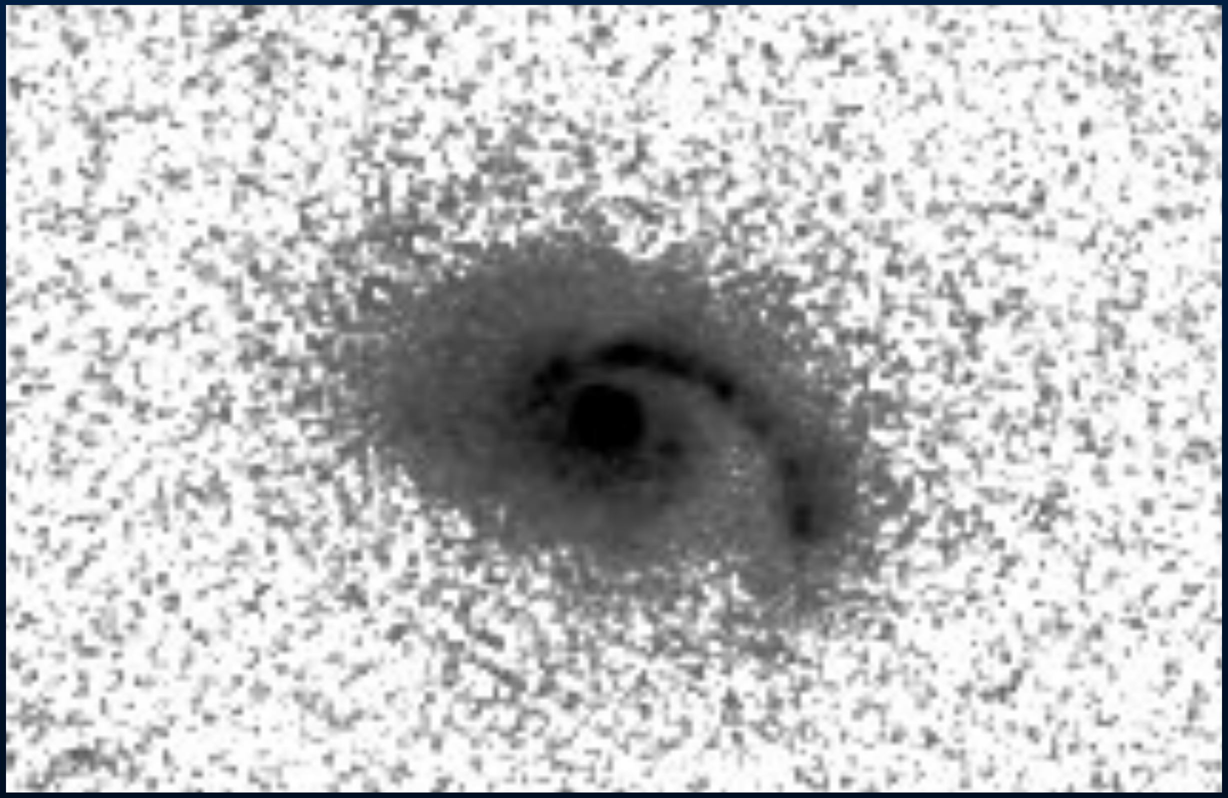
The kinematics of intermediate redshift galaxies with LEGA-C

“Emission Line Galaxies with MOS”
Cambridge
Sep 20th, 2017

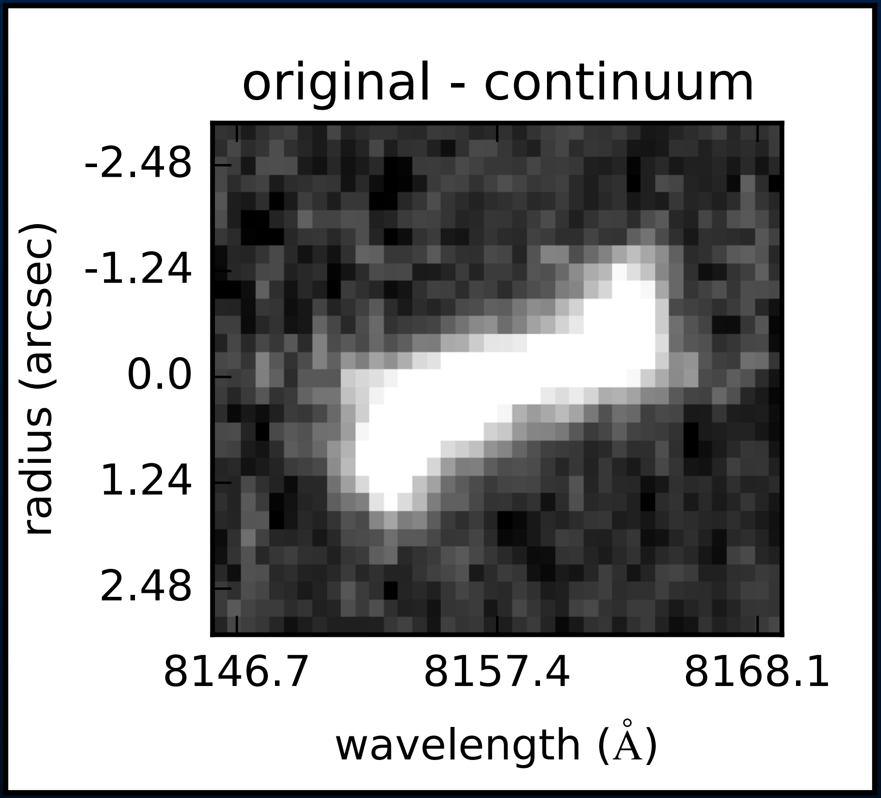
Caroline Straatman
LEGA-C collaboration
MPIA

3D modeling

I-band



~~H~~α Hβ

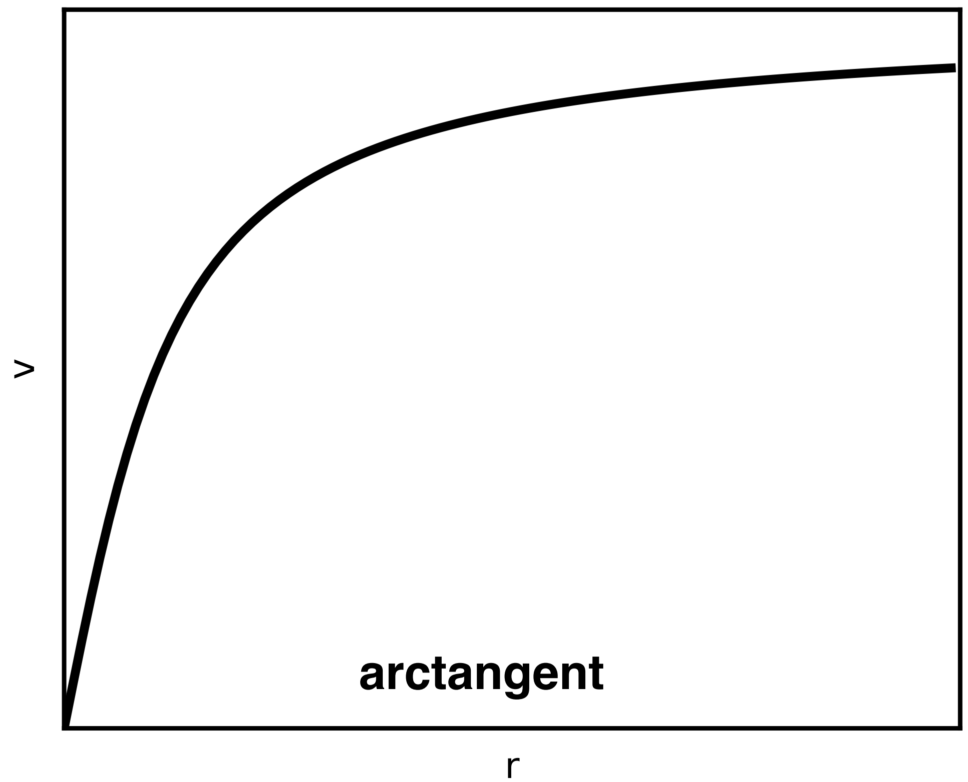


3D - modeling

Recipe 🎂🍰

See also Price+16

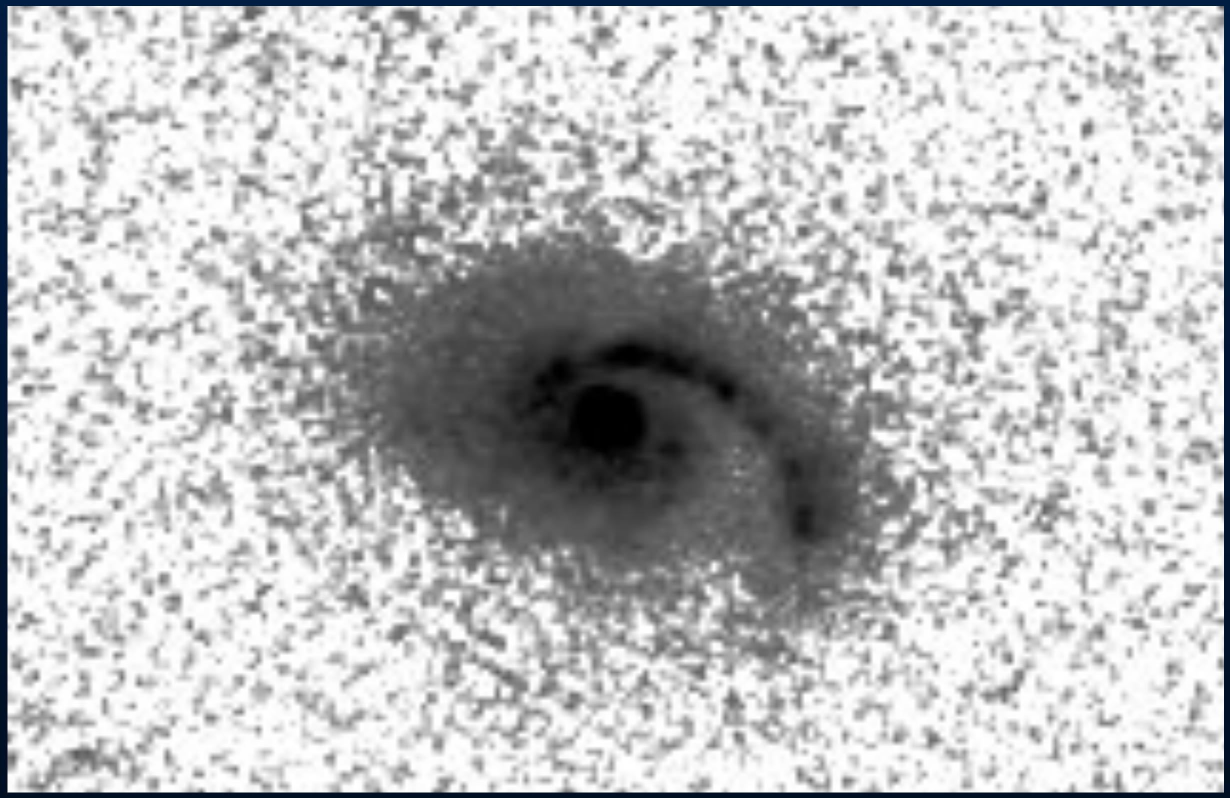
Ingredients
gasdisk: exponential
sigma: constant
velocity (R): arctangent
(...)
inclination
slit angle
PSF
(...)



