THE FORMATION HISTORY MODEL

A SIMPLE MODEL OF GALAXY FORMATION

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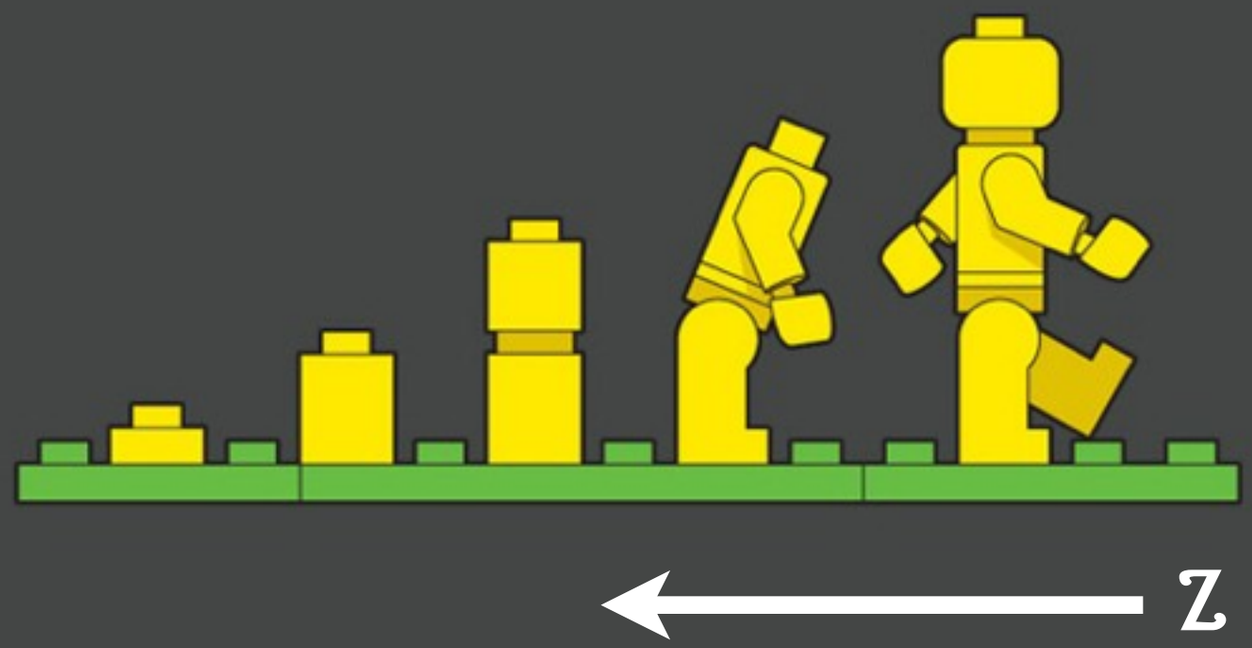
[2] Swinburne University of Technology

GALAXIES ARE COMPLICATED

!

SIMON MUTCH SYNTHETIC UNIVERSES WORKSHOP - MARCH 2013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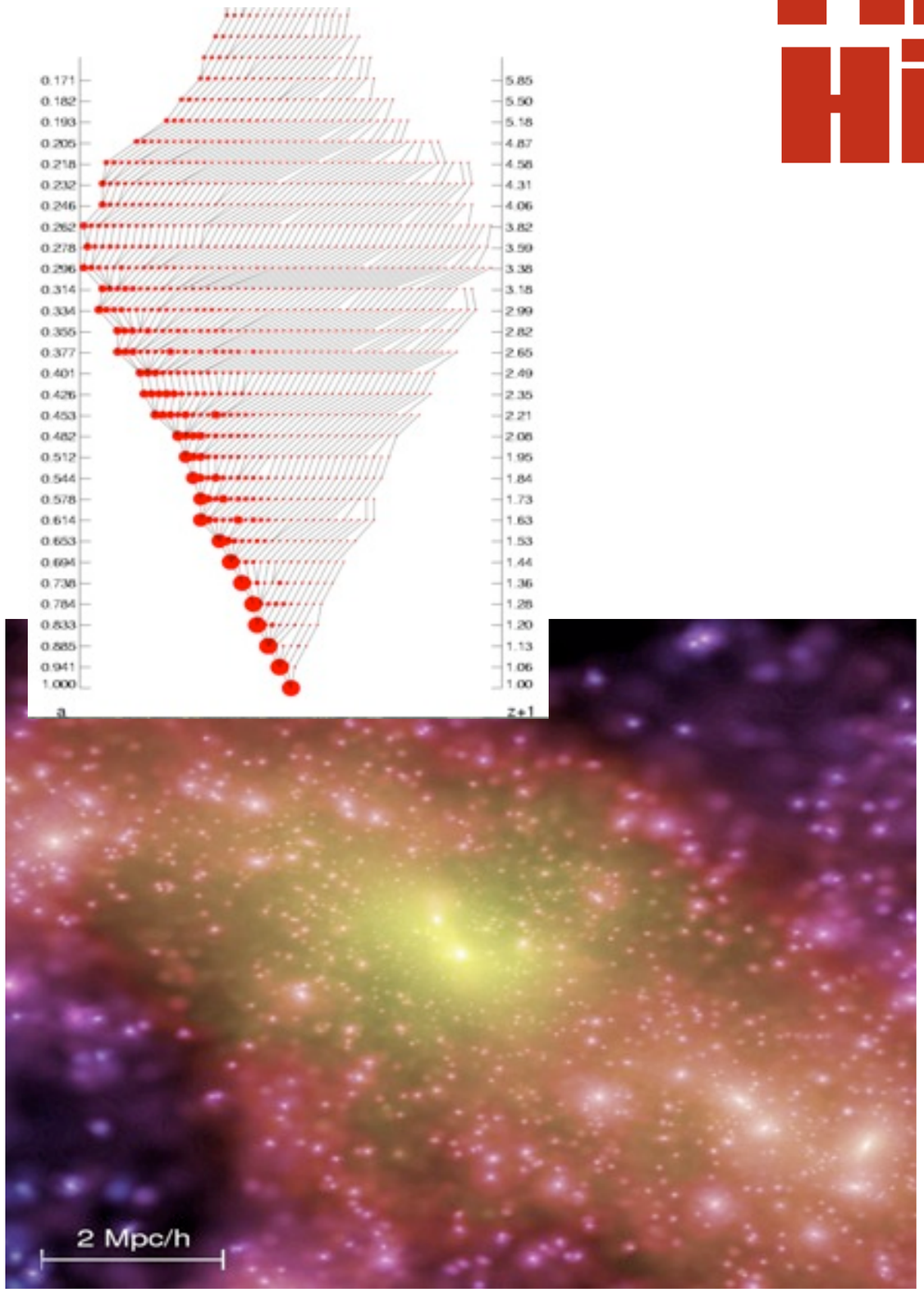
The Formation History model



