LOUIS LEGRAND

H. J. McCRACKEN, M. DOUSPIS, N. AGHANIM

STELLAR TO HALO MASS RELATION
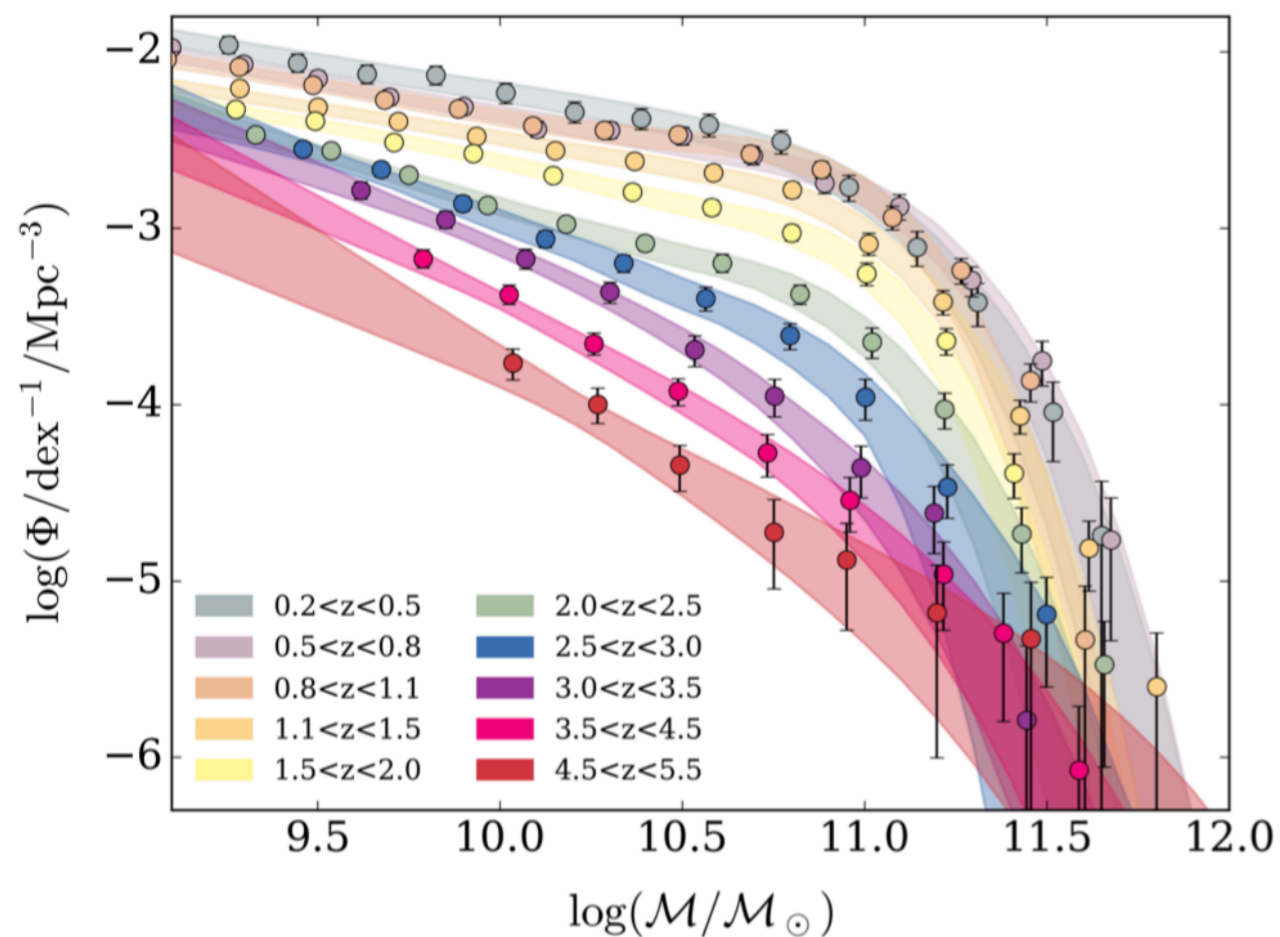
GALAXIES AND DARK MATTER

Silk & Mamon 2012

STELLAR TO HALO MASS RELATION

▸ What is the link between the stellar content and the dark matter halo of galaxies ?

  ▸ How is the galaxy stellar mass related to the dark matter halo mass ?

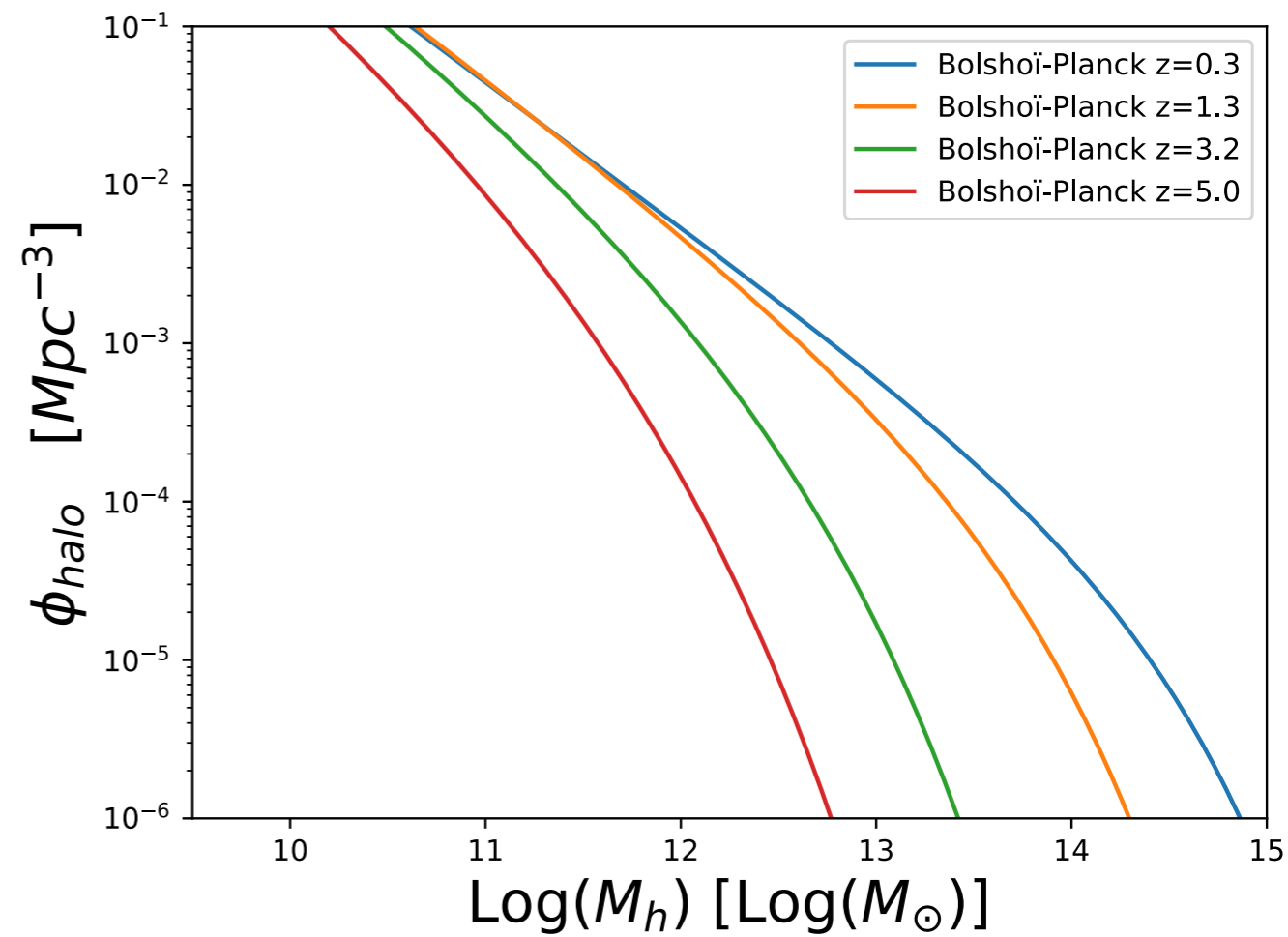 ▸ Did the stellar-to-halo mass relation evolve with time ?

