Current numerical and physical limitations of the EAGLE and APOSTLE simulations. Some paths for the future.

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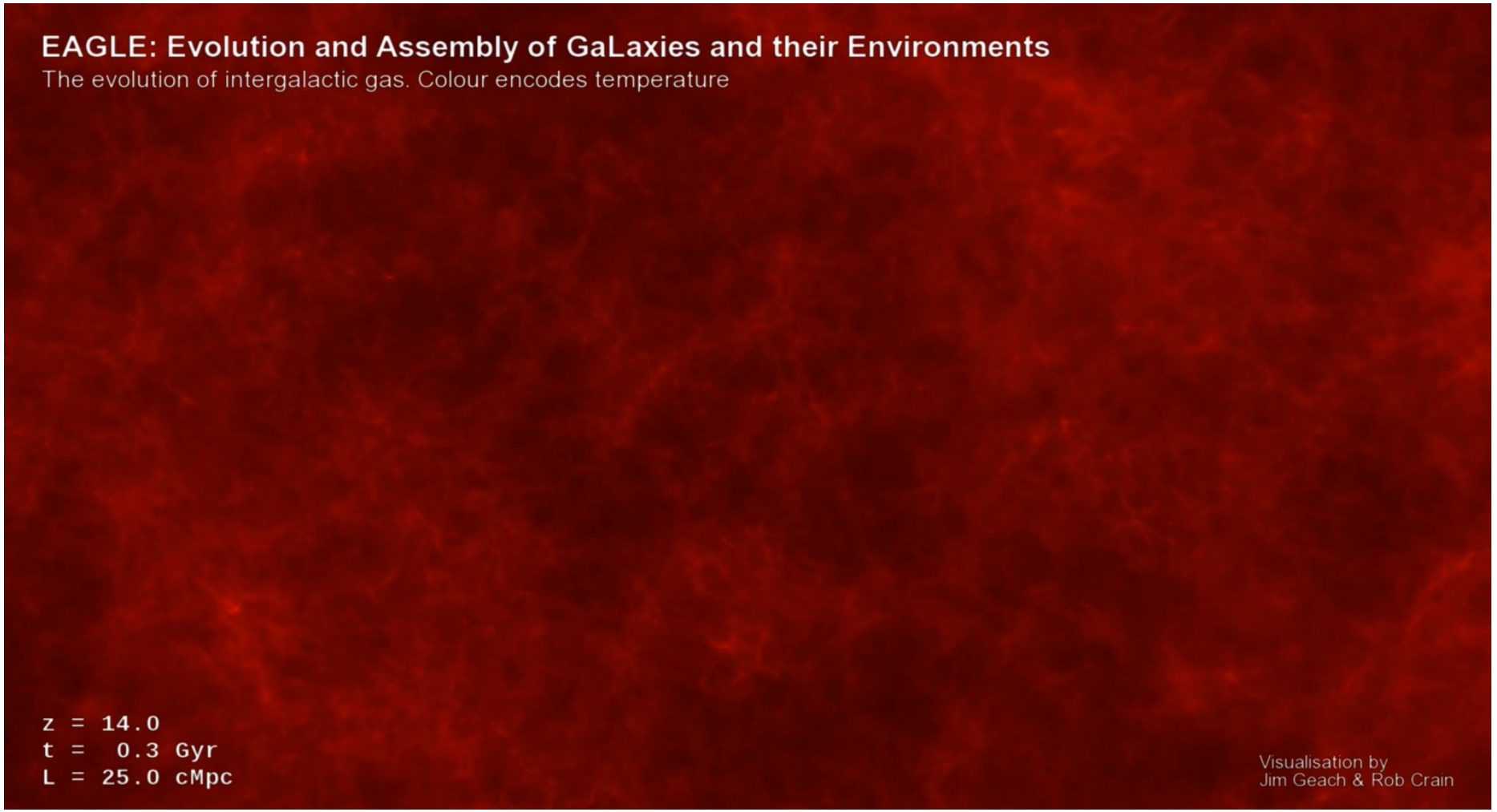
www.eaglesim.org → Public Galaxy Catalogue

