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Accurate Non-Linear Predictions Beyond ΛCDM

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Modelling NL Stats Beyond ΛCDM

(A quick reminder from Matteo Cataneo's talk)

$$P(k, z)$$

The full NL matter power spectrum in model of interest (e.g. f(R), wCDM, massive neutrinos)

Cataneo et al. (2018)

Modelling NL Stats Beyond ΛCDM

(A quick reminder from Matteo Cataneo's talk)

$$P(k,z) = P^{\rm pseudo}(k,z) \times$$

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Obtained by modifying the initial conditions in ***a ΛCDM simulation***

Cataneo et al. (2018)

Modelling NL Stats Beyond ΛCDM

(A quick reminder from Matteo Cataneo's talk)

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"Response function": From halo-model, cheap to compute

Cataneo et al. (2018)

Modelling NL Stats Beyond ΛCDM

(A quick [illegible] eo's talk)

THE KEY TO NL PREDICTIONS WITH ACCURACIES ~1%

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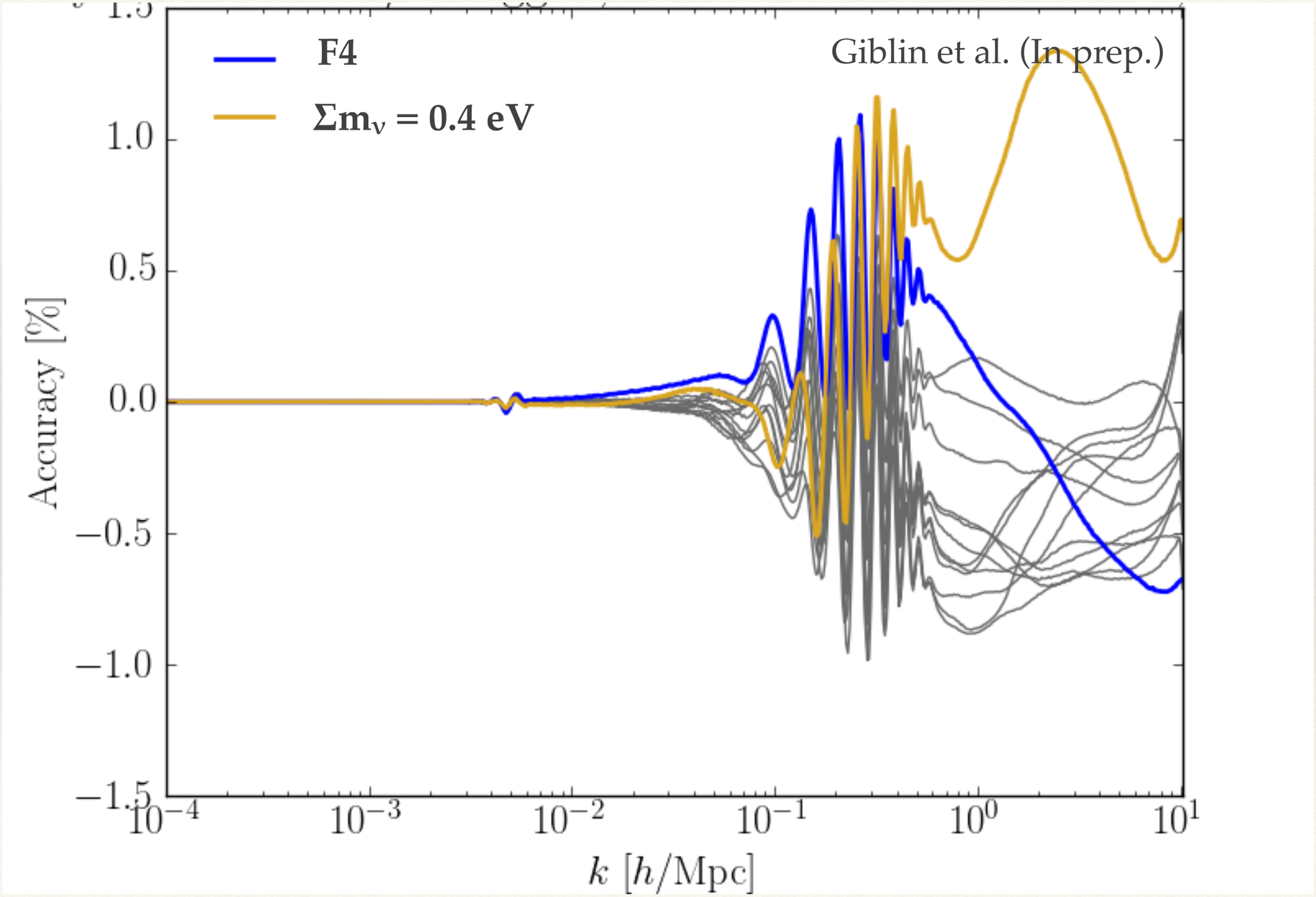
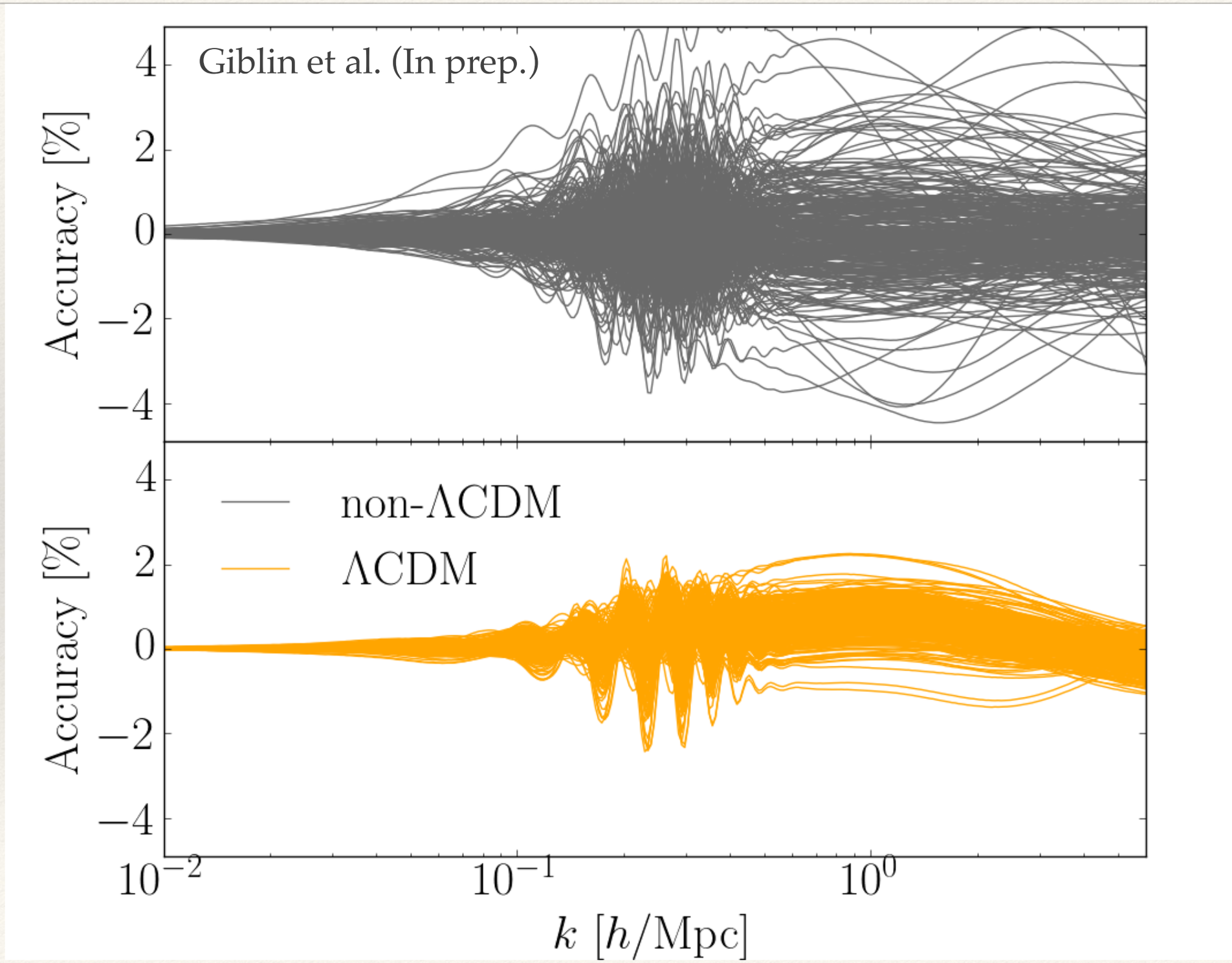
What I've done / Questions I've asked (and answered)

