EWASS 2015

Measuring the radial growth of discs with extended UV profiles

Gabriele Pezzulli
(University of Bologna)

Filippo Fraternali (Bologna)
Samuel Boissier (LAM-Marseille)
Juan Carlos Muñoz-Mateos (ESO)

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Inside-out growth of discs

- <u>Theory:</u> Tidal torques (Peebles 1969)

  Angular momentum increases with time

  ➡ Outer parts form later ➡ <u>radial growth</u>!

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  Past disc structure (challenging!)

  - resolved SFH (CMD, spectroscopy)

  - Comparison with high-z discs

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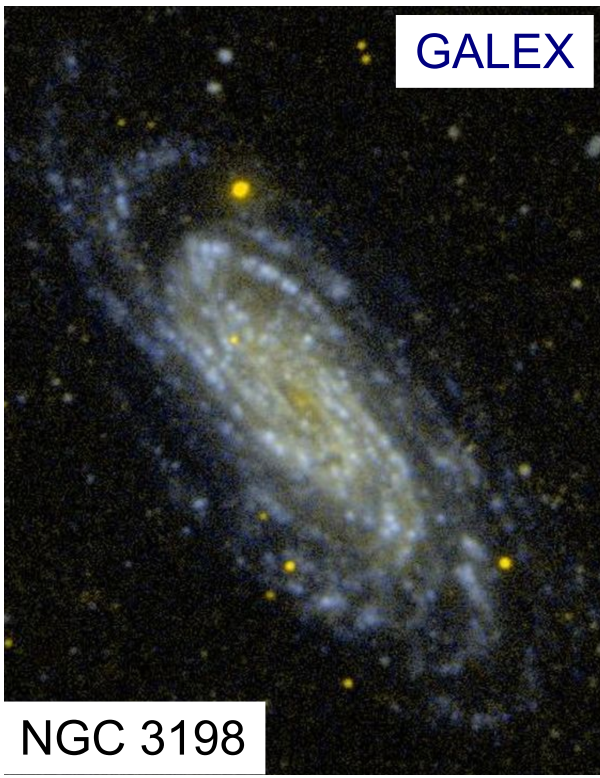
Can we detect inside-out growth *in act* ?

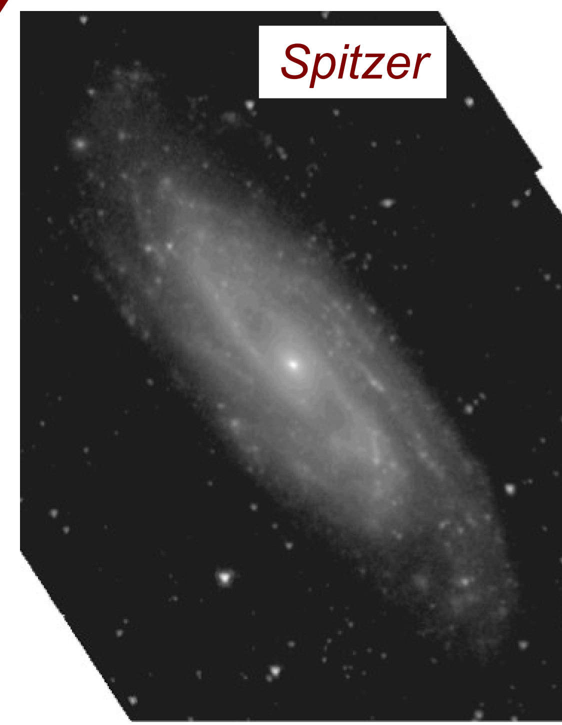
Inside-out growth in act

Spiral galaxies actively forming stars today...

YOUNG STARS



OLD STARS



Compare spatial distributions

Constrain ongoing RADIAL EVOLUTION!

The universal profile of stellar mass

Exponential profile:

$$\Sigma_\star(t,R) = \frac{M_\star(t)}{2\pi R_\star^2(t)} \exp\left(-\frac{R}{R_\star(t)}\right)$$

2 parameters:
- stellar mass $M_\star$
- radial scalelength $R_\star$

(both evolving with time)

...what about star formation?

Star formation in exponential discs

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$$\nu_M \equiv \frac{\dot{M}_\star}{M_\star}$$

Specific MASS growth rate

$$\nu_R \equiv \frac{\dot{R}_\star}{R_\star}$$

Specific RADIAL growth rate

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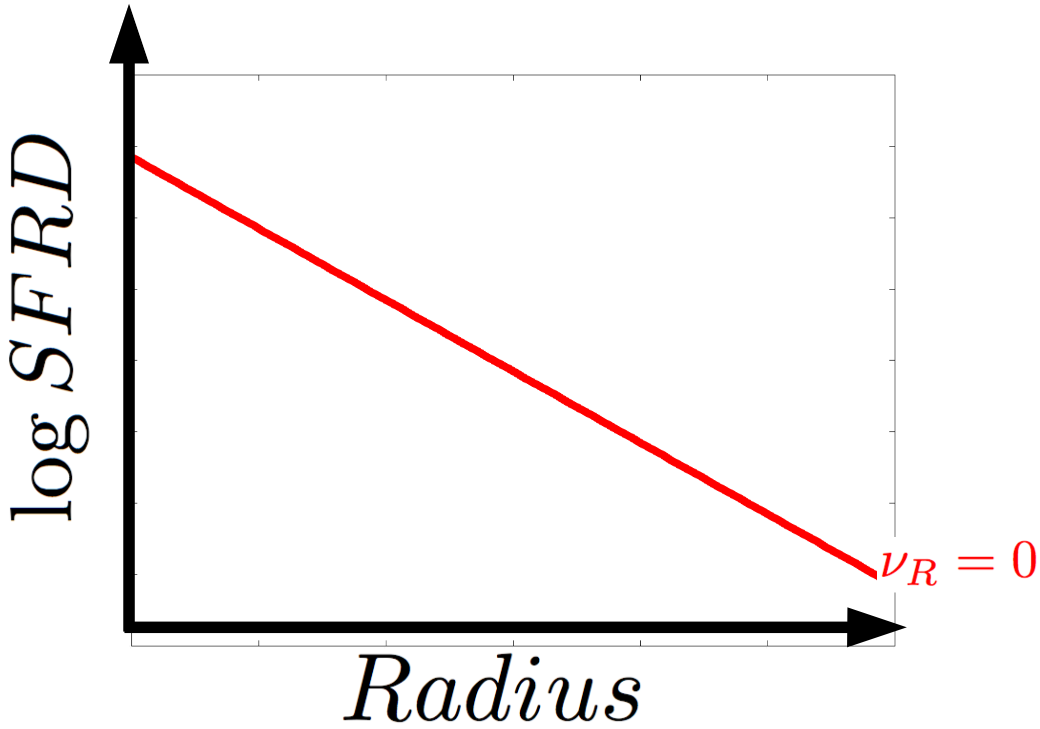

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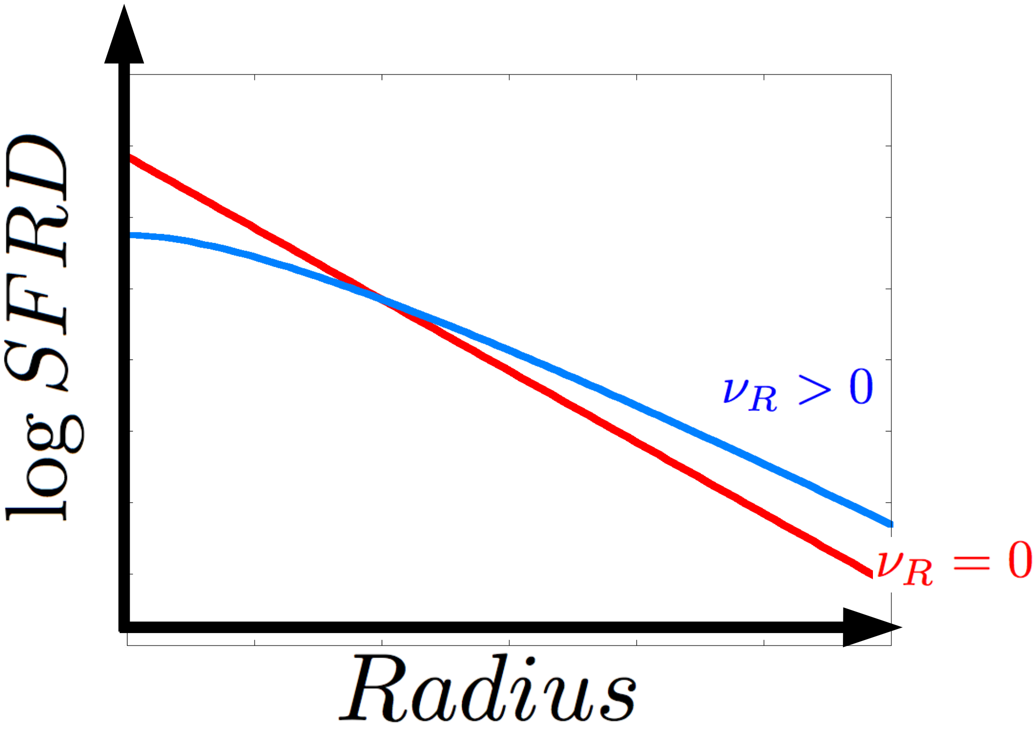

