Some approaches for modelling the likelihood of maps and power spectra

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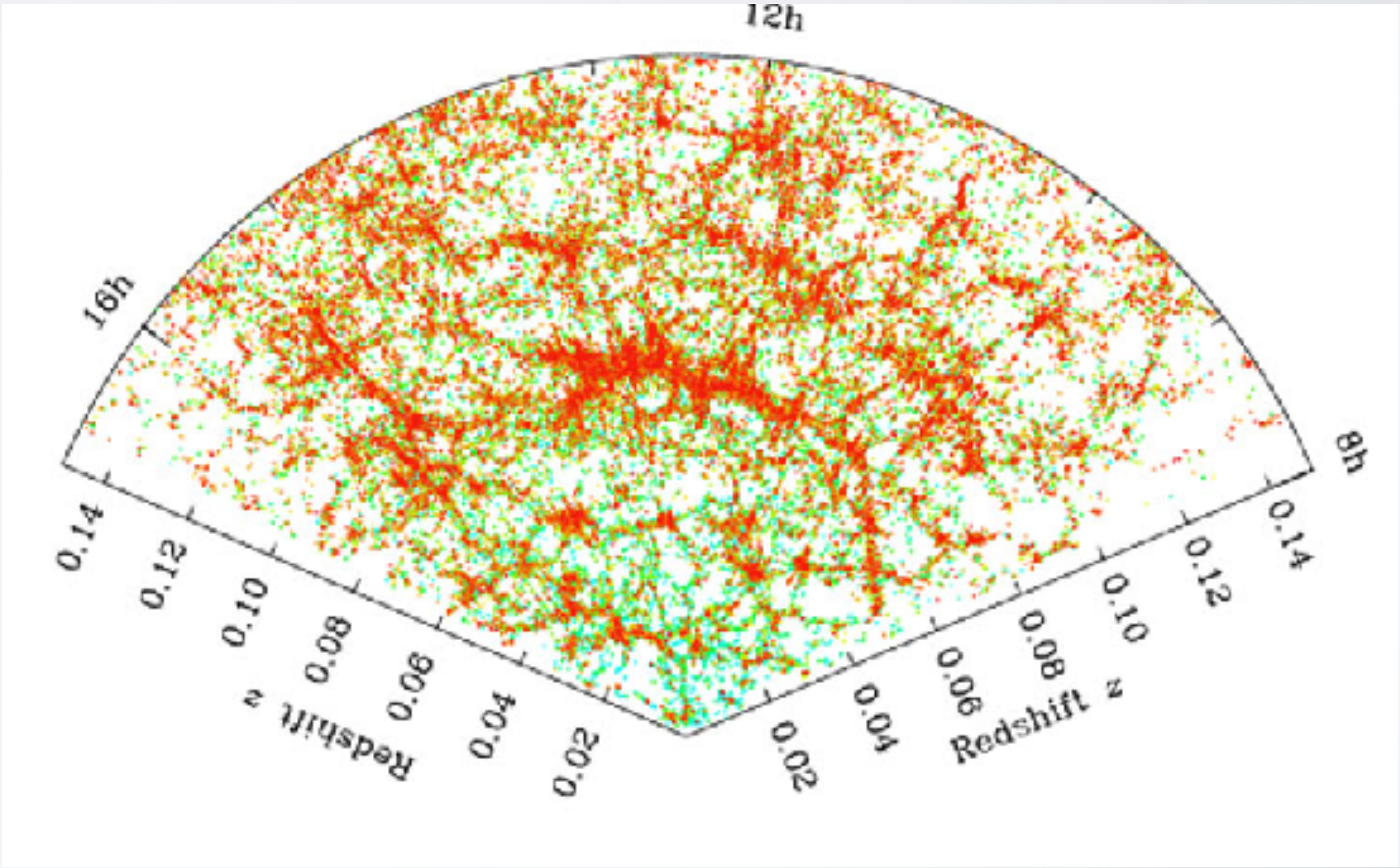
Gaussianizing transforms