- Trained a GP emulator on a suite of (fake) simulations…
  - Can we *accurately* predict the NL $P^{pseudo}(k,z)$ for existing extensions to ΛCDM?
  - **Can we predict it for *arbitrary* extensions which the emulator *has never seen before*?**

Modelling NL Stats Beyond ΛCDM



Modelling NL Stats Beyond ΛCDM



Summary

- The Cataneo et al. (2018) methodology combined with the Giblin et al. (In prep.) emulator give you *non-linear* cosmological statistics with ~2% level accuracy *for any reasonable extension to ΛCDM.*

Modelling NL Stats Beyond ΛCDM

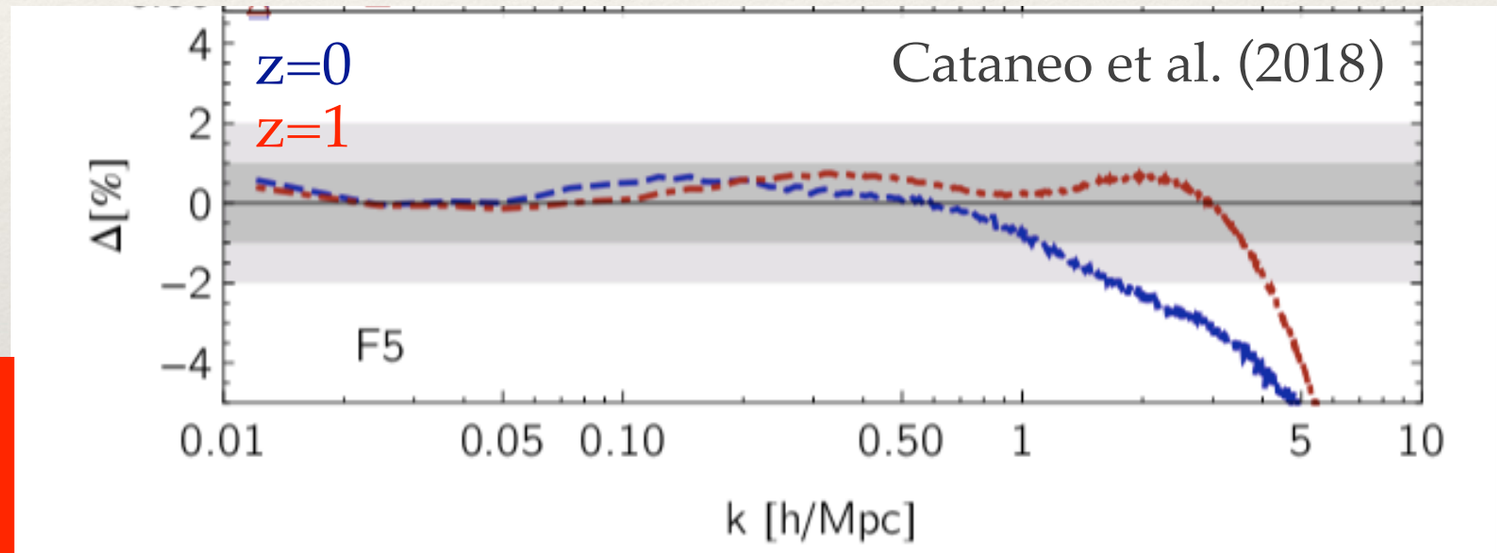
From the halo model

$$P^{\rm real}(k) = \mathcal{R}(k) \times P^{\rm pseudo}(k)$$

THE KEY TO NL PREDICTIONS WITH ACCURACIES ~1%

$$P_L^{\rm real}(k, z_j$$

f(R) Gravity



Modelling NL Stats Beyond ΛCDM

Recipe for emulating $P^{\rm pseudo}(k)$

User inputs $P_L^M(k)$ for arbitrary model M and the 5 cosmological params for the matching $P_L^{\Lambda CDM}(k)$

A PCA breaks this into 8 numbers parameterising its deviations from ΛCDM

These are fed into a GPR Emulator which has been trained on how these numbers relate to $P_{NL}^N(k)$, where **N** is an ensemble of simulated models

$P_{NL}^M(k)$ returned to user

As long as M is contained by model ensemble **N**, the emulator provides accurate predictions for $P_{NL}^M(k)$ - it need not have been trained on Model M.