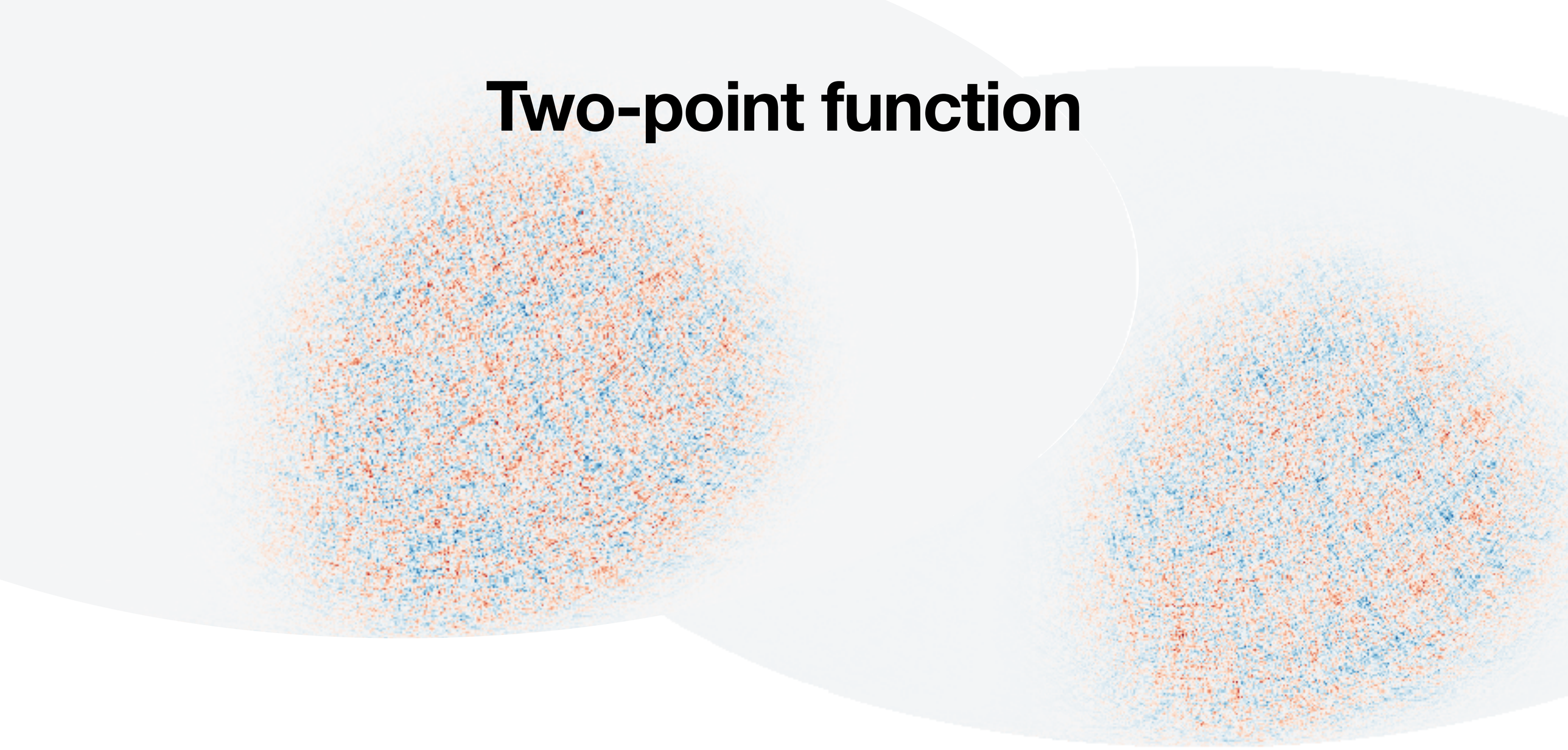
Likelihoods of two-point functions

Subtleties and surprises in parameter inference

Veronika Oehl

ETH zürich

Two-point function



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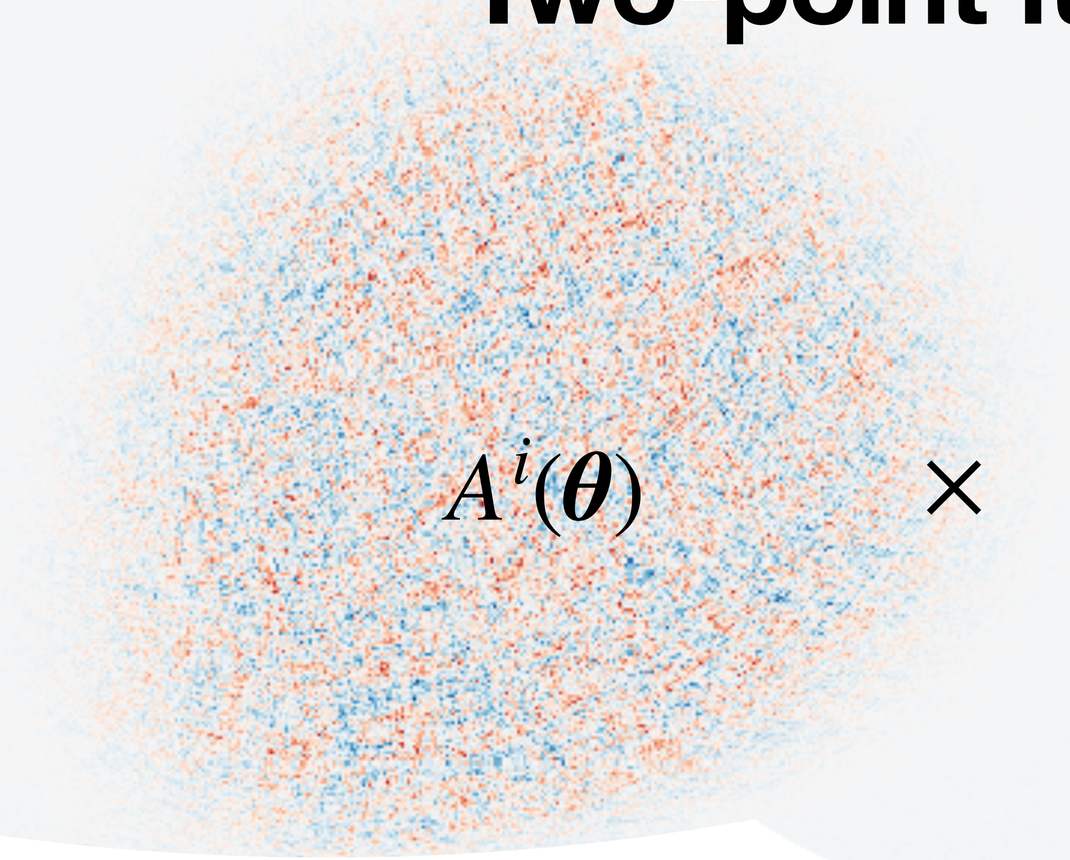
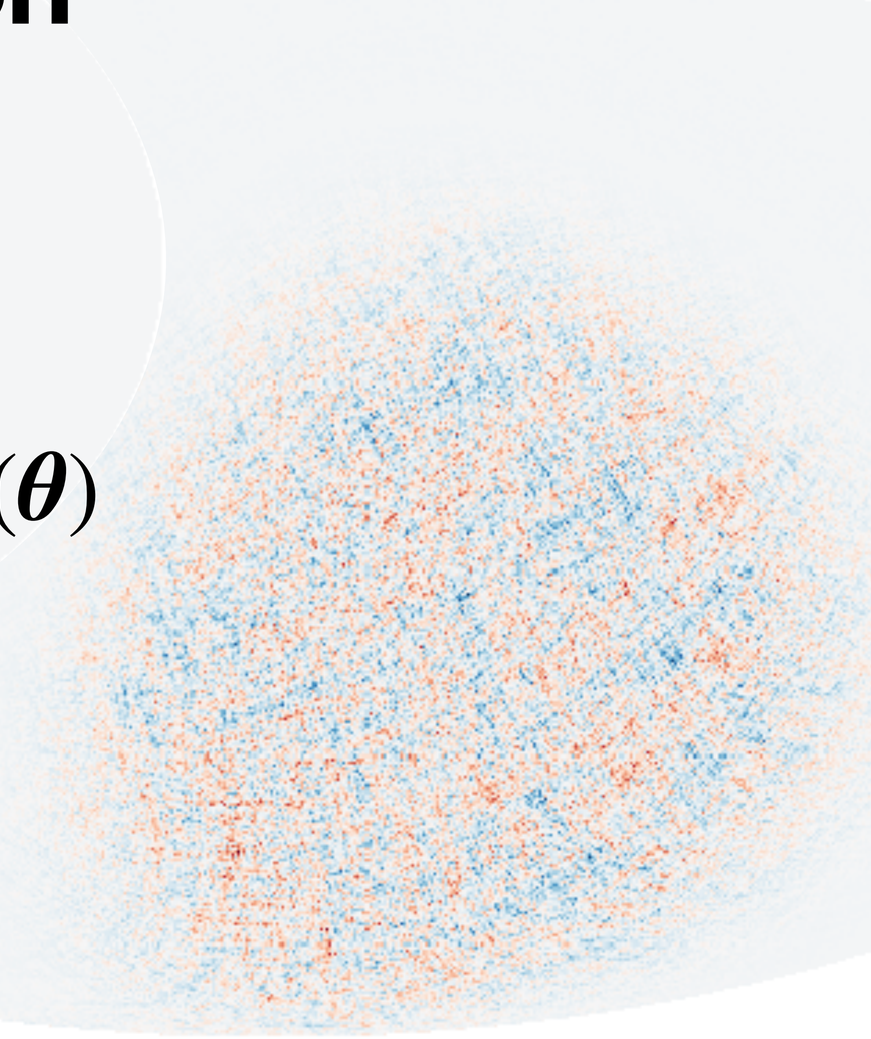


