Small-scale Structure with the Hubble Space Telescope

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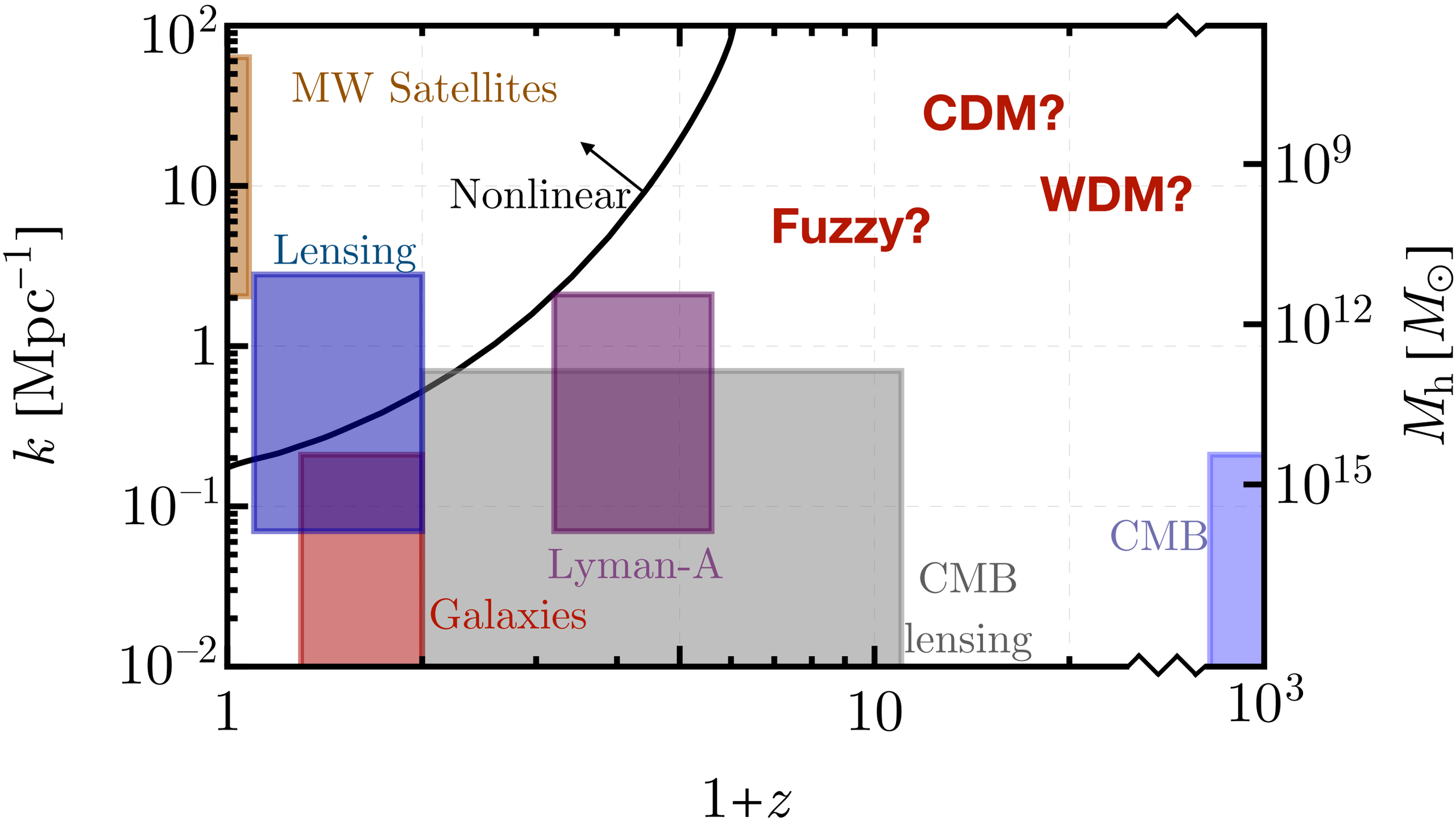
Clay Fellow

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

Based on:
arXiv: 2110.13161
arXiv: 2110.13168
Sabti, JBM, Blas:

The question:



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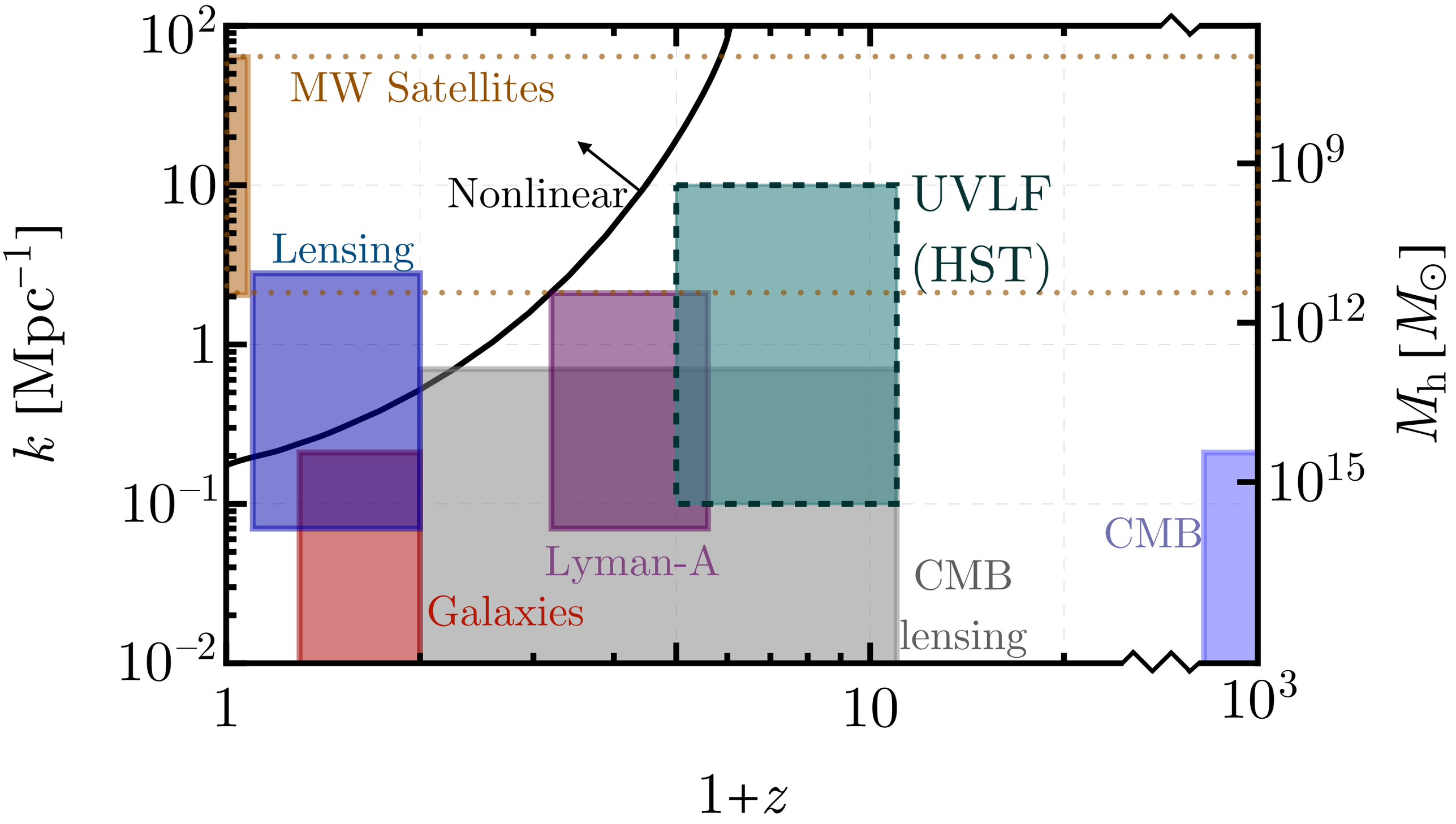

The data:

HST UV Luminosity Functions

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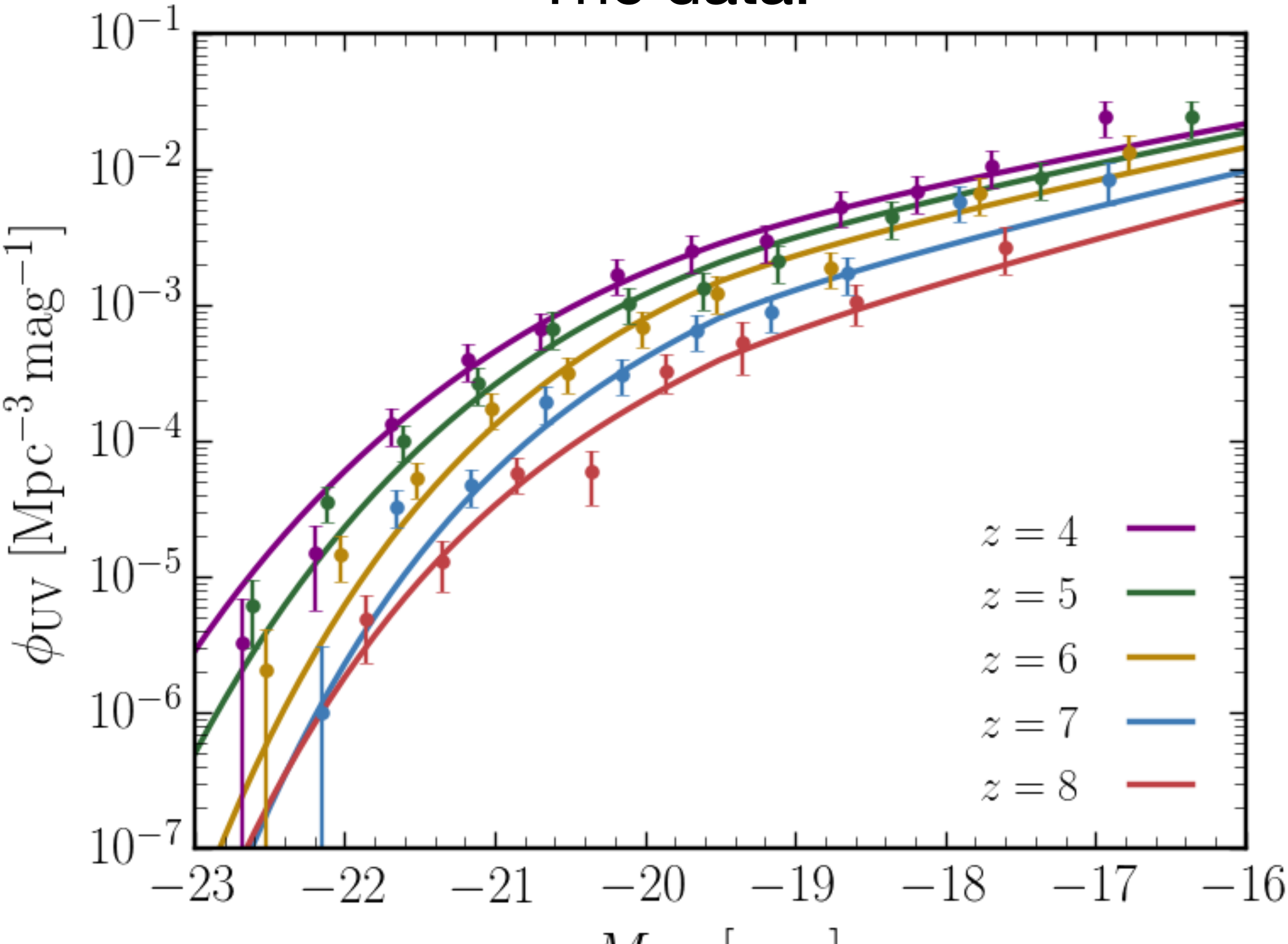
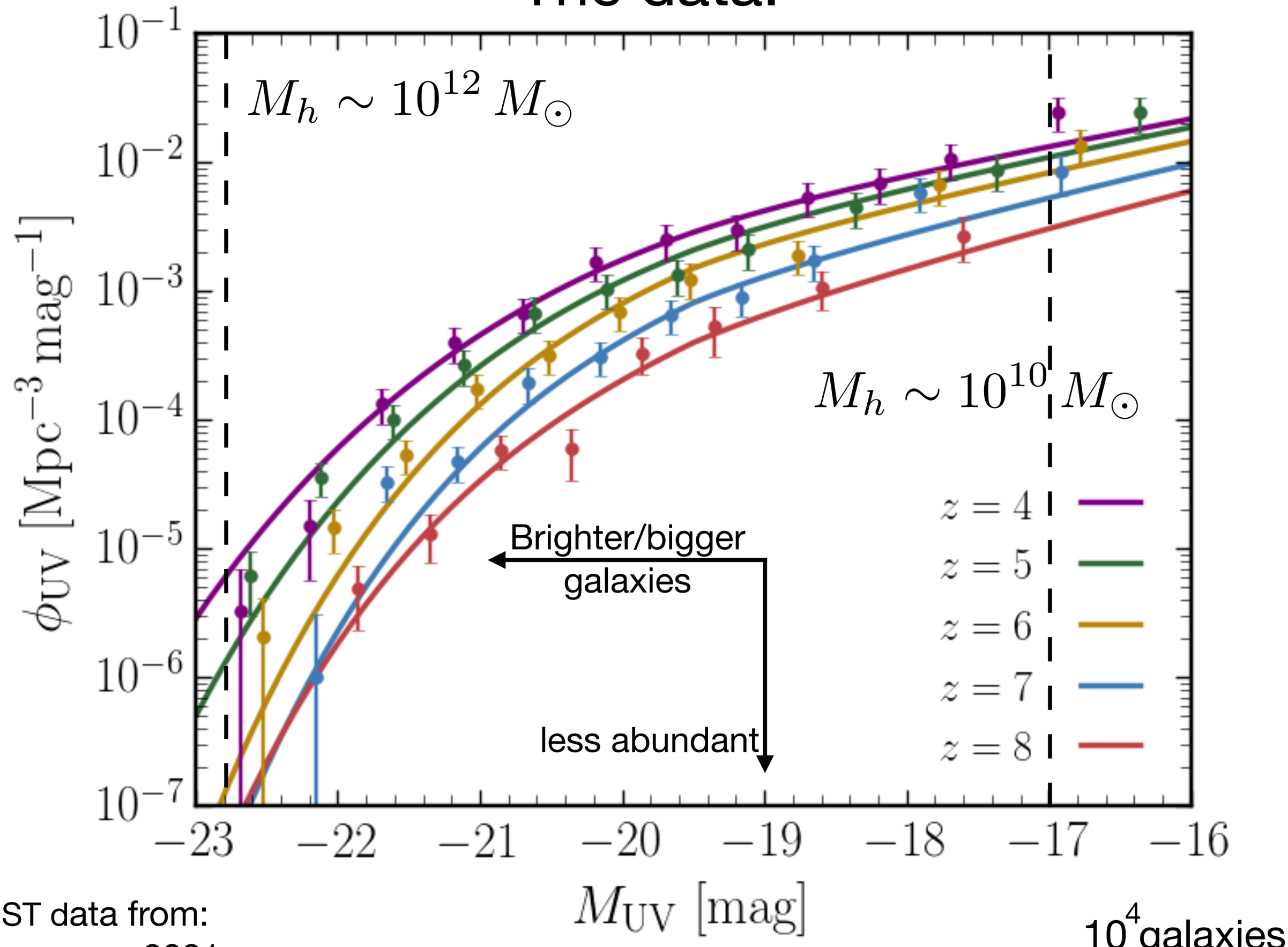