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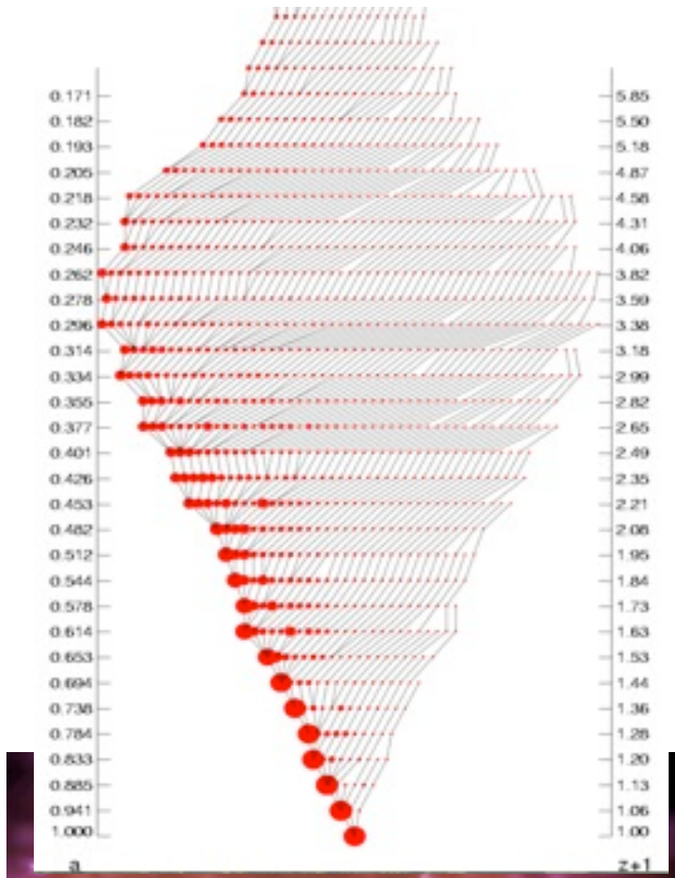
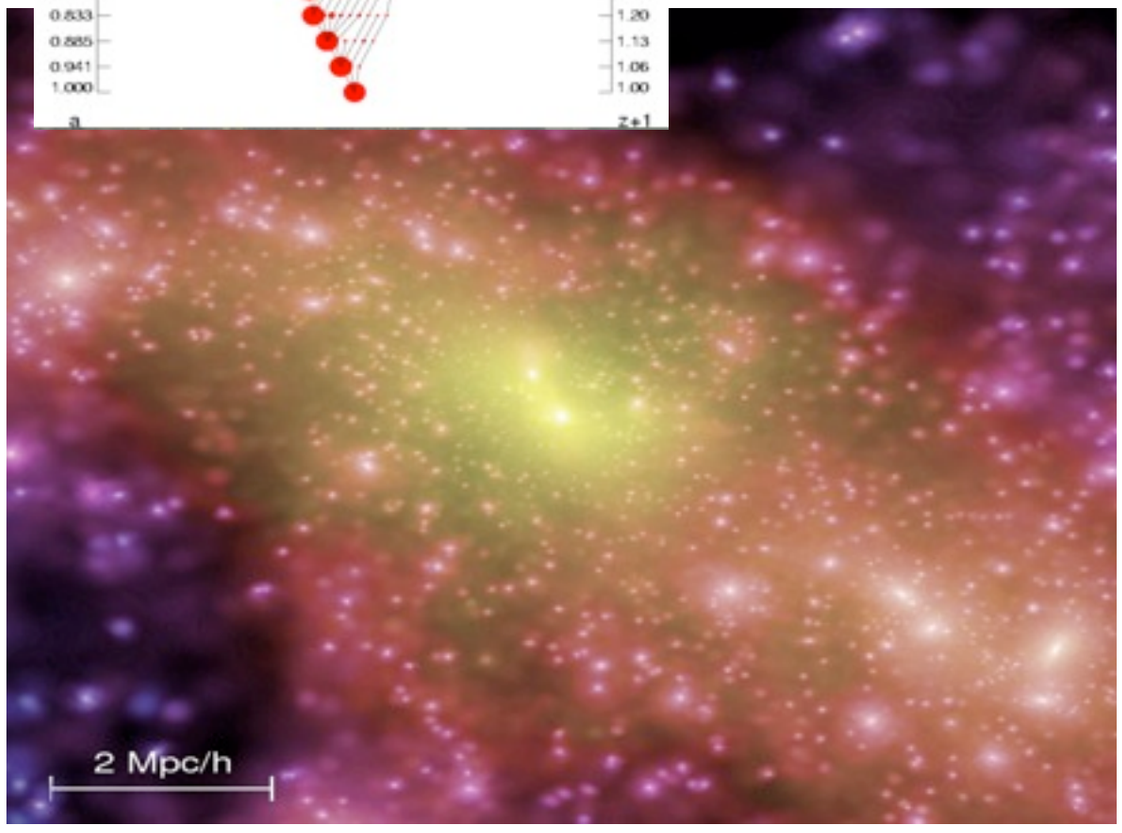
The Formation History model





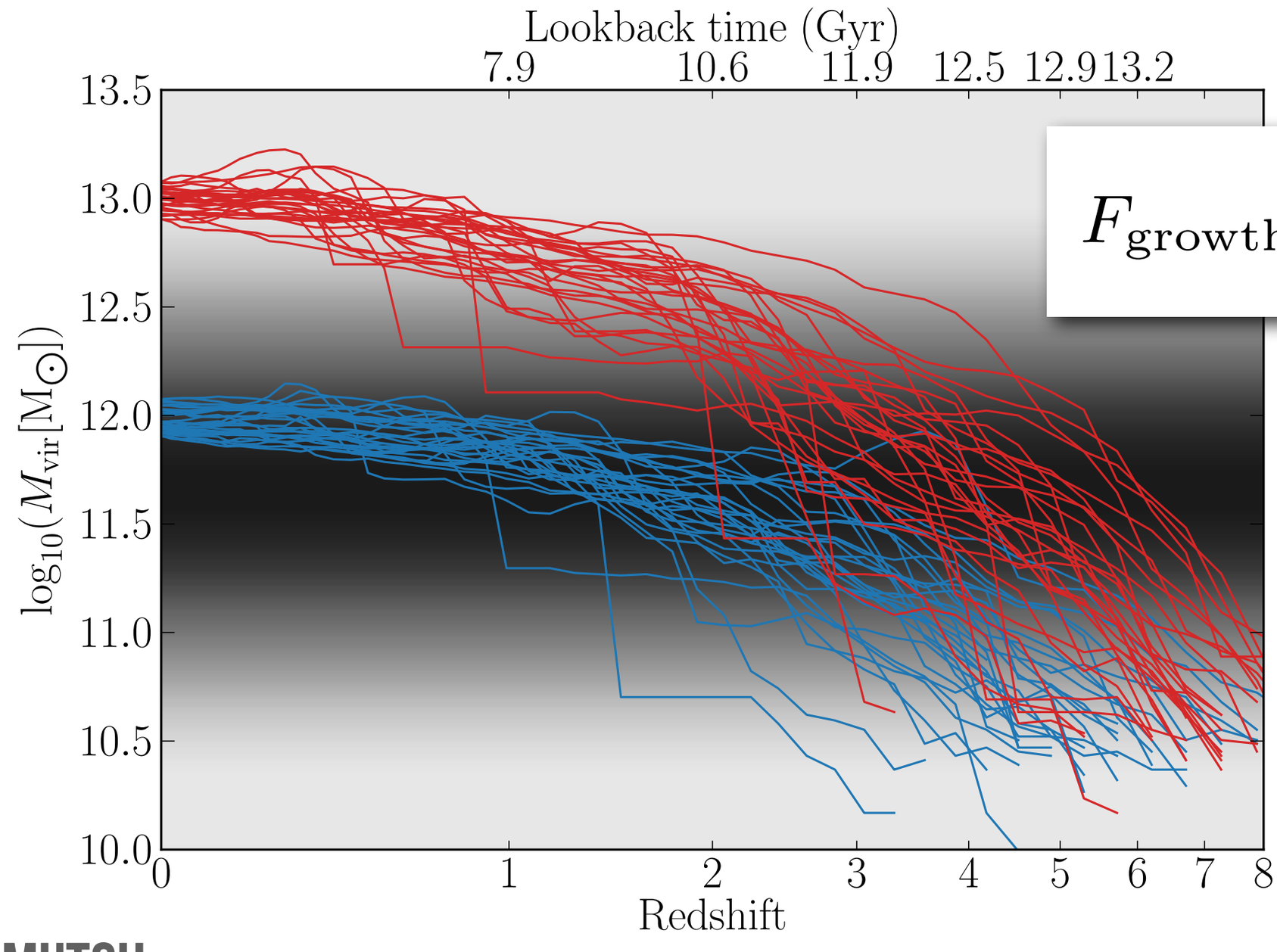
$$\dot{M}_* = F_{\mathrm{growth}} \cdot F_{\mathrm{phys}}$$