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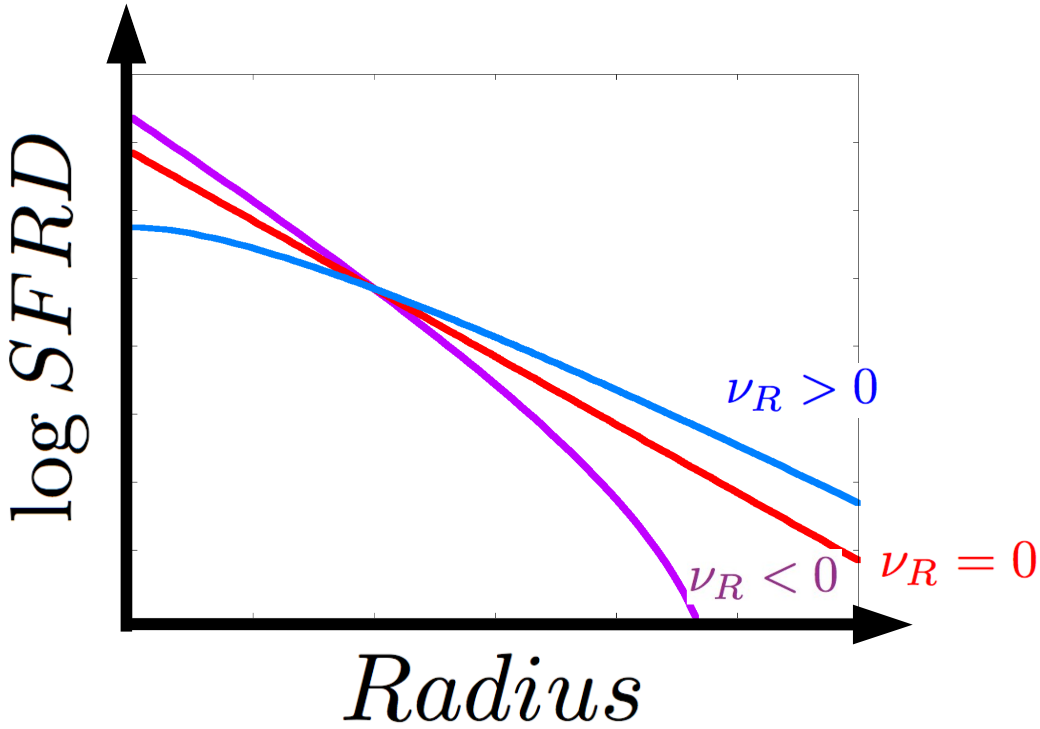

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The measurement

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NIR

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FUV

Correction for dust extinction

FIR

NIR

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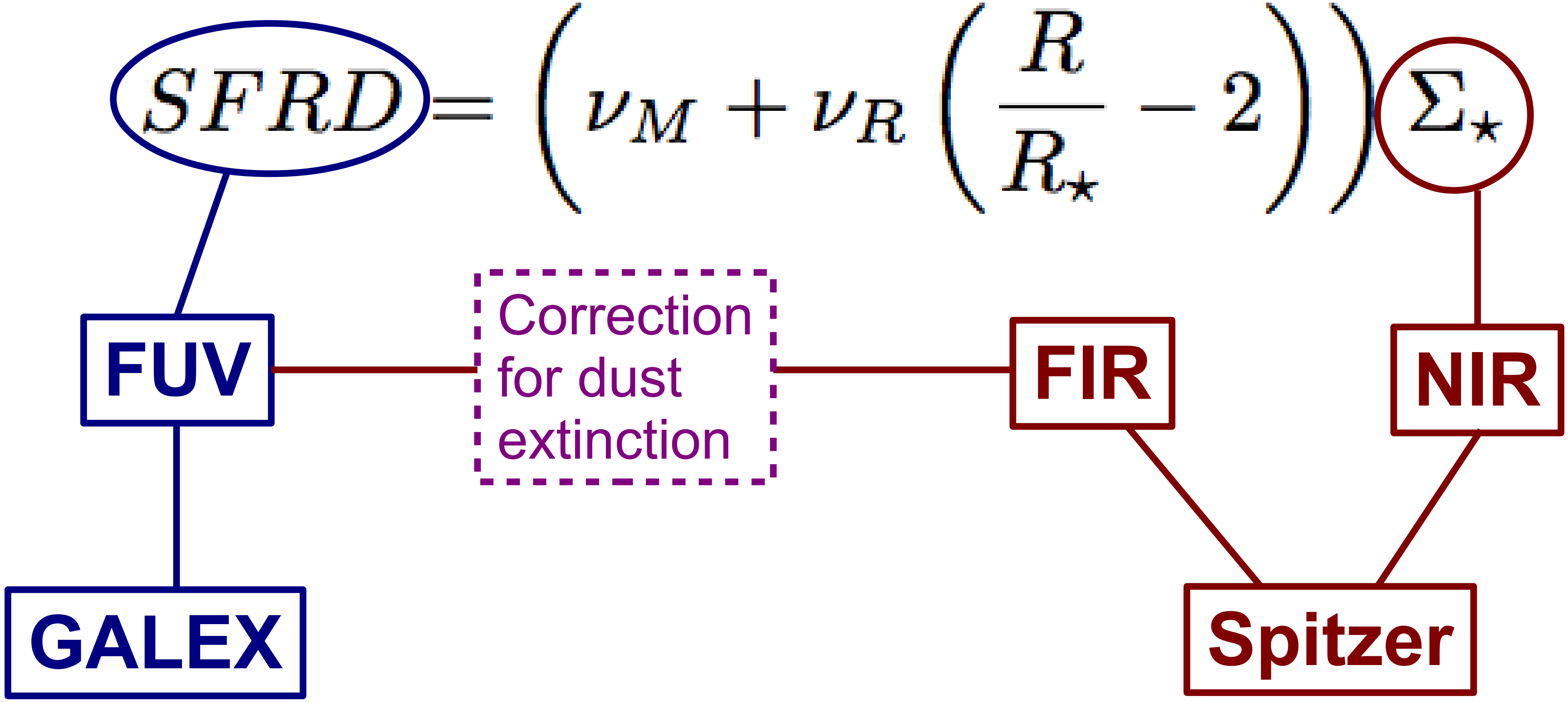

