OUTLINE

- Evidence for growth of individual galaxies
- Evolution of SF-ing galaxies
- Open issues + plan of attack

Arjen van der Wel (MPIA - Heidelberg)

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- Evidence for growth of individual galaxies

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Evidence for growth of individual galaxies

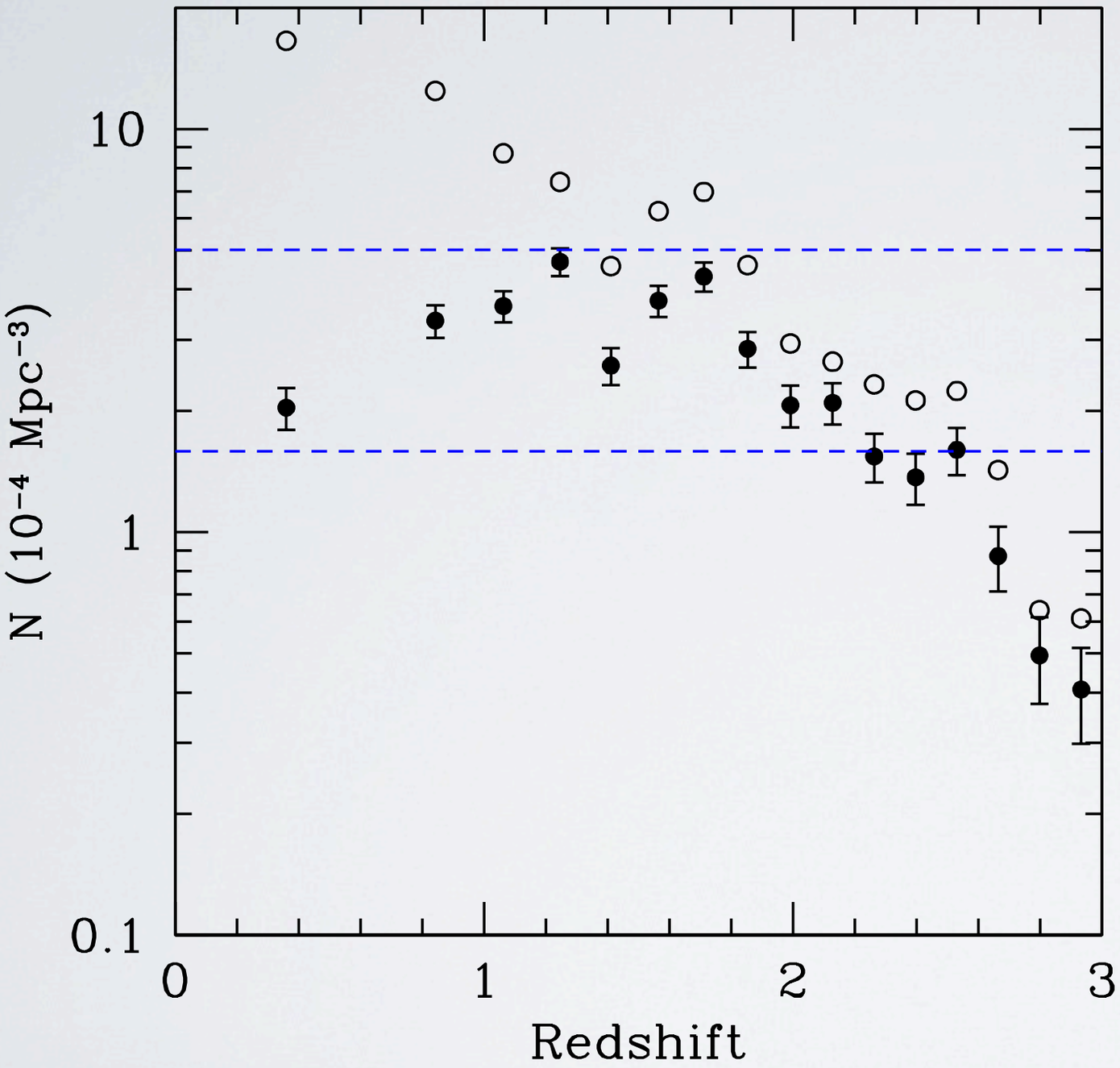
Hypothesis

Individual quiescent galaxies do not grow over time

Test

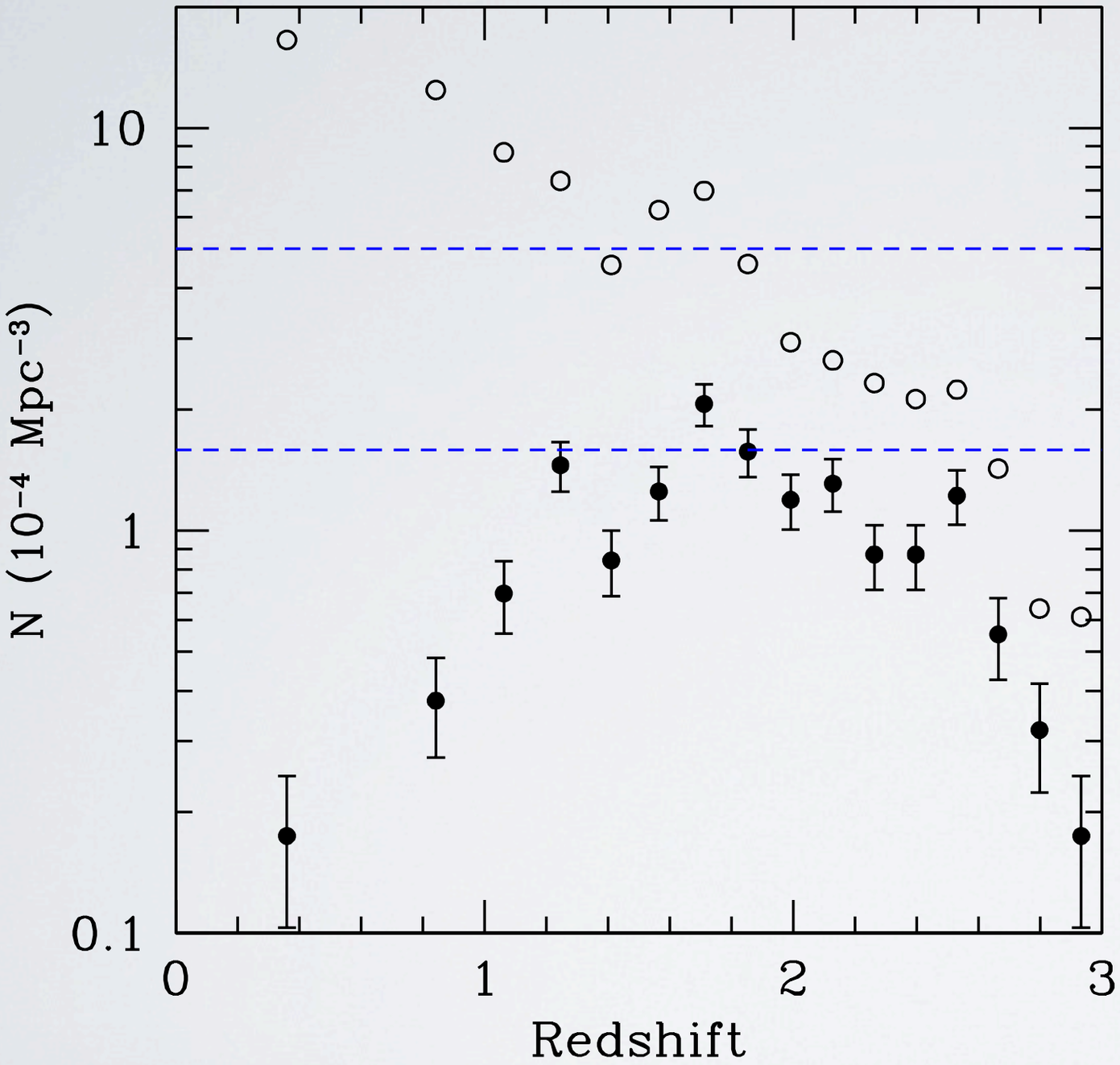
Nowhere in (M, Re)-space does the volume number density increase with redshift

Evidence for growth of individual galaxies



No number density evolution for quiescent galaxies with Sigma > 10.3 Msol/kpc^2 (see Damjanov et al.)