HST data from:
Bouwens+ 2021

10^4 galaxies

The data:



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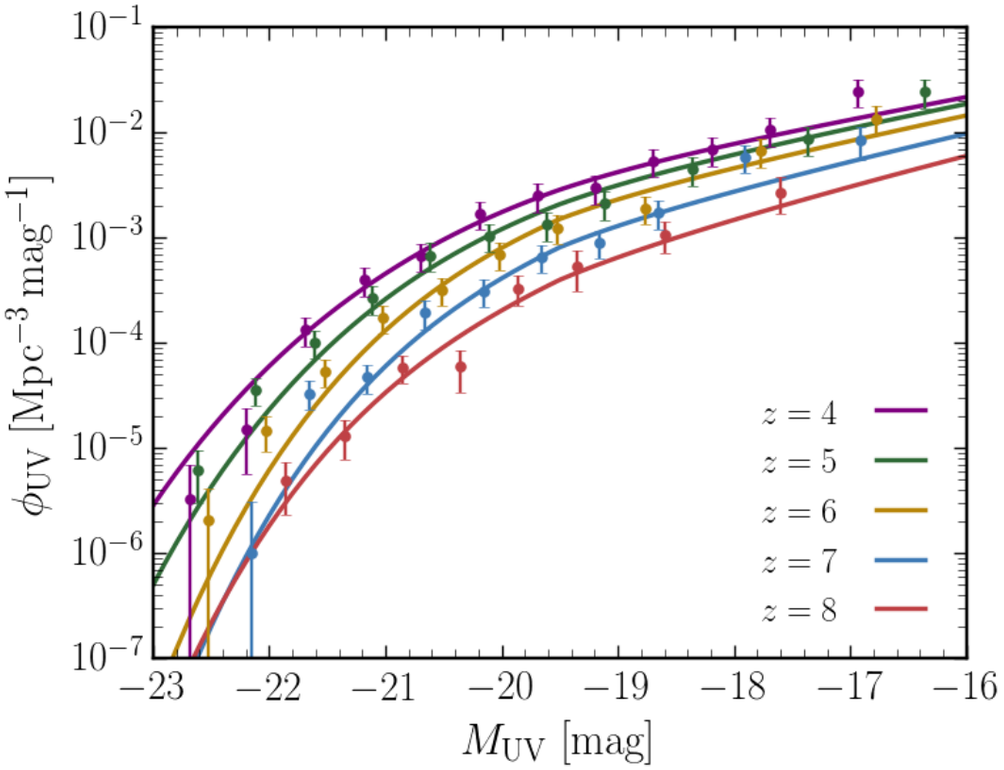
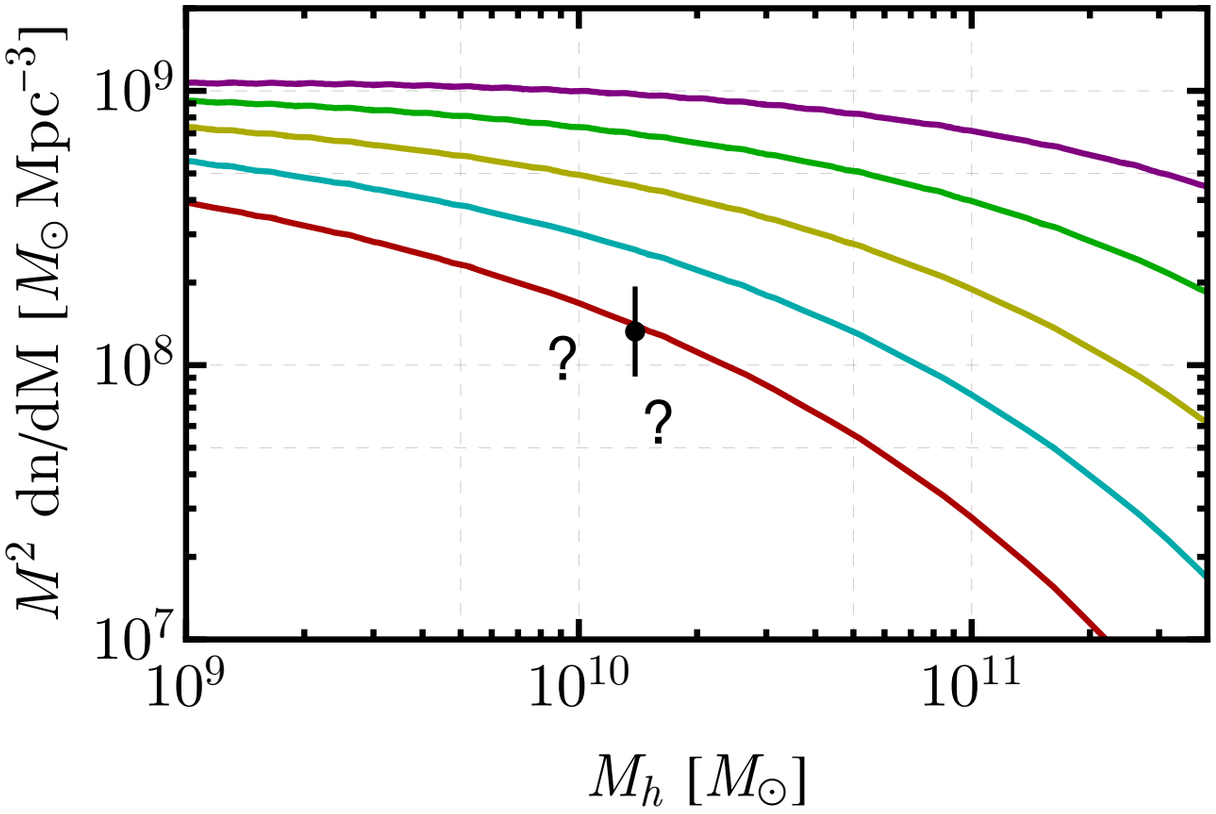
Can we learn cosmology?

Cosmo+Astro



Cosmo



Halo-galaxy connection

HST UV Luminosity Functions
(Semi-analytic model)

$$\phi_{\rm UV} = \frac{dn}{dM_{\rm UV}} = \frac{dn}{dM_h} \times \frac{dM_h}{dM_{\rm UV}}$$

UV Luminosity Function

Data

Halo Mass Function

Cosmology

Halo-galaxy connection

Astrophysics

Sabti, JBM, Blas arXiv: 2009.01245

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-Separate cosmology from astrophysics?

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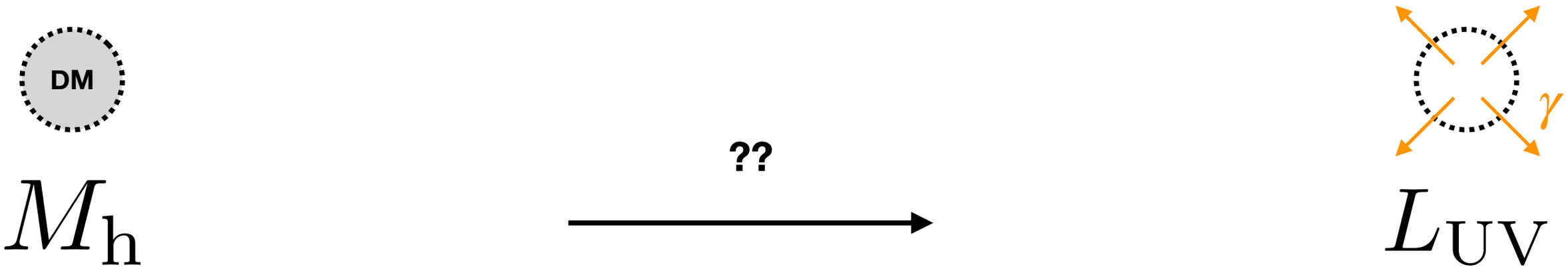
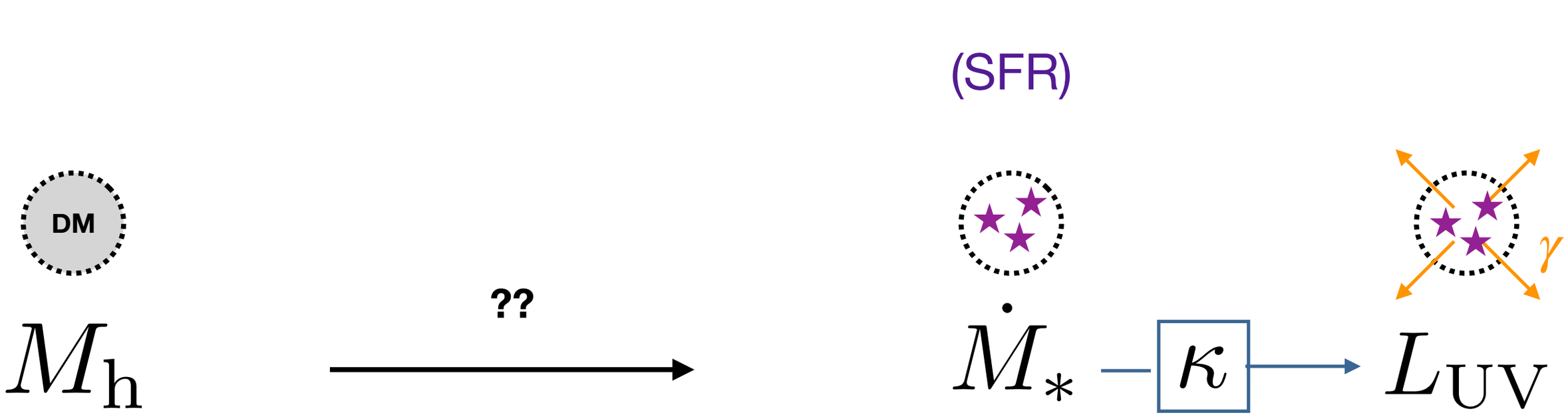
HST UV Luminosity Functions
(**Simple** theoretical model)



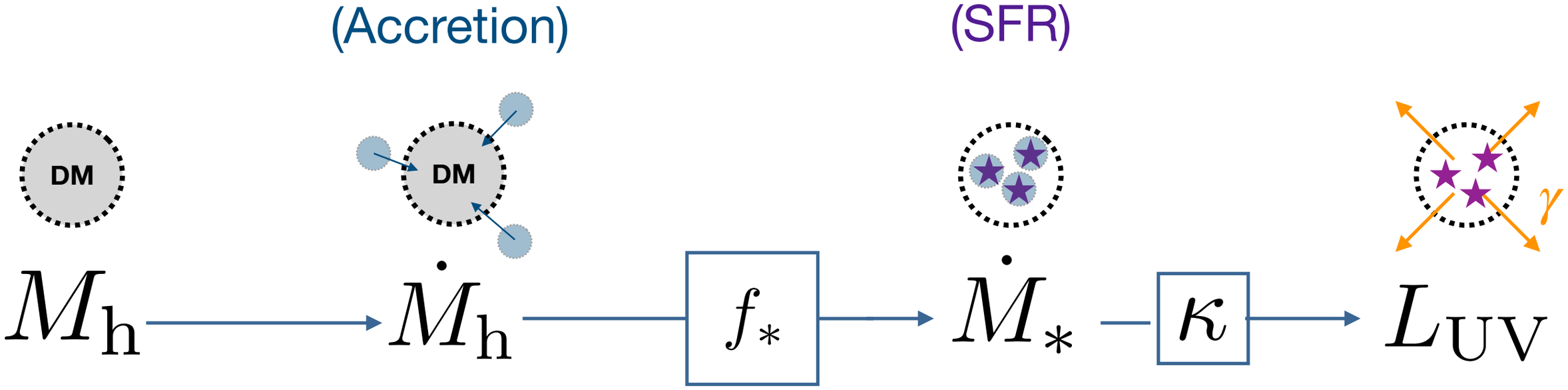
HST UV Luminosity Functions
(**Simple** theoretical model)

