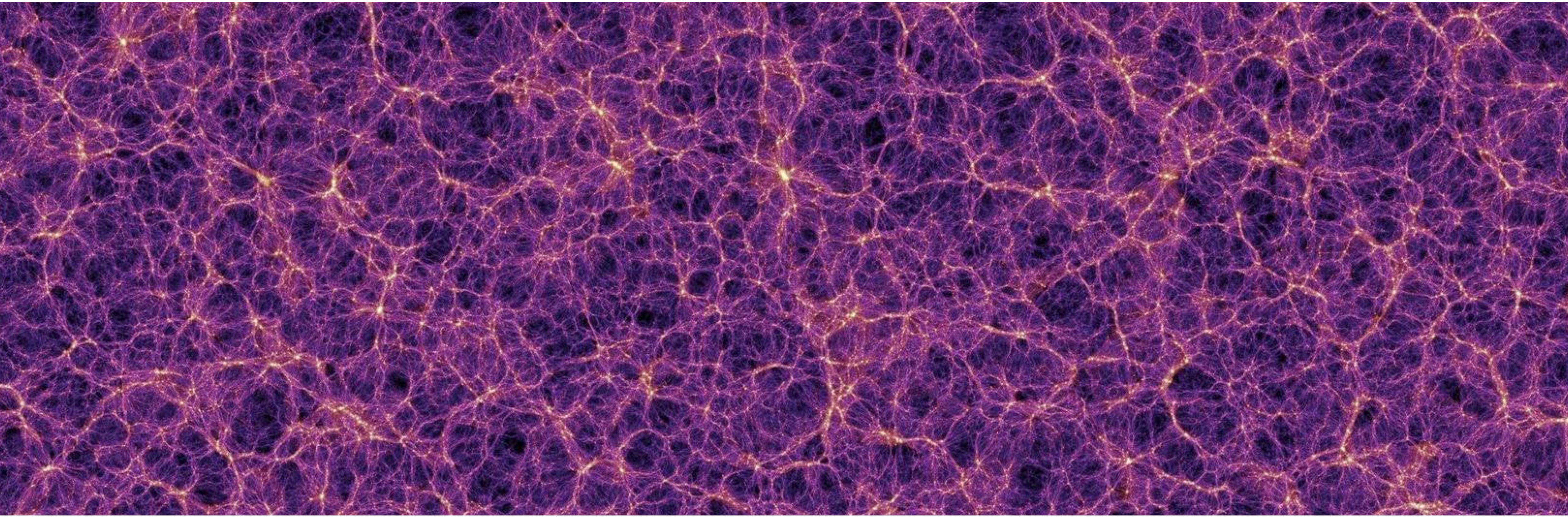


Non-linear cosmic structure formation

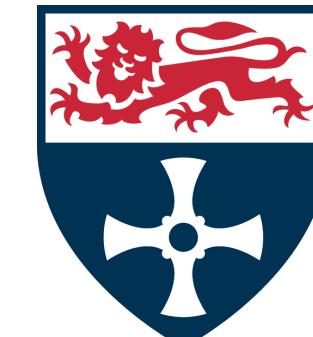


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University



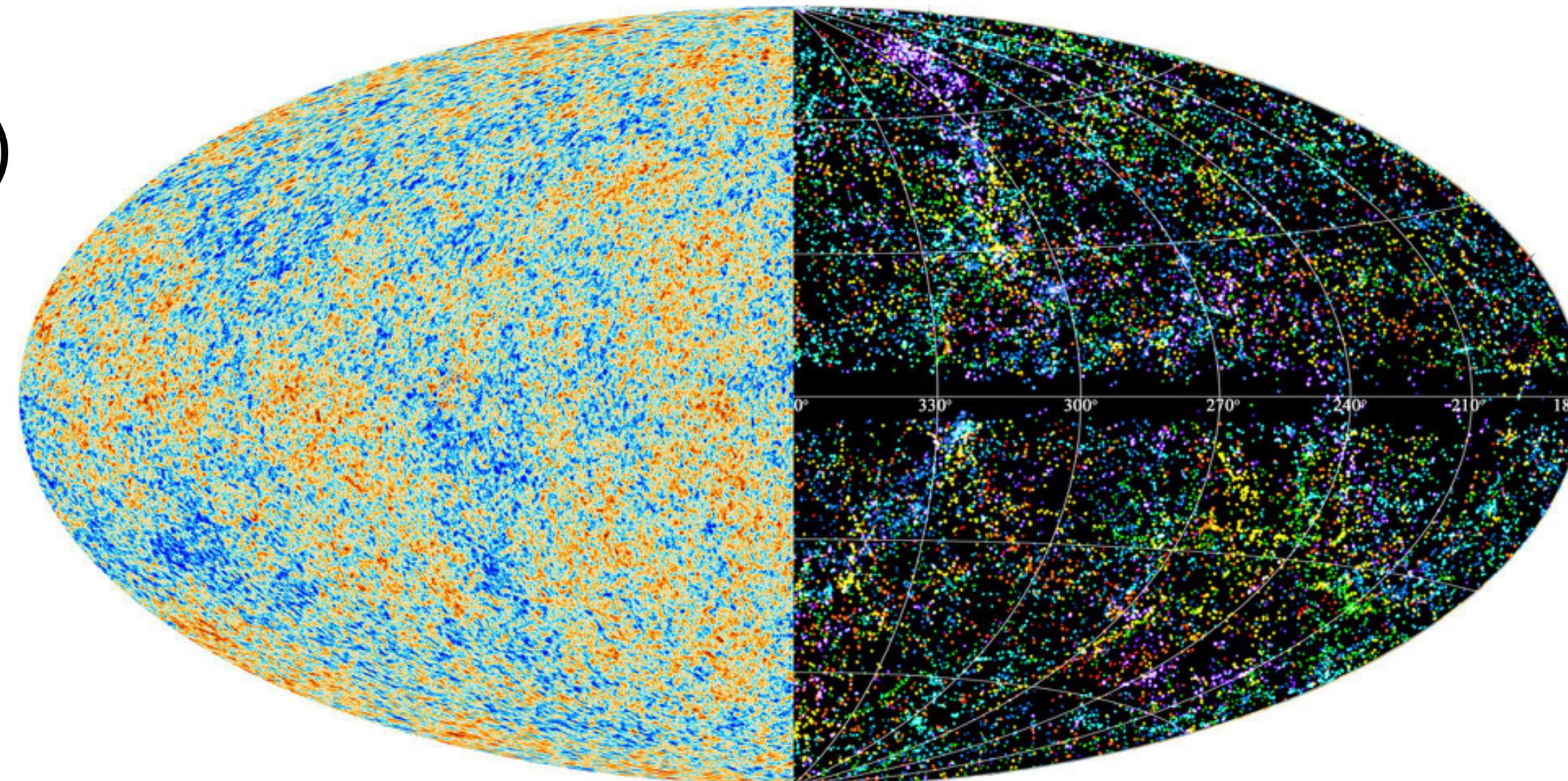
astrobites

THE ASTRO-PH READER'S DIGEST | SUPPORTED BY THE **AAS**

Cosmic structure

Early universe (CMB)

- small fluctuations
 $(\sim 10^{-5} \bar{\rho})$
- simple statistics
- 2D data (single time)



Late universe (LSS)

- large fluctuations
 $(\sim 100 \bar{\rho})$
- complex statistics
- 3D data (through cosmic time)

Take away: LSS hosts more information than the CMB, but it's difficult to extract

What sort of information?