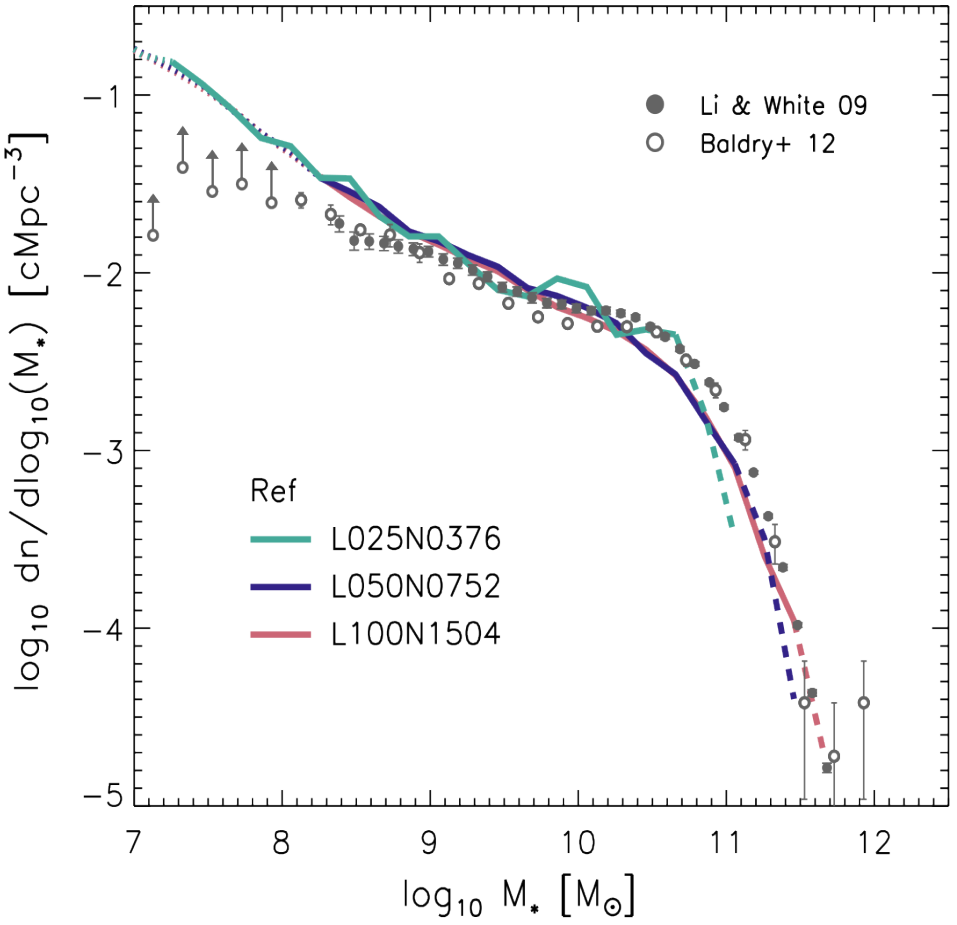
EAGLE in a nutshell

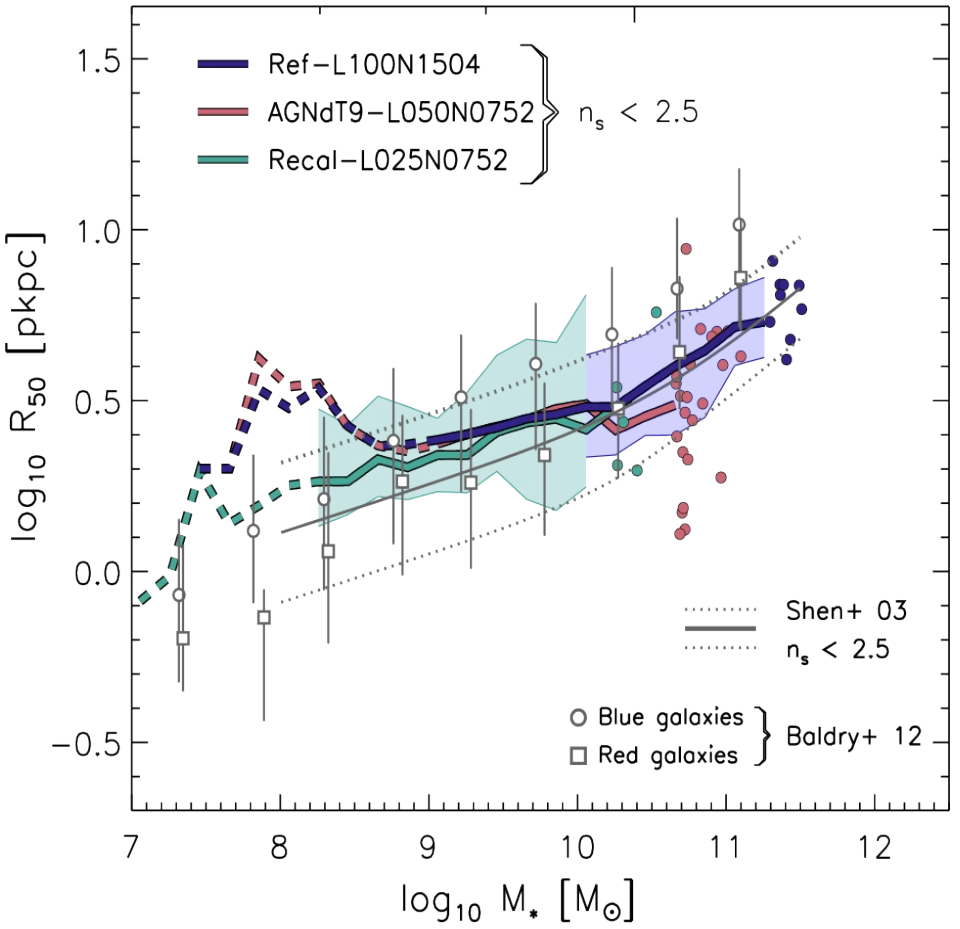


Schaye+2015 (1407.7040), Crain+2015 (1501.01311), Schaller+2015 (1509.05056)

EAGLE in a nutshell

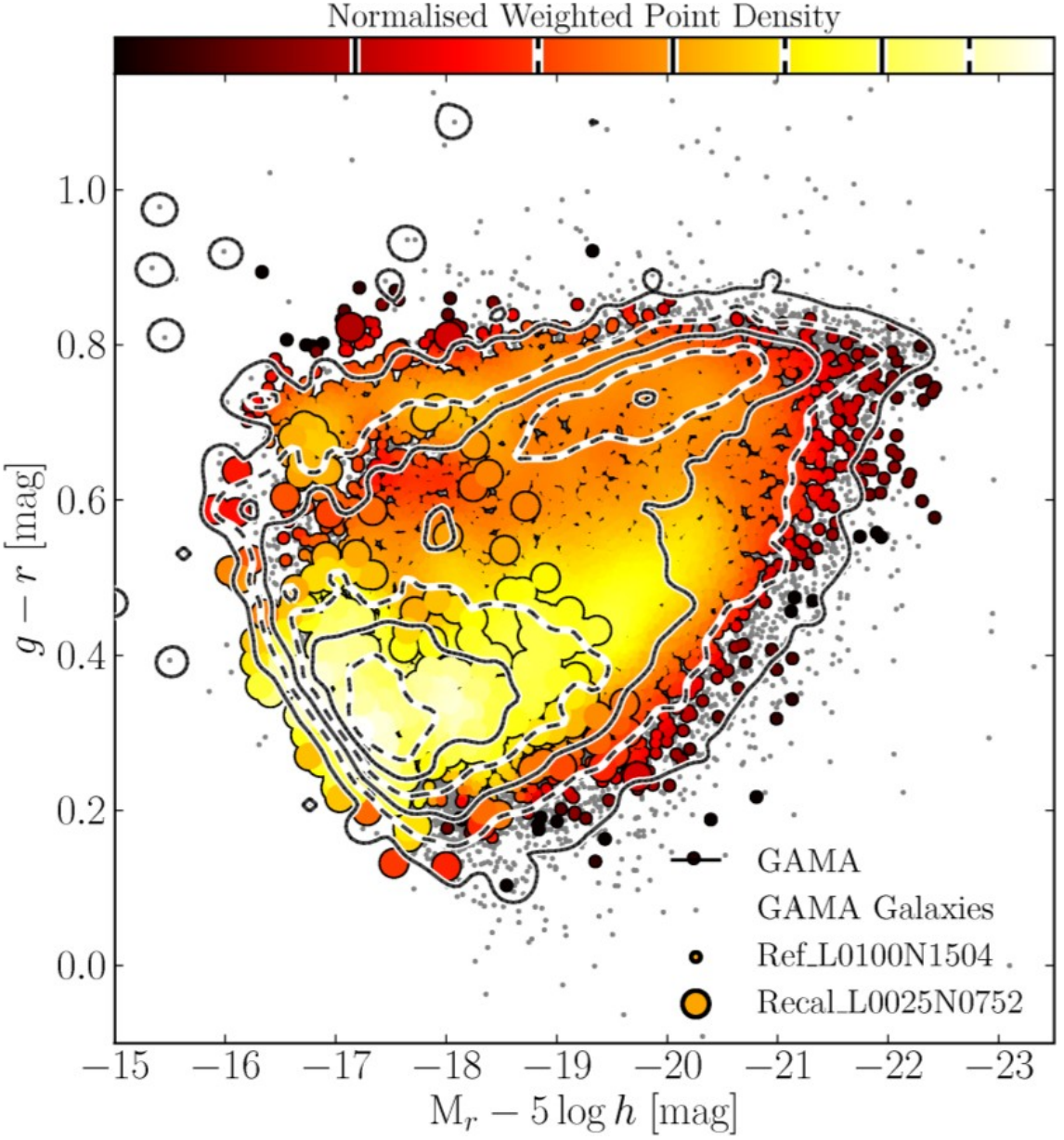
Free parameters in the model were calibrated to reproduce the z=0 GSMF and relation between galaxy masses and sizes.





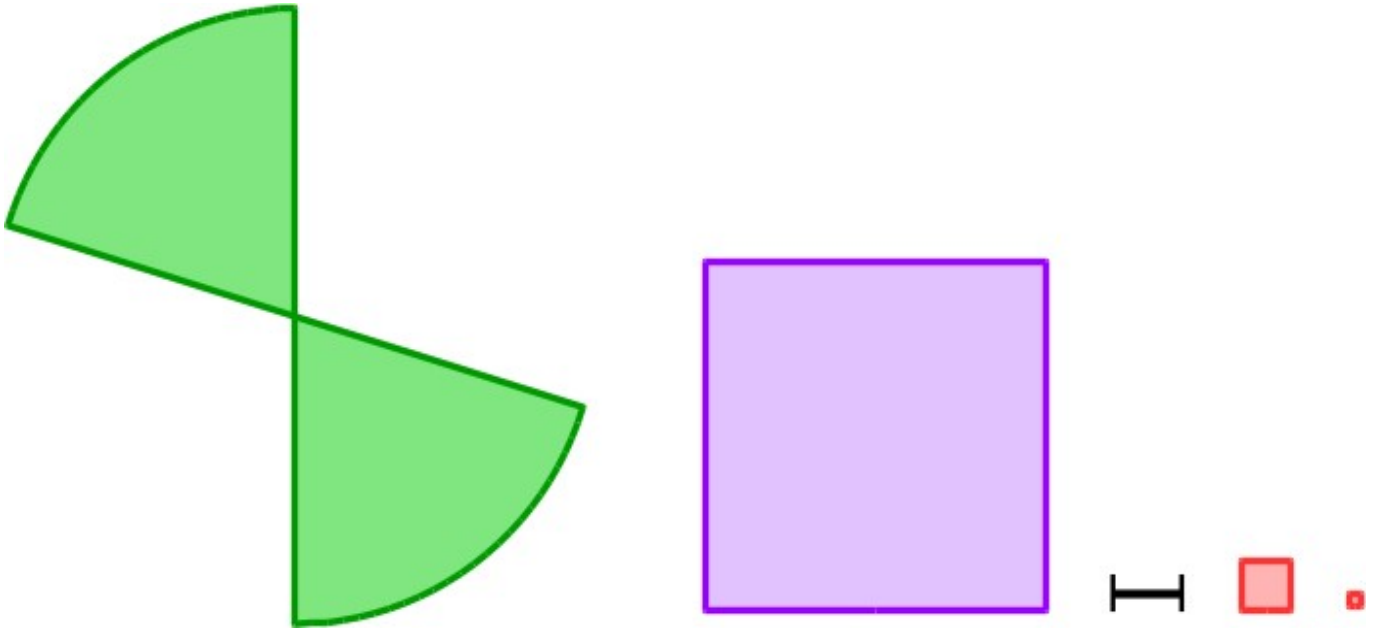
→ Looks like we have a plausible mass-loading function (by construction !)

