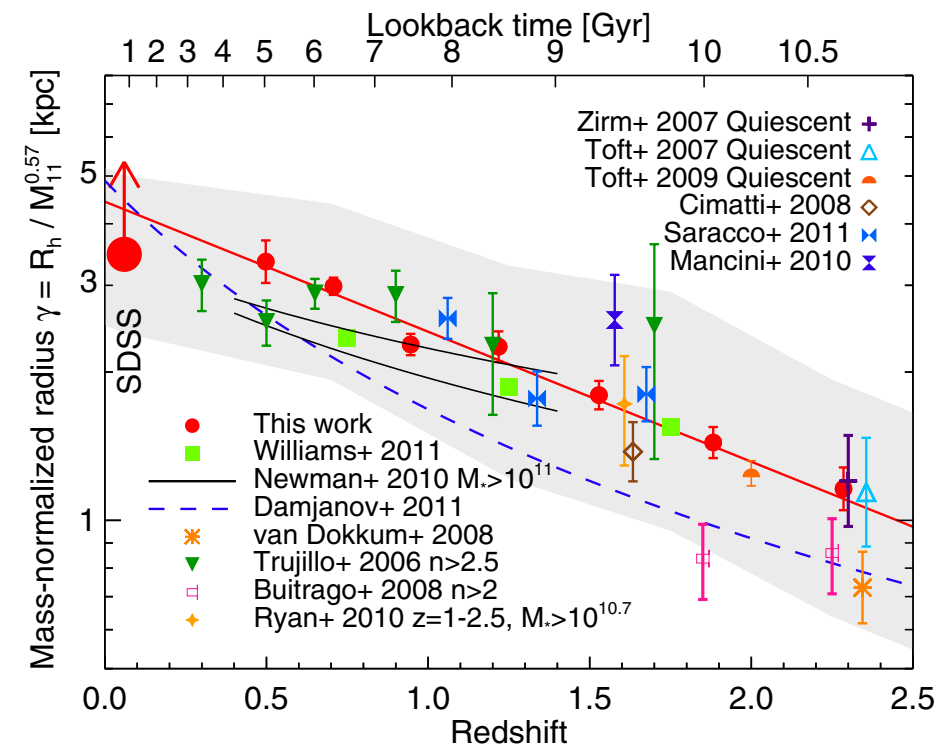
Nearly the
SDSS-I
volume!

No
Evolution!

