Improving the BAO peak measurement by reconstruction: the Fast Action Minimization Method

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june, 4 2018

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BAO as a standar ruler

Sound Horizon, r_s == radius of perturbation shell

Key idea:

Cosmological model ➜ prediction for r_s

➜ **Measure rs to constrain the Cosm. Model**

How to do it:

The BAO signature is **imprinted** in the density field
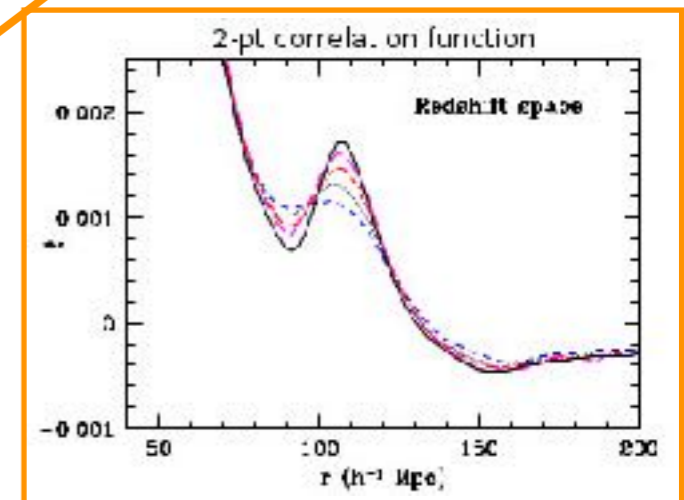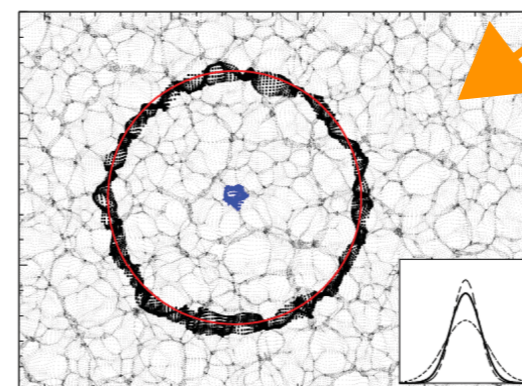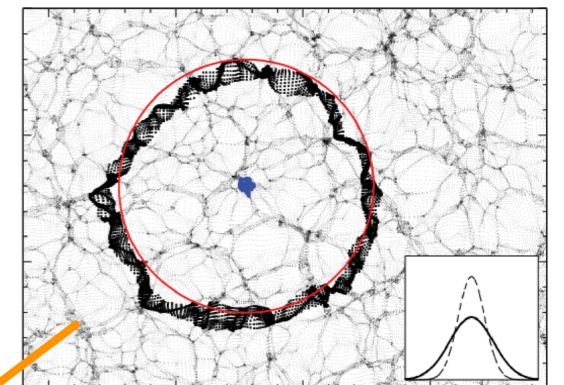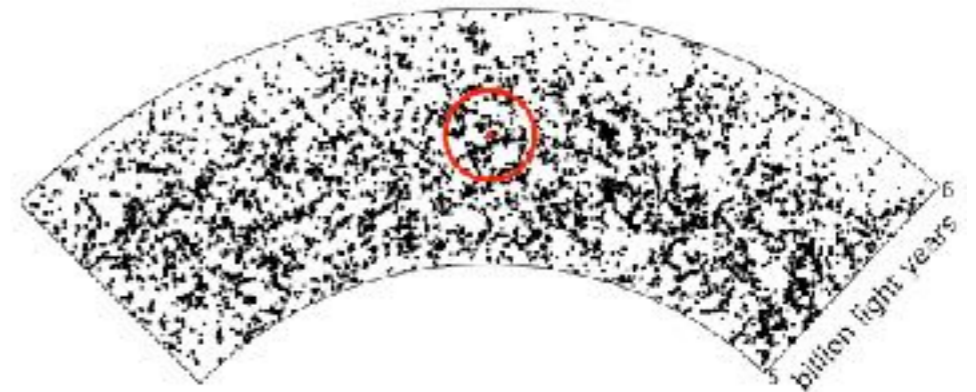
➜ **Looking at the density field to "detect the shell".**
Ex: 2pt-correlation function, **BAO == peak**

Problem:

Non linear clustering ➜ **broadening of the peak**

Solution:

RECONSTRUCTION !