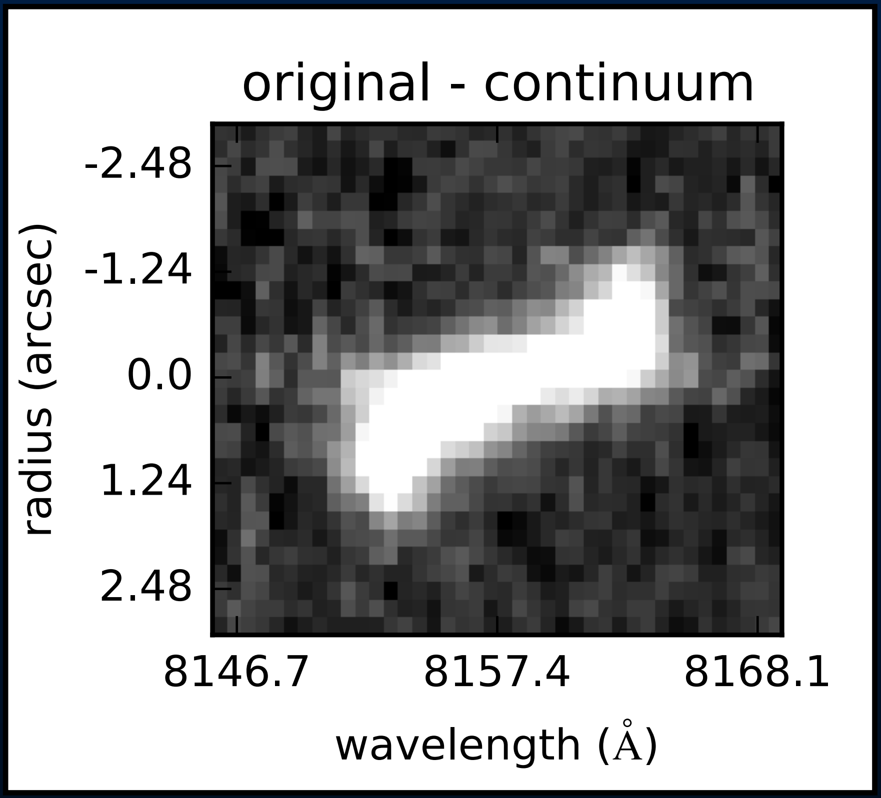
Directions
Model the gas disk in 3D and simulate light path through VIMOS instrument.

3D modeling

I-band

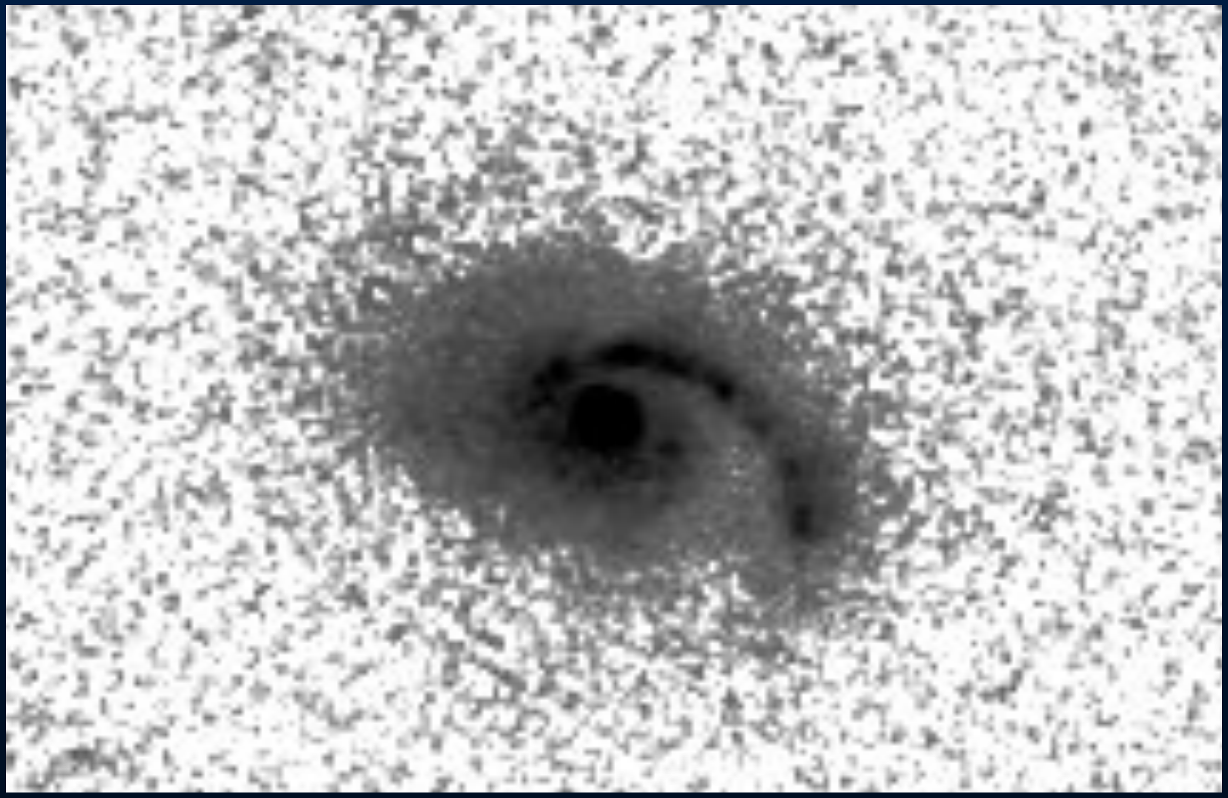


Hβ



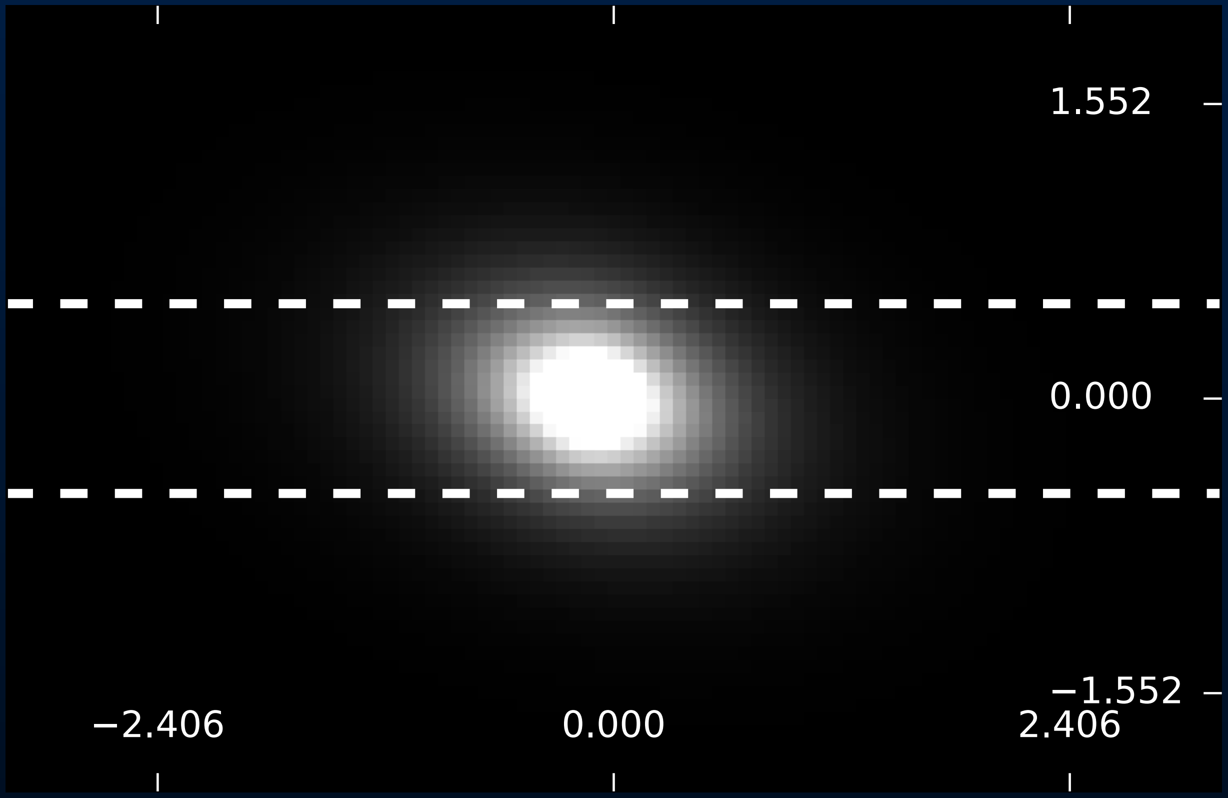
3D modeling

I-band



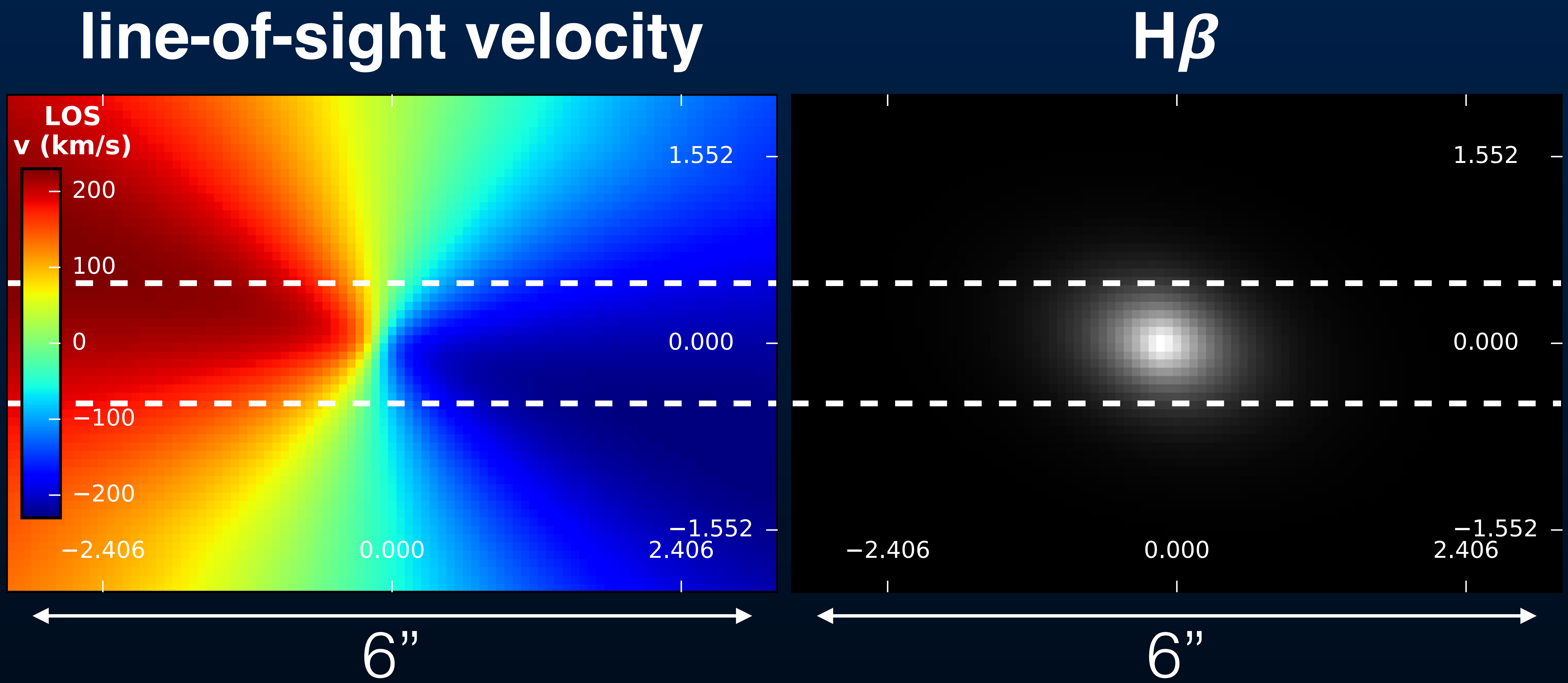
6”