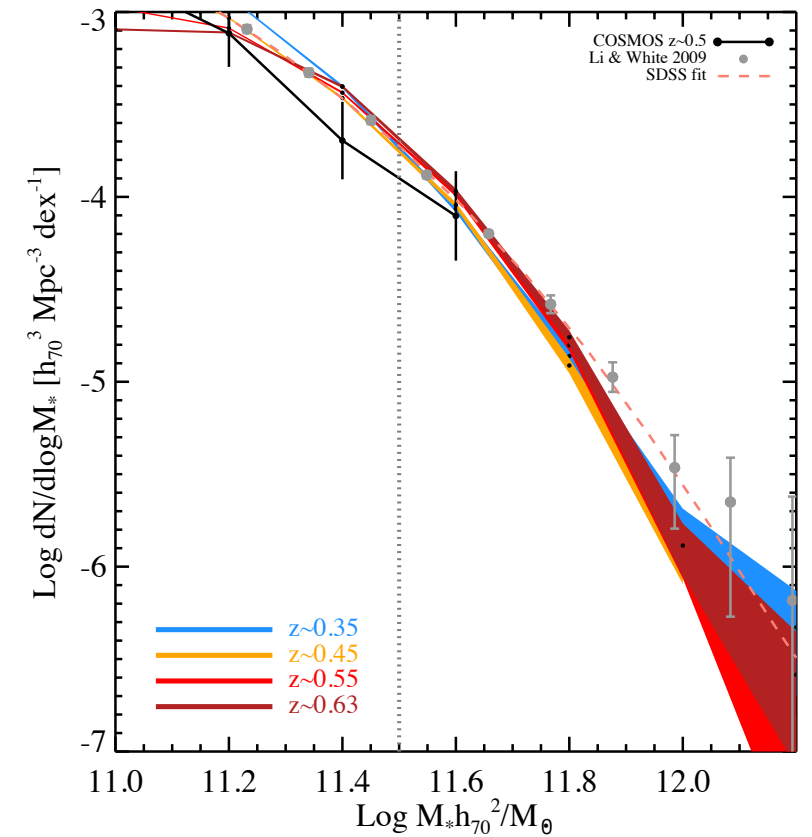
Predicted mass growth



Observed size growth



No observed mass growth

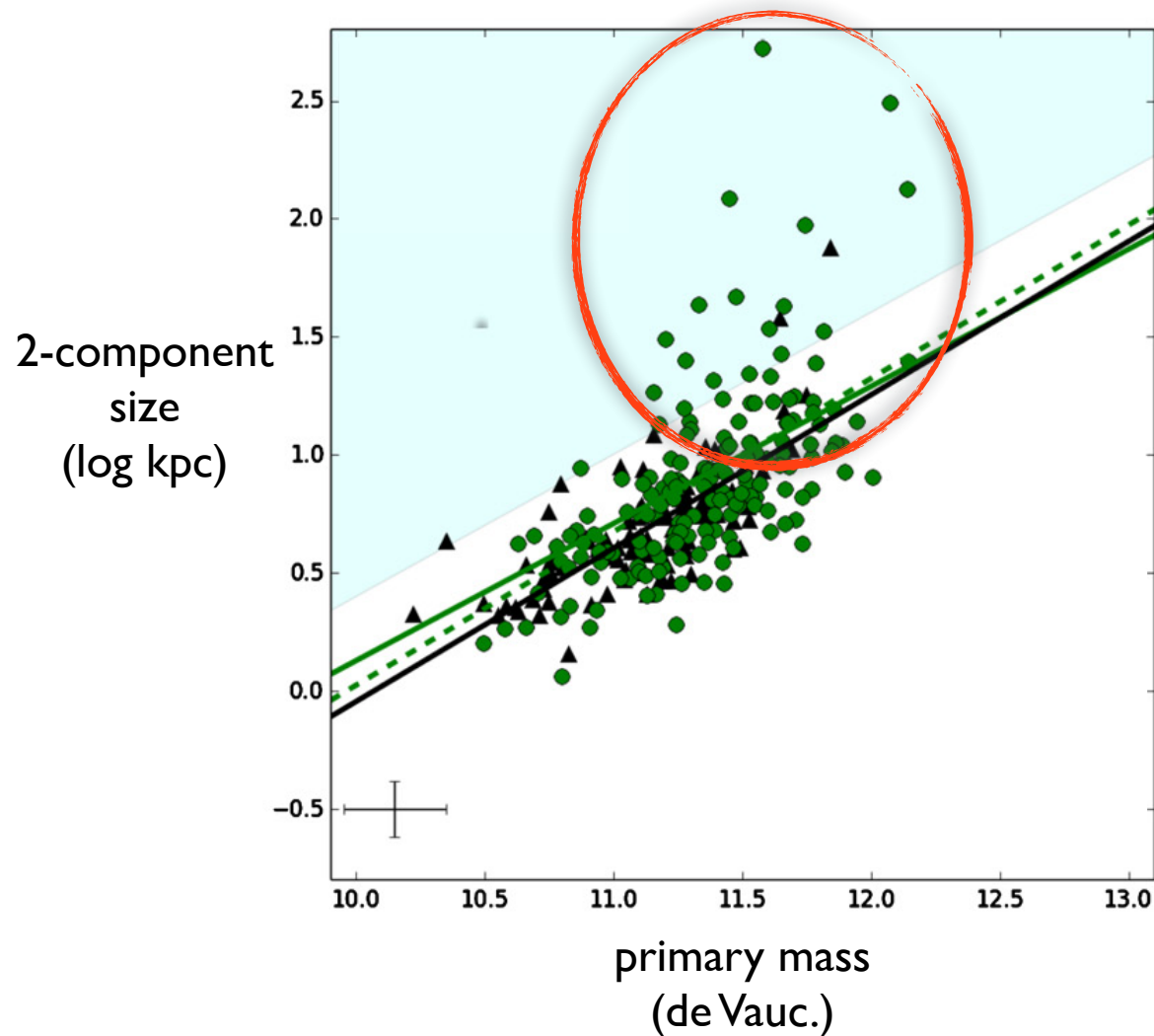


What are we missing here?