Cosmology parameters

- Hubble parameter
- Matter fraction
- Growth of structure

Fundamental physics

- Neutrino mass
- Modified gravity
- Dark energy
- Early universe

Challenges for LSS

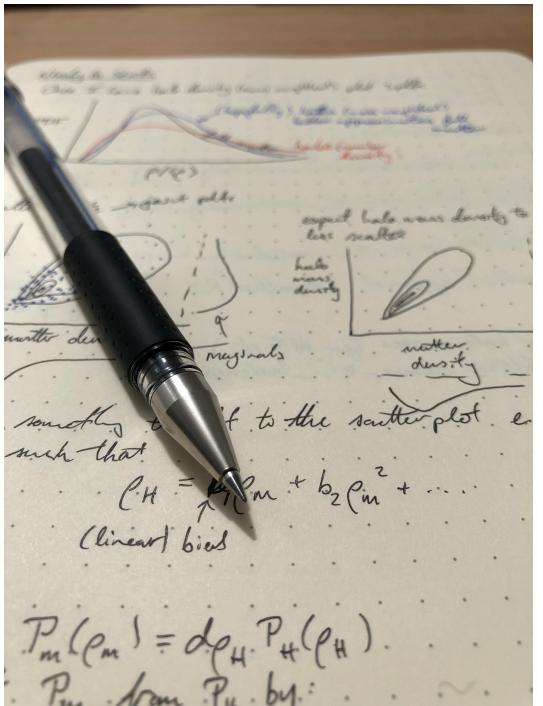
- Choose **summary statistics** to concisely capture behaviour of physics



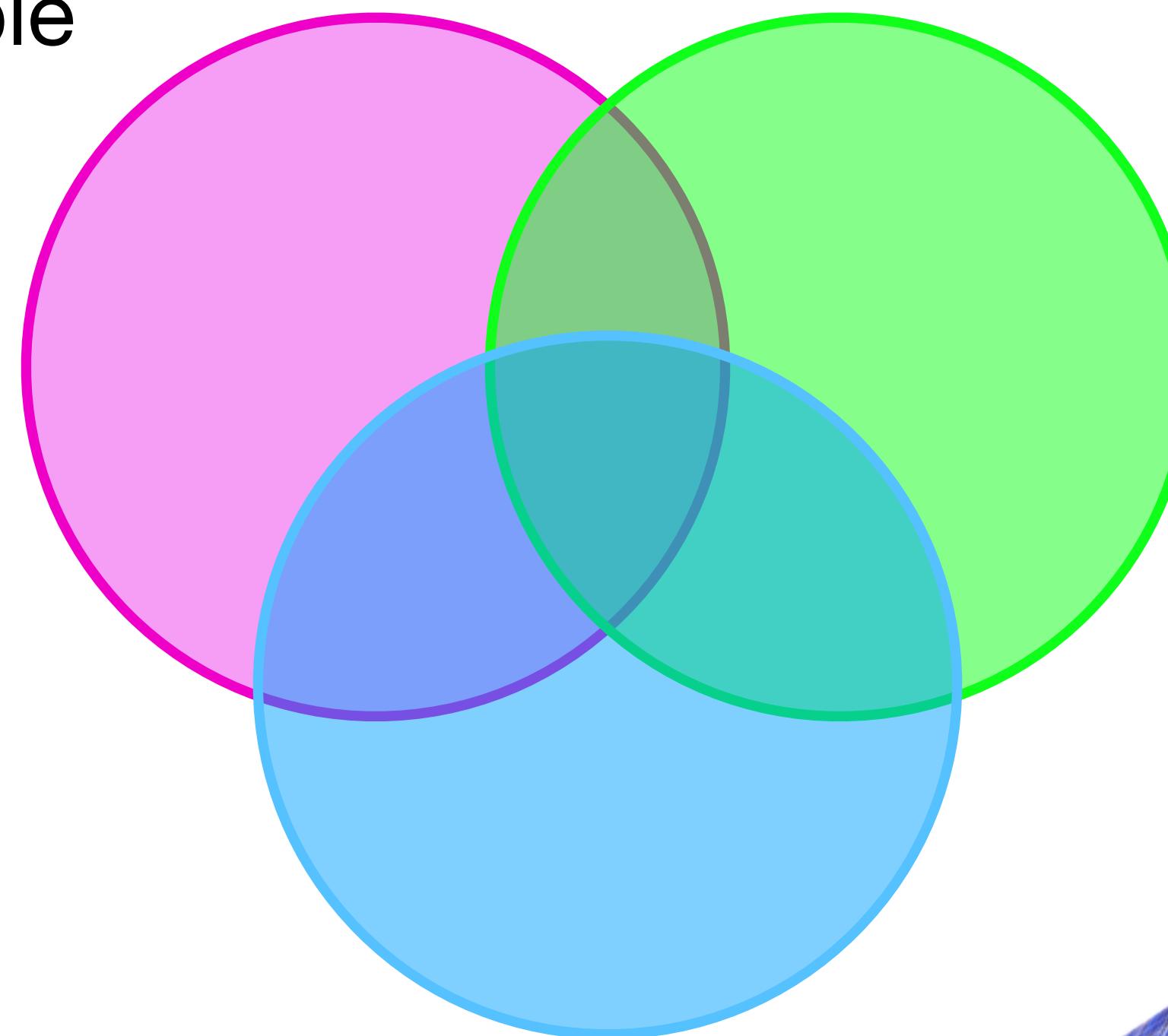
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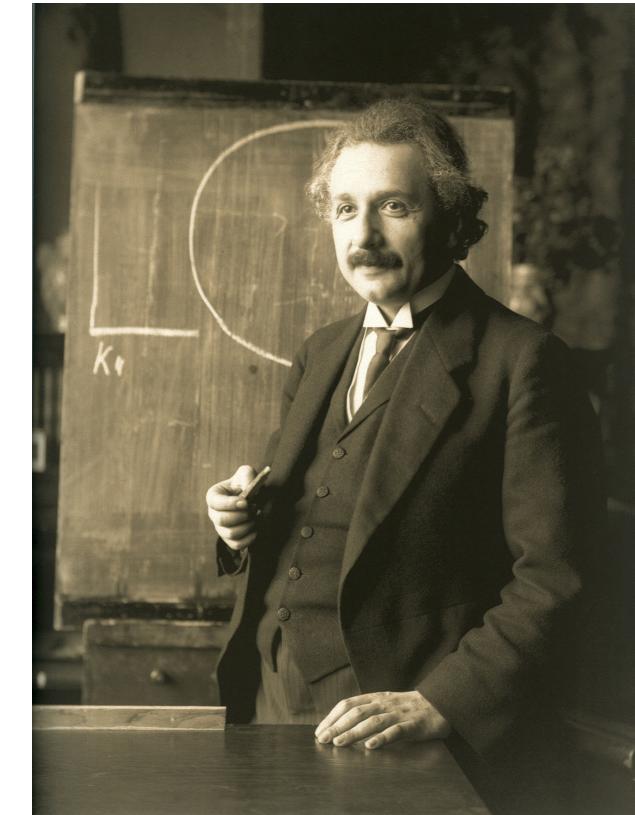
Wishlist



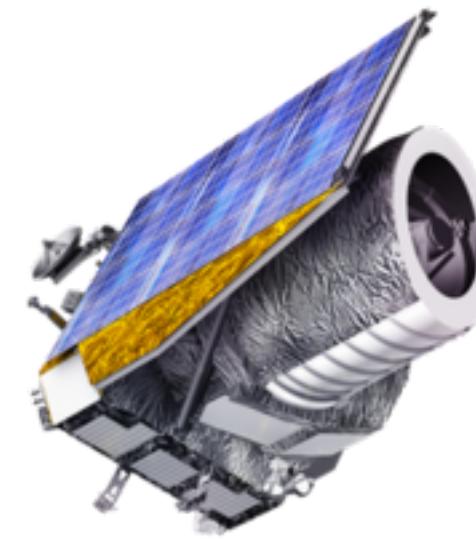
Predictable
(theory)



