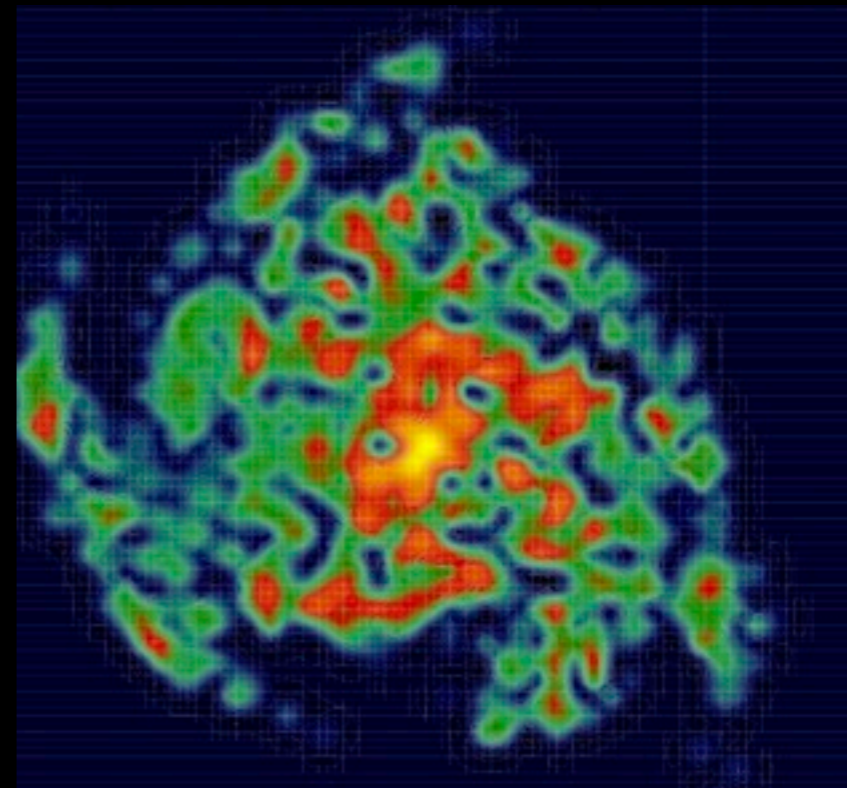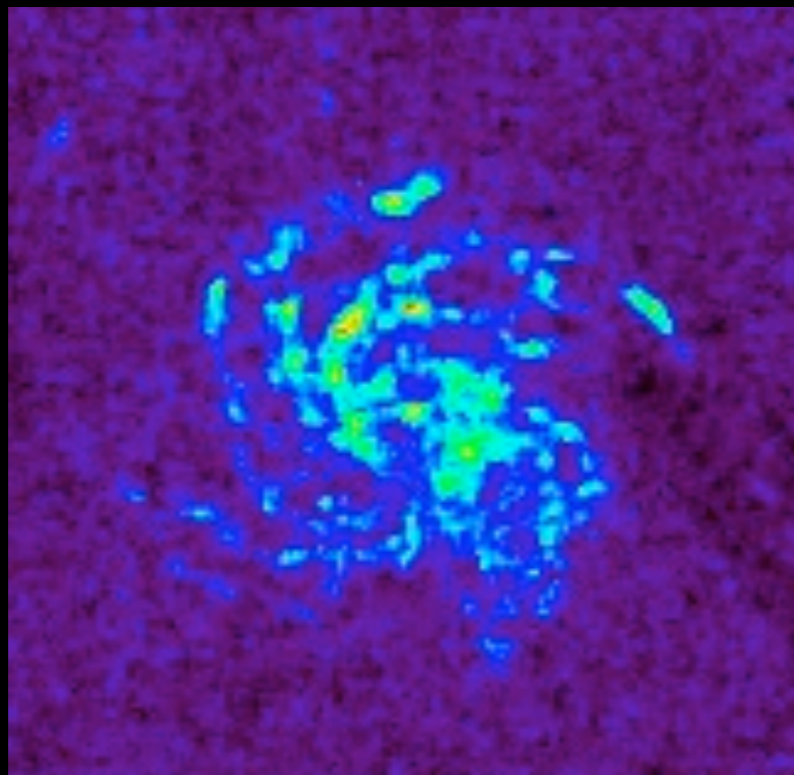# The Jeans Conjecture and the IMF
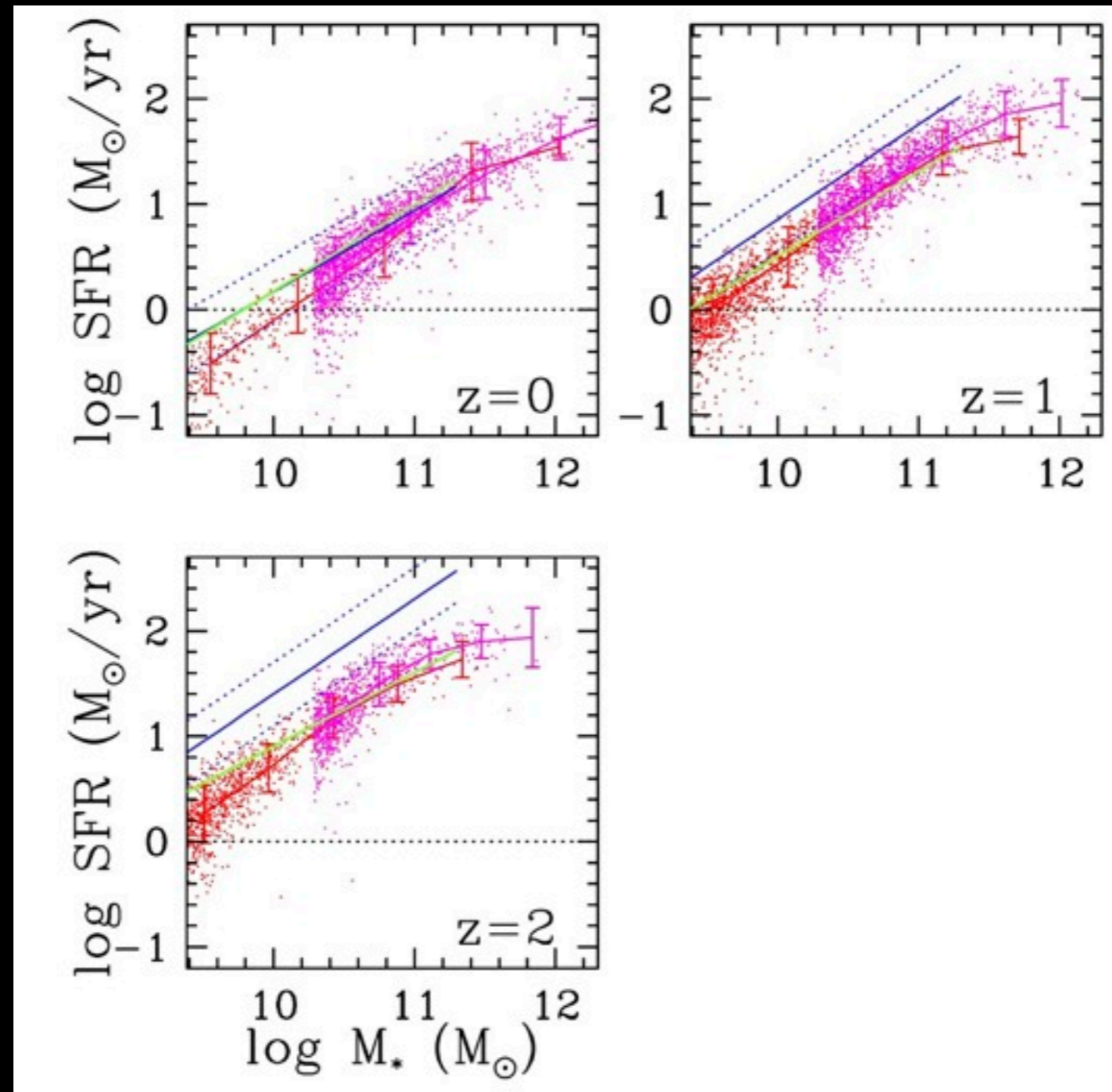
Desika Narayanan
Bart J Bok Fellow
University of Arizona

(with Romeel Davé)

Is the IMF at high-z Top-Heavy?
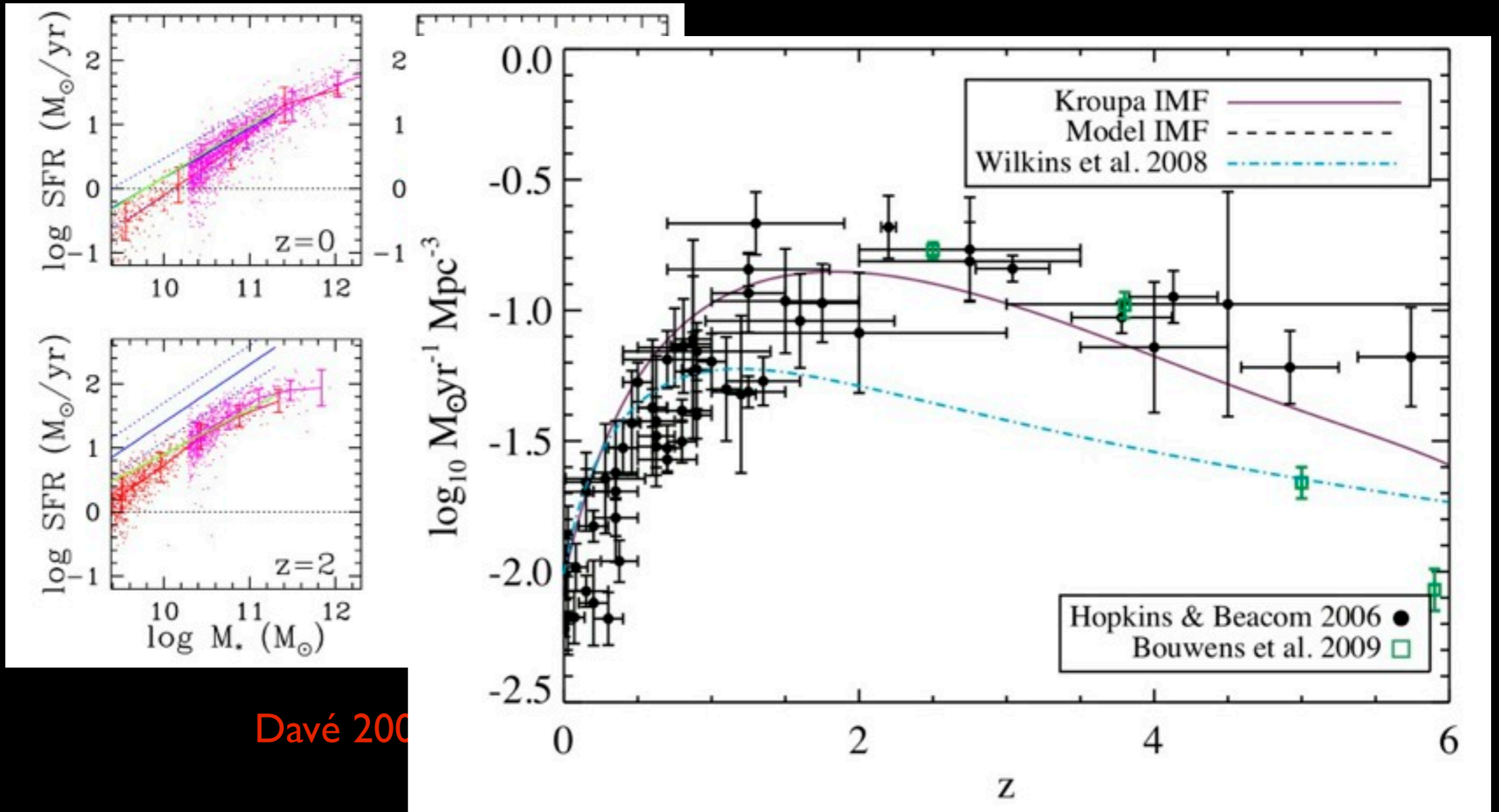## Indirect evidence from z~2 SFRs