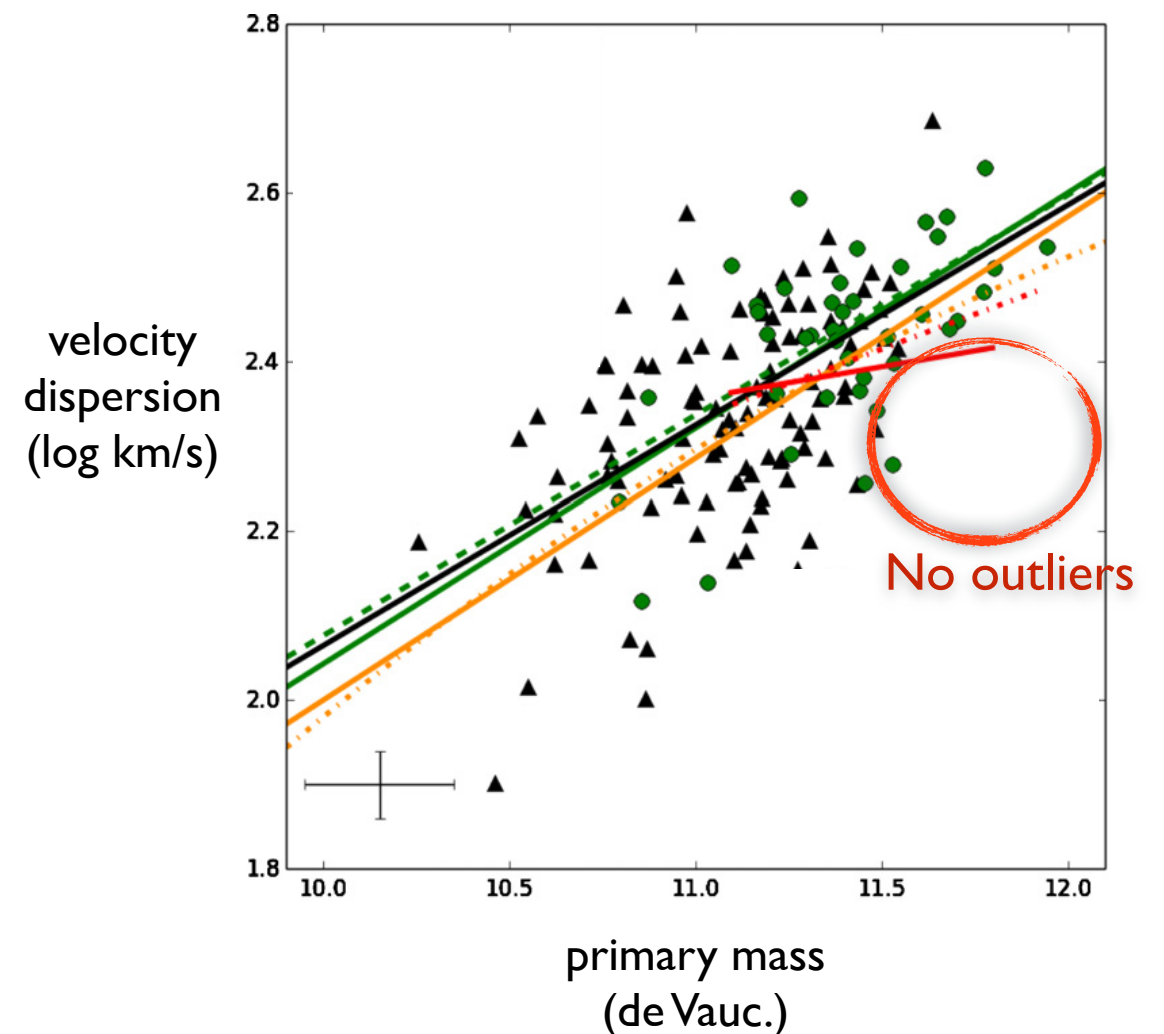
Multiple components: Envelopes and cores

We combined high-res (HST) imaging + spectroscopy
~40 BCGs in COSMOS at $z \sim 0.6$

