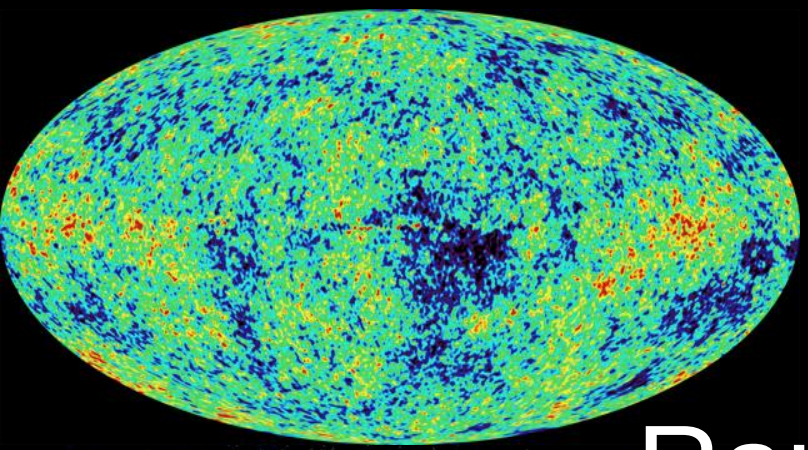
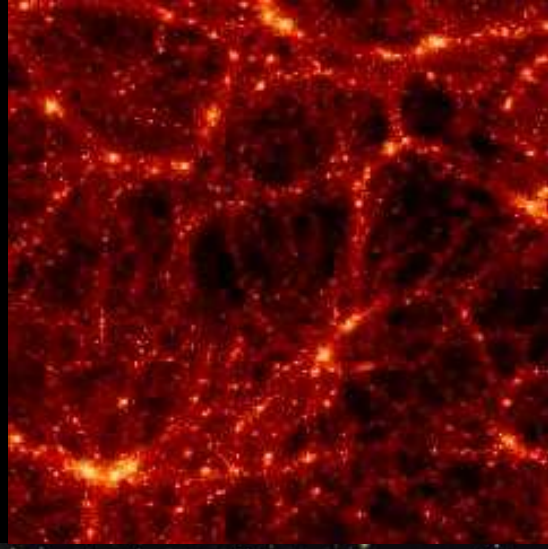
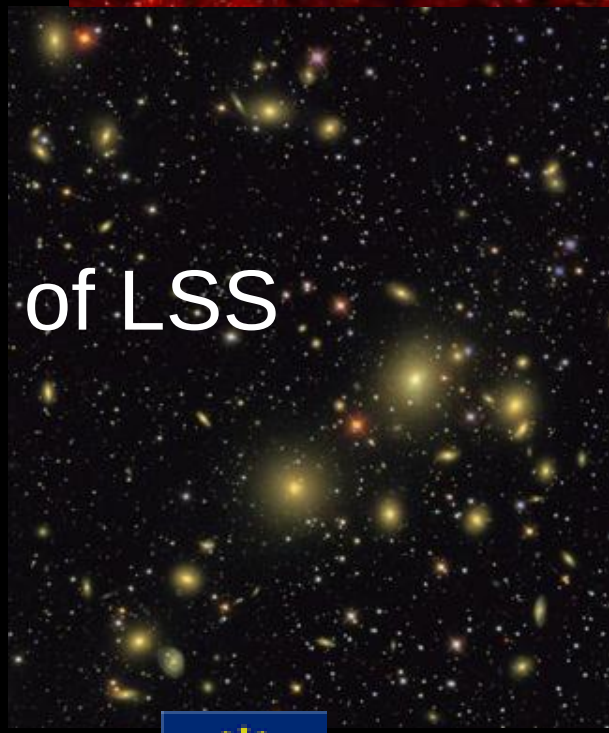




Raul Jimenez

The most non-linear phase of LSS



http://icc.ub.edu/~jimenez

CERN

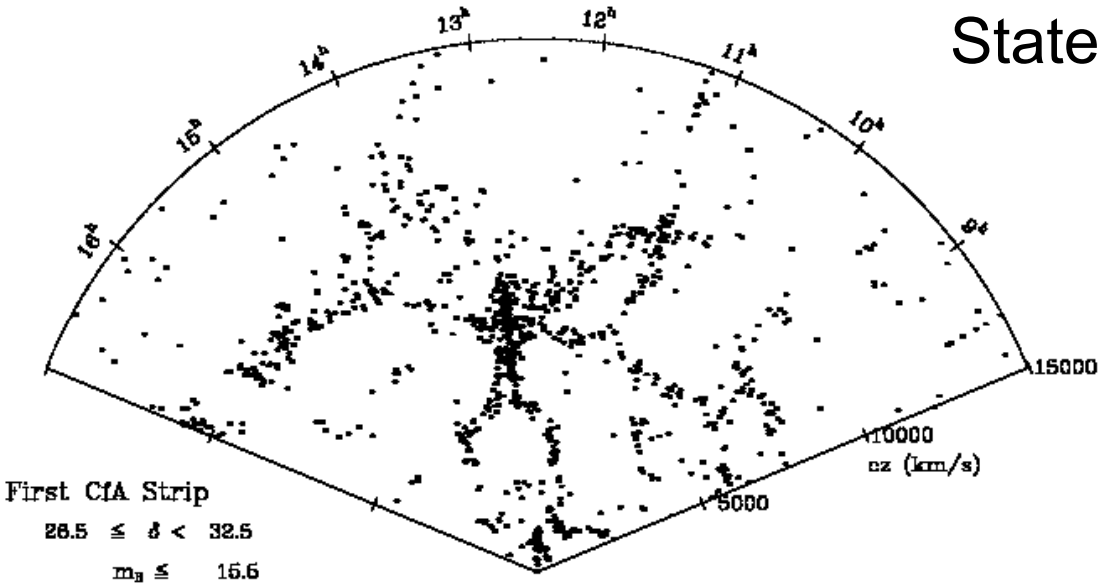
icrea
Institució Catalana de Recerca i Estudis Avançats

ICCUB
Institut de Ciències del Cosmos

UNIVERSITAT DE BARCELONA

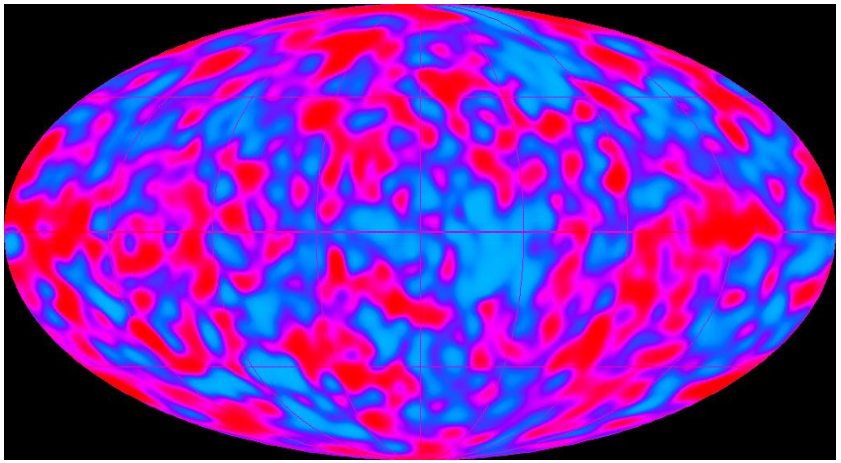
IEEC

Extremely successful model



State of the art of data then…

~14 Gyr
(a posteriori information)