THE "BARYONIC GROWTH" FUNCTION

THE "PHYSICS" FUNCTION

THE baryonic growth function

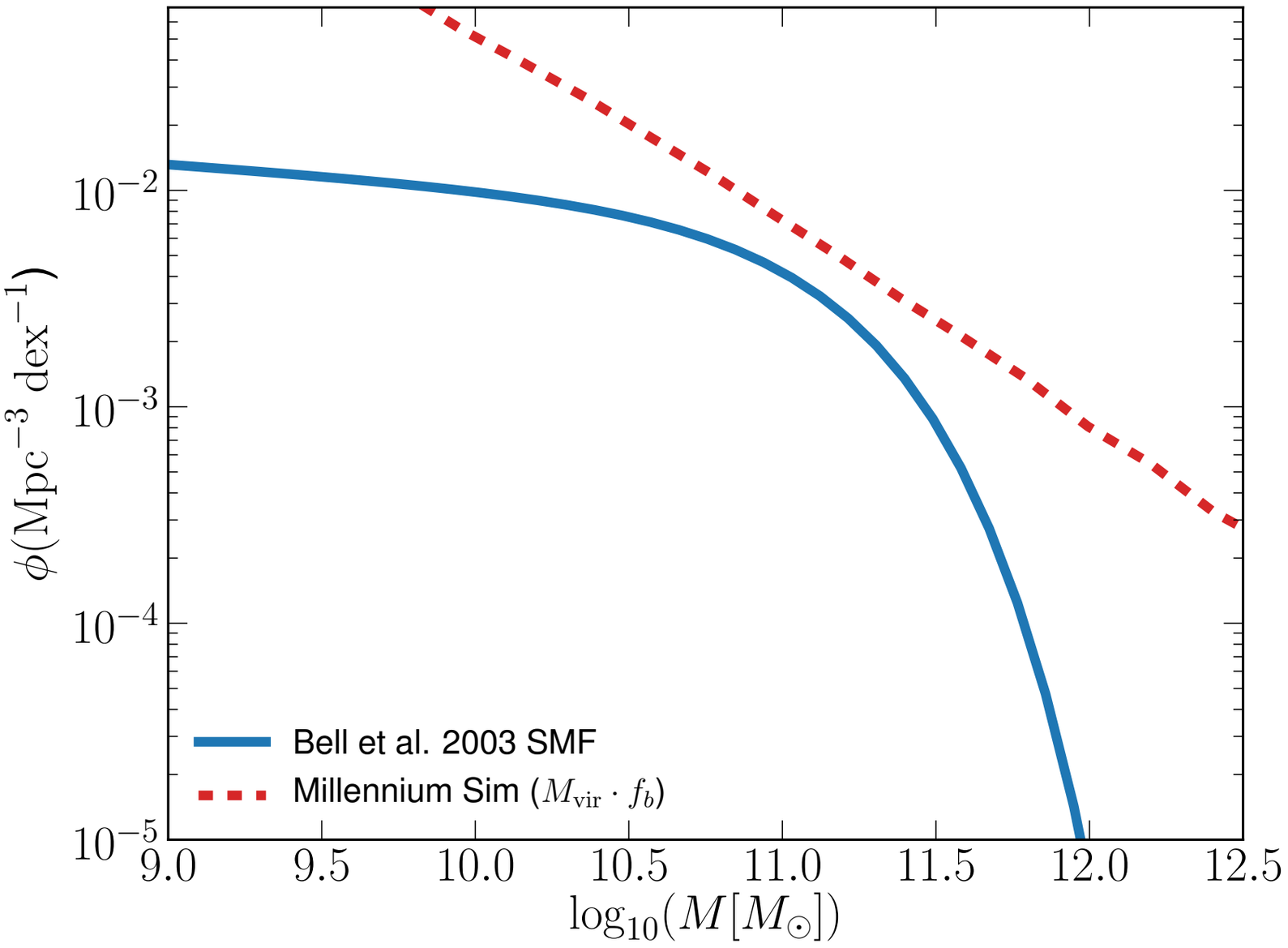
$$\dot{M}_* = \boxed{F_{\rm growth}} \cdot F_{\rm phys}$$



$$F_{\rm growth} = f_{\rm b}\frac{dM_{\rm vir}}{dt}$$

THE PHYSICS FUNCTION

$$\dot{M}_* = F_{\rm growth} \cdot \boxed{F_{\rm phys}}$$



THE PHYSICS FUNCTION

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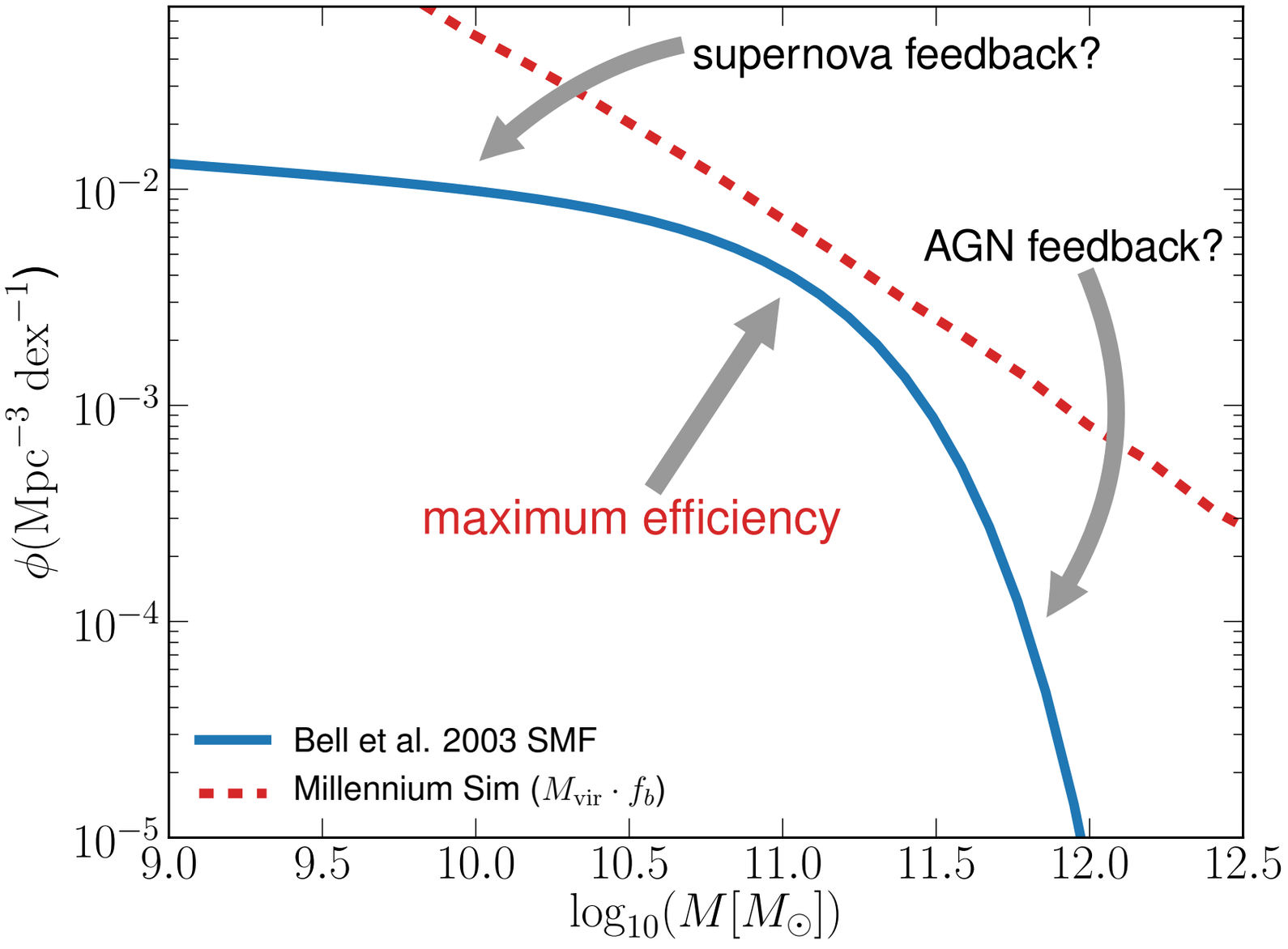