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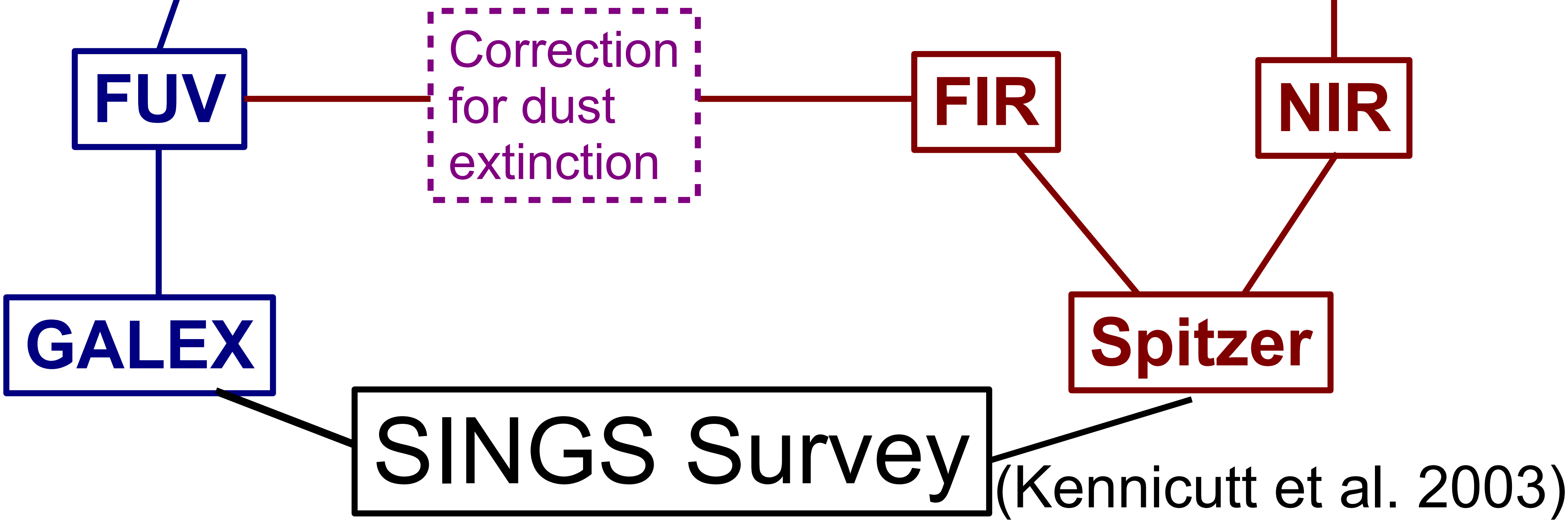
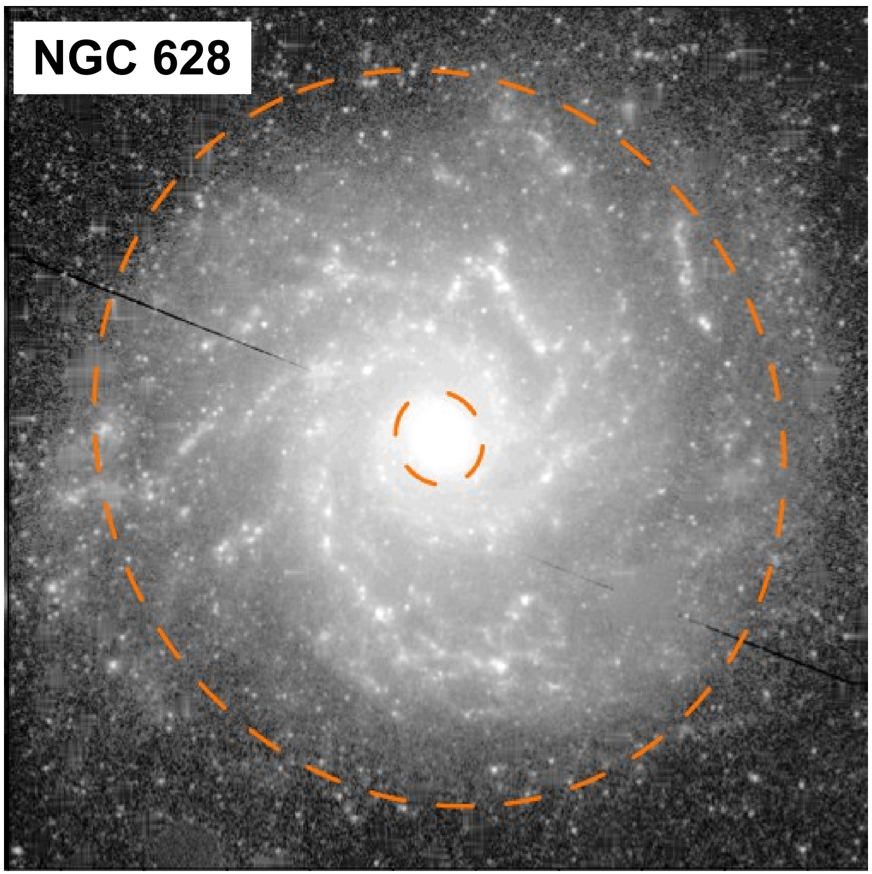


<u>Our sample</u>: 35 spiral galaxies

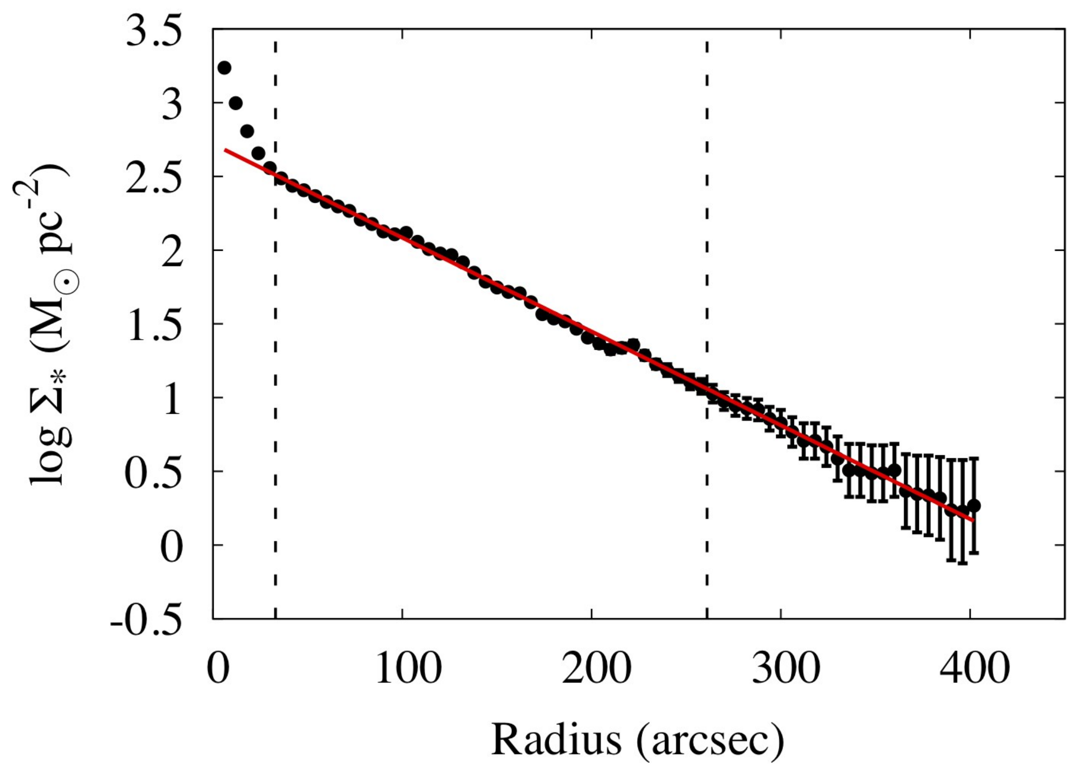
Radial profiles: Muñoz-Mateos et al. 2009, 2011

The measurement

1. Stellar mass surface density from 3.6 μm



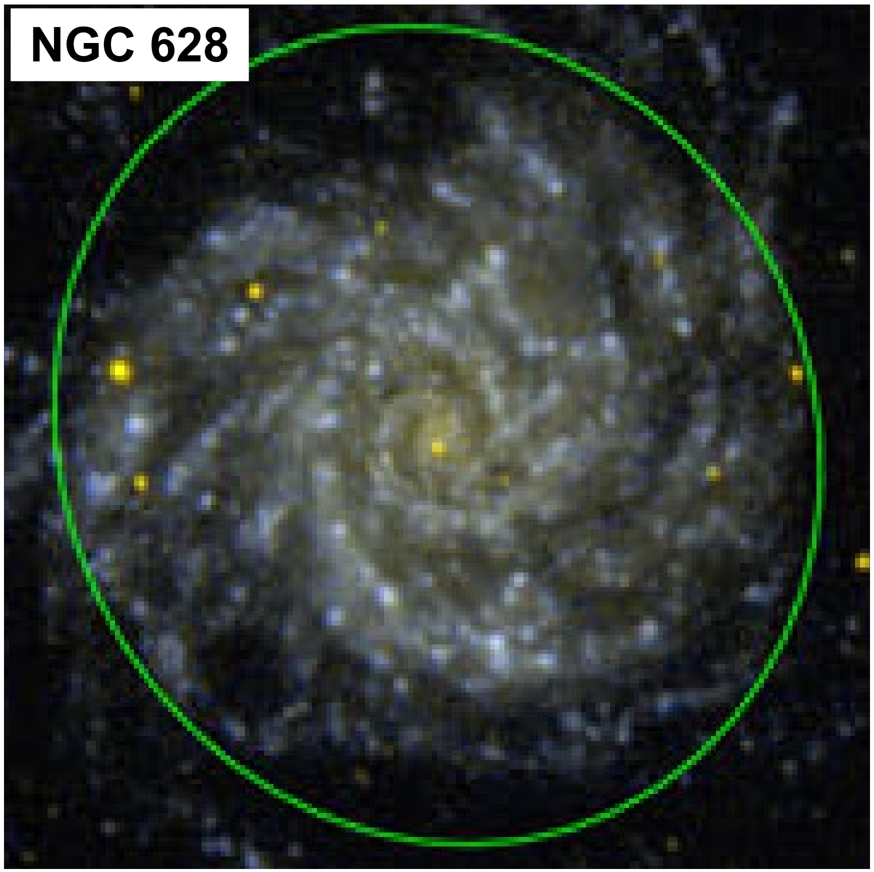
$$\Sigma_\star(R) = \frac{M_\star}{2\pi R_\star^2} \exp\left(-\frac{R}{R_\star}\right)$$



Measure $M_\star$ $R_\star$

The measurement

2. Star formation rate surface density from (corrected) FUV



Gil de Paz et al. (2007)