2-pt correla on function

eFAM* Results (Preliminary)

Simulation: DEUS

z = 0	$M_{halo} > 10^{12} M_{sun}$	L_{box} = 21 Gpc h^{-1}	Cosmology: LCDM, WMAP7

Mocks: sub-cubes

Cutting the Parent simulation into **512** Sub-cubes of **Lsub = 2 Gpc h^{-1} (N$_{halos}$ ~ 23k)**
Separated by a 0.5 Gpc h^{-1}

* *Non-linear* numerical action method instead of Lagrangian *perturbative* à la Padmanabhan
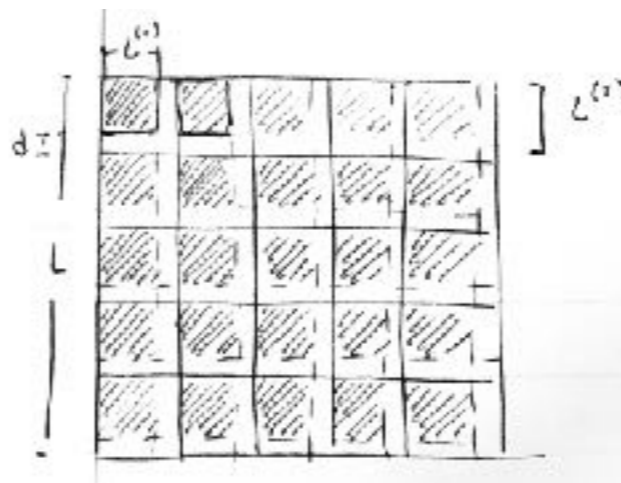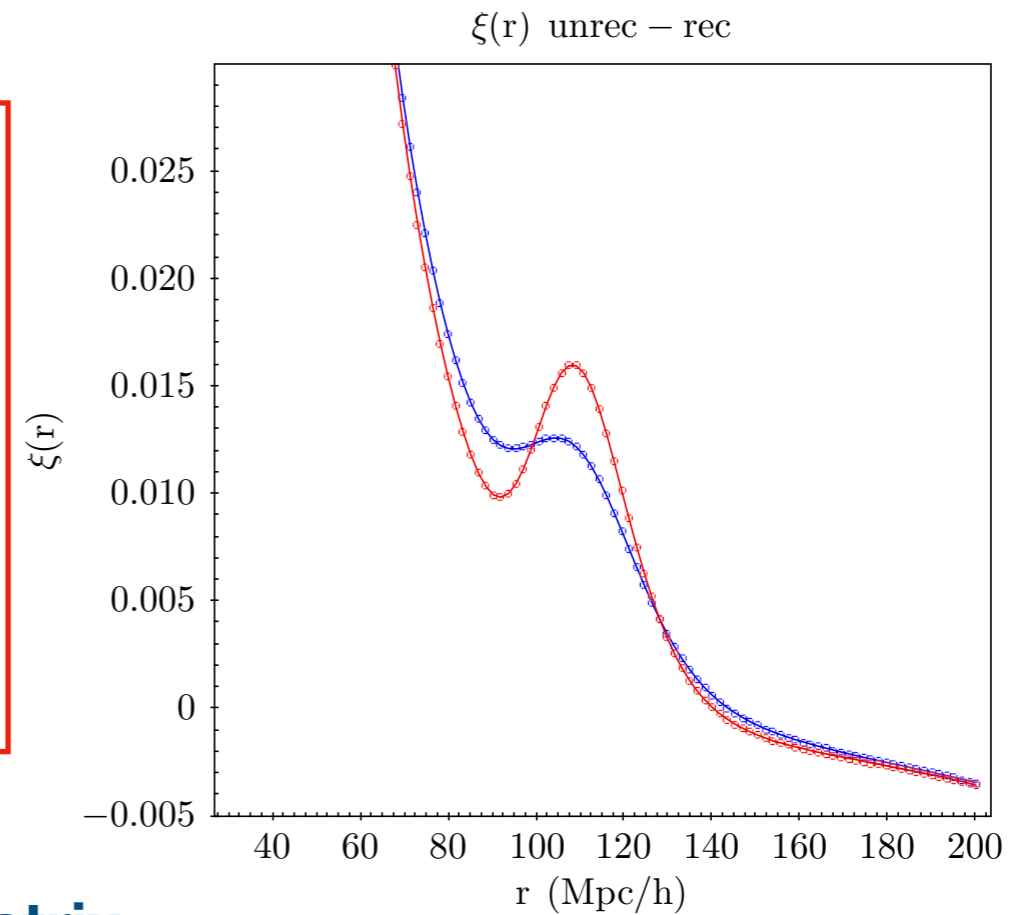