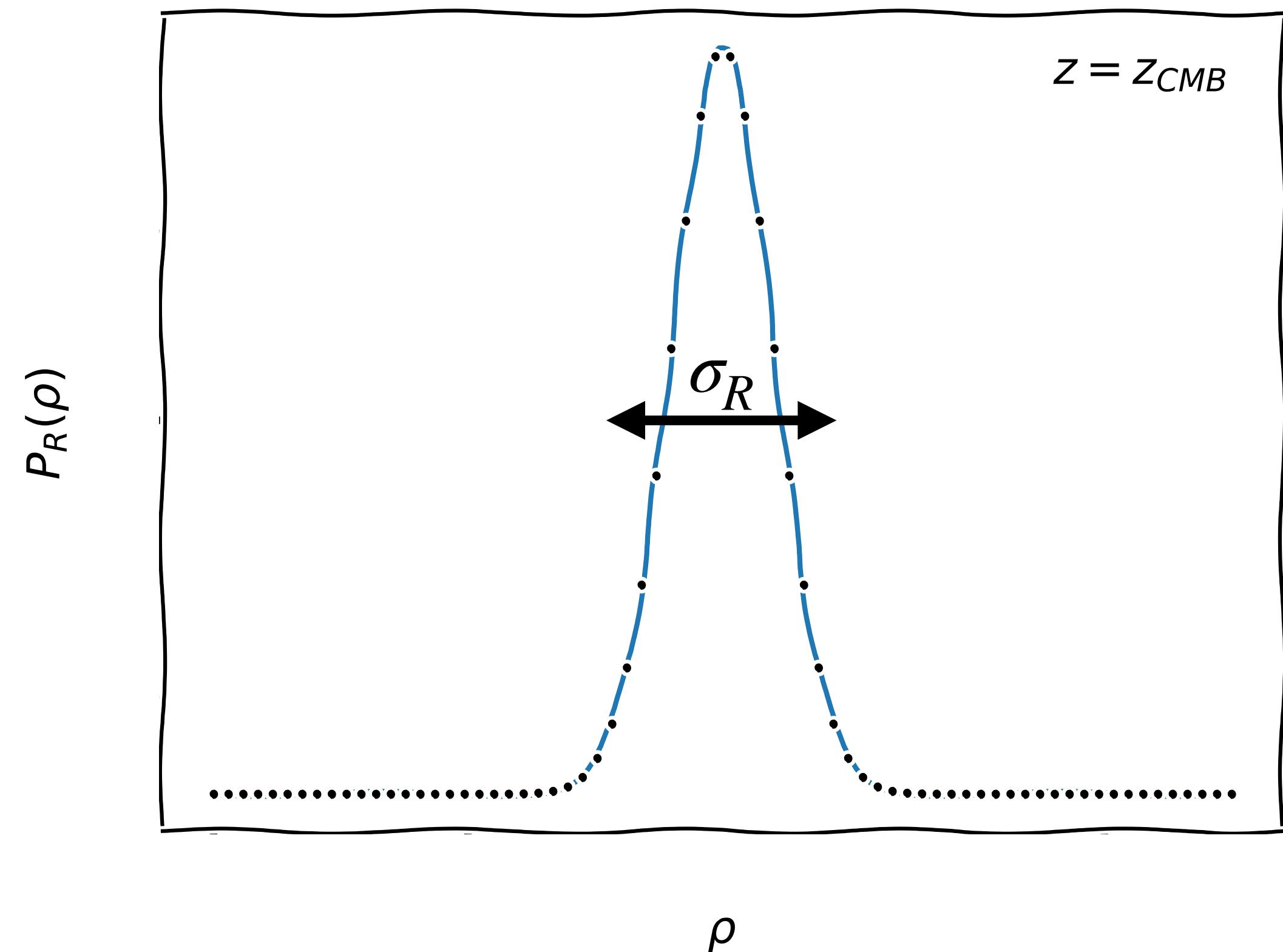
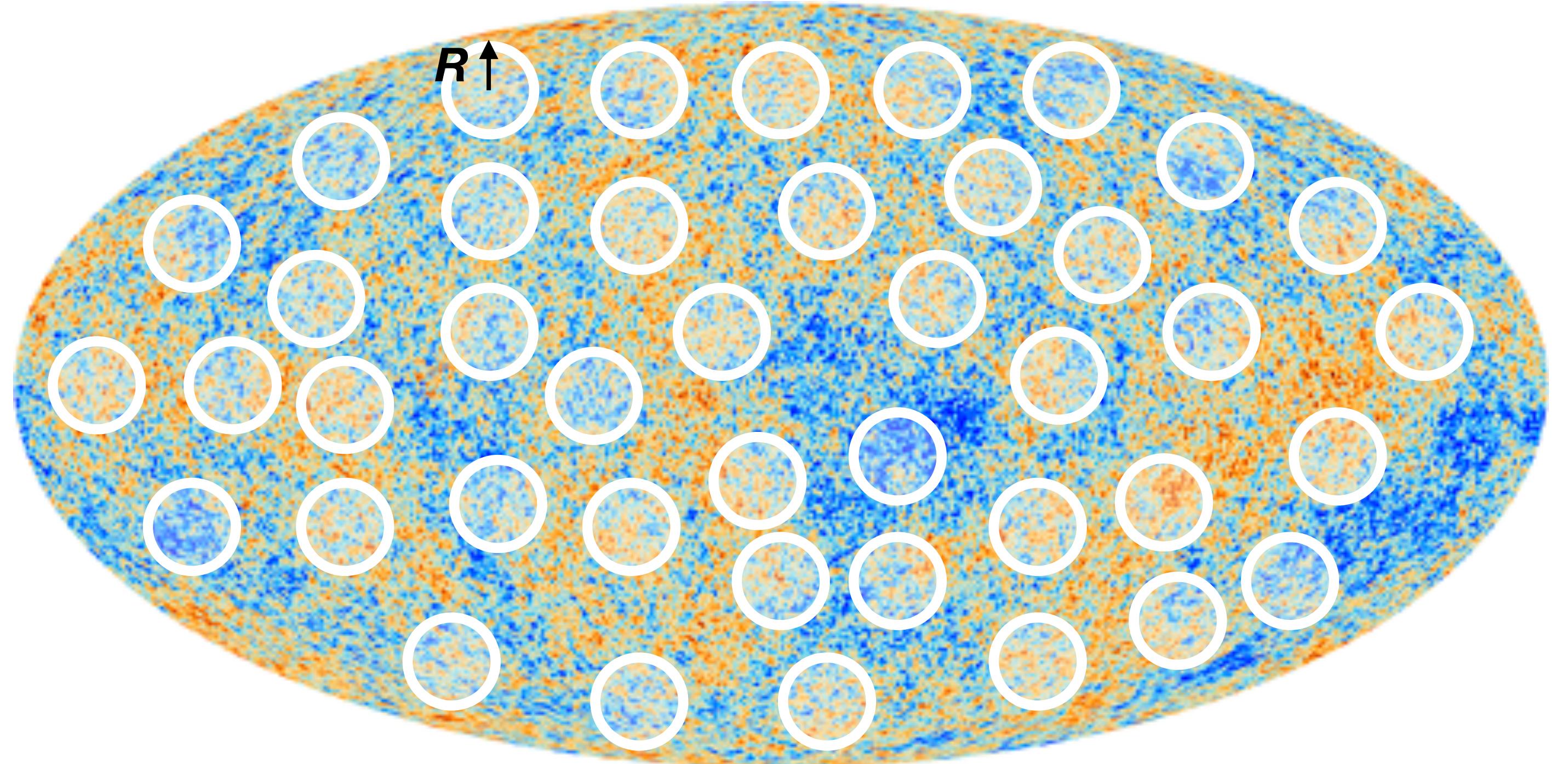
Useful
(physics)