Vulcani, Bundy, et al. 2014



BCG progenitors are growing envelopes at $z \sim 0.6$

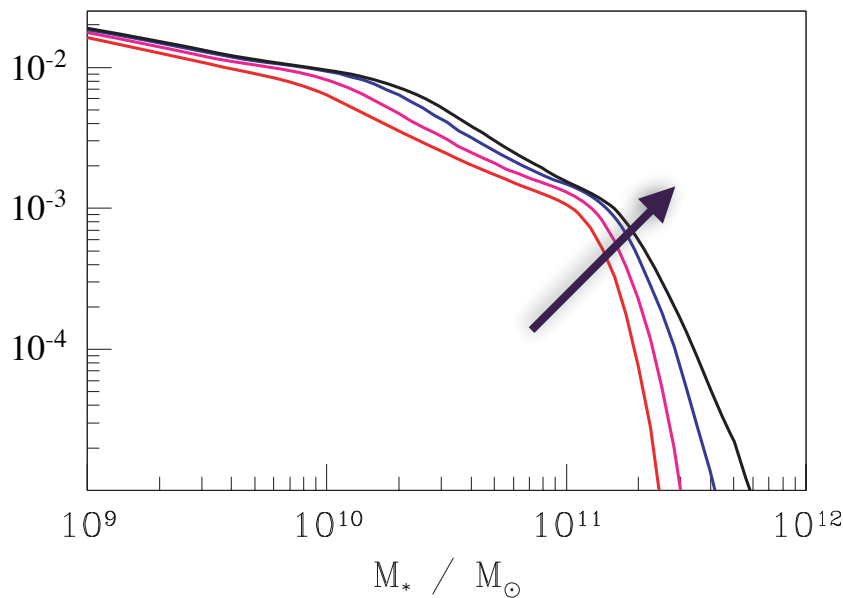


But their central, “primary” components are static

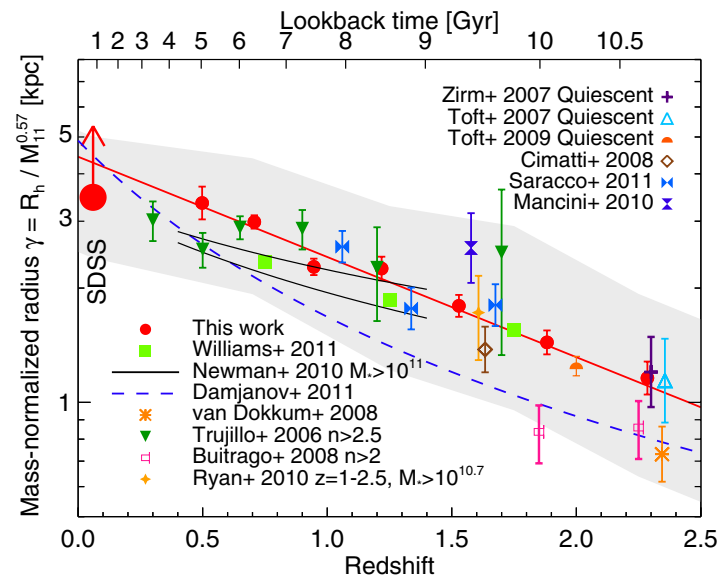
Also see: Huang+13, D’Souza+14, Patel+13, Greene+15, Bernardi+13, Kravtsov+14

Potential resolution of the puzzle...

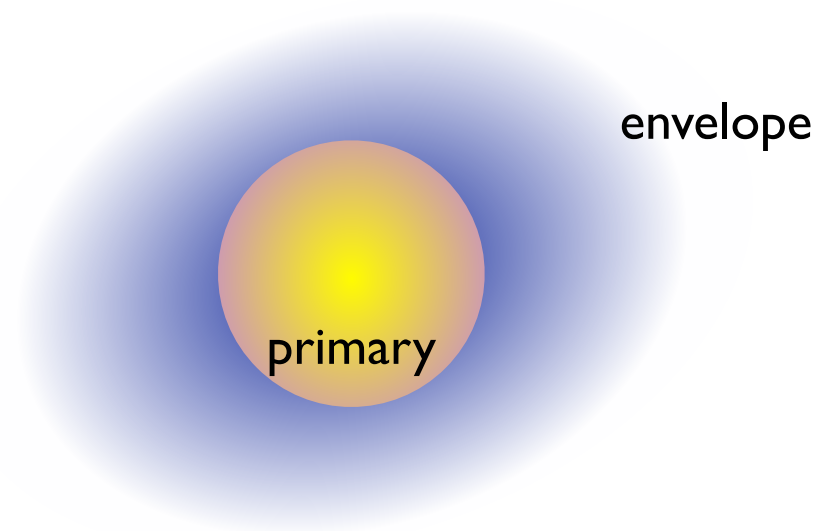
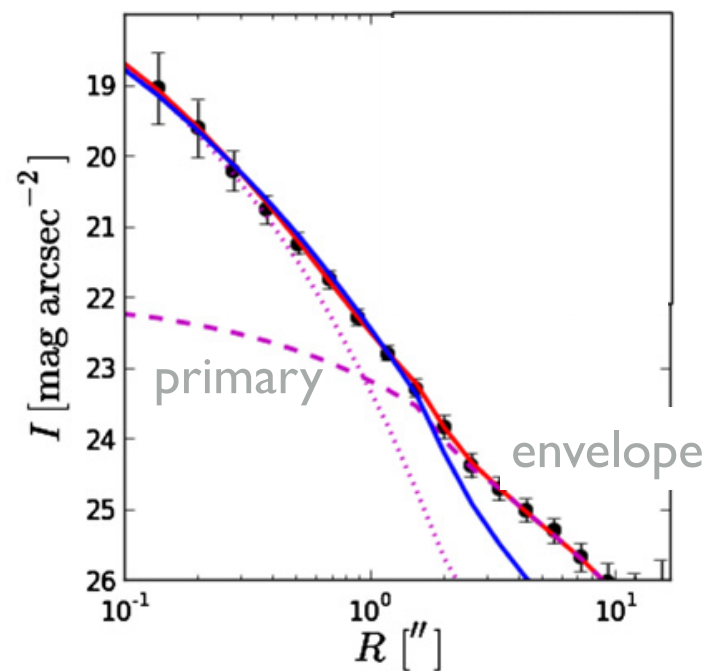
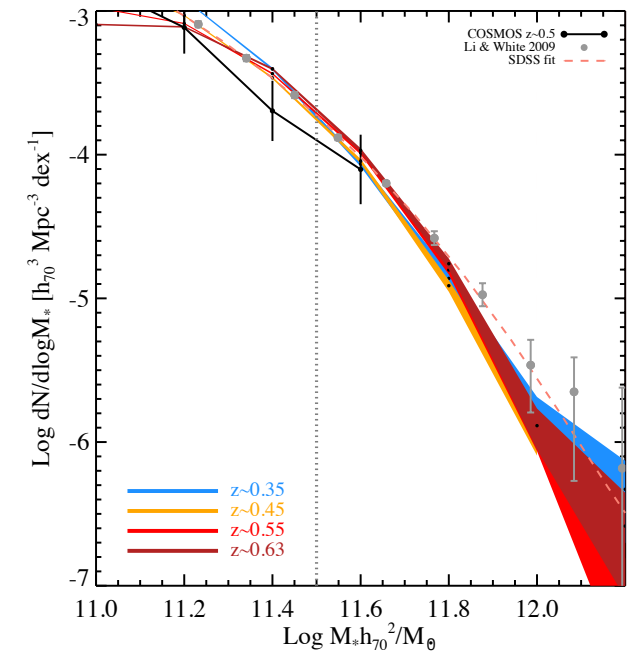
Predicted mass growth