$$A^i(\boldsymbol{\theta}) \quad \times \quad A^j(\boldsymbol{\theta})$$



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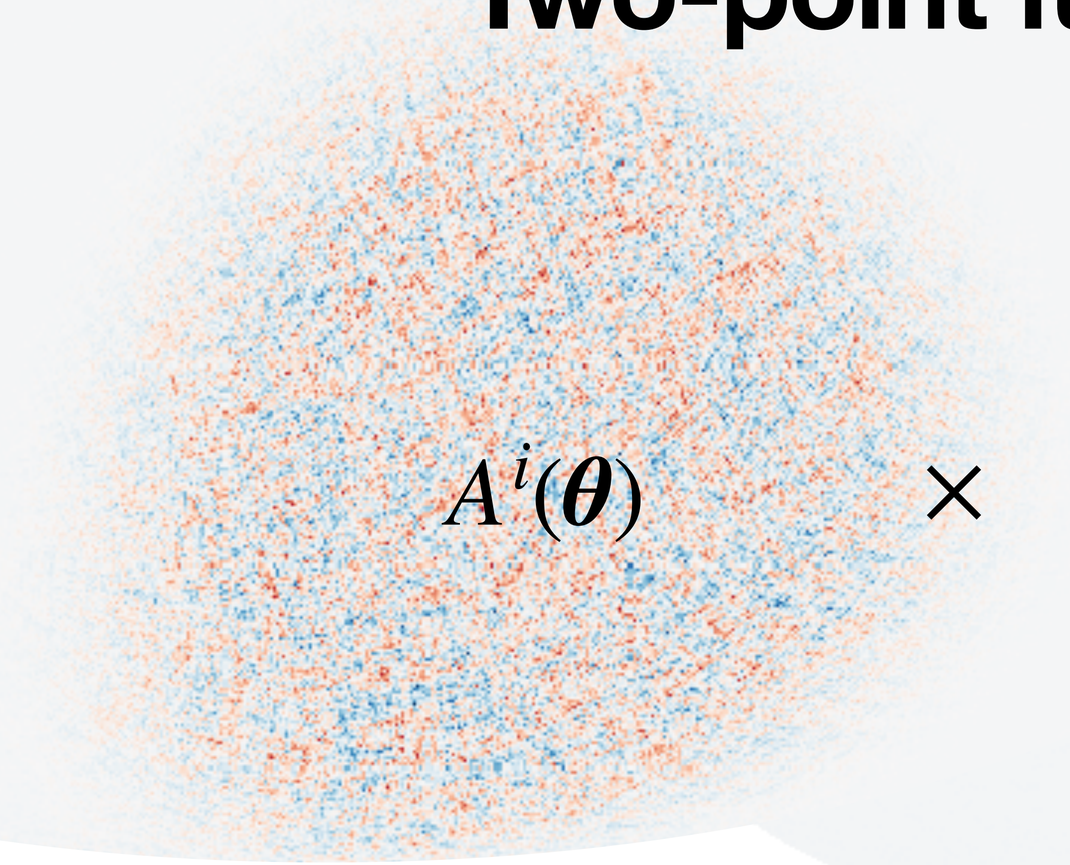

$$A^i(\boldsymbol{\theta}) \quad \times \quad A^j(\boldsymbol{\theta})$$

$$\xi^{ij}(\theta) = \left\langle A^i(\boldsymbol{\theta}')\, A^j(\boldsymbol{\theta}' - \boldsymbol{\theta}) \right\rangle$$

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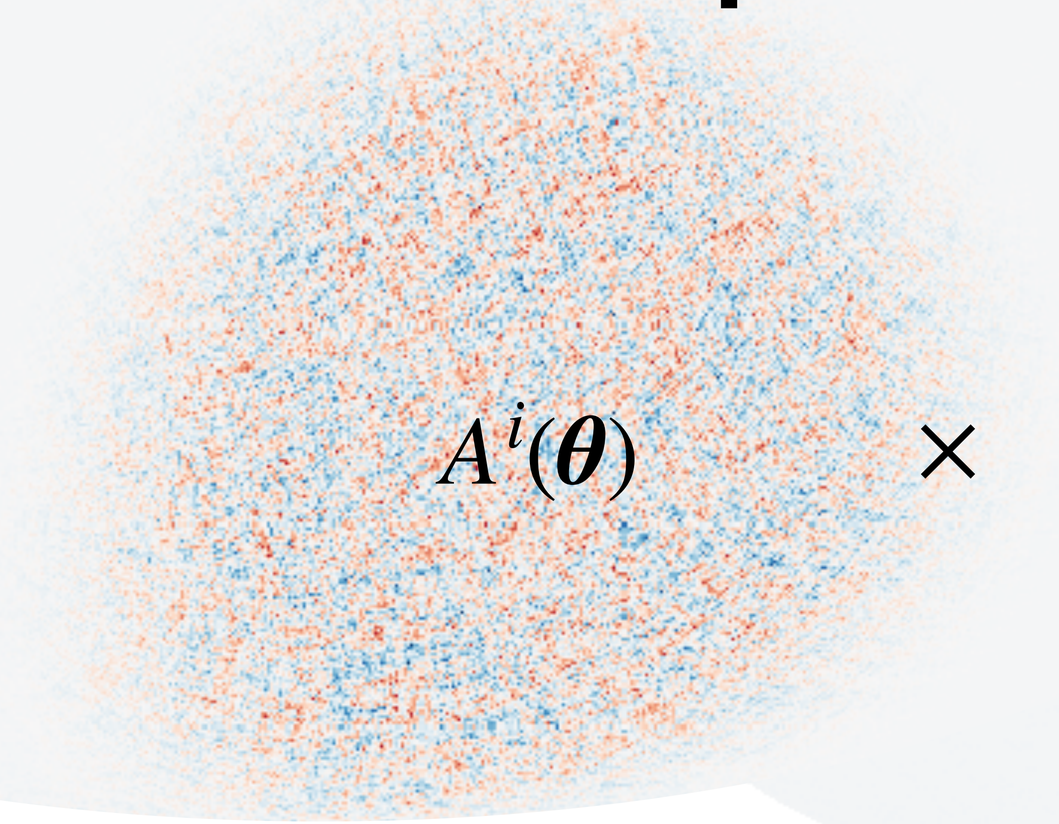

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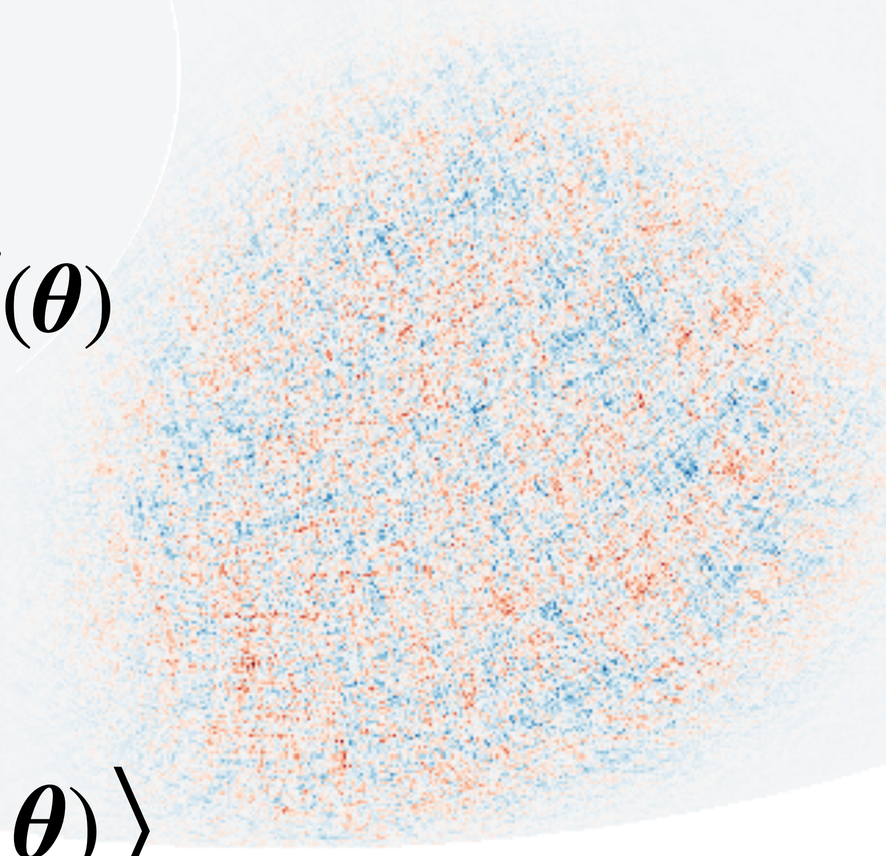

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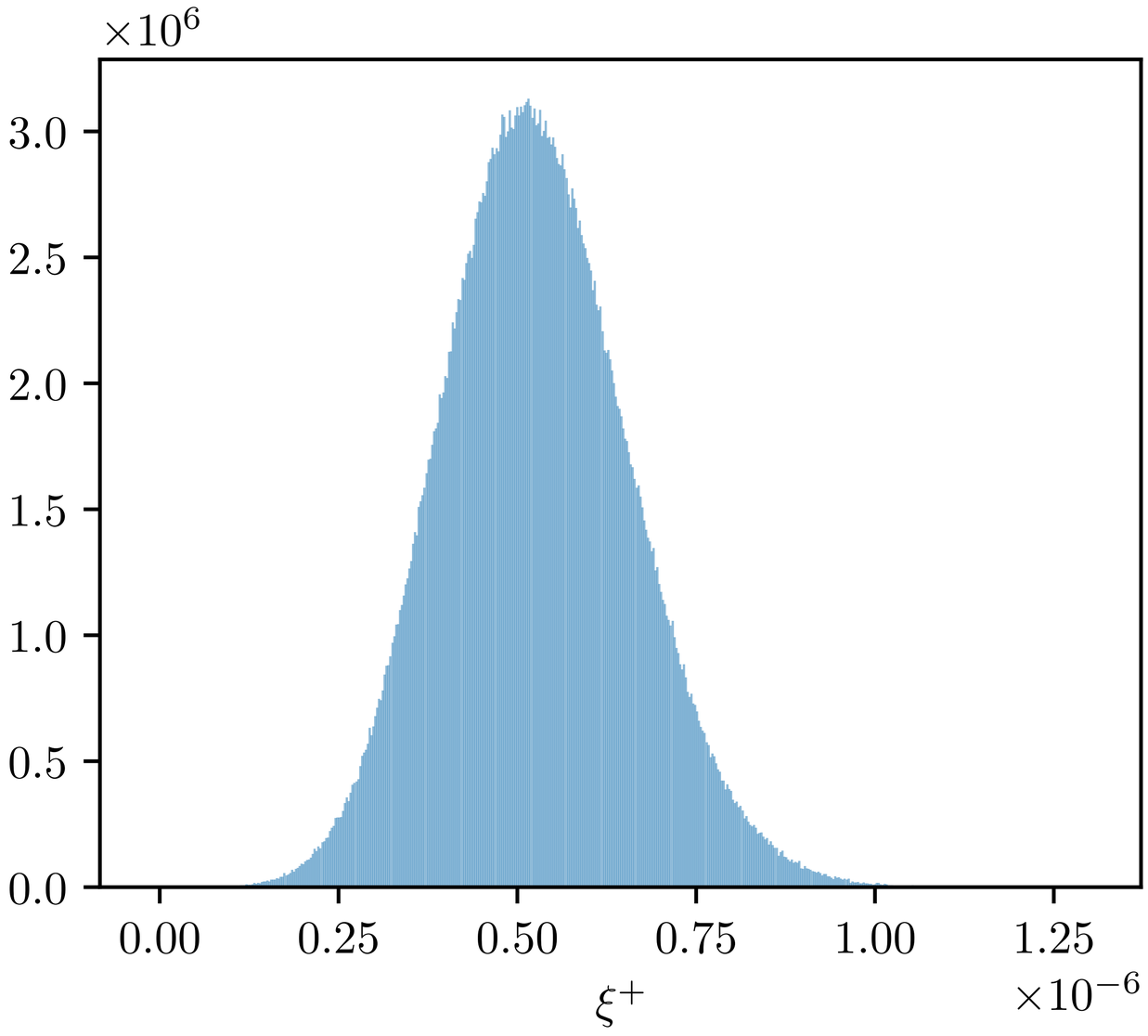
for example: weak lensing shear