Assumption 1: UV light comes from young stars



HST UV Luminosity Functions
(**Simple** theoretical model)

Assumption 2: $\dot{M}_*$ is a parametric function of $M_{\rm h}$



HST UV Luminosity Functions
(**Simple** theoretical model)

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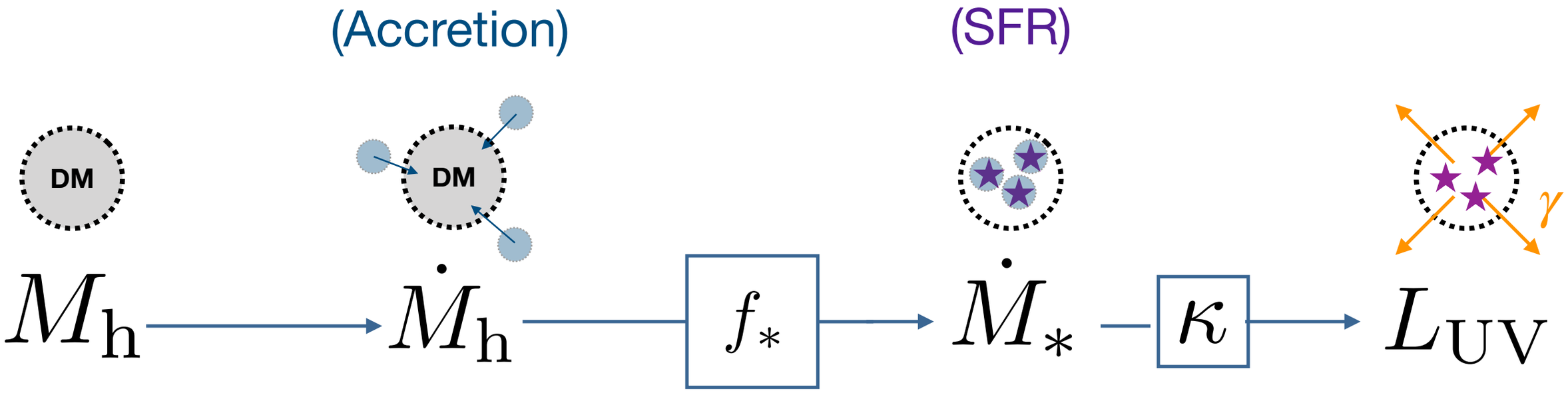
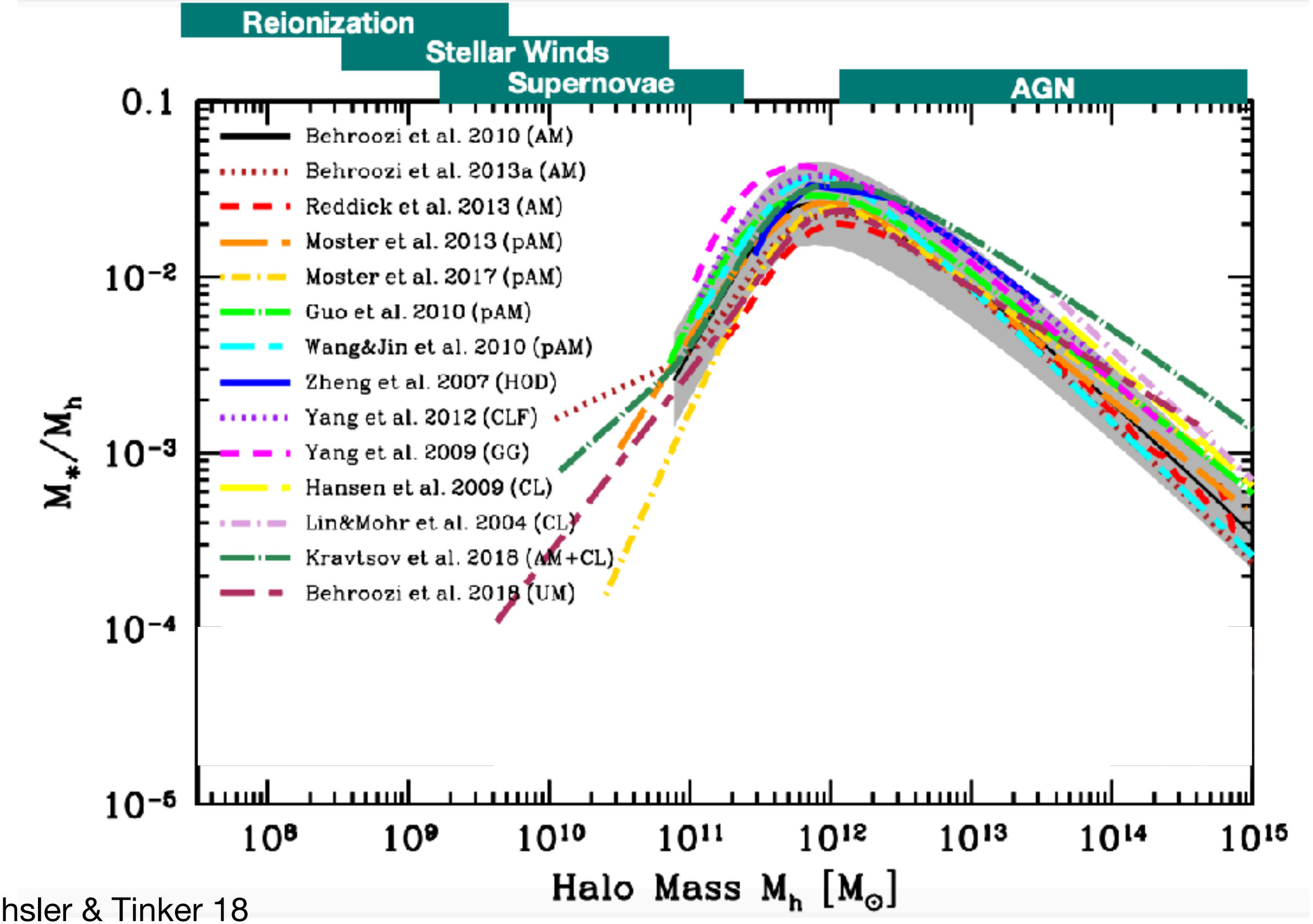


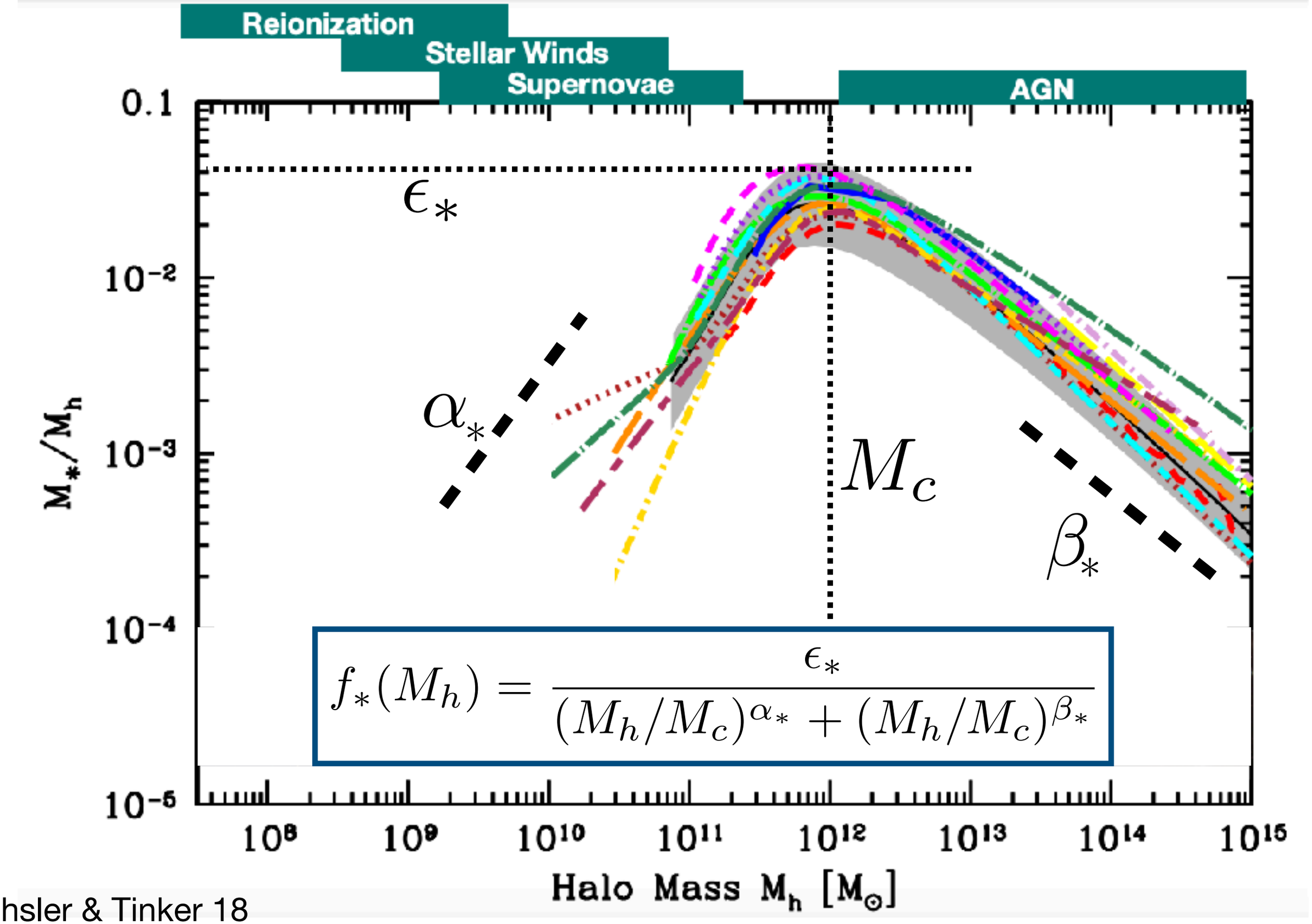
What is the function f_* ?

Halo-galaxy connection



Wechsler & Tinker 18
(based on Behroozi+18)