CPU time eFAM < 3h

2pt correlation function

- Routine: CosmoBolognaLib (F. Marulli)
- Estimator: Landy and Szalay $\xi(r) = \frac{DD(r) + RR(r) - 2DR(r)}{RR(r)}$
- Power Spectrum calculator: CAMB
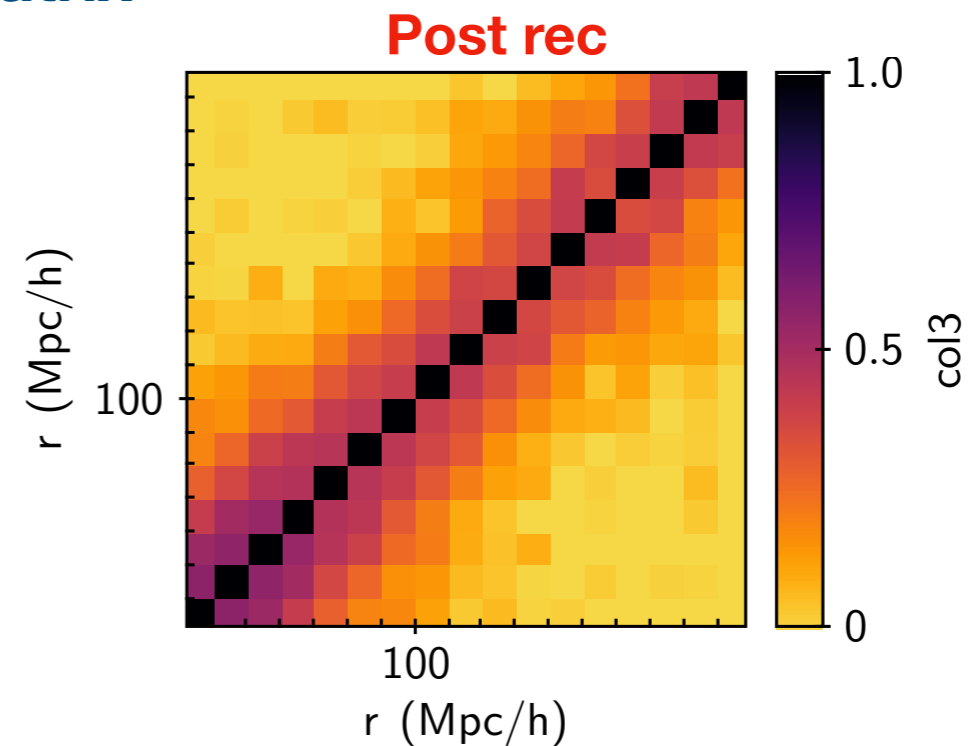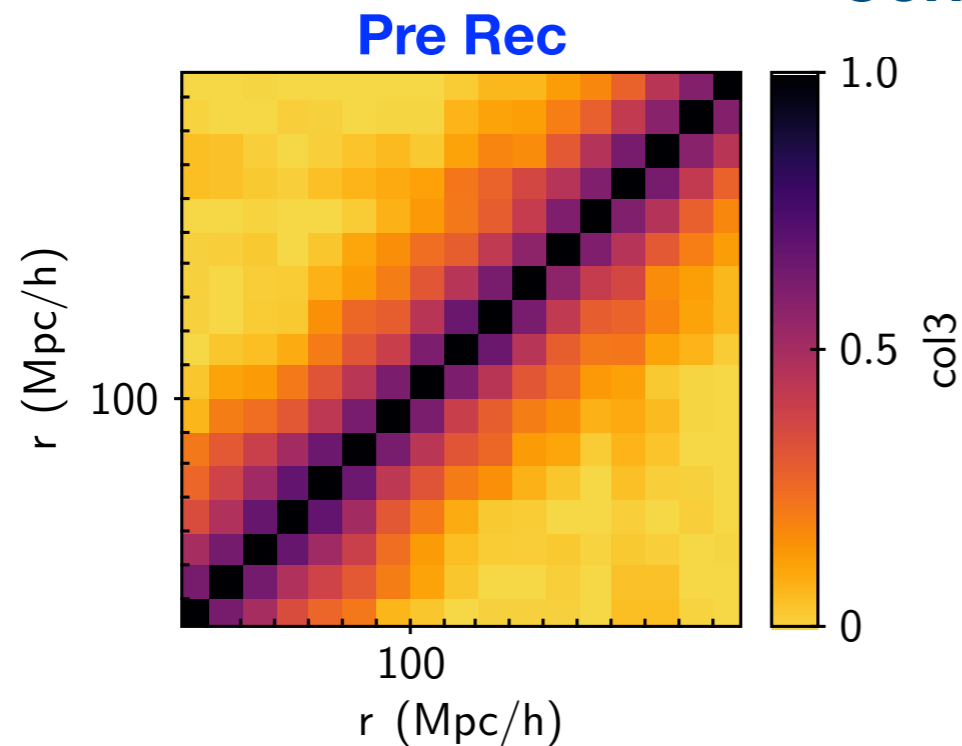- Minimization method: MCMC