EAGLE in a nutshell



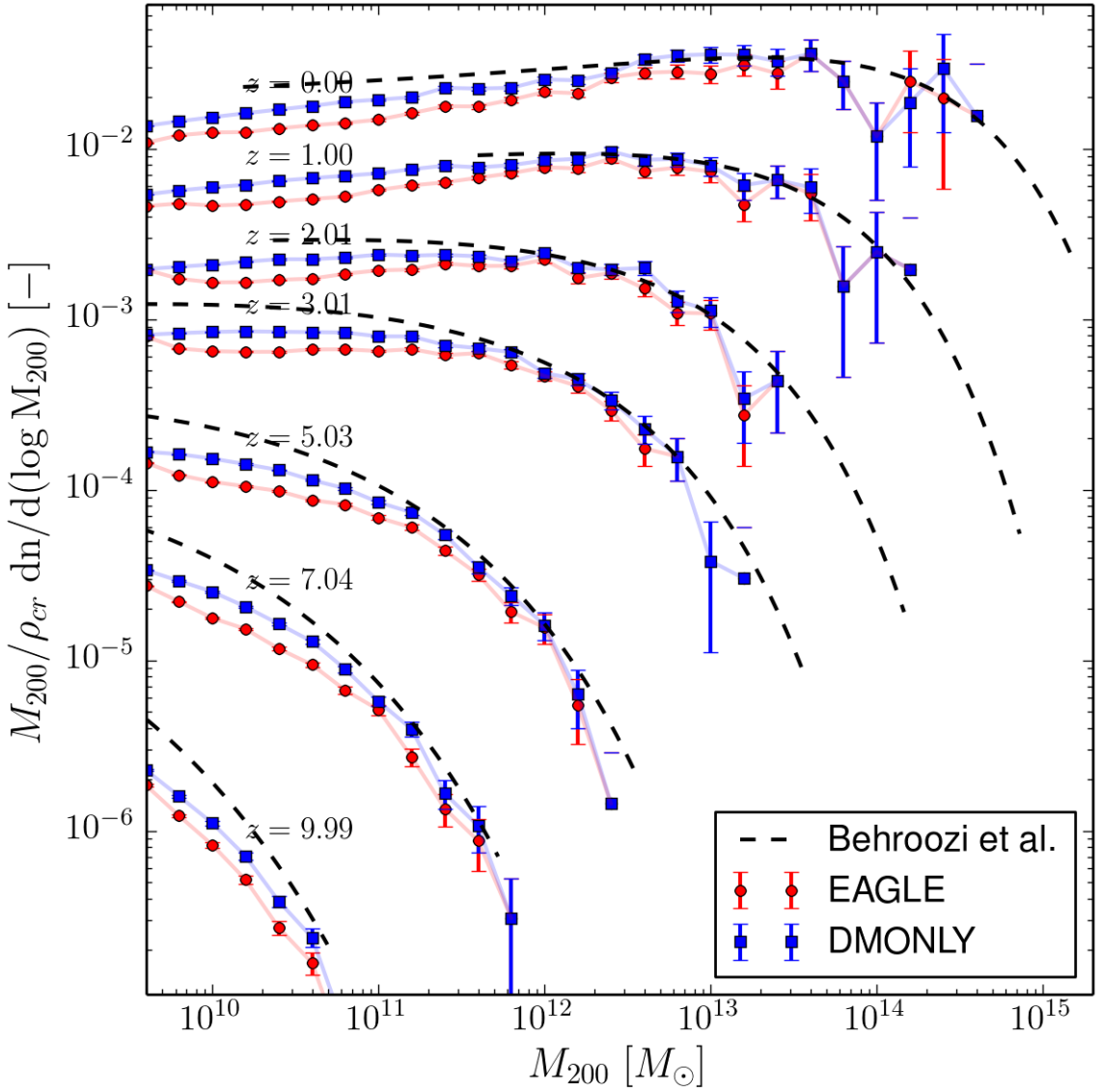
Trayford+2015 (1504.04374)

A sizeable problem for cosmology



4.5M CPU hours (final run) + 40M hours (calibration) + 2M hours (post-processing)

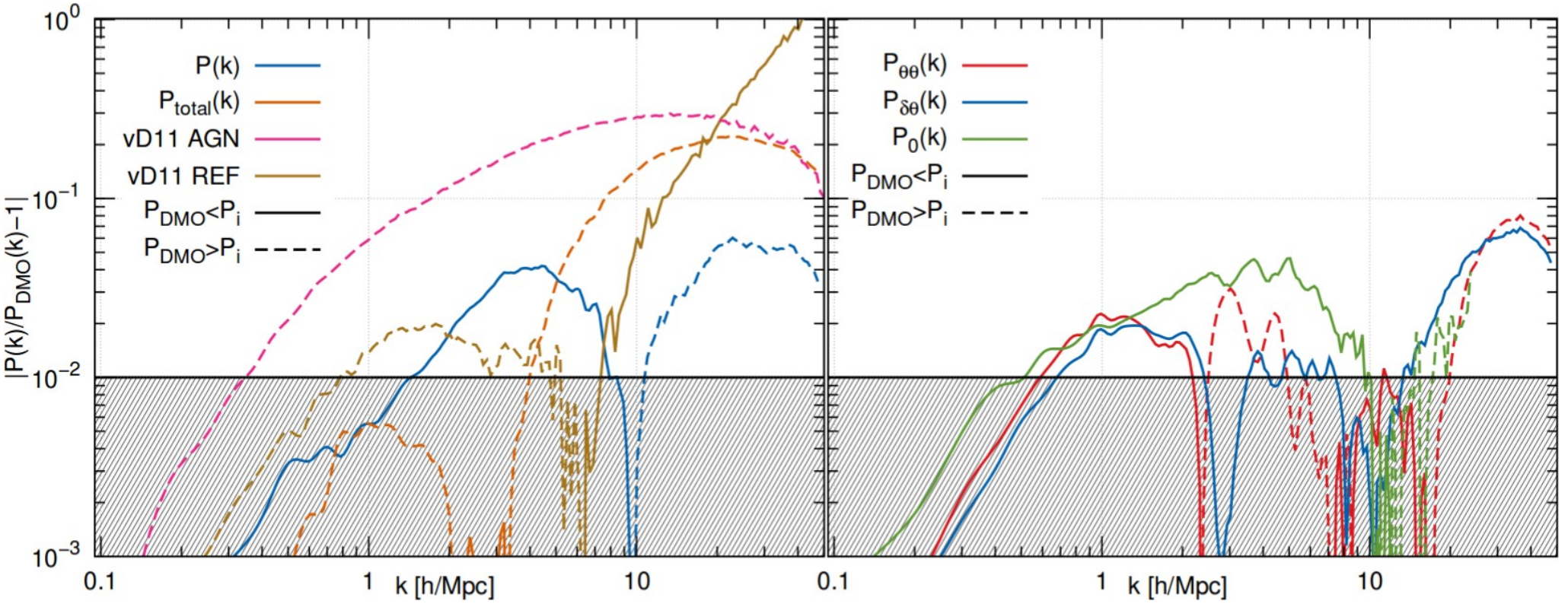
Baryons-DM interaction



- Halo mass functions change between DMONLY and HYDRO (>10% level) !
- If (big if) one could measure the HMF, and would use DMONLY as reference point, one would infer modified gravity at the many-sigma level !