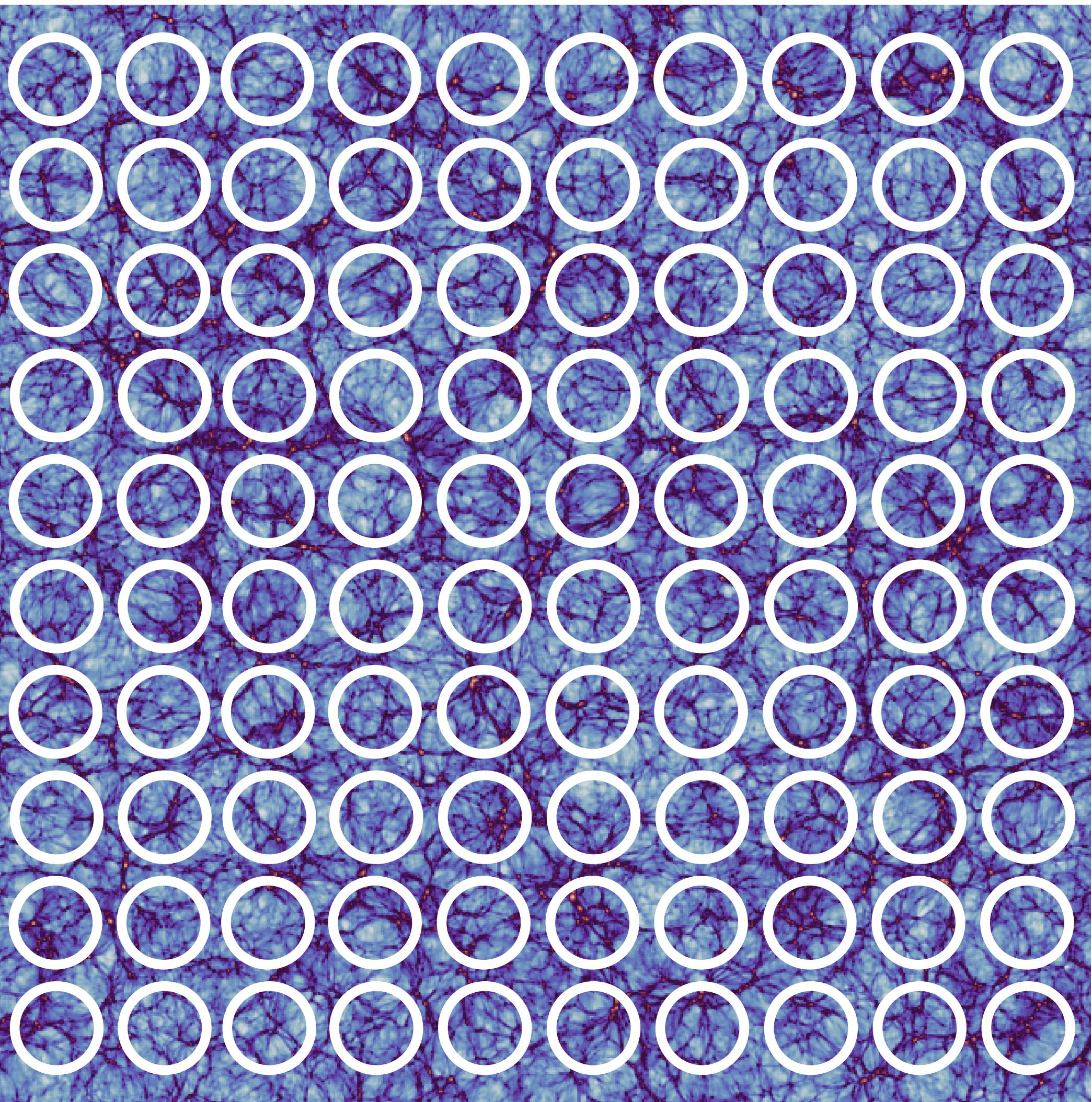
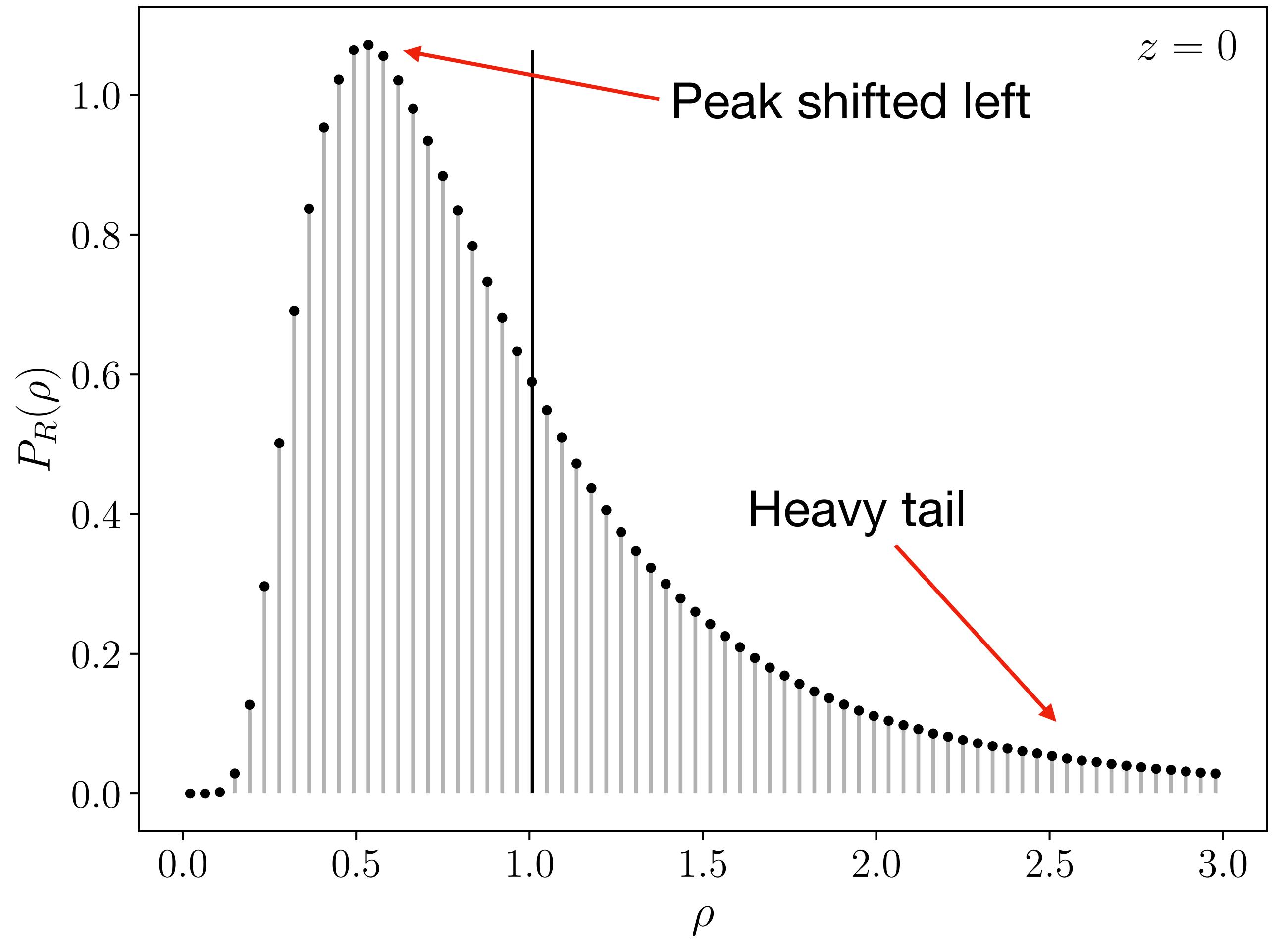
Measurable
(experiment)