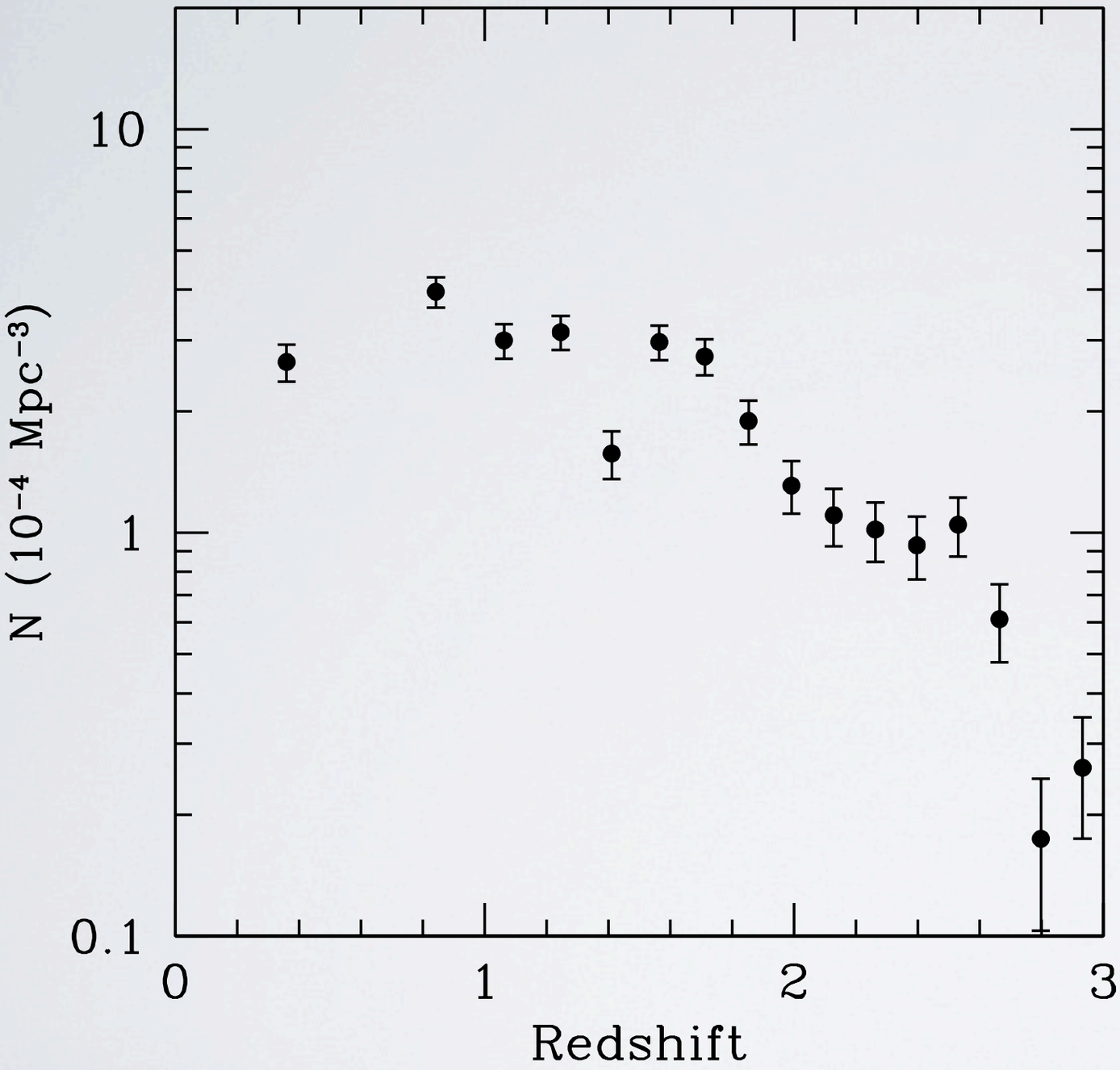
Evidence for growth of individual galaxies



No number density evolution for quiescent galaxies with Sigma > 10.3 Msol/kpc^2 (see Damjanov et al.)

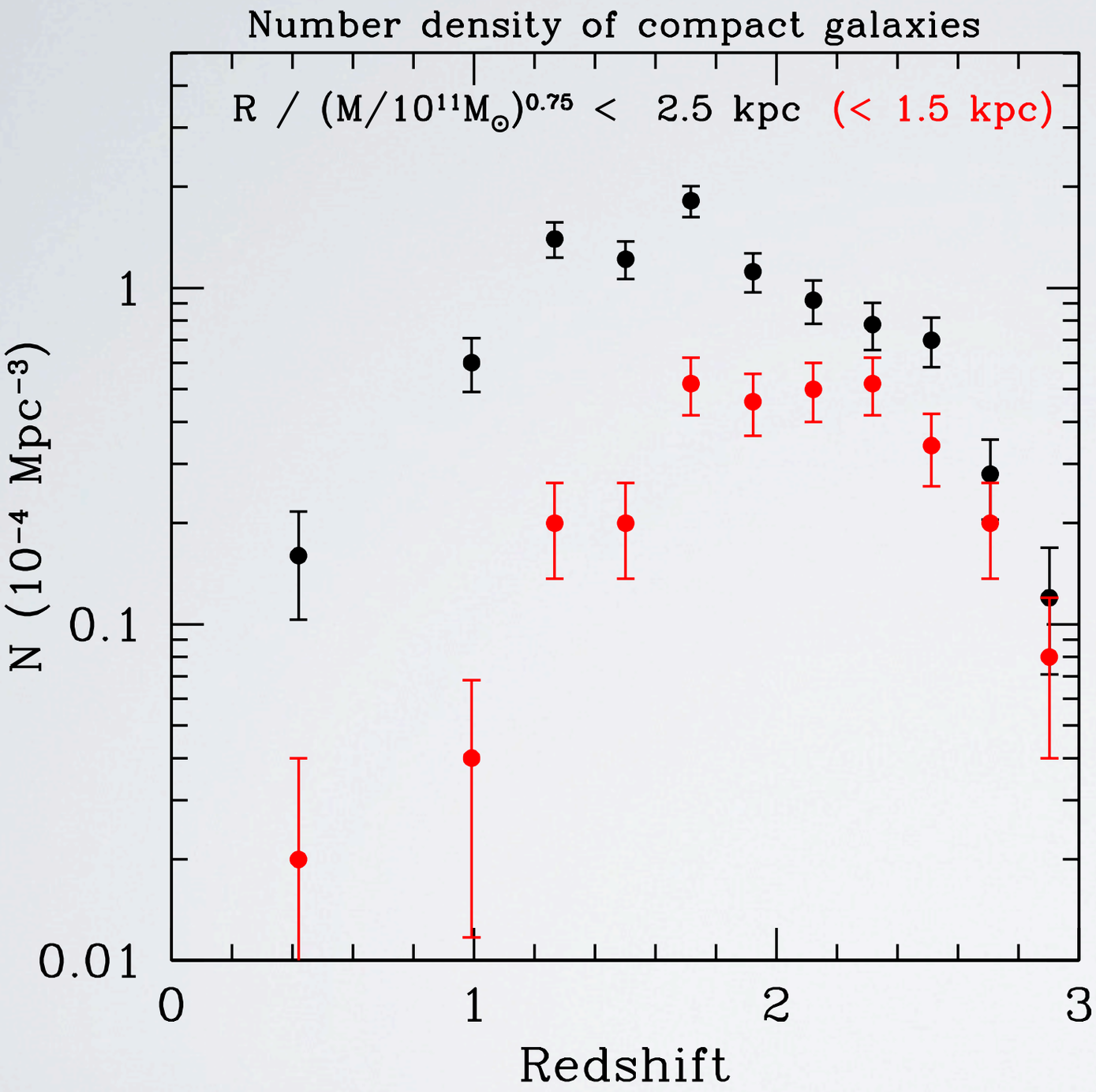
Strong number density evolution evolution for quiescent galaxies with Sigma > 10.8 Msol/kpc^2

Evidence for growth of individual galaxies



No number density evolution
for quiescent galaxies with
3e10 < M < 1e11 && Re < 2.5 kpc
(see Carollo et al.)