Hβ



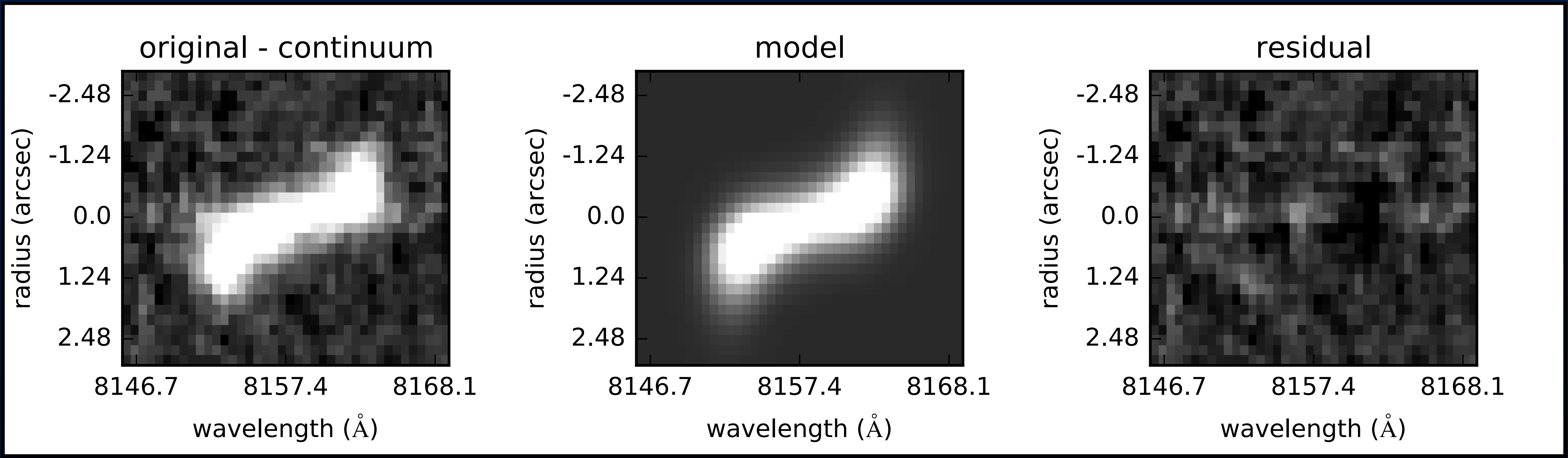
6”

3D modeling


line-of-sight velocity
LOS
v (km/s)
200
100
0
−100
−200
1.552
0.000
−1.552
−2.406
0.000
2.406
6”
Hβ
1.552
0.000
−1.552
−2.406
0.000
2.406
6”

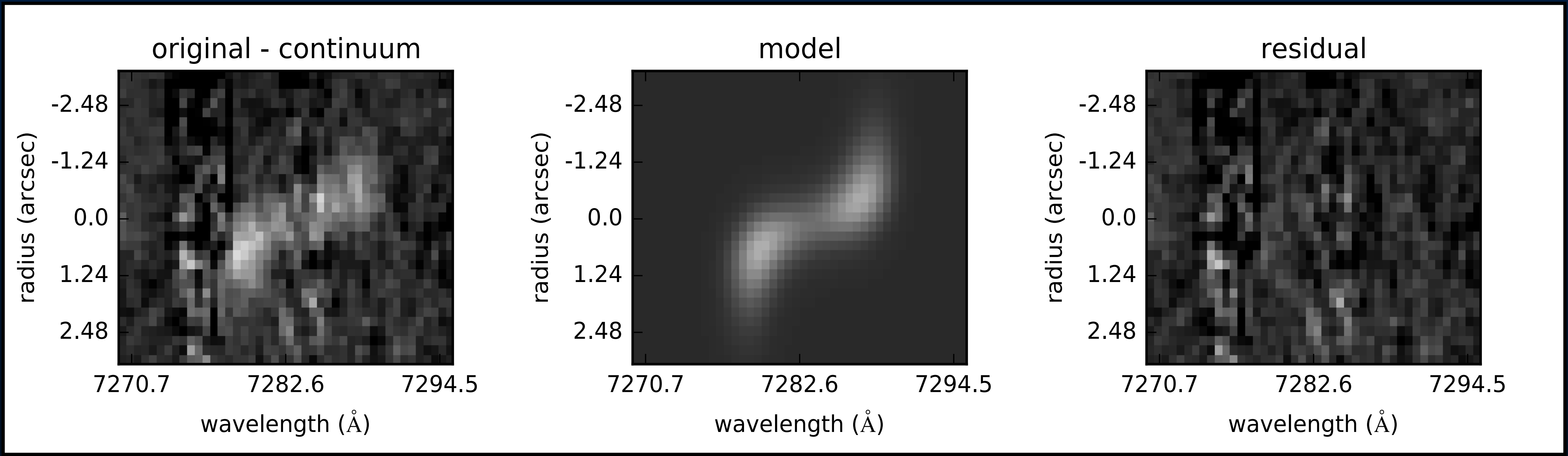
3D modeling

Hβ



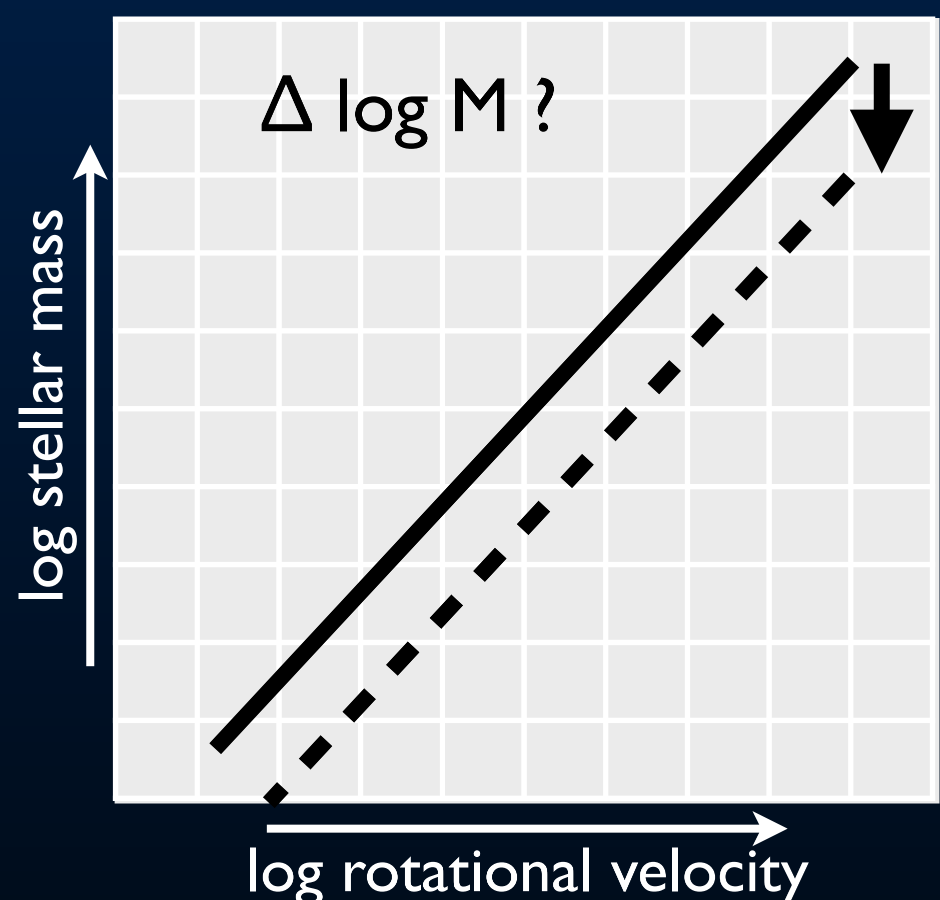
3D modeling

Hγ



What's inside a galaxy?

stellar mass Tully Fisher relation

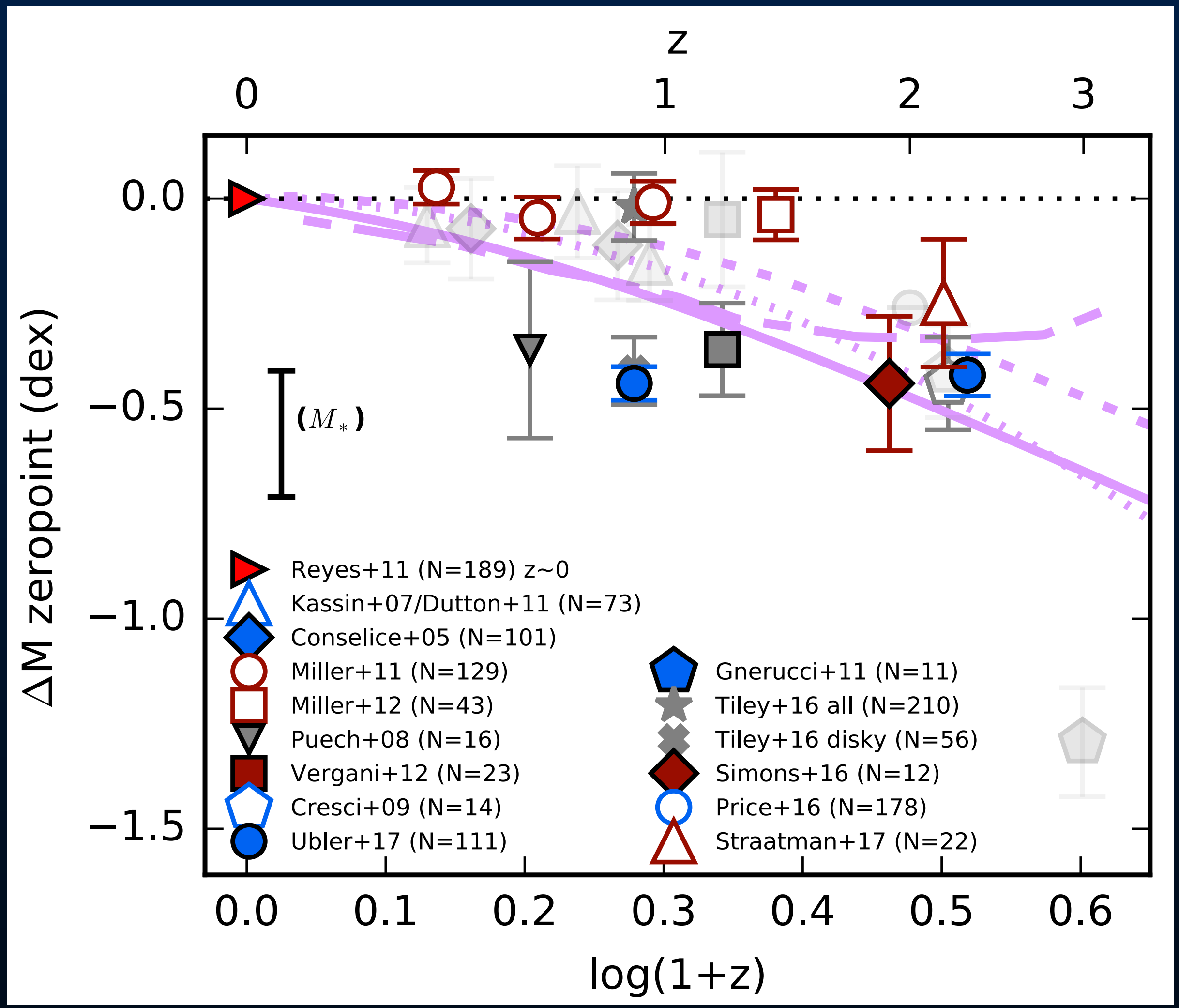


stars + gas + DM

Use stellar + gas dynamics to find out how well stellar light traces total dynamical mass.