MASS FUNCTIONS

Stellar mass function:
COSMOS Field

Halo mass function:
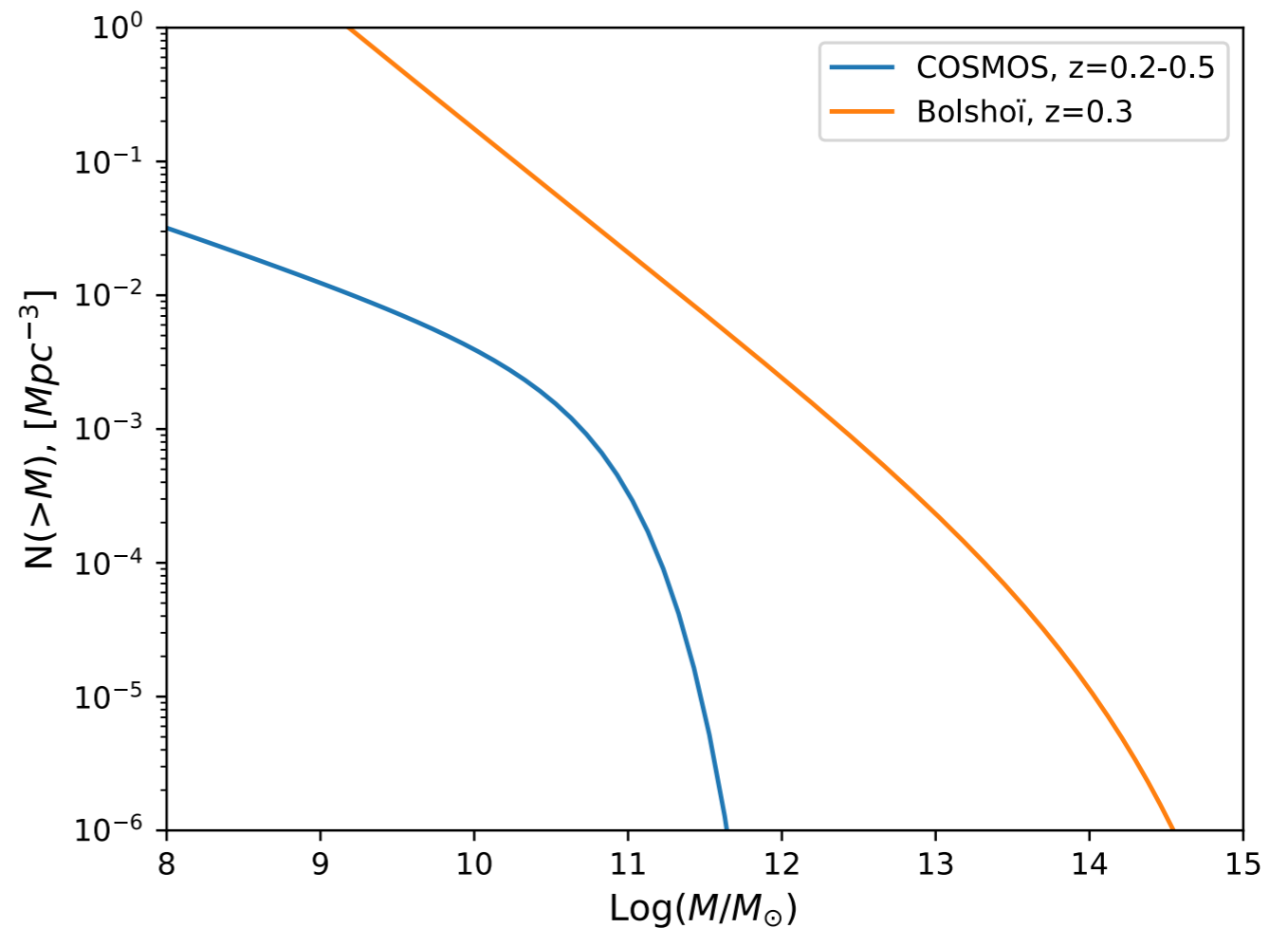Bolshoï DM only simulation

Davidzon et al. 2017

Behroozi, 2013b

ABUNDANCE MATCHING TECHNIQUE

▸ Hypotheses :

    ▸ Halos contain only one galaxy.

    ▸ The most massive galaxies are in most massive halos, etc.

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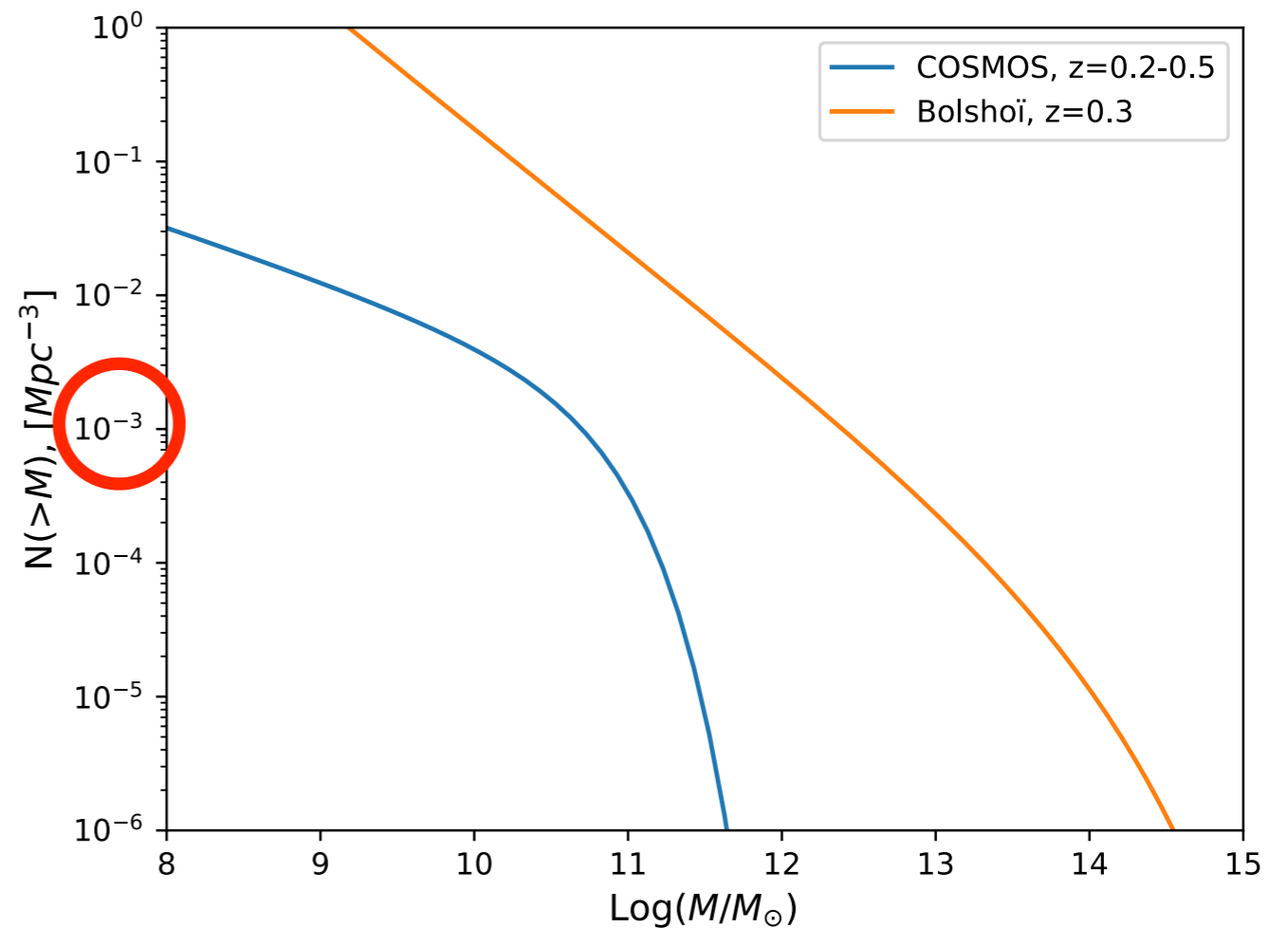# ABUNDANCE MATCHING TECHNIQUE