Evidence for growth of individual galaxies



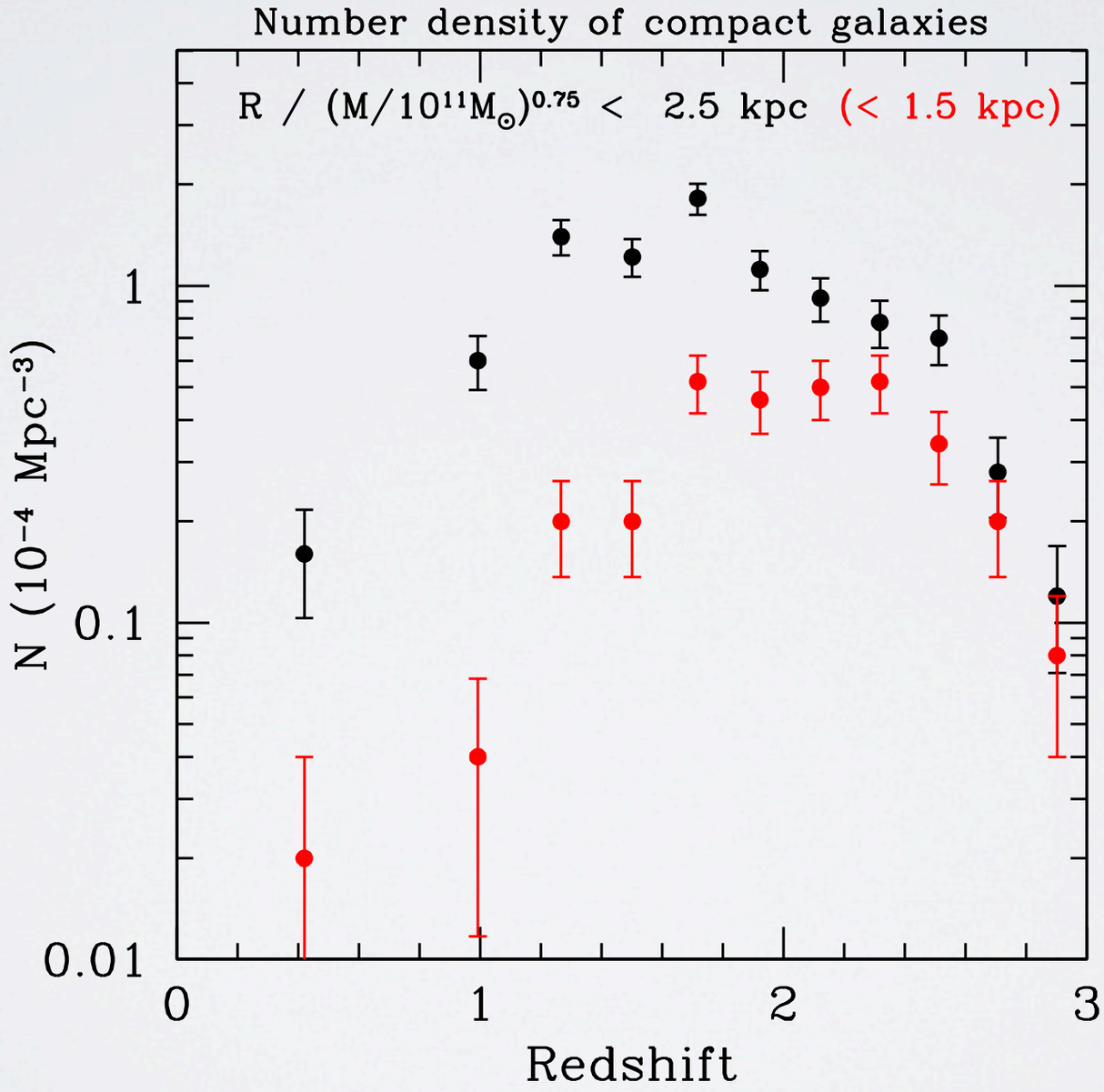
No number density evolution
for quiescent galaxies with
3e10 < M < 1e11 && Re < 2.5 kpc
(see Carollo et al.)

Strong number density evolution
for compact quiescent galaxies
in the same mass bin
but selected parallel to the relation

Evidence for growth of individual galaxies

Caveat

If galaxies do not grow, then we should take into account mass loss
(~0.1 dex between z=2 and z=0)



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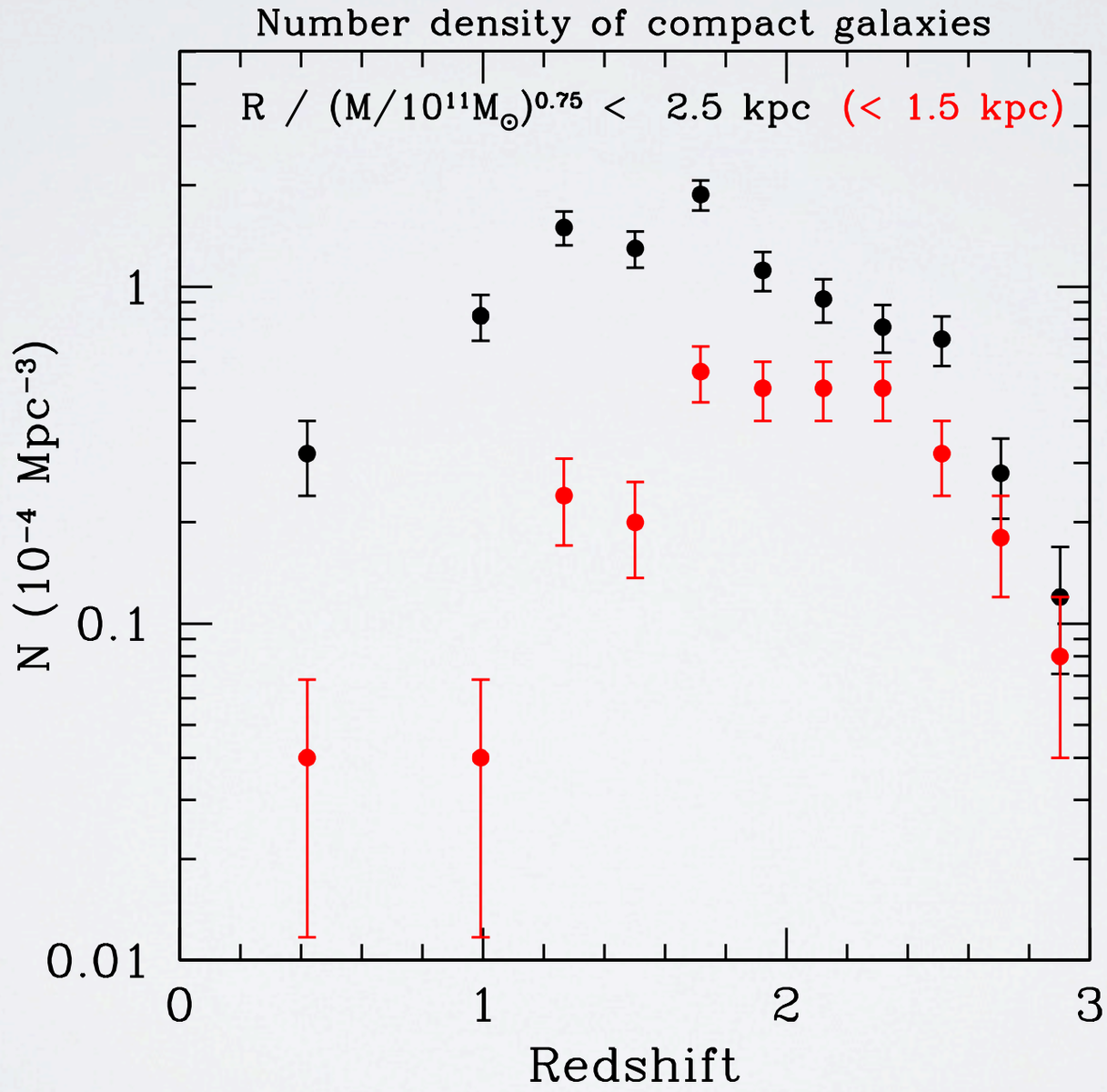


