Panel Discussion on
Limits of pt, setting external priors, setting k_NL, how to squeeze info from LSS on small scales

Maria Tsedrik, Jamie Sullivan, Guido D’Amico

Why do we need priors?

$$\chi^2_{\rm m}(\Omega\,|\,d) \approx \chi^2(\Omega, n_{\rm best-fit}\,|\,d) + \log\left[\det F_2(\Omega)\right]$$

in linear nuisance

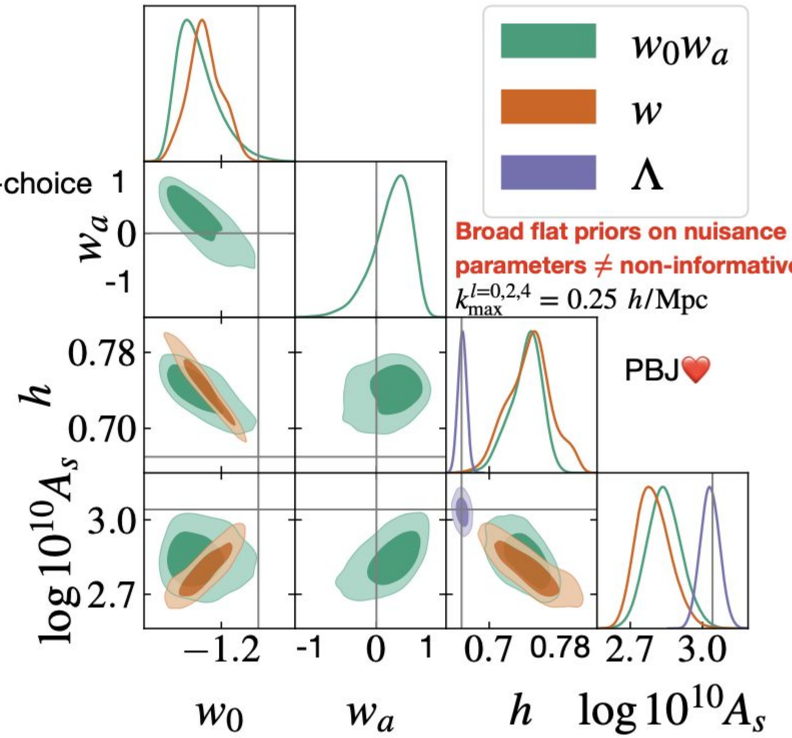
Profile likelihood

Laplace term

sensitive to prior-choice

$$F_{2,ij} = P^{\rm m}_{i,l}{\rm Cov}^{-1}_{ll'}P^{\rm m}_{j,l'} + {\rm C}^{-1}_{n,ij}$$

sensitive to parameterisation



Broad flat priors on nuisance parameters ≠ non-informative

$k^{l=0,2,4}_{\rm max} = 0.25\ h/{\rm Mpc}$

Euclid Flagship-fits: $z = [0.9, 1.2, 1.5, 1.8]$

Potential "solutions"

- ☐ adding more data (bispectrum/BAO/CMB)
- ☐ statistical solutions (re-parametrisation of parameters, profiling)
- ☐ **get more info on nuisance parameters**

Copilot, show me a typical telecon on priors and projection effects

Priors…

- In Bayesian analysis, data update our belief on the model and its parameters. Must start from a probability measure on parameters.
  There is no "uninformative prior".
- And what if data are not precise enough?

The status of LSS EFT analysis: two manifestly equivalent implementations of the manifestly correct theory on manifestly the same data produce manifestly different results. #cosmology

This seems a little strong. Ignoring bispectrum loops (which are quite preliminary), the main power spectrum results from the three groups are similar. This is true with / without windows (and with broad priors on eft parameters). But we should check for residual differences!

Priors on counterterms? The encarnation of the devil on Earth.