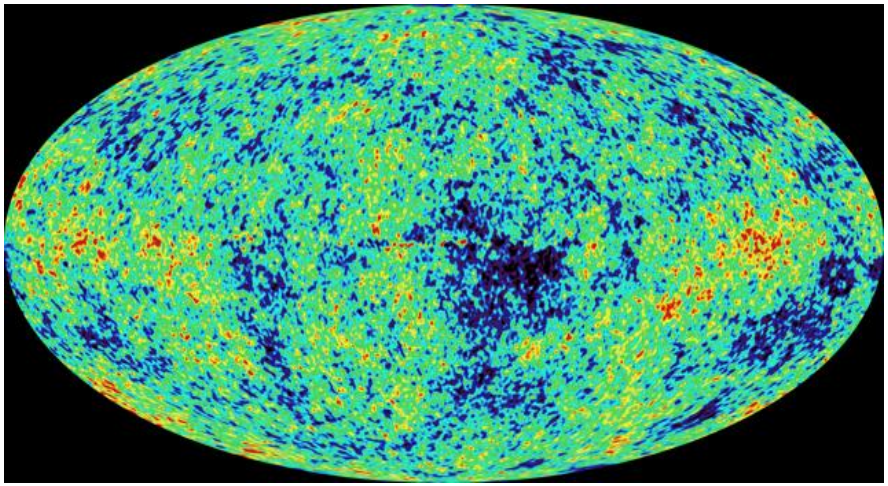


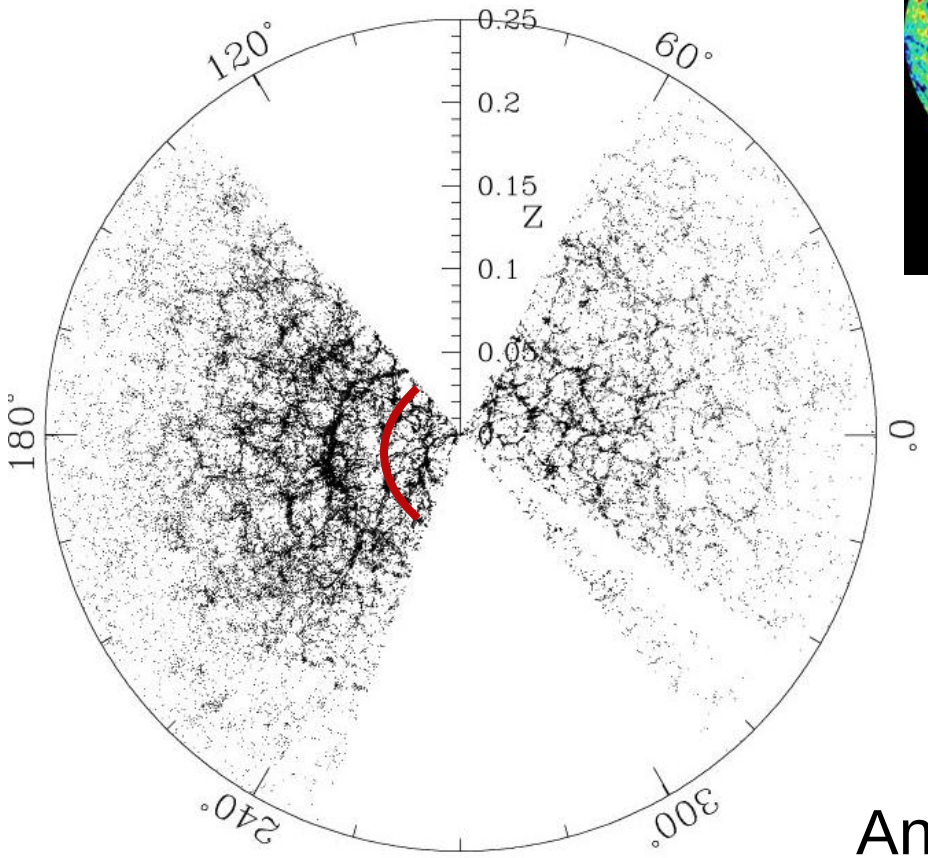
(DMR)COBE

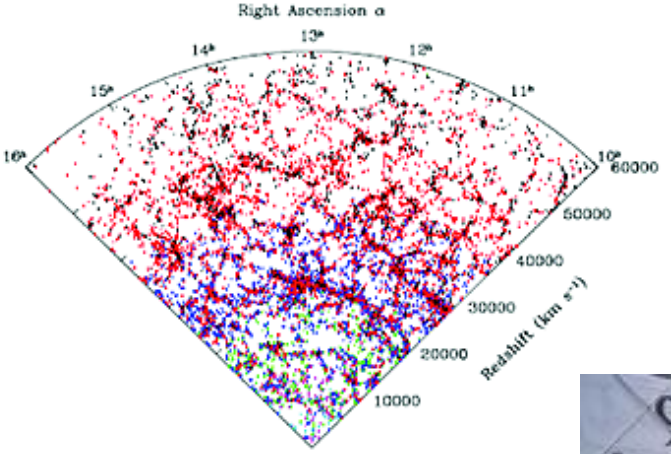
CMB

380000 yr
(a posteriori information)