Evidence for growth of individual galaxies

Hypothesis

Individual quiescent galaxies do not grow over time

Test

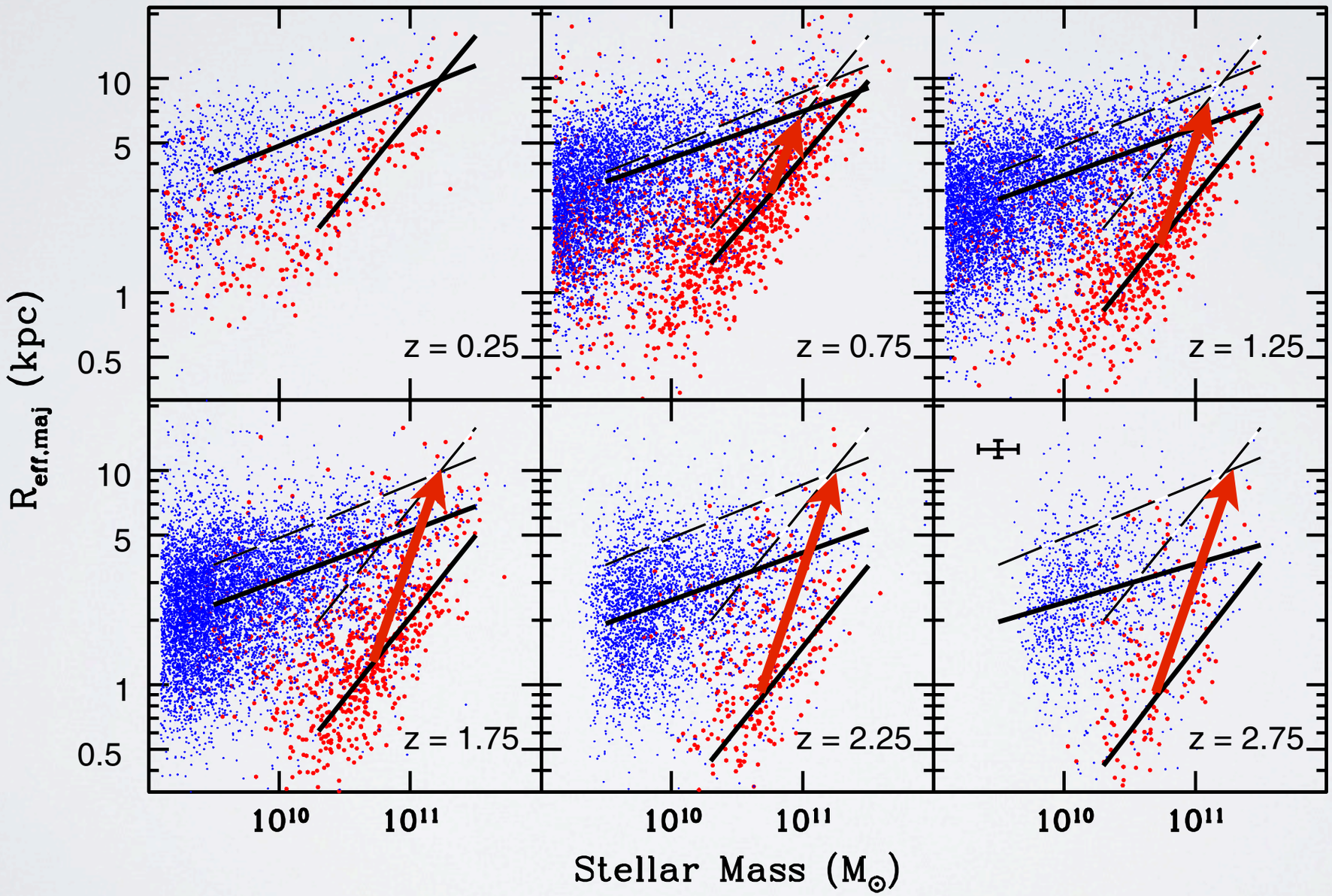
Nowhere in (M, Re)-space does the volume number density increase with redshift

Result

There are quiescent galaxies with mass > 3e10 Msol that grow over time
Typical z~2 quiescent galaxies grow in size over time by at least a factor 3

Evidence for growth of individual galaxies

Scatter is small and constant with redshift:
descendants of compact galaxies are similar in size as
galaxies that quenched much later



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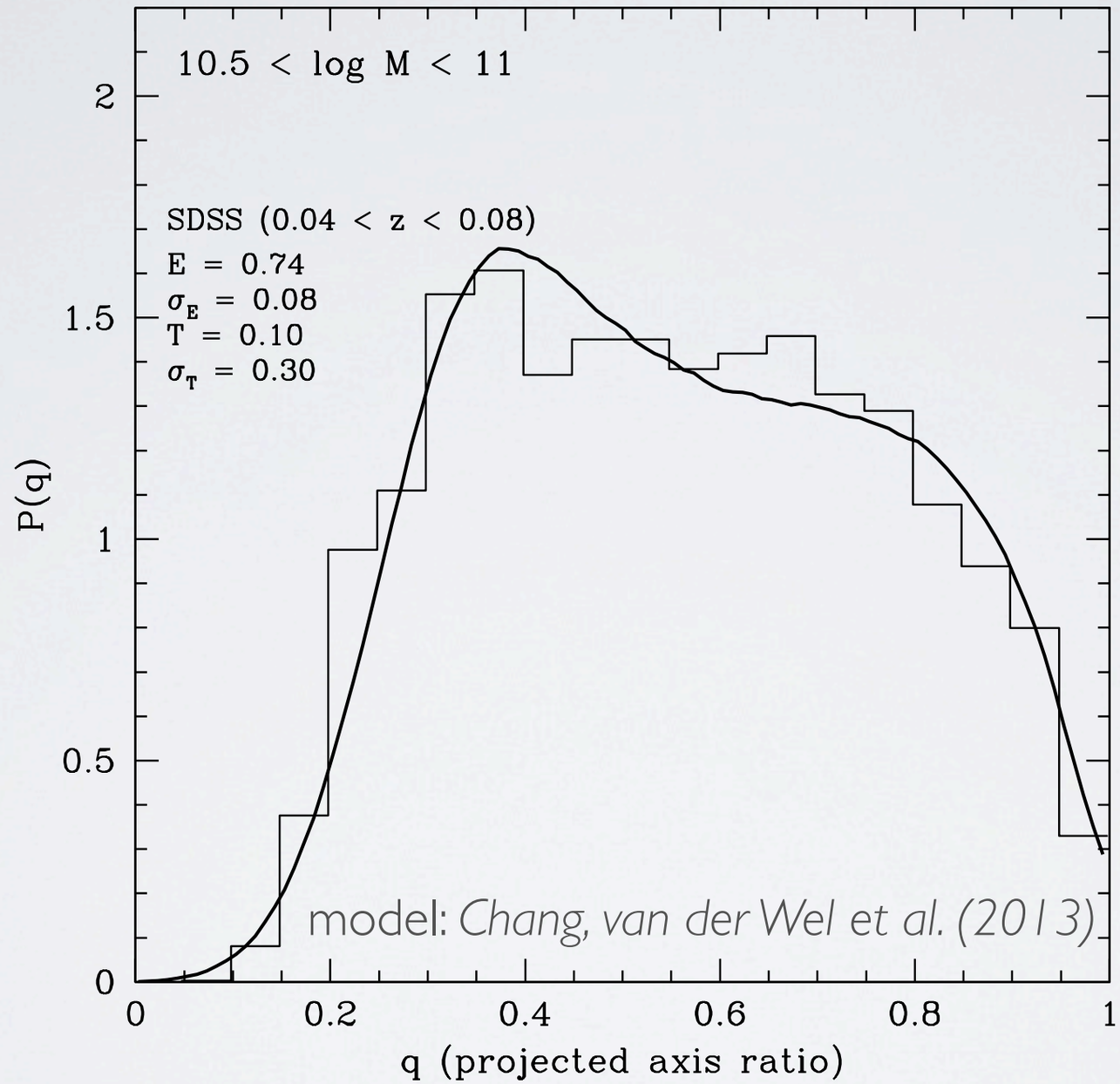
Evolution of SF-ing galaxies