Davé 2008

Is the IMF at high-z Top-Heavy?
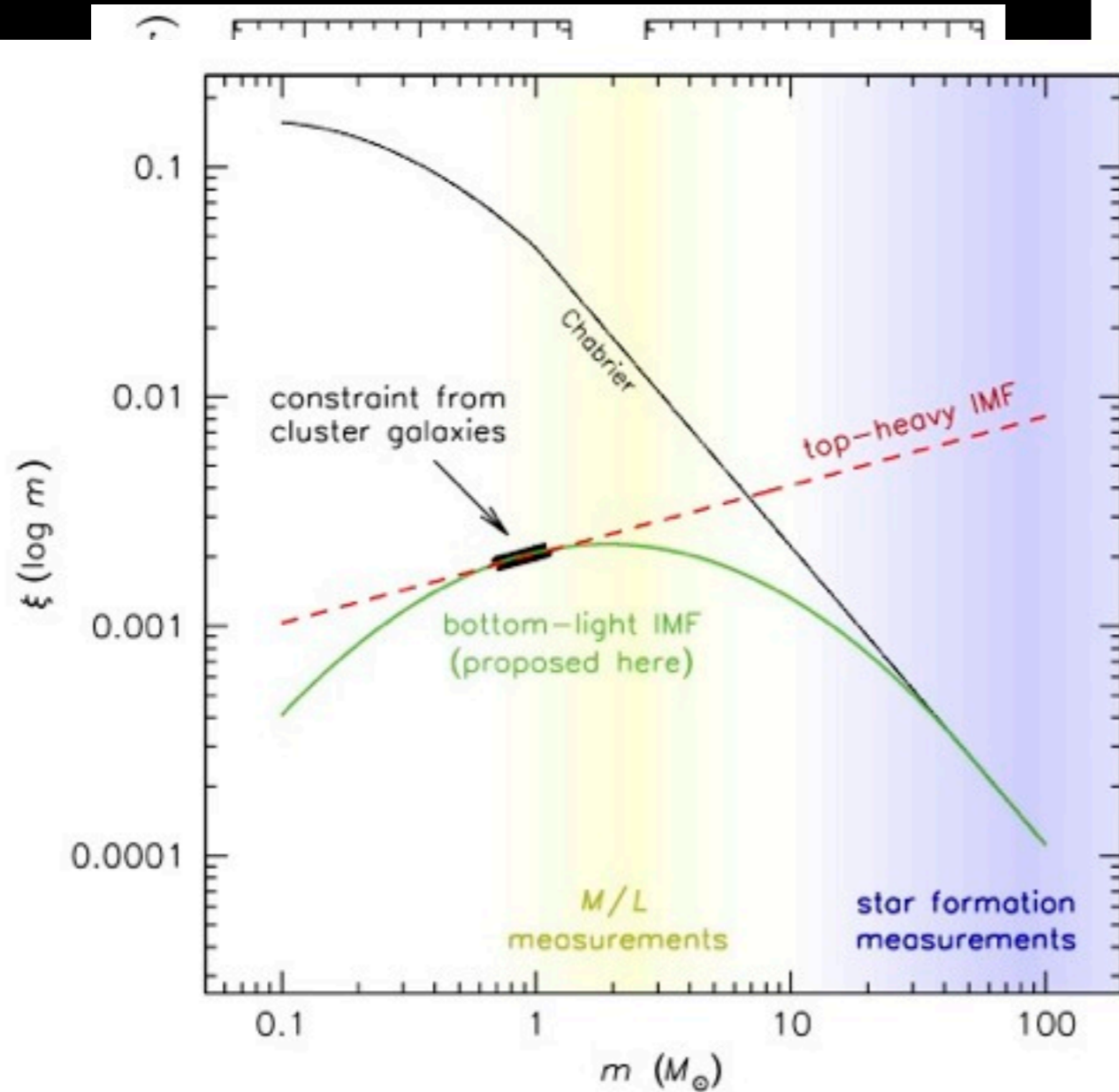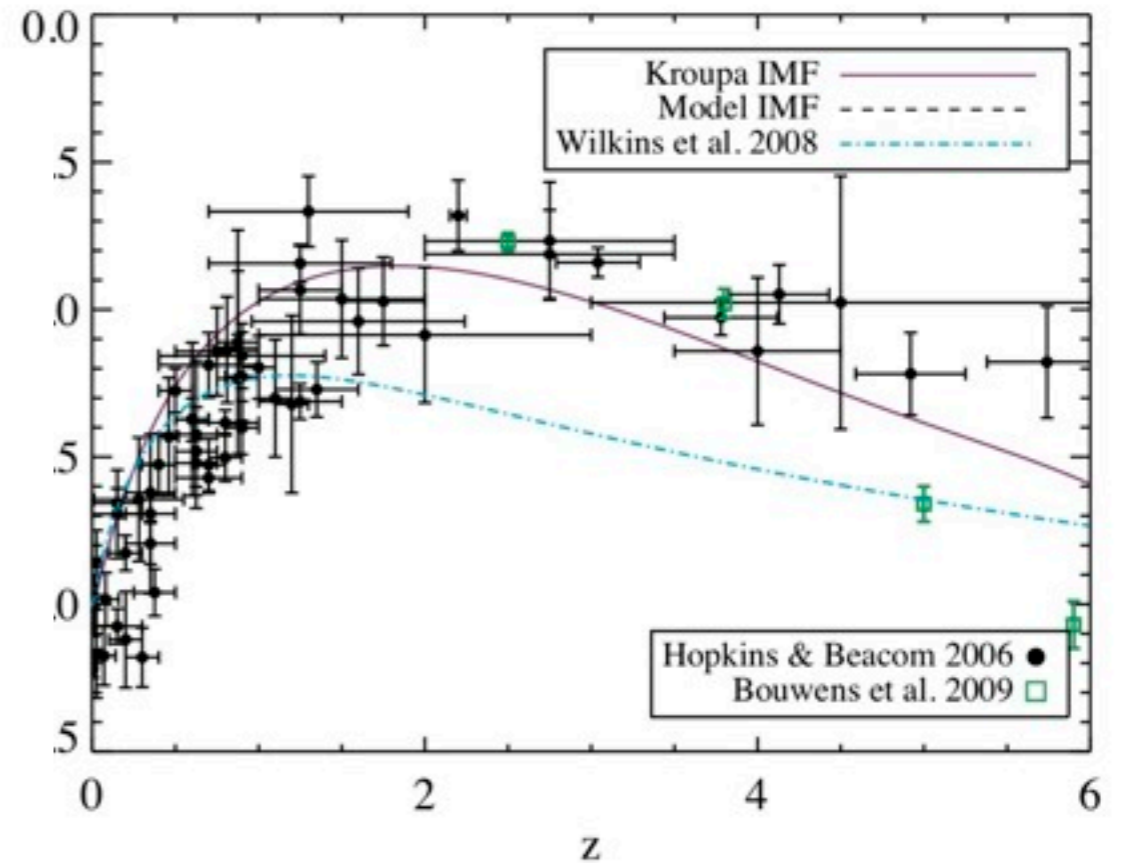## Indirect evidence from z~2 SFRs