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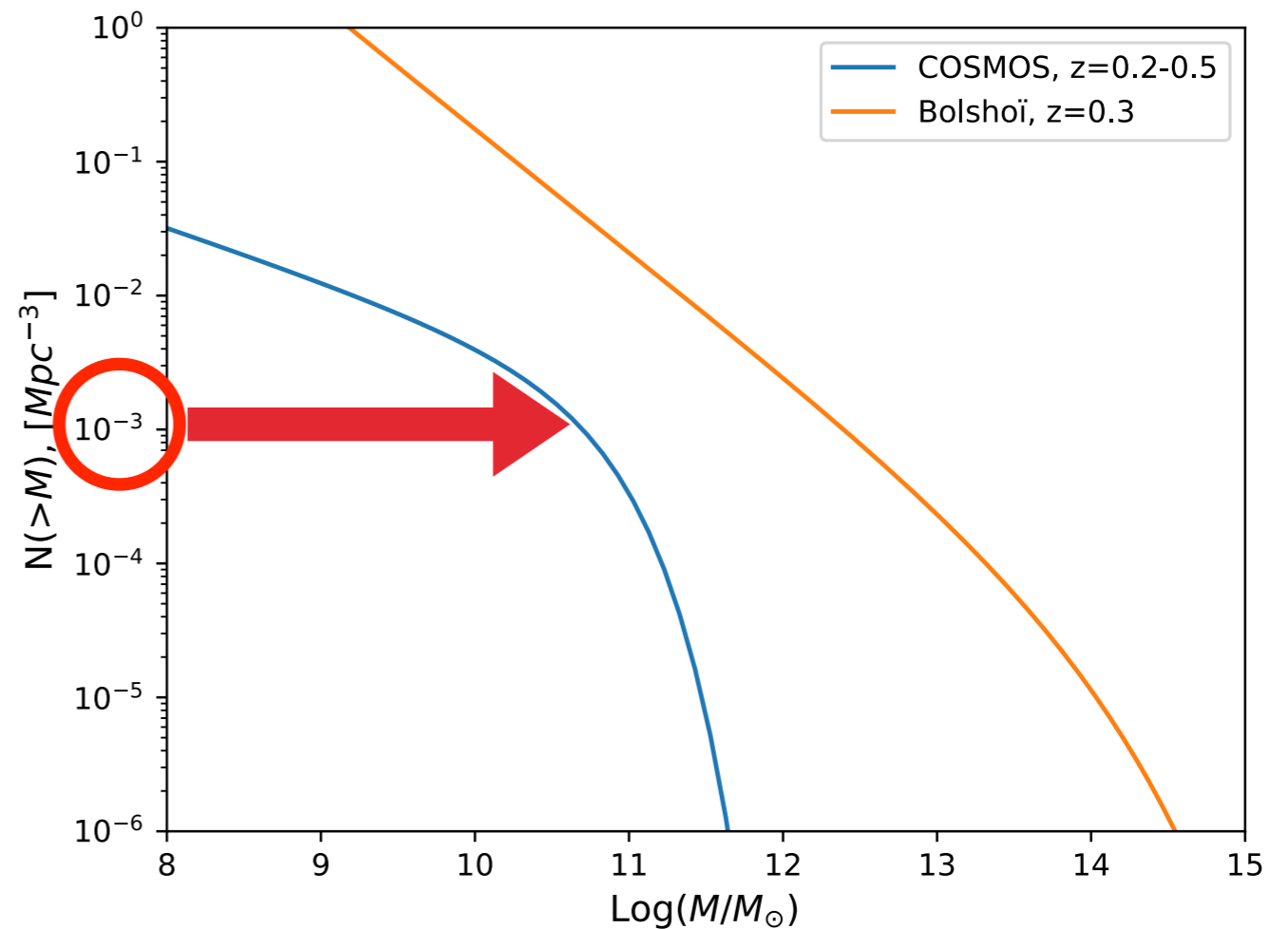   ▸ The most massive galaxies are in most massive halos, etc.