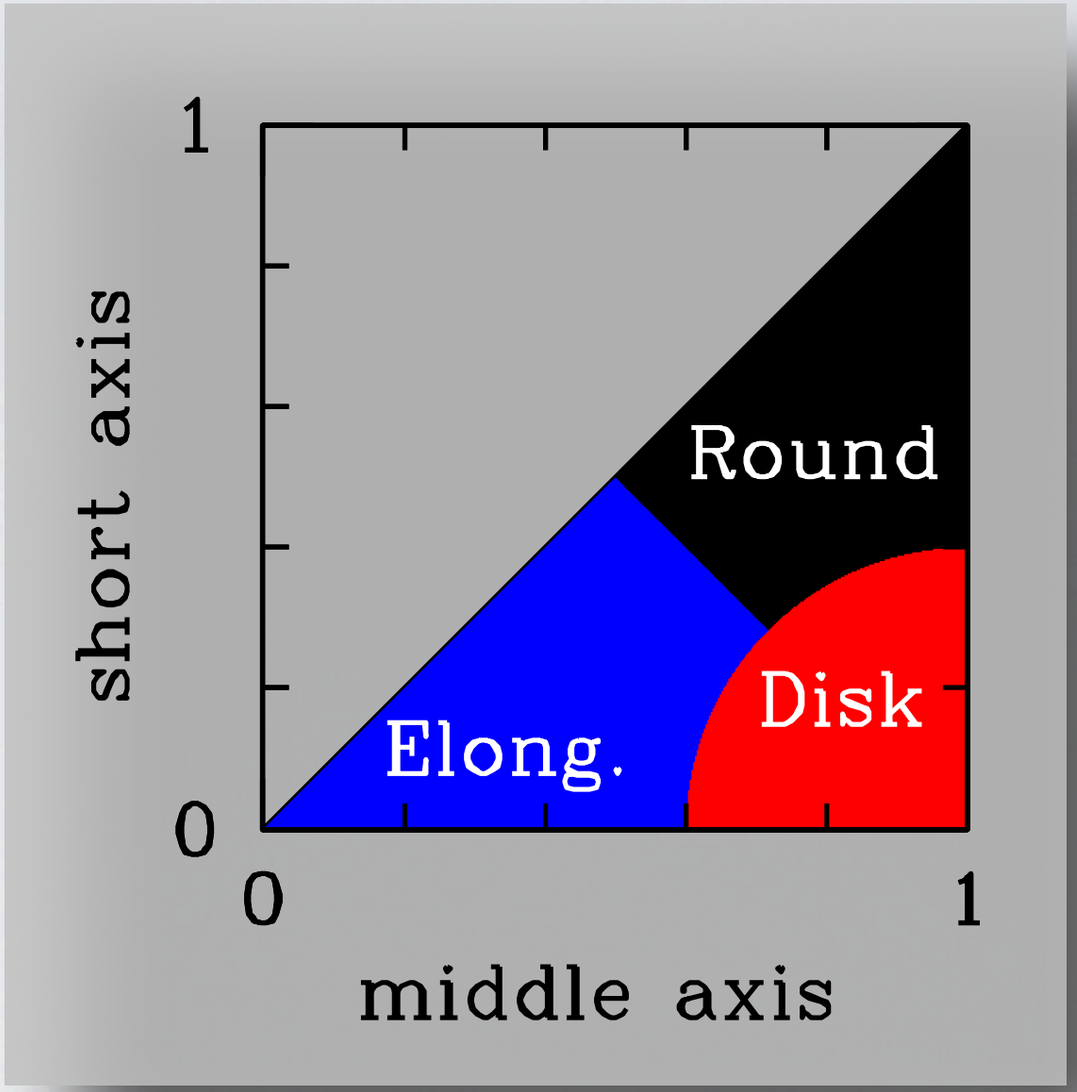
Shape distribution of 17584 galaxies at z ~ 0.06