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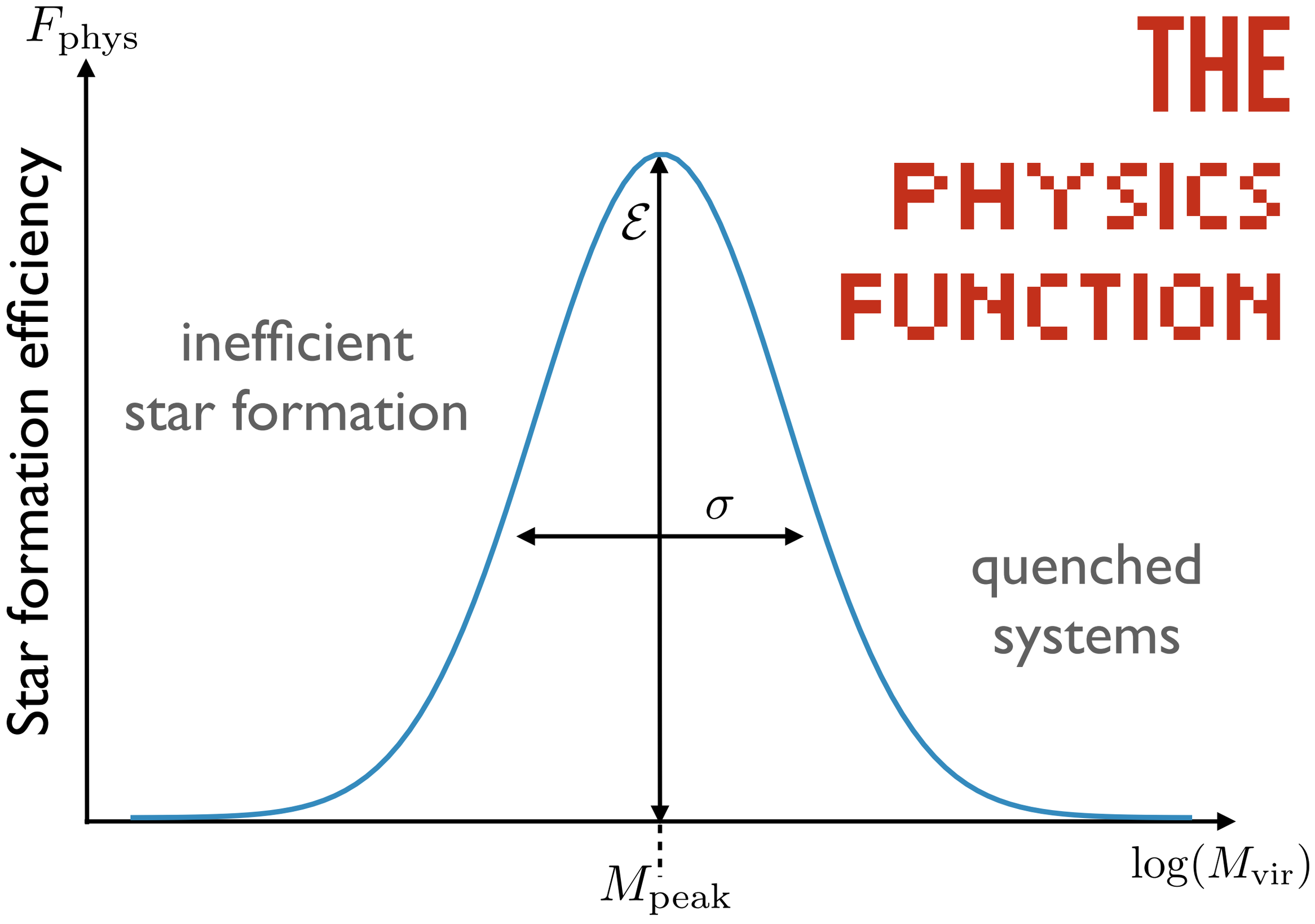