eFAM Results: fitting the averaged 2p-cf

	Pre Rec	Post Rec
α	1.125	1.121
σ_α	0.00250413	0.00205138
Σ_{nl}	(10.4 ± 0.9) Mpch^{-1}	(3.28 ± 1.4) Mpch^{-1}

Improving factor: $\mathbf{I} = \sigma_\alpha^{\text{pre}} / \sigma_\alpha^{\text{Post}} \sim \mathbf{1.22}$

$\xi(r)$ unrec $-$ rec

Correlation Matrix

Pre Rec

Post rec

eFAM Results: fitting mocks 2p-cf

$< \alpha > = 1.13 \pm 0.04$

$< \alpha > = 1.12 \pm 0.03$

$< \sigma_\alpha \% > = 6.9 \pm 2.7$

$< \sigma_\alpha \% > = 4.3 \pm 2.2$
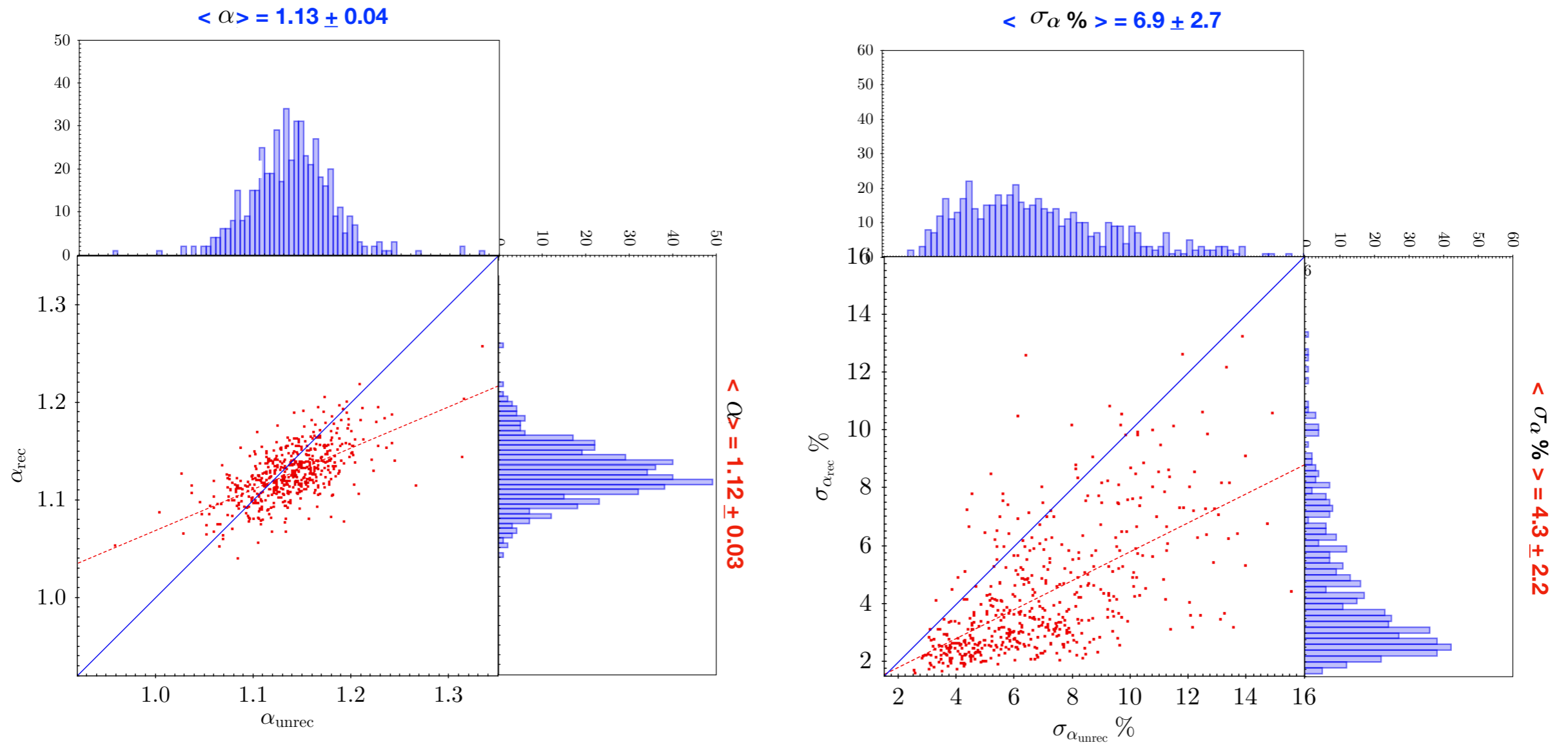
N. of mocks w/ $\sigma_\alpha > 7\%$:   **69** $\longrightarrow$ **14**