Halo-galaxy connection: a SAM



Wechsler & Tinker 18
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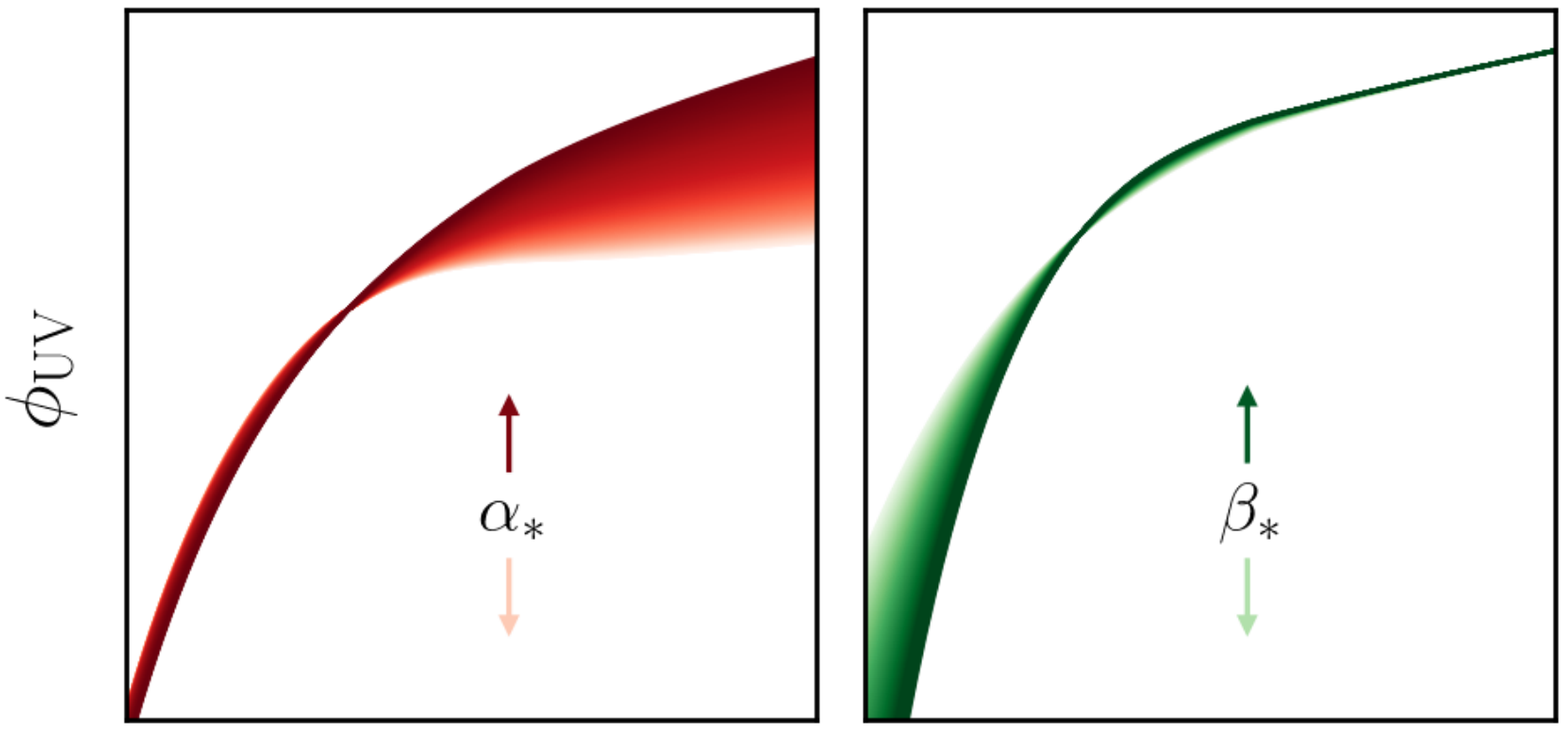
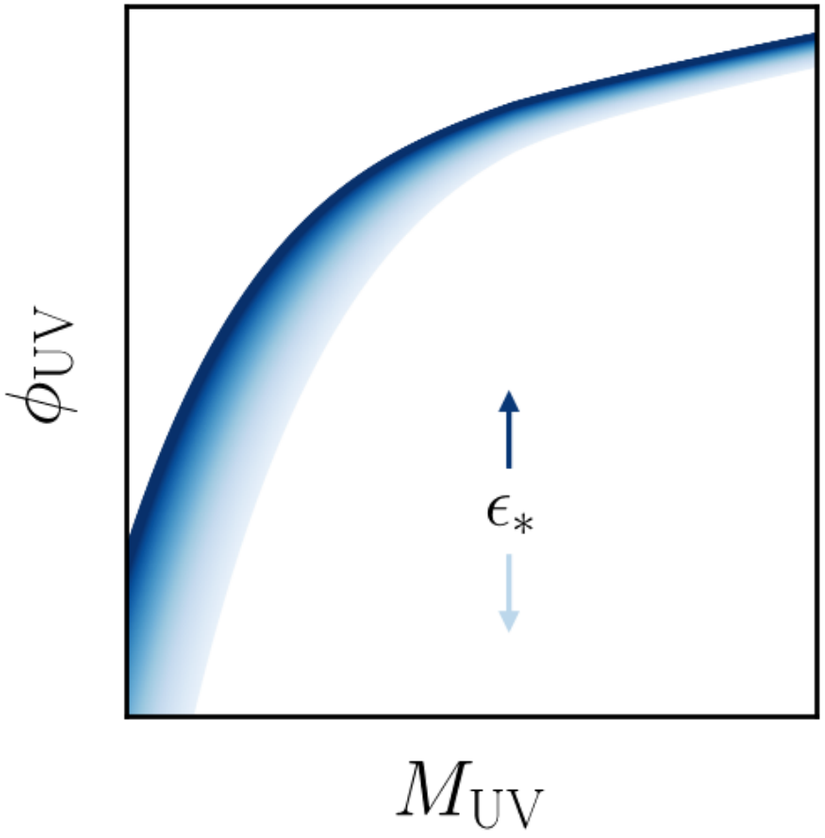
The parameters of our SAM



Brighter/bigger galaxies

less abundant



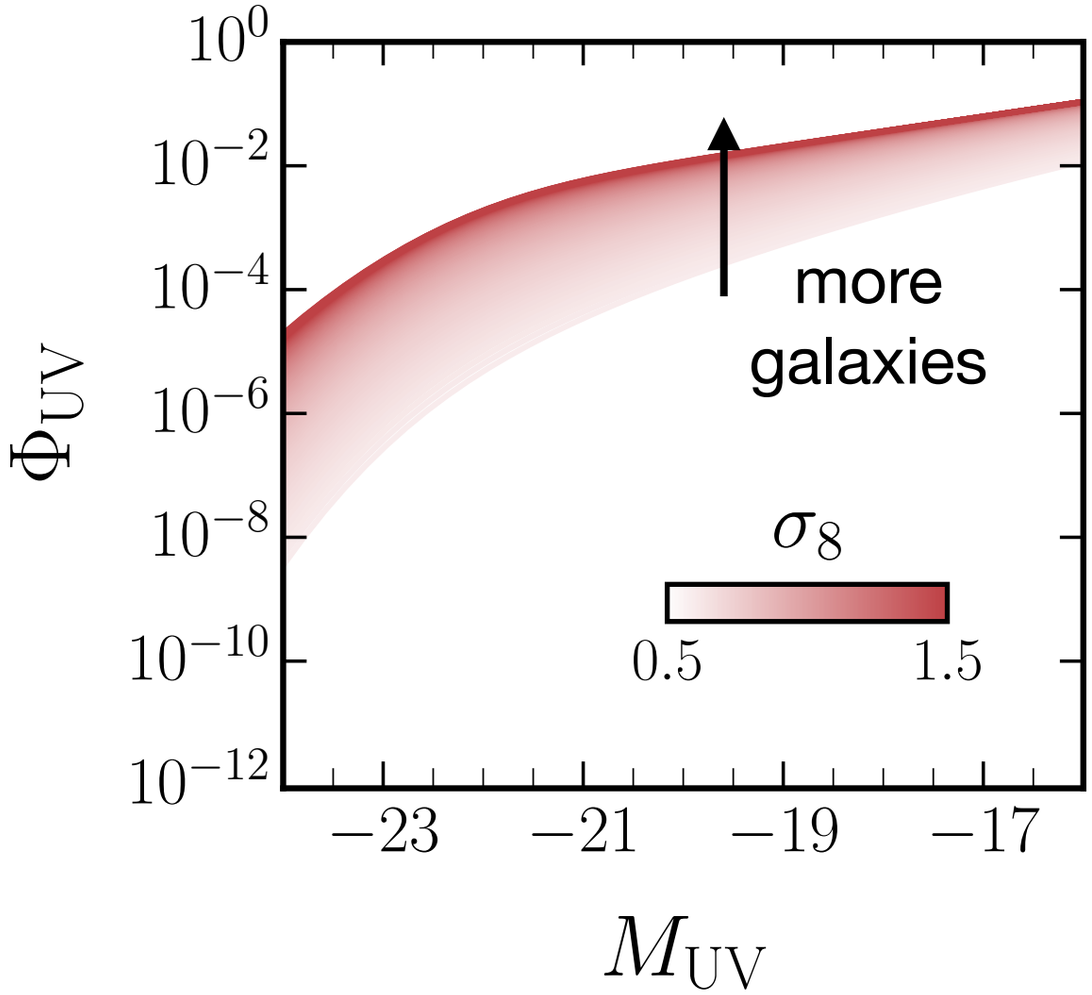
$$f_*(M_h) = \frac{\epsilon_*}{(M_h/M_c)^{\alpha_*} + (M_h/M_c)^{\beta_*}}$$

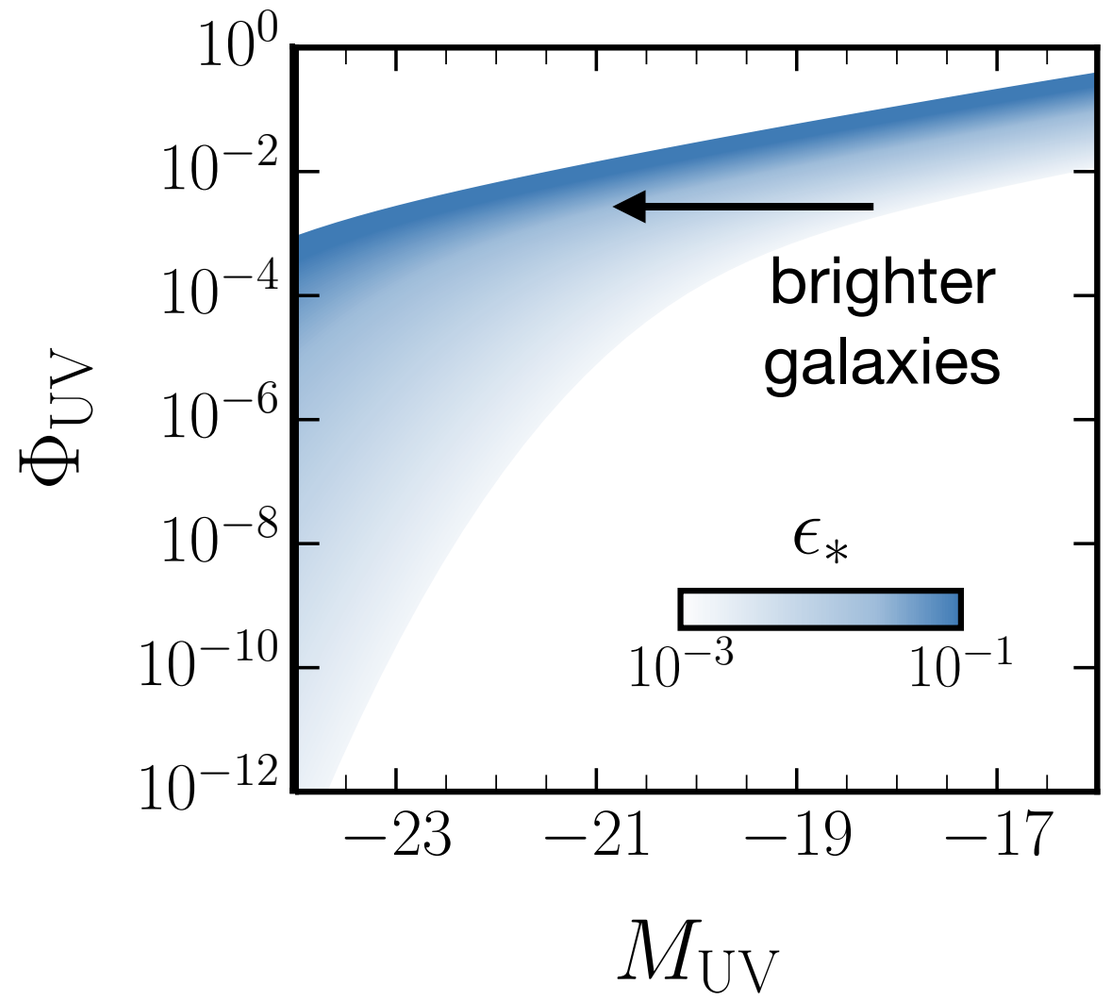
Astrophysics

(plus dust corrections)

Sabti, JBM, Blas arXiv: 2009.01245

What cosmology can we learn?