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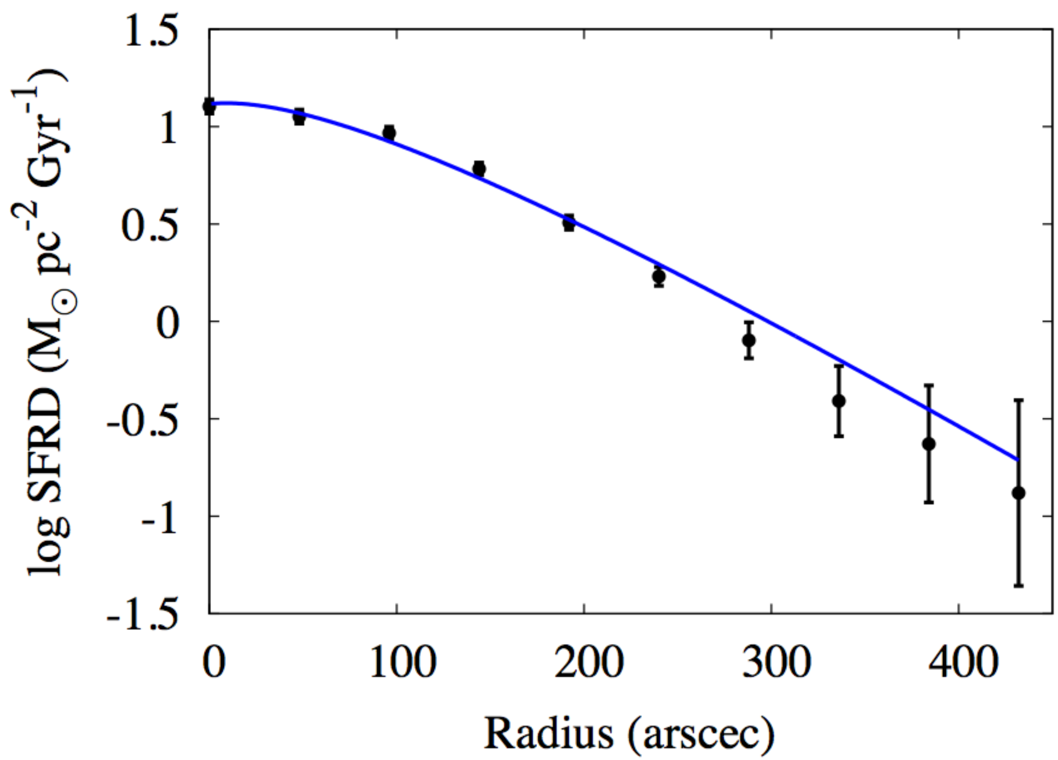

Measure ν_M ν_R

Results (1)

Pezzulli et al. 2015 MNRAS

- Almost all (32/35) galaxies with <u>positive</u> radial growth rate

$$\nu_R > 0$$

Ongoing INSIDE-OUT GROWTH!

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Ongoing INSIDE-OUT GROWTH!

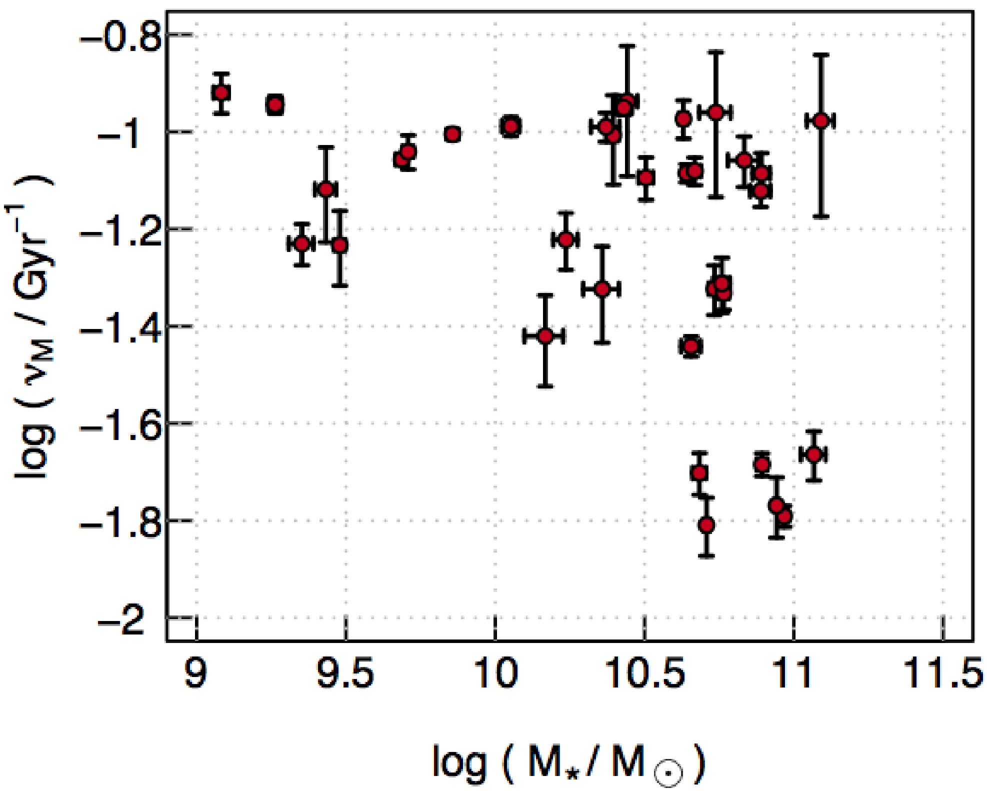
- 2/35 compatible with either growth or shrinking
- 1/35 shrinking (NGC 1097) (probably merging!)

Results (2)

Pezzulli et al. 2015 MNRAS

ν_M

- ~ 0.1 Gyr^(-1)
- Scatter increasing with mass



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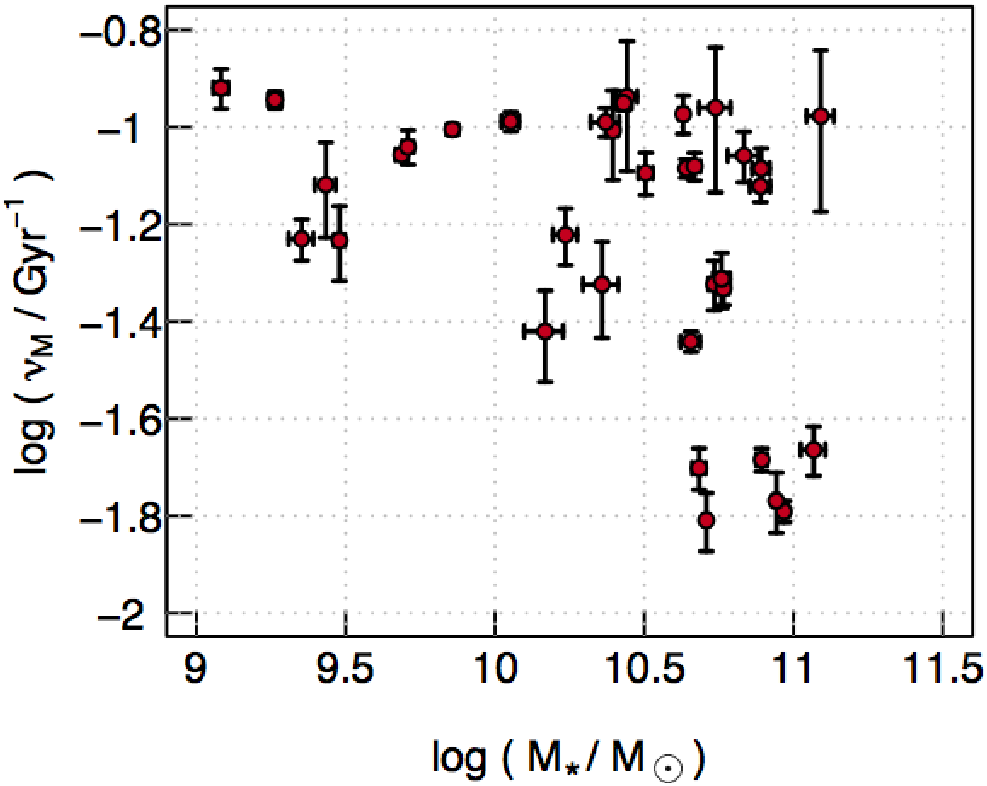
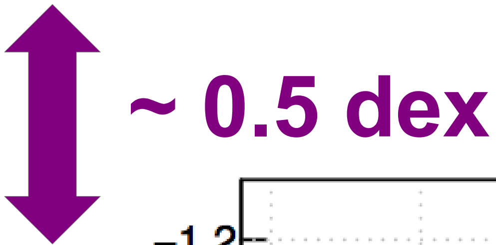
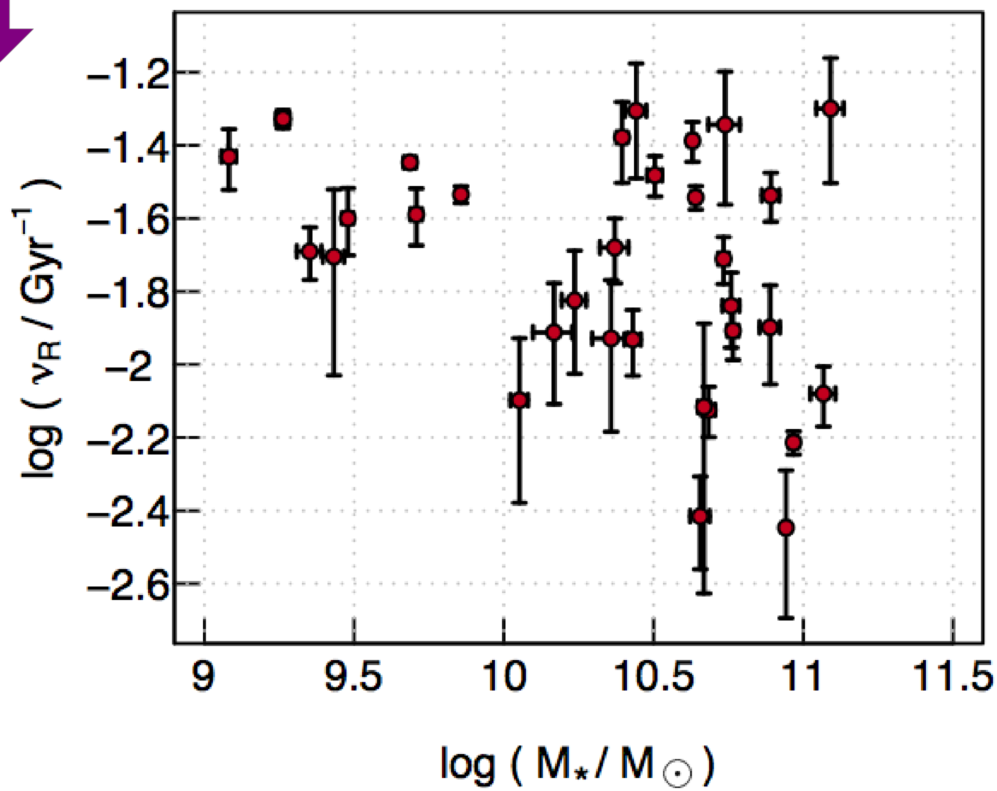
ν_R