See also Cusworth+2014 on the same topic.

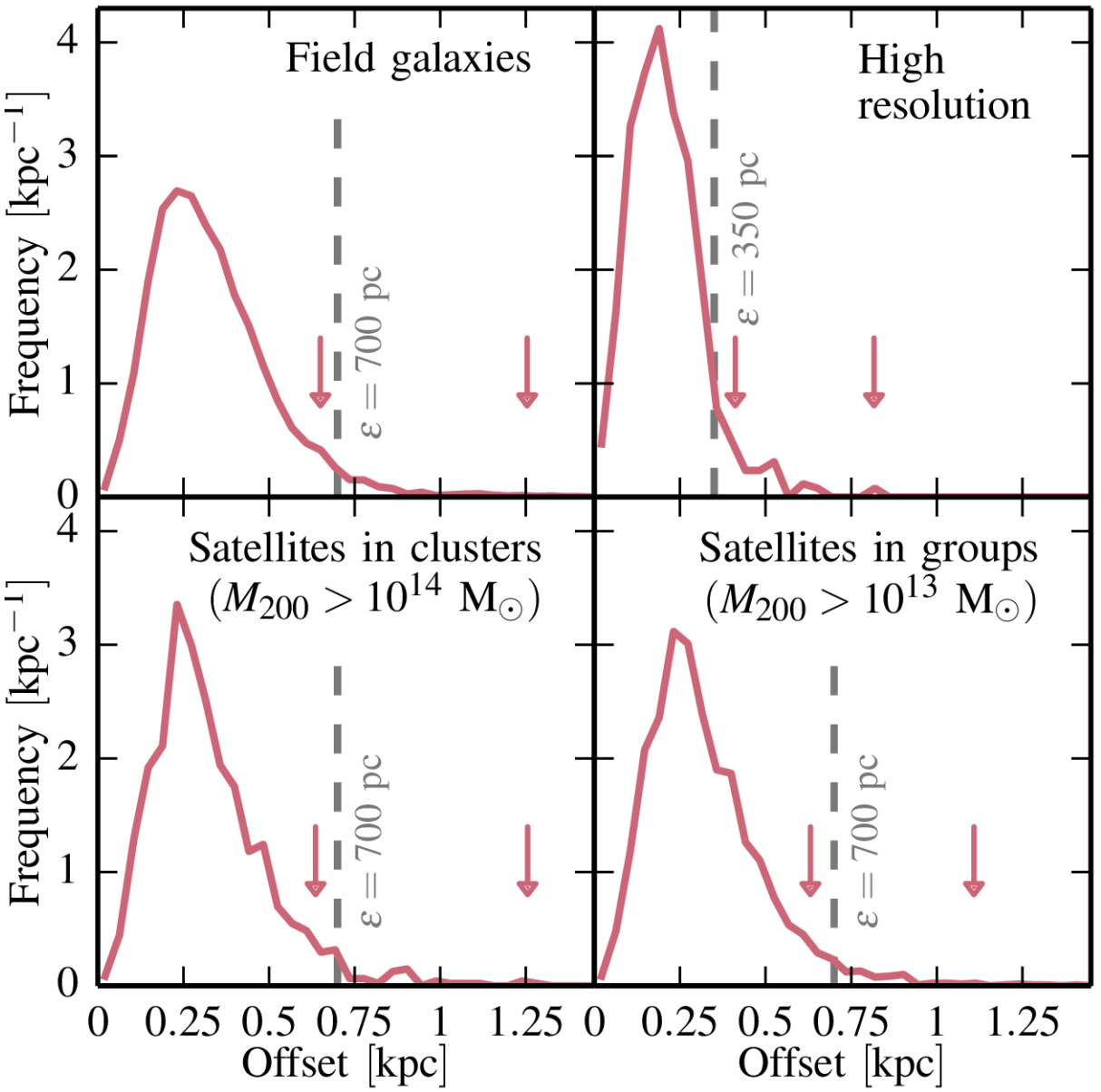
Baryons-DM interaction



Hellwing, Schaller et al. 2016

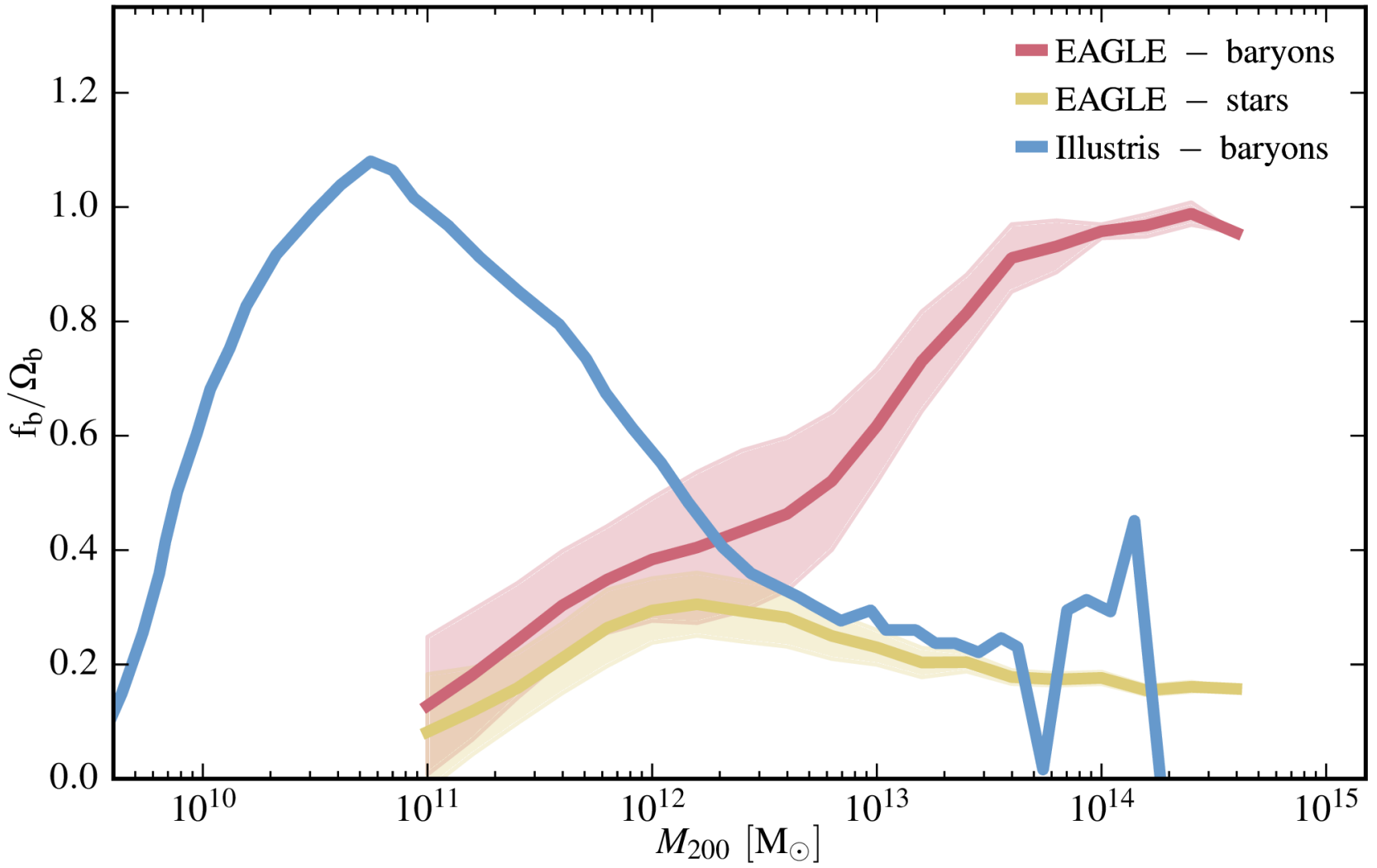
Total matter power-spectrum different (between n-body and EAGLE) at >1% level.
Not a trivial effect:
- not easy to “fit” out of a DMONLY simulation.