Sampling distribution of a correlation function estimator



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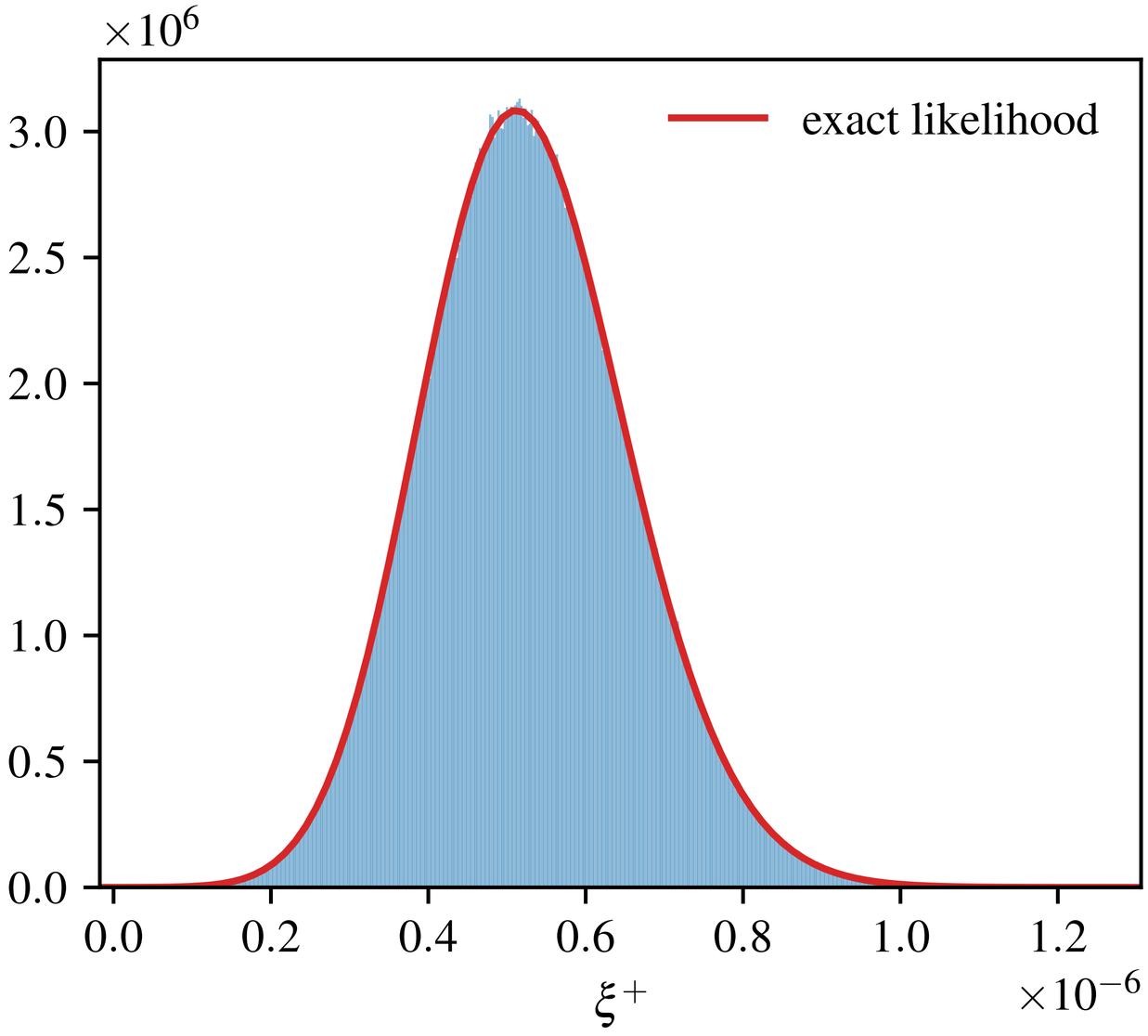

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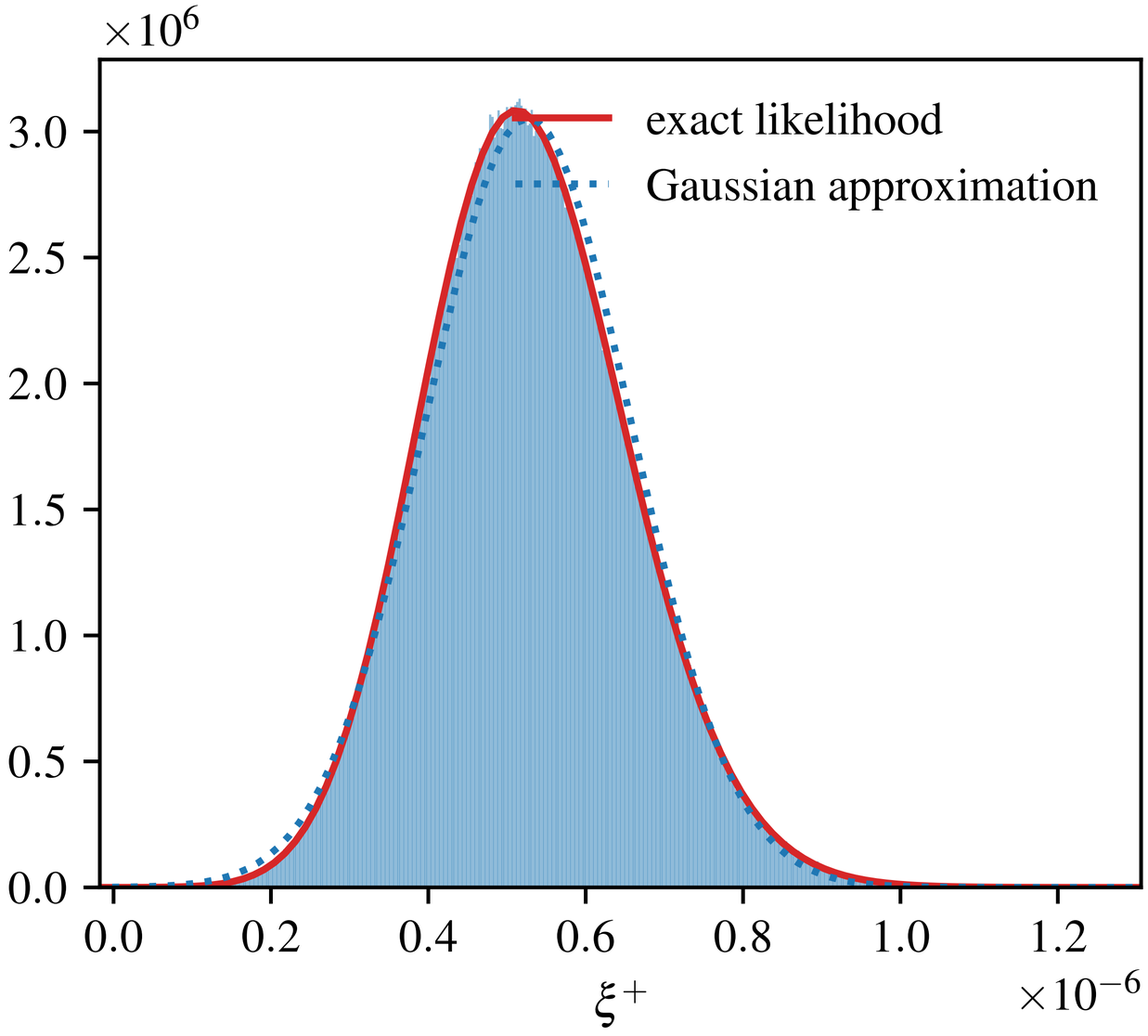

Same inference with different likelihoods

$$p(S_8 \,|\, \xi^{+}_{S5-S5}(\bar{\theta}_3)) \propto p(S_8)\; p(\xi^{+}_{S5-S5}(\bar{\theta}_3) \,|\, S_8)$$

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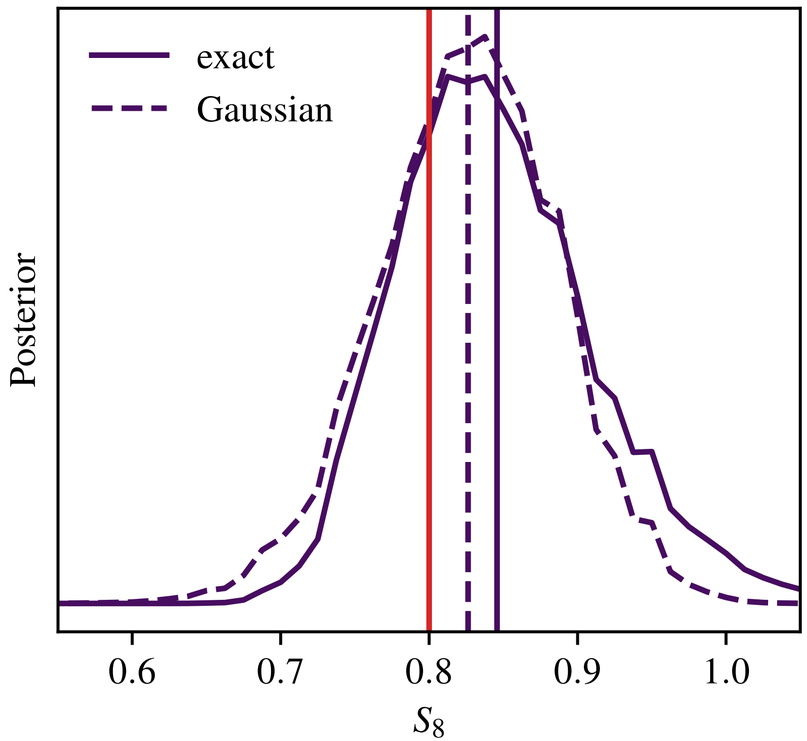

