Effective Field Theory

IN A NUTSHELL

Dr L. Fonseca de la Bella


The motivation of this work...

* *Large-scale structures*
* *Galaxy surveys*

Challenges:

- *Description of galaxy distribution*
- *Small-scale physics*
- *Line-of-sight effects*
- *Large-scale phenomena*
- *Others (open discussion)*

MENÜ

* *Matter power spectrum*
  * *Perturbation Theory*
  * *Effective Field Theory*
  * *Redshift-space mapping*
  * *IR-resummation*

* *Halo power spectrum*

A tablespoon of bias models

DARK MATTER POWER SPECTRUM IN ~~REDSHIFT~~ SPACE

REAL

Standard Perturbation Theory – Dark Matter

My model:

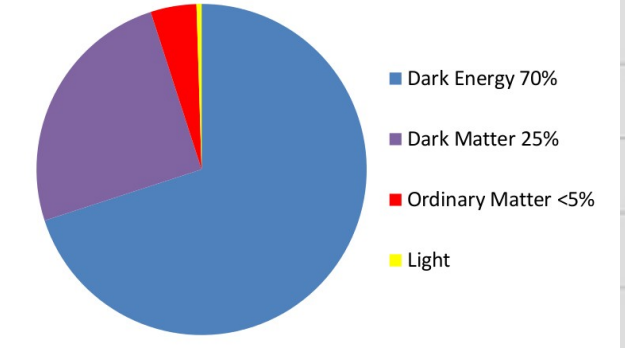
GR + ΛCDM

Flat, homogeneous, isotropic universe

Fluid components:

Energy density ρ

Pressure P



My calculations:

Fluid equations for dark matter

$$P = 0$$
$$\rho = \rho_0 + \delta\rho$$
$$\delta = \frac{\delta\rho}{\rho}$$

- Perfect fluid behaviour
- Non-relativistic limit
- Negligible vorticity

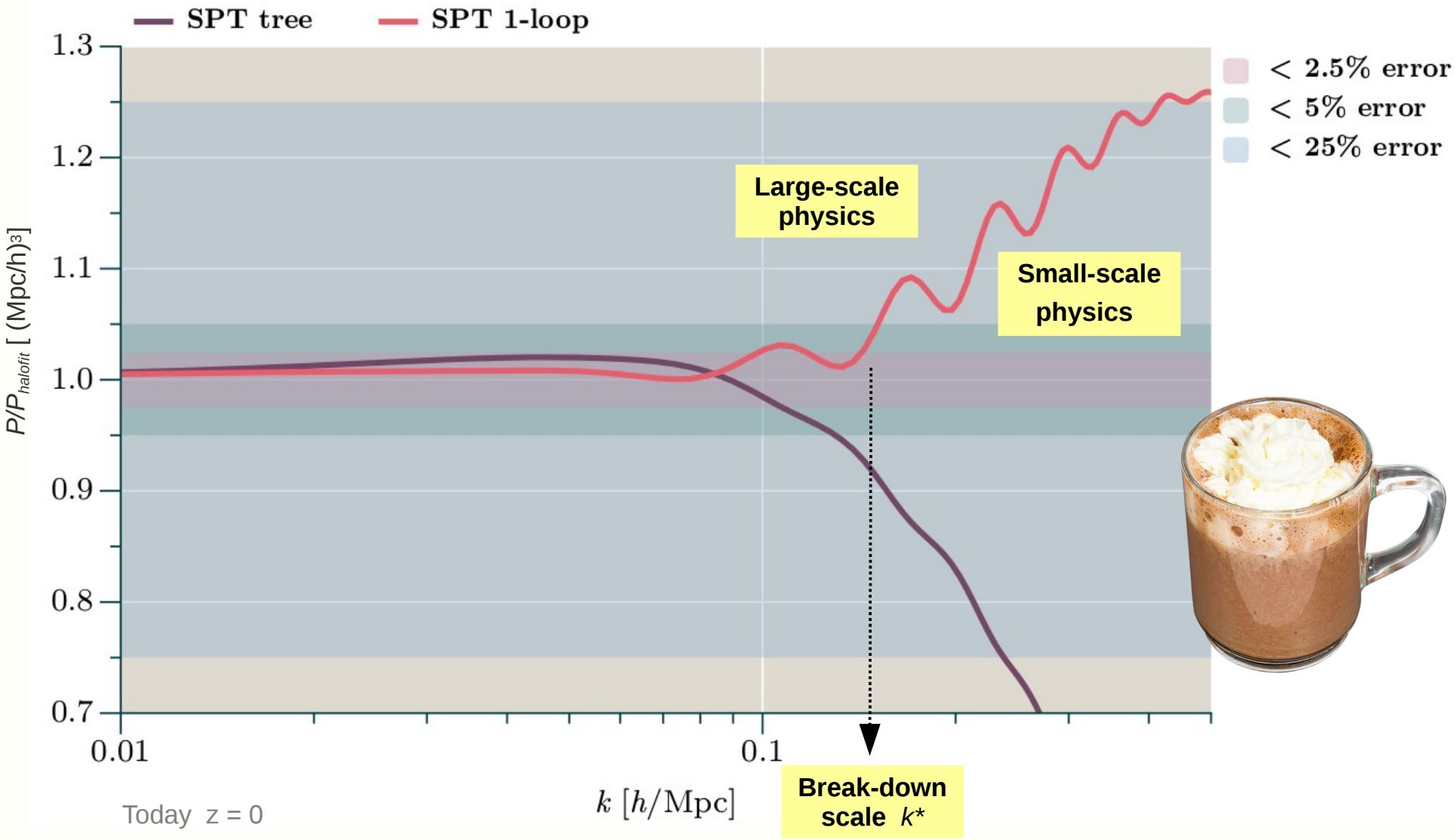
Perturbative solution:

$$\delta = \delta^{(1)} + \delta^{(2)} + \delta^{(3)}$$

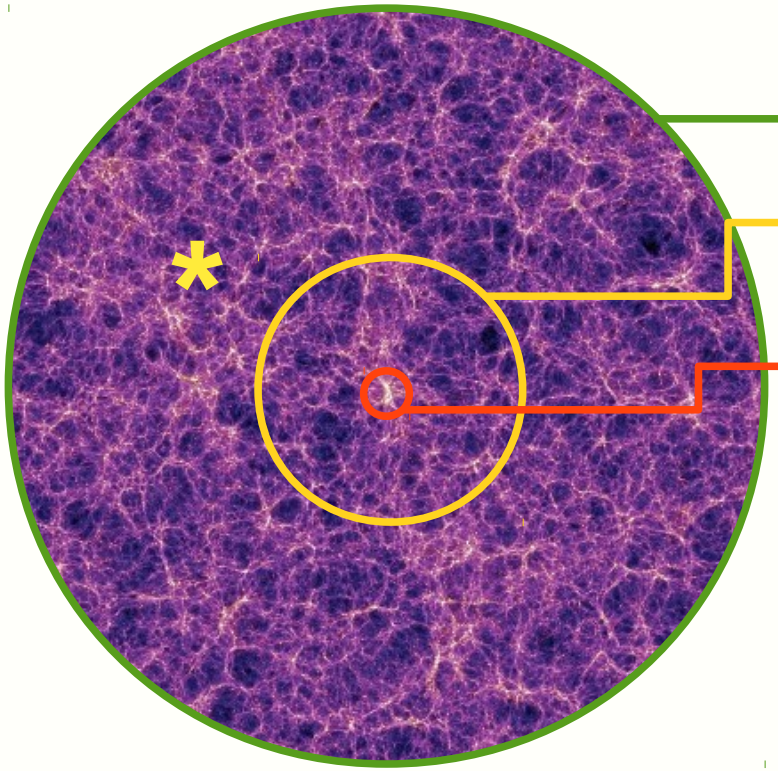
2Point correlation function

$$P^{SPT}_{1-loop}(k,z) = P_{11}(k,z) + P_{13}(k,z) + P_{22}(k,z)$$

Standard Perturbation Theory — *Predictions vs data*



Effective Field Theory – *Small-scale physics*



Linear regime – SPT works

Mild non-linear regime – SPT breaks down, k^*

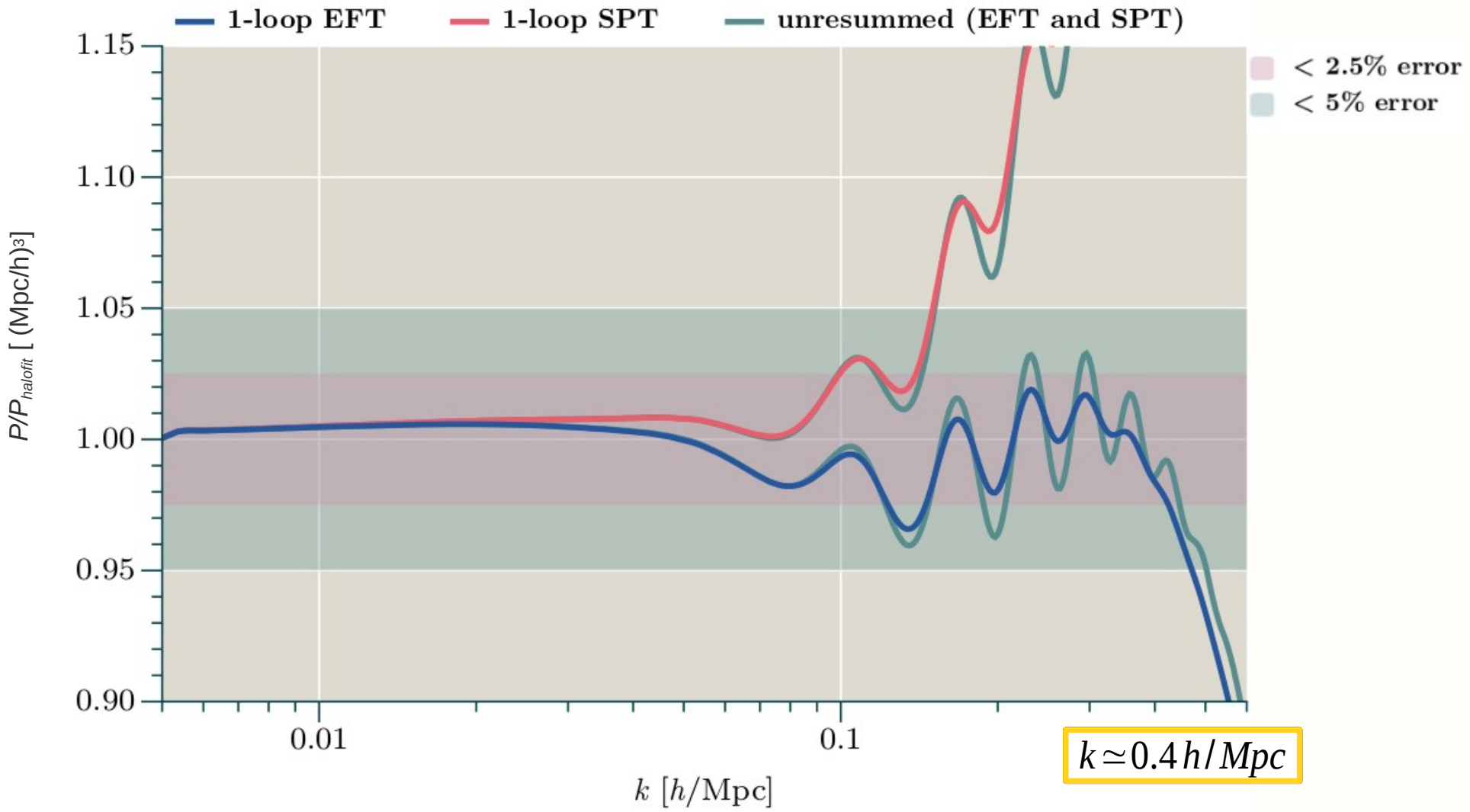
Non-linear regime – unknown physics, k_{NL}

$$\xi(r) \longrightarrow P_{\delta\delta}(k) \supseteq \int_{k_{IR}}^{k*} \mathrm{d}^3\mathbf{q} f(\mathbf{q}) g(\mathbf{q}, \mathbf{k}-\mathbf{q}) + \int_{k*}^{k_{NL}} \mathrm{d}^3\mathbf{q} f(\mathbf{q}) g(\mathbf{q}, \mathbf{k}-\mathbf{q}) = P^{\mathrm{SPT}}_{1\ \mathrm{loop}}(k) + \underbrace{\frac{c_\delta^2}{k_{NL}^2}} k^2 P_{\mathrm{lin}}(k)$$

COUNTER-TERM

Nbody simulations

Effective Field Theory – *Predictions vs data*



de la Bella et al. 2017