Evolution with redshift

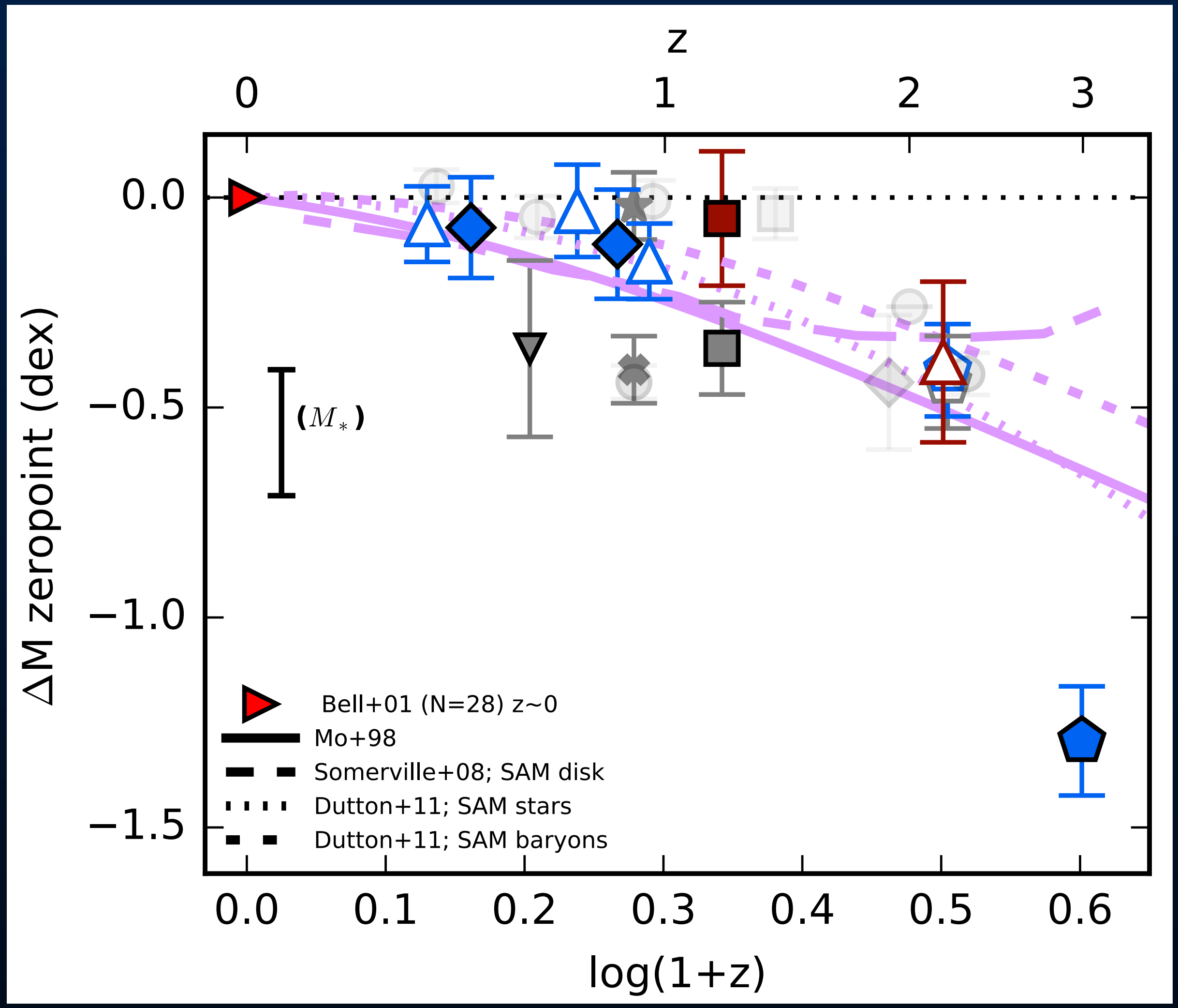
Slope @ Reyes+11   Log M ~ 3.4 log V



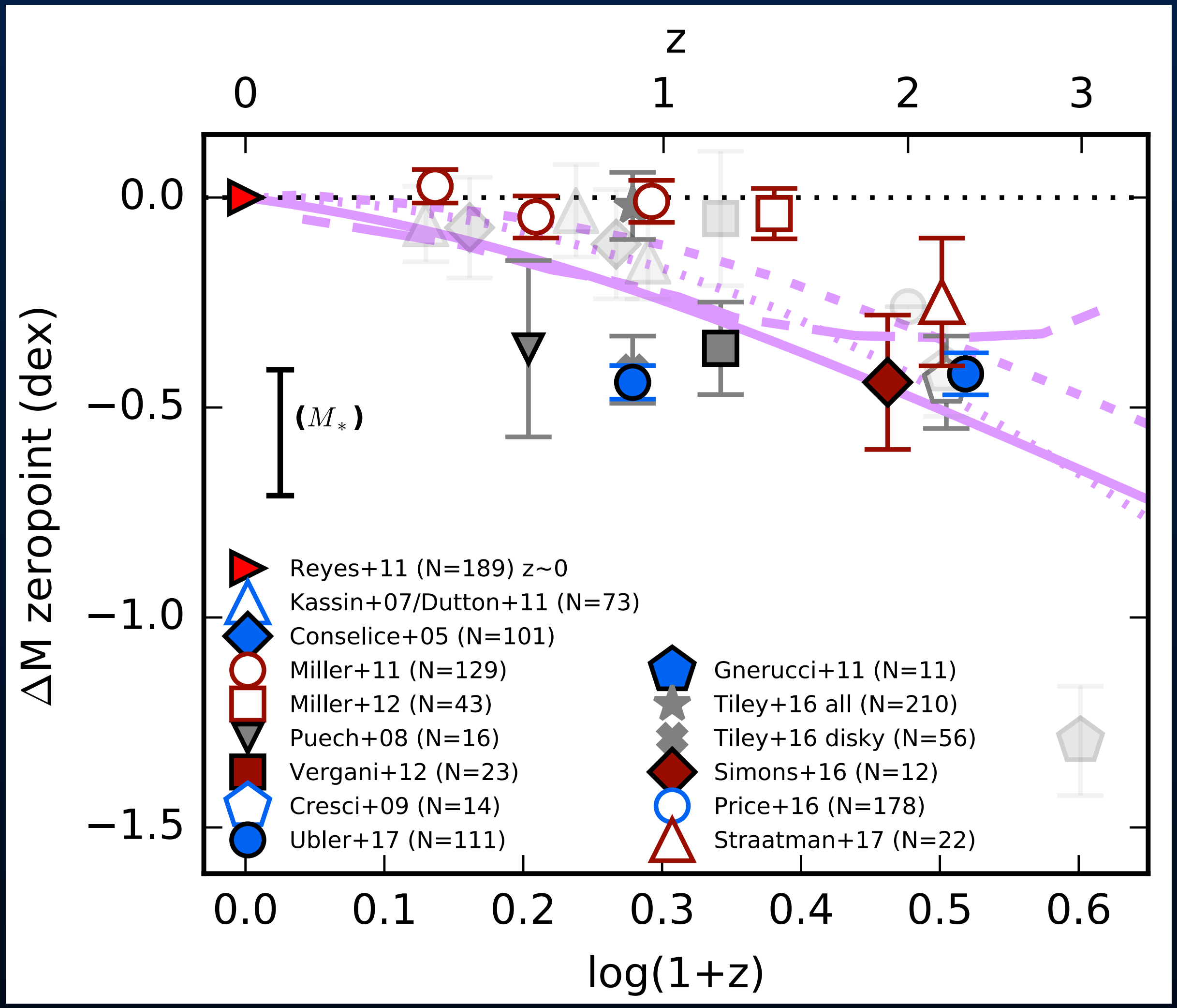
See also Straatman+17

Evolution with redshift

Slope @ Bell+01 log M ~ 4.5 log V



Slope @ Reyes+11 Log M ~ 3.4 log V

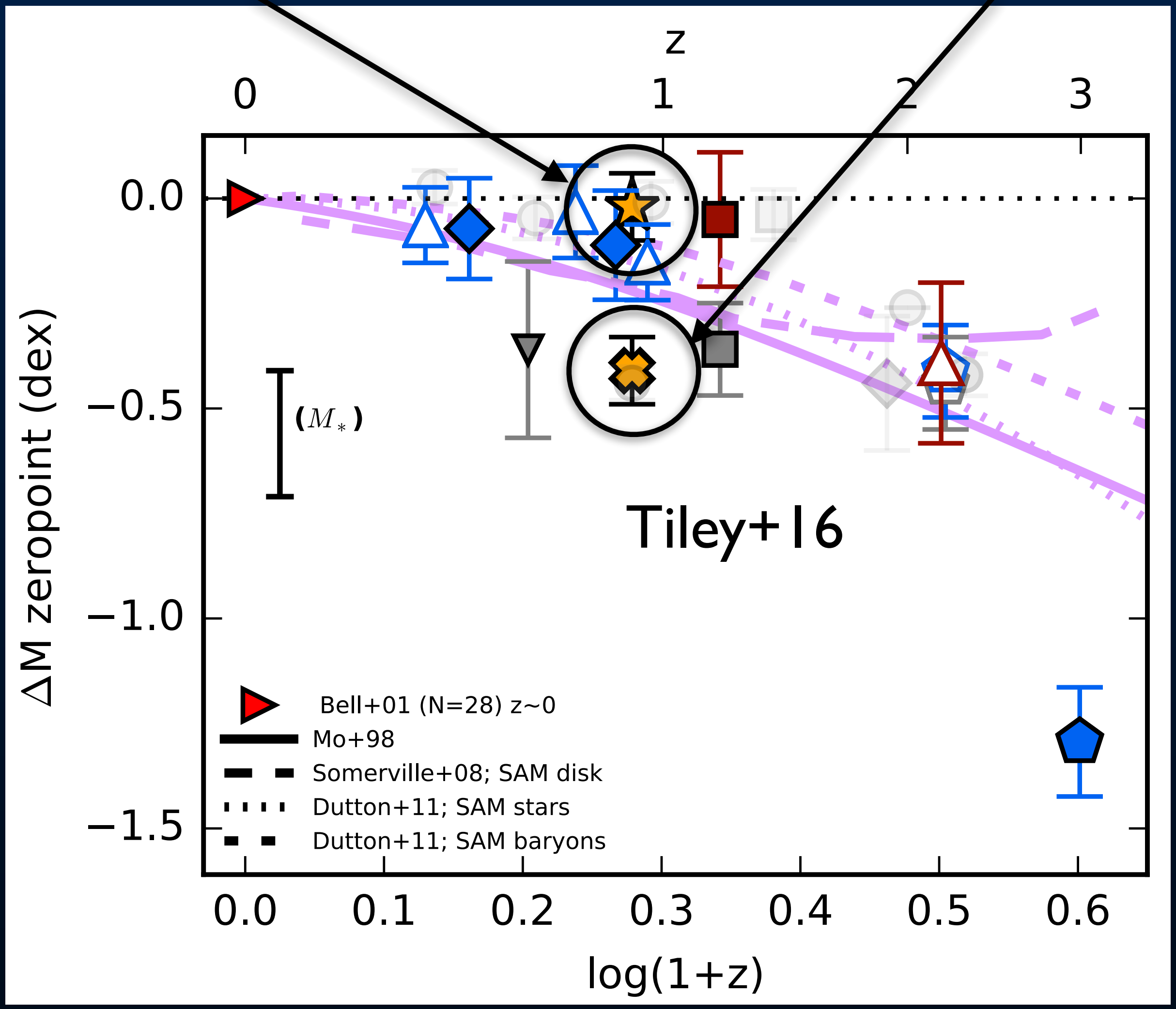


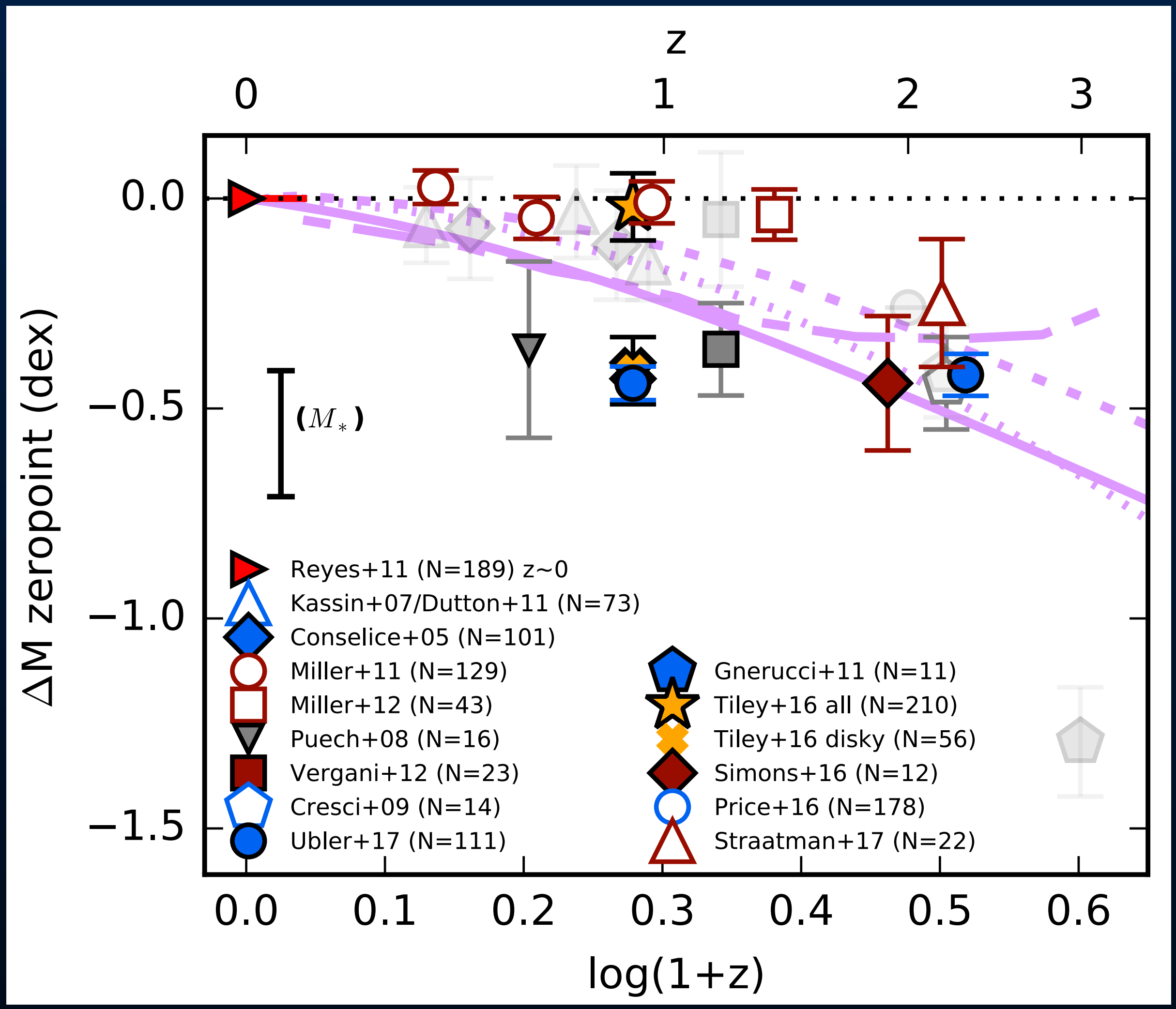
See also Straatman+17

Selection bias

Δ log M (M⊙) = **0.39** dex

all **disky: v/σ**

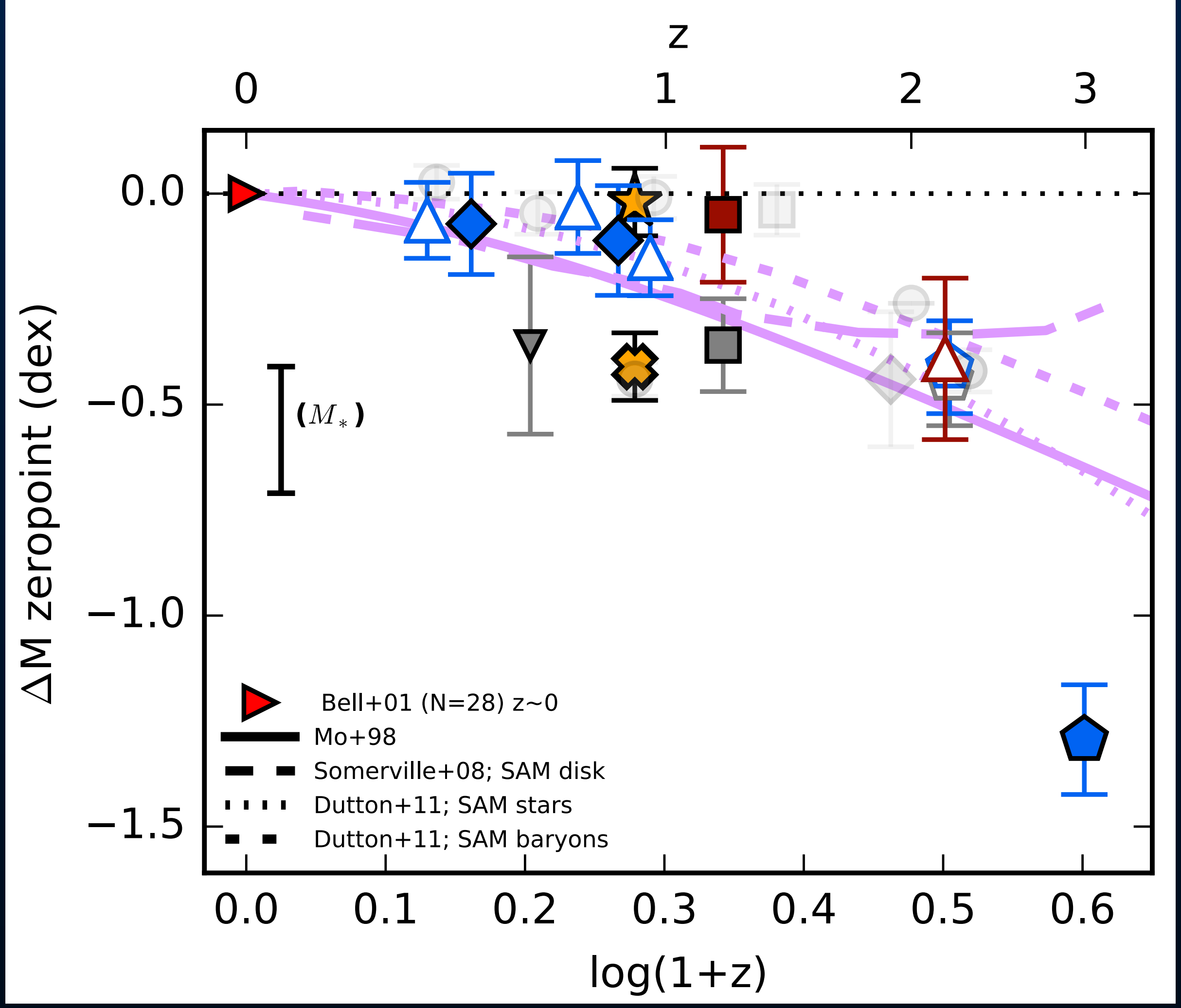




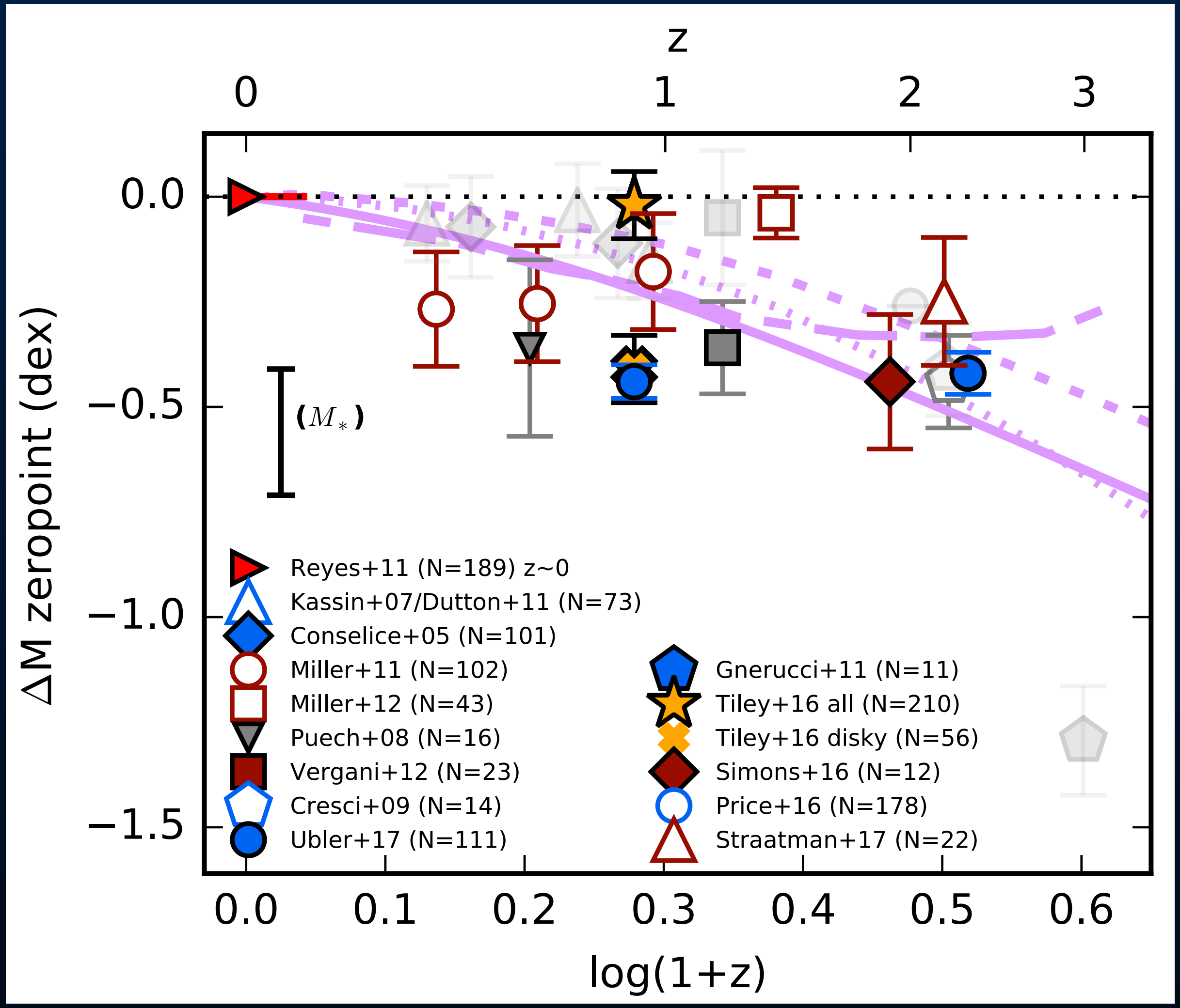
See also Straatman+17

Stellar mass