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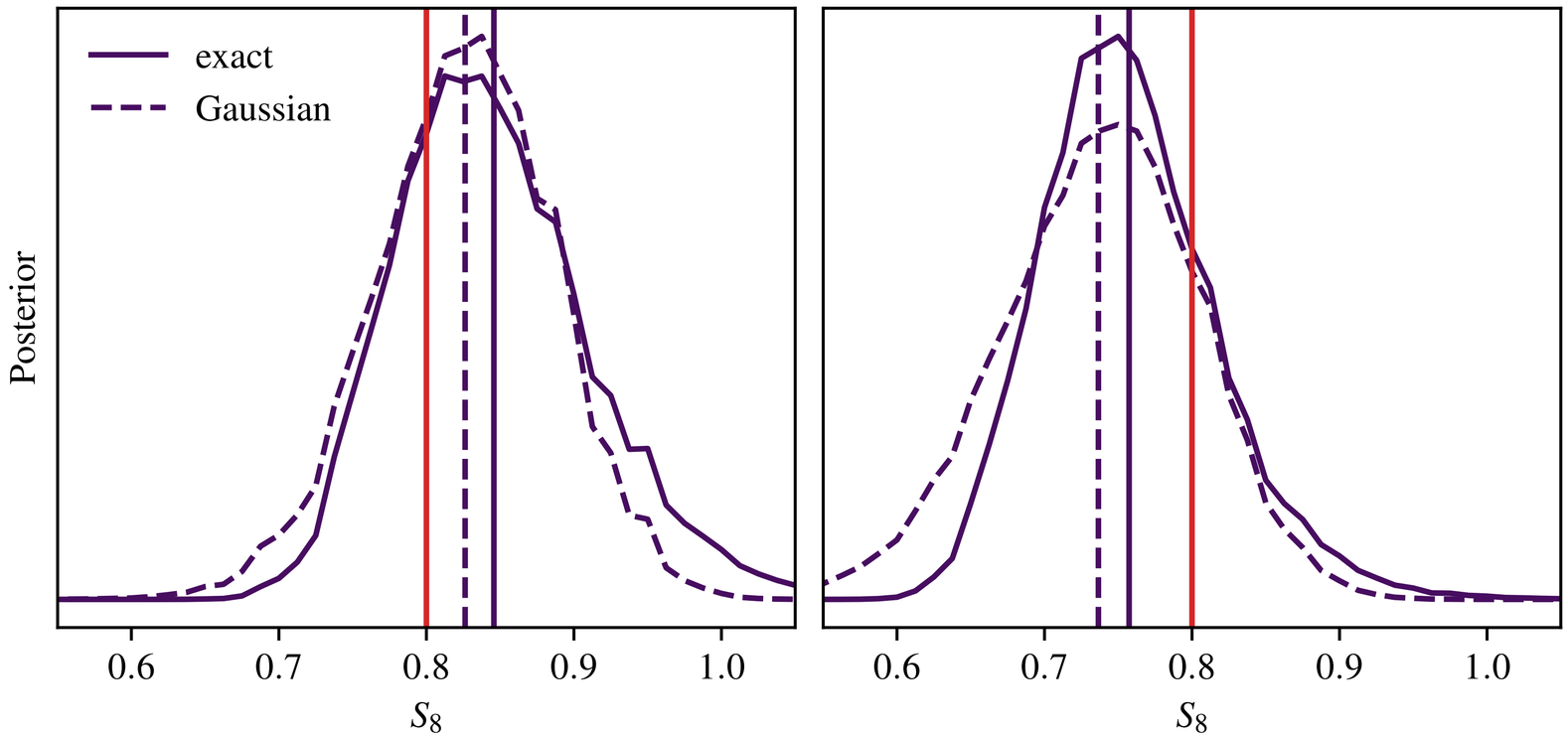

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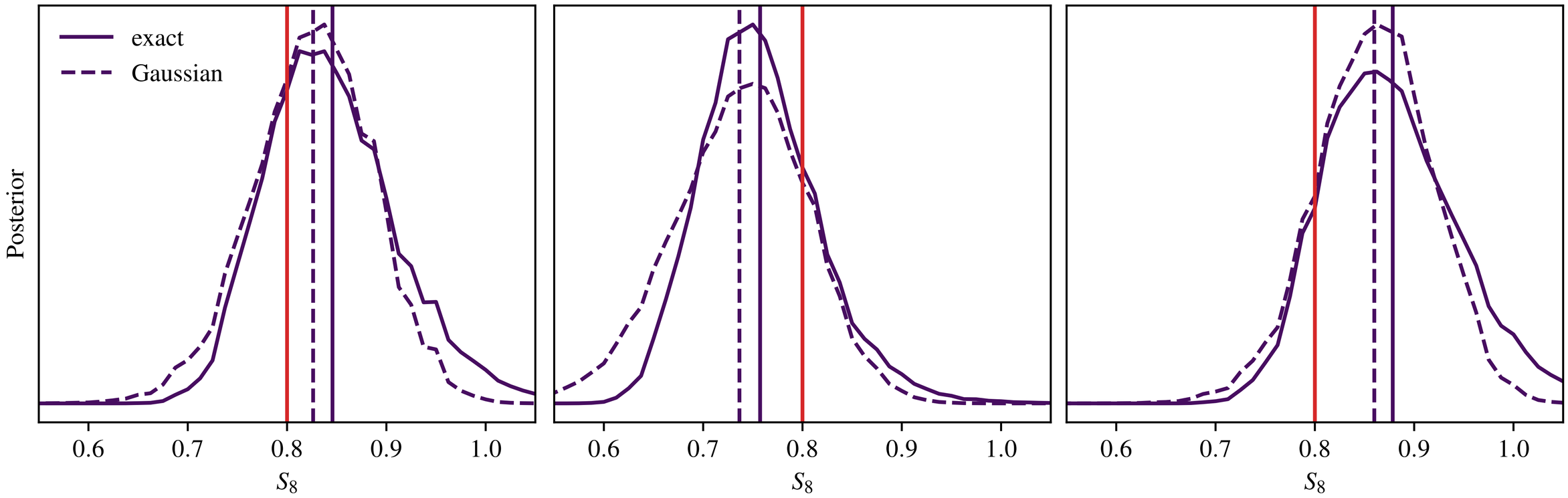
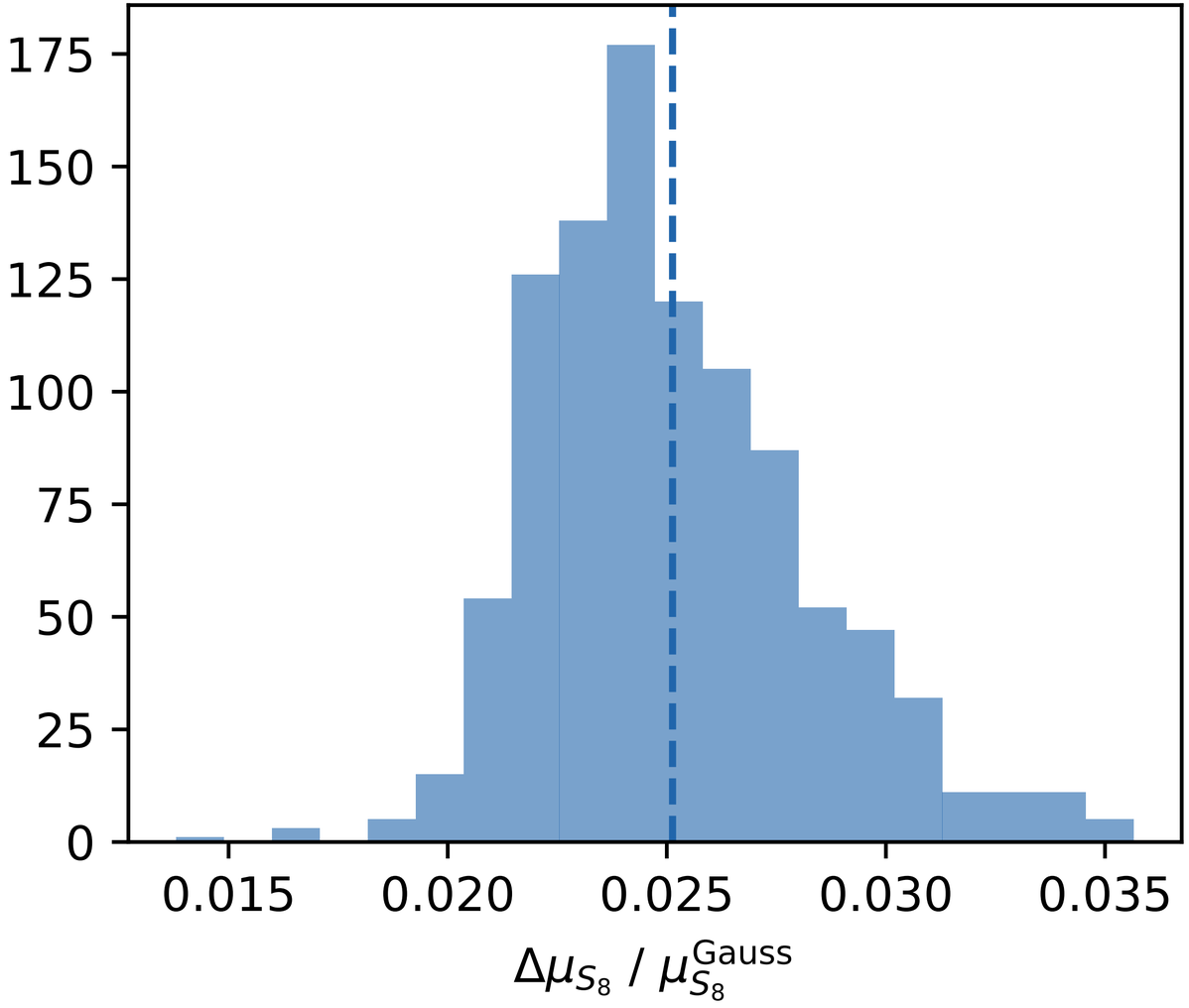


Differences in the posterior mean

$$\Delta\mu_{S_8} = \mu_{S_8}^{\text{exact}} - \mu_{S_8}^{\text{Gauss}}$$



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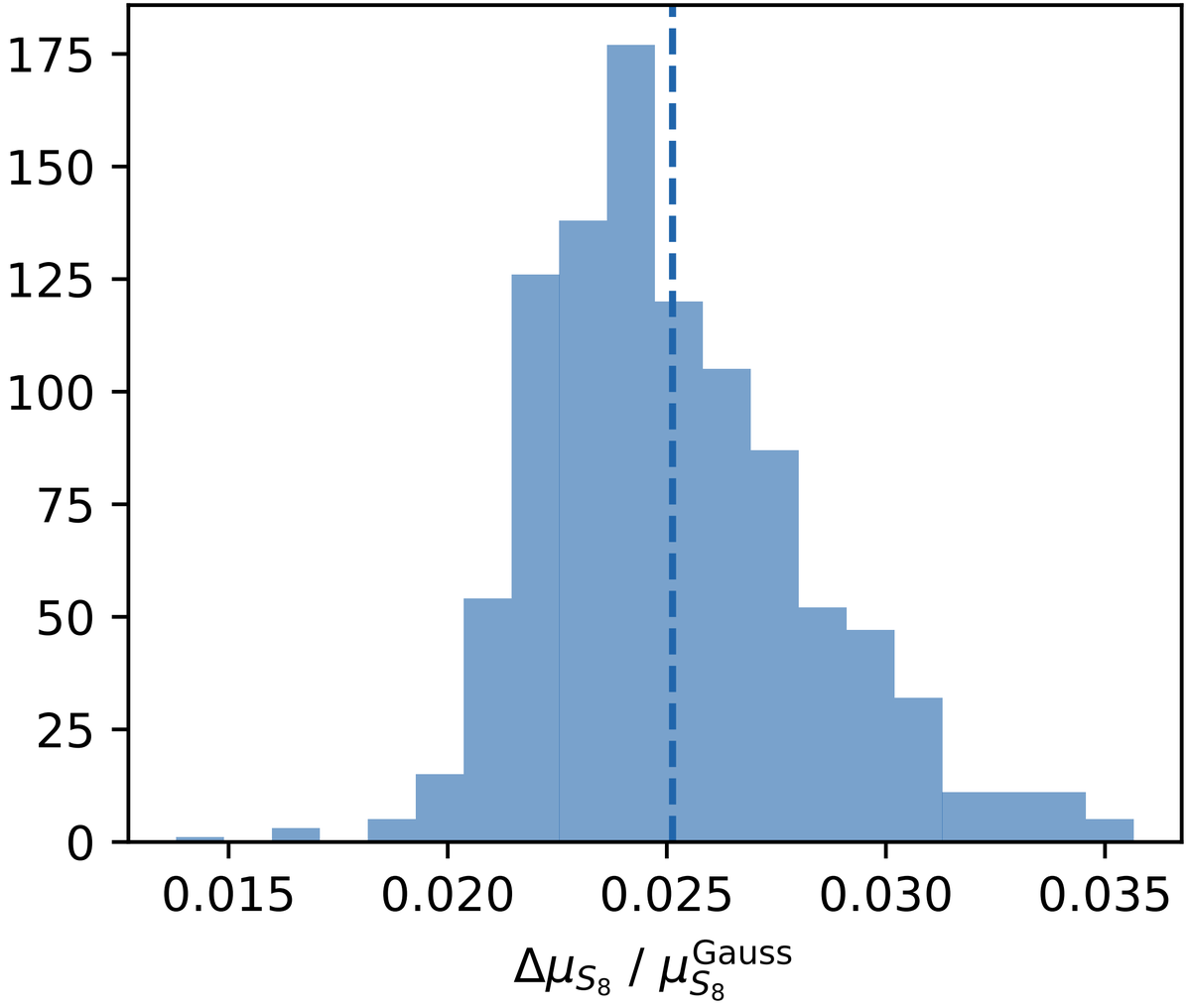