Baryons-DM offset ?



Schaller et al. 2015

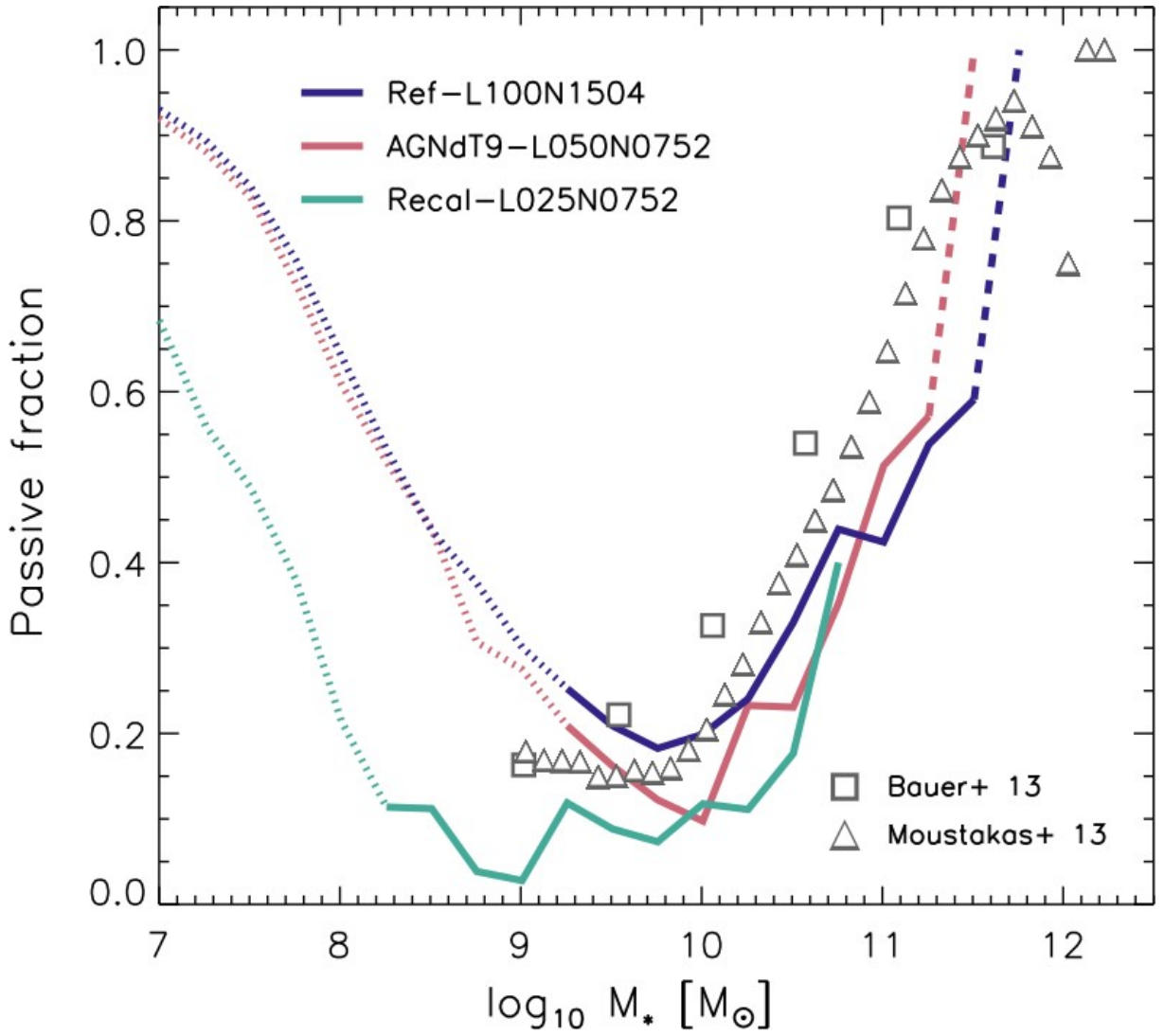
Is getting the GSMF good enough ?



Is getting the GSMF good enough ?

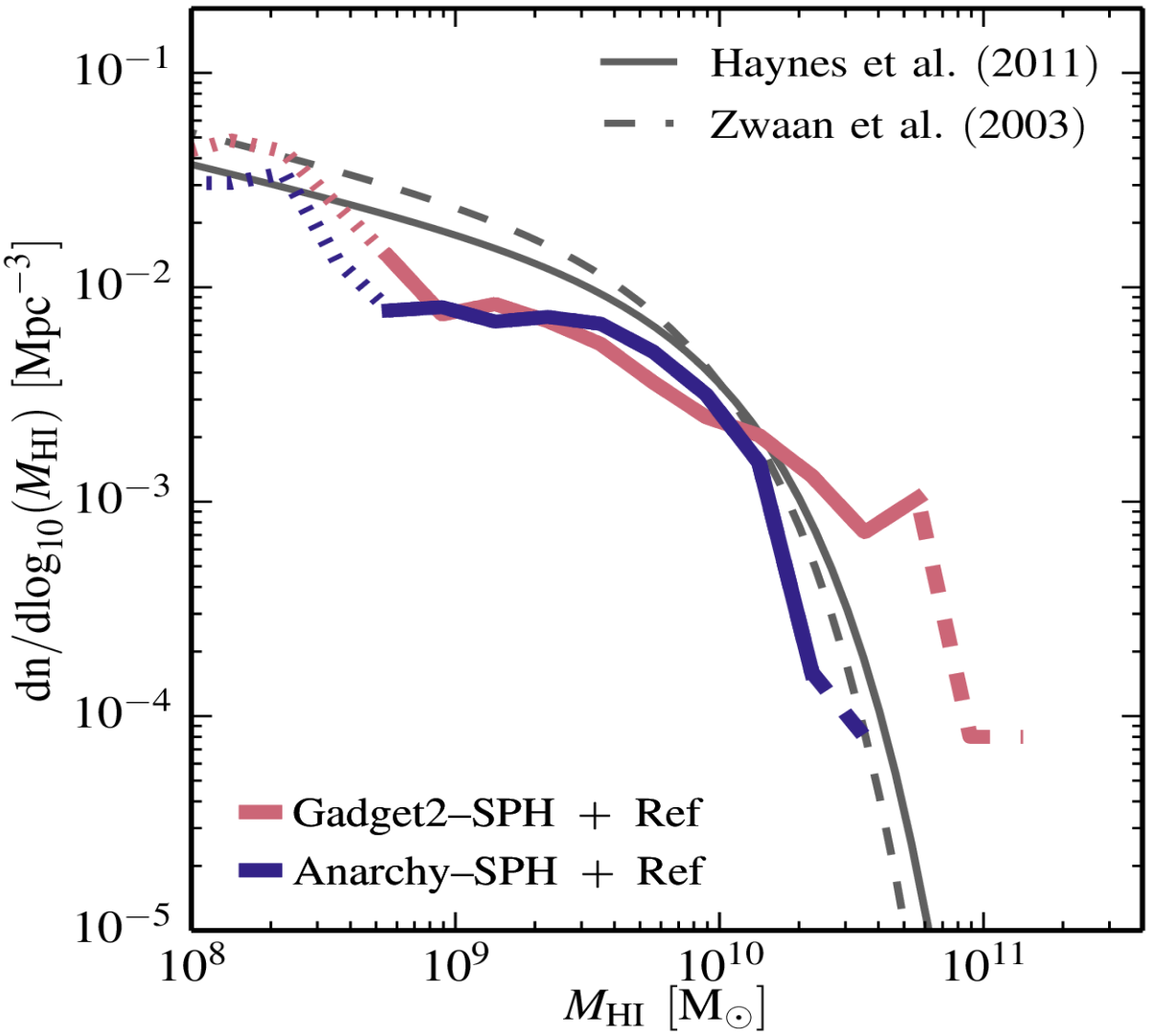
- There seem to be more to it.
- Different Mass-loading functions that give the ~ same GSMF lead to different results.
- Need more constrains to discriminate the Mass-loading functions.