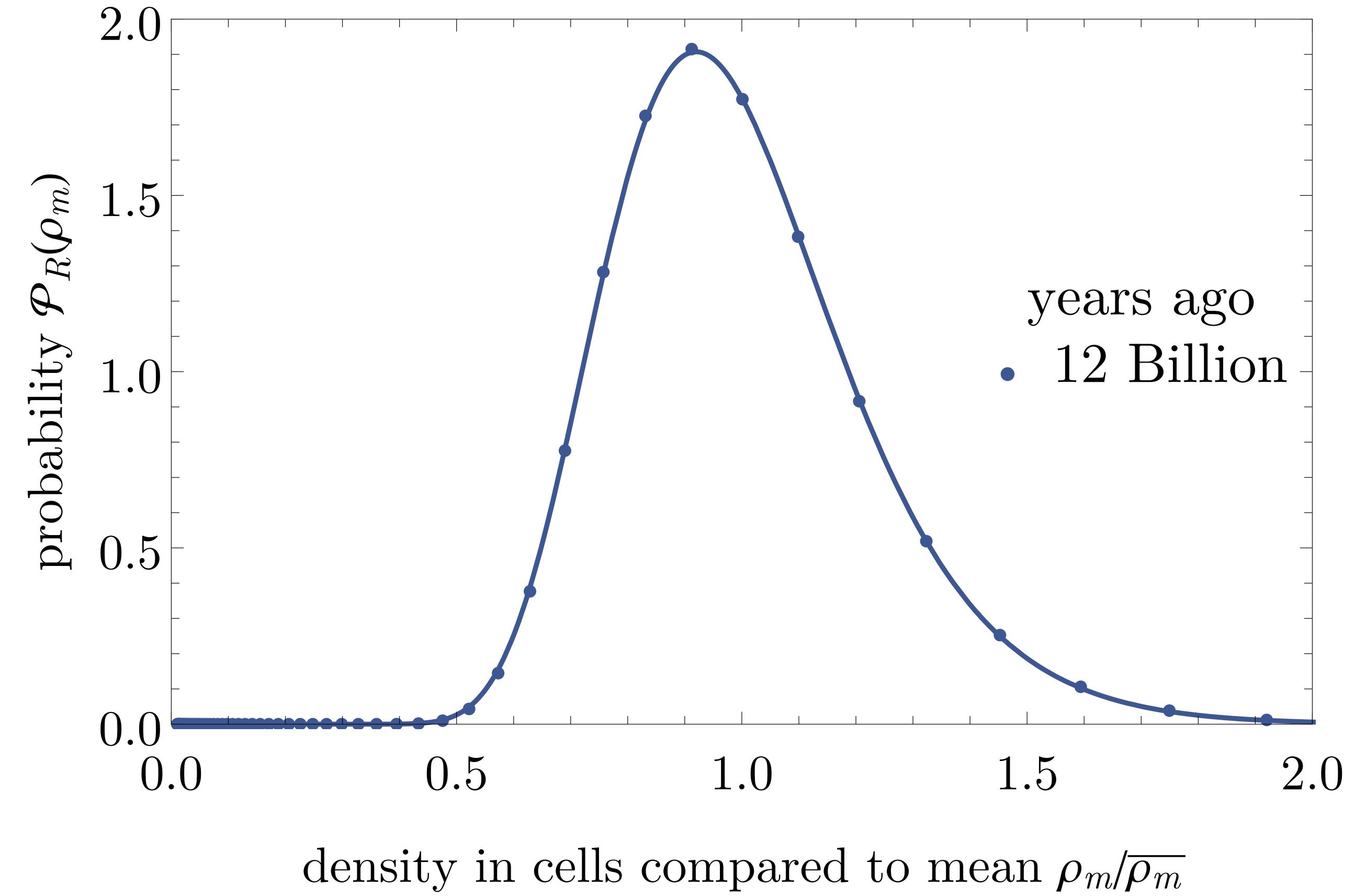
An example: one point functions



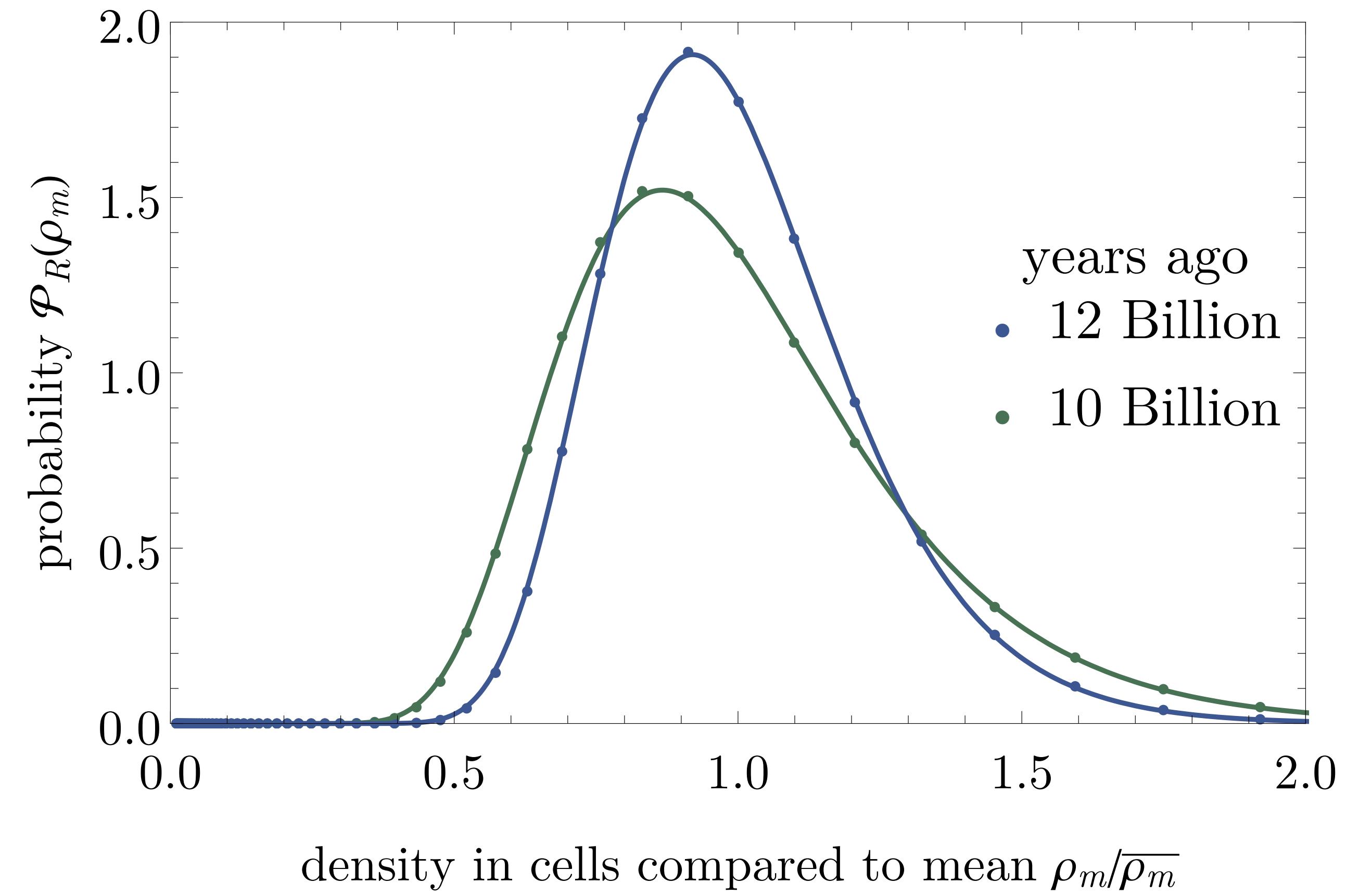
One point functions: LSS



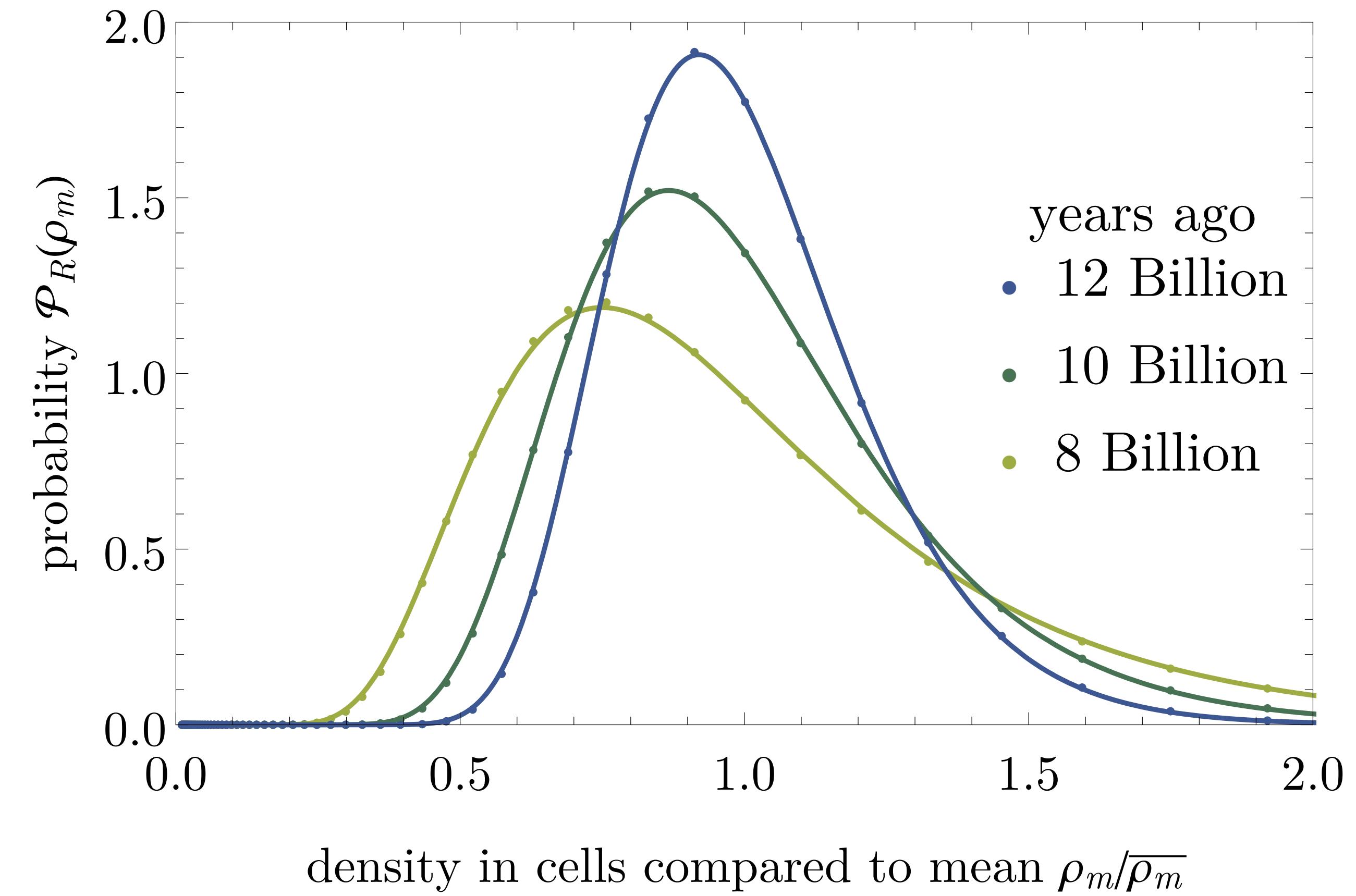
Analytic prescription?