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single datapoint

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datavector

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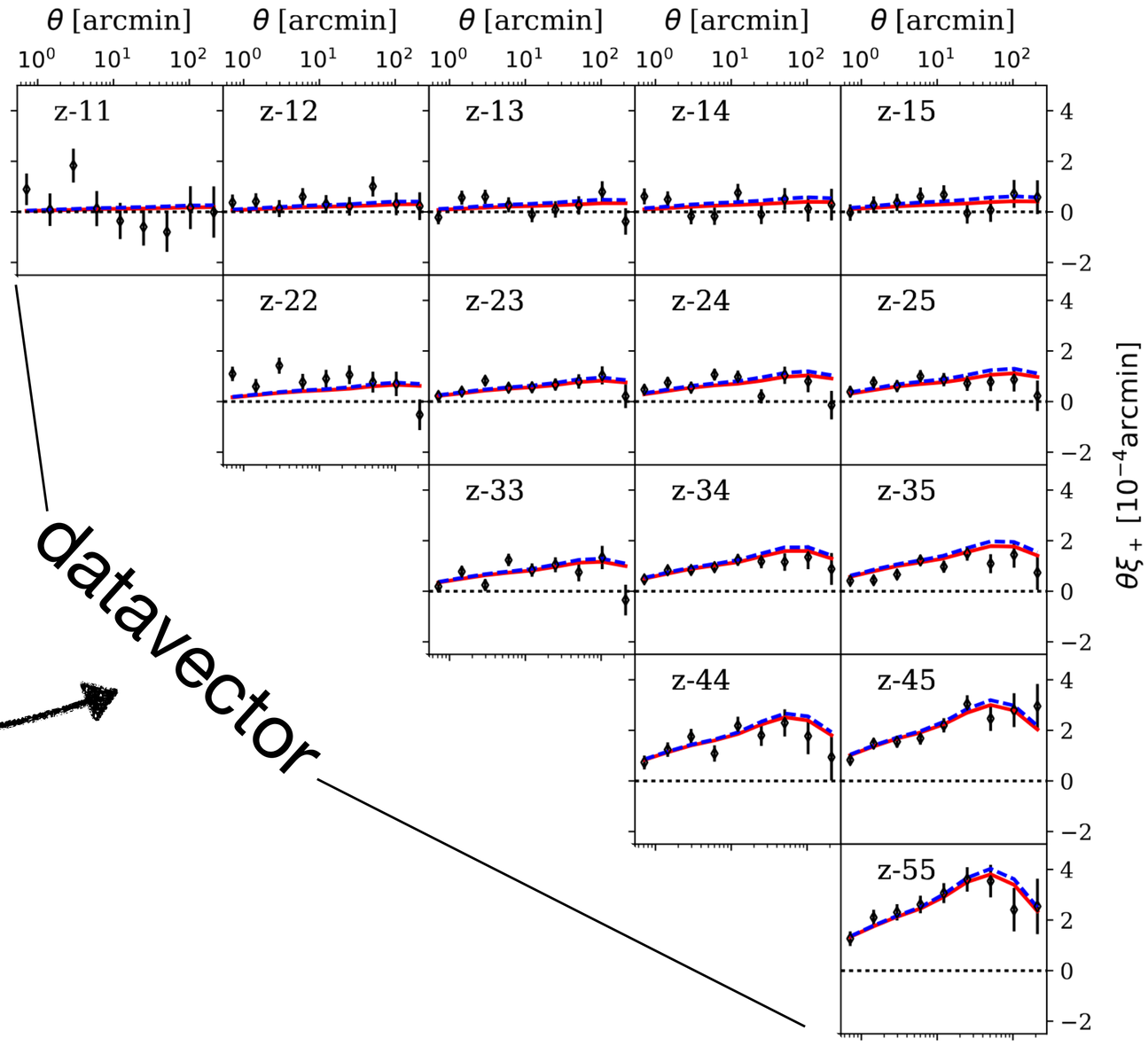

Asgari et al., 2021

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single datapoint

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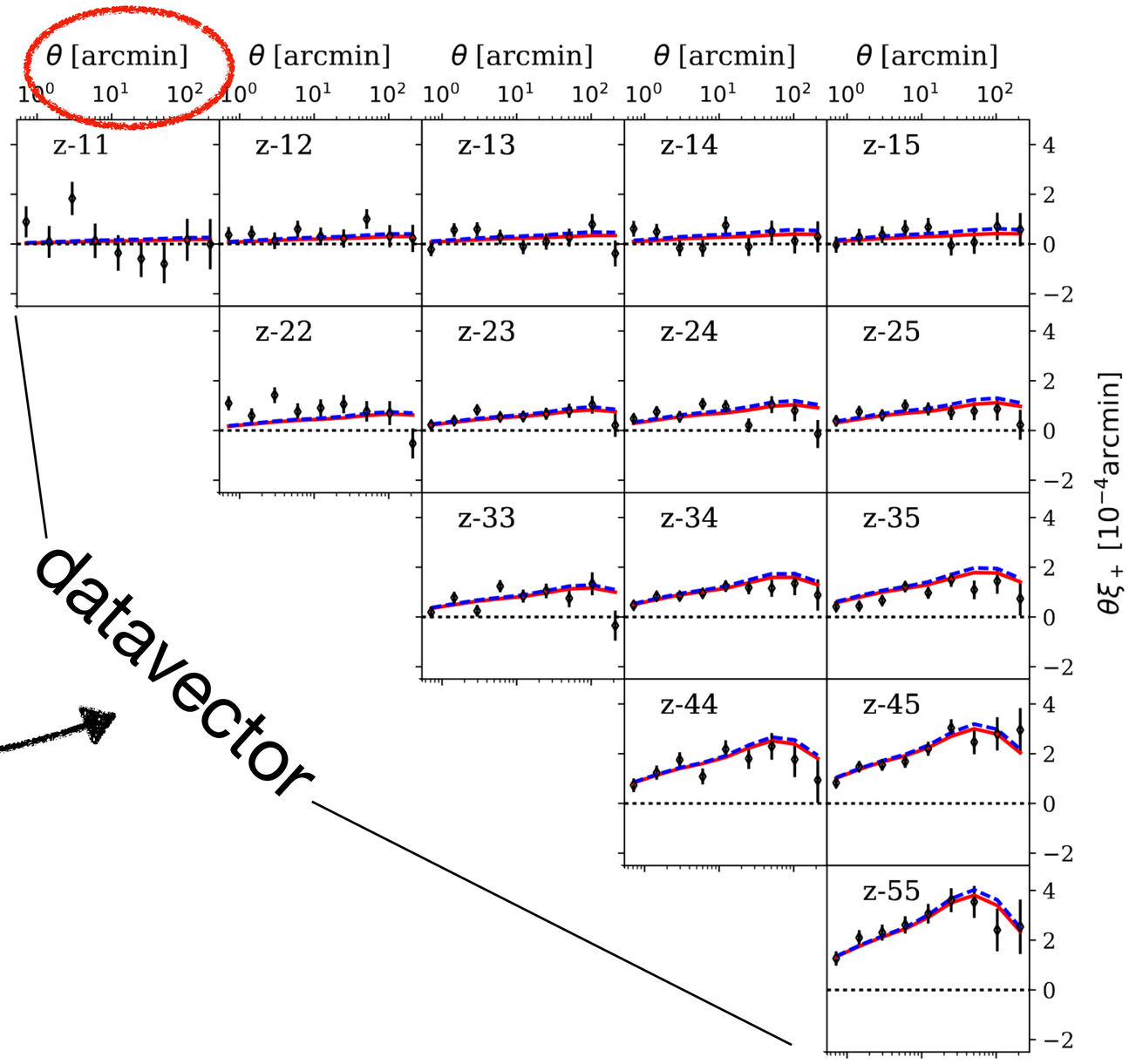