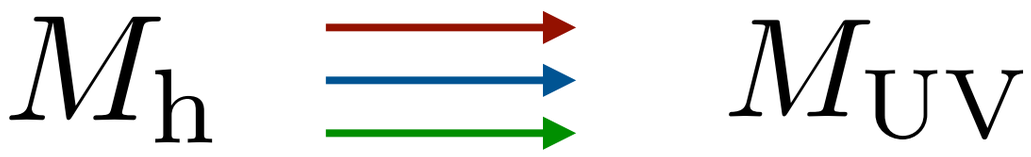


-Separate cosmology from astrophysics

Sabti, JBM, Blas, arXiv: 2110.13161+2110.13168

GALLUMI

Fast (~10 ms) SAM + likelihood



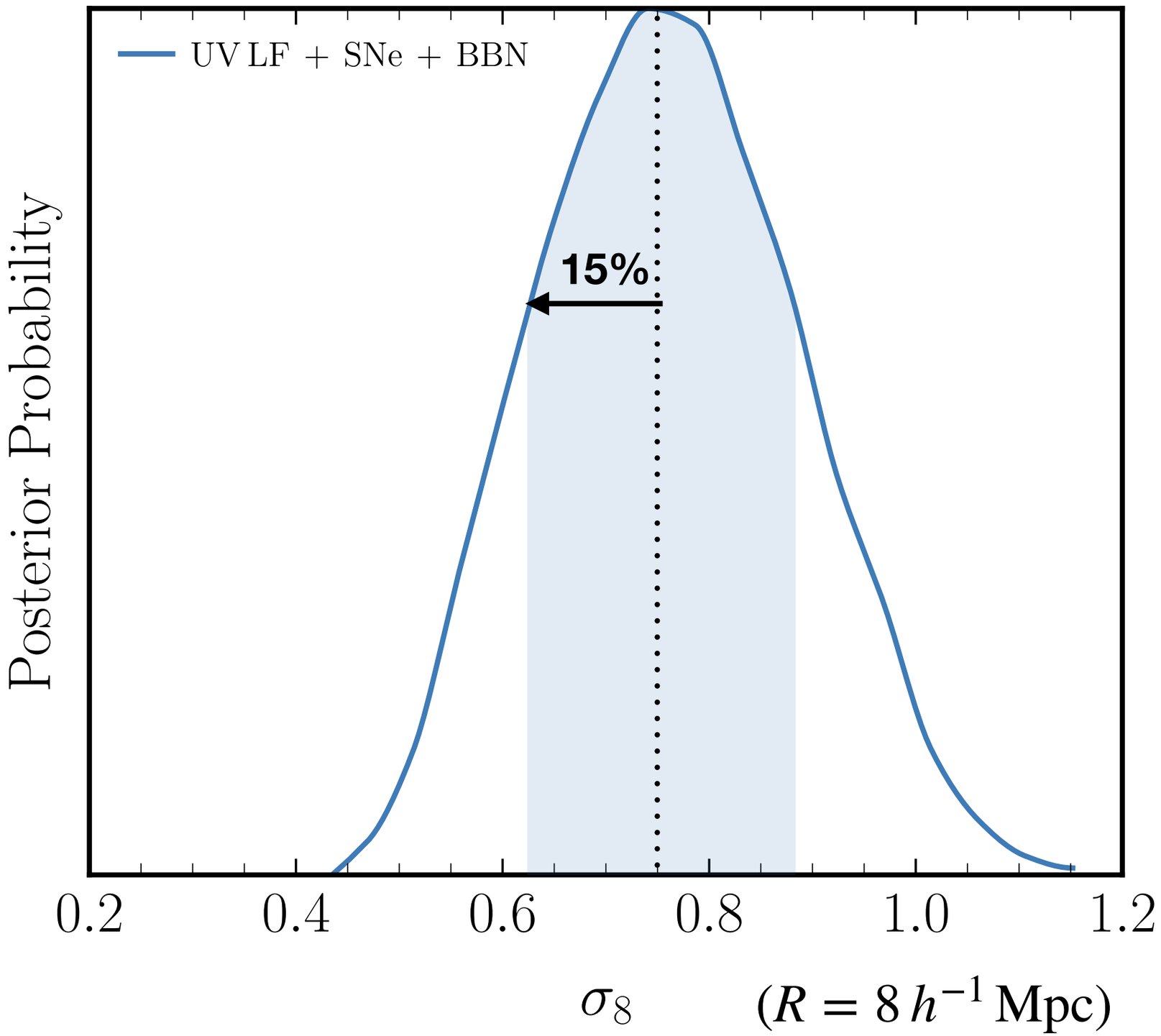
Three models and different dust assumptions

Scattering in the halo-galaxy connection

Talks to Montepython 3 + public

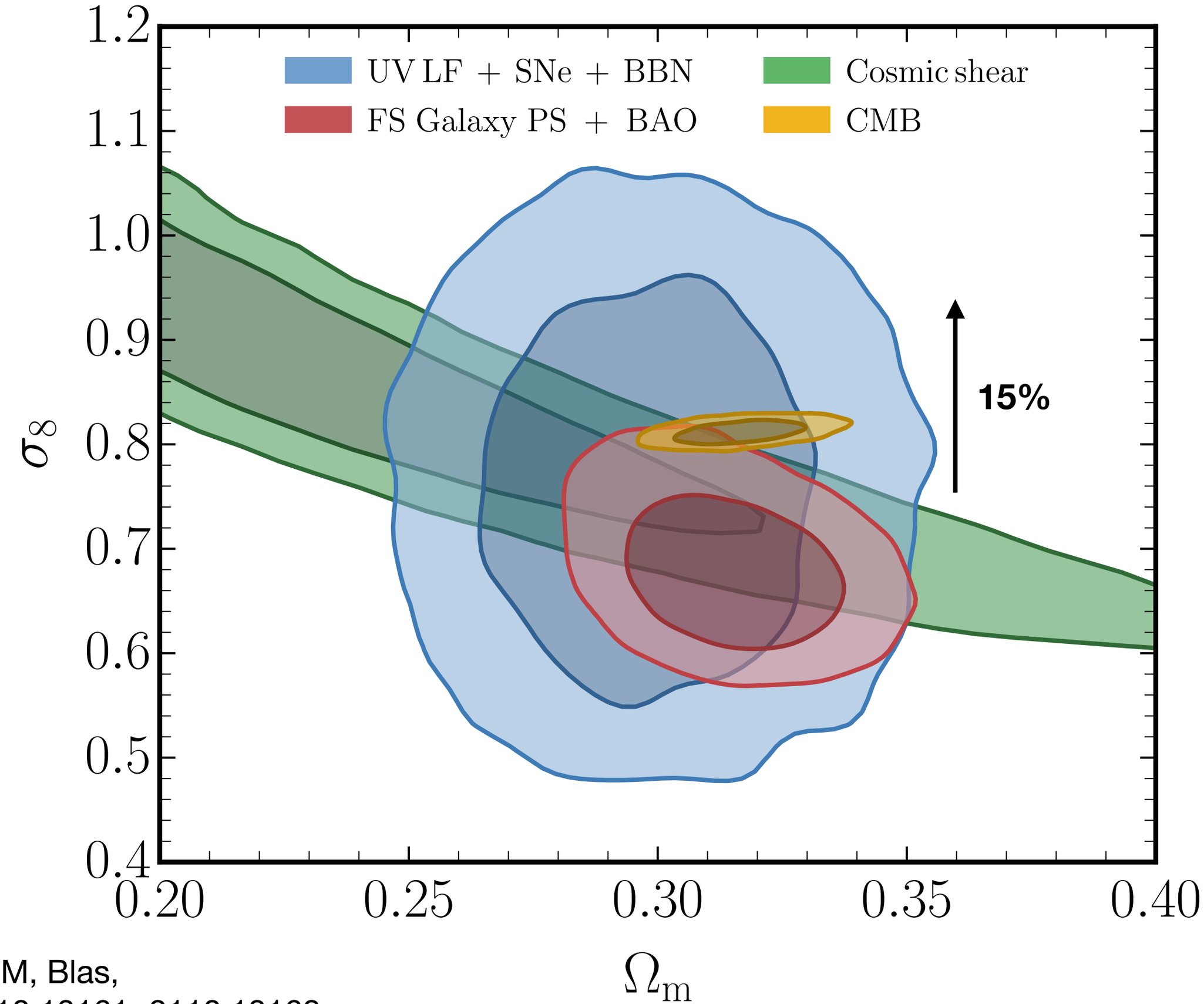
Sabti, JBM, Blas, arXiv: 2110.13161+2110.13168

What cosmology can we learn?



Sabti, JBM, Blas, arXiv: 2110.13161+2110.13168

In context:



Sabti, JBM, Blas,
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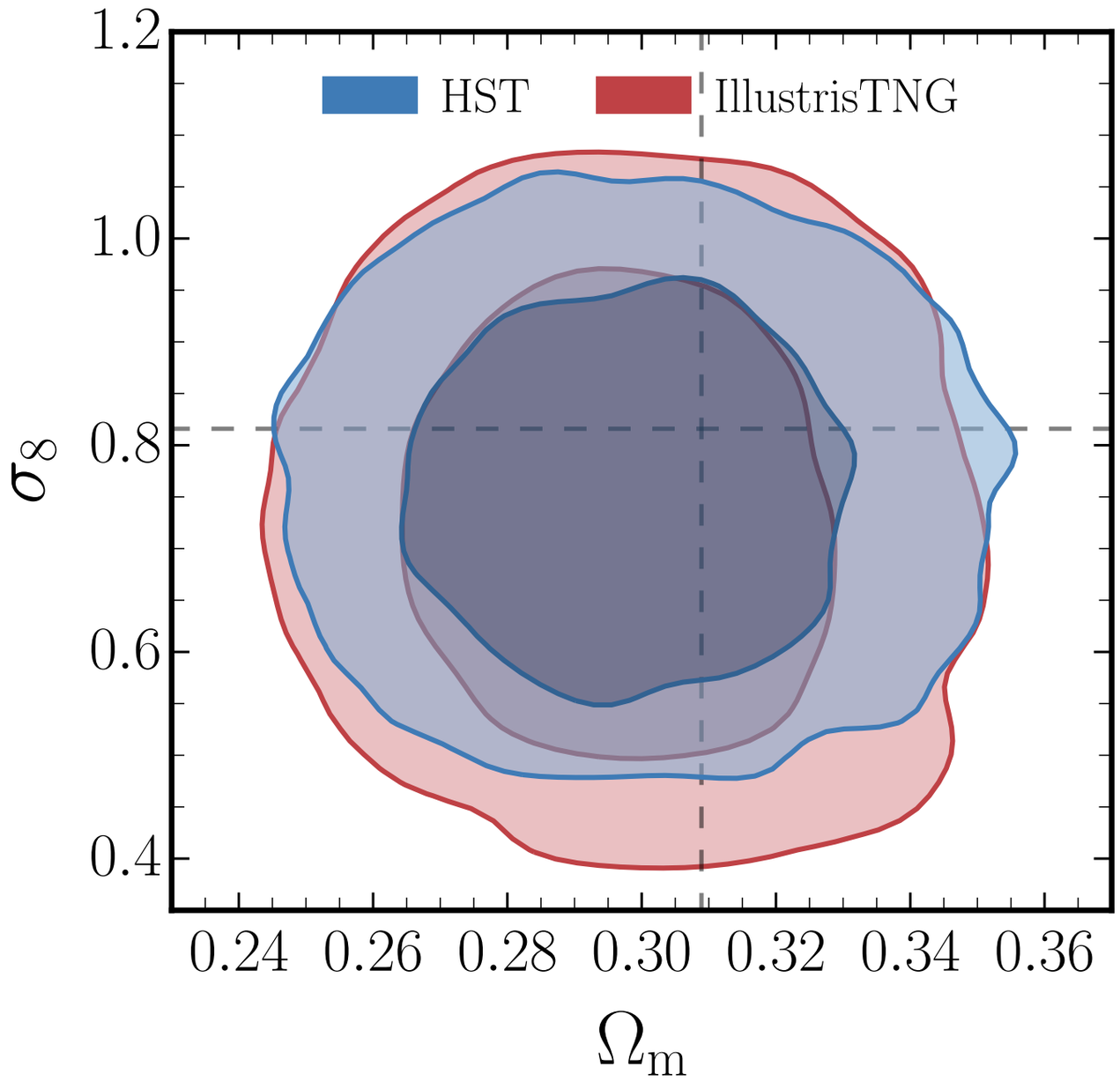
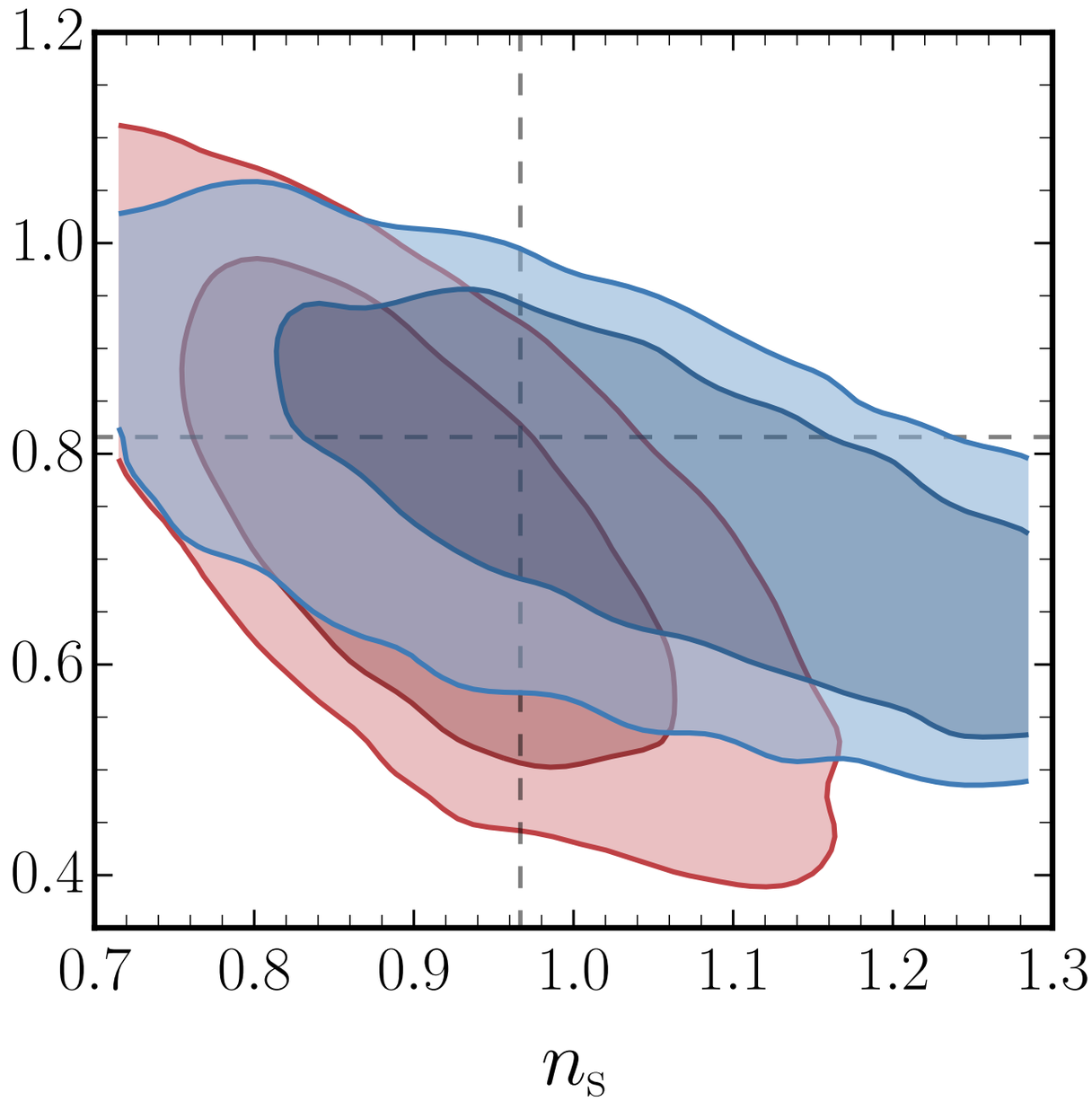
Cross check with sims