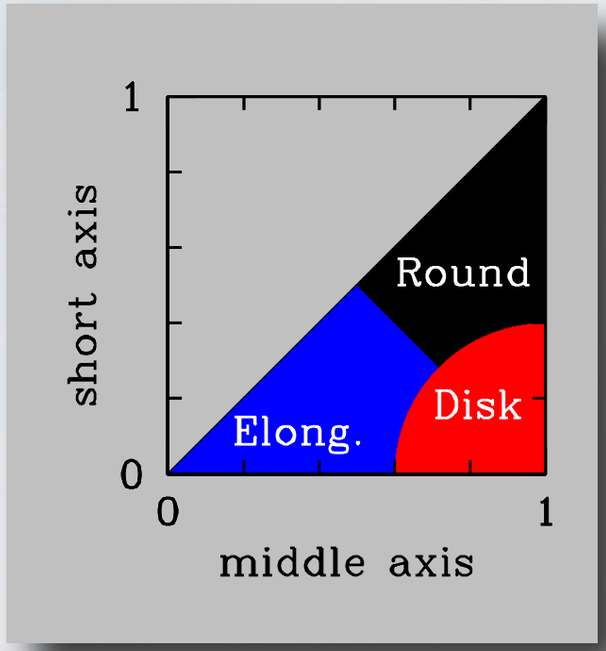


flat

round

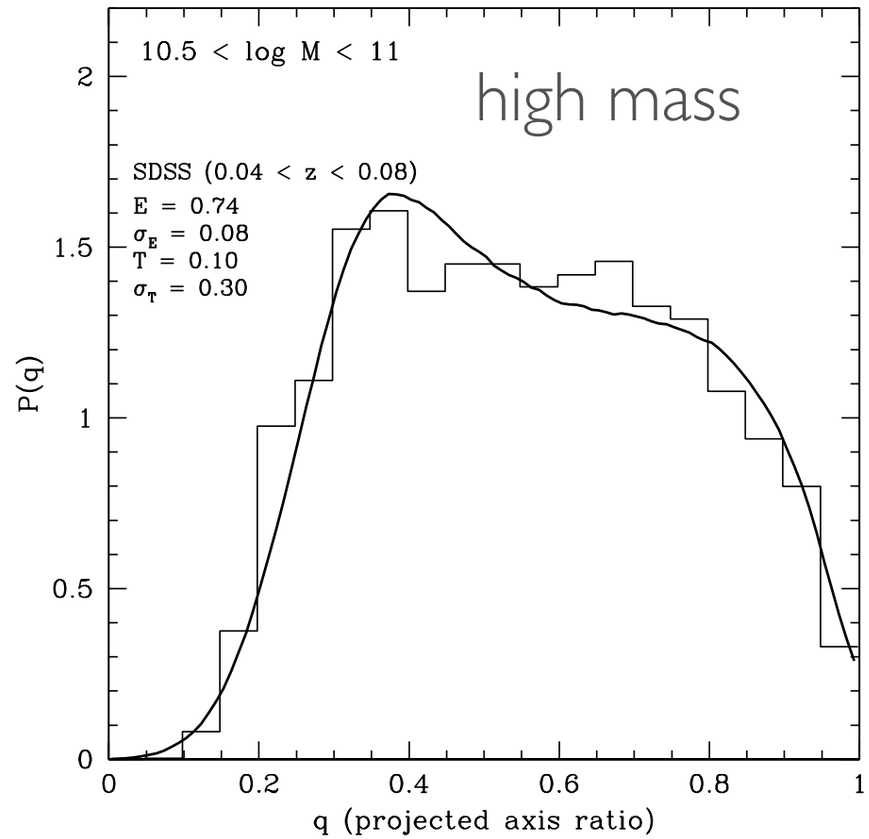
Triaxial shapes

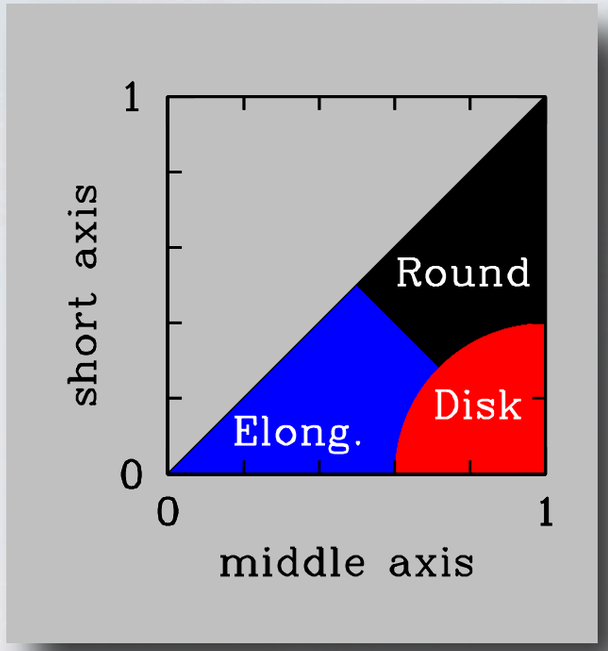



1
short axis
Round
Elong.
Disk
0
0
1
middle axis

100%

0%


10.5 < log M < 11
high mass
SDSS (0.04 < z < 0.08)
E = 0.74
σ_E = 0.08
T = 0.10
σ_T = 0.30
P(q)
0
0.5
1
1.5
2
0
0.2
0.4
0.6
0.8
1
q (projected axis ratio)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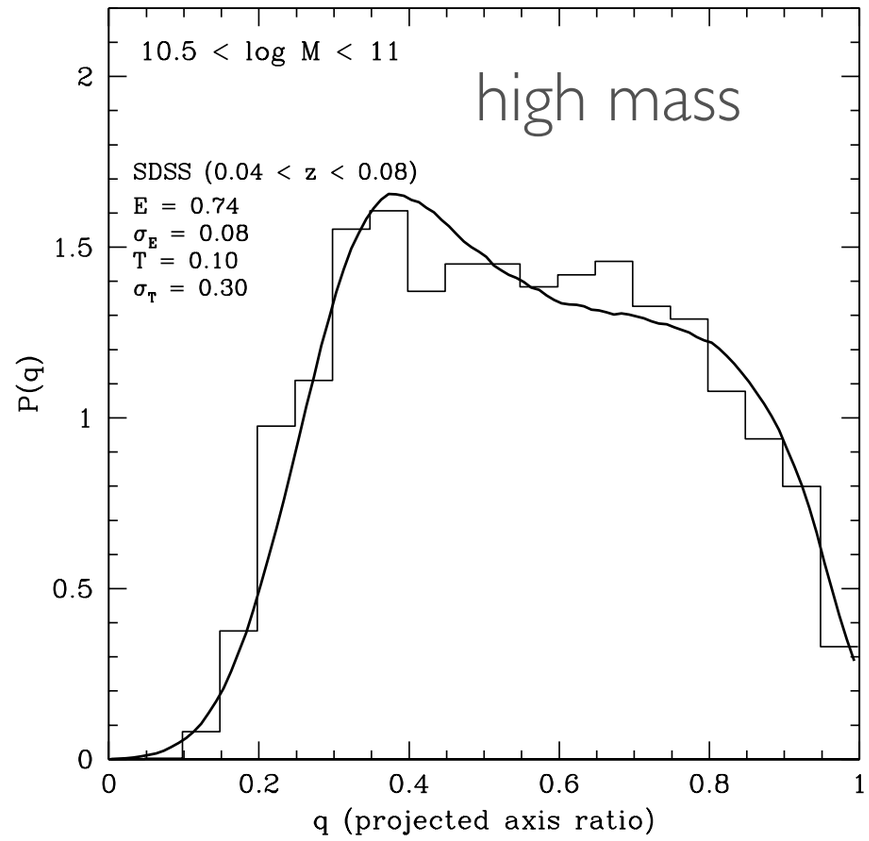
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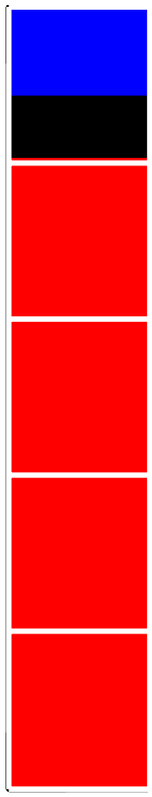
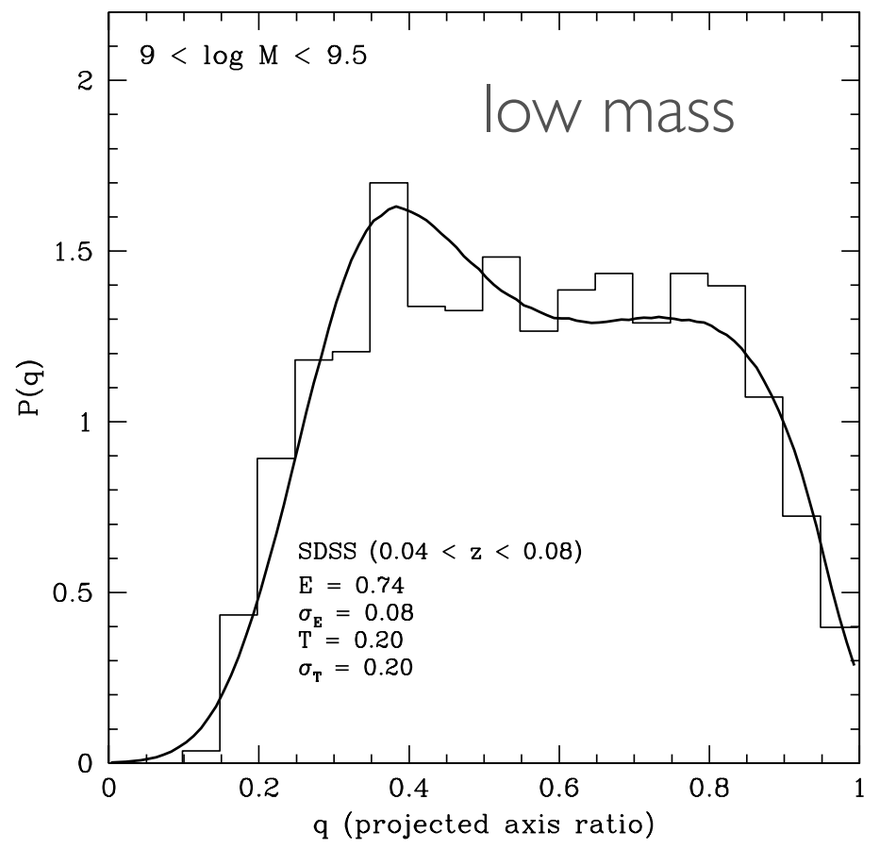
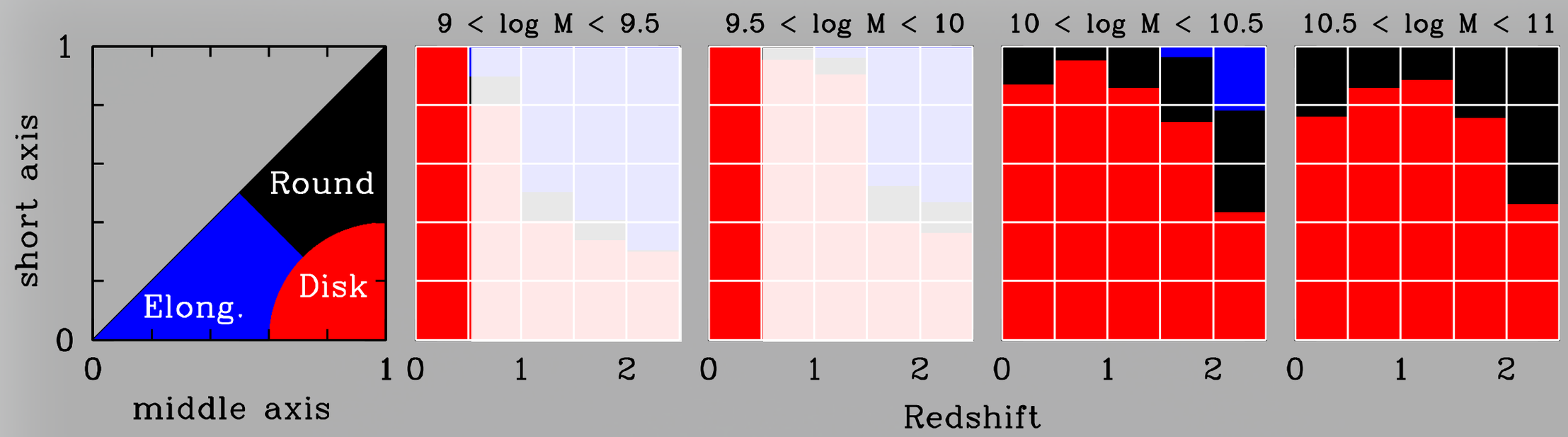