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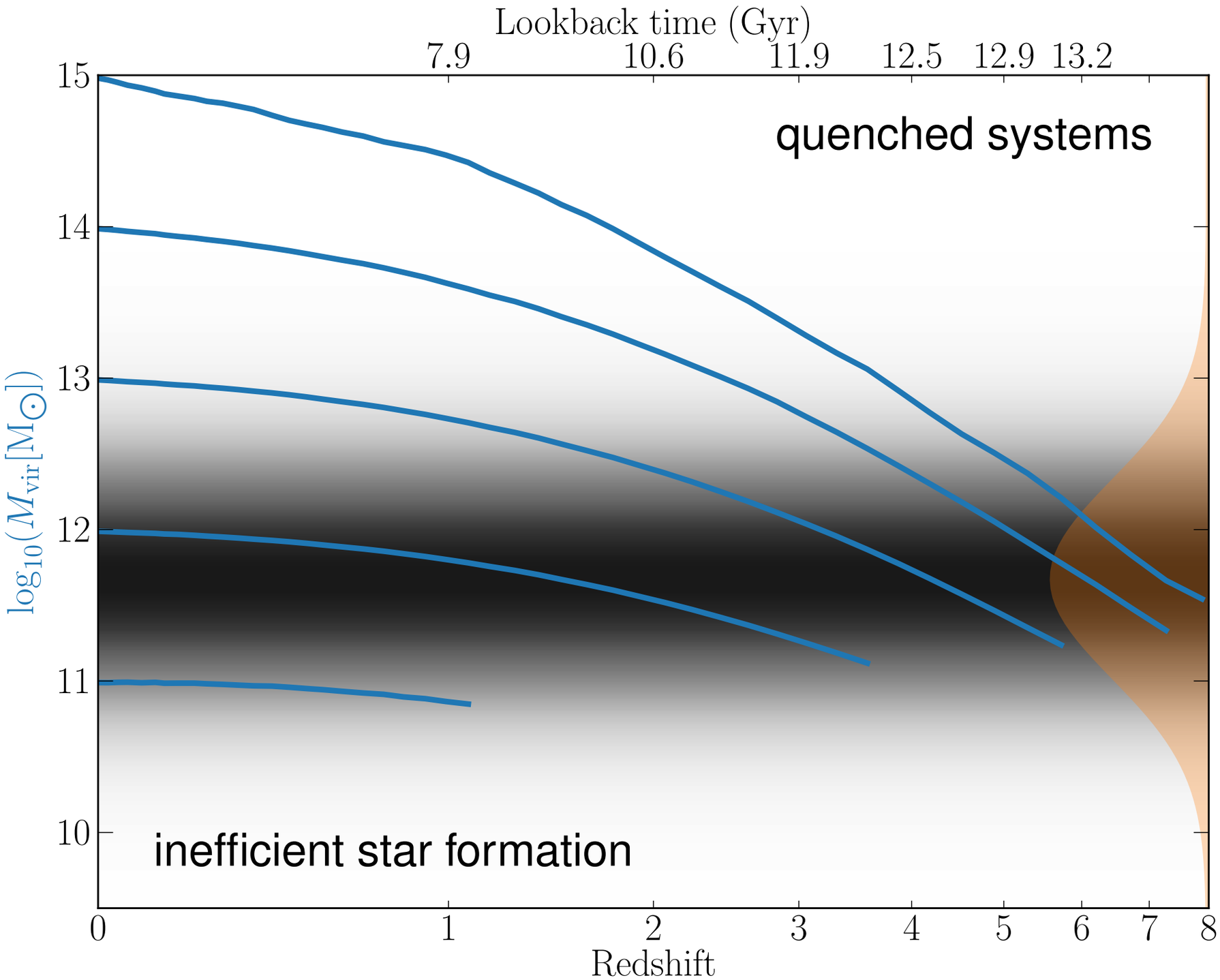
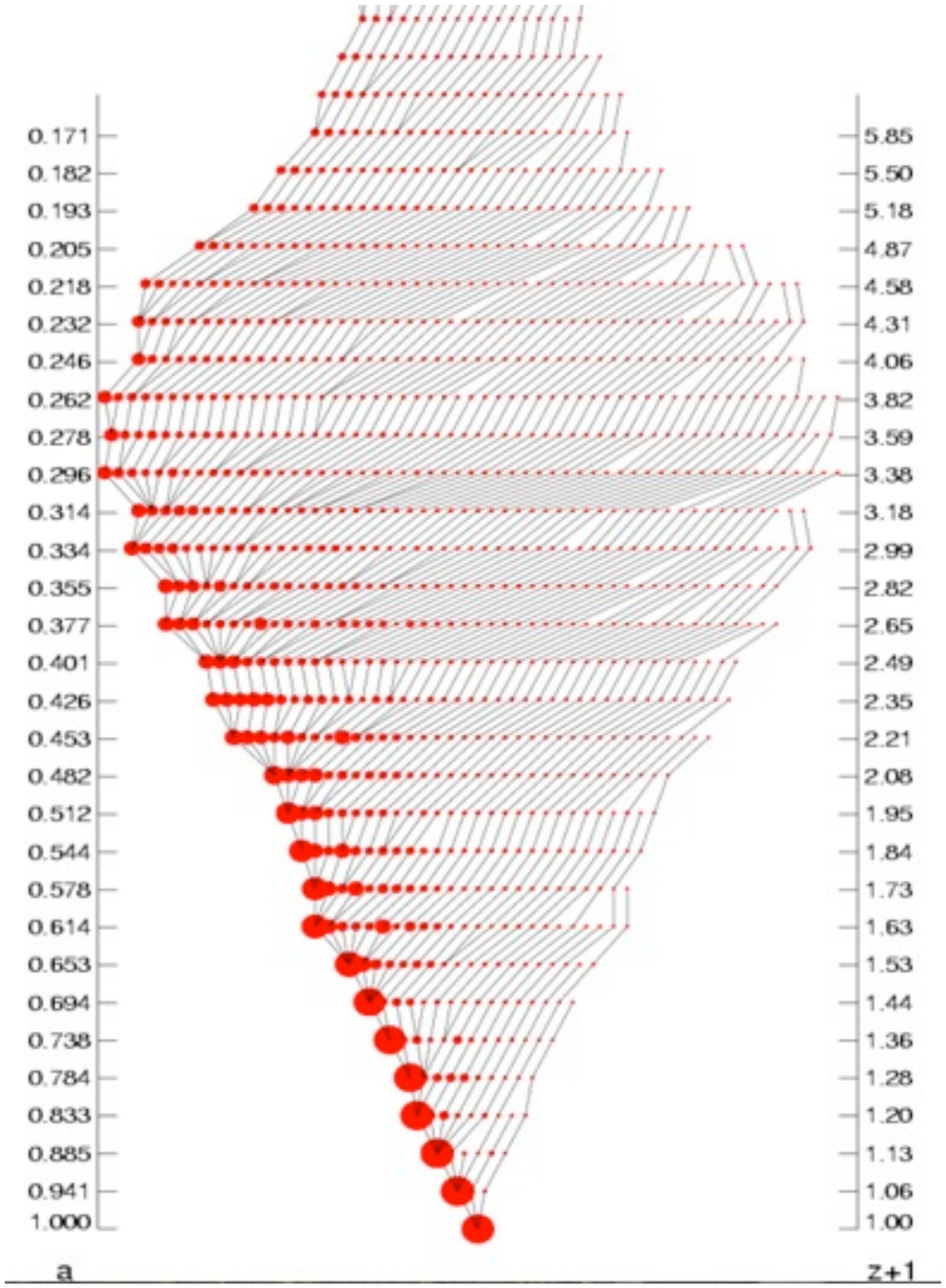


PUTTING IT ALL TOGETHER...



$$\mathrm{SFR} \equiv \dot{M}_* = F_{\mathrm{growth}} \cdot F_{\mathrm{phys}}$$

$$F_{\mathrm{growth}} = f_{\mathrm{b}} \frac{dM_{\mathrm{vir}}}{dt}$$

$$F_{\mathrm{phys}} = \mathcal{E}_{M_{\mathrm{vir}}} \exp\left(-\left(\frac{\Delta M_{\mathrm{vir}}}{\sigma_{M_{\mathrm{vir}}}}\right)^2\right)$$

SOME BASIC RESULTS...