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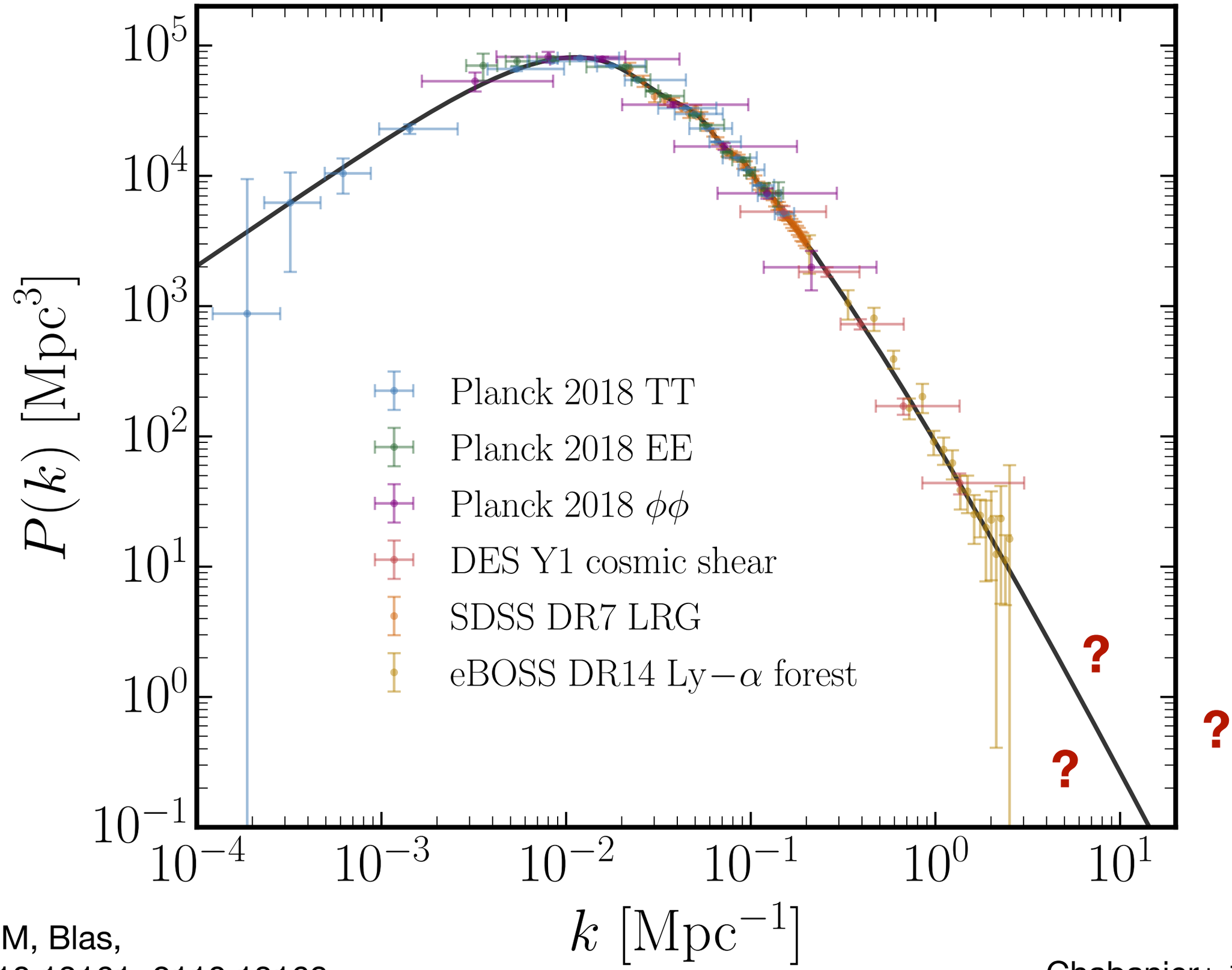
IllustrisTNG data from
Vogelsberger+ 1904.07238

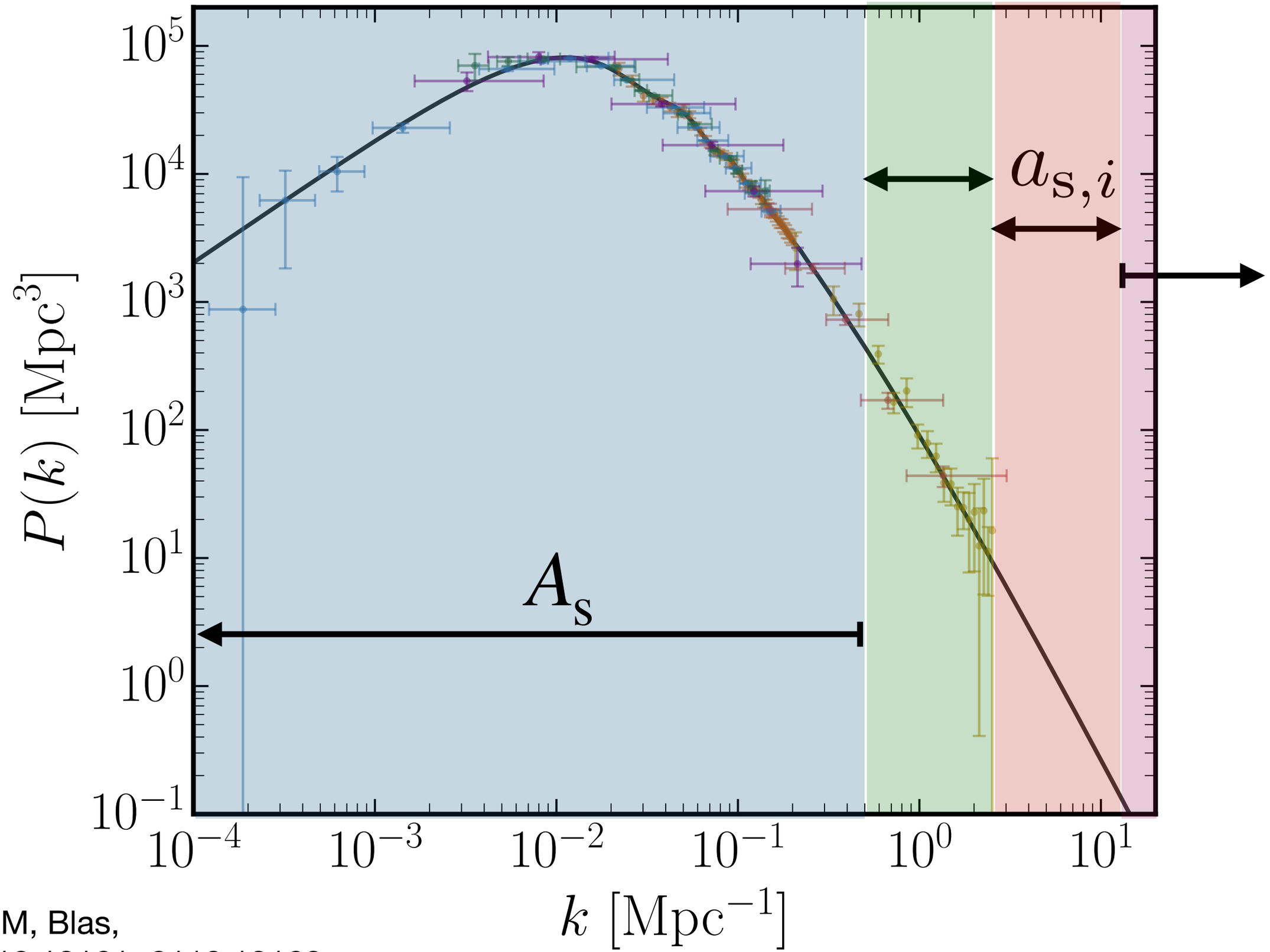
Smaller galaxies -> higher k



Sabti, JBM, Blas,
arXiv: 2110.13161+2110.13168

Chabanier+ 1905.08103

Smaller galaxies -> higher k



Sabti, JBM, Blas,
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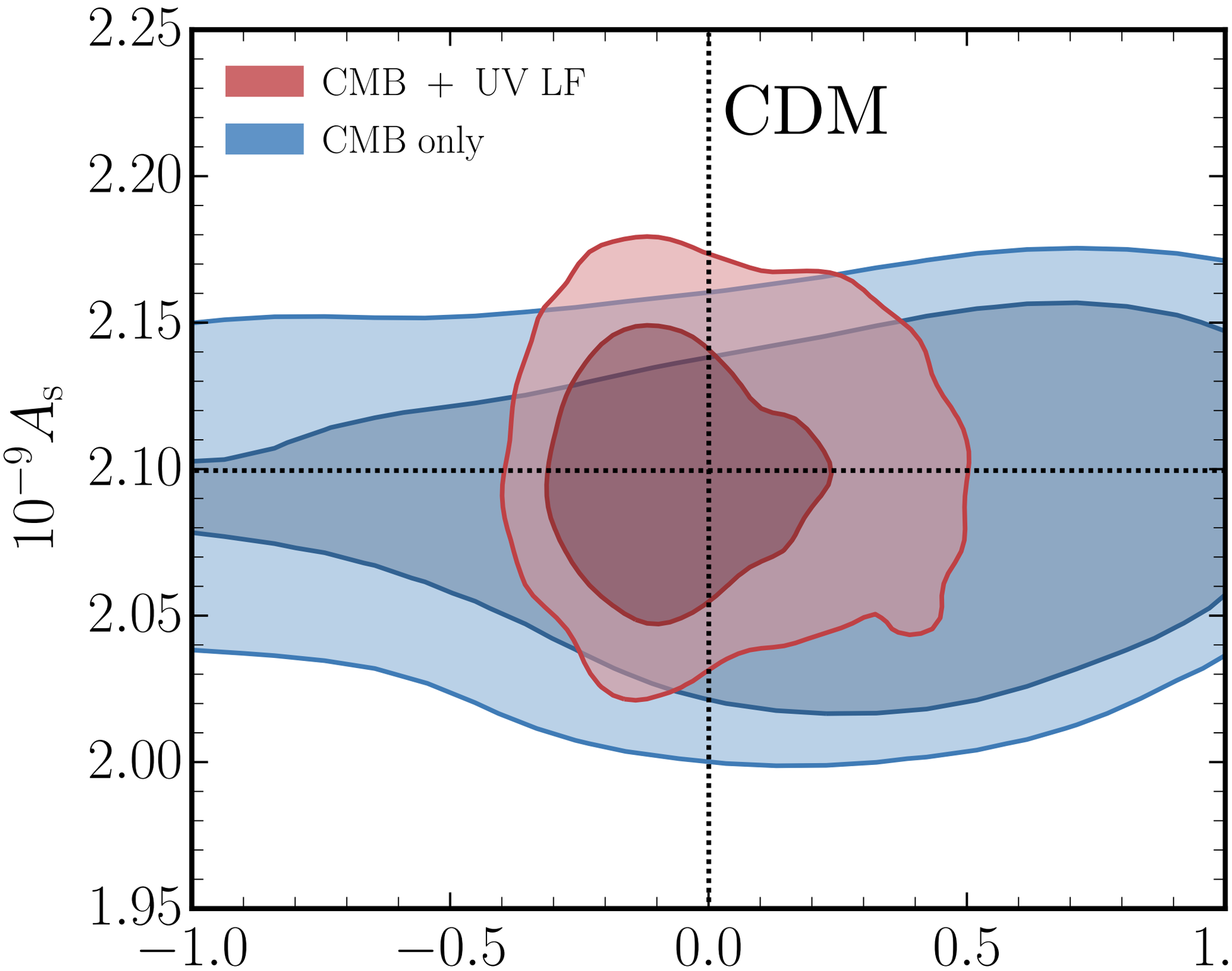