AH & Mead 2017, arXiv: 1709.03924

If this could be made Gaussian our lives would be easier



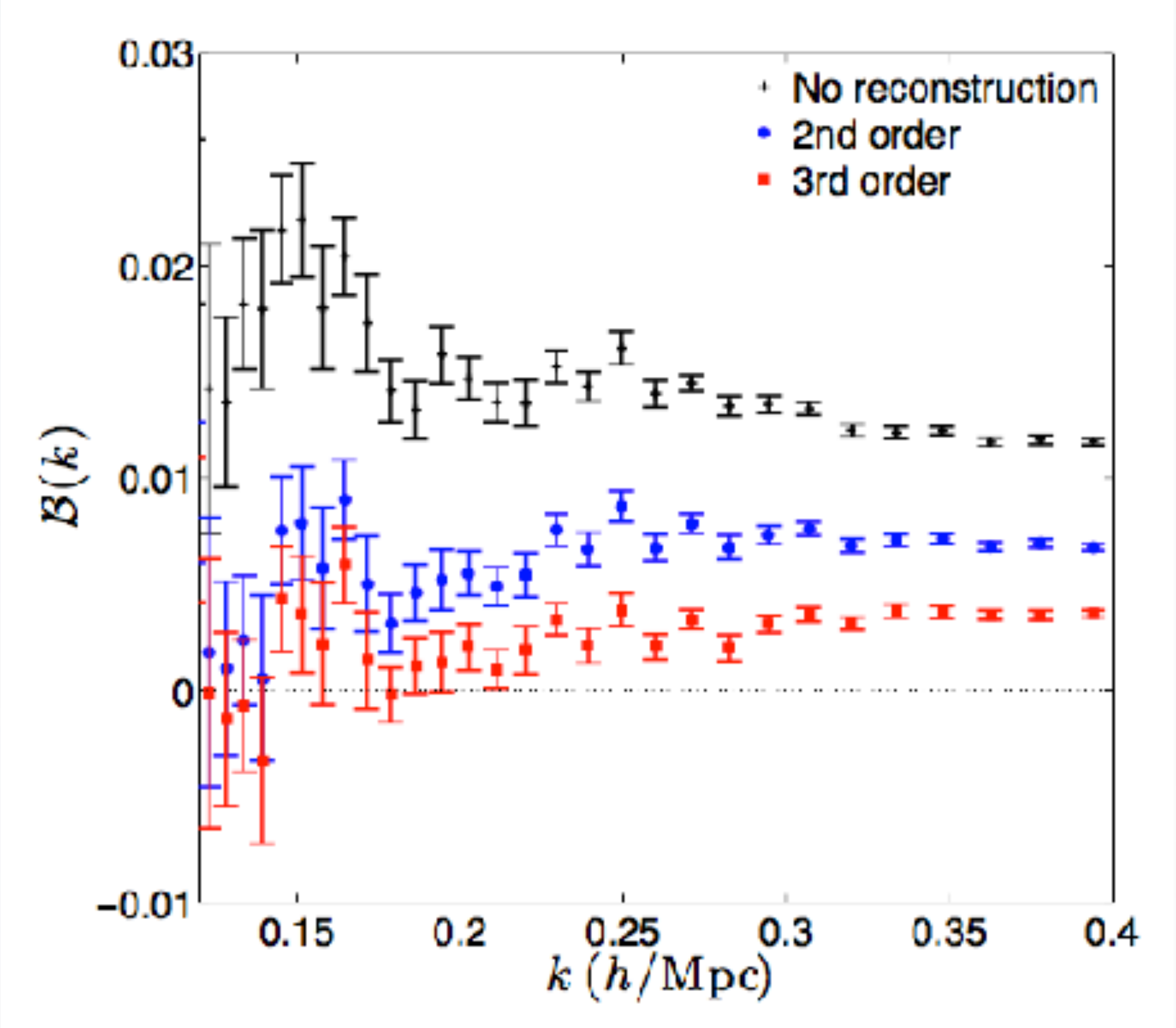
e.g. logarithms, Box-Cox, clipping, etc.

Gaussianizing transforms

AH & Mead 2017, arXiv: 1709.03924

Use perturbation theory to design Gaussianizing transforms

$$\delta \to f(\delta)$$



Suppressed bispectrum

Gaussianizing transforms

AH & Mead 2017, arXiv: 1709.03924

Use perturbation theory to design Gaussianizing transforms

$$\delta \to f(\delta)$$

$$p(\delta|P,B,T) = p_G\left[f(\delta;P,B,T)|P\right]\left|\frac{\mathrm{d}f}{\mathrm{d}\delta}\right|$$

Gives a non-Gaussian multivariate pdf for the map - Bayesian inference in the non-linear regime...

Combining theory and simulation covariances in the likelihood

AH & Taylor 2018, on arXiv very soon...

$$\hat{\mathbf{C}}^{*} = \hat{\lambda}\mathbf{C}_{T} + (1 - \hat{\lambda})\hat{\mathbf{C}}$$

Combinations of theory and simulation covariances (e.g. shrinkage)

$$-2\ln L = (\mathbf{y} - \mu)^{\mathbf{T}}\hat{\mathbf{C}}^{*\mathbf{-1}}(\mathbf{y} - \mu)$$

Is this the correct likelihood?

Do you need to de-bias the inverse here?