Davé 200

Wilkins & Trentham (2008)
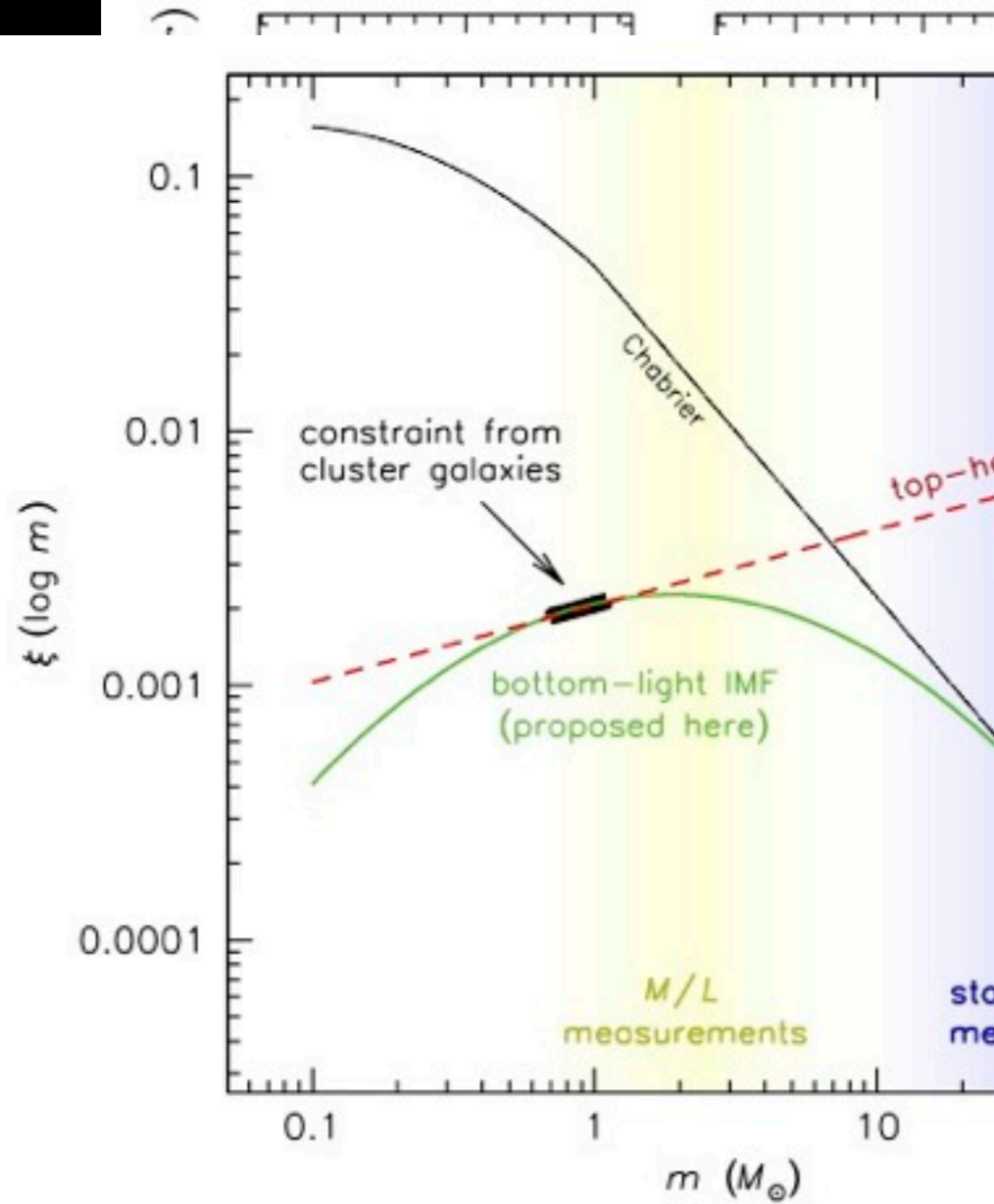Narayanan & Davé (2012)
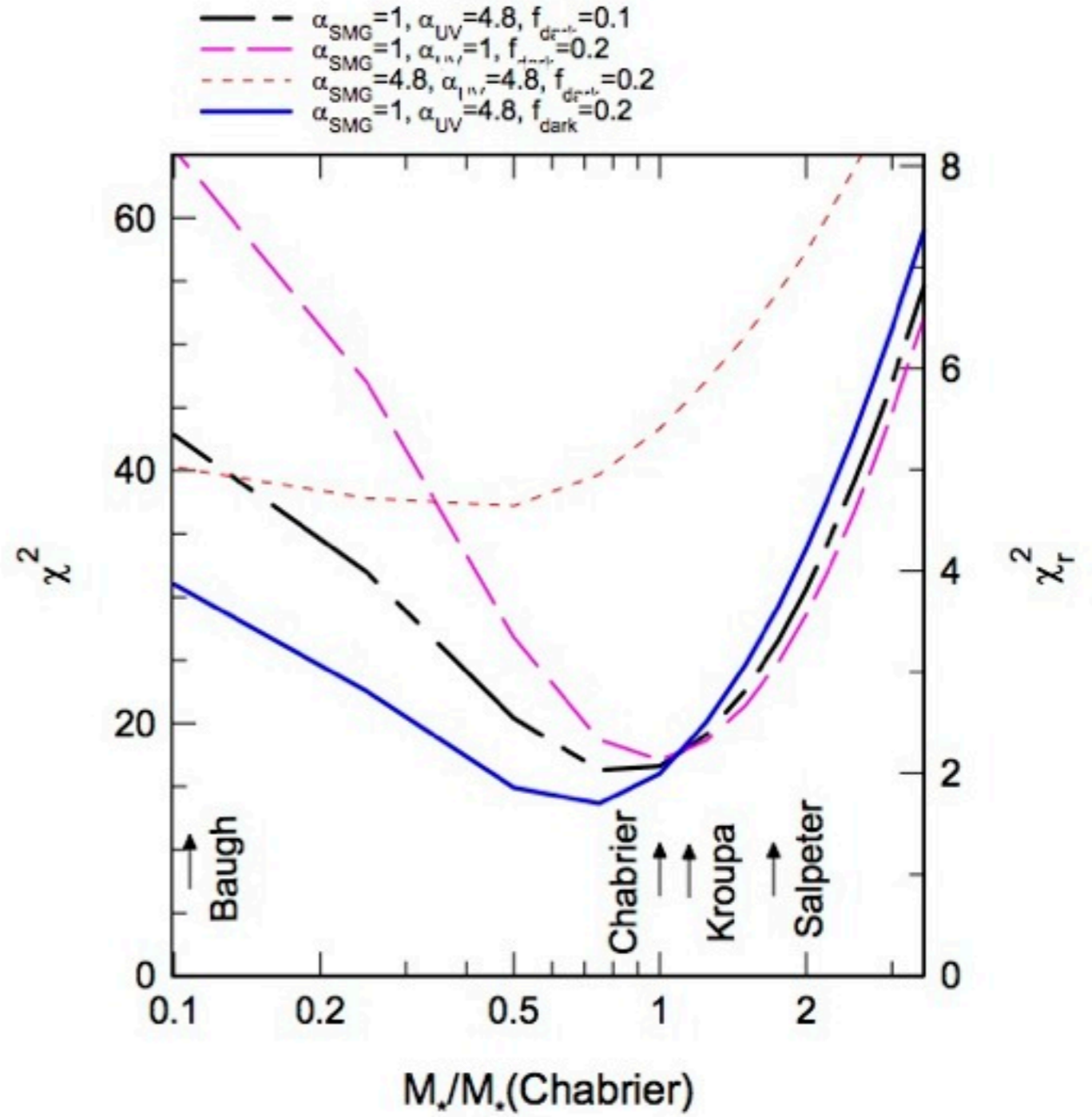
Is the IMF at high-z Top-Heavy?

van Dokkum 2008

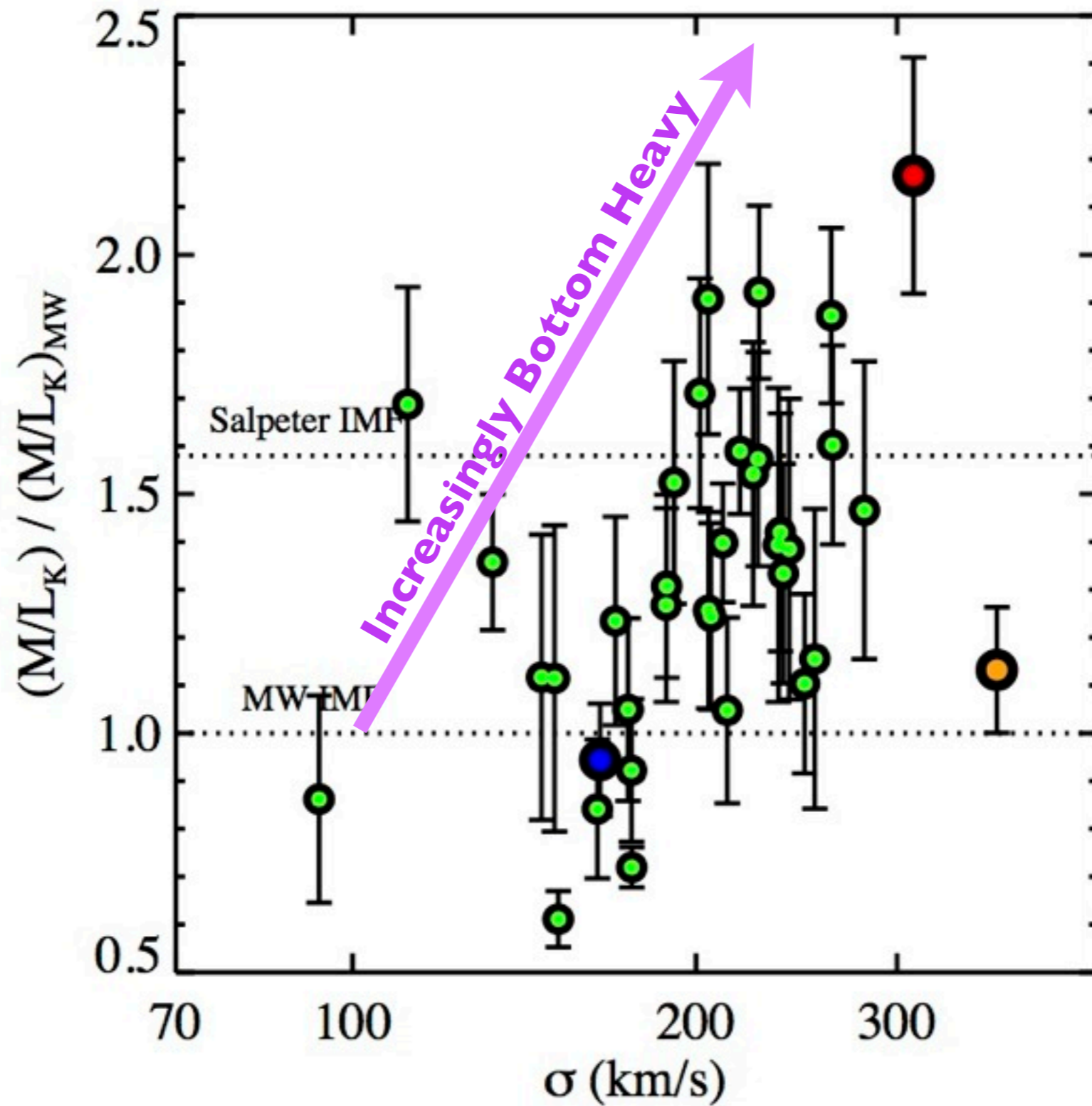Wilkins & Trentham (2008)
Narayanan & Davé (2012)

Is the IMF at high z Top-Heavy?