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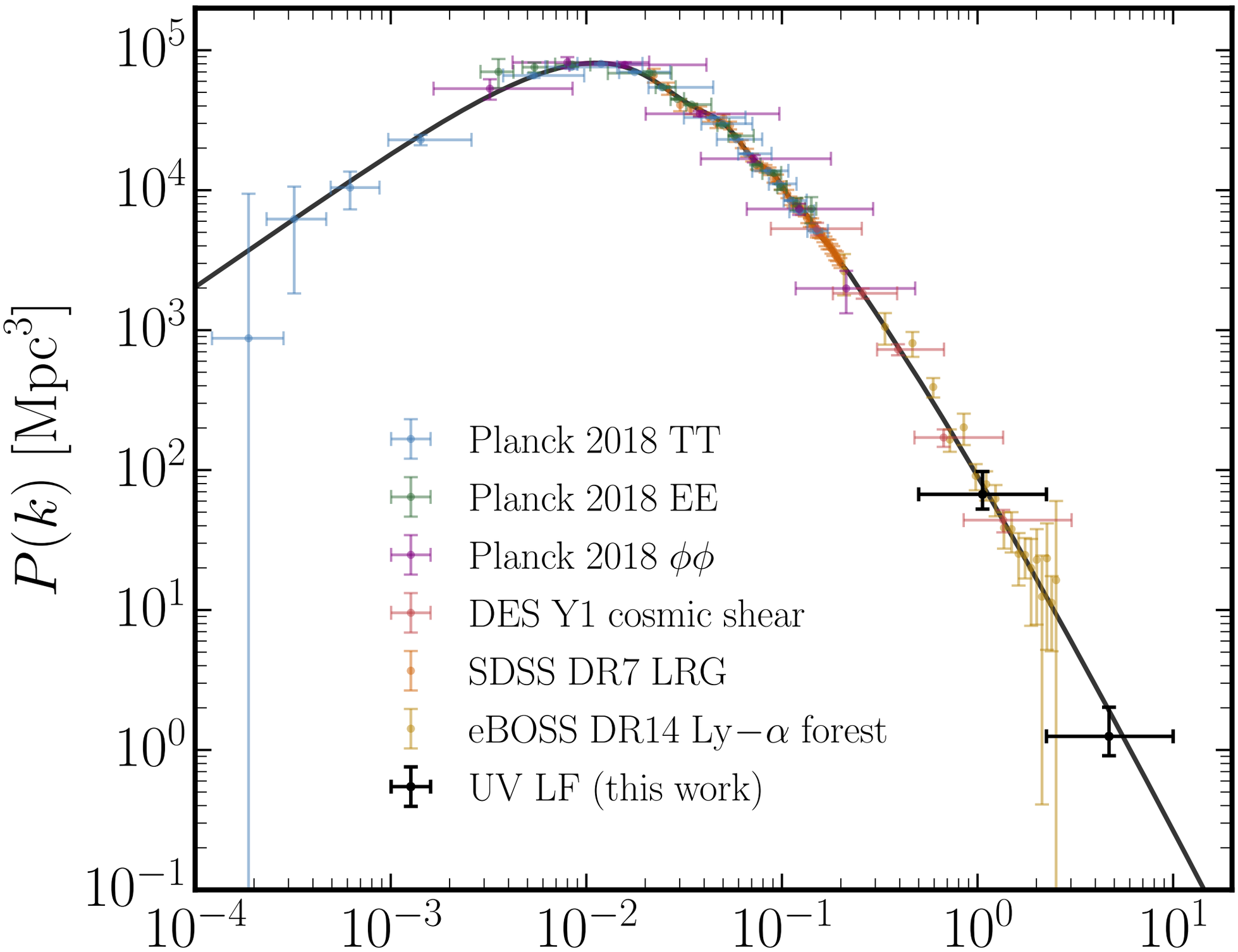

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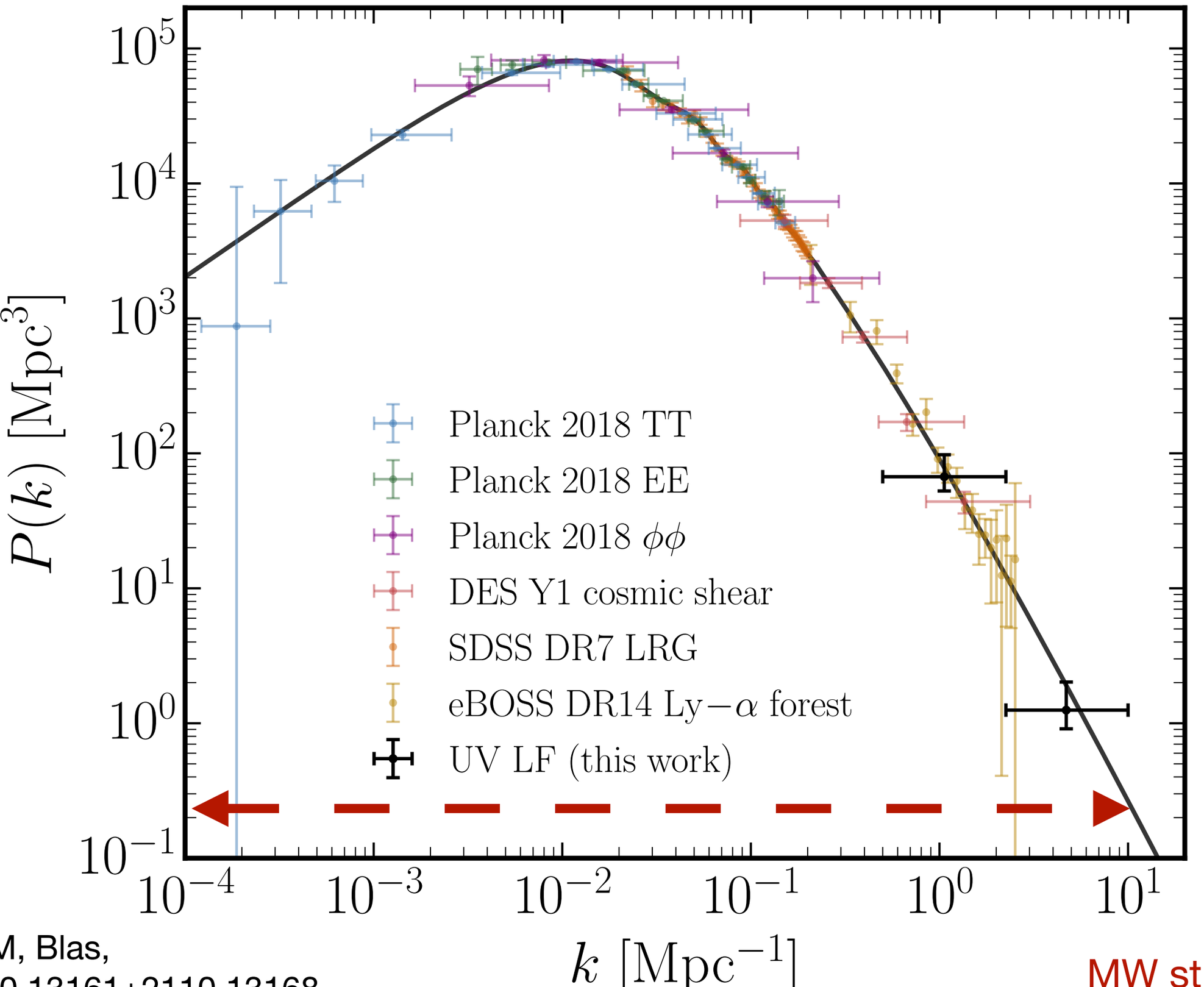

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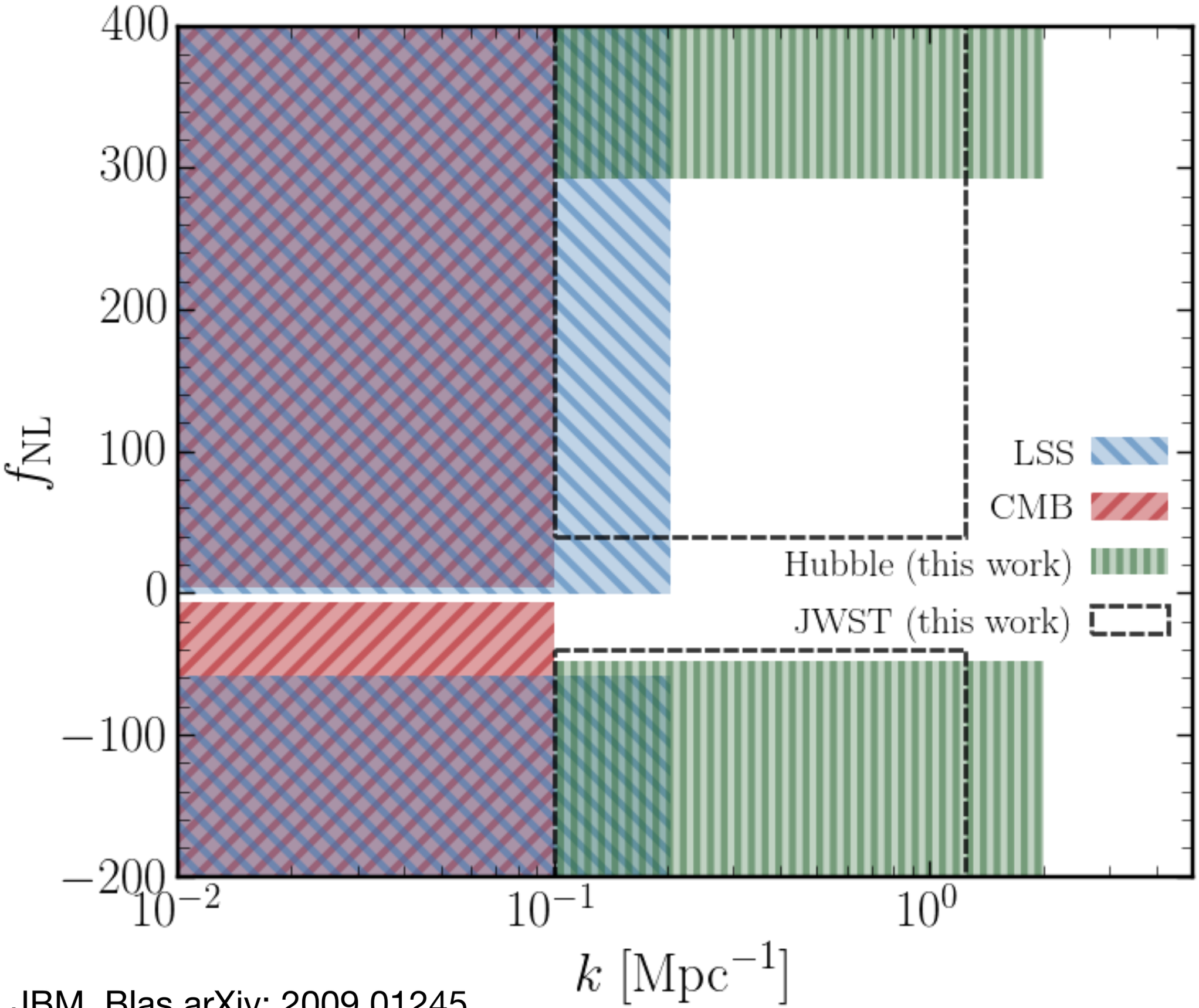
Cf. DES,
MW streams, etc.

Constraints on PNG at different scales



Sabti, JBM, Blas arXiv: 2009.01245

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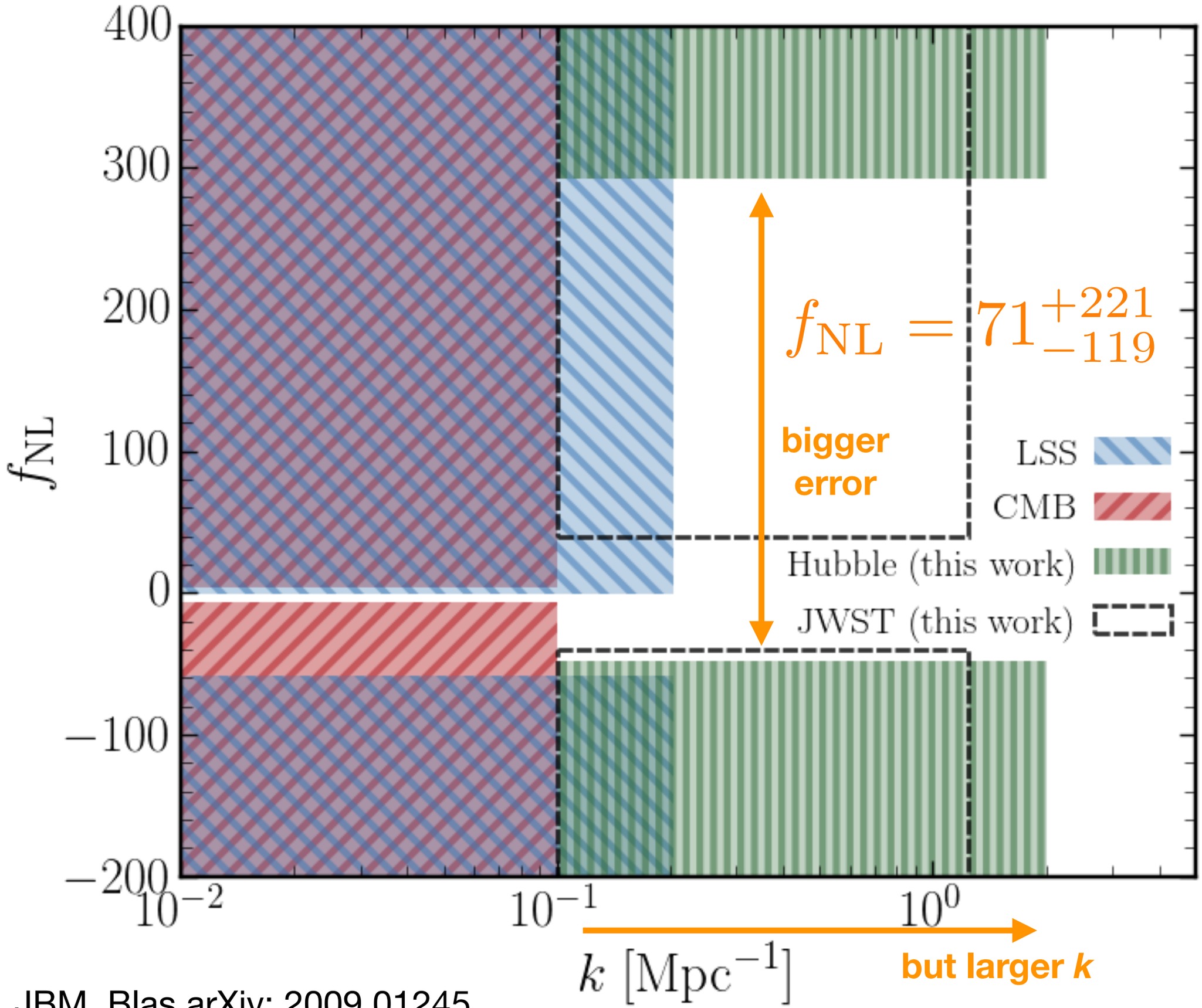