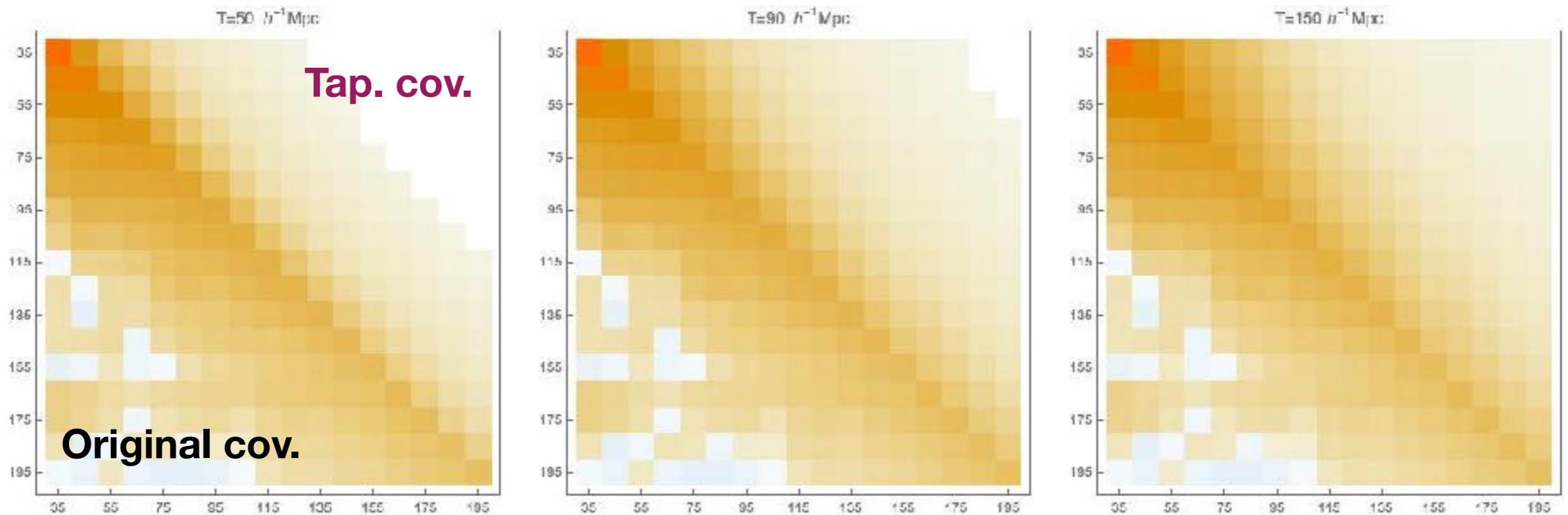# eFAM Results: fitting mocks 2pcf

Analysis of "bad-constrained" mocks

$\xi(r)\ \mathrm{urec-rec}$

$\mathrm{X}(\alpha)\ \mathrm{unrec-rec}$
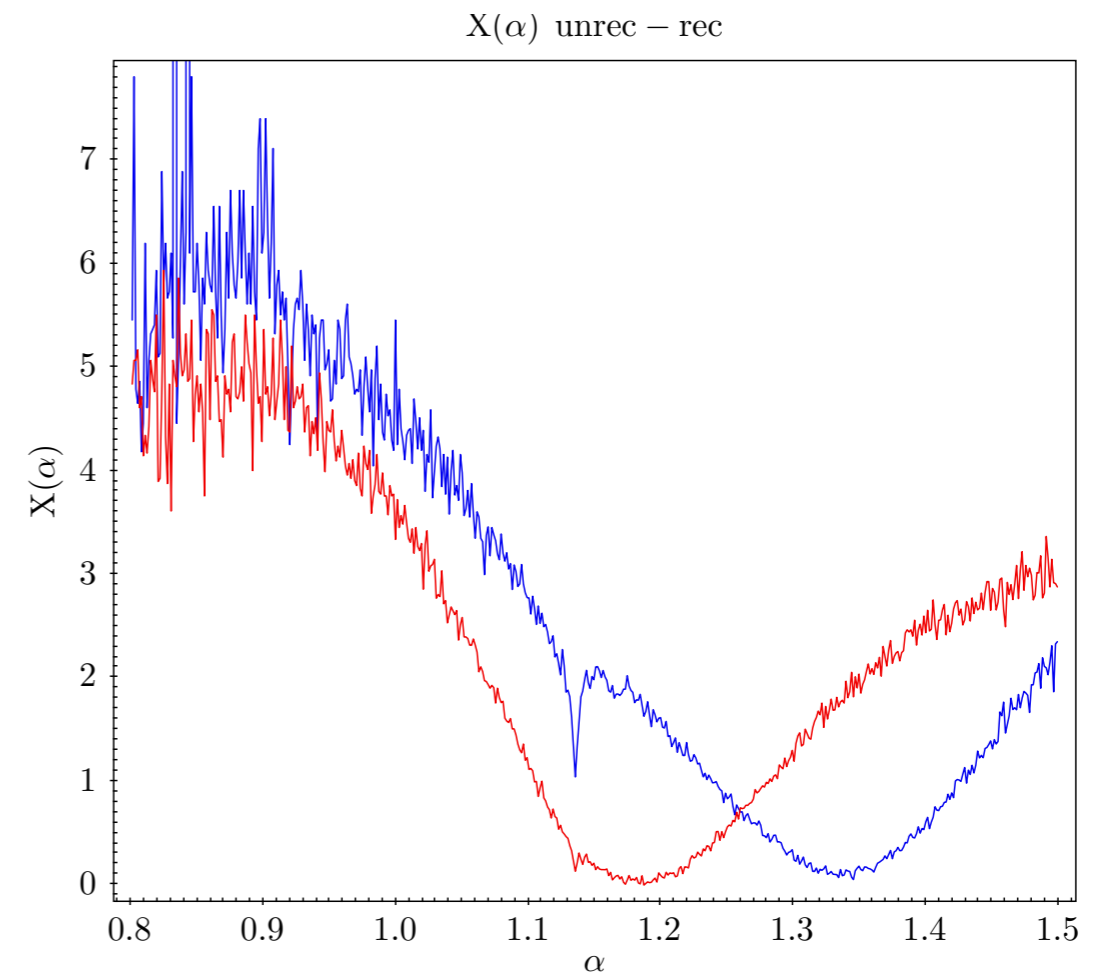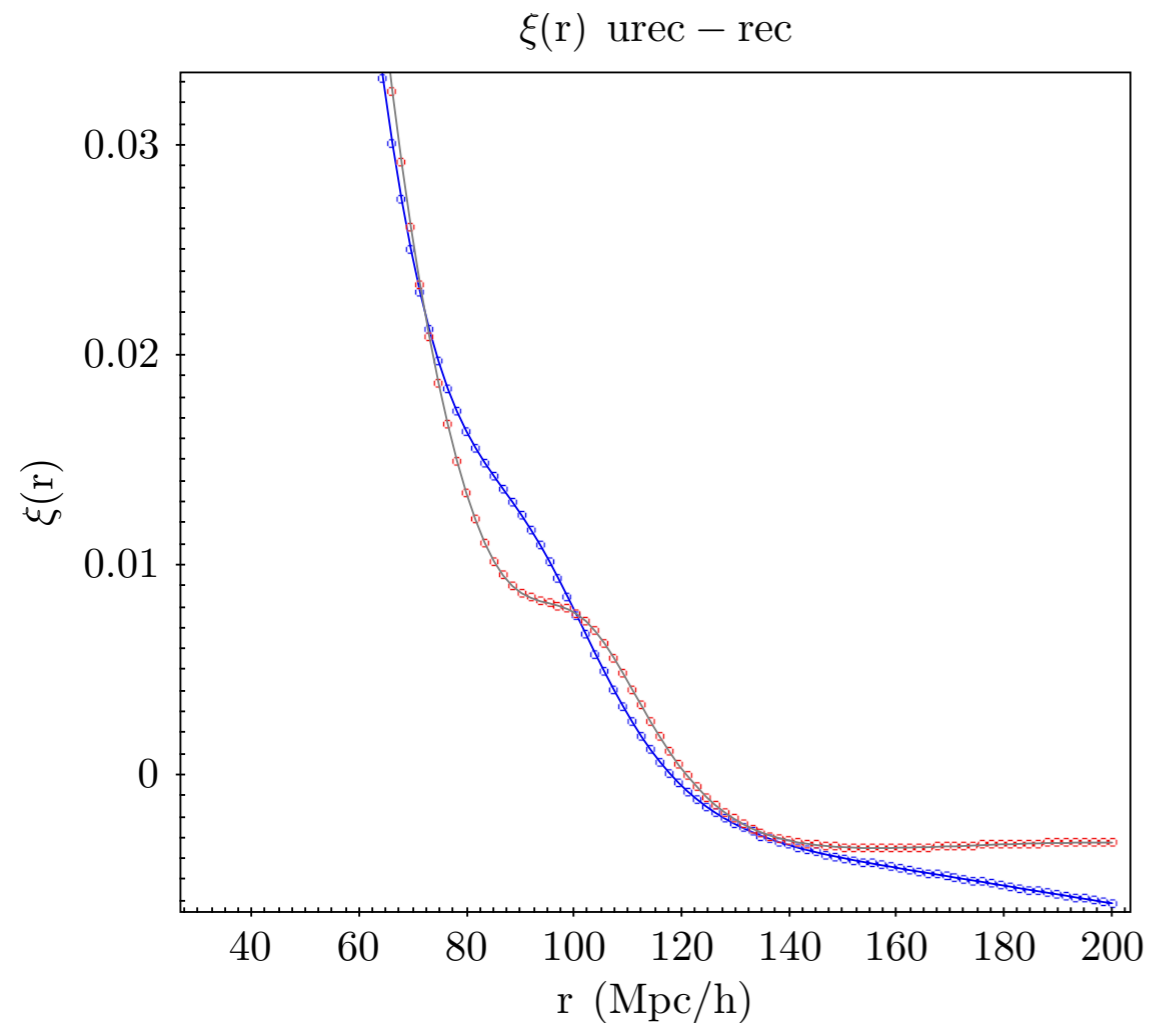
	Pre Rec	Post Rec
α	1.315	1.203
σ_{α}	0.092	0.090

eFAM Results: coming soon …

Covariance matrix regularisation: tapering

(Paz & Sánchez 2015)

Summary

❖ 10^5 particles, CPU time = 8h

❖ Polynomial expansion at 10th order (ZA: 1st order)

❖ LCDM DEUS halos simulation instead of 2-LPT mocks (!!!)

❖ Work in progress:
redshift space computations,
fit with tapered Con matrix,
modelling od RSD

Thank you for the attention

eFAM Results: fitting mocks 2pcf