Observed size growth

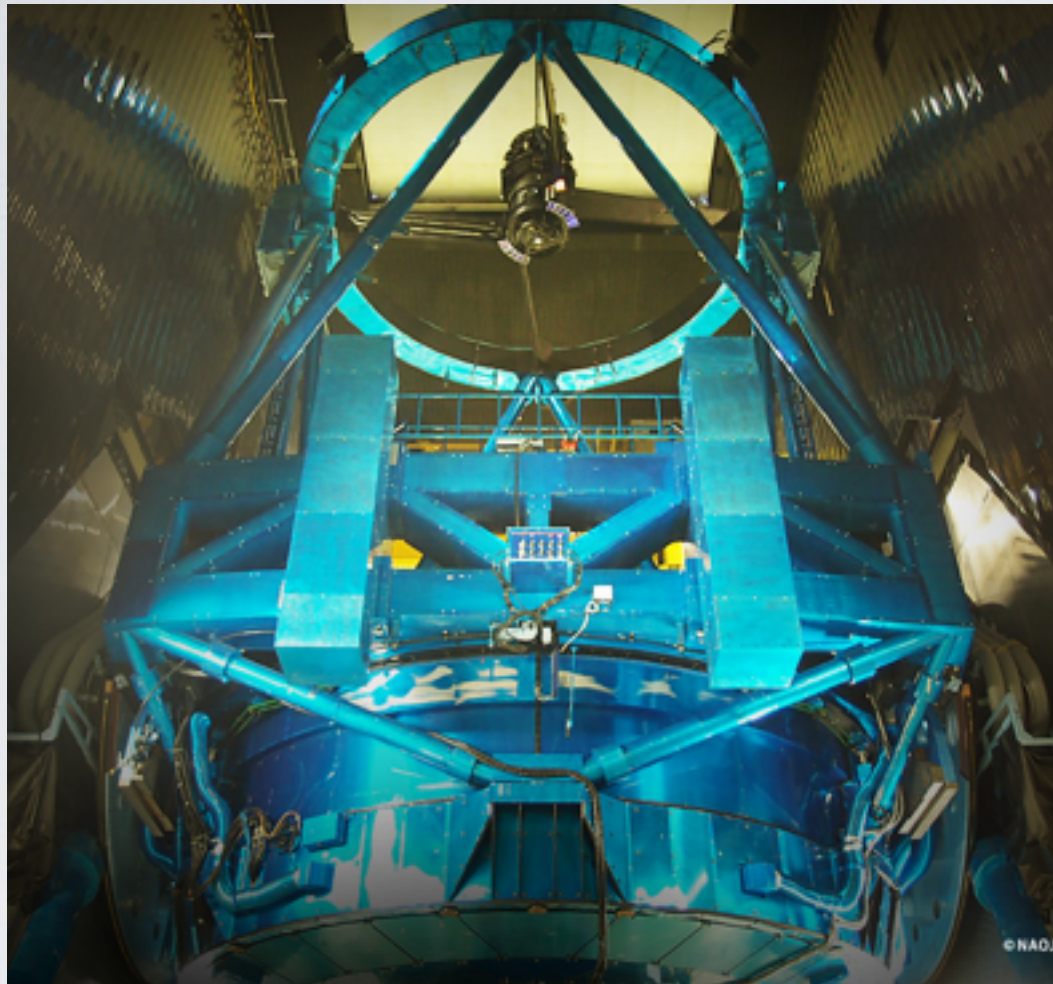


No observed mass growth



Hypothesis: Surveys to date have only measured primary components.
These don't grow.