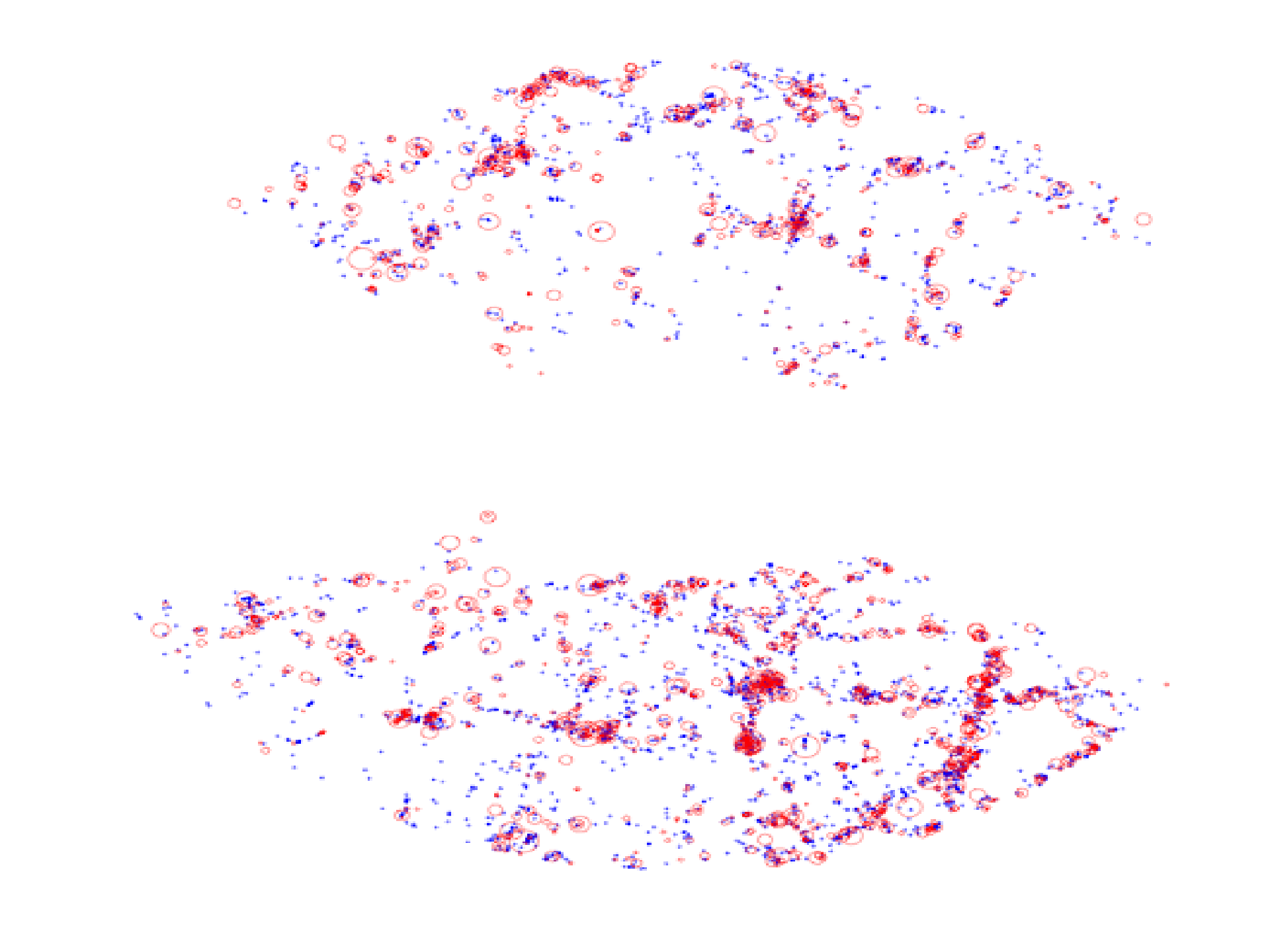
Avalanche of data







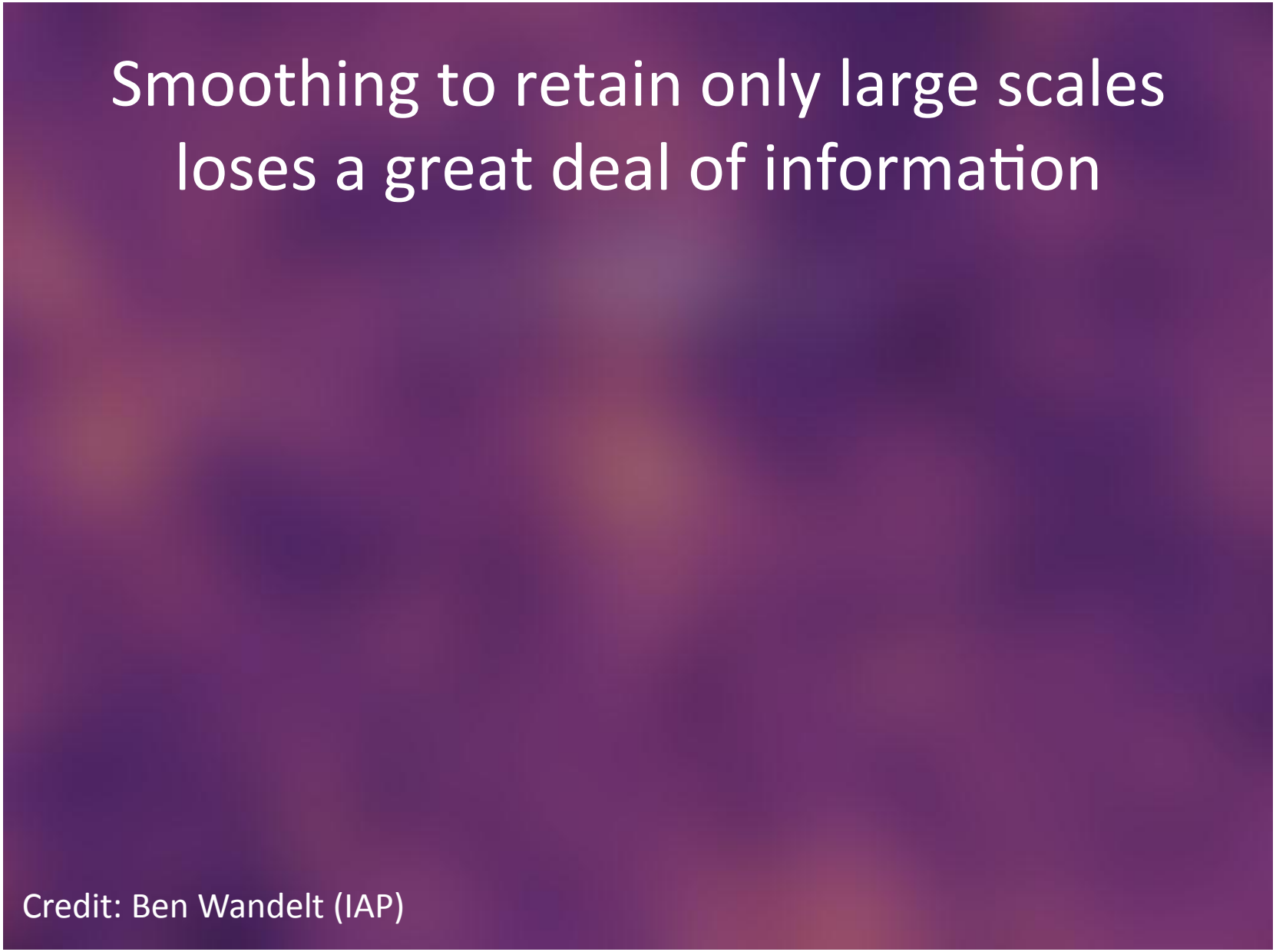
And it still holds!



How to deal with non-linearity?