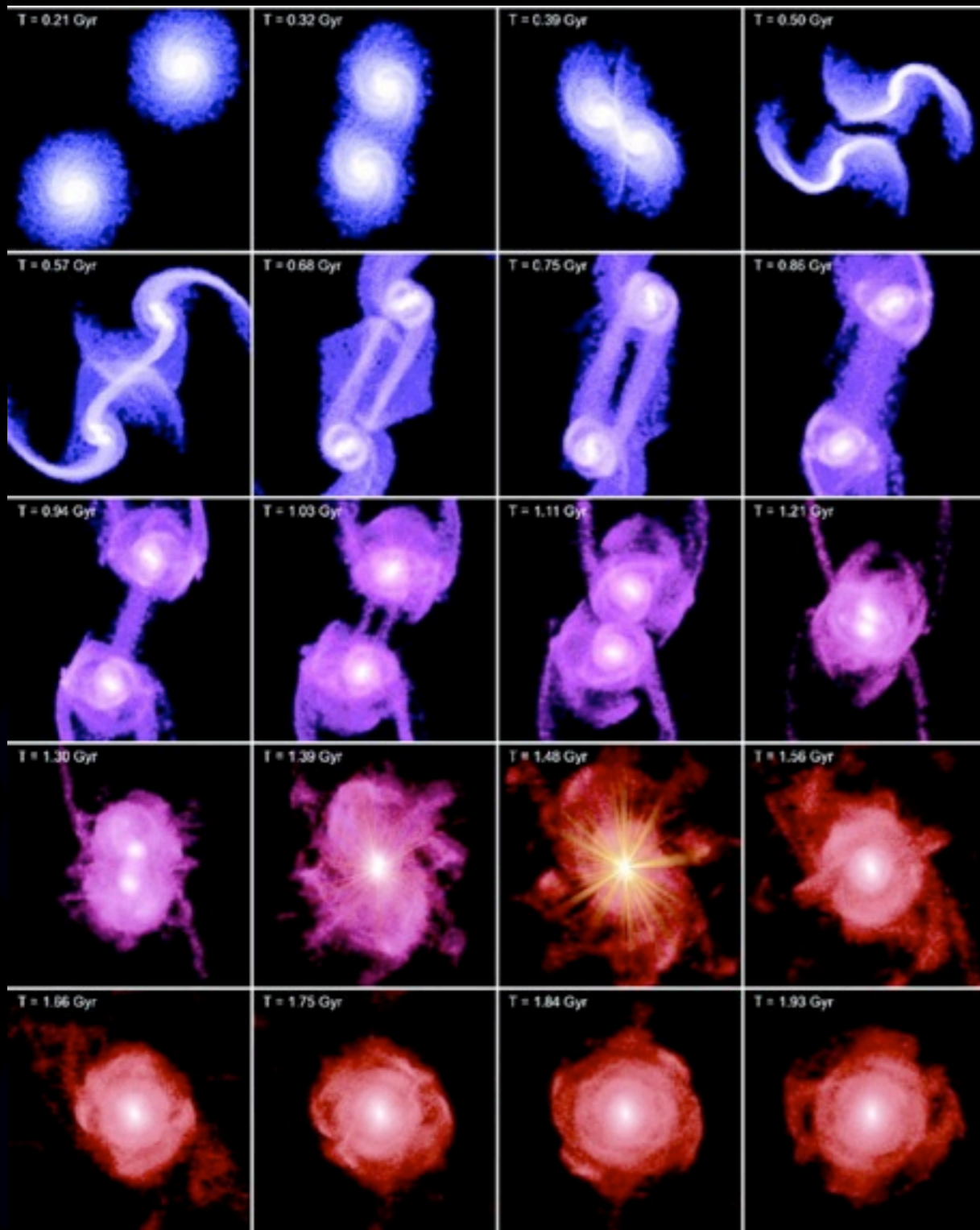van Dokkum 2008

Tacconi 2008

Is the IMF at high-z Top-Heavy?
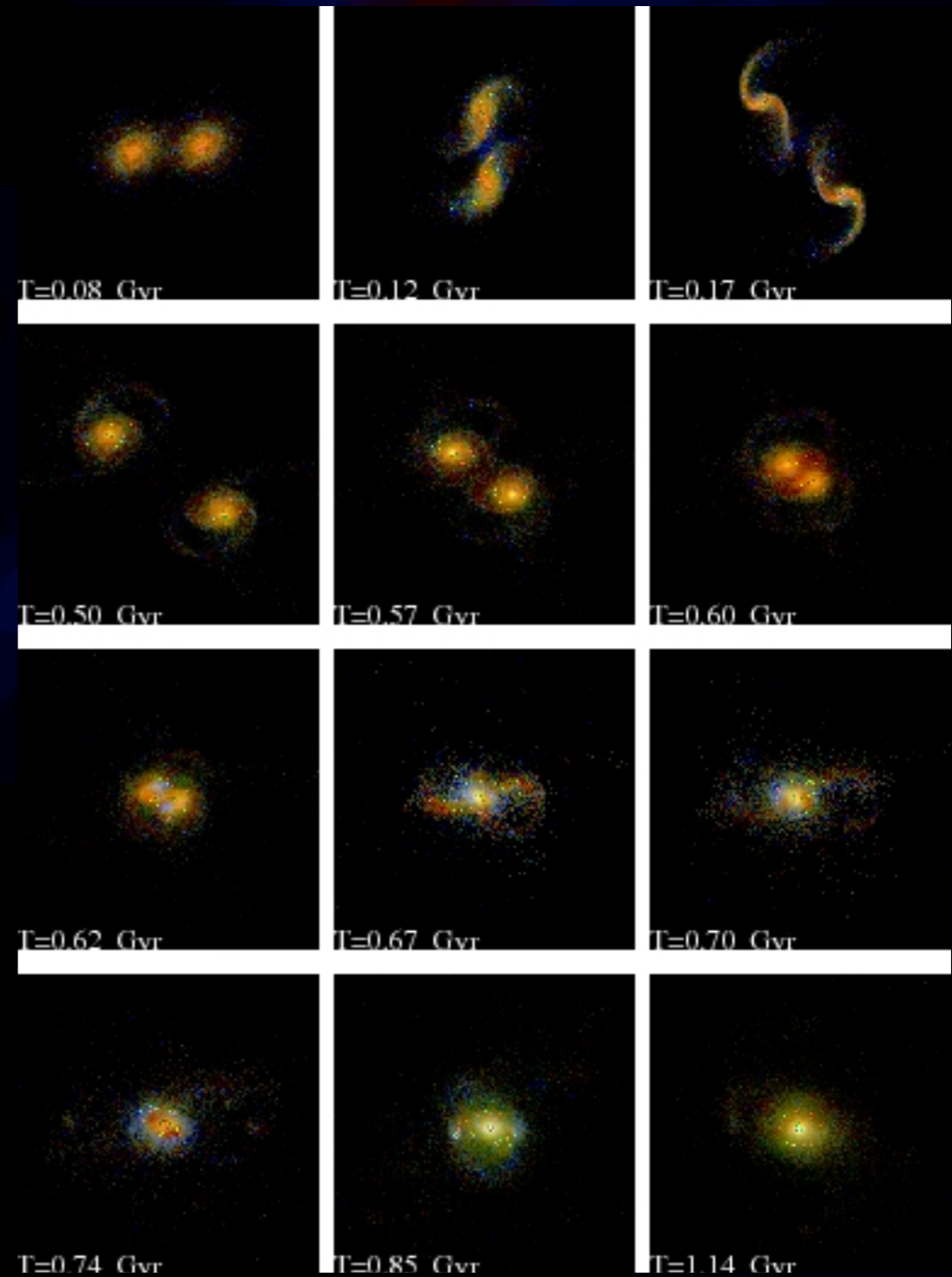## (then how are their descendents bottom-heavy?)

Conroy & van Dokkum 2012

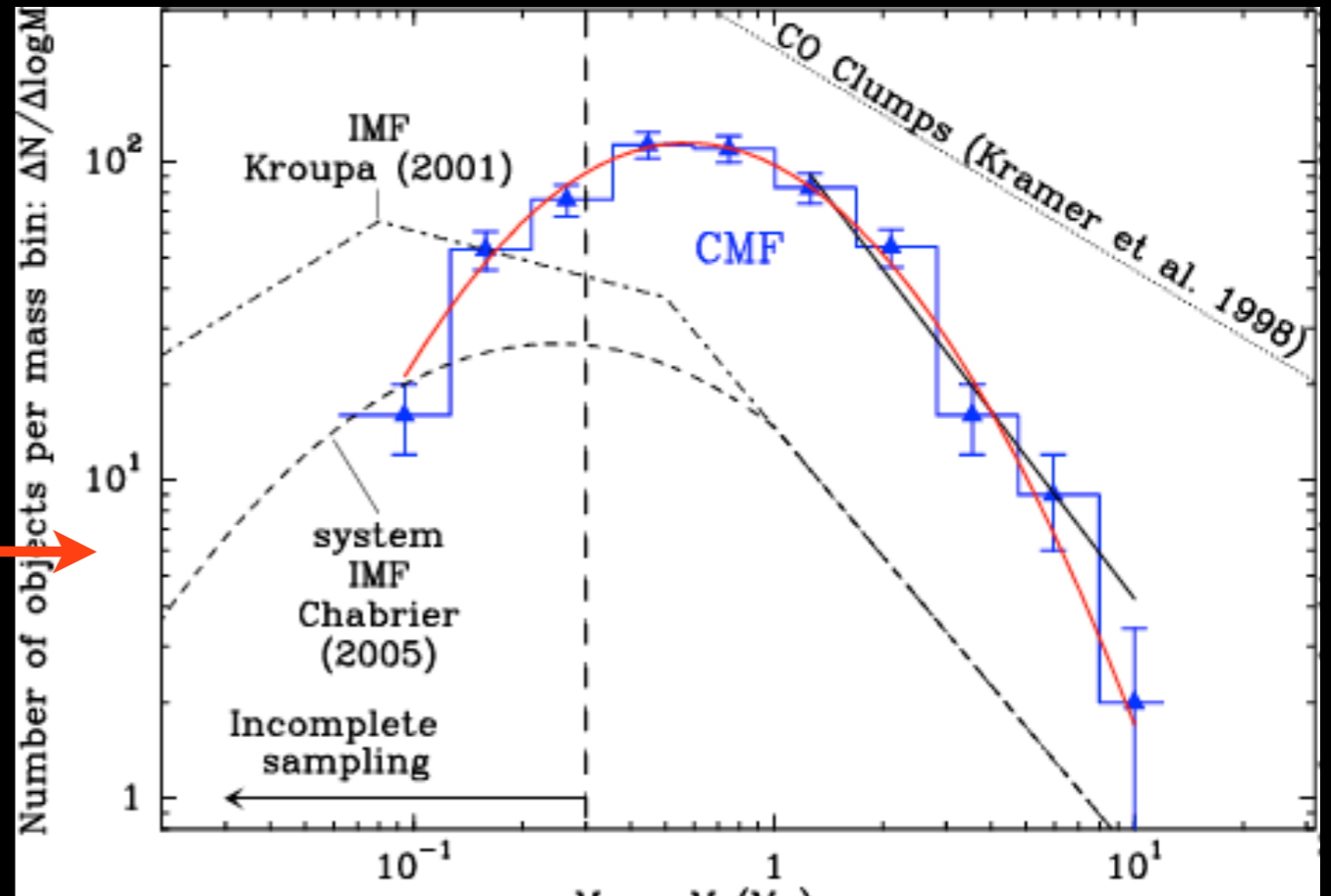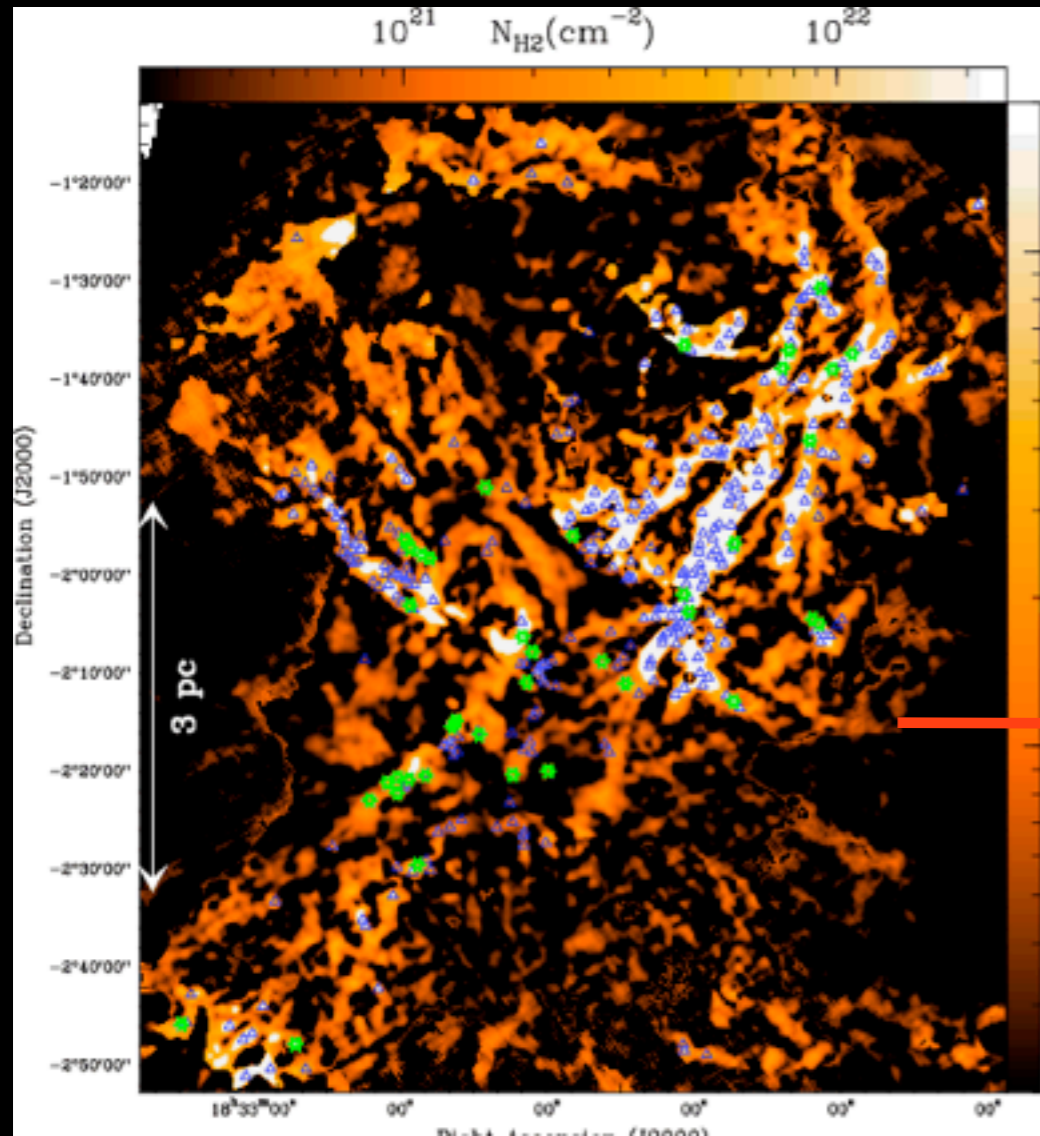# Gadget: to get model discs and mergers at z=0,2