Things to improve



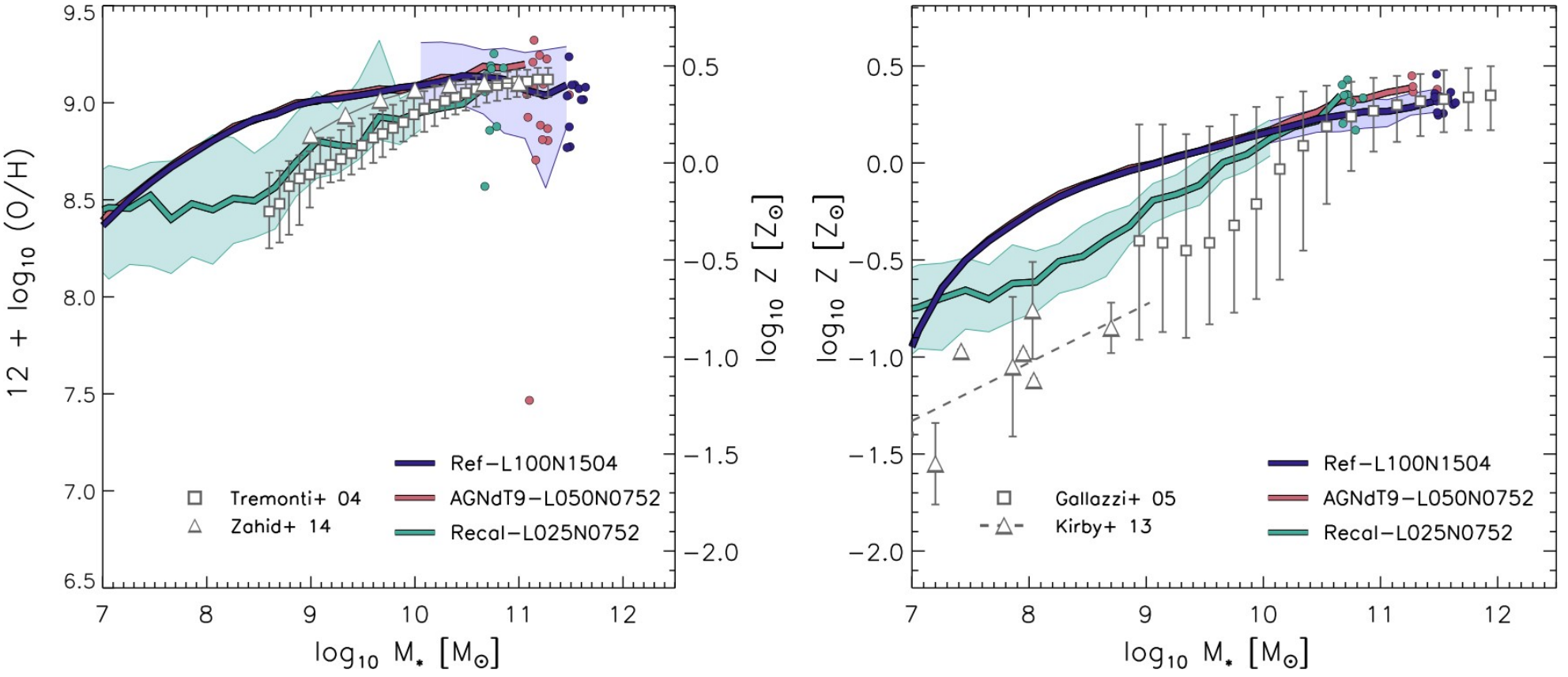
Onset of quenching at too large a mass → change AGN ?

Things to improve



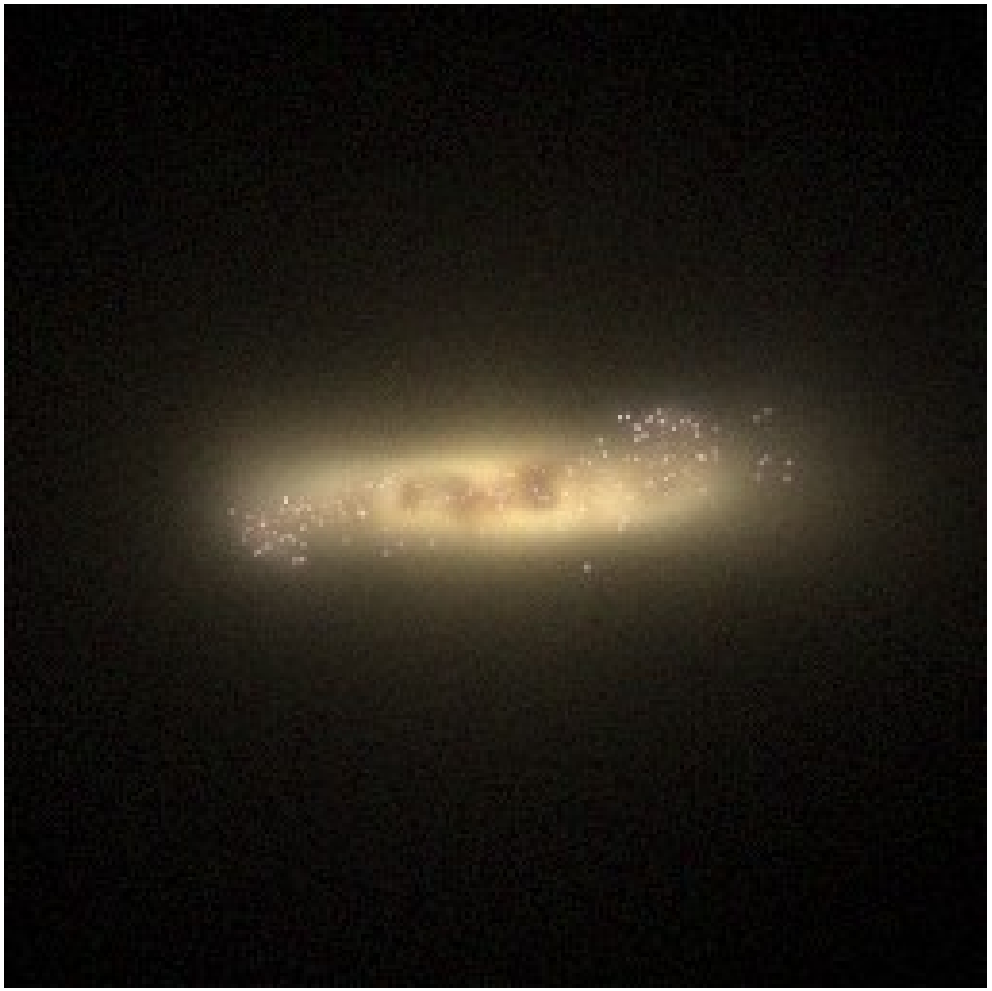
HI not great at low masses (Rob's talk). Improved SPH is important here.

