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ΕP

# A slow downfall of star formation efficiency in massive star-forming galaxies

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Sesto, 13/01/16







(Peng+10: a=**1.0**)





10<sup>10</sup>

M∗: stellar mass [M⊙]

 $10^{11}$ 

starbursts

Salim+07 z=0 SFR: Hα a=**0.65** 

(Peng+10: a=**1.0**)



 $10^{12}$ 





100

10

10<sup>9</sup>













is it an increase of stellar mass? or a decrease of SFR?



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 Is there a growing component that increases the stellar mass but not the SFR? Bulges?

(Abramson+14, Whitaker+15) (but see Guo+15)

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decomposition of the HST H-band profiles with GIM2D (Simard+99,02)



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B/T = (M_{\star} - M_{disk})/M_{\star}
B/T = 0 \leftrightarrow pure disk
B/T = 1 \leftrightarrow pure bulge
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- Corrected for ≠ mass-to-light ratios of bulge and disk
- Tested with simulations (see also Pannella+09, Bruce+12,14, Lang+14)

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Sample: CANDELS fields 0.7 < z < 1.3 $log(M^*) > 10.2$  (H $\leq$ 22.5)

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the SFR –  $M_{disk}$  relation, unique slope?

Using galaxies with Spitzer MIPS and/or Herschel detection (SFR =  $SFR_{IR} + SFR_{UV}$ )

 SFR – M<sub>\*</sub> slope: 0.54±0.05



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Using galaxies with Spitzer MIPS and/or Herschel detection  $(SFR = SFR_{IR} + SFR_{UV})$ 

 SFR – M<sub>\*</sub> slope: 0.54±0.05

SFR – M<sub>disk</sub>
 slope: 0.60±0.05



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Using galaxies with Spitzer MIPS and/or Herschel detection (SFR =  $SFR_{IR} + SFR_{UV}$ )

- SFR M<sub>\*</sub>
   slope: 0.54±0.05
- SFR M<sub>disk</sub>
   slope: 0.60±0.05
- → "bending" still present with disks only
- → bulges are not the answer



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along the Main Sequence, using Herschel stacking



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(see also Magdis+10,12, Magnelli+12, Santini+14, Béthermin+15)

\_.....  $M_{gas} = (1/Z) \times (1-f)/f \times M_{dust}$ ------Franco & Cox 86

FMR, Manucci+10

Z: metallicity f: % of metals in dust Leroy+08, Magdis+12 Assuming:

- single dust grain composition
- M\* -- Z relation
- fixed value of f

Cross-checked with  $H_1+CO$  at z=0

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#### A mass-dependent decrease of SFE from z=2 to z=0

- $\square$  Magdis+12 (z=2)
- $\diamond$  this work (CANDELS z=1)
- this work (HRS z=0)



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from z=2 to z=0: the "slow downfall" of the SFE

Schreiber+16



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Schreiber+16

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→ two different processes: *fast* quenching *slow* downfall





• bulge growth/quenching (Martig+10,Abramson+14,Whitaker+15)



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- → need to study how the SFE evolves with other parameters (metallicity, AGN accretion/jet, outflows, halo mass, ...)
- $\rightarrow$  if possible, for individual galaxies
- → ALMA can help us move forward (see David Elbaz's talk)

#### **Conclusions** and take away points

- the Main Sequence has a varying slope
- flattens at high stellar mass and low redshift
- not linked to bulge growth
- generated by a downfall of star formation efficiency