- Similar shape... BUT
- shifted downwards!







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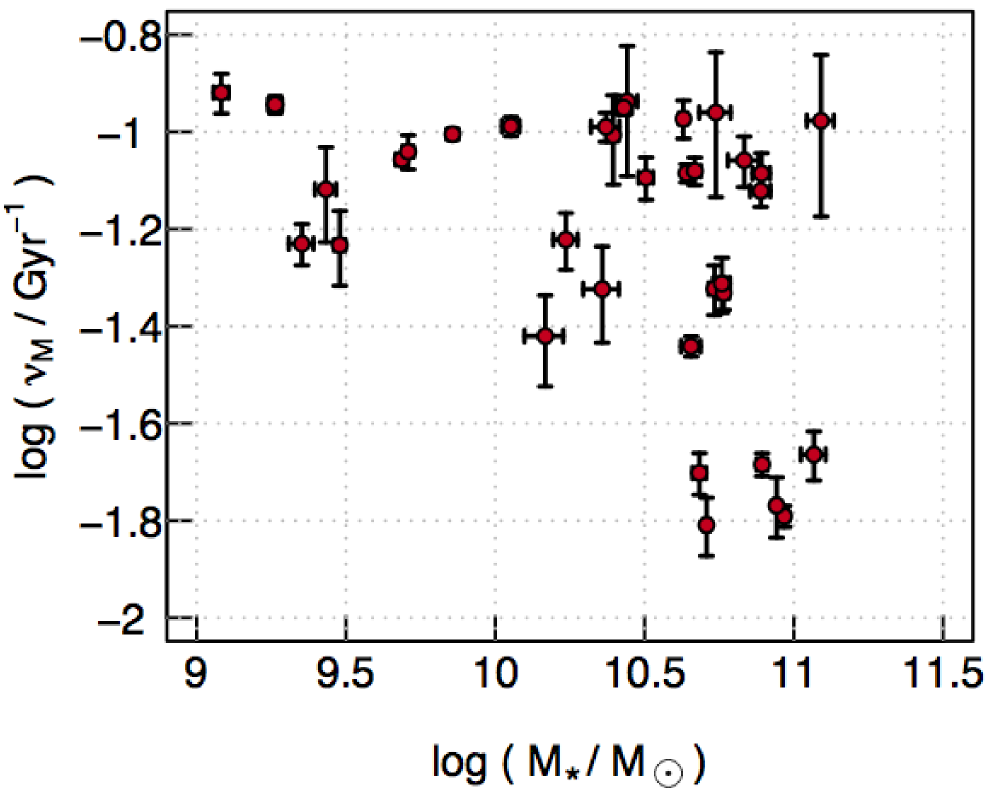
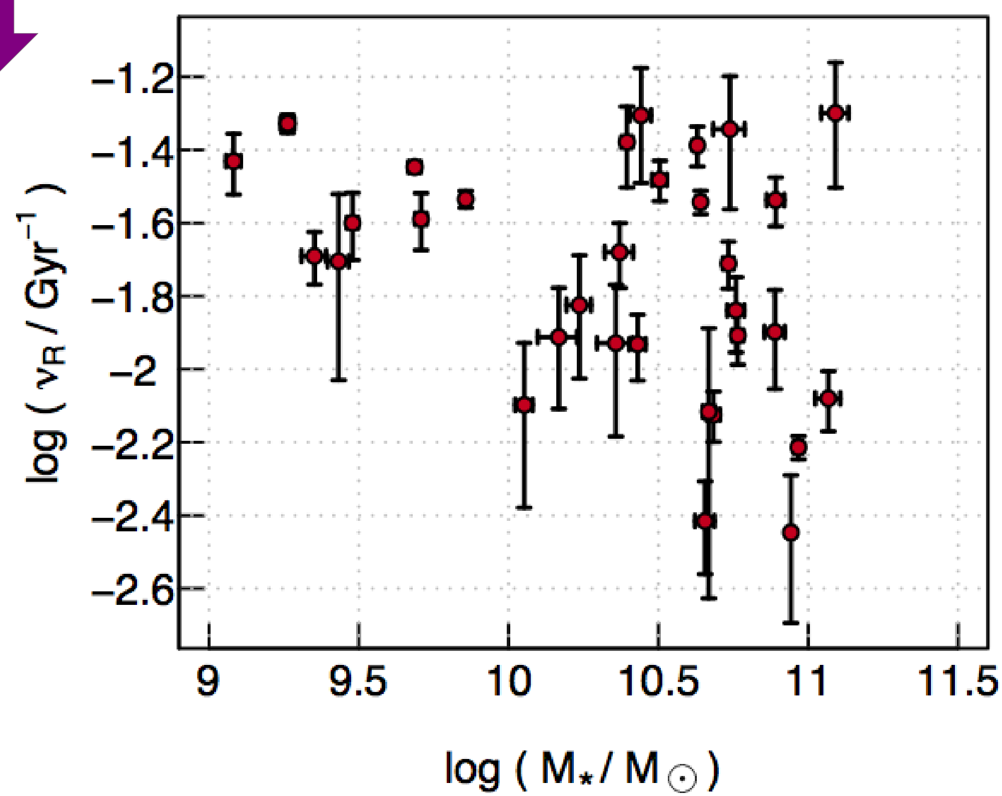