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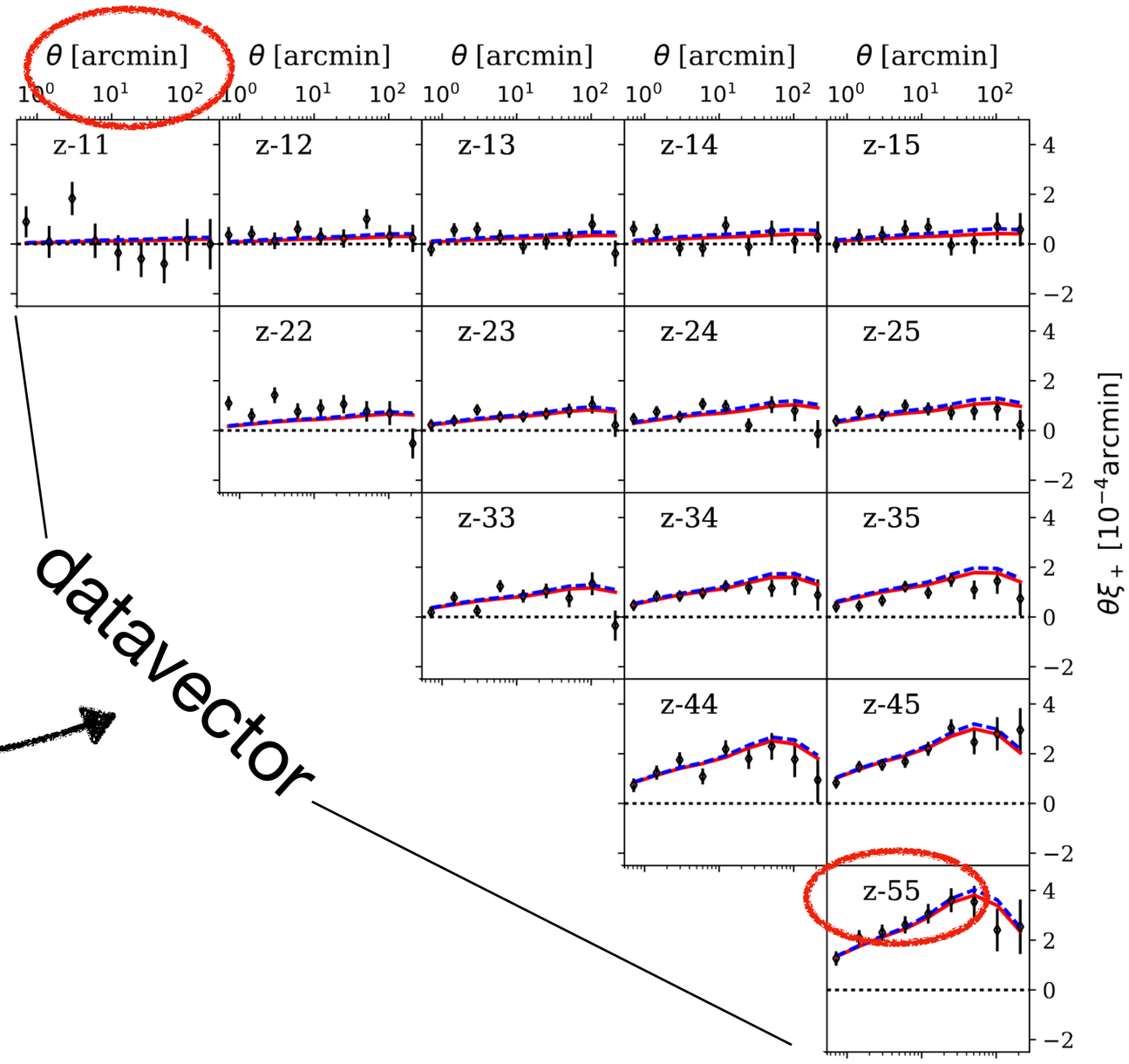

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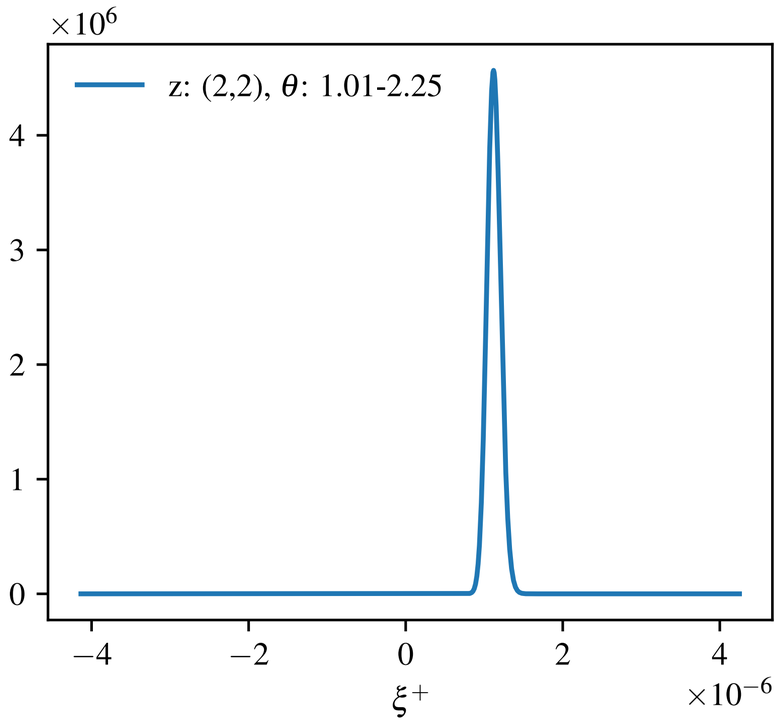
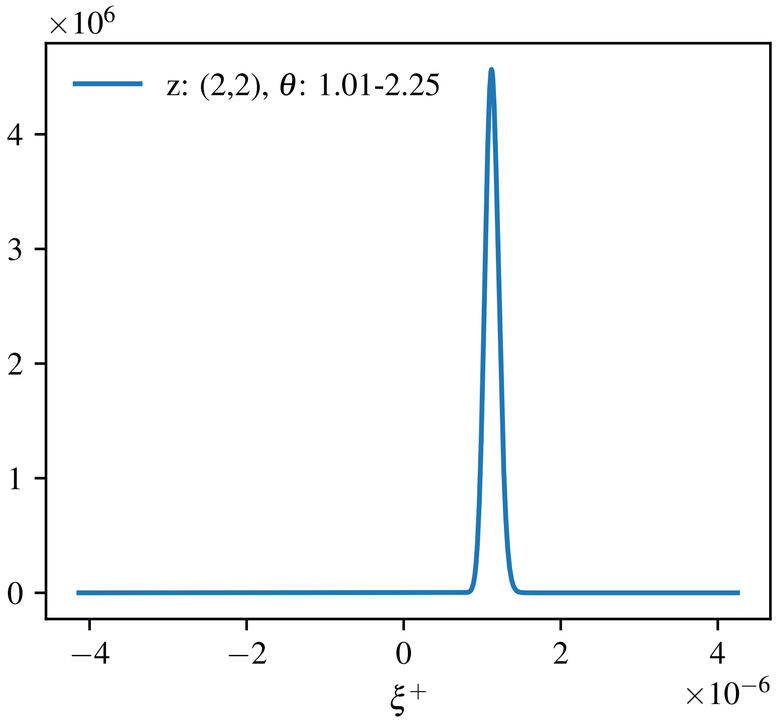
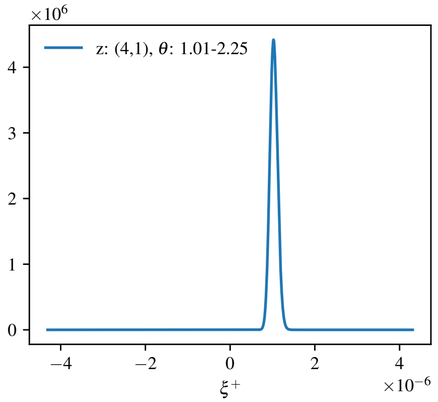
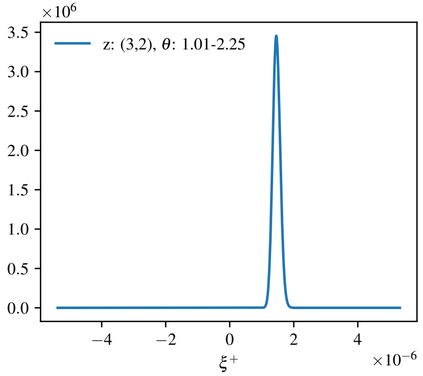
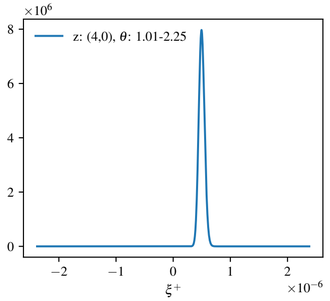
Asgari et al., 2021