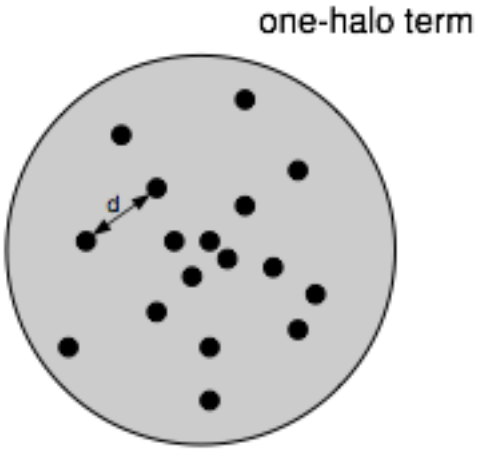
Credit: Ben Wandelt (IAP)

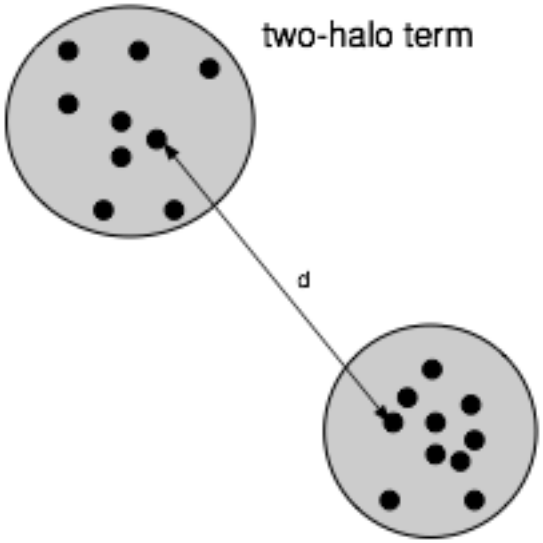
Smoothing to retain only large scales loses a great deal of information

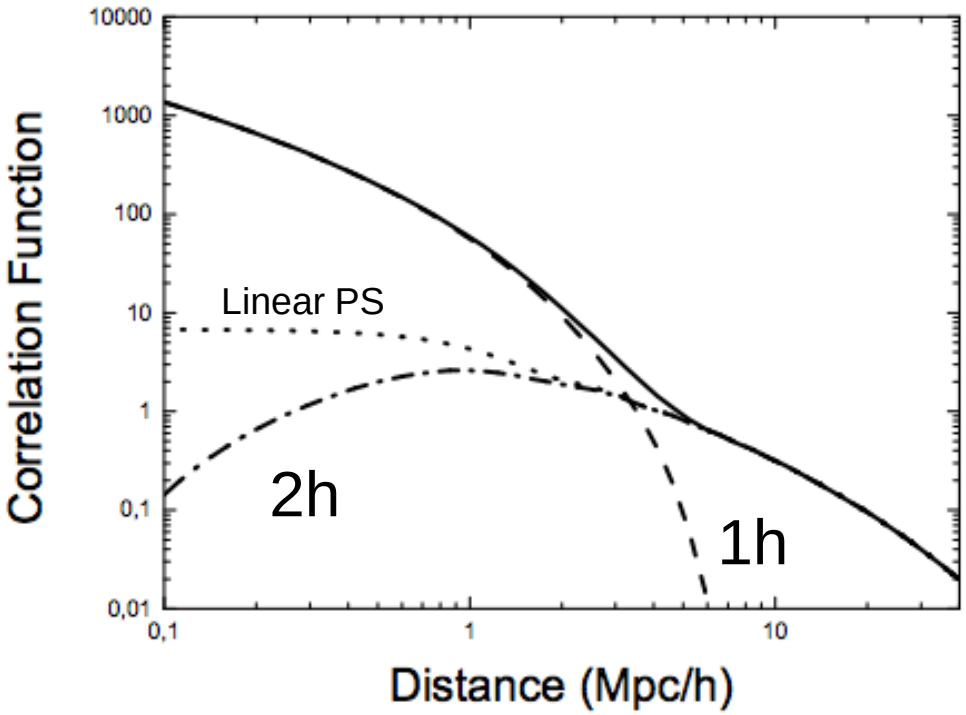


Credit: Ben Wandelt (IAP)

The Halo Model







The Halo Model

$$\xi_{dm}(\mathbf{r}) \equiv < \delta(\mathbf{x})\delta(\mathbf{x}+\mathbf{r}) >$$

$$\xi_{dm}(\mathbf{r}) = \xi^{1h}_{dm}(\mathbf{r}) + \xi^{2h}_{dm}(\mathbf{r})$$

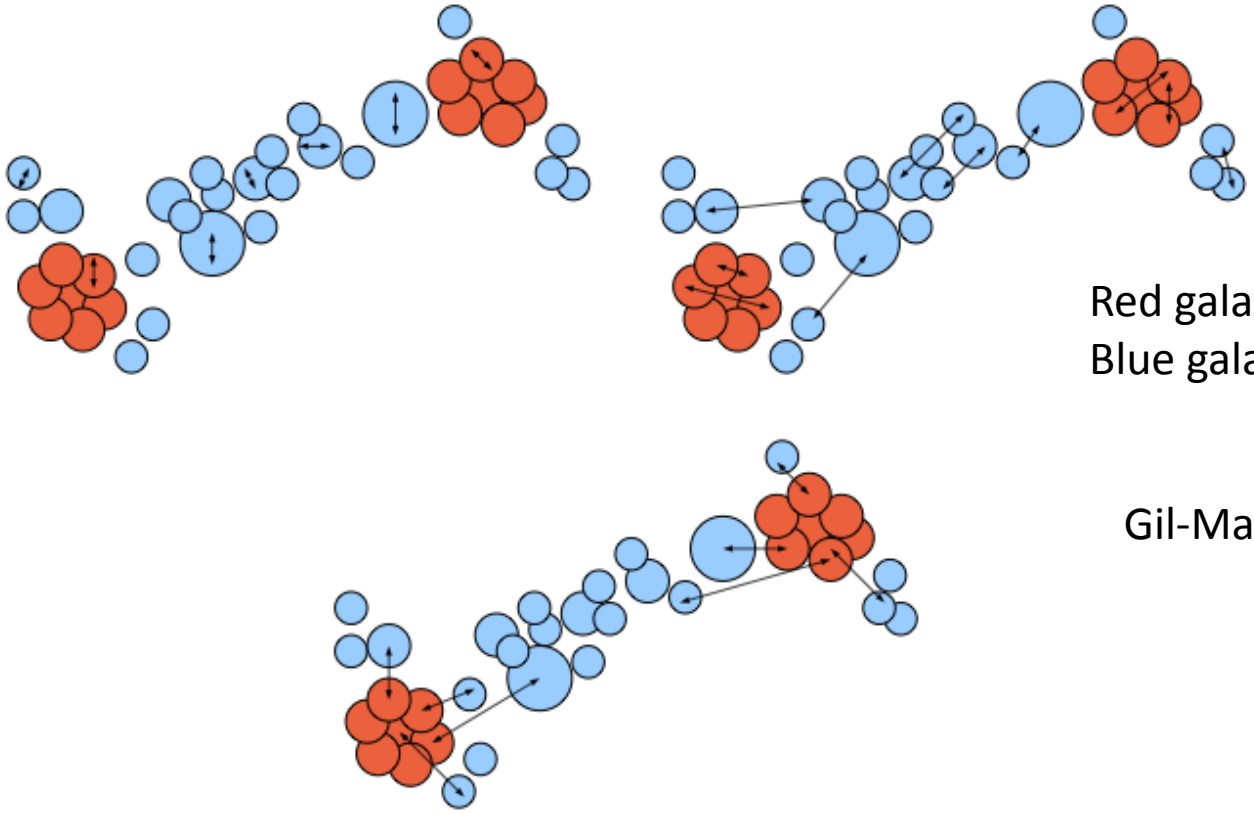
$$\xi^{1h}_{dm}(\mathbf{r},z) = \int dm \, \frac{m^2\, n(m,z)}{\bar{\rho}^2_h(z)} \int_V d^3\mathbf{x}\, u(\mathbf{x}|m)\, u(|\mathbf{x}+\mathbf{r}||m)$$

$$\xi^{2h}_{dm}(\mathbf{r},z) = \int dm' \, \frac{m'\, n(m',z)}{\bar{\rho}_h(z)} \int dm'' \, \frac{m''\, n(m'',z)}{\bar{\rho}_h(z)} \int_V d^3\mathbf{x}'\, u(x'|m') \int_V d^3\mathbf{x}''\, u(x''|m'')\xi_{hh}(|\mathbf{x}'-\mathbf{x}''+\mathbf{r}|,z,m',m'')$$