Prospects with Hyper Suprime Cam



- Hyper Suprime Cam (HSC)
- 1.5 deg imager on Subaru
- Survey began in 2014
- *grizY* to 26 AB over 1400 deg²



Prospects with Hyper Suprime Cam

$z=0.326$

$z=0.328$

0.997

$z=0.420$

$z=0.419$

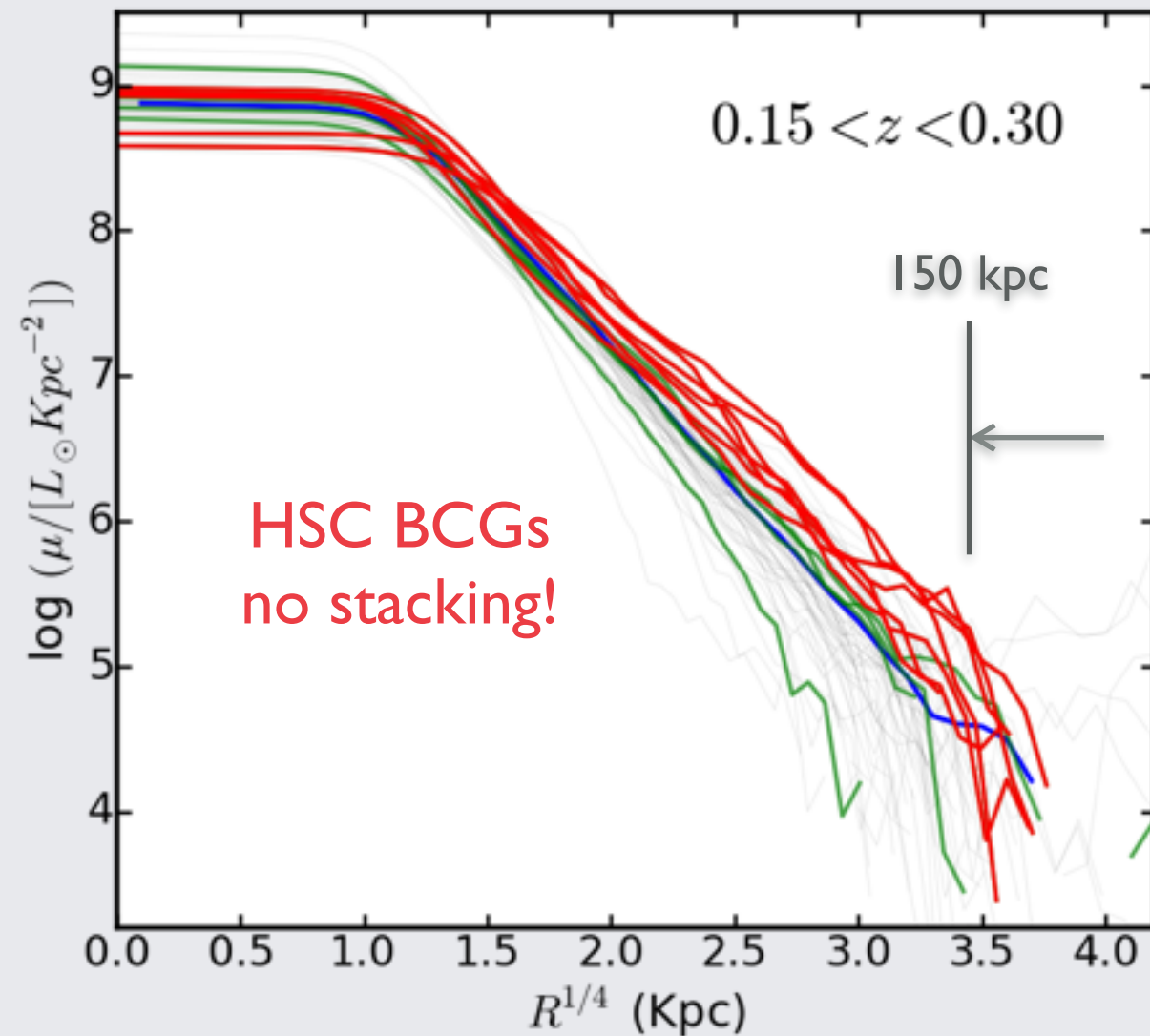
0.956

$z=0.436$

$z=0.436$

0.875