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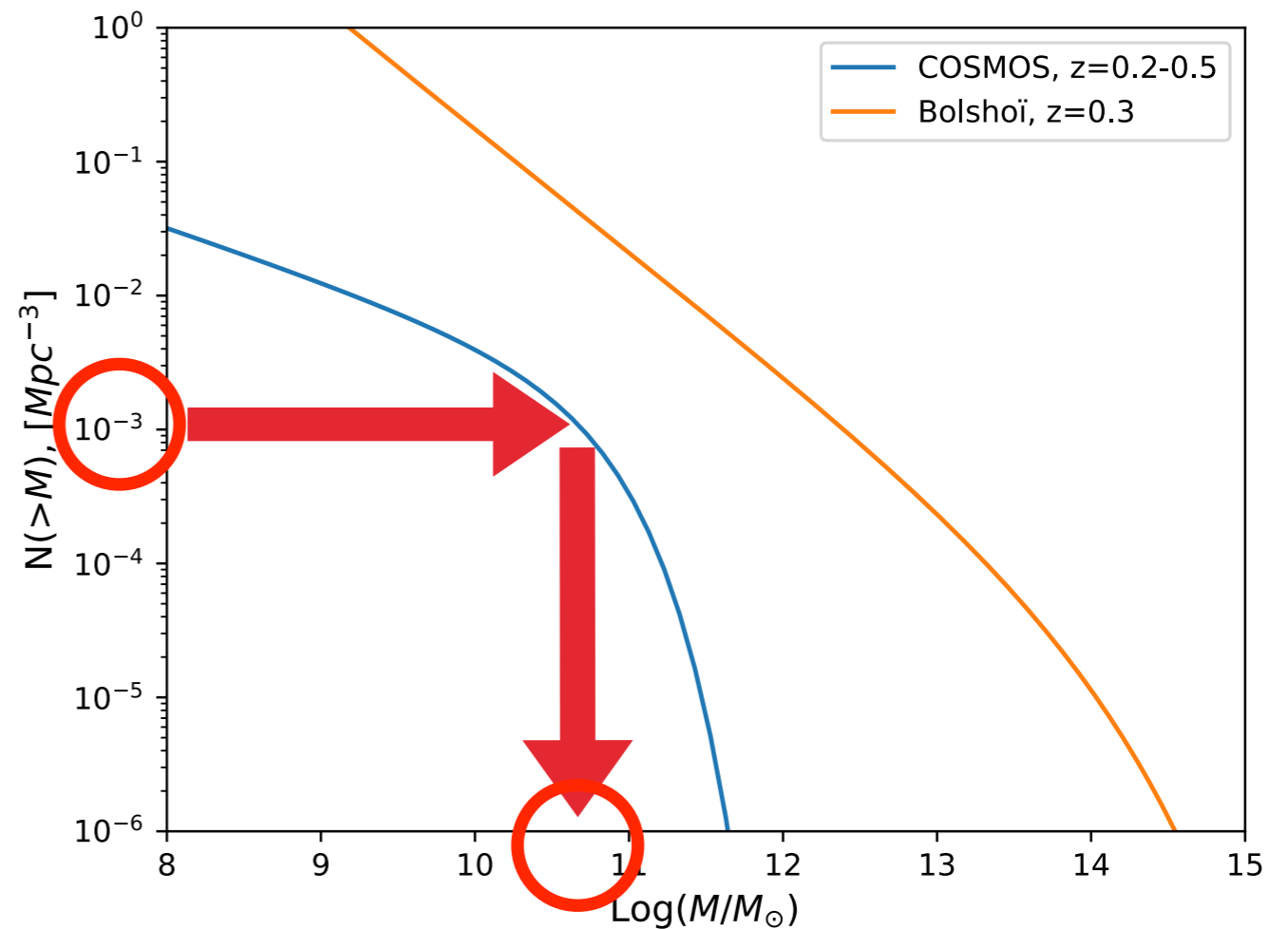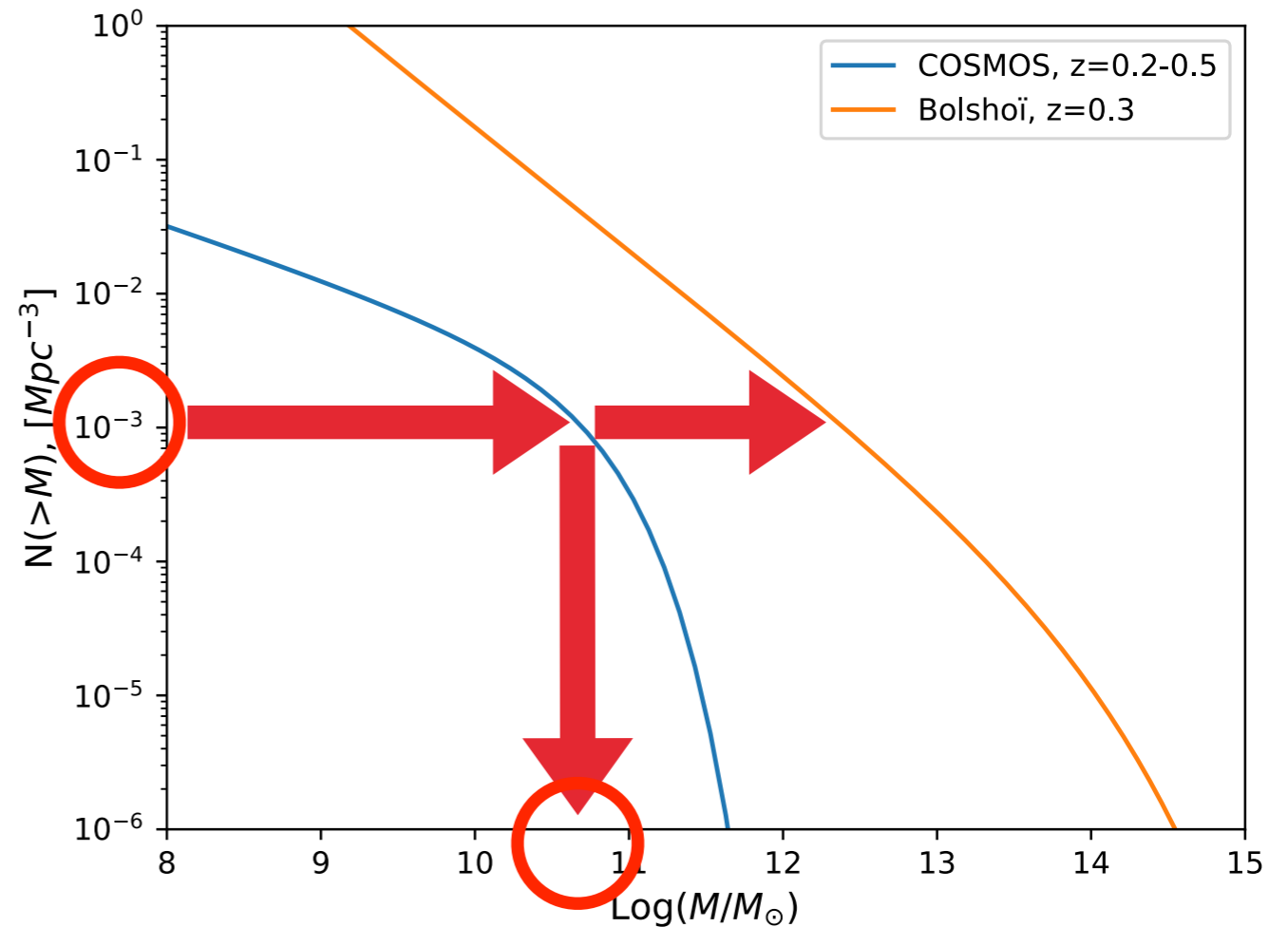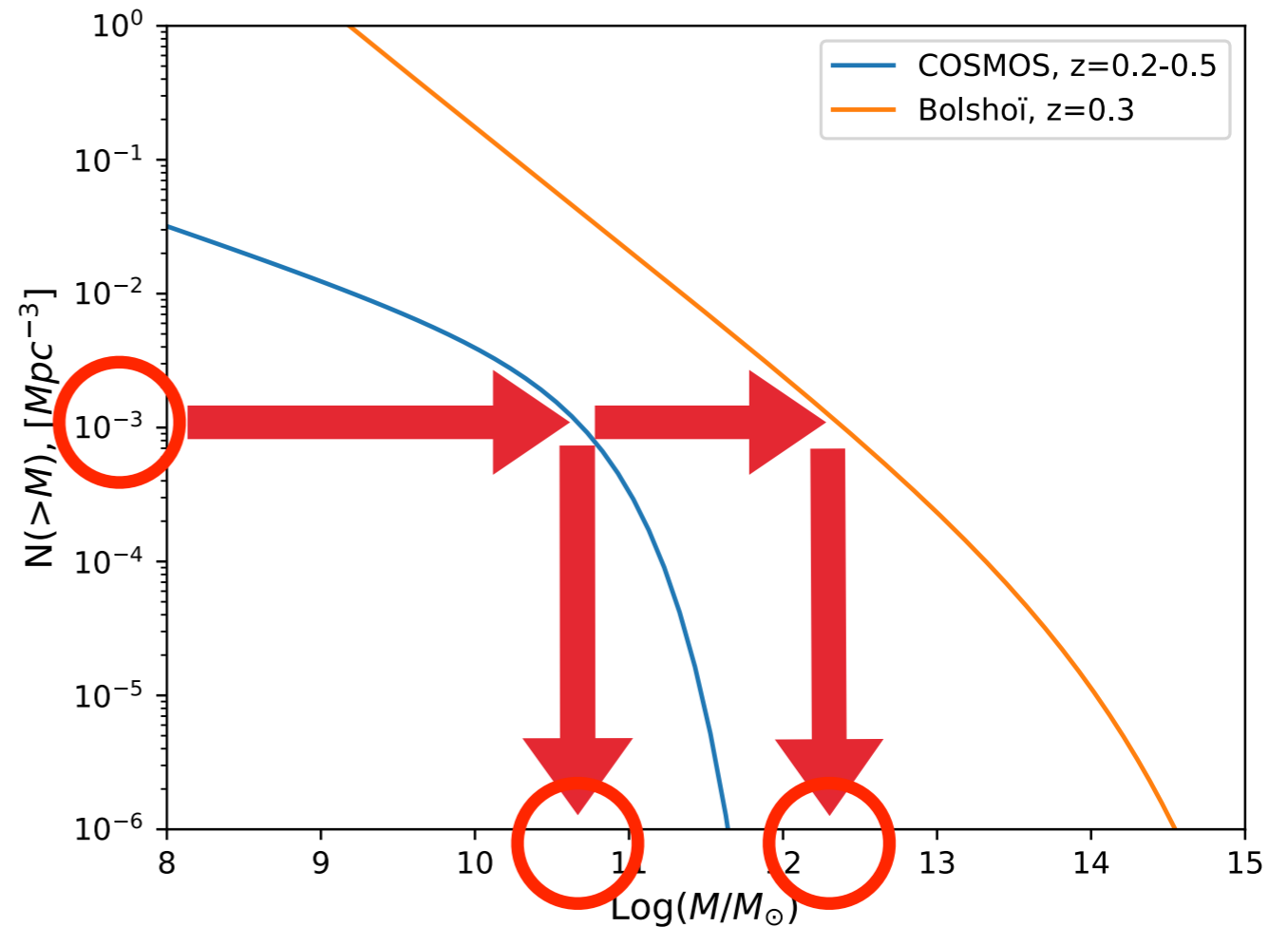
Stellar mass   Dark matter mass