And provides a formalism to also model the clustering of galaxies: just modify the density profile of the one halo term

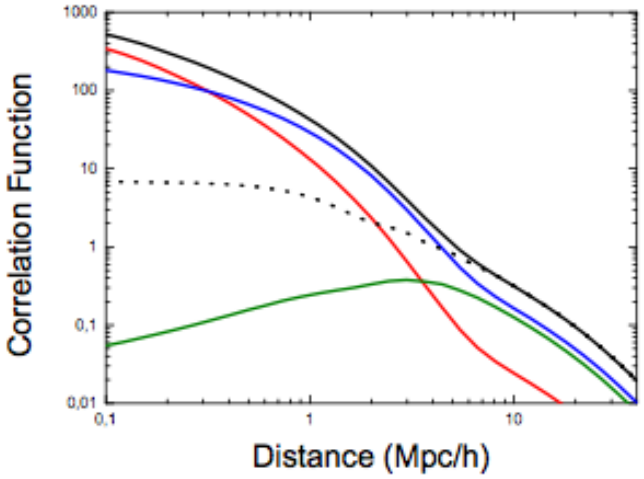
$$u(r|m,c) \equiv \frac{\rho(r|m,c)}{m}$$

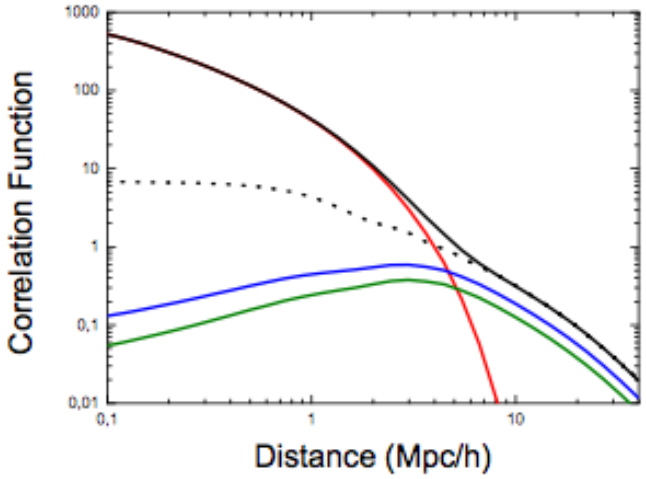
$$1 = \int_0^{r_{vir}(m)} d^3\mathbf{x}\, u(x|m,c)$$



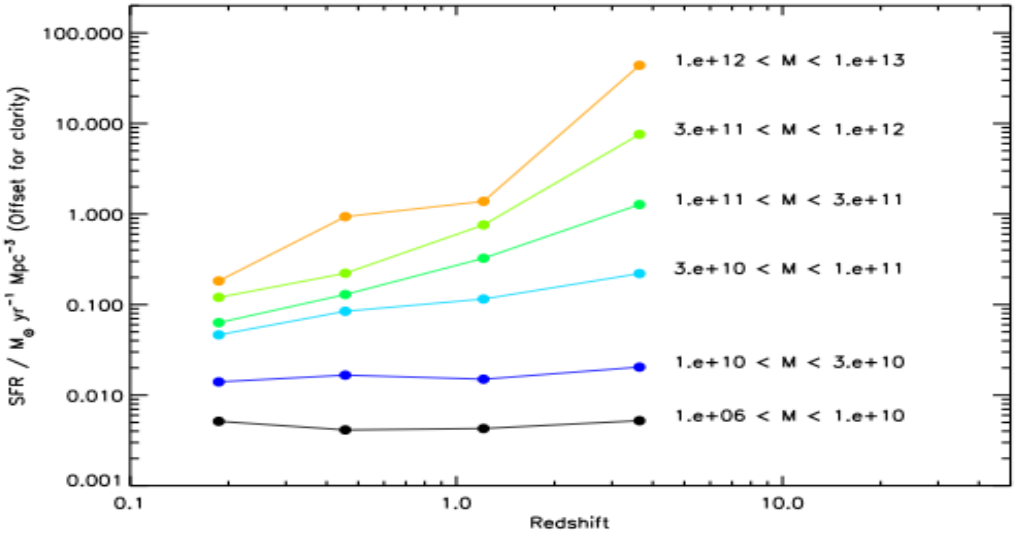
Red galaxies are in clusters and
Blue galaxies in filaments