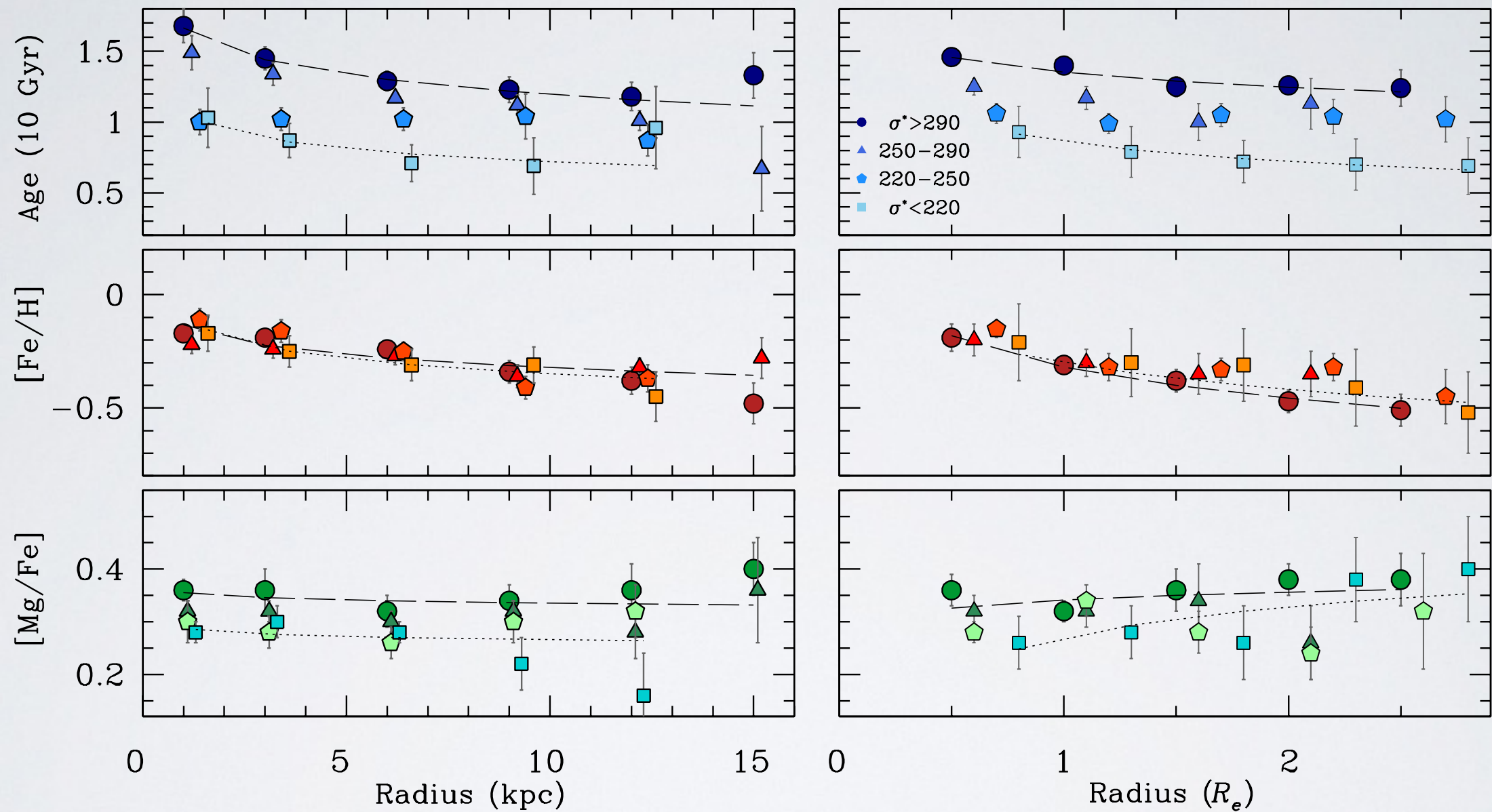
69.231



SDSS g'r'i'-Color Image

Prospects with MaNGA

Greene+15, 100 galaxies



MaNGA (DR13): 171 Early-types to 2.5 R_e

MaNGA Update

2014-2020: 10,000 galaxies

Spatial resolution = 2'' (1-2 kpc)

Spectral resolution = 60 km/s (sigma)

Wavelength range: 3600Å to 10,000Å

S/N = 4-8 at 1.5 Re (~3 hours)