Springel et al. 2003-2005
T.J. Cox et al. 2005-2008

Sunrise: to get dust temperatures

Jonsson et al. 2006, 2009
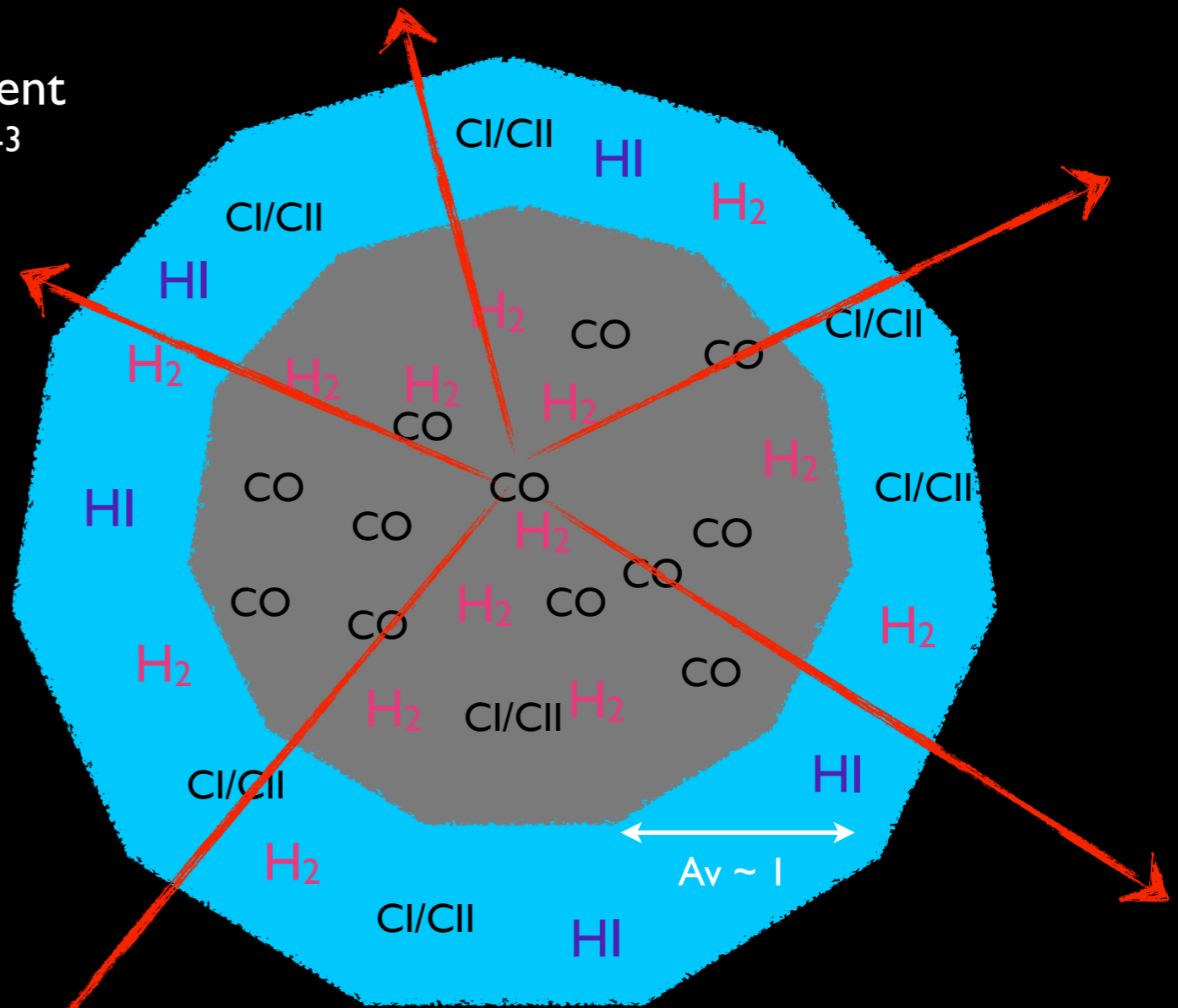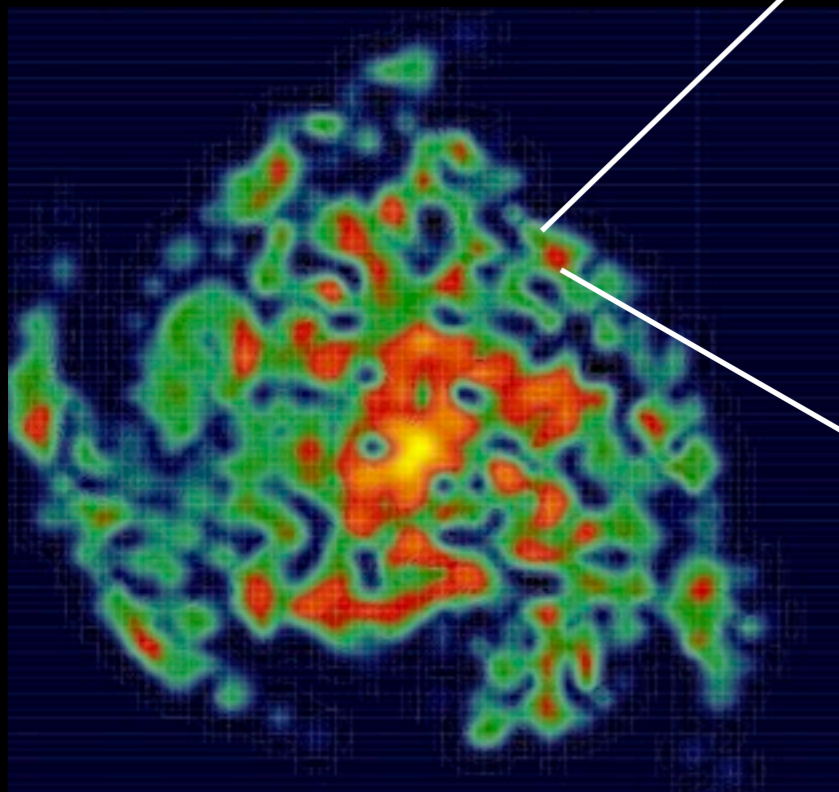Jonsson & Primack 2010