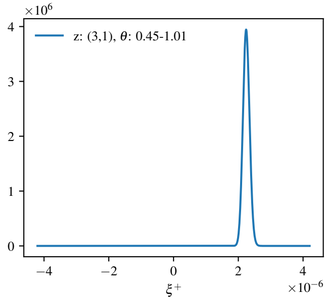

×10^6
z: (2,2), θ: 1.01-2.25
4
3
2
1
0
−4
−2
0
2
4
ξ+
×10^−6

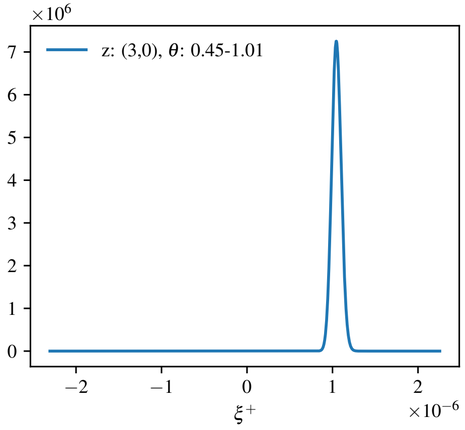


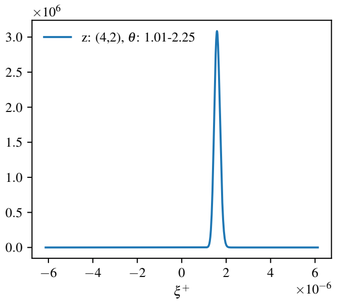


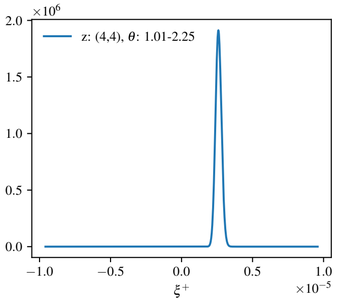


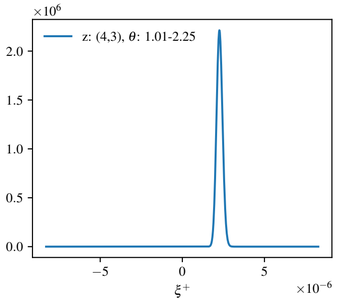


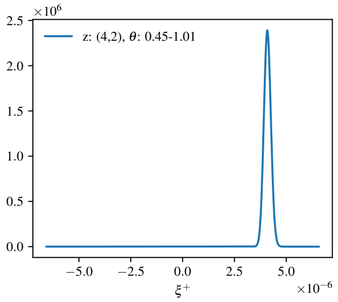






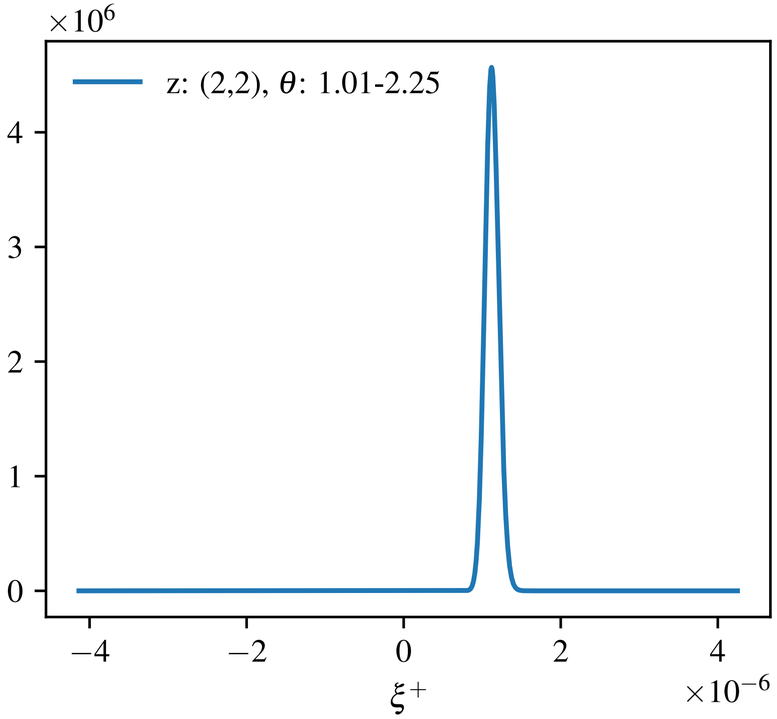


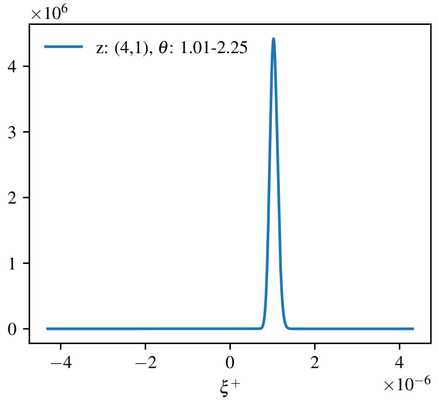


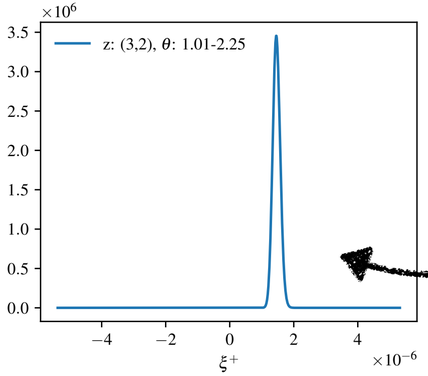


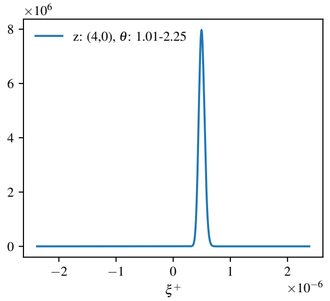
Veronika Oehl

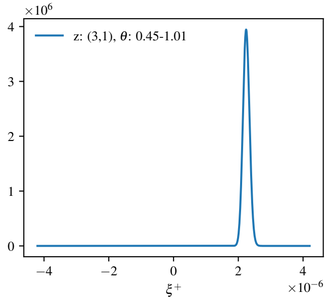
1D likelihood (marginal)

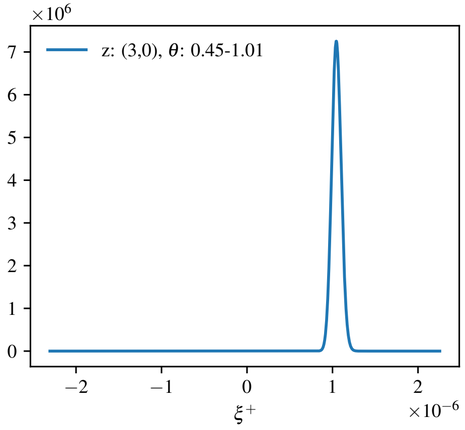


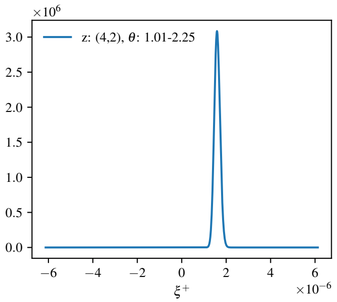


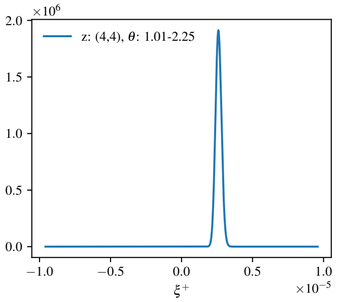


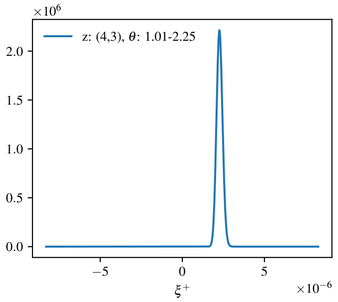


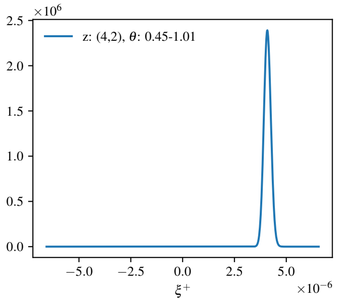








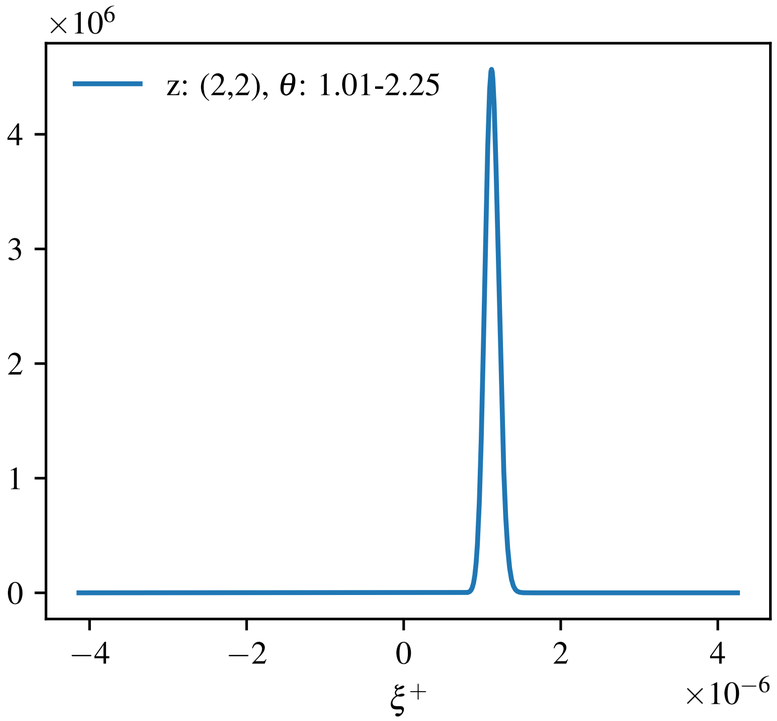


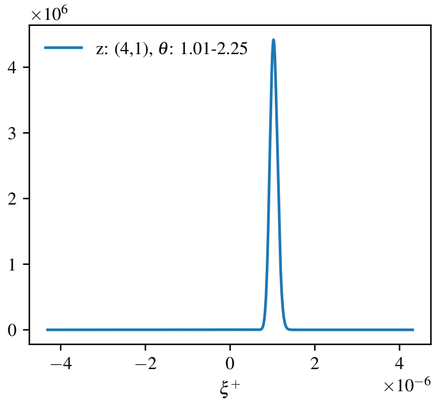


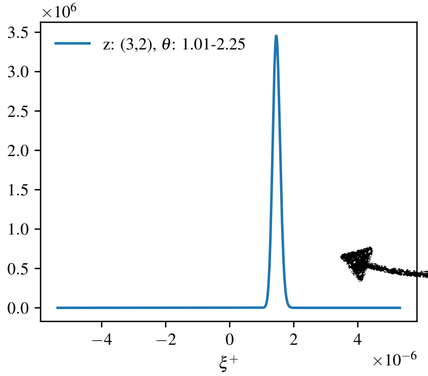
Veronika Oehl

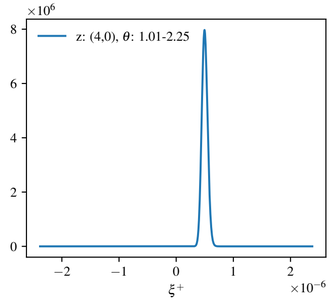
Copula

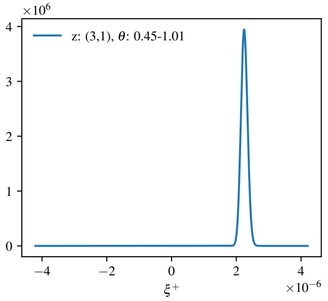
1D likelihood (marginal)