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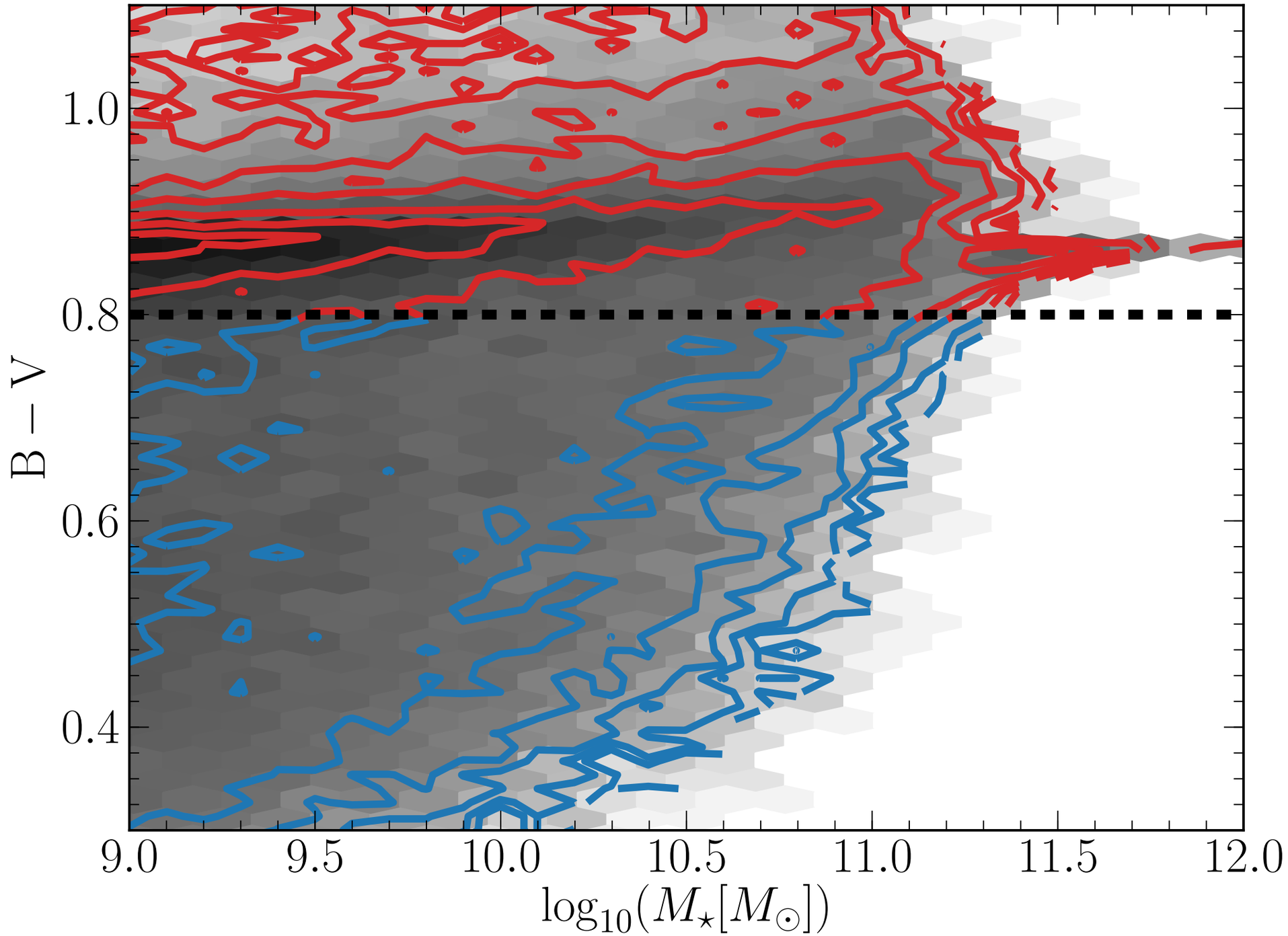

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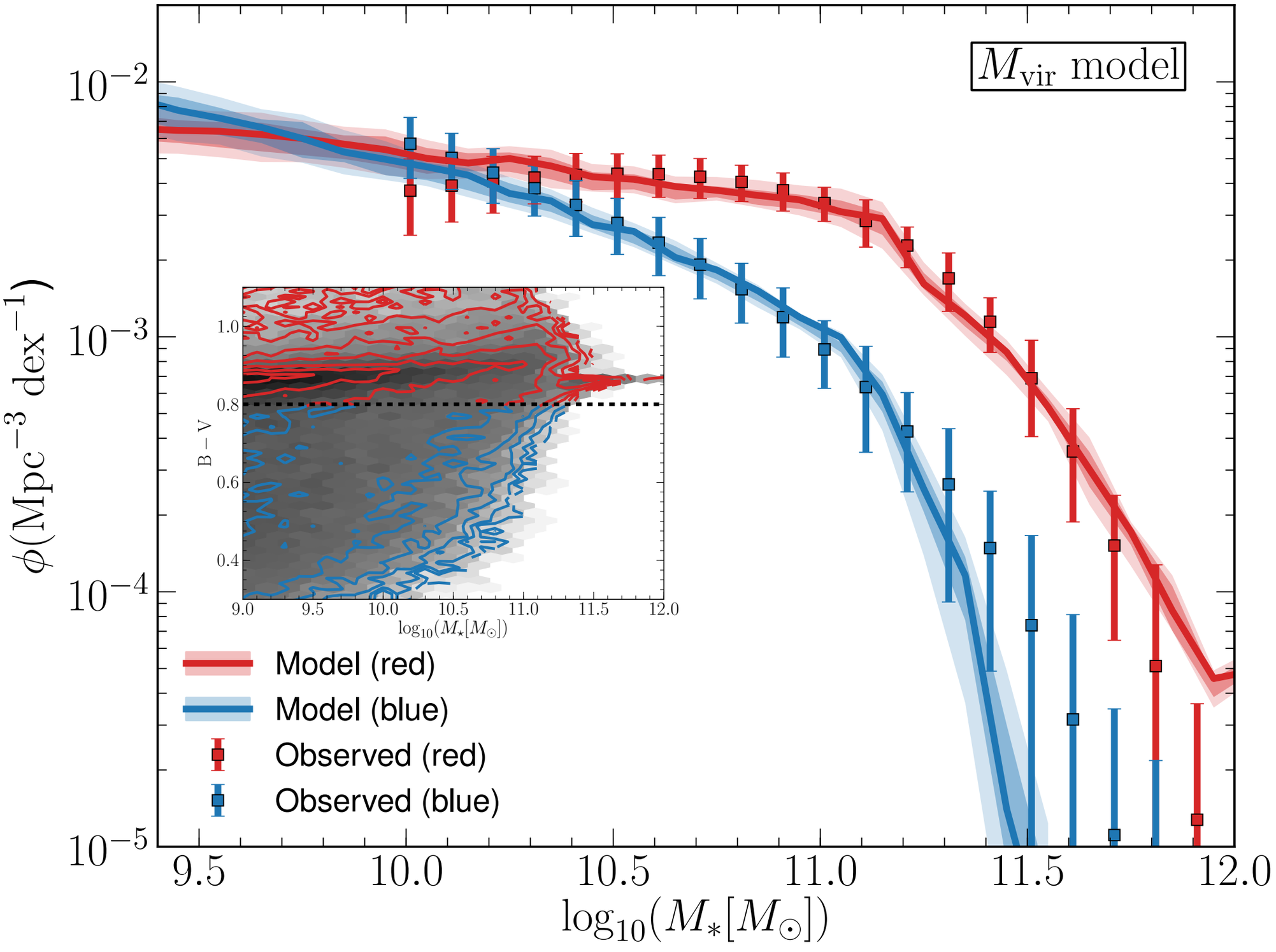