Assumption: $M_{crit} \sim M_J$

André et al. 2010

$$\Gamma_{pe} + \Gamma_{CR} - \Lambda_{line} + \Psi_{gd} = 0$$

$$M_J \sim T^{3/2} / n^{1/2}$$

scales with SFR

becomes efficient
at $n \sim 10^4$ cm^{-3}

CI/CII   HI   H$_2$

CI/CII   HI

H$_2$ H$_2$ H$_2$ CO   CO   CI/CII

H$_2$ CO   H$_2$ H$_2$

HI   CO   CO   CO   H$_2$ CI/CII

CO   CO   H$_2$ CO

H$_2$ H$_2$ CO   CO

H$_2$ CI/CII   H$_2$

CI/CII

HI

H$_2$ CI/CII   HI   Av ~ 1

$\Sigma_{GMC} > 100$ M$_\odot$pc^{-2}

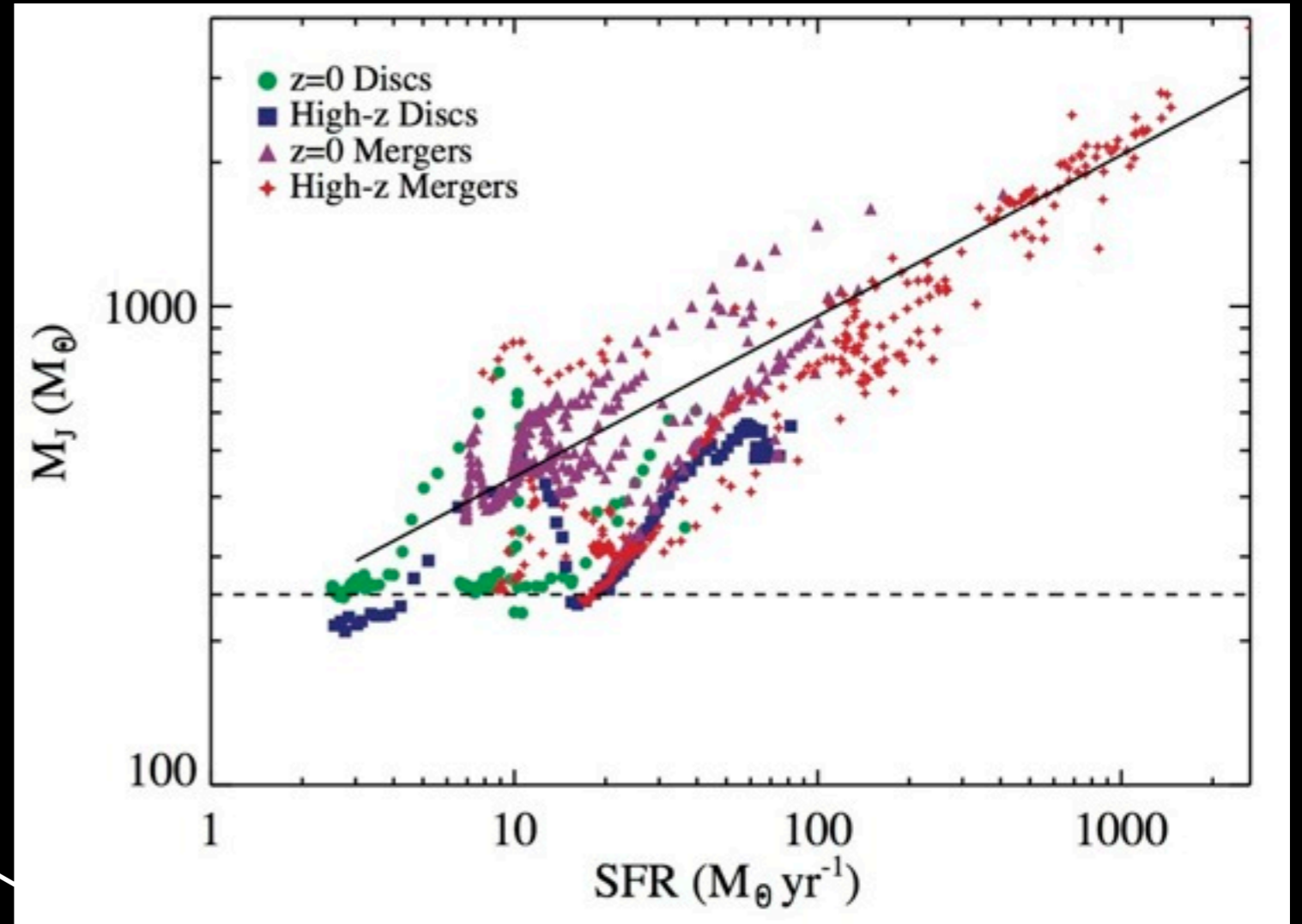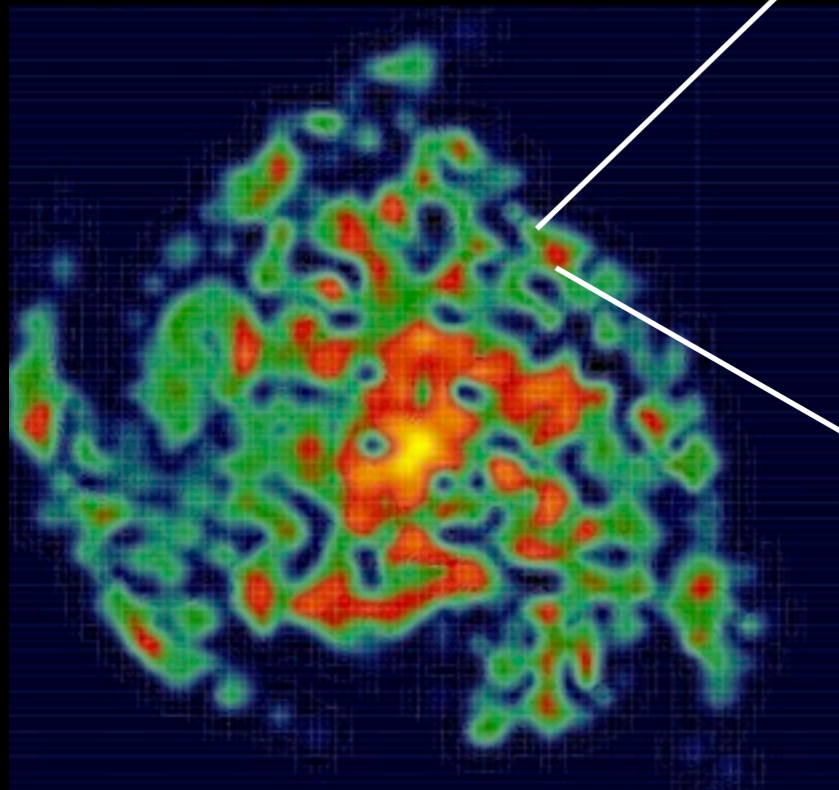Krumholz, McKee & Leroy (2011)
Narayanan et al. (2011b)

Desika Narayanan

$$\Gamma_{pe} + \Gamma_{CR} - \Lambda_{line} + \Psi_{gd} = 0$$

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Narayanan & Davé 2012
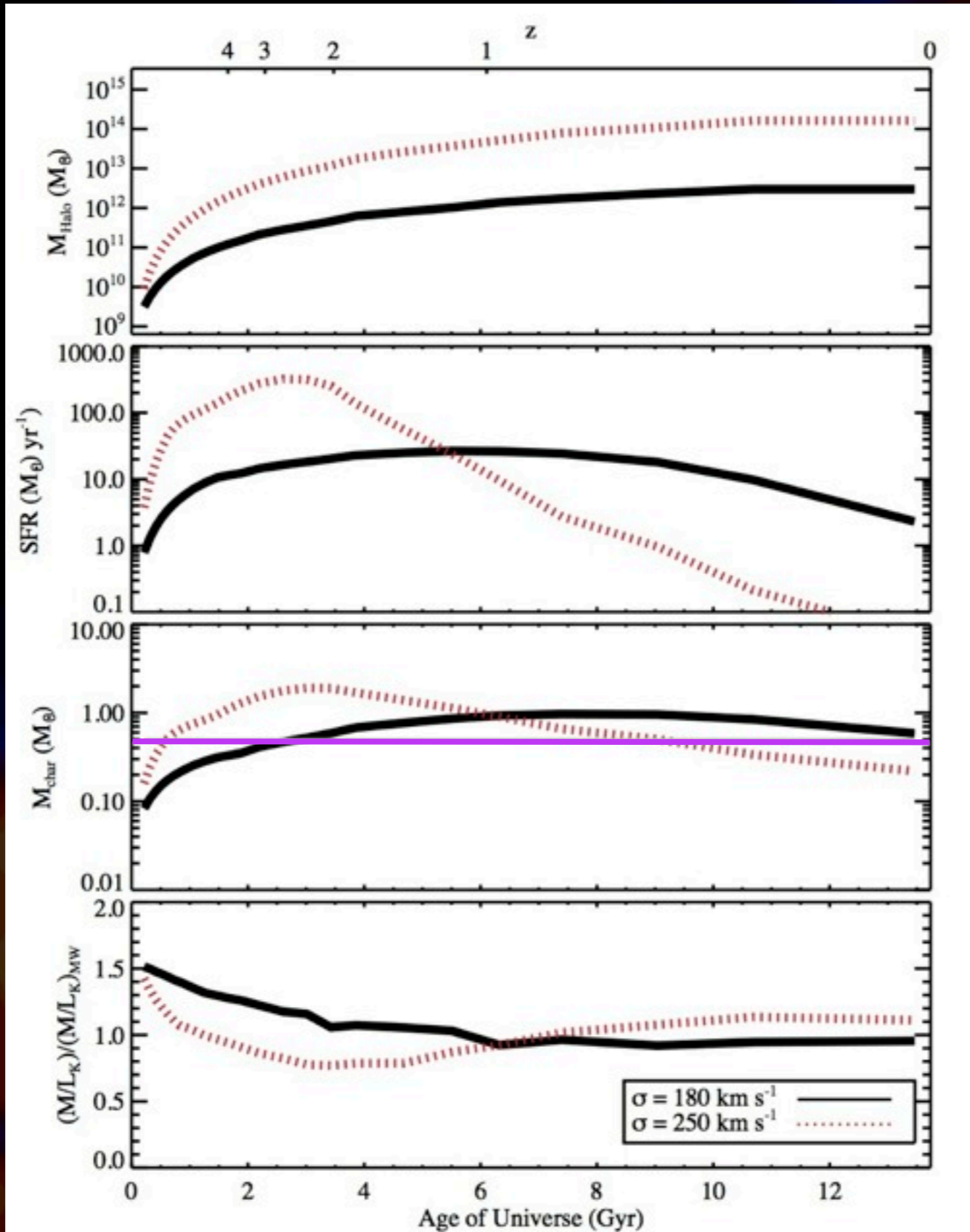
$$M_J \sim T^{3/2} / n^{1/2}$$

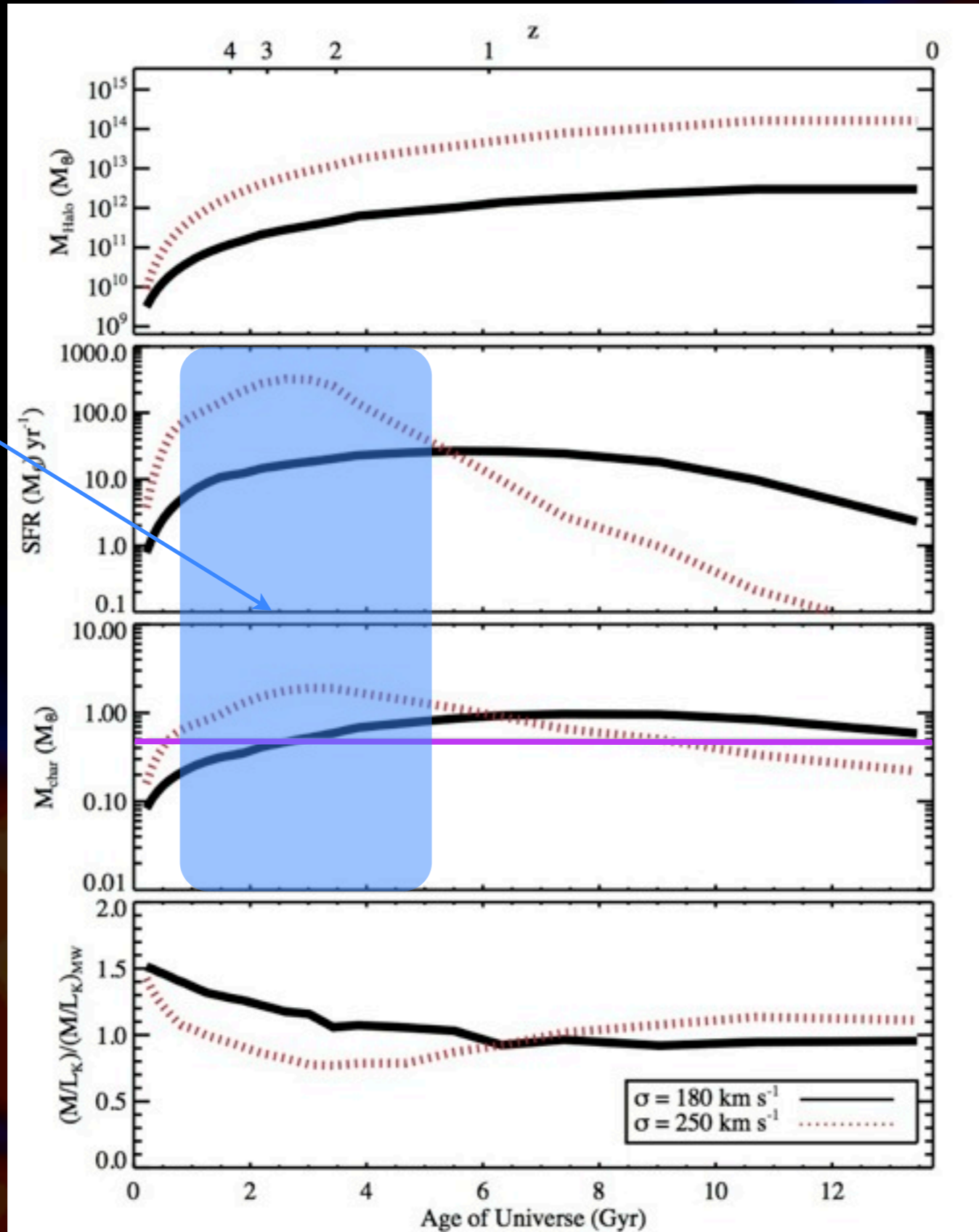Narayanan & Davé (in prep.)