- Just wait. Sooner or later data will just not care about the priors

- Perturbativity prior

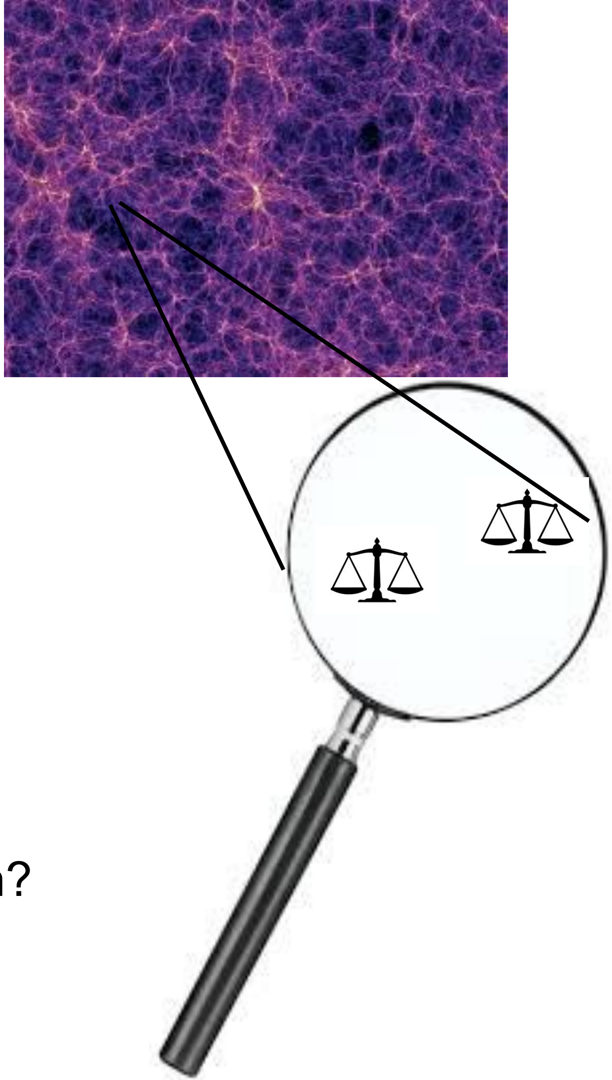
$$\mathcal{P}_P = \frac{1}{2N^P_{\text{bins}}} \sum_{i\in\text{bins}_P} \left(\frac{P^h_{\text{1-loop}}(k_i)}{\sigma_P^{\text{P.P.}}(k_i)} \right)^2 \qquad \mathcal{P}_B = \frac{1}{2N^B_{\text{bins}}} \sum_{i\in\text{bins}_B} \left(\frac{B^h_{\text{1-loop}}(k_1^i, k_2^i, k_3^i)}{\sigma_B^{\text{P.P.}}(k_1^i, k_2^i, k_3^i)} \right)^2$$

$$\sigma_P^{\text{P.P.}}(k) \sim S^P(k) P^{k_{\max}}_{\text{1-loop}} \,, \qquad \sigma_B^{\text{P.P.}}(k_1, k_2, k_3) \sim S^B(k_1, k_2, k_3) B^{k_{\max}}_{\text{1-loop}}$$

$$S^P_{\text{1-loop}}(k) \sim b_1^2 P_{11}(k) \left(\frac{k}{k_{\text{NL}}} \right)^{3+n(k)} \qquad S^B_{\text{1-loop}}(k_1, k_2, k_3) \sim B^h_{211}(k_1, k_2, k_3) \sum_{i=1}^{3} \left(\frac{k_i}{k_{\text{NL}}} \right)^{3+n(k_i)}$$

- Get some controlled UV information.
  We used some old fitting formulas from simulations.
  Now, the idea is to do a dedicated search. As a first step, fitting HOD. But have to marginalise over them.

Small-scale Information?



How small is “small”? 10 Mpc/h? 2 Mpc/h? 0.5 Mpc/h?

Could you ever trust near or below the halo scale?

And at high-z?

Roll up our sleeves and do astrophysics? (Priors)

Simulations *and* data? Redshift evolution?

Or maybe some statistics?

Abandon the straightforward bias parameterization?

(Baryons, satellites, FoG, mass profiles……………………….)

Summary of Questions

- How do we get more information on the nuisance parameters of PT models?

- Can we determine theoretically what the scales of nonlinearities are? How do they depend on cosmology?

- Will we still need simulations as a check of PT and kmax?
We could use self-consistent NNLO methods

- What physical priors can we place on nuisance parameters?

- Can higher-loop PT extract more information from smaller scales? Is it limited by the large number of extra nuisance parameters?