STELLAR TO HALO MASS RELATION

$$\log_{10}(M_h) = \log_{10}(M_1) + \beta\log_{10}\left(\frac{M_*}{M_{*,0}}\right) + \frac{\left(\frac{M_*}{M_{*,0}}\right)^{\delta}}{1 + \left(\frac{M_*}{M_{*,0}}\right)^{-\gamma}} - \frac{1}{2}$$

Abundance matching hypotheses give :

Behroozi et al. 2010

$$\phi_* = \phi_h \frac{d\log_{10}(M_h)}{d\log_{10}(M_*)}$$

MCMC with :

- ▸ 5 free parameters
- ▸ 10 bins in redshift
- ▸ 2 HMF (Bolshoï simulation and Tinker et al. 2008)

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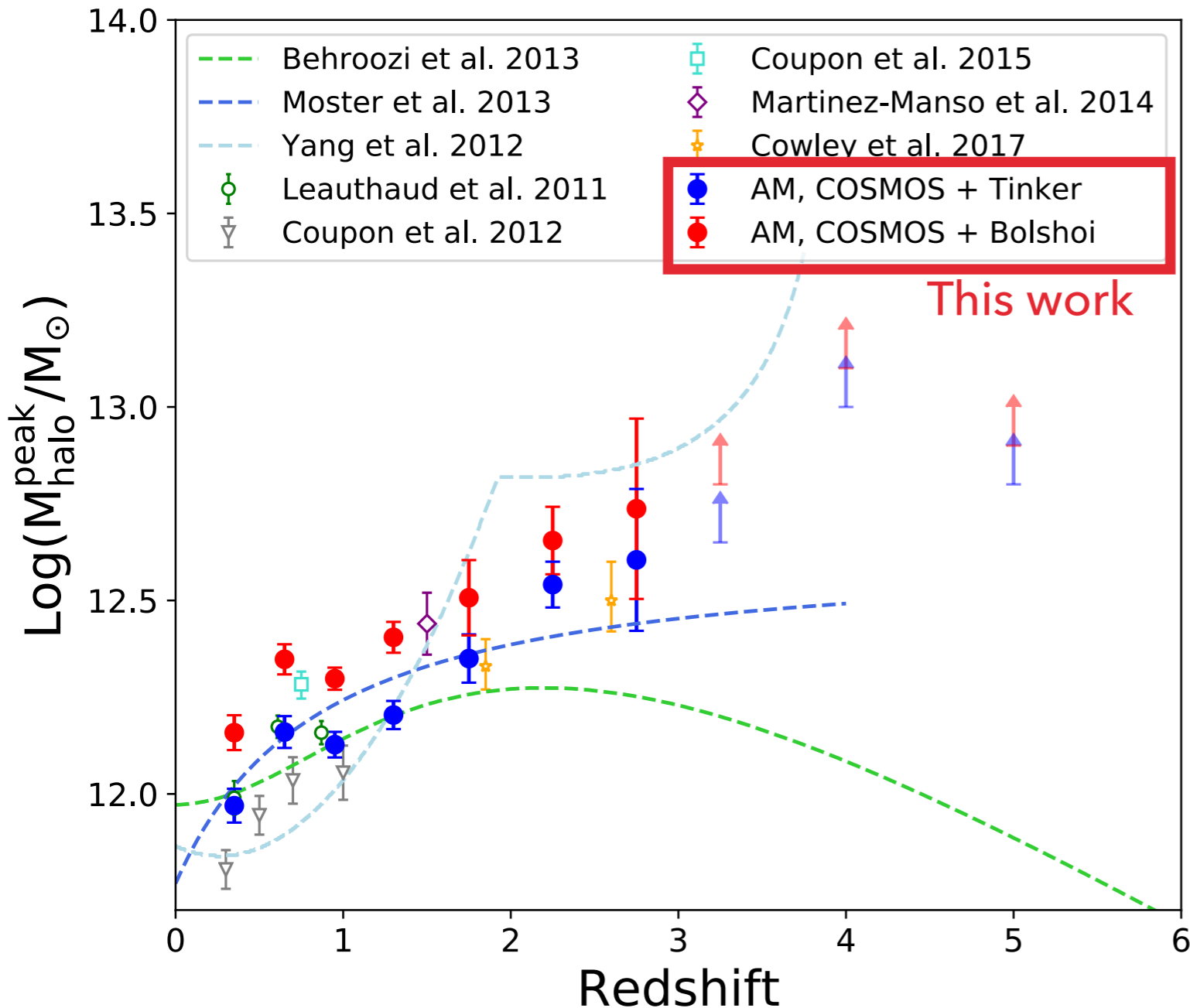
RESULTS

Legrand, McCracken et al. in prep.

RESULTS

EVOLUTION OF PEAK HALO MASS

- ▸ First study using only one survey from z~0 to 5.

- ▸ No peak for z > 3.

- ▸ Vary with the HMF.
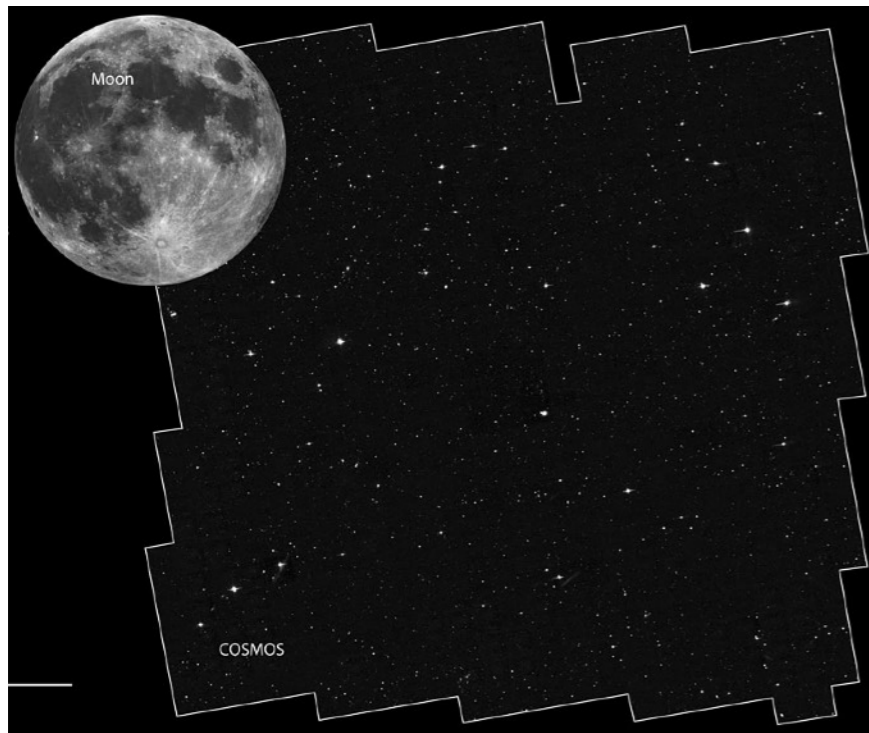
- ▸ Halo downsizing : Peak Halo Mass decreases with time.