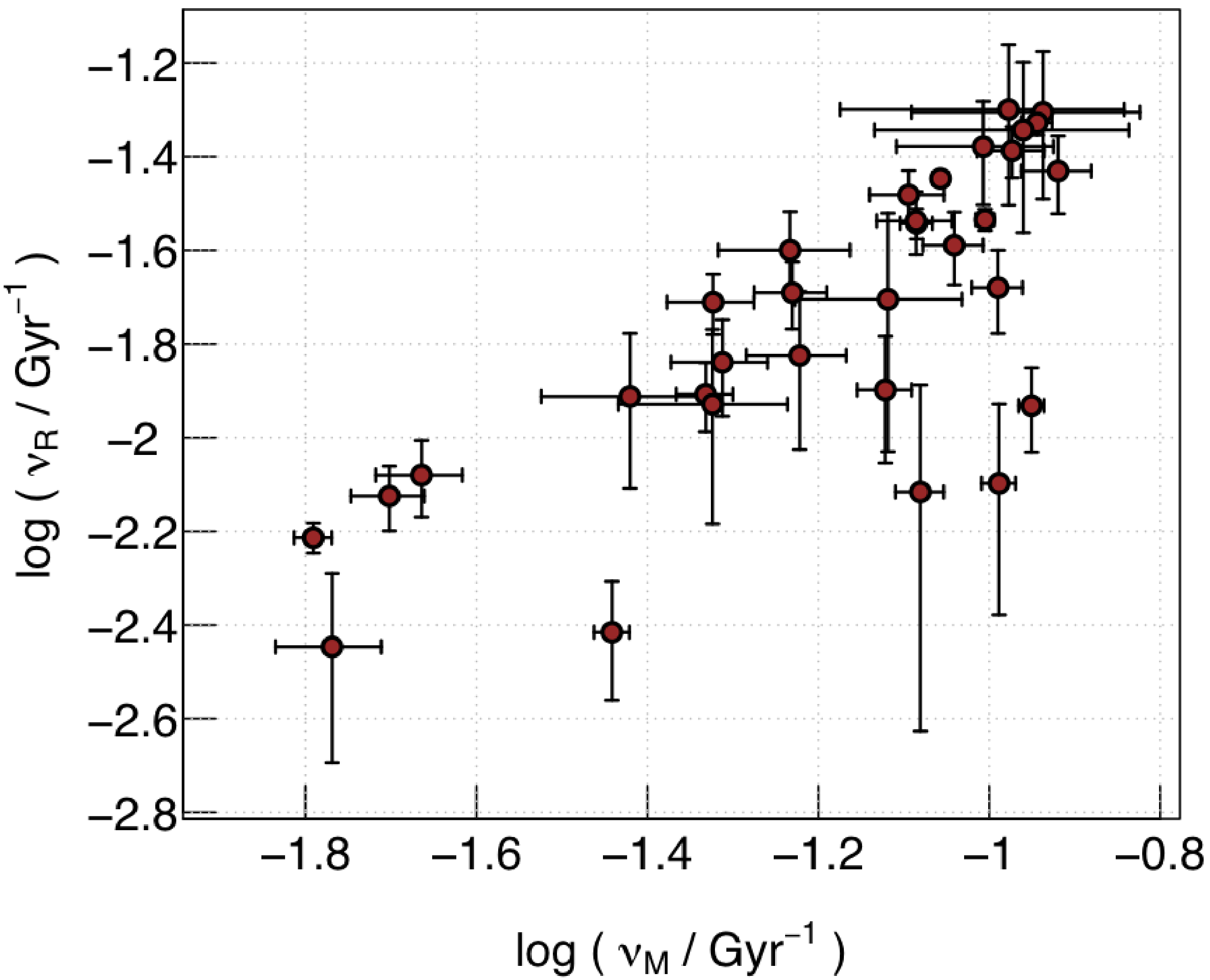
~ 0.5 dex



Radial growth ~ 3 times slower than mass growth

Results (3)

Pezzulli et al. 2015 MNRAS



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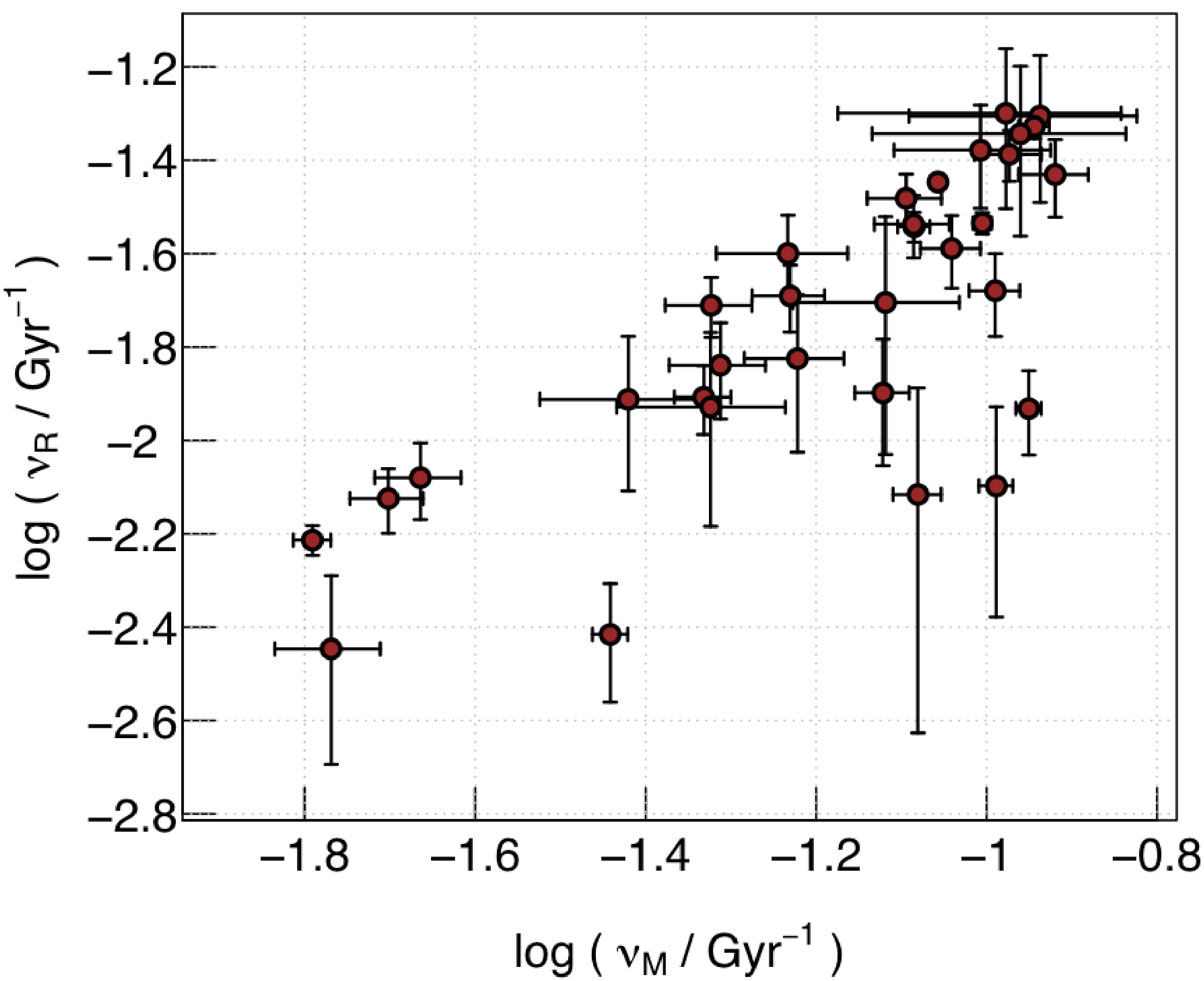
Pezzulli et al. 2015 MNRAS

A SIMPLE MODEL

Tully-Fisher:
(McGaugh 2012)