$M_J \sim T^{3/2} / n^{1/2}$

M_{halo}

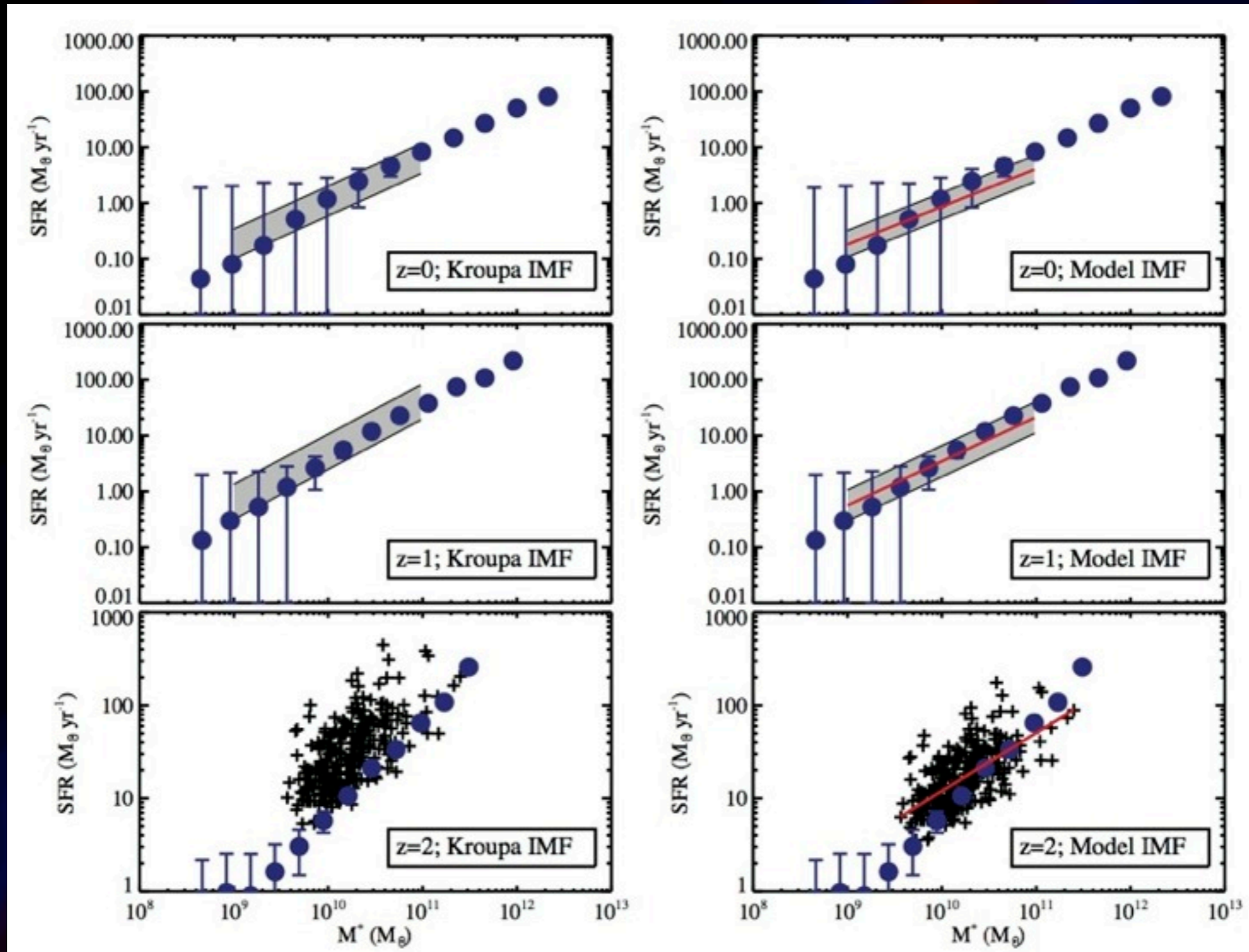$n \sim 10^4\text{-}10^5 \text{ cm}^{-3}$
$T_{gas} \sim T_{dust}$

SFR

M_c

Kroupa

M/L

Narayanan & Davé (in prep.)

z=0-2 SFR-M* relation

$$SFR = \left[\frac{L_{bol}}{10^{10}L_{\odot}}\right]^{0.88} M_{\odot}\,yr^{-1}$$
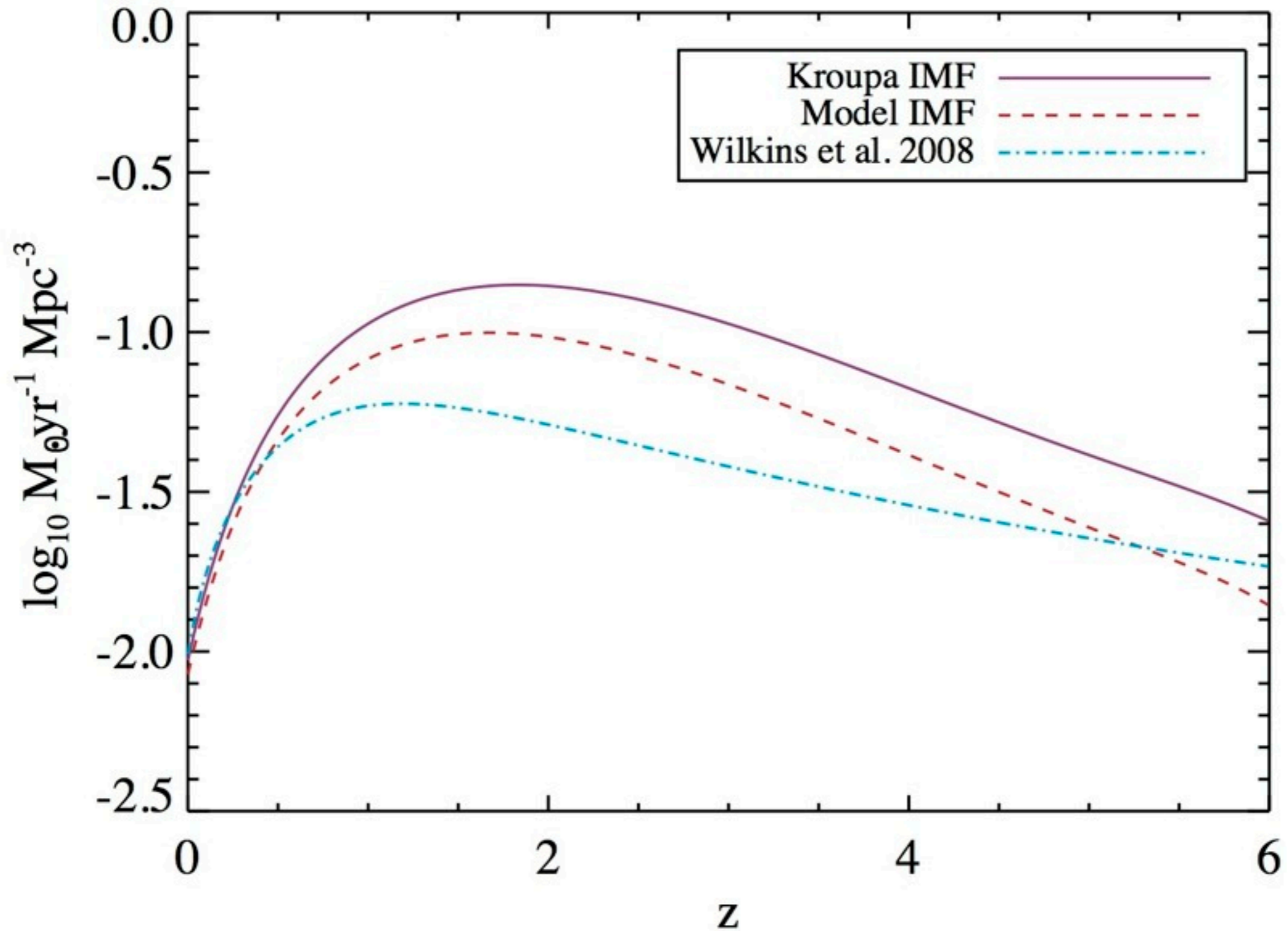
Invariant IMF SFRs

Model IMF SFRs

Narayanan & Davé (2012)

Desika Narayanan

Comparing Cosmic SFR Density Evolution against
Stellar Mass buildup

Narayanan & Davé (2012)