Legrand, McCracken et al. in prep.
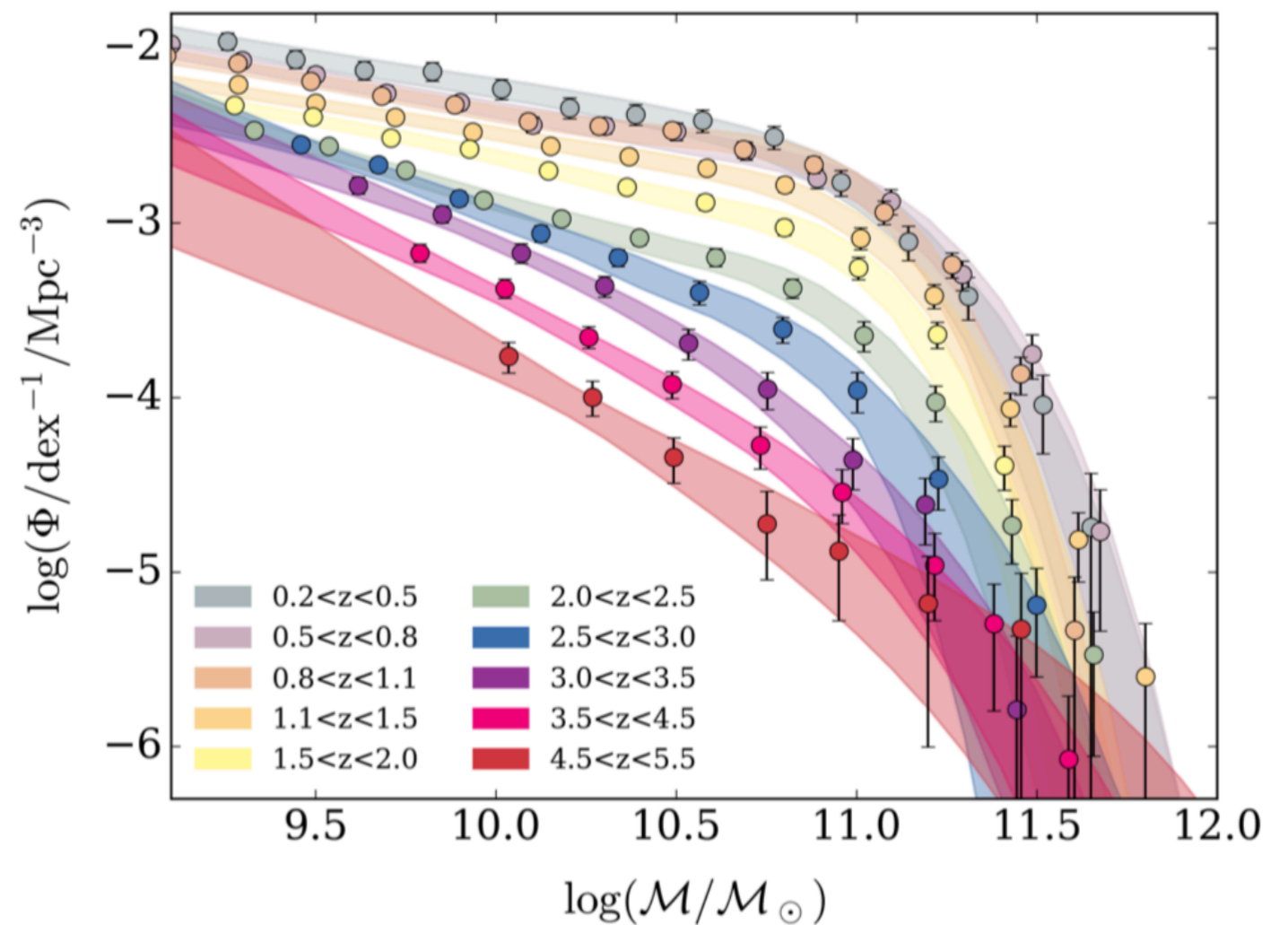
THANK YOU FOR YOUR ATTENTION