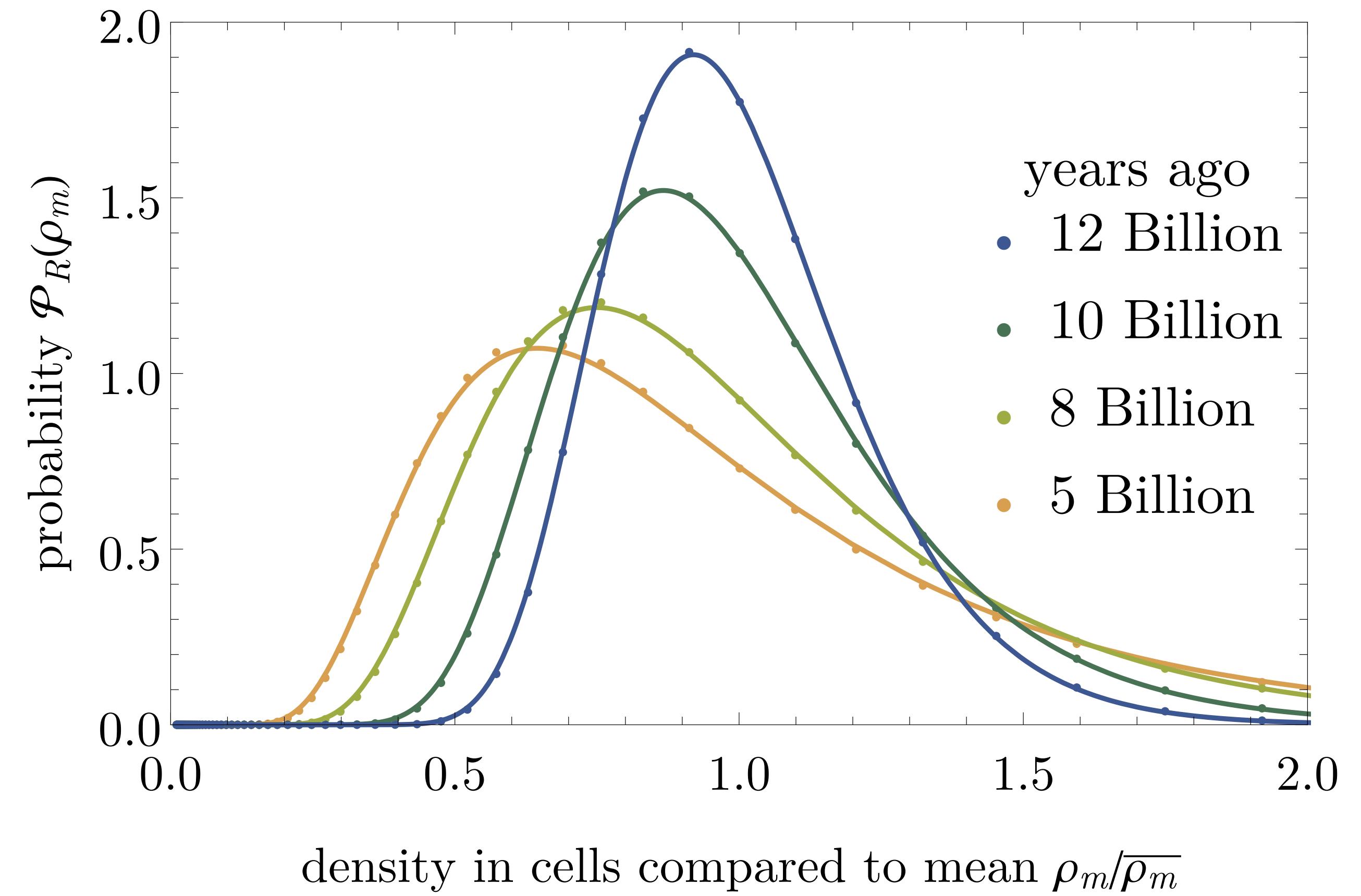
Analytic prescription?



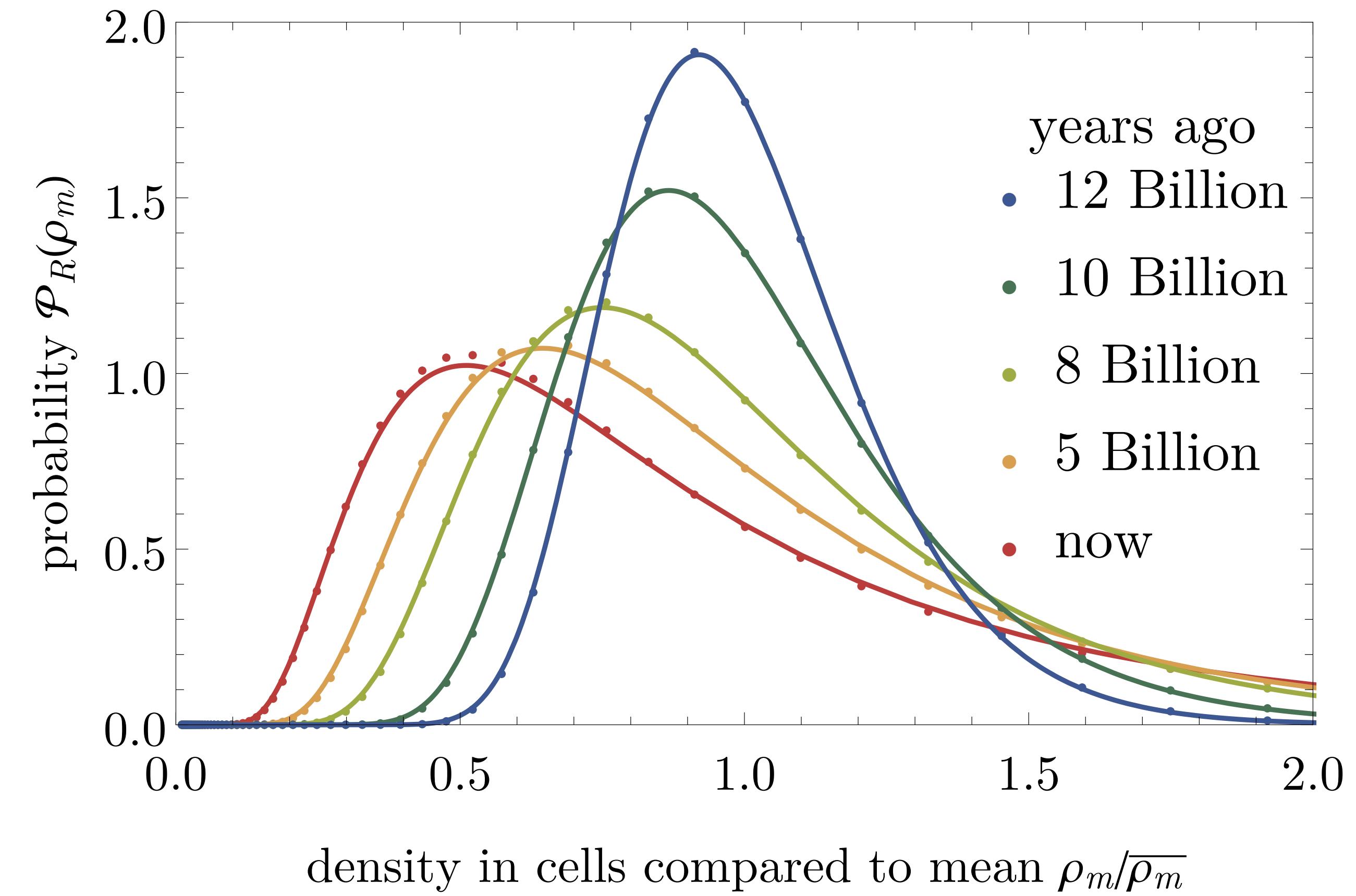
Analytic prescription?