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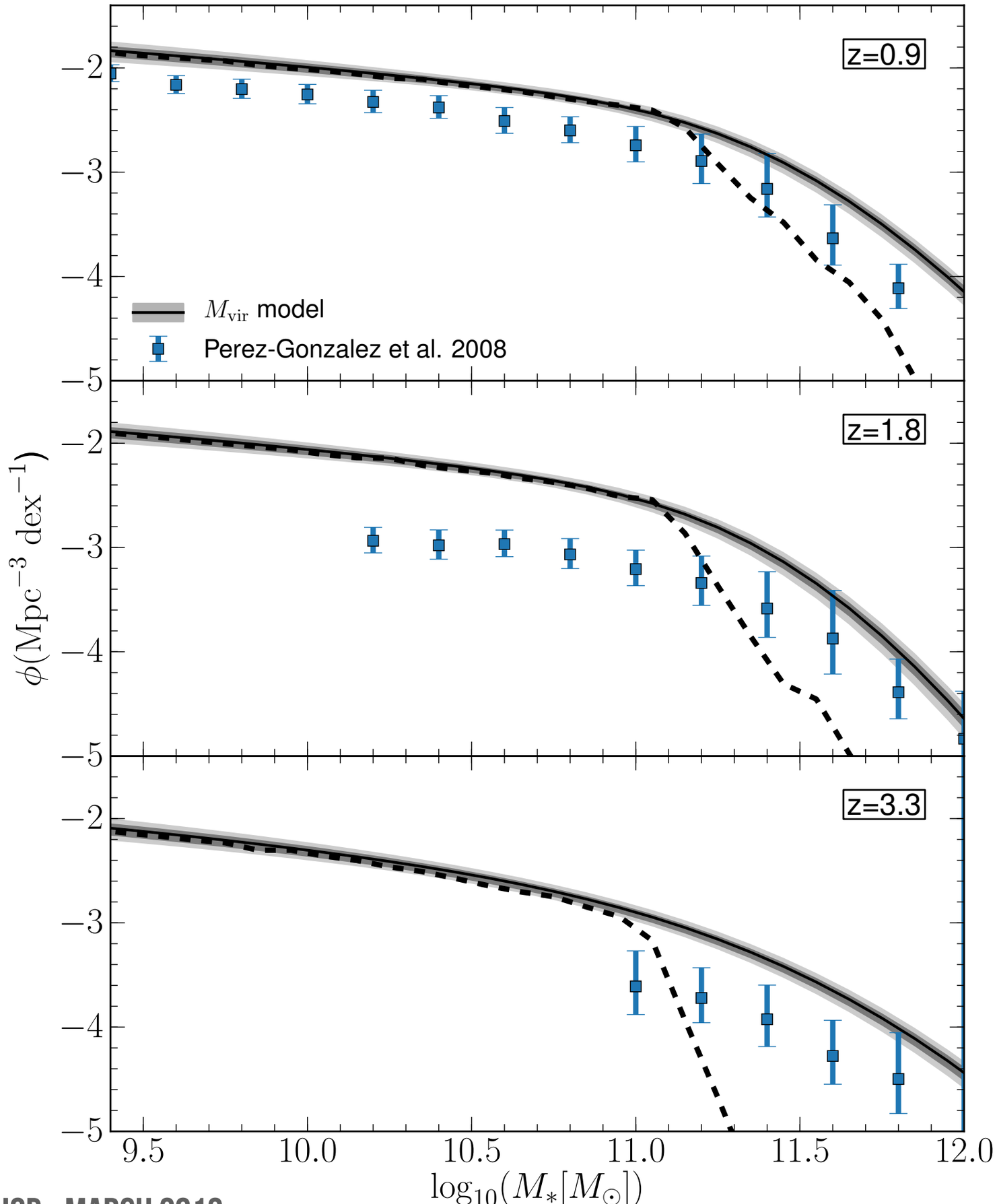

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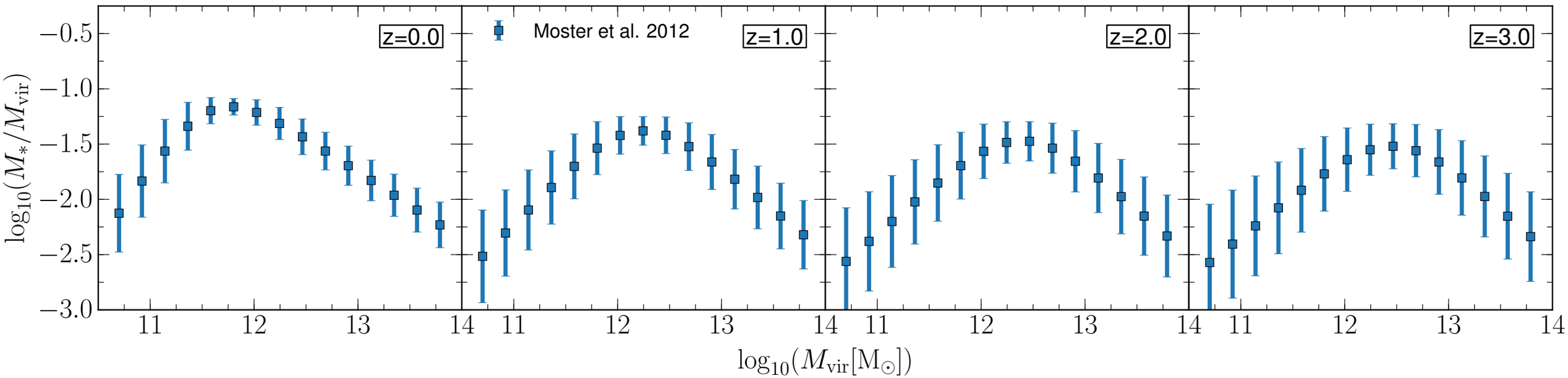

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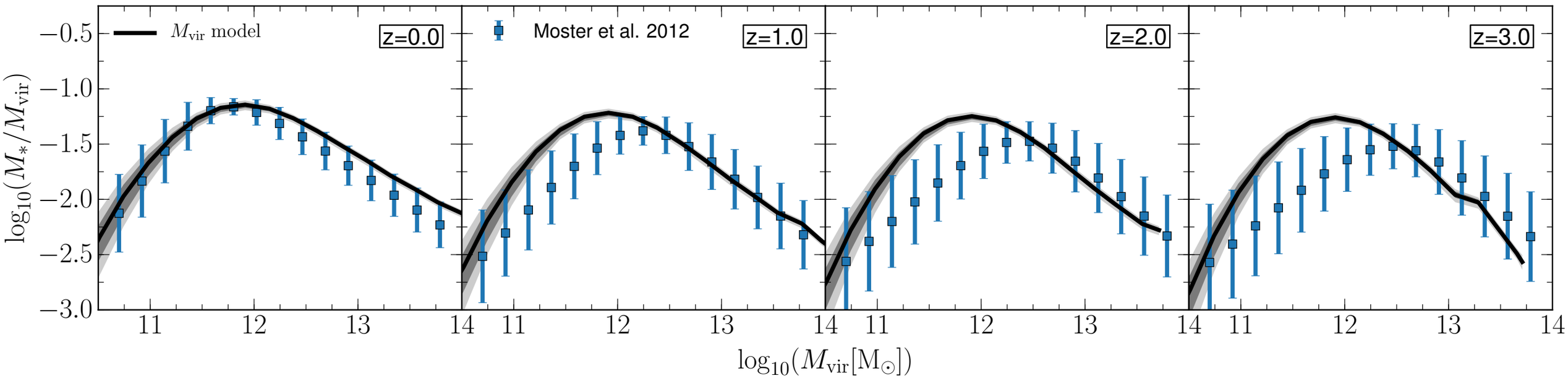
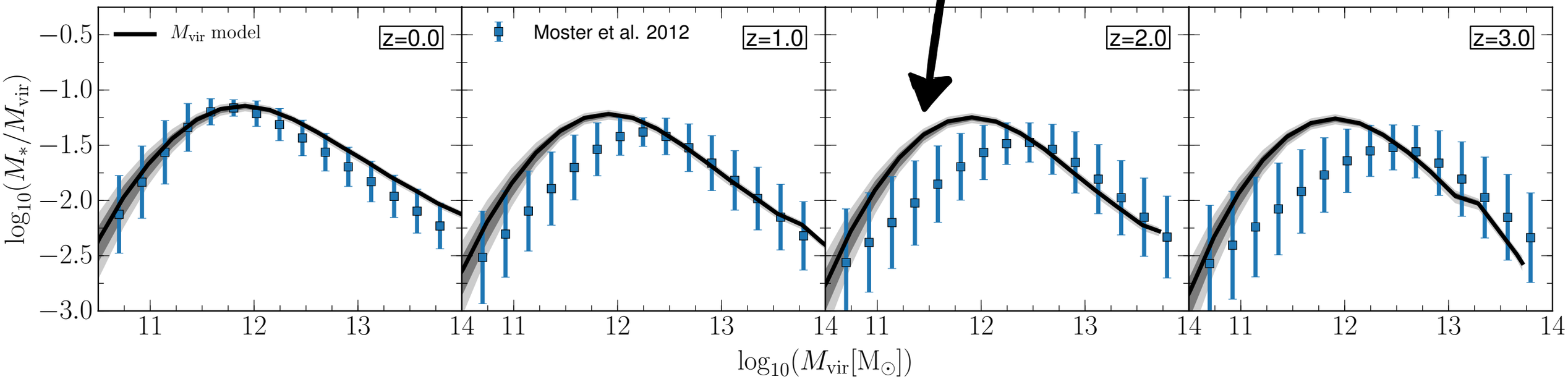


SOME BASIC RESULTS...