*everything with Chabrier03 IMF

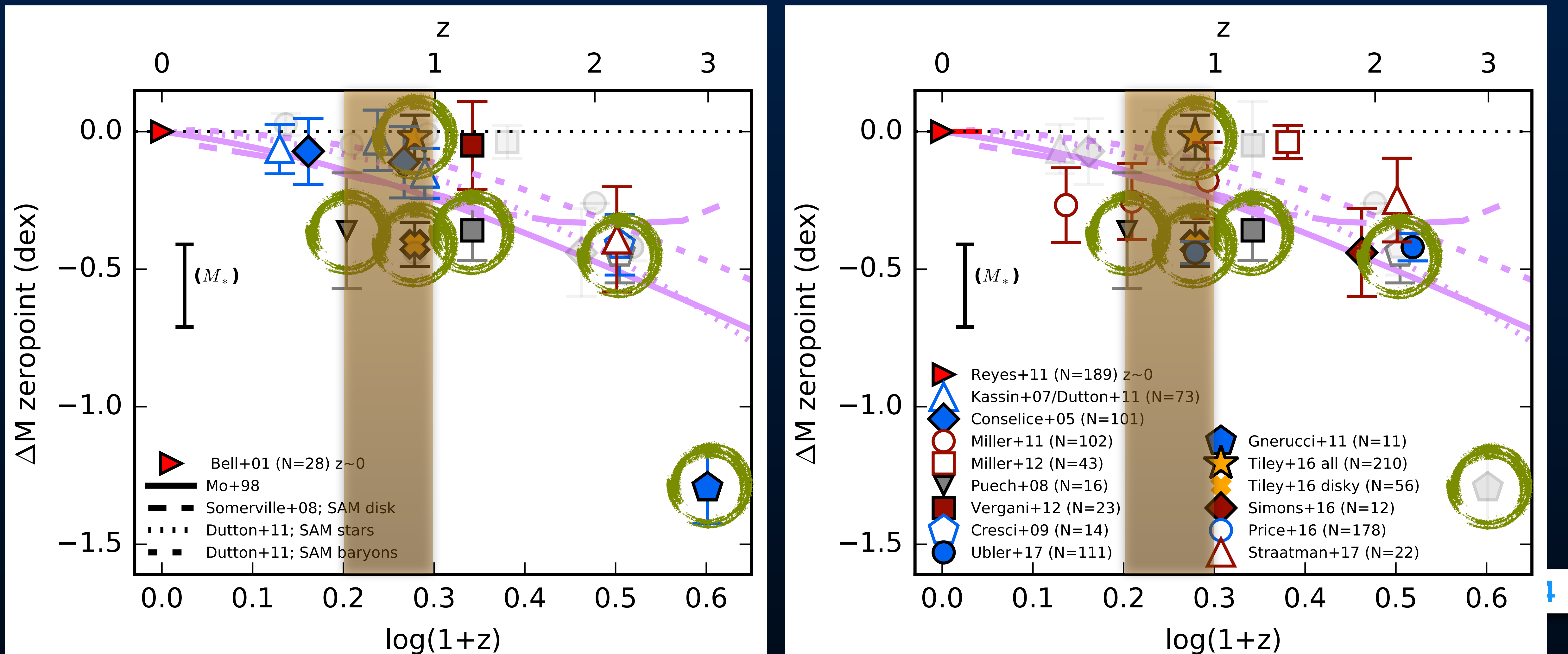


e.g. Miller+11 with 3D-HST masses



See also Straatman+17

LEGA-C: 0.6 ≲ z ≲ 1



See also Straatman+17

sample

N = 57 in DR2

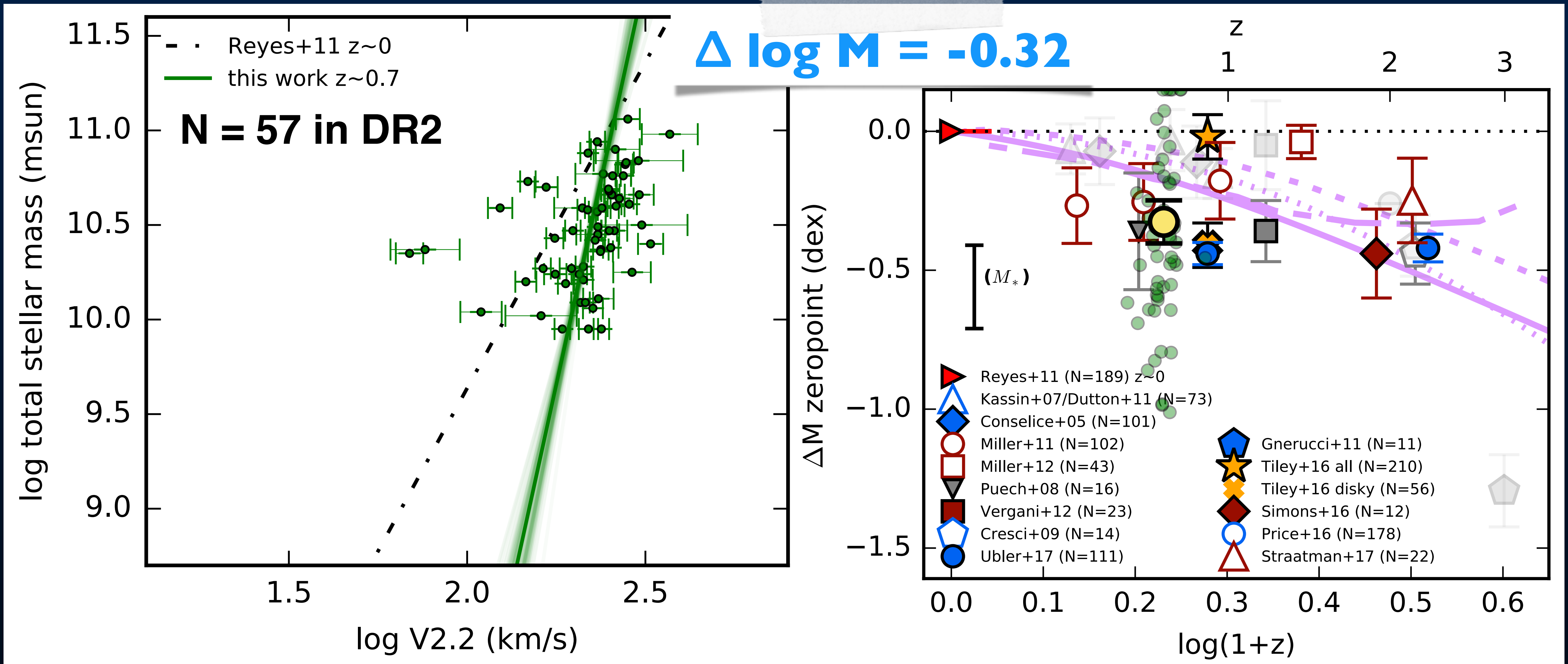
1. H$\boldsymbol{\beta}$ signal with no strong skylines. **by eye*
2. no mergers. **by eye*
3. valid GALFIT fits. **by eye*
   (need radius and inclination)
4. axis-ratio < 0.7.
5. slit misalignment < 40 degrees
6. no AGN. (log OIII5007 / H$\boldsymbol{\beta}$ < 0.5)
7. not quiescent.
   (log sSFR > log 1 / 3t_h + 0.3; Damen+09)