$$V \propto M^{0.25}$$



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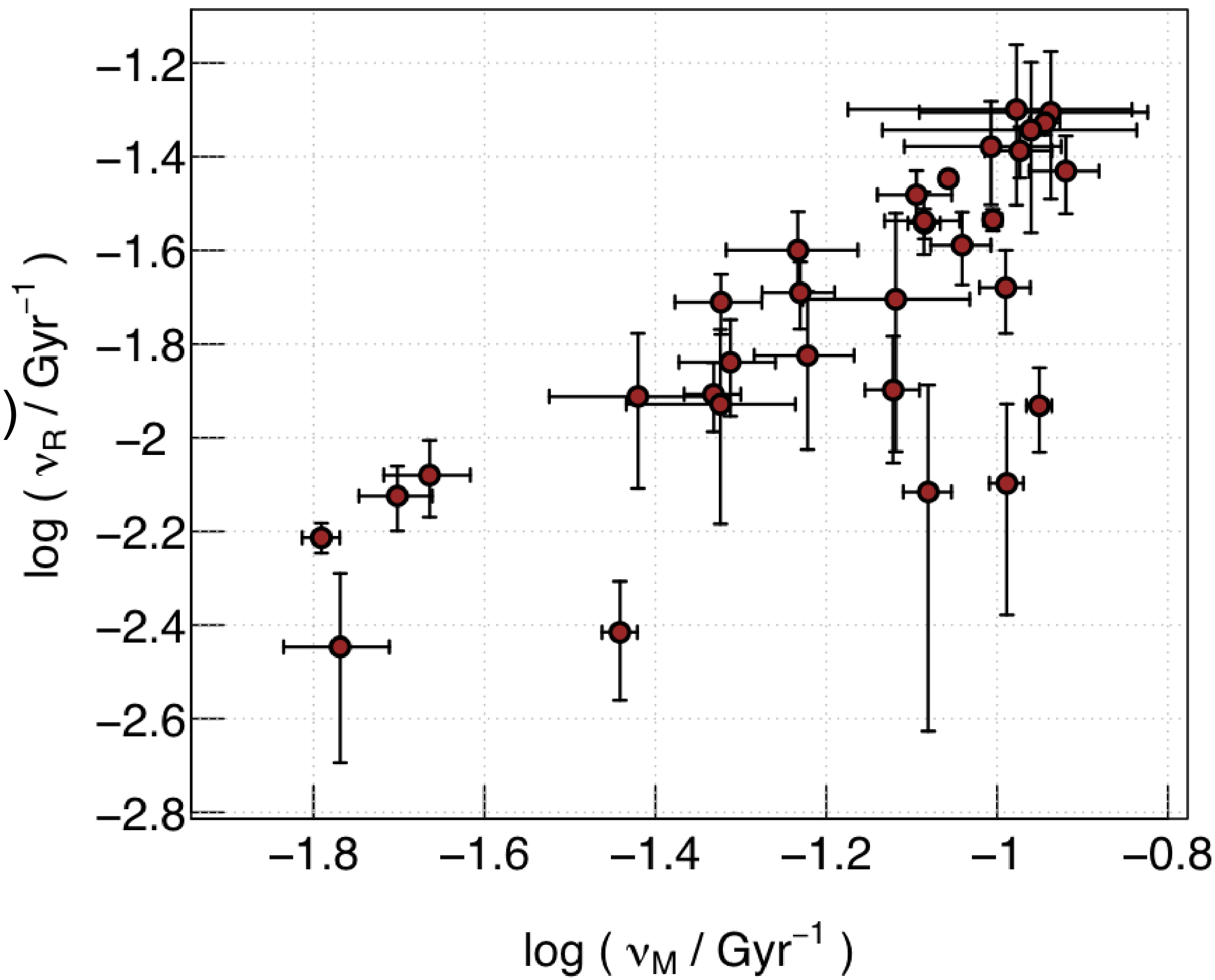

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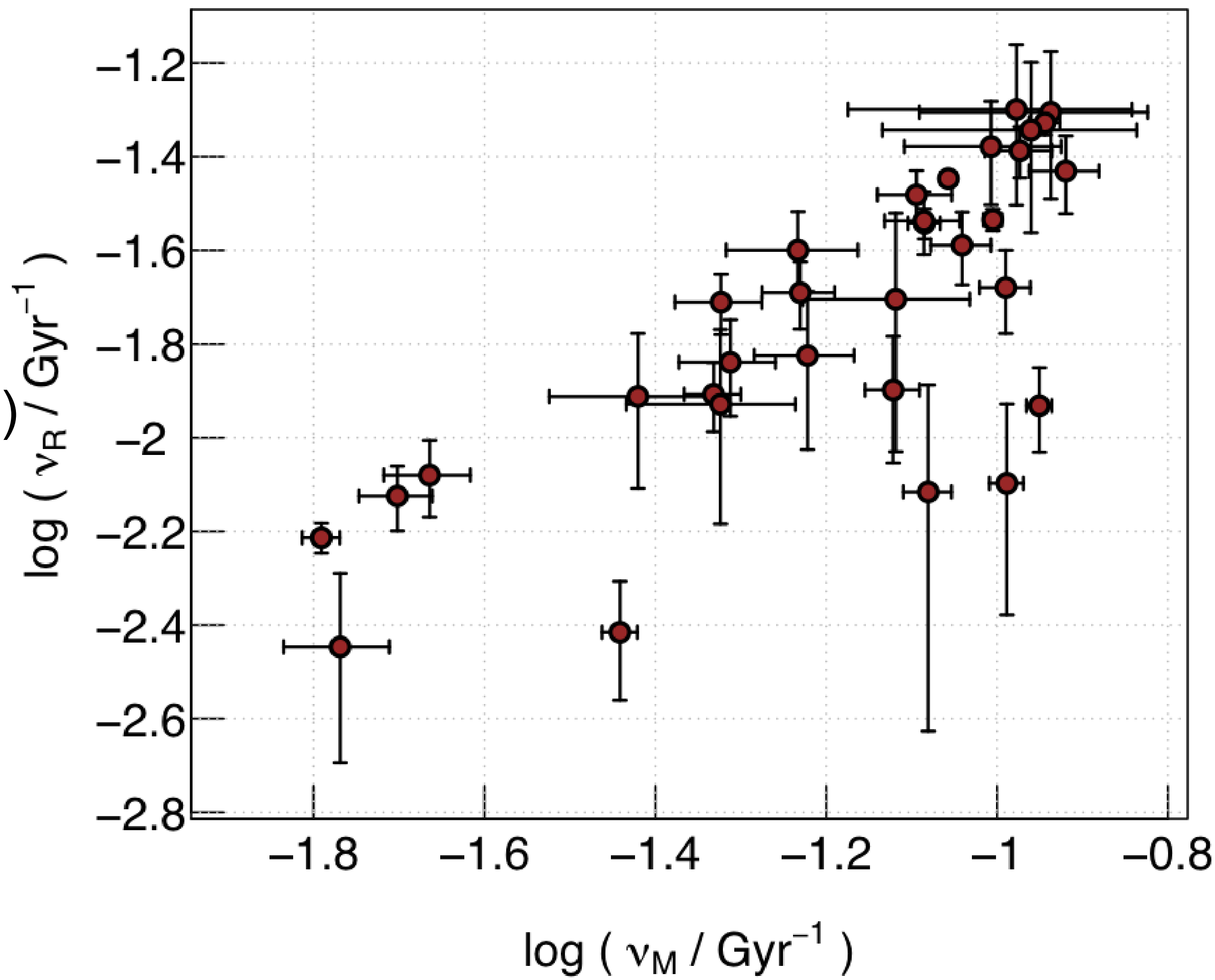

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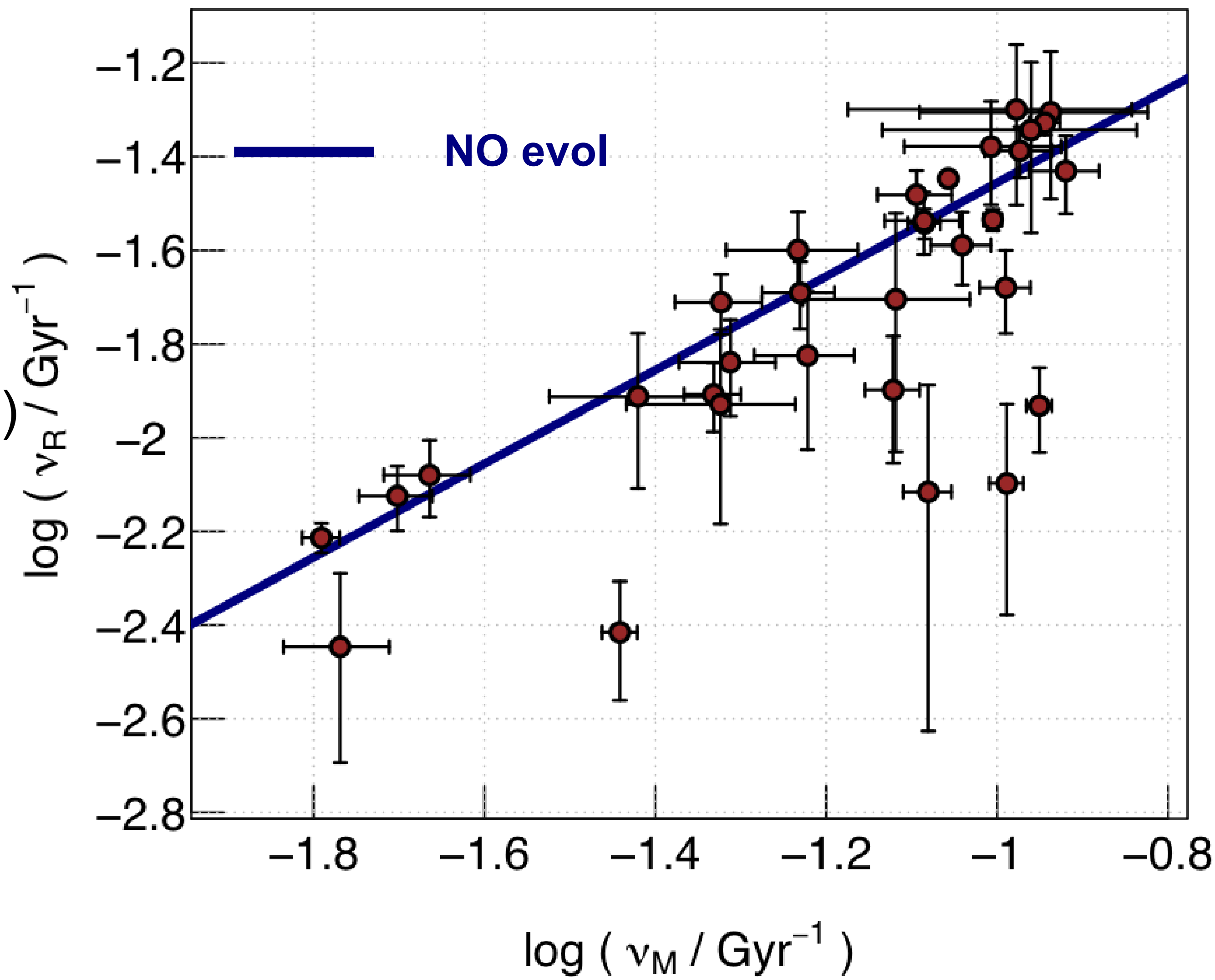