BACKUP SLIDES

2. OBSERVATIONS – THE COSMOS FIELD

▸ The Cosmos field :
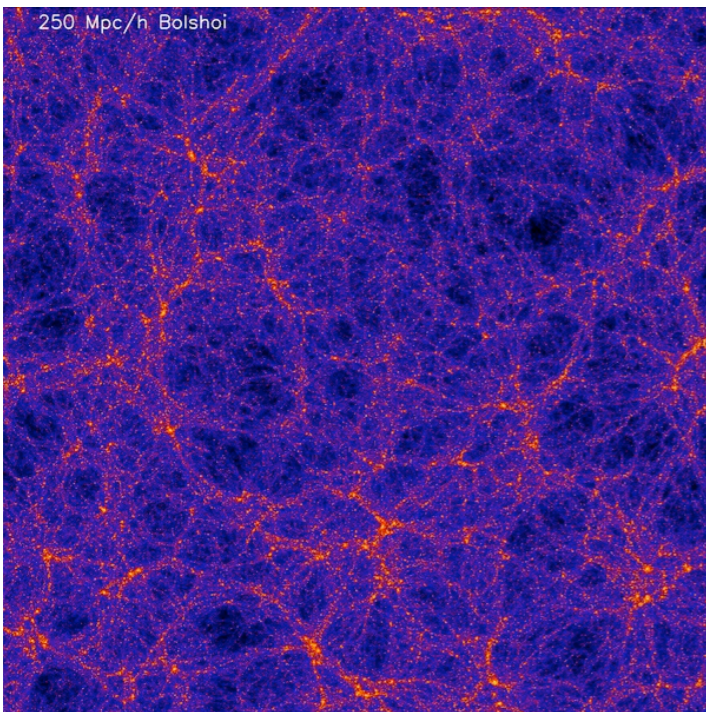
  ▸ 2 deg²

  ▸ +500 000 galaxies
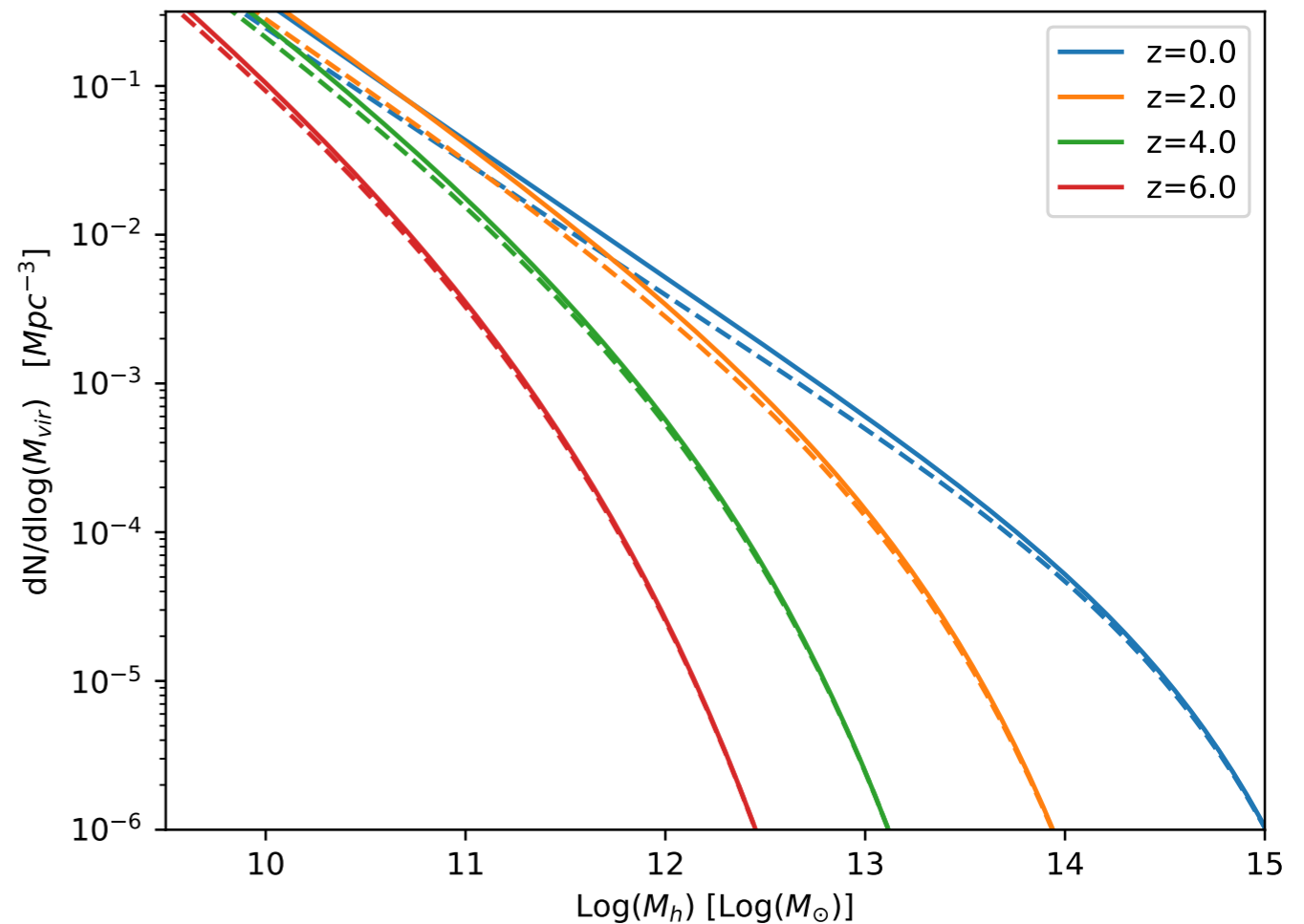
  ▸ 0<z<6

▸ Stellar mass function

Davidzon et al. 2017

NASA, ESA

2. SIMULATIONS – BOLSHOÏ

▸ The Bolshoï simulation :

  ▸ Dark matter only

  ▸ (250 Mpc/h)^3

  ▸ 8.10^9 particules

  ▸ Resolution 5.10^{10} h^{-1} M$_\odot$
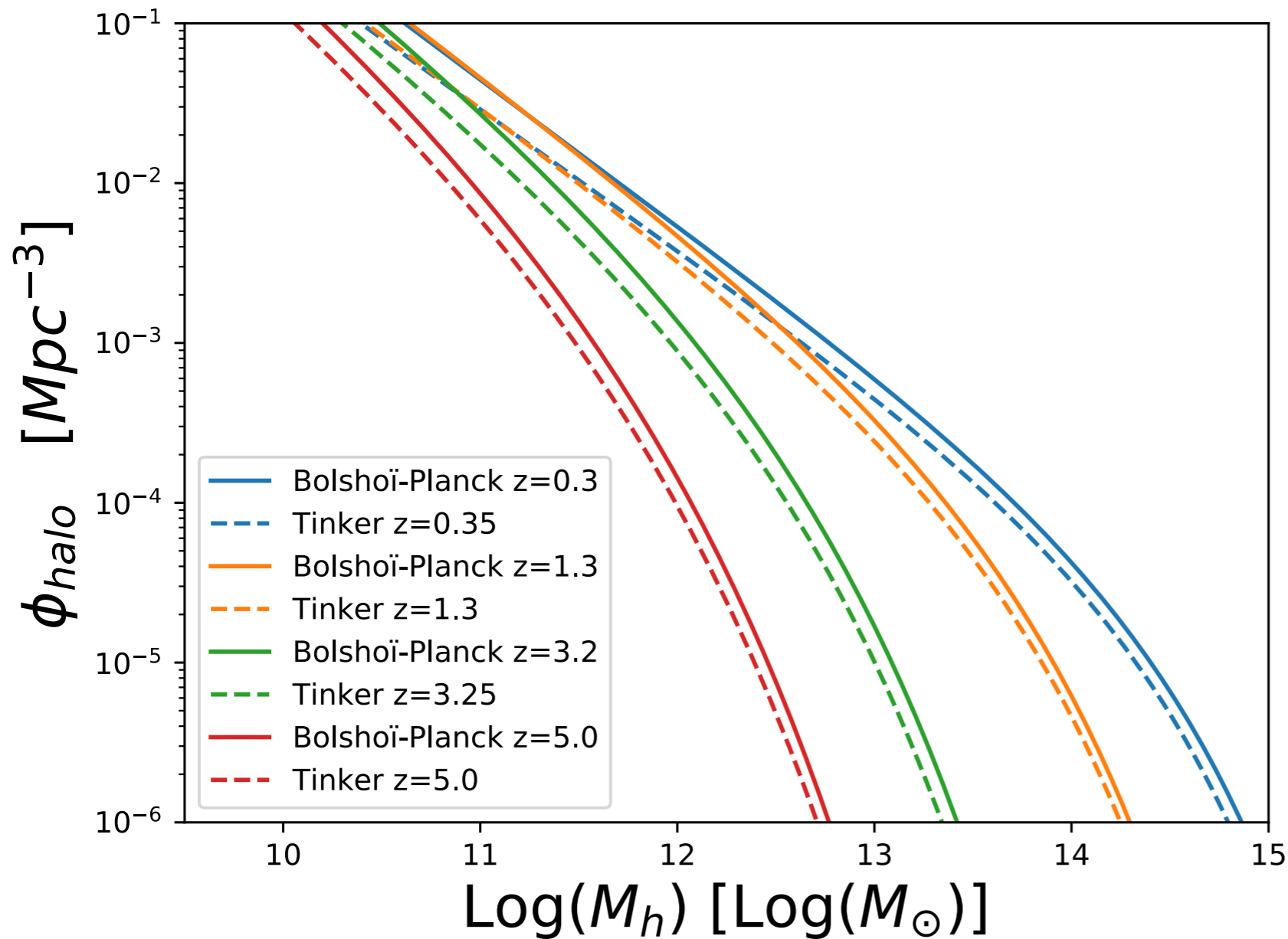
▸ Halo mass function