9 < log M < 9.5
low mass
SDSS (0.04 < z < 0.08)
E = 0.74
σE = 0.08
T = 0.20
σT = 0.20
P(q)
q (projected axis ratio)

Evolution of SF-ing galaxies

956 $>10^{10}$ $M_\odot$ galaxies at $1 < z < 2.5$



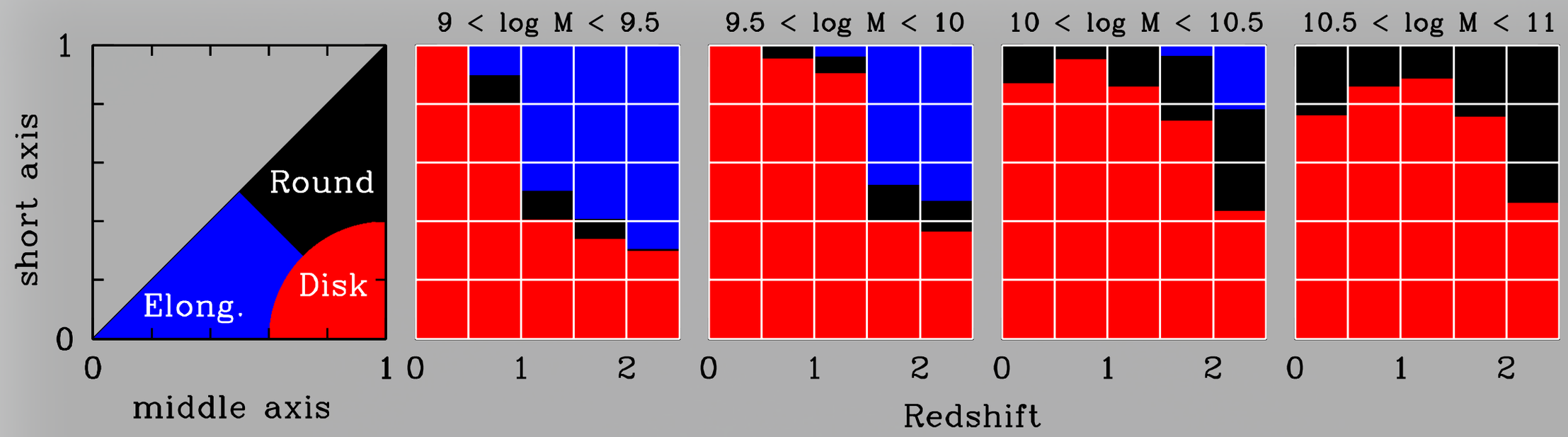
van der Wel et al. (2014b)

Up to z ~ 2 the majority of
massive ($>10^{10}$ $M_\odot$) star-forming galaxies are **disks**

Implication: majority of stars formed in disks

Evolution of SF-ing galaxies

3081 $10^9 < M/M_\odot < 10^{10}$ galaxies at $1 < z < 2.5$



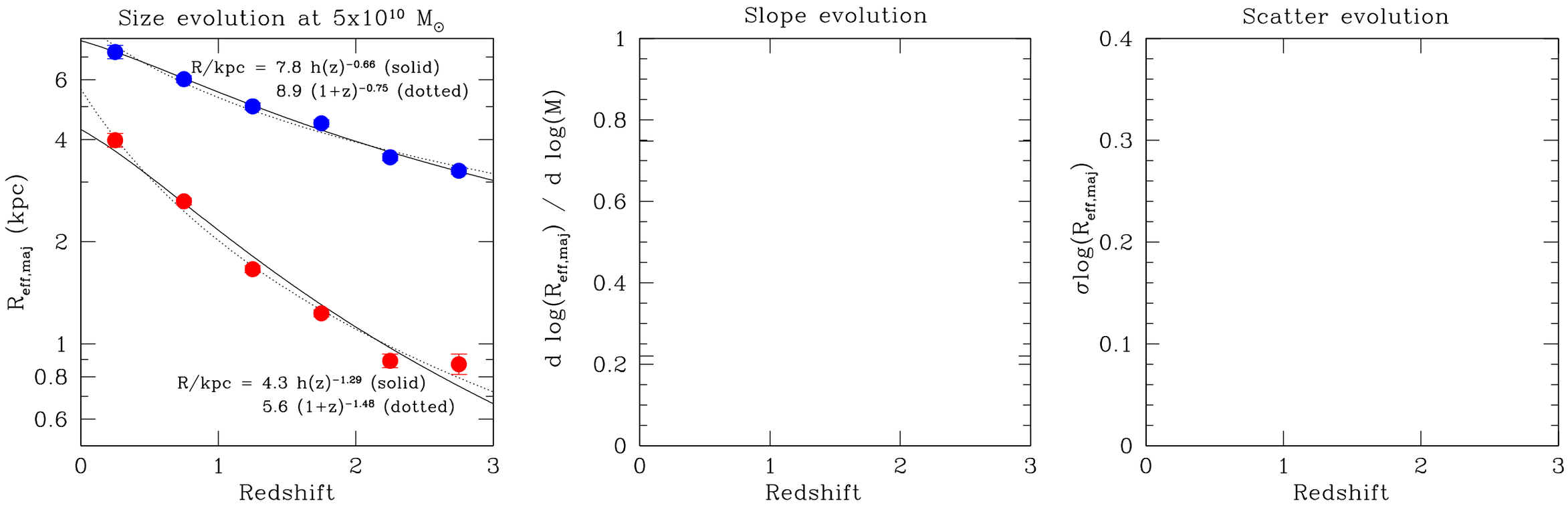
van der Wel et al. (2014b)