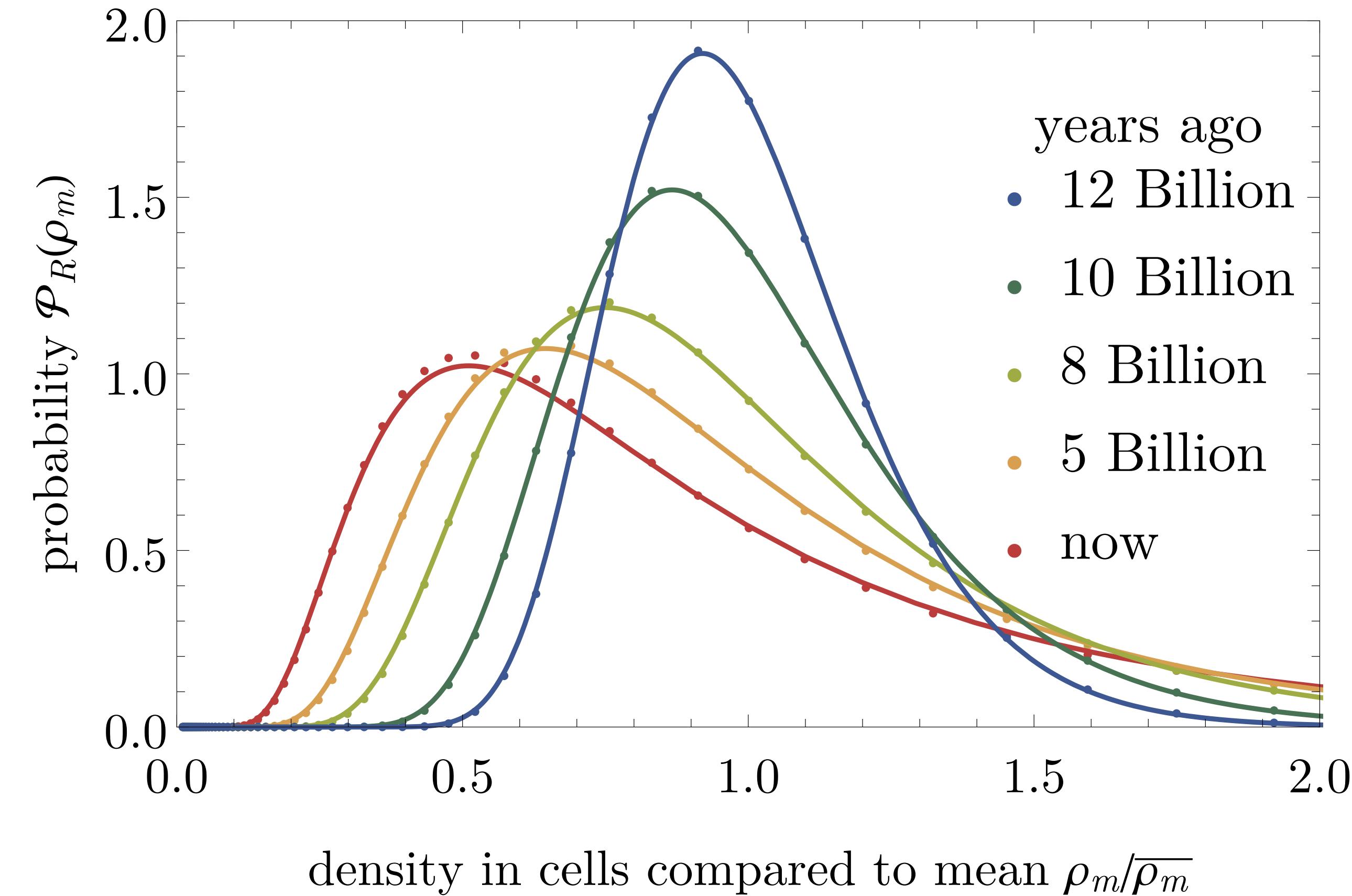
Analytic prescription?



Analytic prescription?



Statistics from spherical collapse



Mild theoretical assumptions

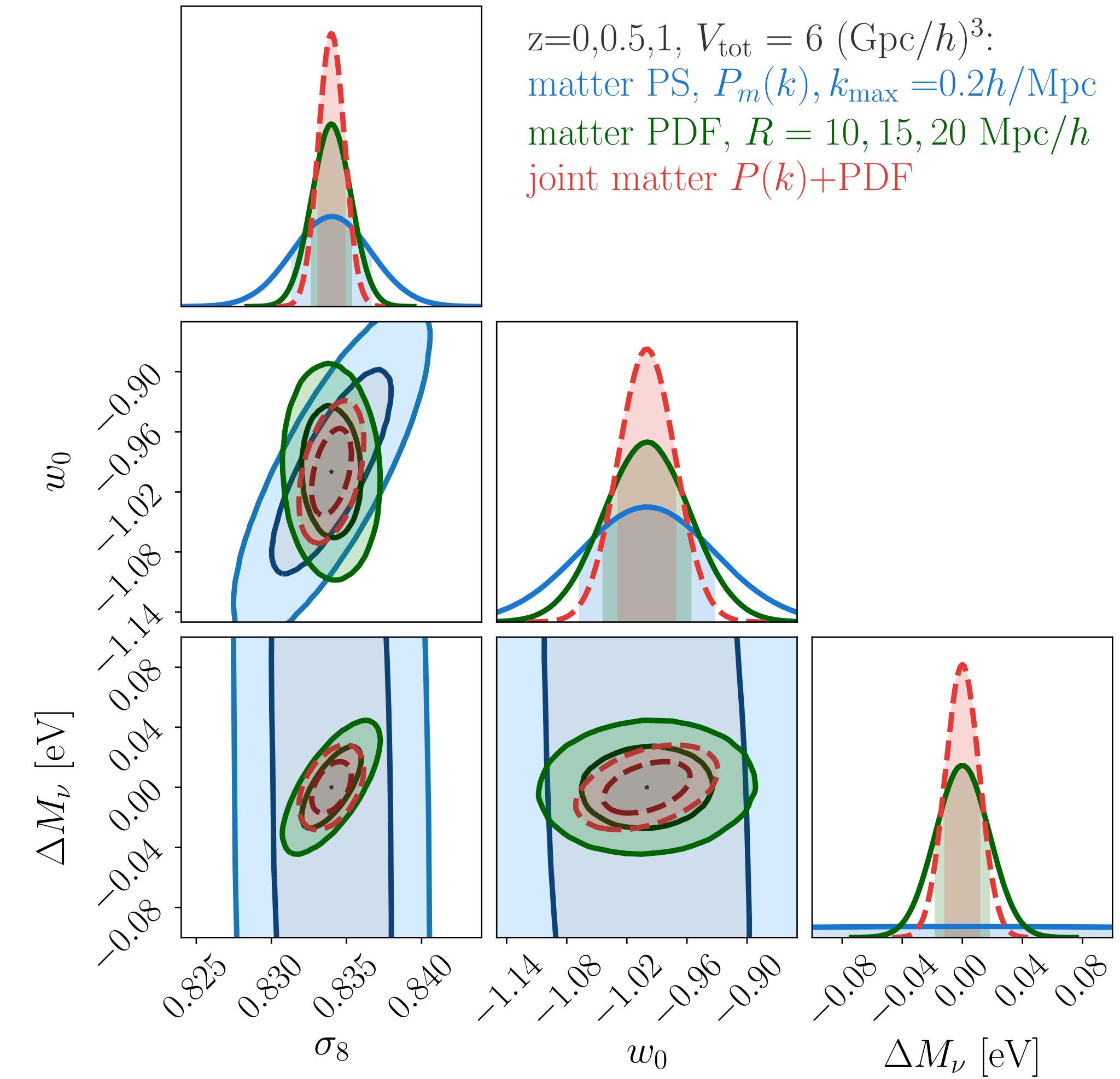
Analytic ingredients (spherical collapse dynamics)

Theory curve fit simulation points!