250 Mpc/h Bolshoi

Kyplin et al. 2011

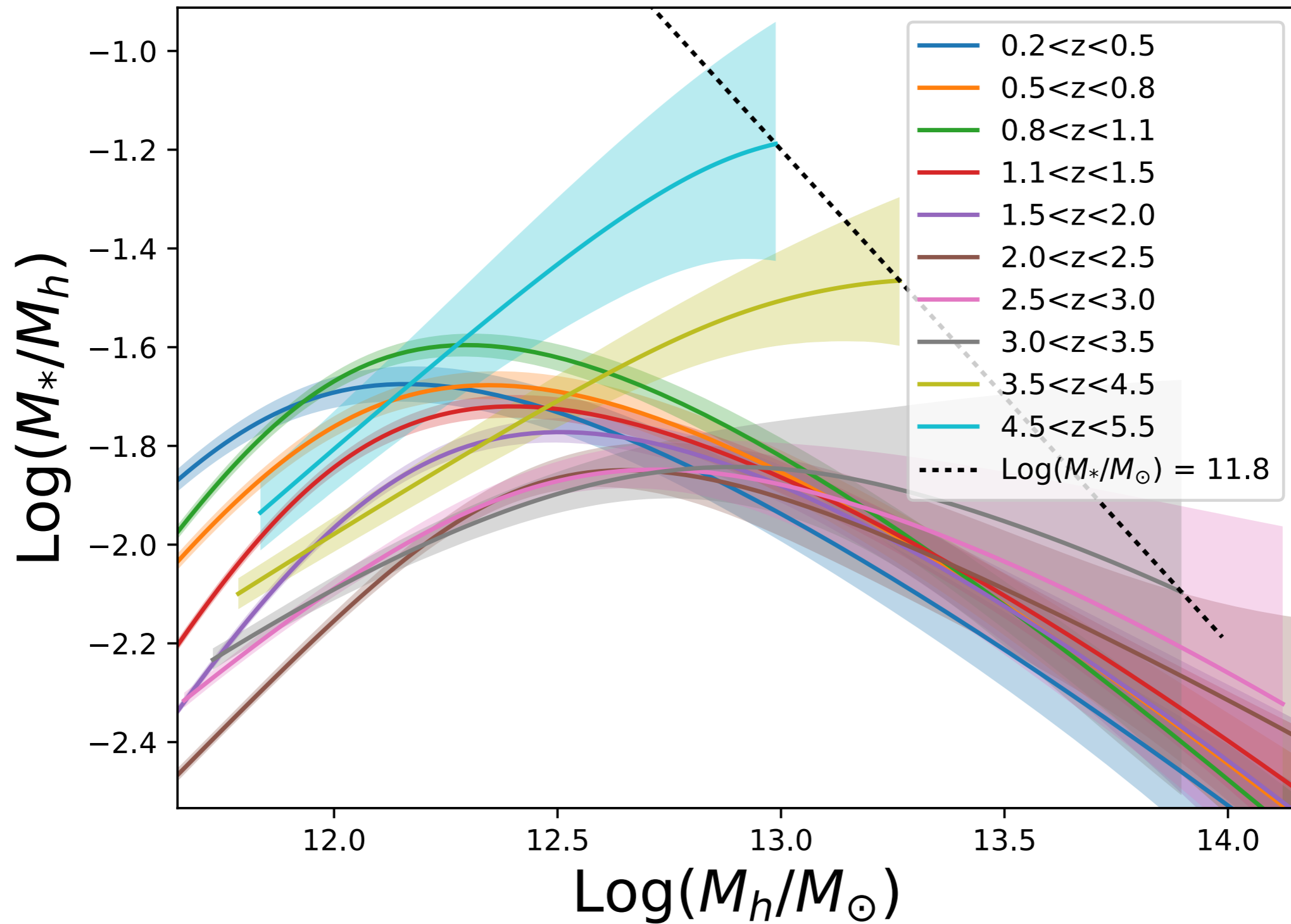Dashed lines for central halos and solid lines are for both satellite and central halos

Behroozi, priv. comm.

TINKER AND BOLSHOI HMF

▸ Tinker et al. 2008 HMF computed from simulations and then rescaled to the Planck Cosmology.

▸ Bolshoï HMF is a fit of Tinker HMF on a DM only simulation with Planck parameters.

RESULTS

SHMR

SHMR Cosmos / Bolshoi
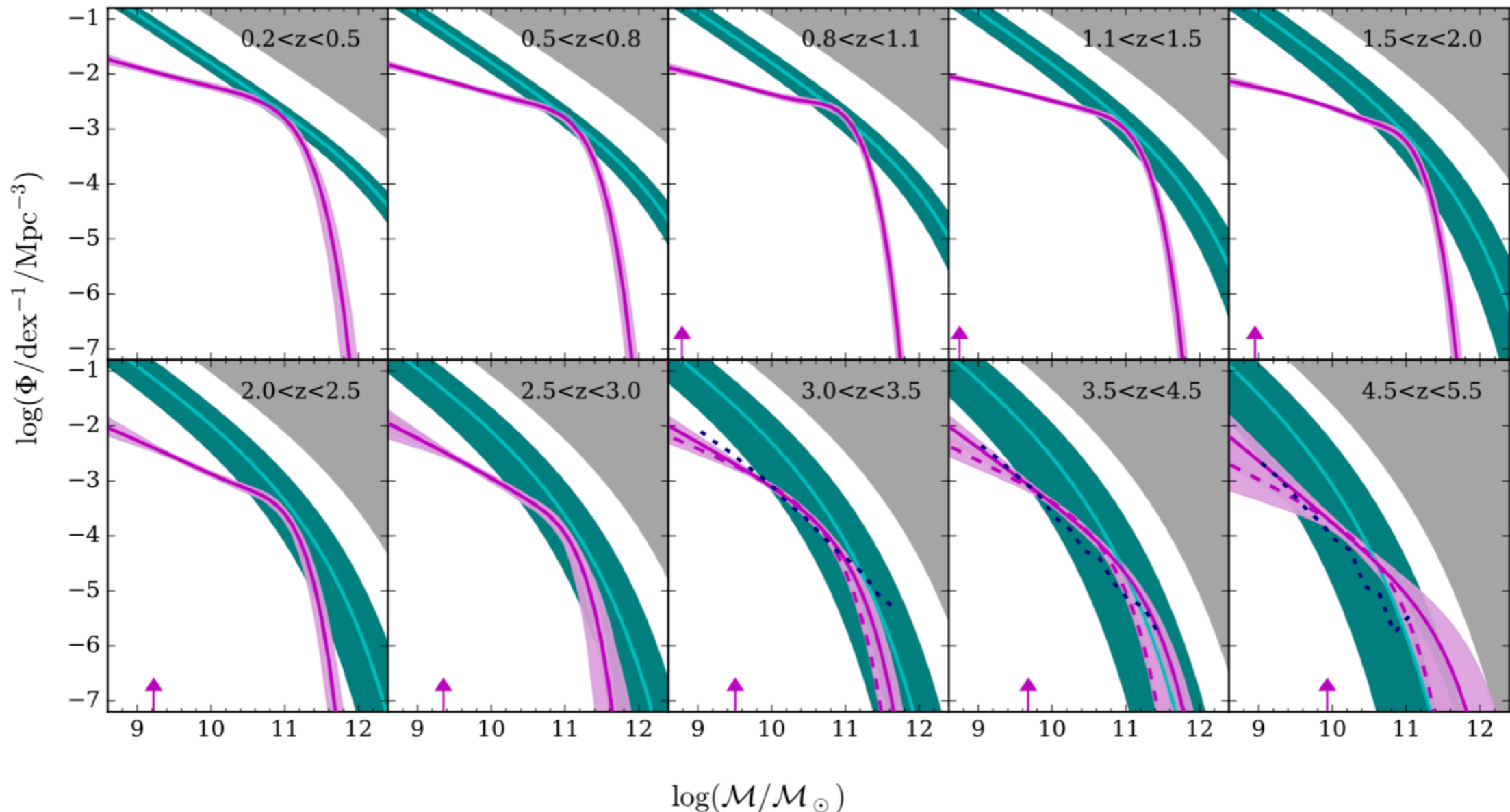
DAVIDZON ET AL. 2017

Fig. 18. Evolution of HMF (cyan line) vs. SMF (magenta) from $z = 0.2$ to 5.5. In each panel halo mass is multiplied by a factor 0.018, that is, the SHMR at $z = 0$ and $\mathcal{M}_h = \mathcal{M}_h^\star$ (according to Behroozi et al. 2013). Shaded cyan regions show the uncertainties in the HMF shift by taking the 1σ error of the SHMR parametrisation. At $z > 2.5$, the solid magenta line is our fiducial fit of the SMF, while the dashed magenta line is the Schechter function with $\log(\mathcal{M}_\star/\mathcal{M}_\odot)$ fixed to 10.6 (see Fig. 8). The shaded magenta regions combine the 1σ CL of the two fits, to give a conservative estimate of the uncertainties. A grey shaded area highlights the "forbidden region" where, according to the Ω_b/Ω_m ratio, no galaxies are expected. Black dotted lines at $z > 3$ are the SMFs predicted from the semi-analytical model of Garel et al. (2016), converted to the IMF of Chabrier (2003).

SCATTER IN STELLAR MASS

$$\log_{10}(\phi_{\mathrm{conv}}) \approx \log_{10}(\phi_{\mathrm{th}}) + \frac{\xi^2}{2}\ln(10)\left(\frac{\mathrm{dlog}_{10}(\phi_{\mathrm{th}}(\mathrm{M}_*))}{\mathrm{dlog}_{10}(\mathrm{M}_*)}\right)$$