Desika Narayanan
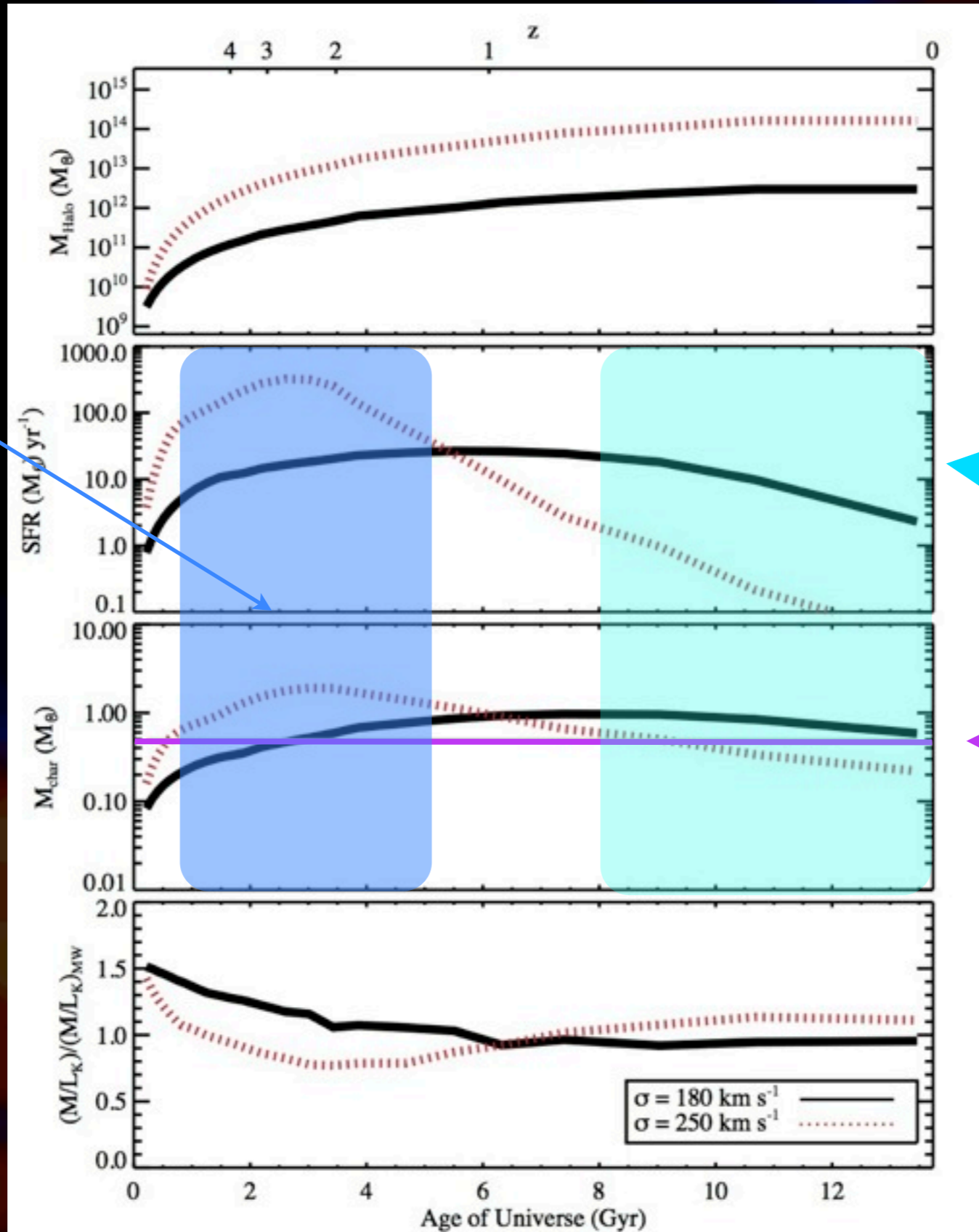
$M_J \sim T^{3/2} / n^{1/2}$

M_{halo}

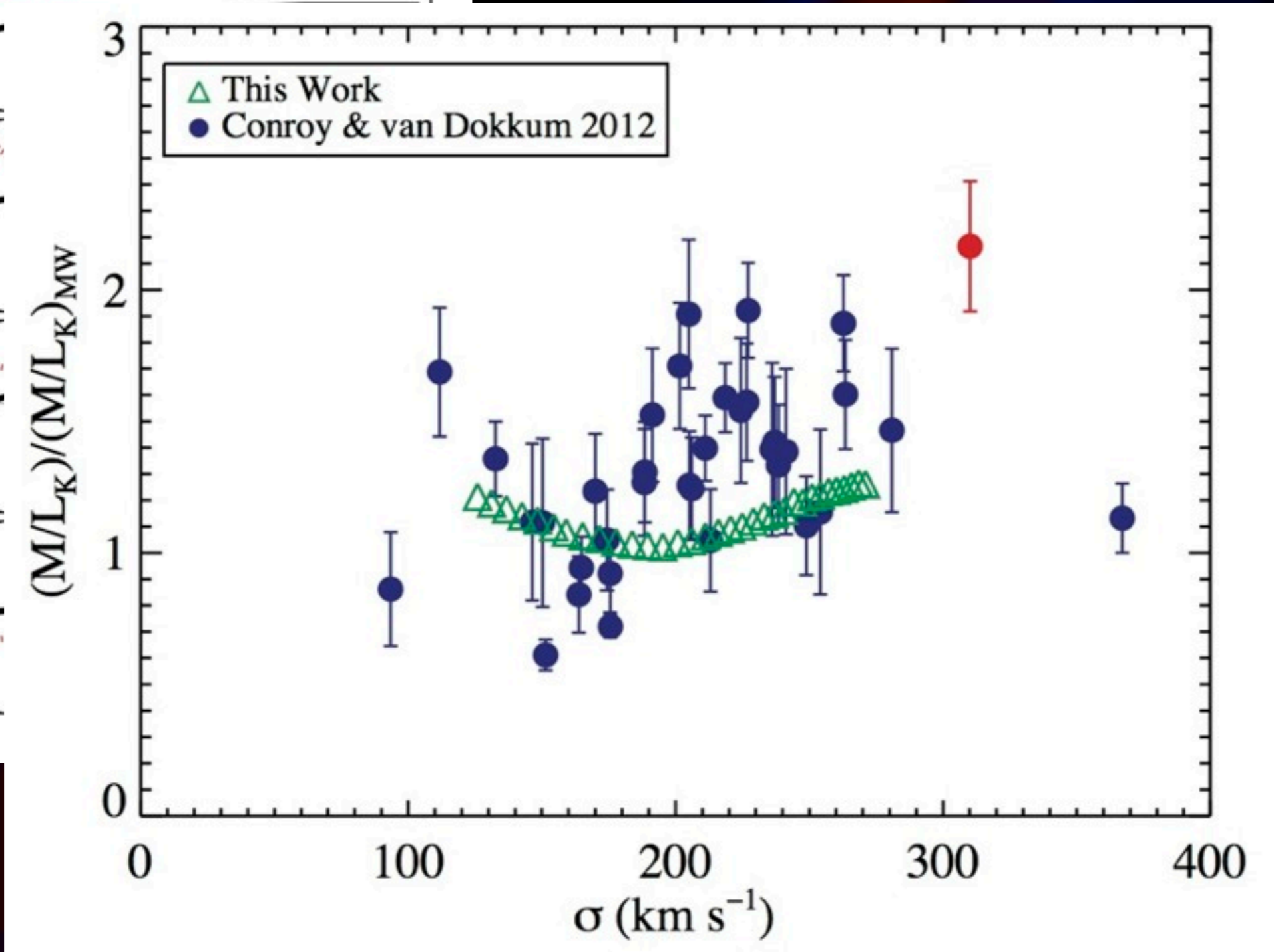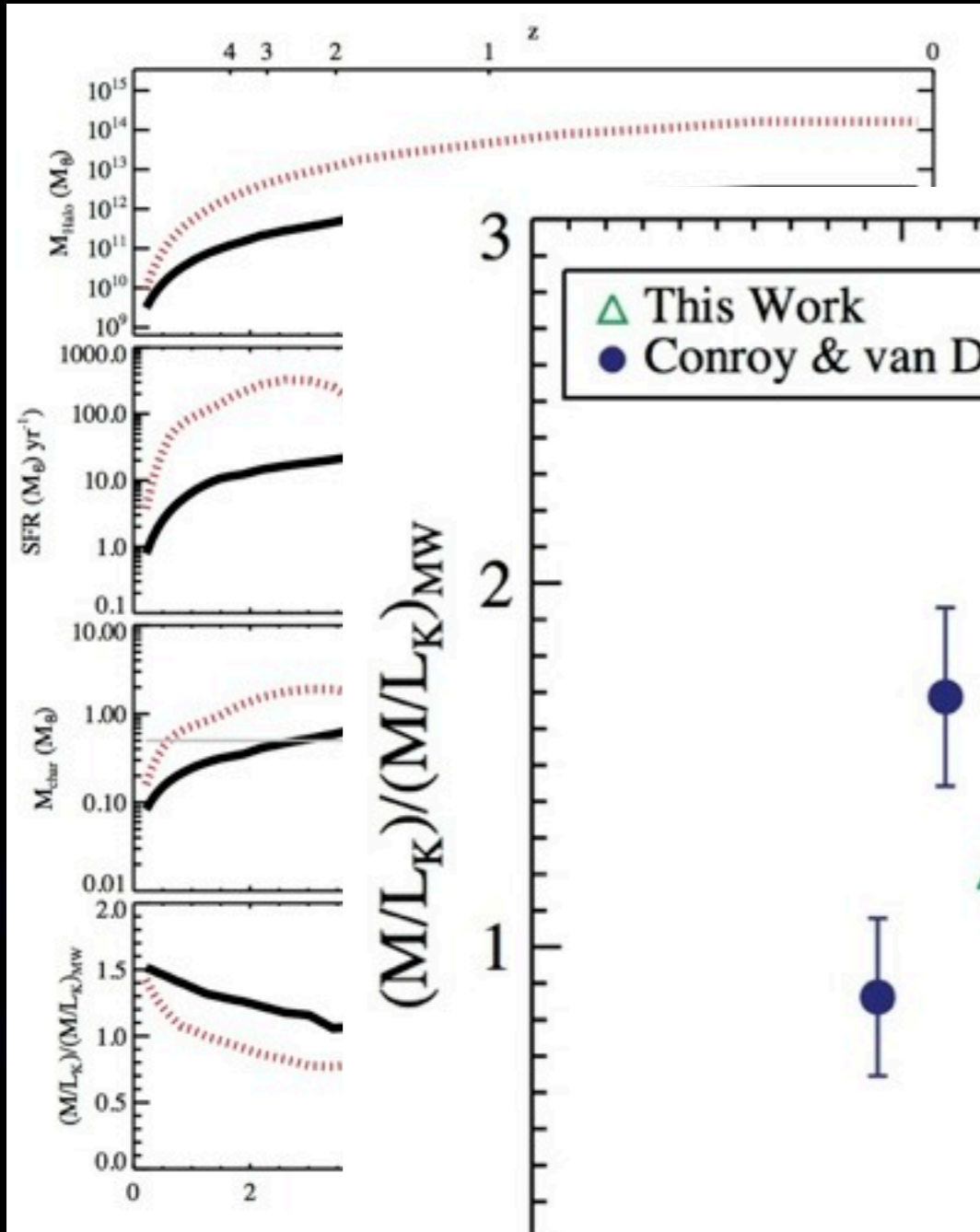$n \sim 10^4\text{-}10^5$ cm^{-3}
$T_{gas} \sim T_{dust}$

SFR

M_c

M/L

SFRs < SFR$_{MW}$
T_{gas} < 10 K

Kroupa

Narayanan & Davé (in prep.)

Narayanan & Davé (in prep.)

Conclusions

Under the Jeans Assumption:

1. Dust-gas coupling can raise temperatures in high-z galaxies enough to drive top-heavy/bottom-light IMFs

2. Decreased SFRs in gas where CRs dominate the temperature can promote bottom-heavy IMFs at low-z:

More massive galaxies have increasingly bottom-heavy IMFs at z~0

Do the Jeans properties of GMCs relate at all to the stellar IMF?