8. line is resolved.
   (v (km/s) has the same sign for 95% of parameter space)

Does the (intercept of the) stellar-mass TFR evolve?

V2.2 = v (R = 2.2 * disk scale radius)

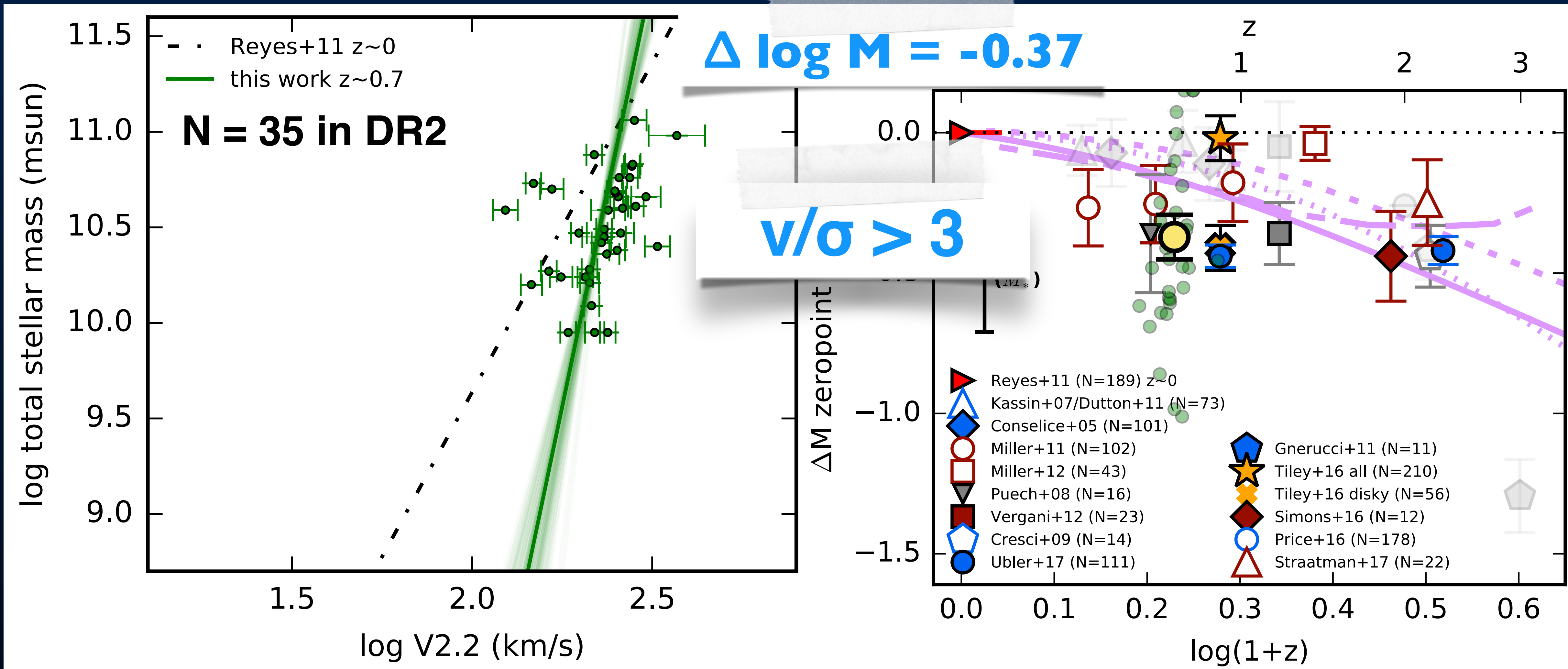
Slope @ Reyes+11 Log M ~ 3.4 log V

Δ log M = -0.32



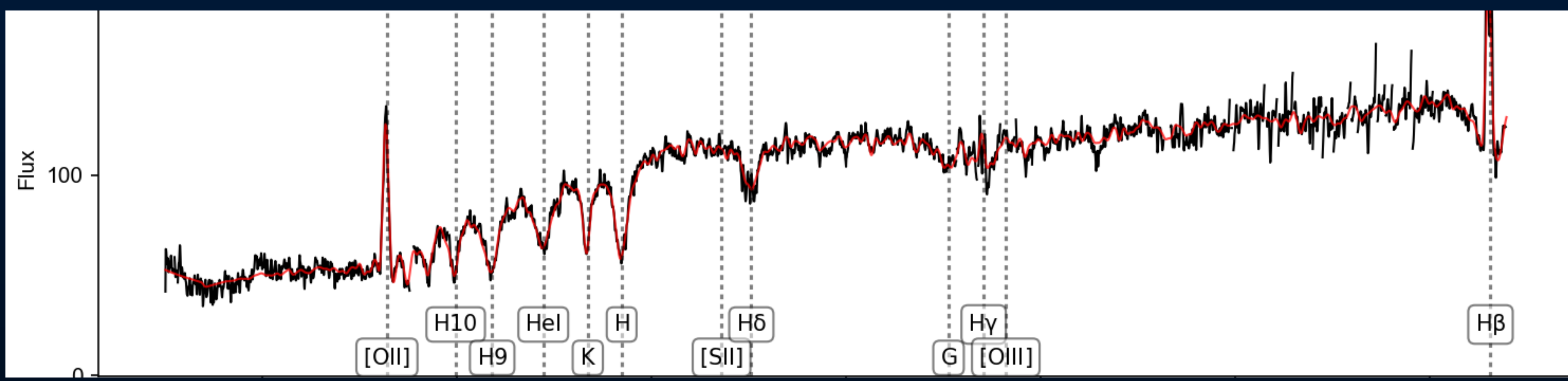
Does the (intercept of the) stellar-mass TFR evolve?

V2.2 = v (R = 2.2 * disk scale radius) **Slope @ Reyes+11 Log M ~ 3.4 log V**

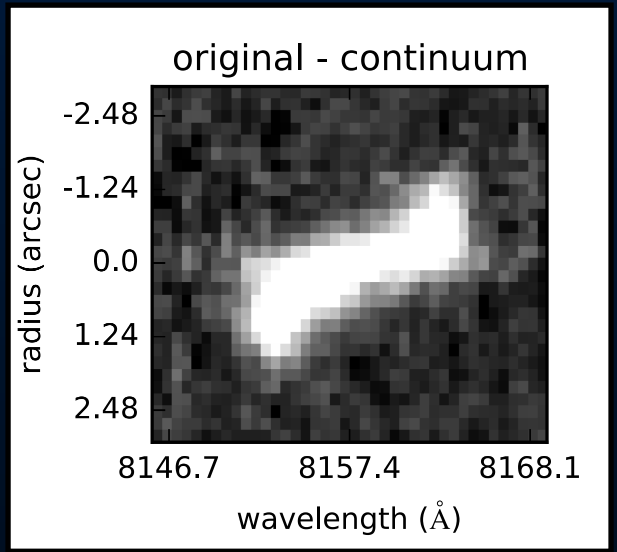


How well does stellar light trace total dynamical mass?