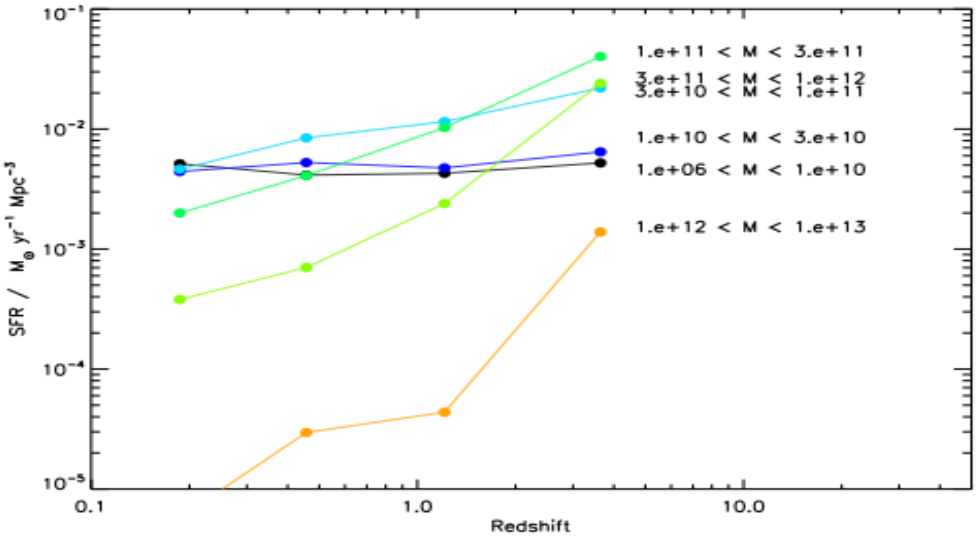
Gil-Marin et al. 2011 MNRAS





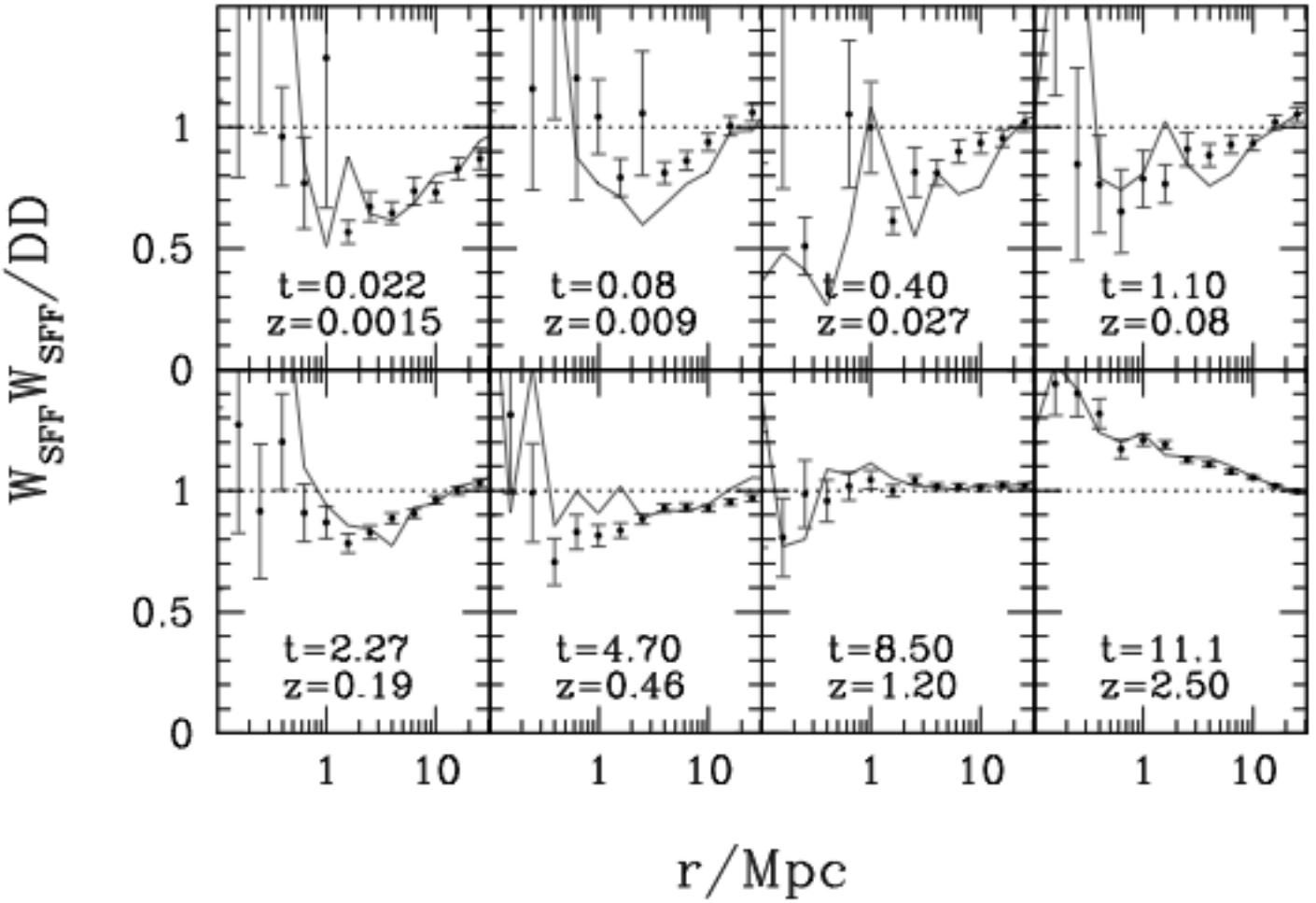
Yet, (present) stellar mass determines where and how the galaxy formed and evolved



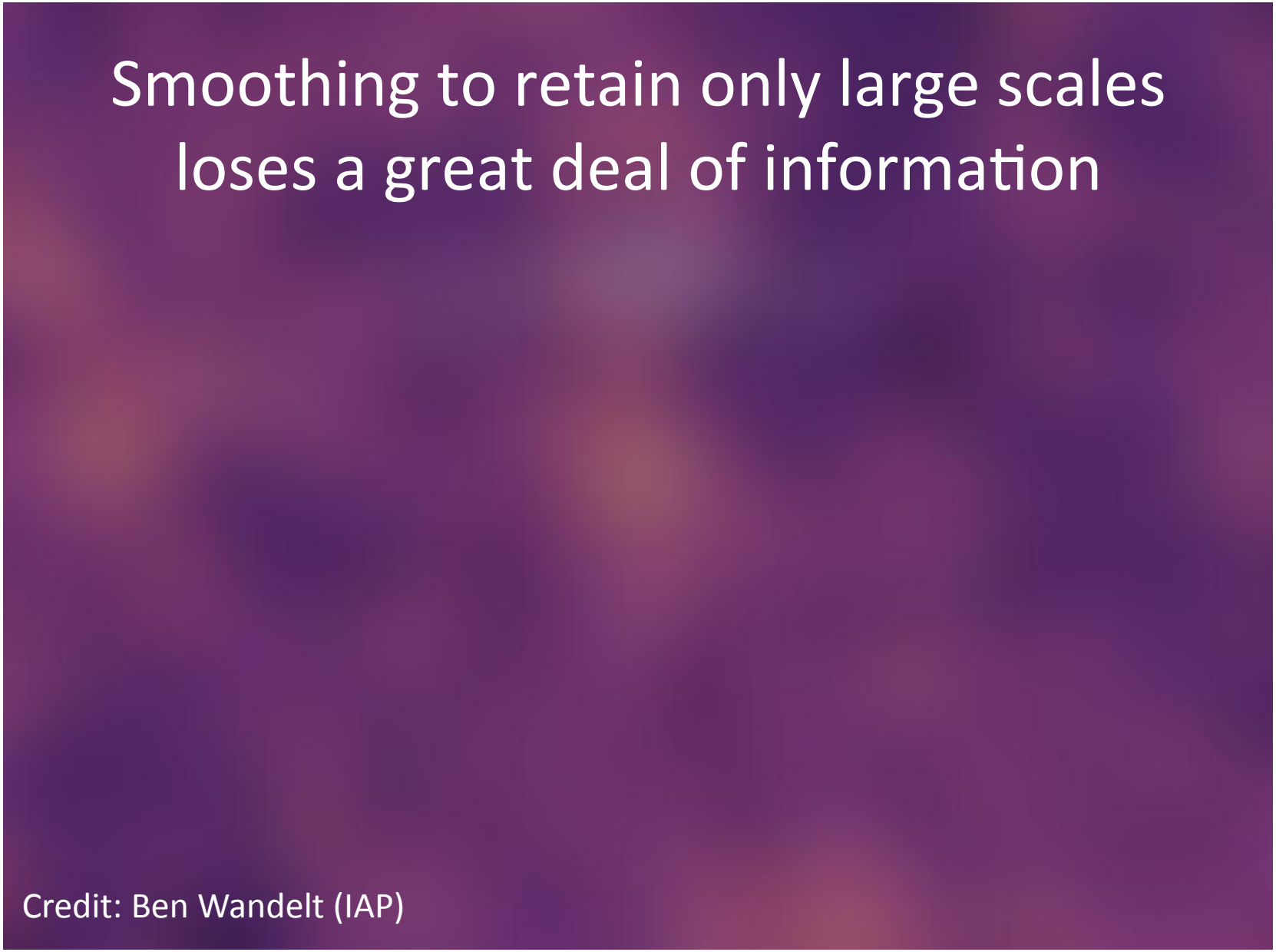


SF as a function of environment (Mark Correlations)