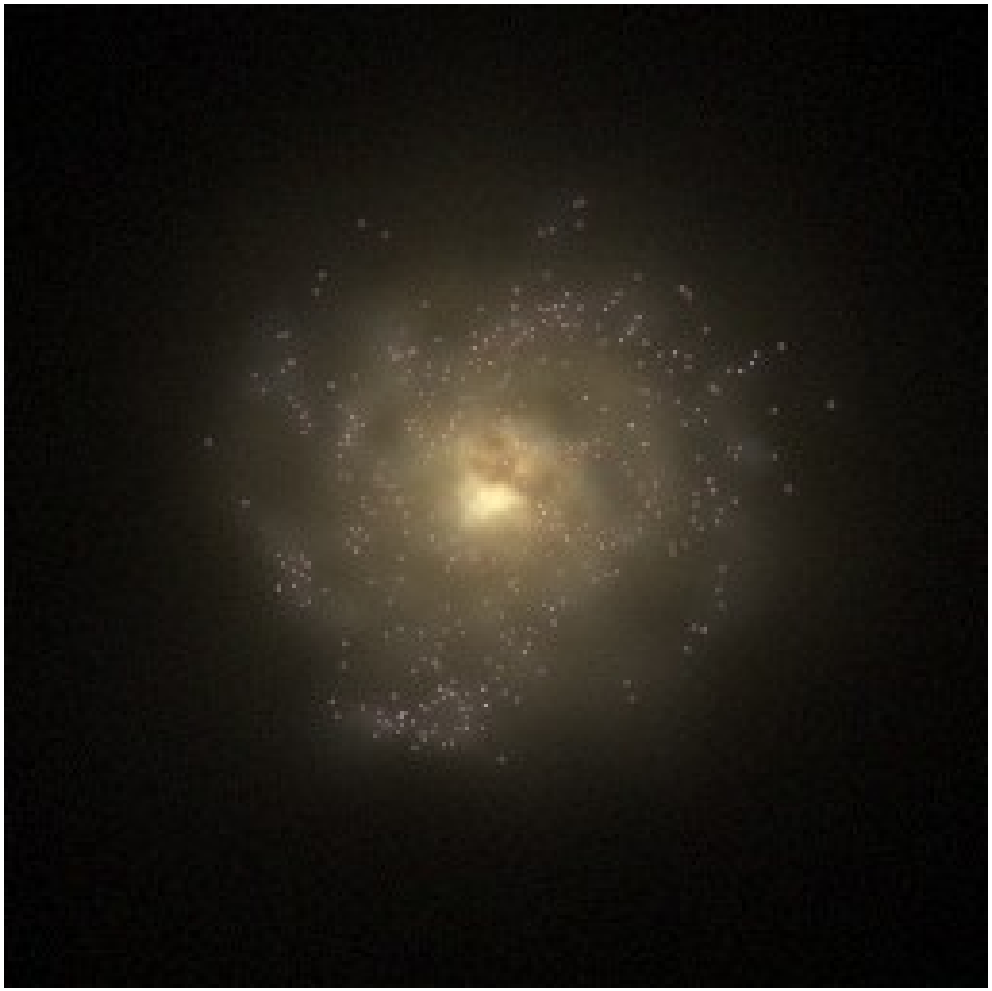
Things to improve



Mass – Metallicity too shallow ? Lack of mixing ? Resolution problem ?