Volume-limited samples: $\log M_{\text{star}} > 9$

Flat in stellar mass and color

Uniform radial coverage



MaNGA Overviews:
Bundy et al. 2015, ApJ, 798, 7
Yan et al. 2016, in prep

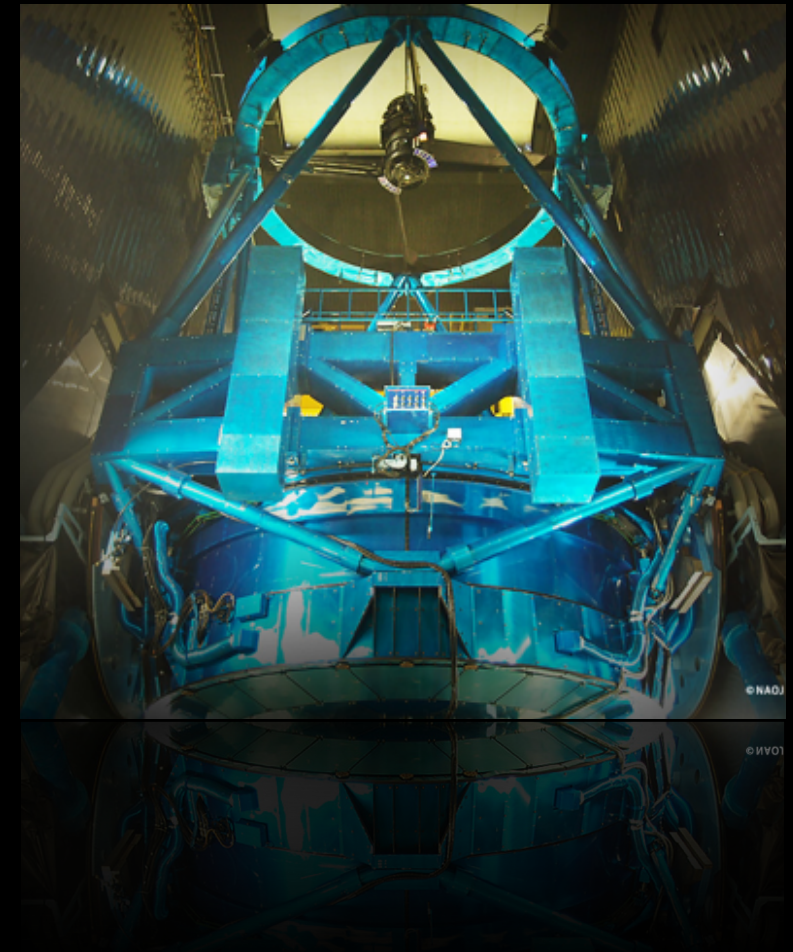
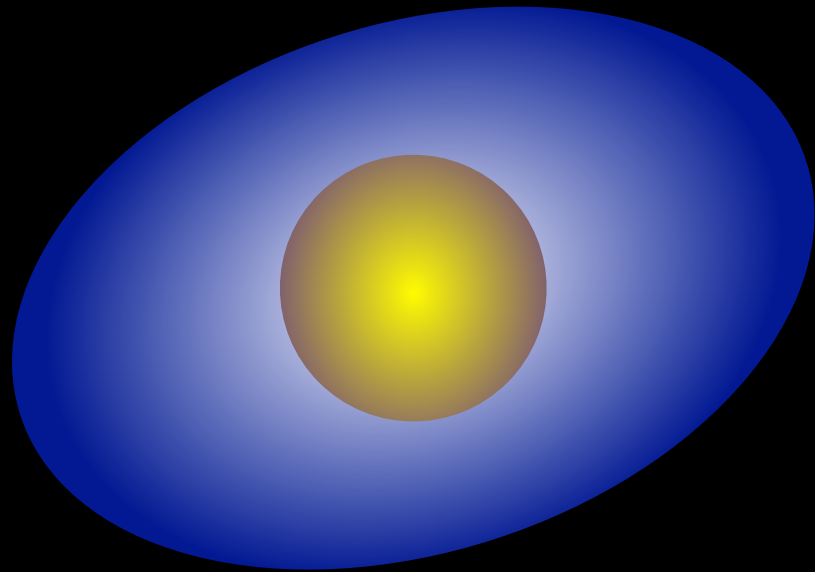
Current status: 2500 unique galaxies

MaNGA Public data release, **1400 unique data cubes**

July 2016

Conclusions

- A puzzle: High-mass galaxies grow in radius but not mass?
- New insight coming from deep wide-field imaging surveys like Hyper Suprime Cam (HSC).



- IFS surveys like MaNGA will provide a “global-to-local” test by measuring the chemistry of outer stellar populations