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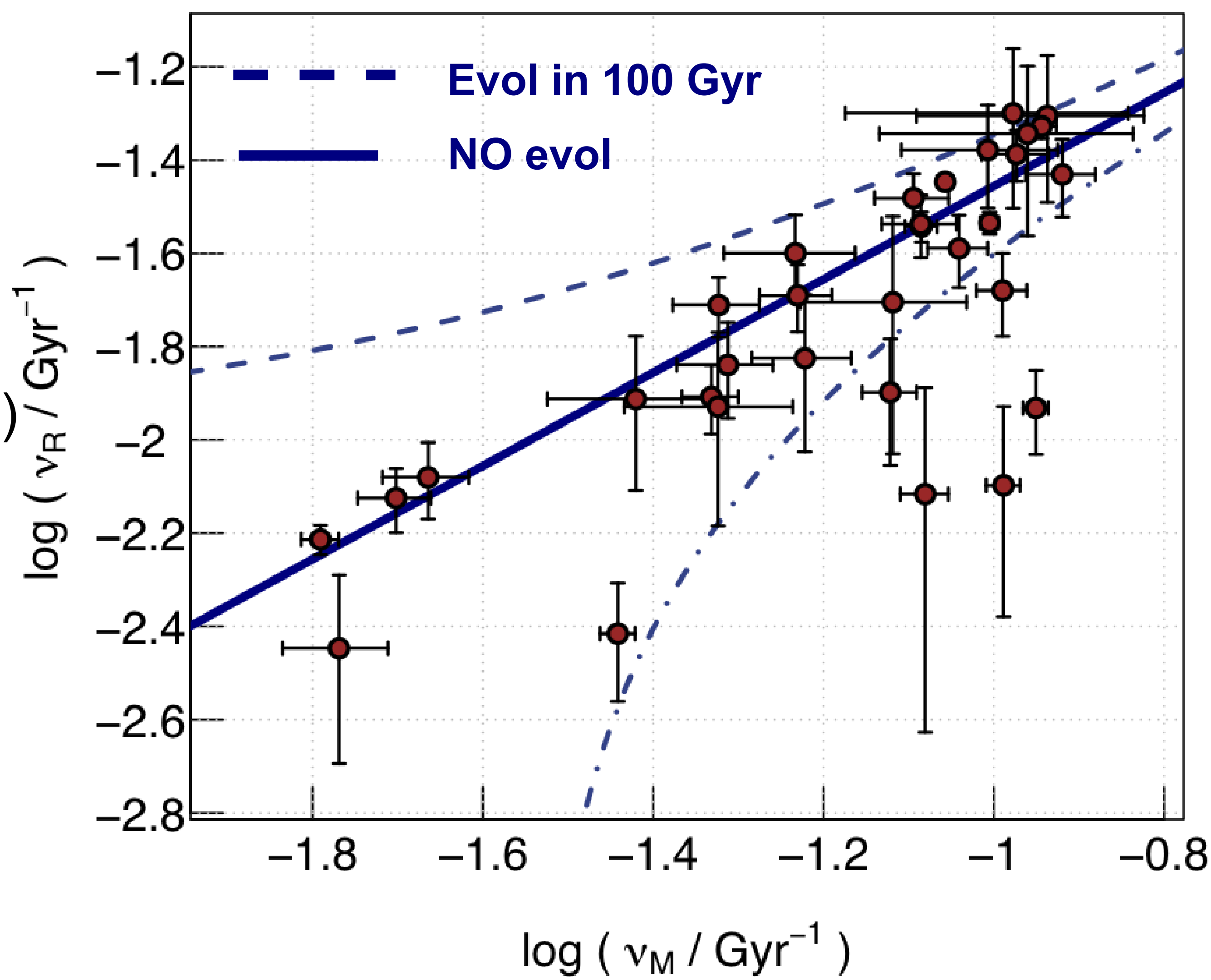

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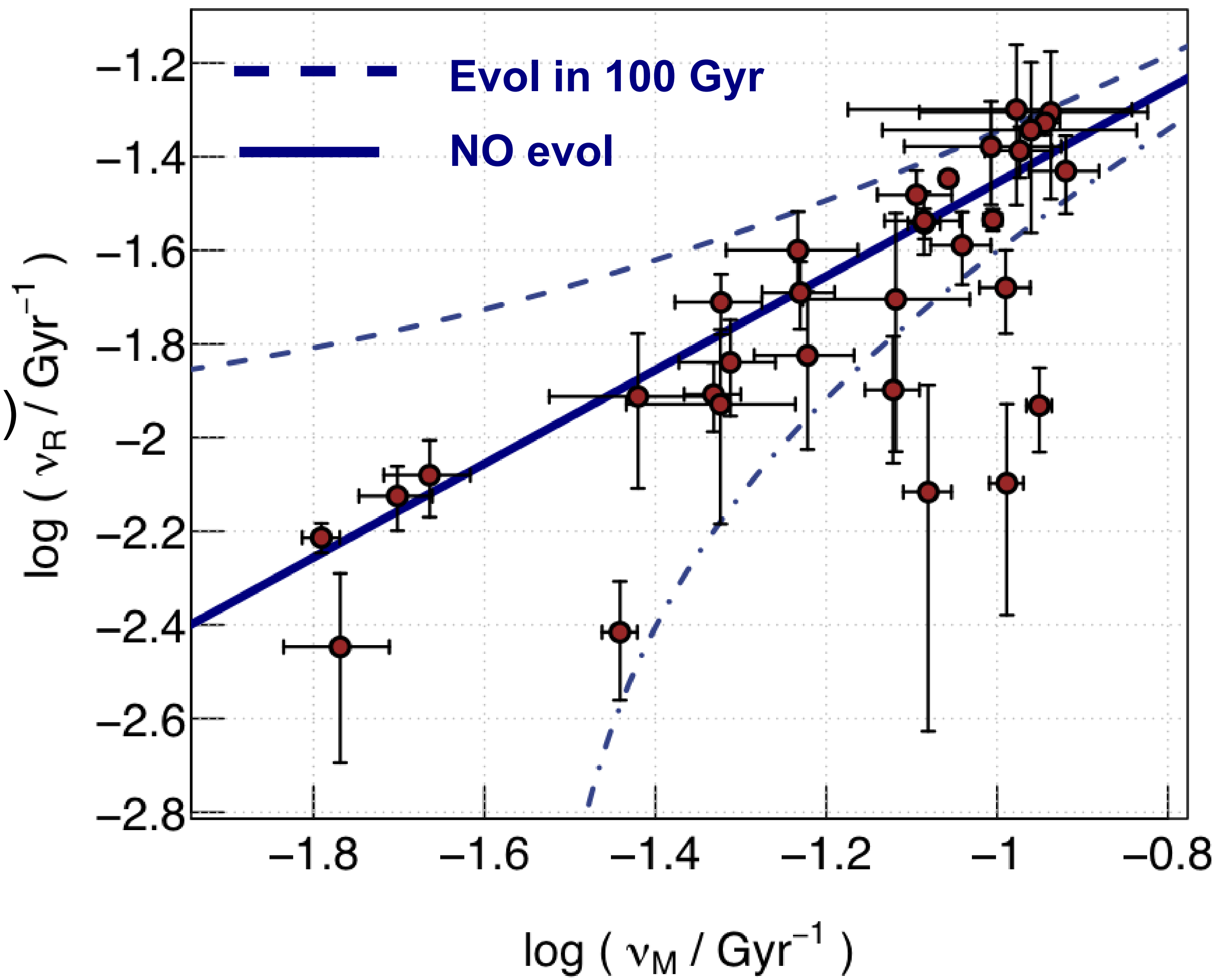

- Sensitive diagnostics for scaling relations
- Preferred model: NO EVOLUTION

CONCLUSIONS

- **SFRD profiles can be used to measure radial growth**
- **Ongoing inside-out growth detected in most galaxies**
- **Main sequence of radial growth: 3 times slower than mass growth**
- **Scaling relations are universal (or evolve on t >> Hubble time)**

THANK YOU!