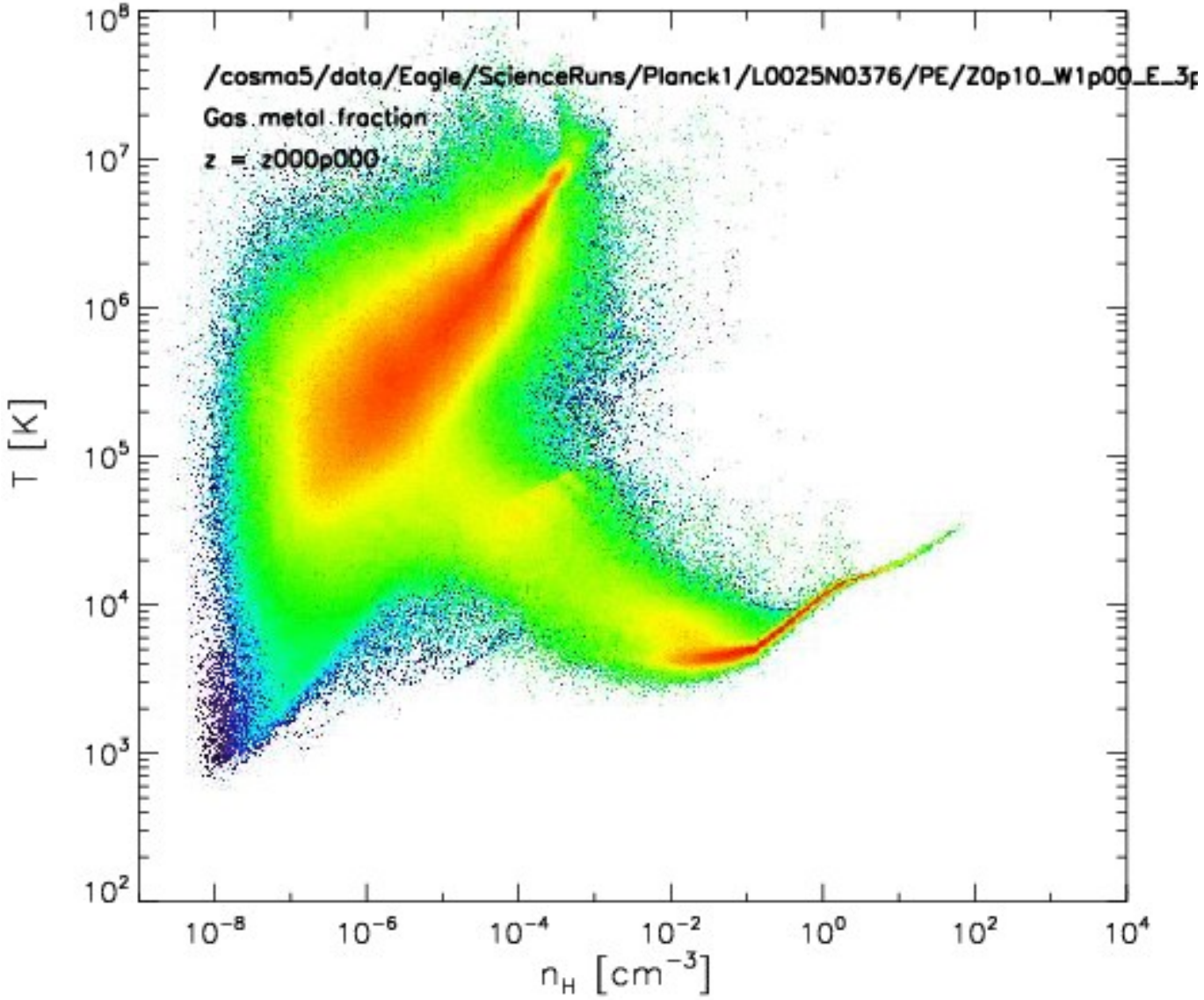
Things to improve



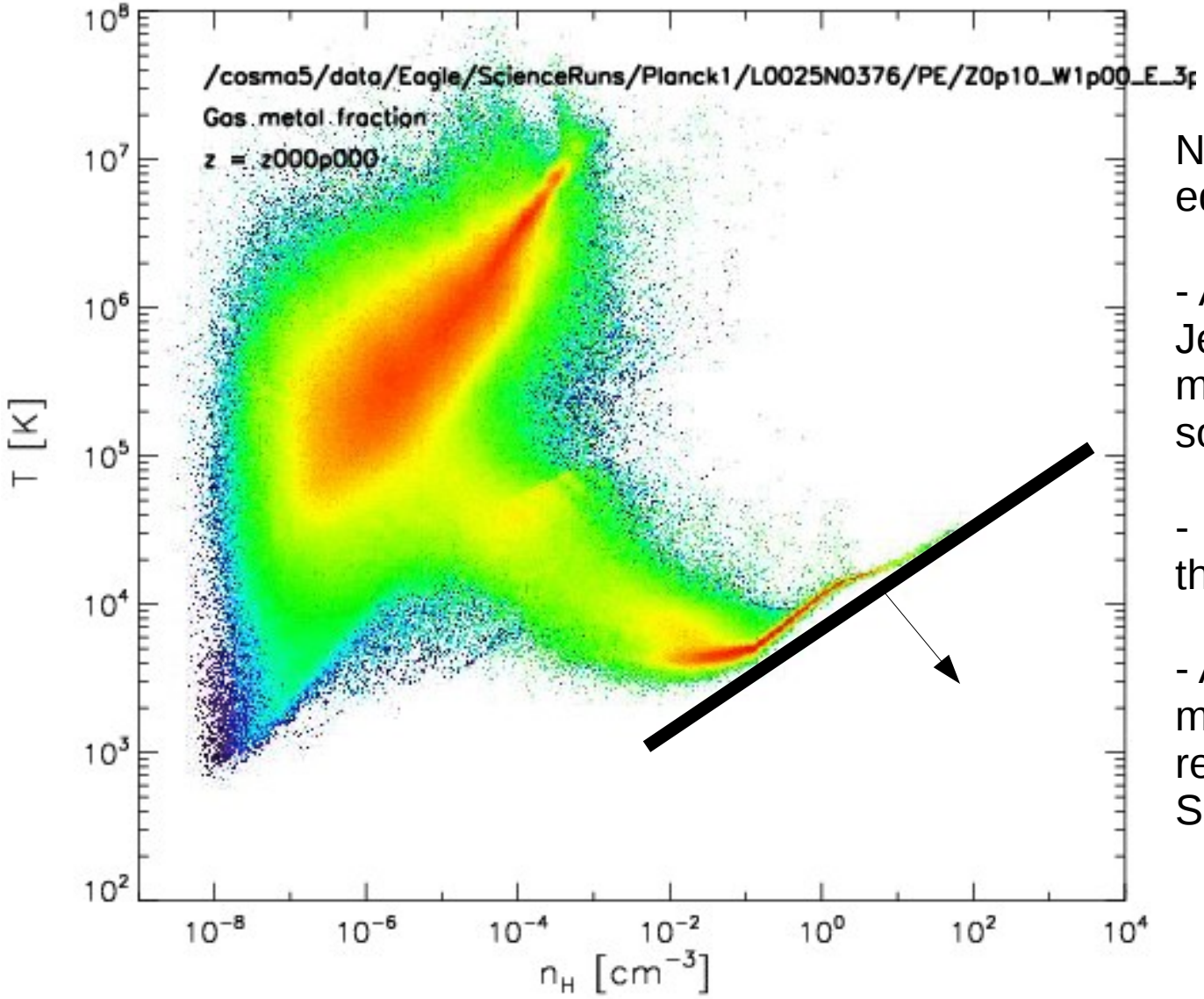


Discs are clearly too thick → EoS problem ? Softening problem ?

Equation of State



Equation of State



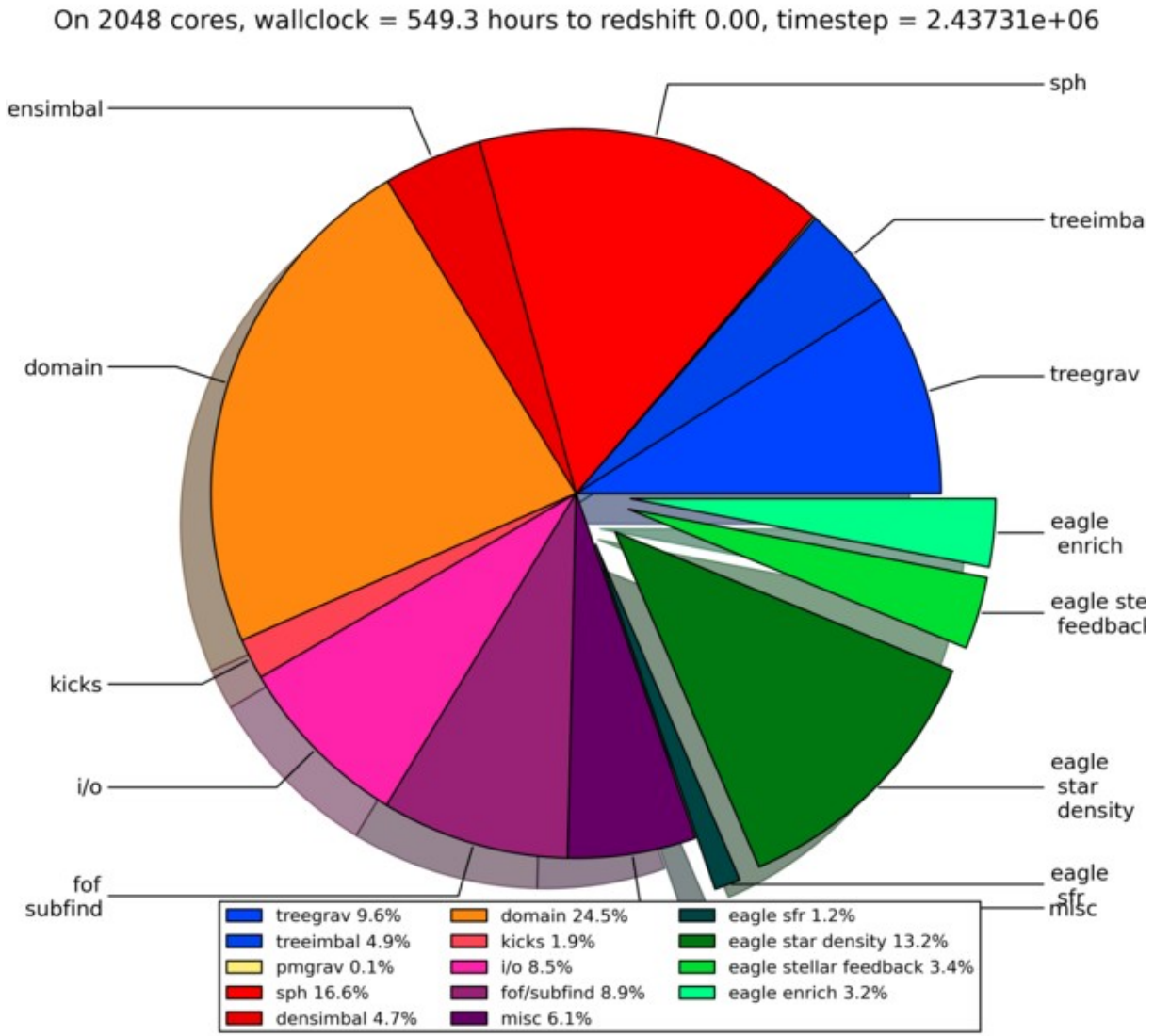
Need to lower the equation of state:

- Allow to resolve smaller Jeans length / Jeans masses with the hydro solver.

- Might help with disk thickness.

- Allows to implement more physics from higher res. models (cooling, SFR,...)

Technical issues



Conclusions

- We have a reasonable “Mass loading function” (by construction !).
- Nevertheless, HI masses, metallicities and disk heights are not greatly reproduced.
- Higher resolution helps for the first two.
- Will need improved model (different EoS, different softening ?).
- Calibration of the future runs will be very expensive and better scaling codes are required.