Interesting physics?

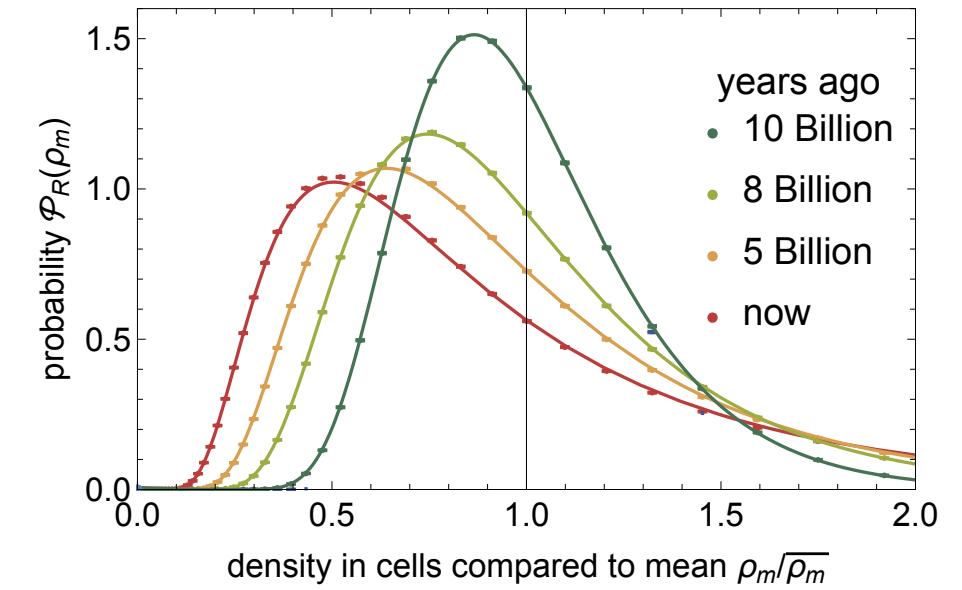
Forecasts for

- Neutrino mass M_ν ✓
- Primordial non-Gaussianity f_{NL} ✓
- Dark energy $w(a)$ ✓
- Modified gravity (in progress) $f(R)$ ⚒

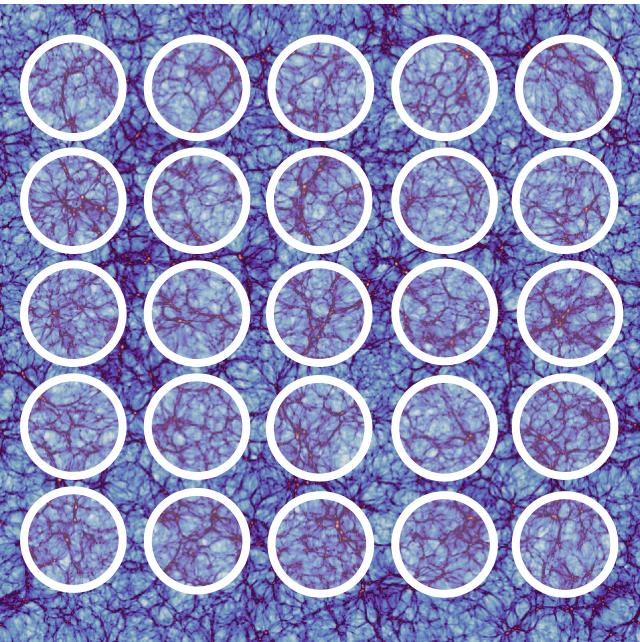
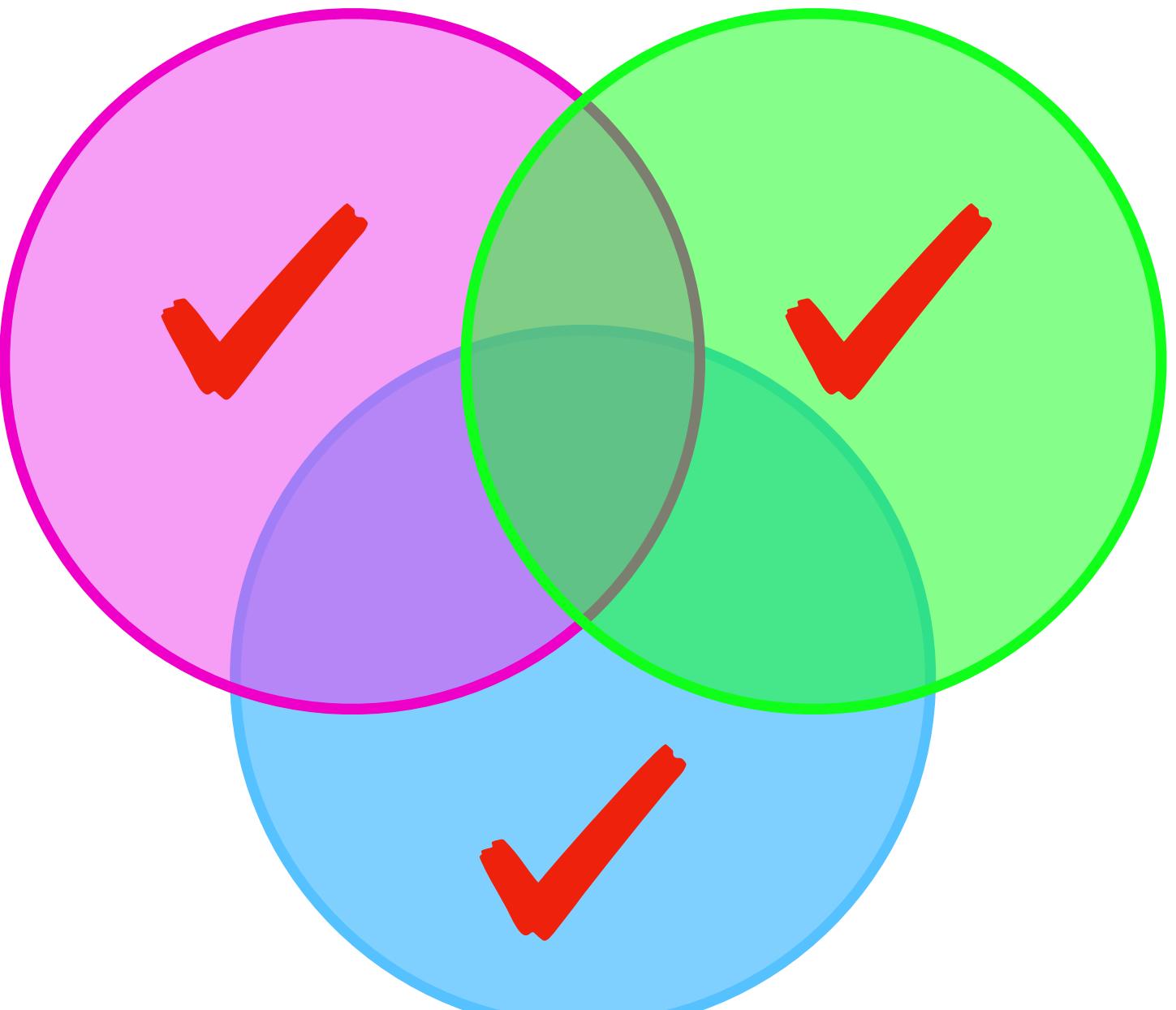


One point functions

Predictable



Measurable



Useful

M_ν f_{NL} $w(a)$ $f(R)$