Combining theory and simulation covariances in the likelihood

AH & Taylor 2018, on arXiv very soon...

$$\hat{\mathbf{C}}^* = \hat{\lambda}\mathbf{C}_T + (1 - \hat{\lambda})\hat{\mathbf{C}}$$

Marginalize over unknown covariance matrix with theory prior

$$-2\ln L = (n+m)\ln\left[1 + \frac{(\mathbf{y}-\mu)^T\tilde{\mathbf{C}}^{-1}(\mathbf{y}-\mu)}{(n-1)}\right]$$

$$\tilde{\mathbf{C}} \equiv \hat{\mathbf{C}} + \frac{m-p-1}{n-1}\mathbf{C}_T$$

Combining theory and simulation covariances in the likelihood

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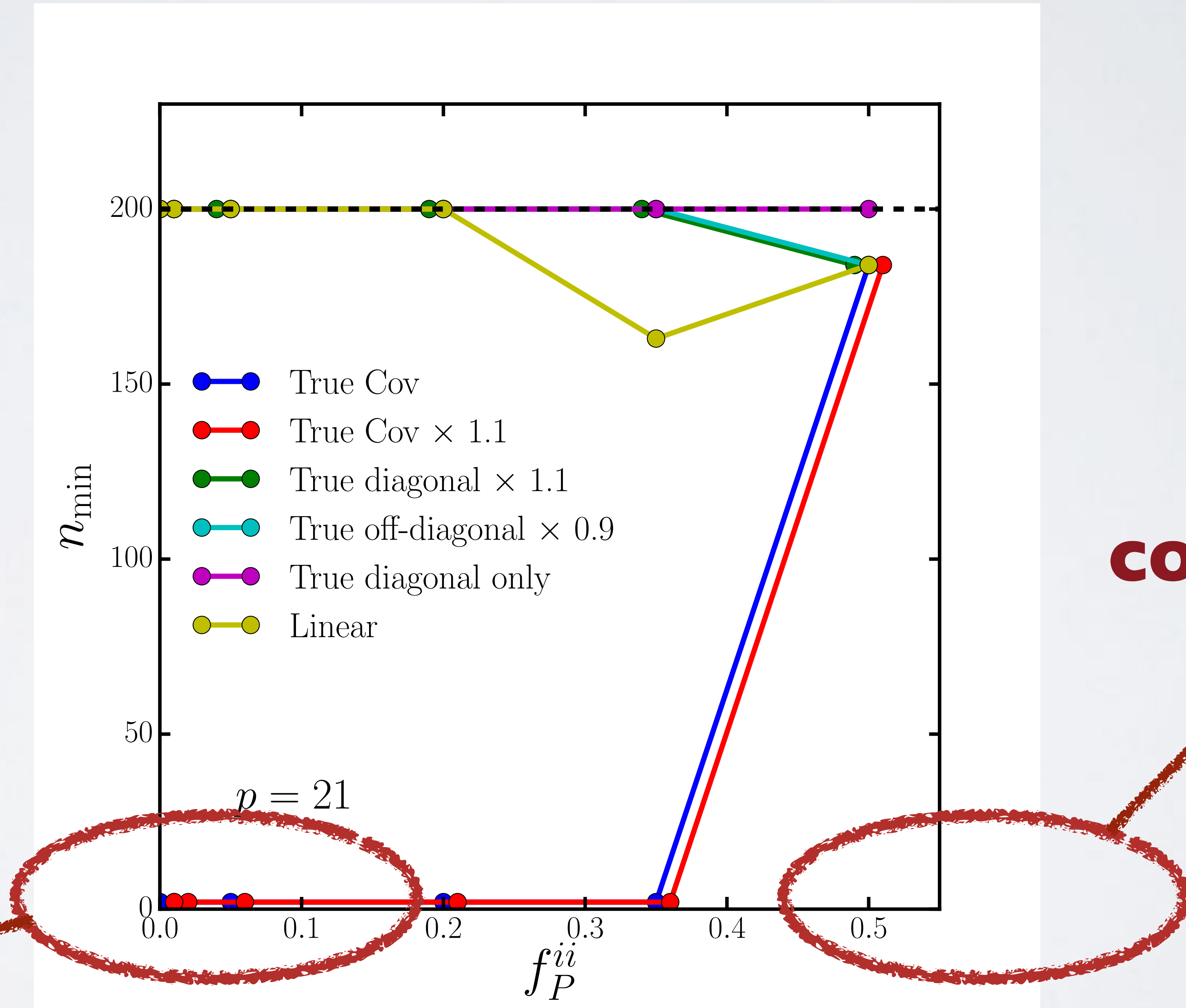

High confidence in theory

Low confidence theory

Thanks

Perturbative Gaussianizing transforms for cosmological fields

AH & Mead 2017, arXiv: 1709.03924

Combining theory and simulation-based covariance matrices for large-scale structure: a Bayesian prescription

AH & Taylor 2018, arXiv: 1804.??????