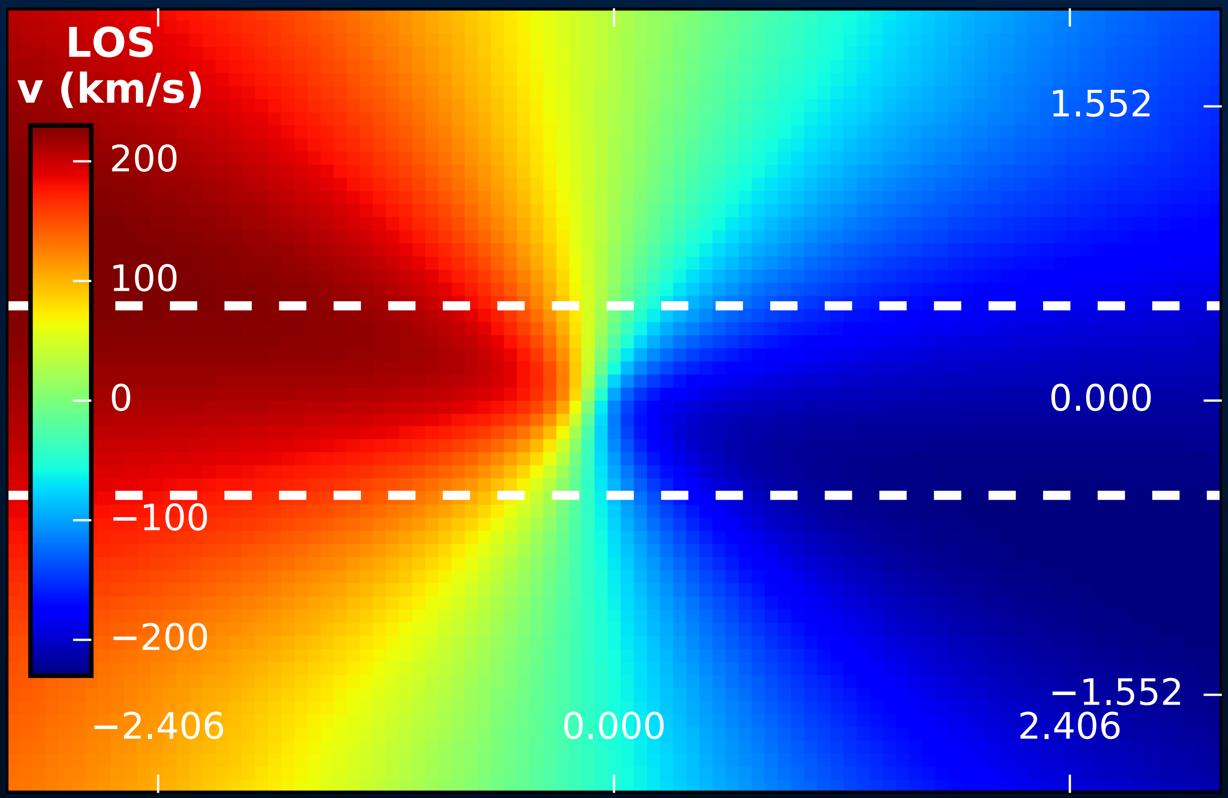
LEGA-C: gas AND stellar dynamics



Hβ



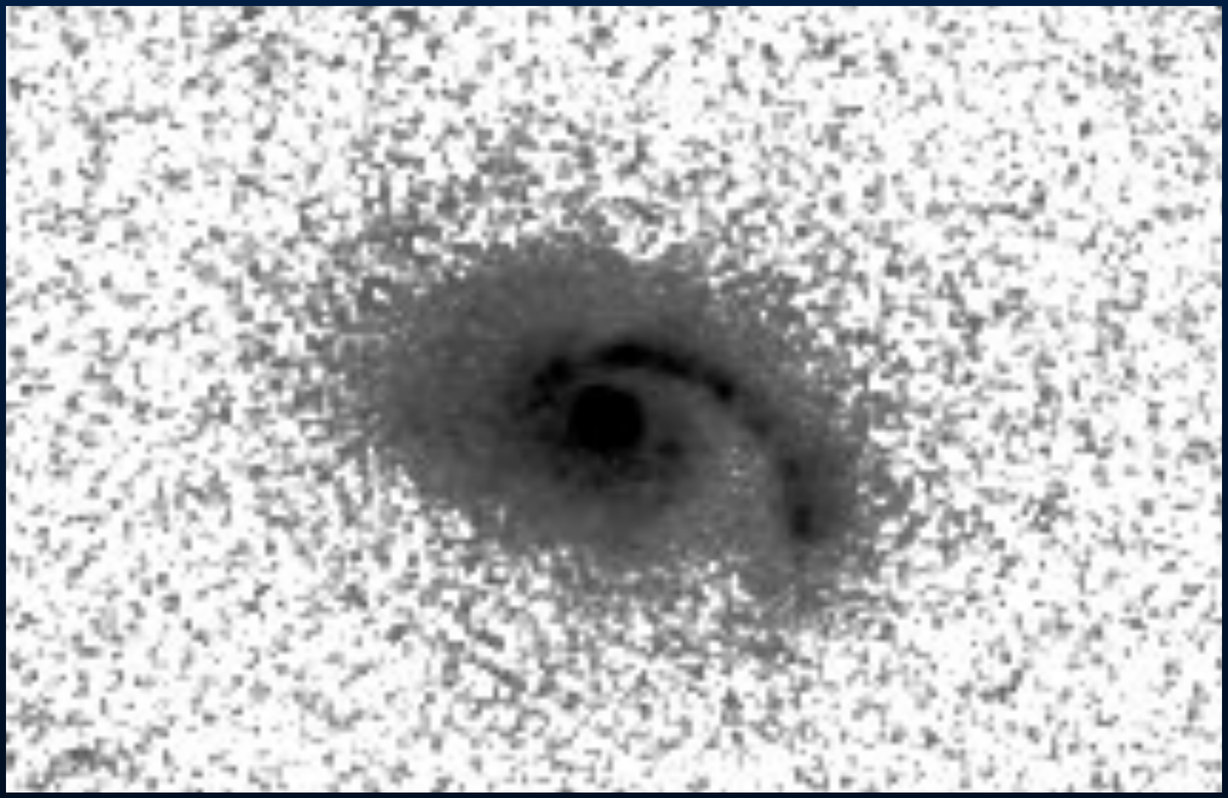
How well does stellar light trace total dynamical mass ?



vRMS = √ ($v^2 + \sigma^2$) … at any radius

How well does stellar light trace total dynamical mass ?

I-band



formula with stellar stuff:

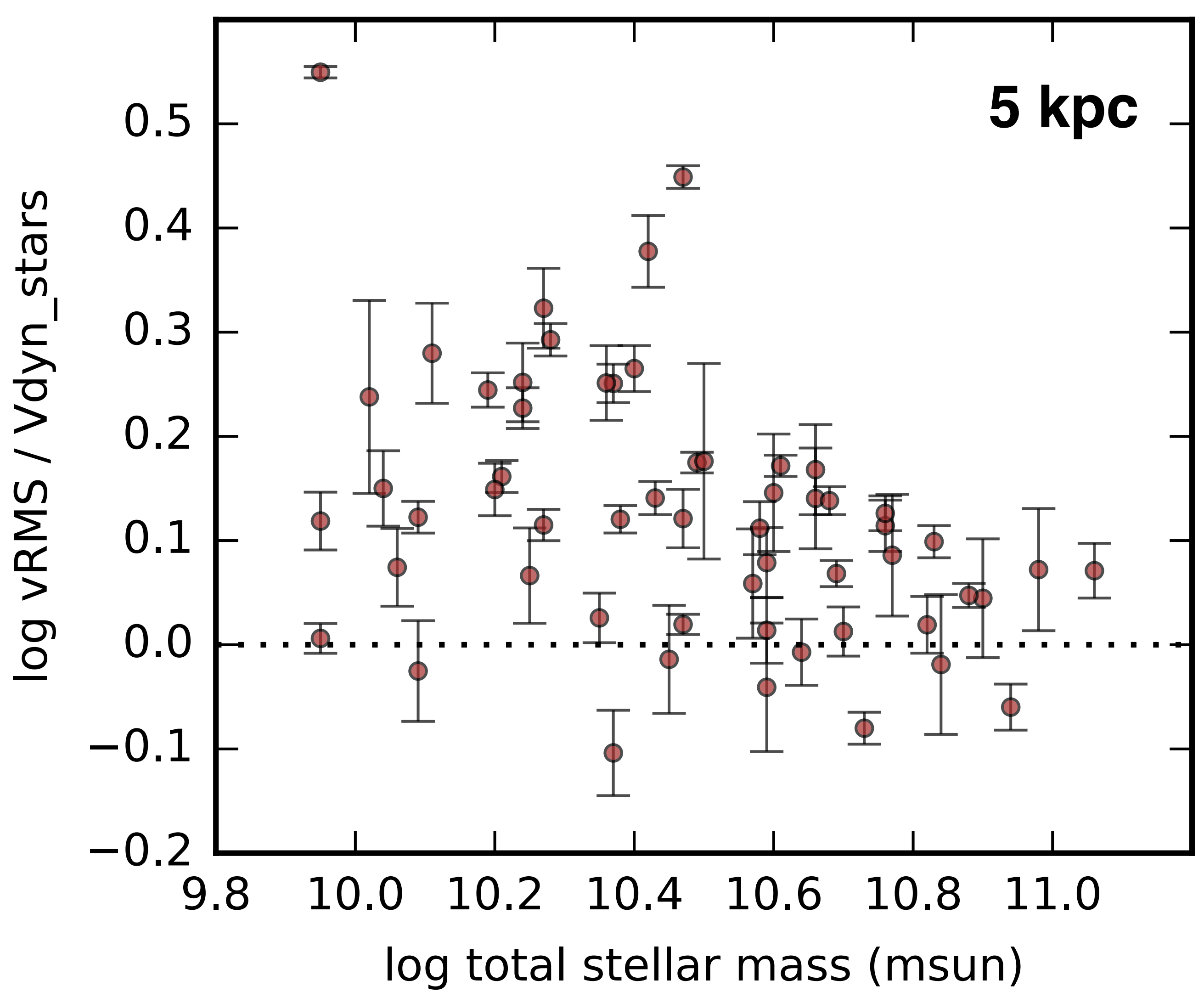
log $\underline{\boldsymbol{Mdyn}_{stars}}$ = 5 log $\underline{\boldsymbol{q}_{axis}}$ + 2 log $\underline{\boldsymbol{\sigma}_{stars}}$ + log $\underline{\boldsymbol{R}_{e}}$ + K($\underline{\boldsymbol{n}_{sersic}}$) + 6.07

$Mdyn_{stars}$ → $Vdyn_{stars}$ … at any radius

Gas and stars move in the same potential, so
vRMS = $Vdyn_{stars}$ … at any radius?

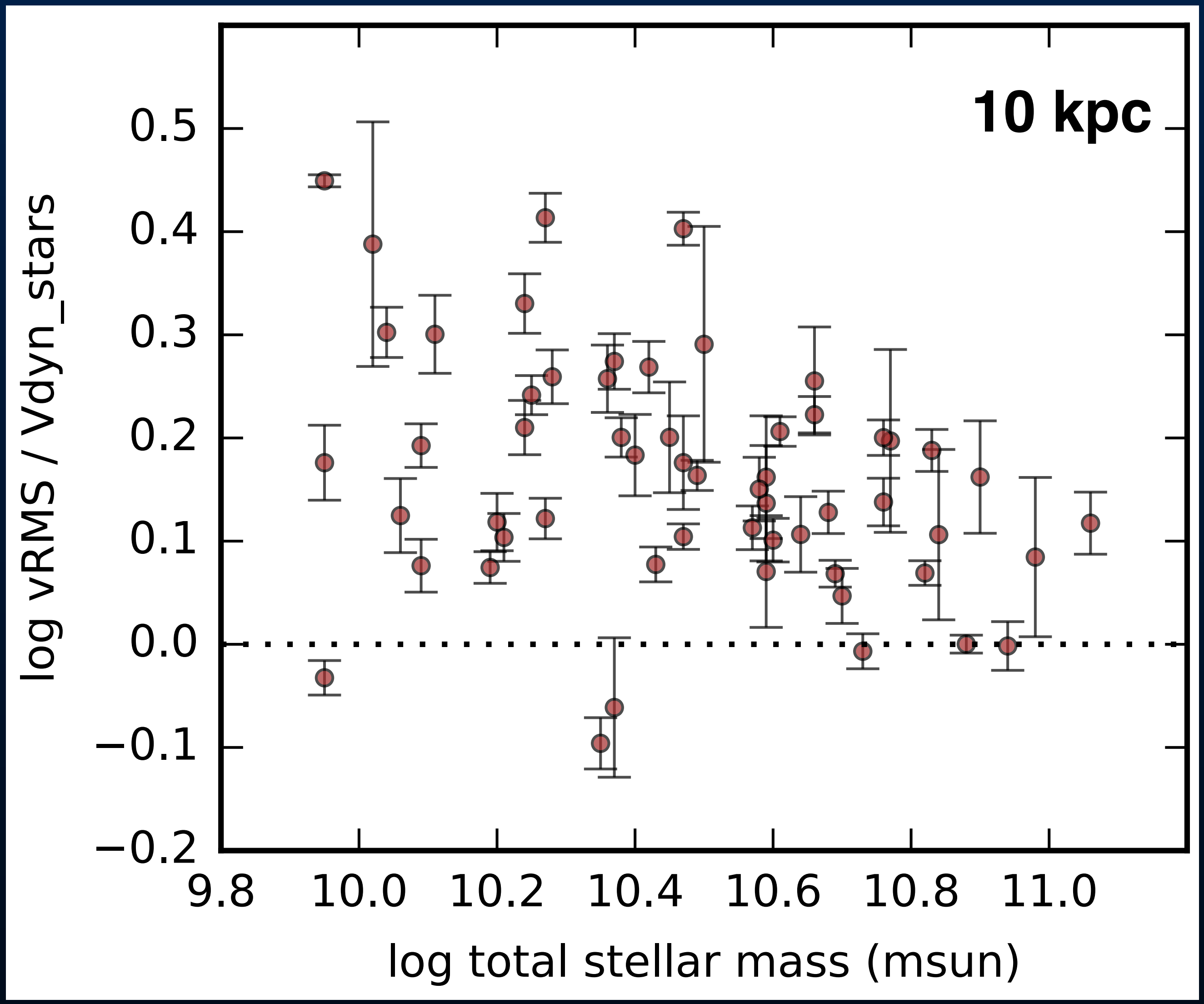
How well does stellar light trace total dynamical mass ?

vRMS = Vdyn$_{stars}$ … at any radius?