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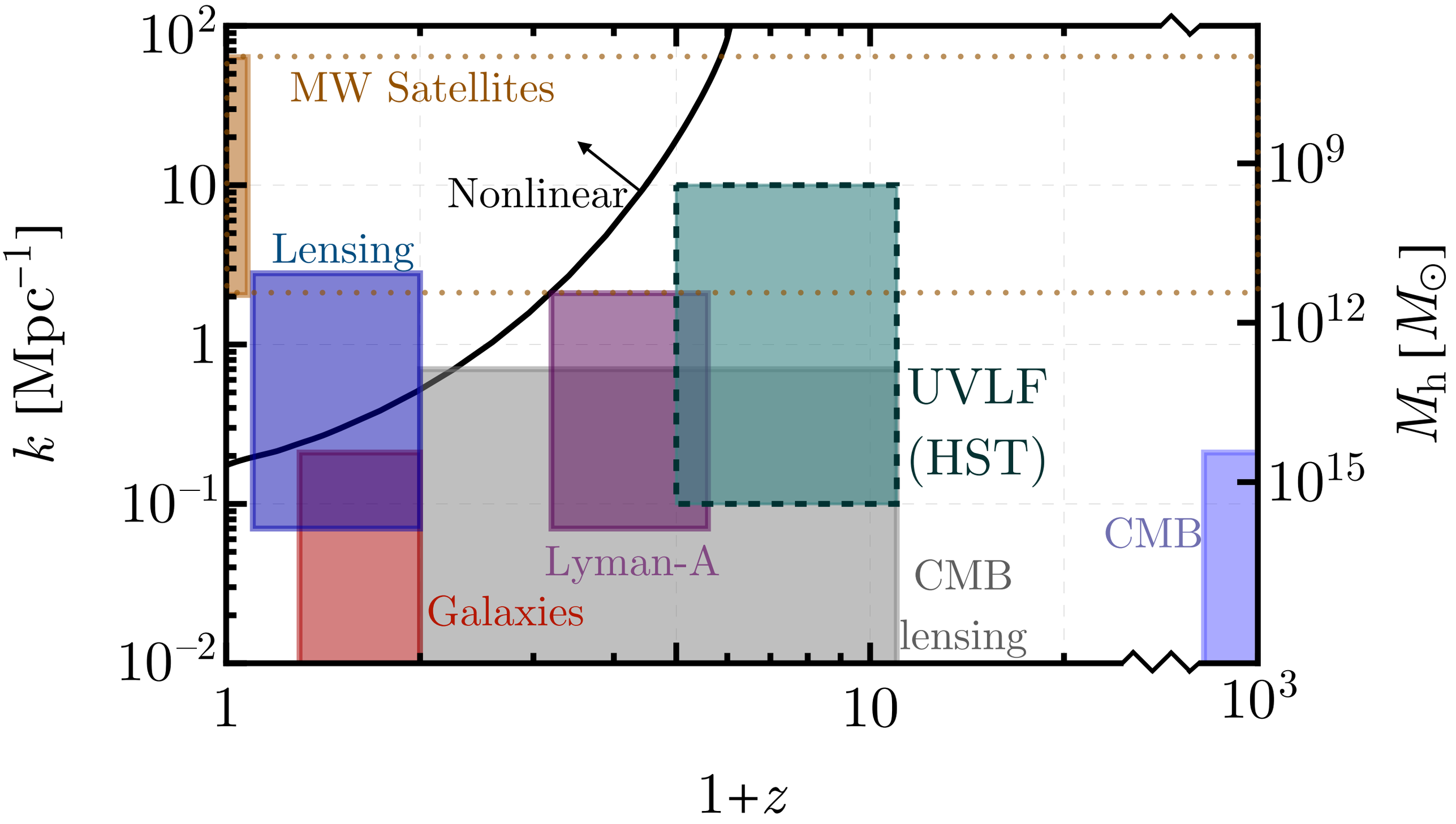
Small scales and high z



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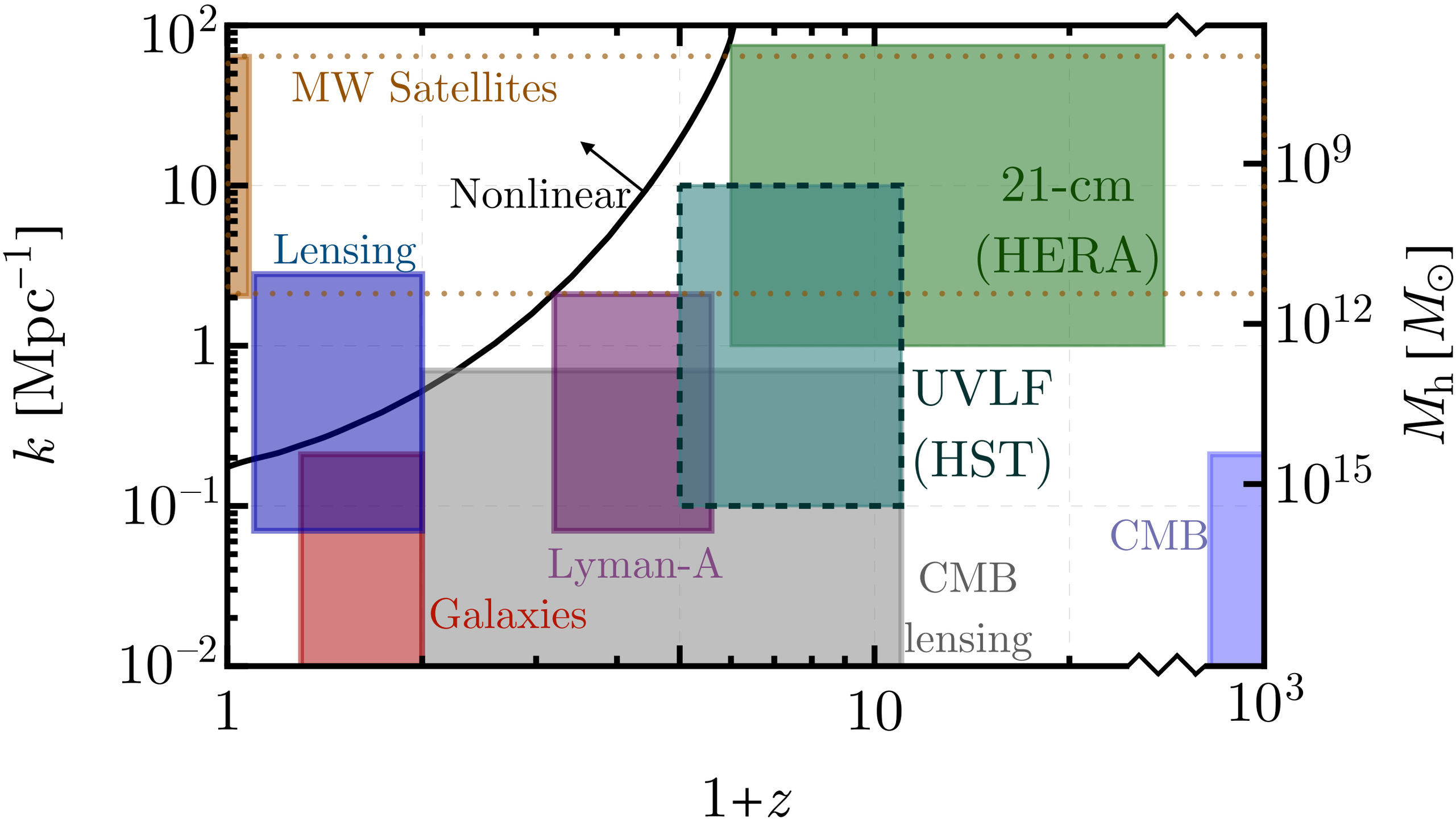
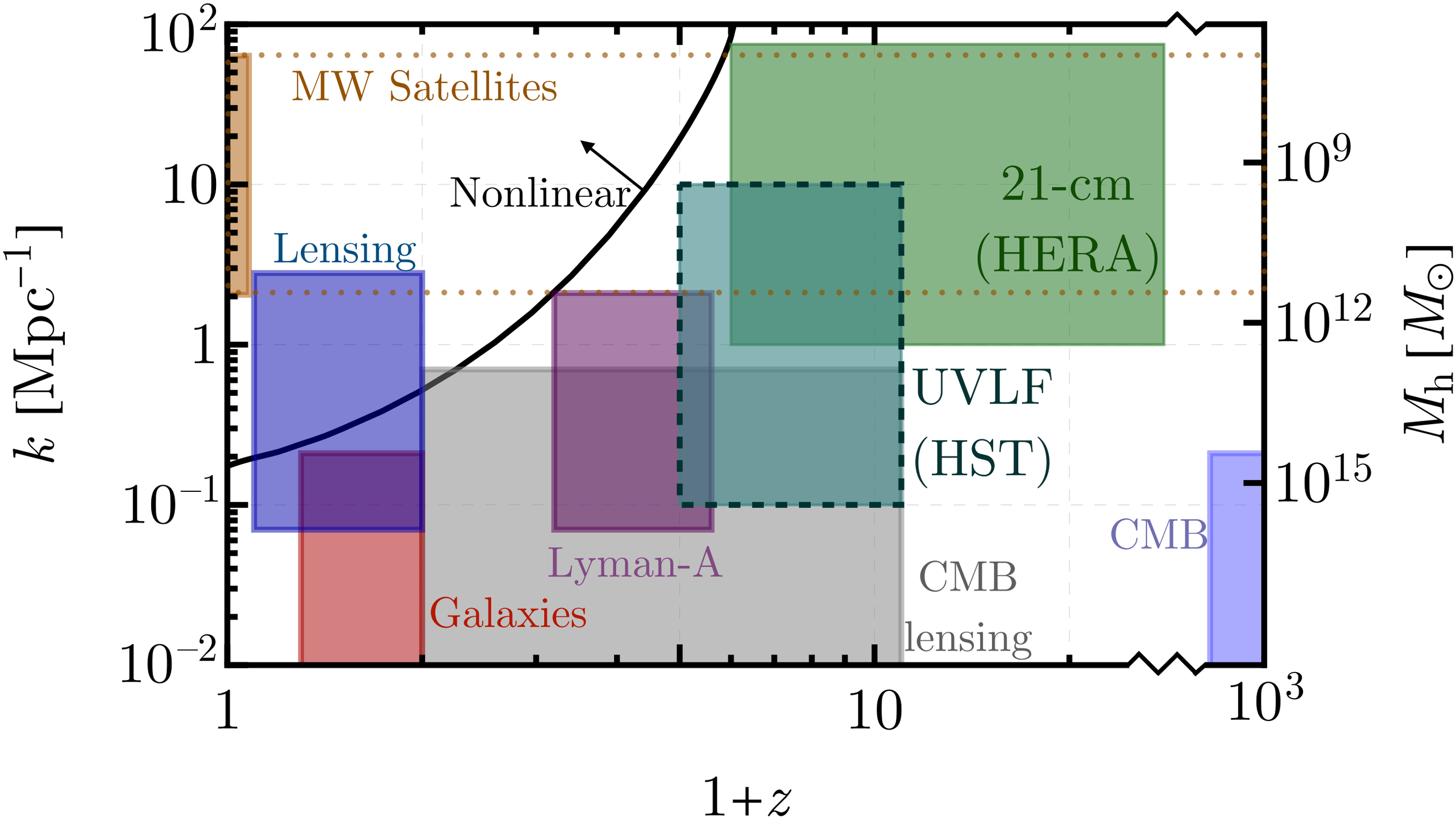


Sabti, JBM, Blas,
arXiv: 2110.13161+2110.13168

JBM, Dvorkin, Cyr-Racine
arXiv: 1911.11144

CDM? - So far yes



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