At $z > 1$, low-mass galaxies ($<10^{10}\ M_\odot$) are **not generally disks;**
they have a large variety in shape: **irregulars**

Implication: MW type galaxies did not start out with sustained stellar disks

Evolution of SF-ing galaxies

$$r(m_*)/\mathrm{kpc} = \mathrm{A} \cdot \mathrm{m}_*^{\alpha}$$



- Galaxy size/mass evolve in proportion to halo size/mass
- The slope does not evolve: galaxy-to-halo mass relation does not evolve

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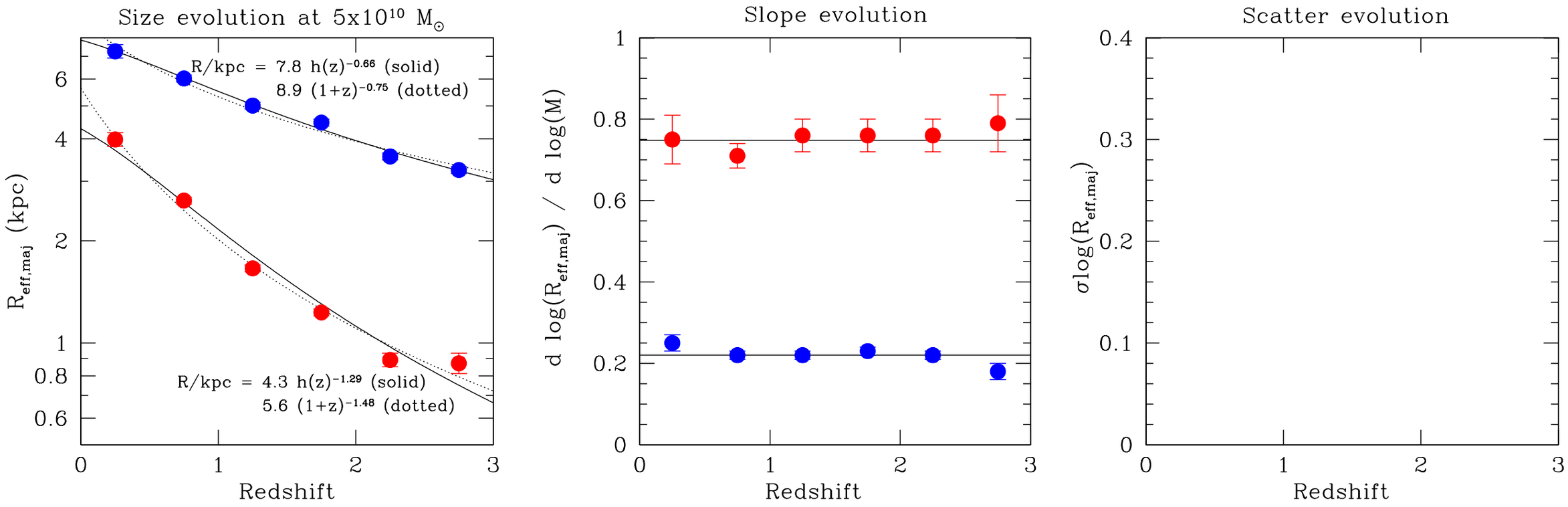

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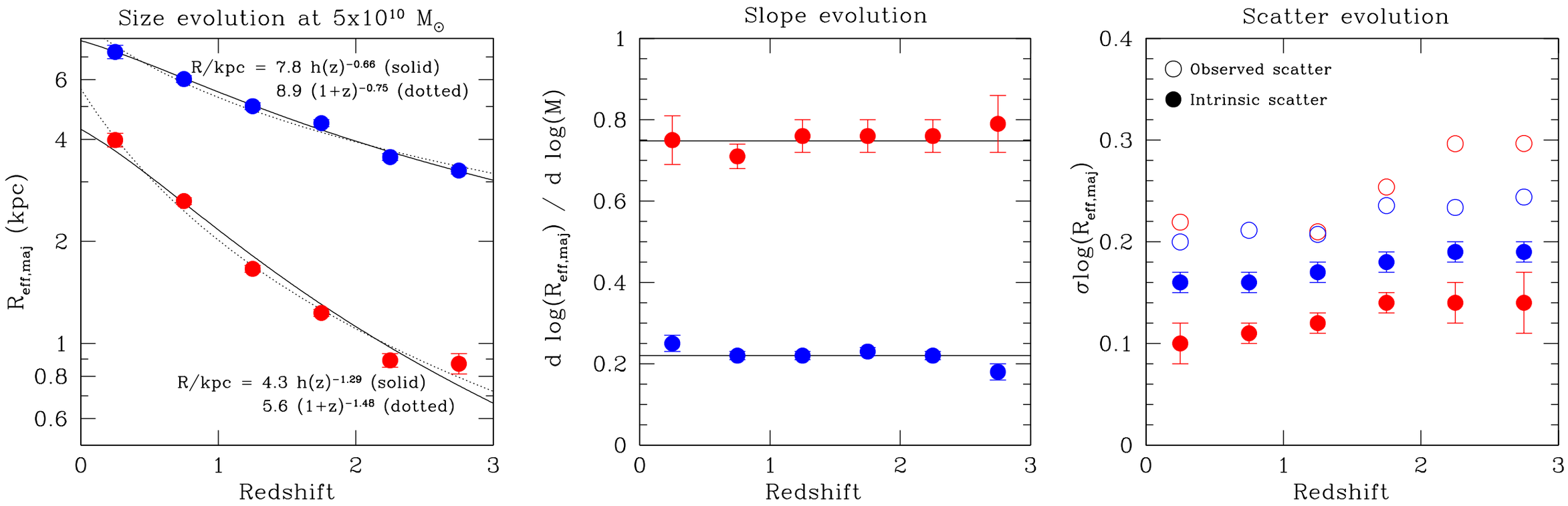

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Open issues + plan of attack

Connecting progenitors and descendants

- We need more information than stellar mass, SFR, and global structure

- We need ages and metallicities at large lookback time

- We need a property that does not change much with time:
  stellar velocity dispersion

LEGA-C

A spectroscopic galaxy survey with VLT/VIMOS

128 nights of VLT/VIMOS time over the next 5 years

LEGA-C

A spectroscopic galaxy survey with VLT/VIMOS

130 nights of VLT/VIMOS time over the next 5 years

Sufficient resolution (R > 2000) and S/N (~20) to measure

I) internal stellar motions

II) stellar ages and metallicities

Sample: 2500 K-band selected galaxies at 0.6 < z < 1.0

LEGA-C

A spectroscopic galaxy survey with VLT/VIMOS

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Christian Wolf (ASU)