How well does stellar light trace total dynamical mass ?

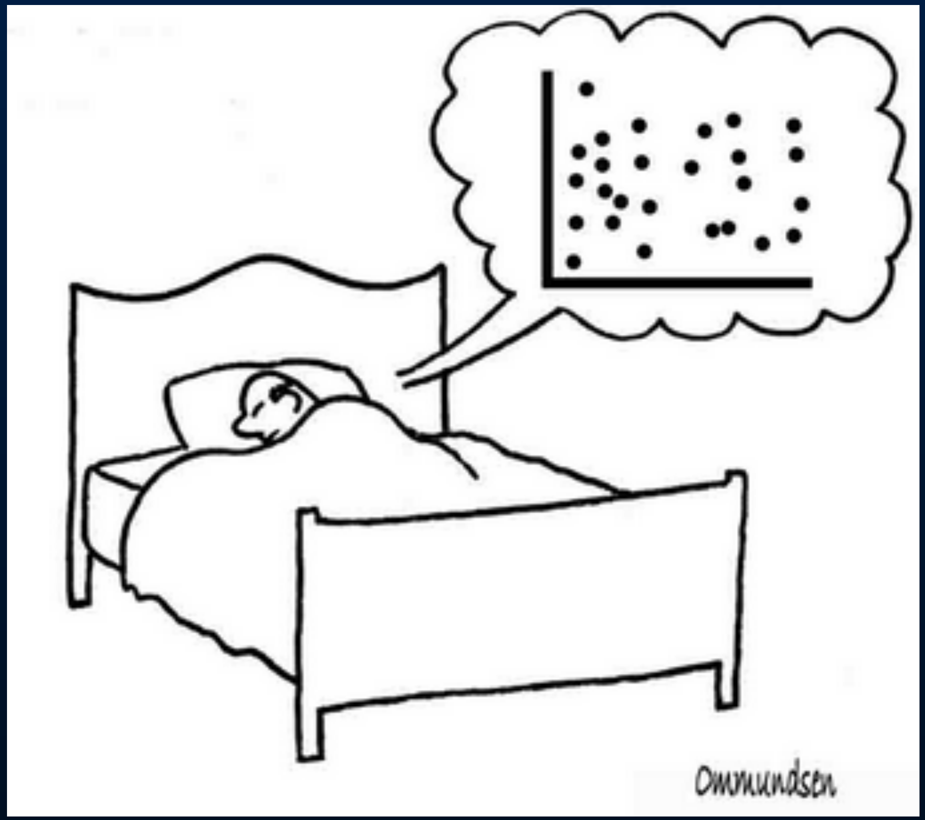
vRMS = $V_{dyn_{stars}}$ … at any radius?



Conclusions

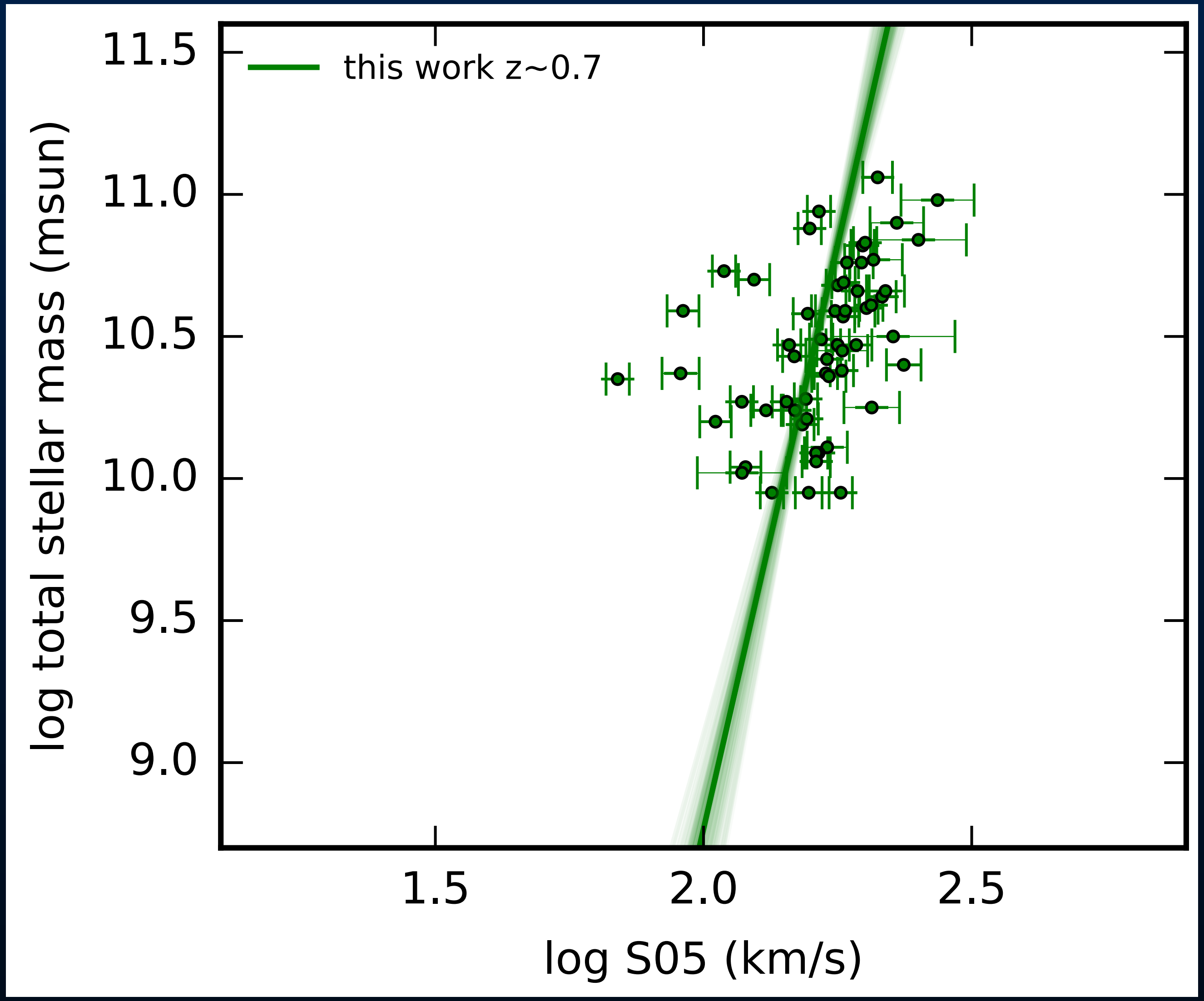
the stellar mass Tully-Fisher relation has evolved since z ~ 0.7

dynamical evidence for presence of gas and/or dark matter at low stellar mass



S05 =√ (v2.2^2 + σ^2)

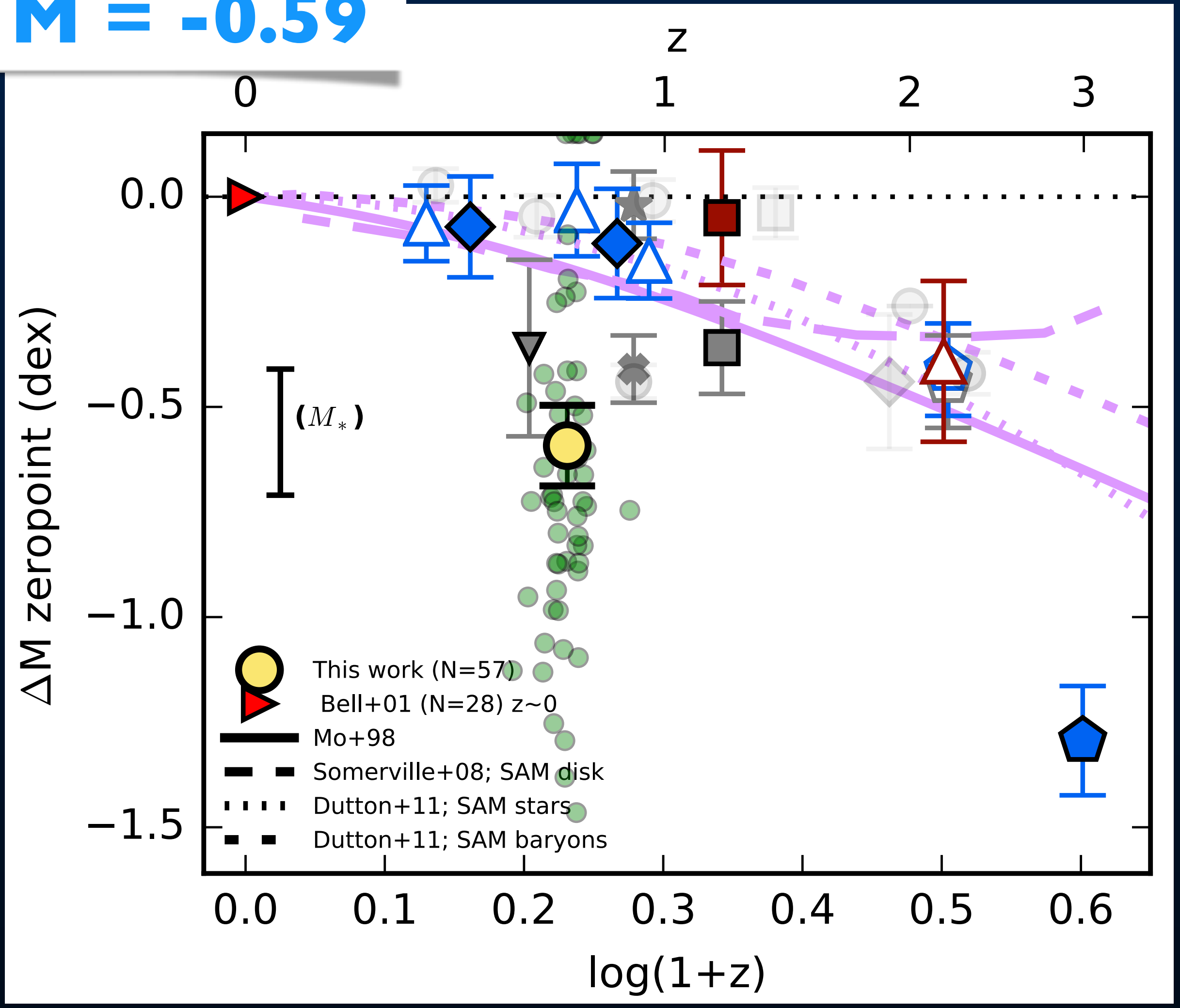
see also: Kassin+07



Does the (intercept of the) stellar-mass TFR evolve?

Slope @ Bell+01 log M ~ 4.5 log V

Δ log M = -0.59



Does the (intercept of the) stellar-mass TFR evolve?

Slope @ Bell+01 log M ~ 4.5 log V

Δ log M = -0.66