TOO MANY STARS IN LOW MASS HALOS



EVOLUTION

$$
\begin{aligned}
\log_{10}(M_{\rm peak}(z)) &= \log_{10}(M_{\rm peak}) \cdot (1+z)^{\alpha_{M_{\rm vir}}} \ , \\
\sigma_{M_{\rm vir}}(z) &= \sigma_{M_{\rm vir}} \cdot (1+z)^{\beta_{M_{\rm vir}}} \ , \\
\mathcal{E}_{M_{\rm vir}}(z) &= \mathcal{E}_{M_{\rm vir}} \cdot (1+z)^{\gamma_{M_{\rm vir}}} \ .
\end{aligned}
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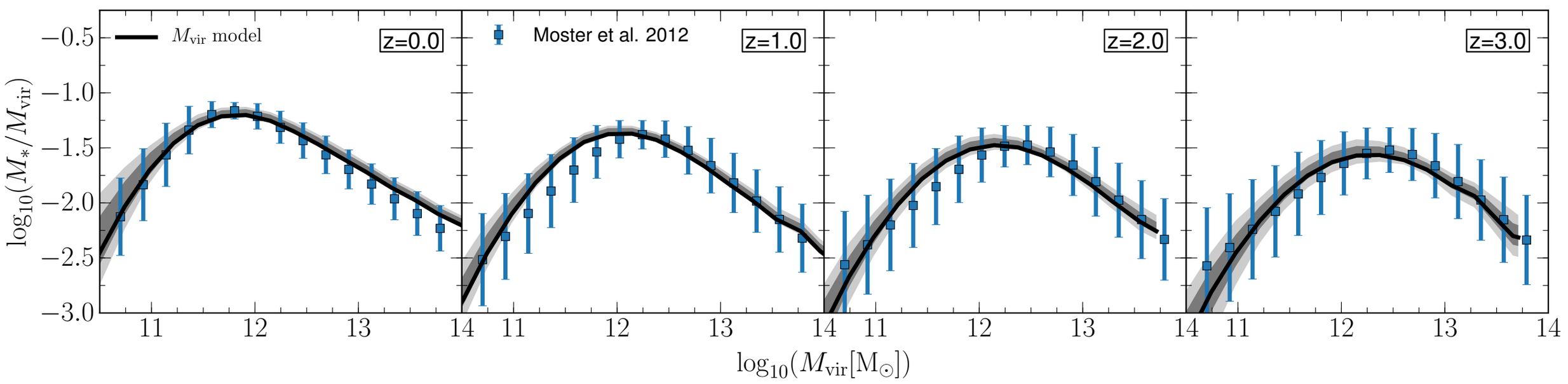

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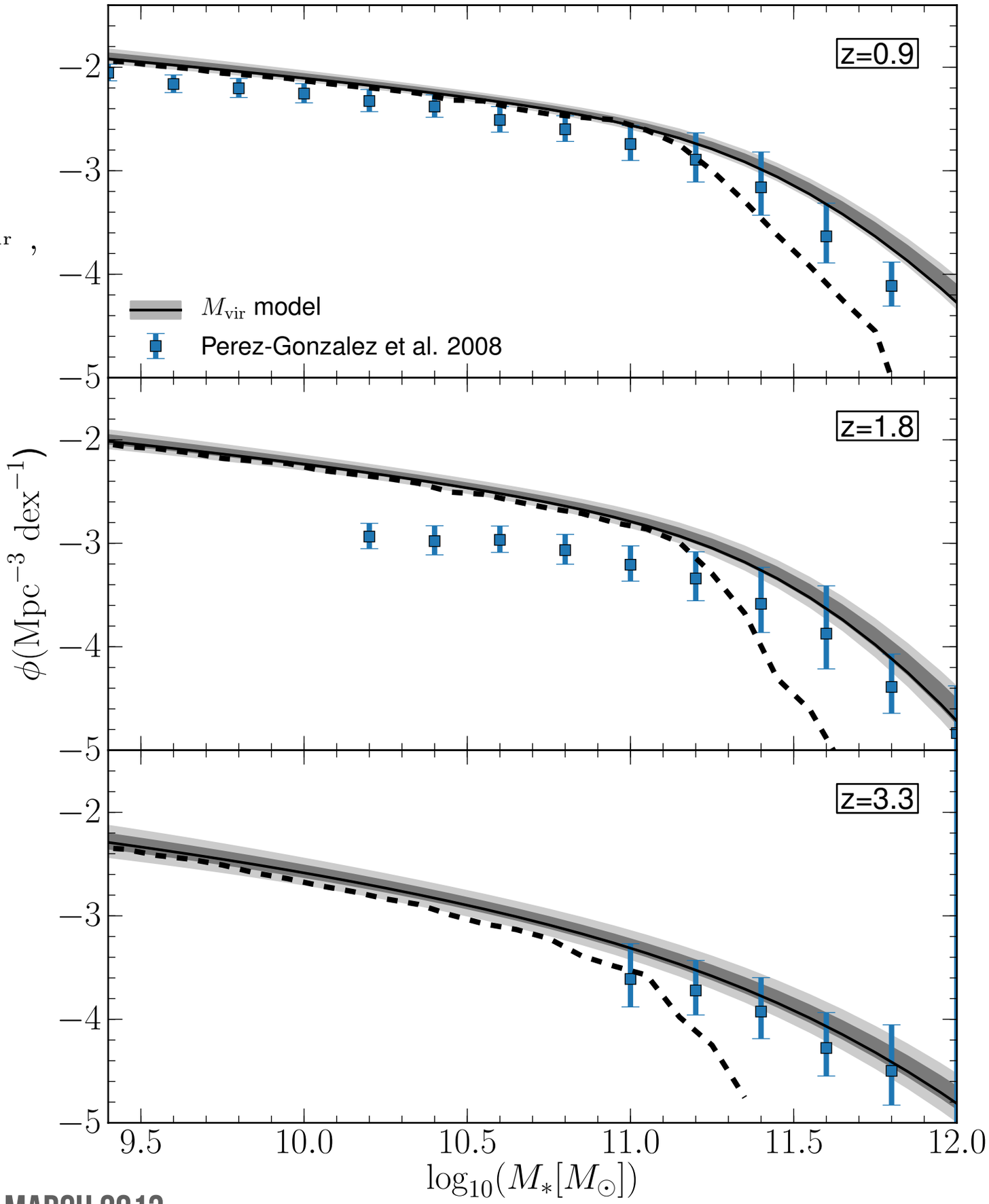

WHAT ELSE CAN WE DO WITH IT?

- **Statistically constrained** catalogues
  - Access to full **formation histories**
- Comparing effects of **dark matter treatment** on galaxy populations
- **Testing general theories** e.g. monolithic collapse, ICL, L_{QSO} vs. SFR, etc.

A FORMATION HISTORY MODEL OF GALAXY GROWTH

- **physically motivated**
  (halo growth ➡ stellar mass growth)
- simple
  $(\dot{M}_* = F_{\mathrm{growth}} \cdot F_{\mathrm{phys}})$
- **adaptable**
- **useful!**
  (fast + provides stellar mass histories, SFRs, colours, ...)