Sheth, RJ, Panter, Heavens, ApJL, astro-ph/0604581

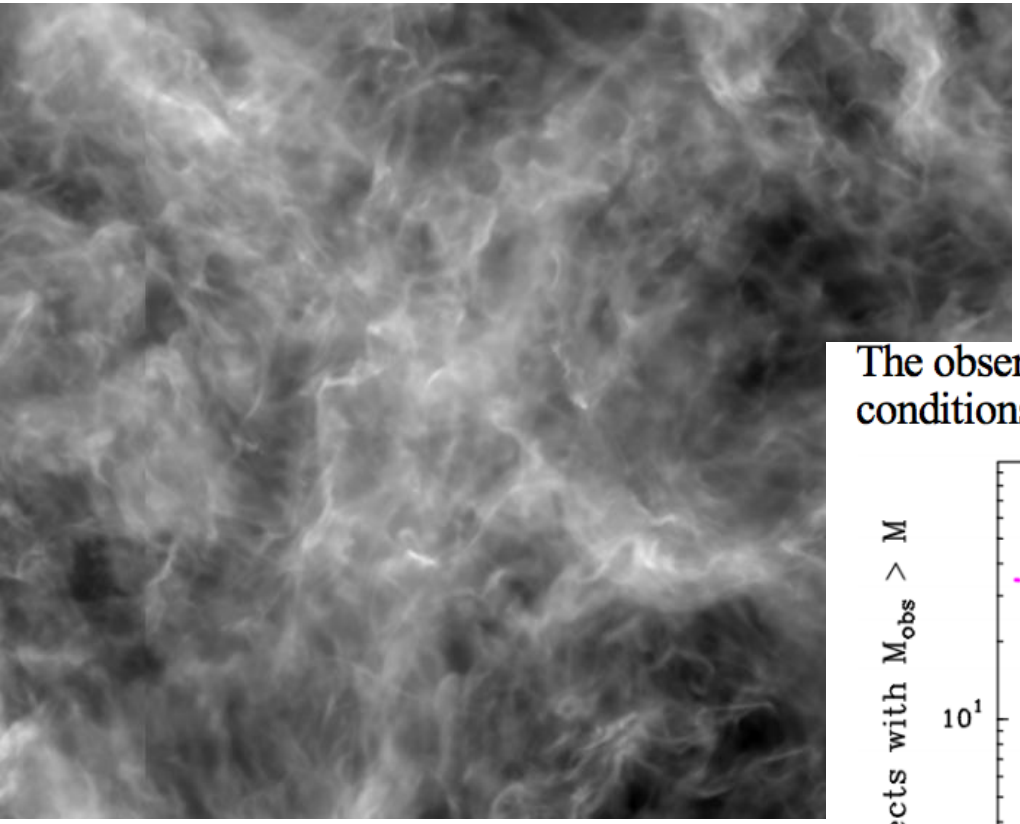


Smoothing to retain only large scales loses a great deal of information

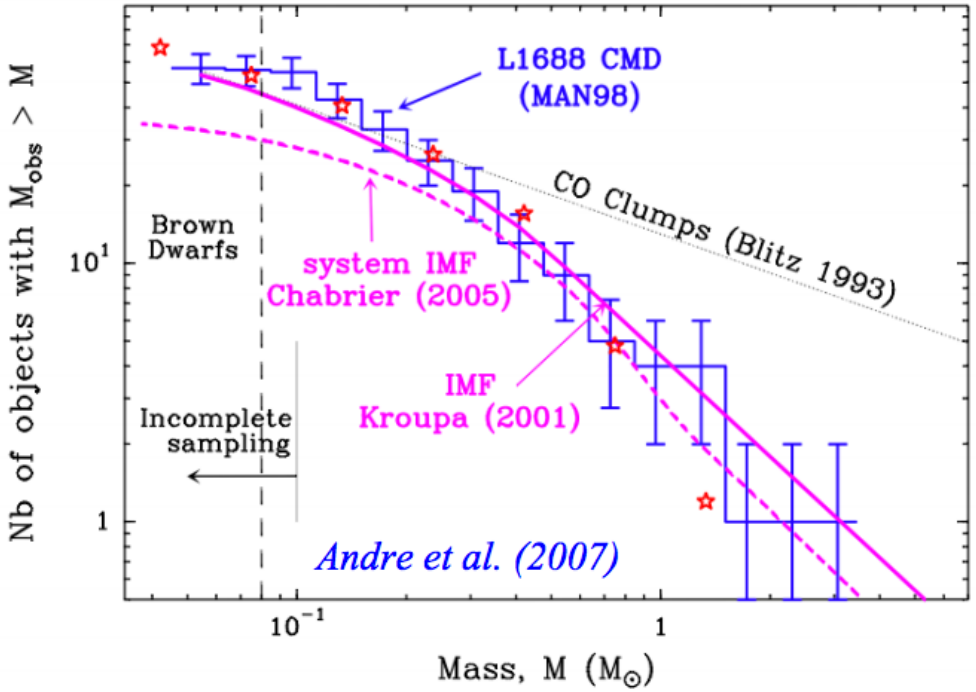


Credit: Ben Wandelt (IAP)

What we have learned from the most non-linear scales:

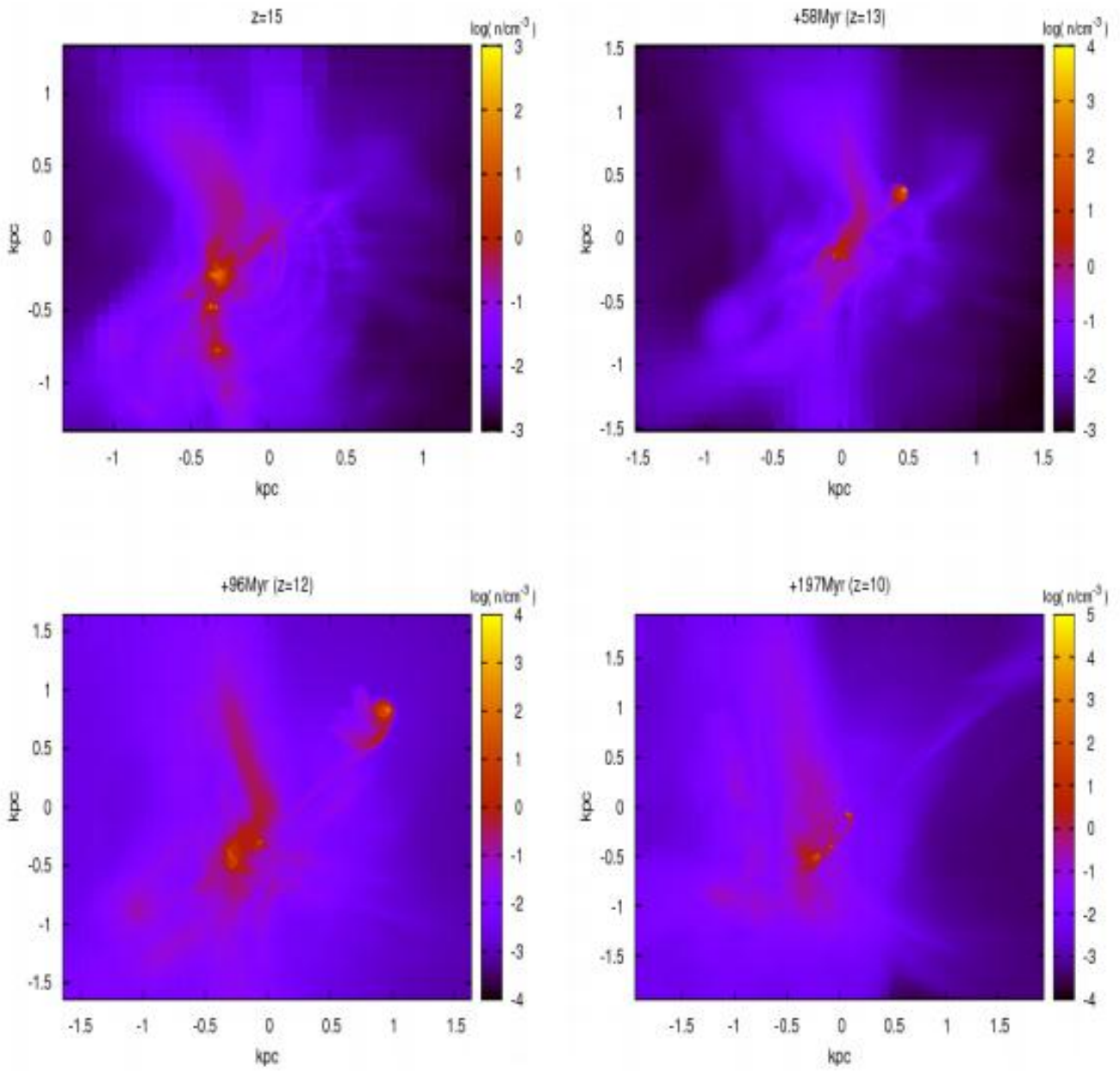


The observed core mass distribution suggests that initial conditions from turbulence are relevant for the IMF.

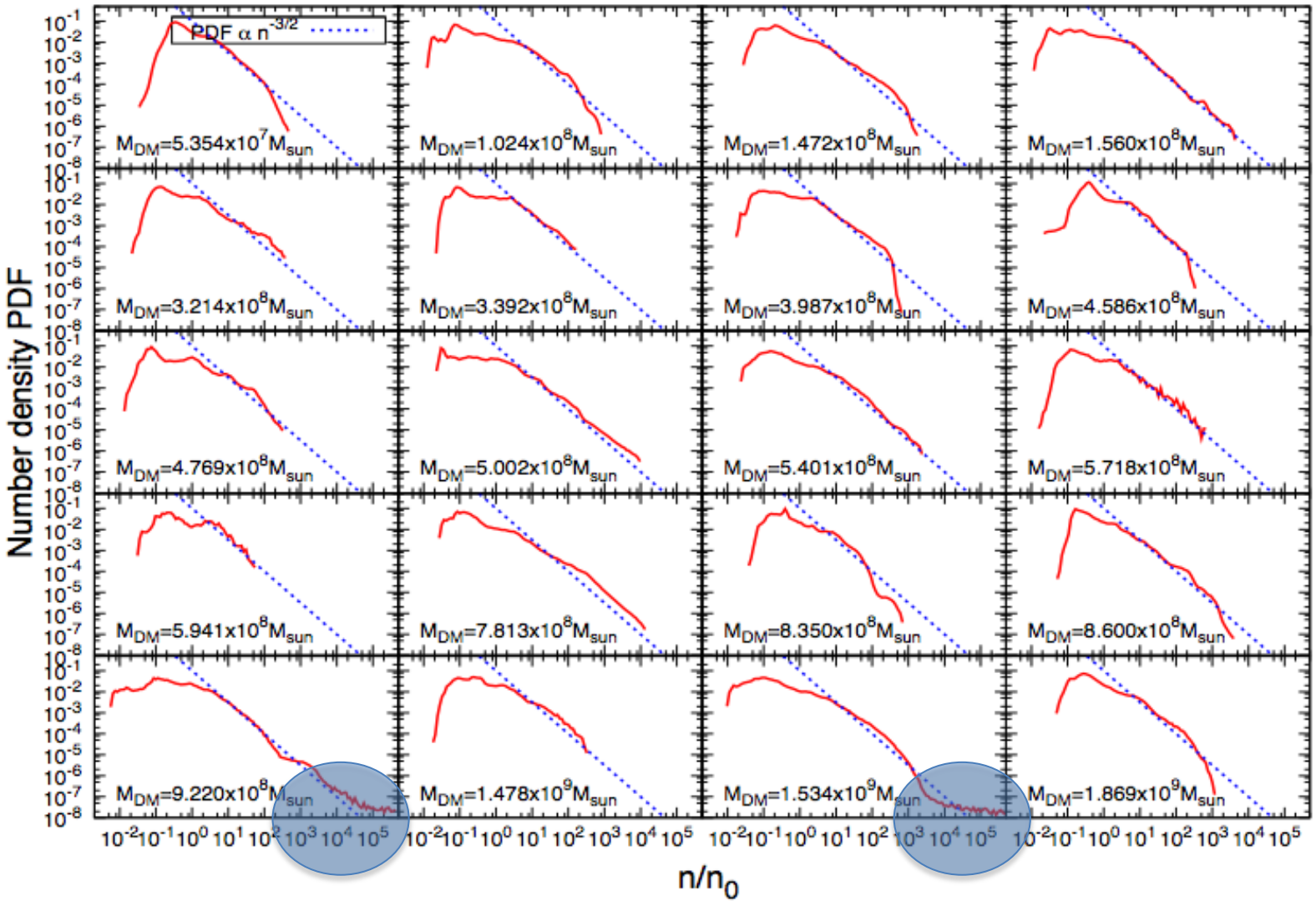


Our findings from hydro-simulations are that a similar picture may apply to galaxies

Prieto, RJ, Marti, 2011 MNRAS



Prieto, Haiman, RJ 2012/2013 MNRAS



Conclusions and Future Outlook

- Smoothing is a very poor way to treat the rich cosmological datasets, i.e. the whole sky
- We need to model the DM halos and galaxies
- Halo model of such is not god enough to obtain % cosmological parameters
- Fully non-linear turbulent flows maybe the clue to exploit scaling laws in non-linearity
- We should take advantage of non-linearity