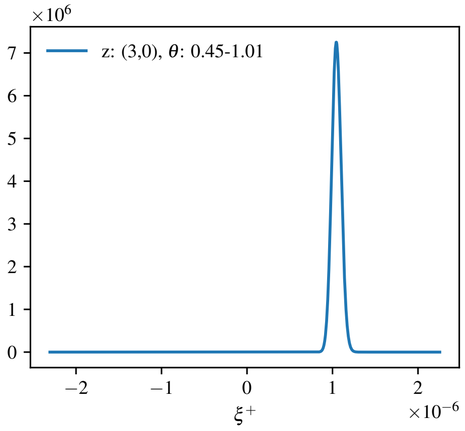


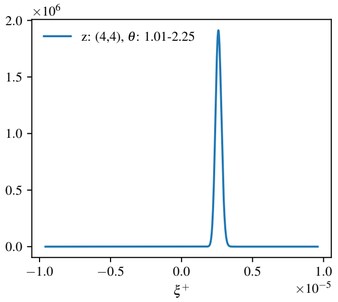


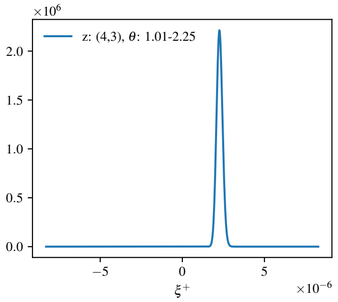


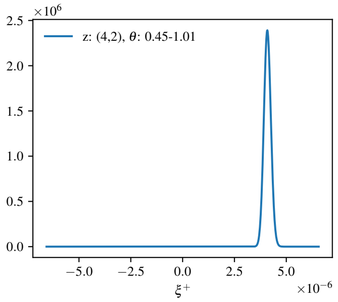


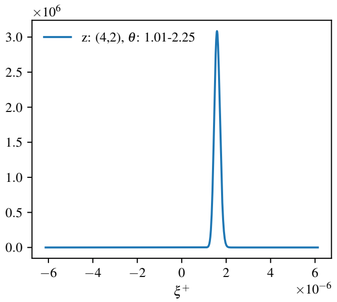








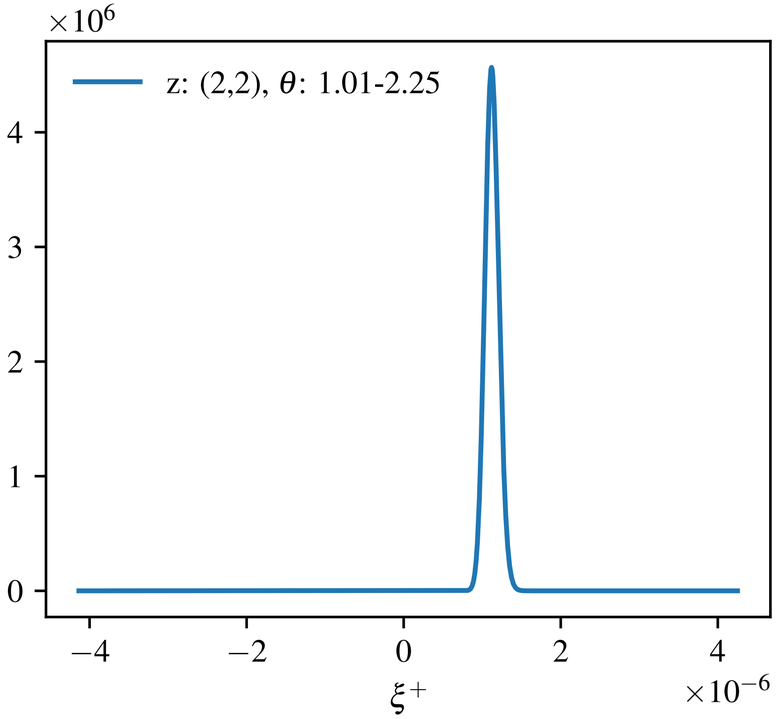


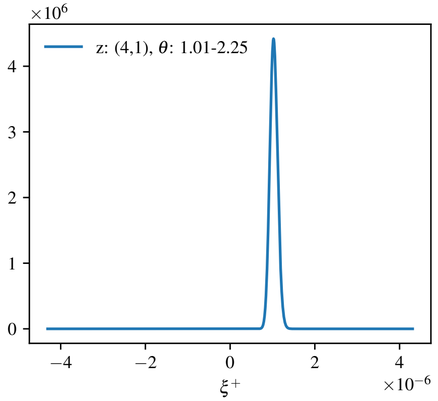


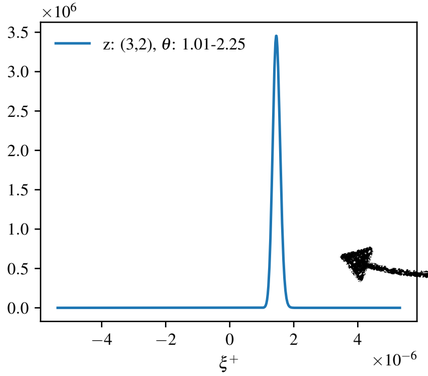
Veronika Oehl

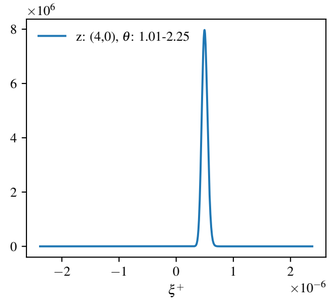
Gaussian Copula

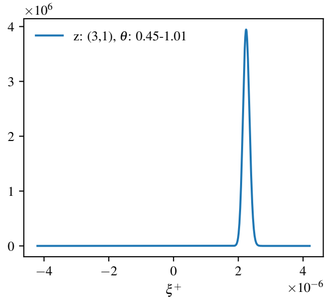
1D likelihood (marginal)

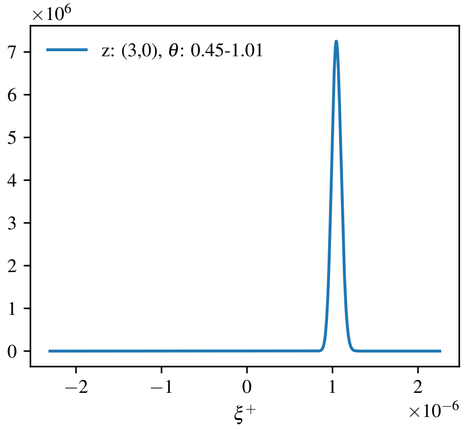


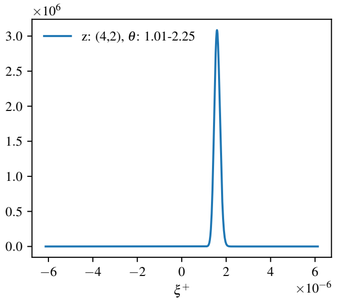


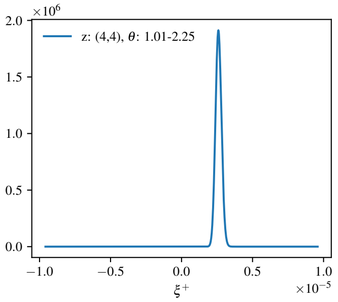


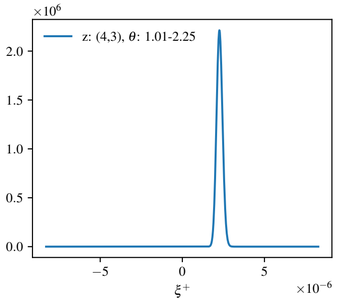


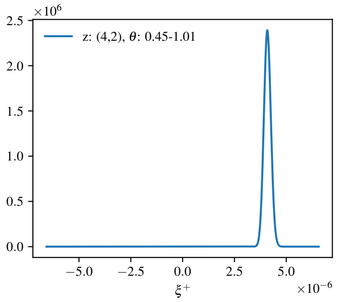












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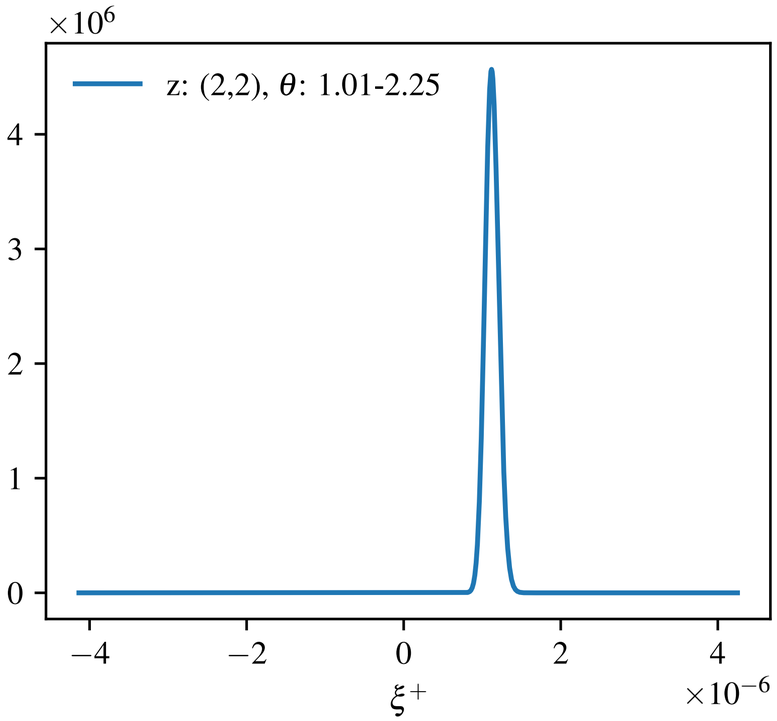
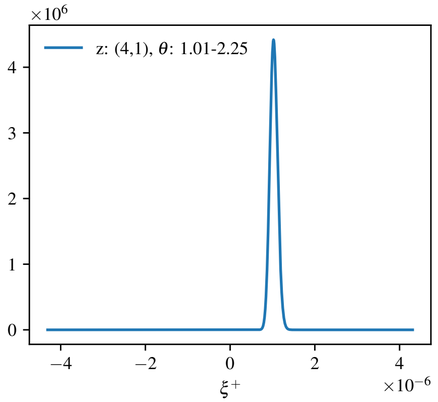
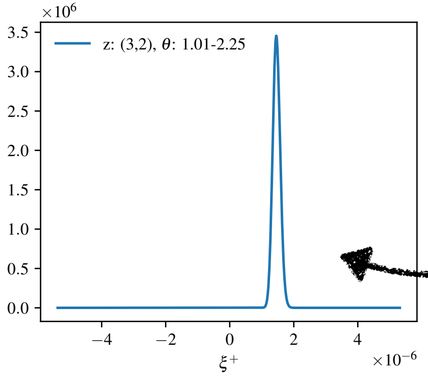
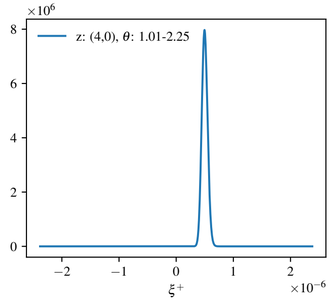






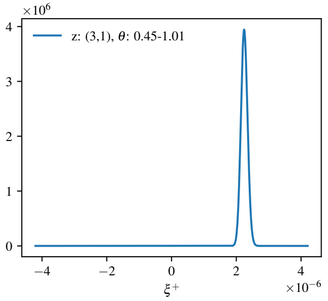
1D likelihood (marginal)

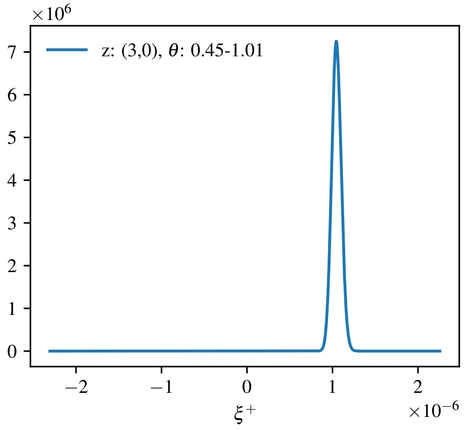


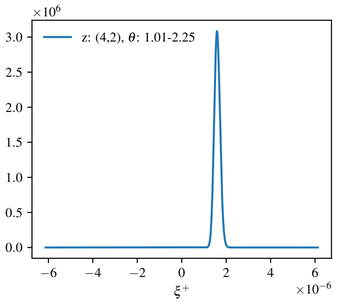
Gaussian

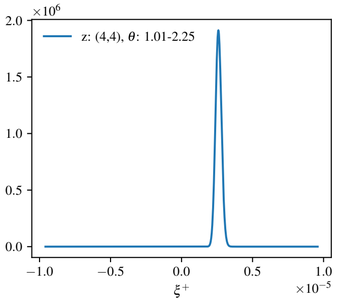
Copula

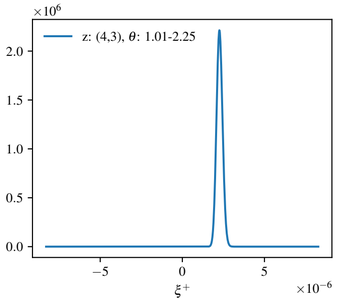
exact covariance from characteristic function

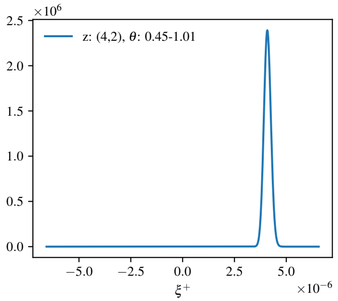












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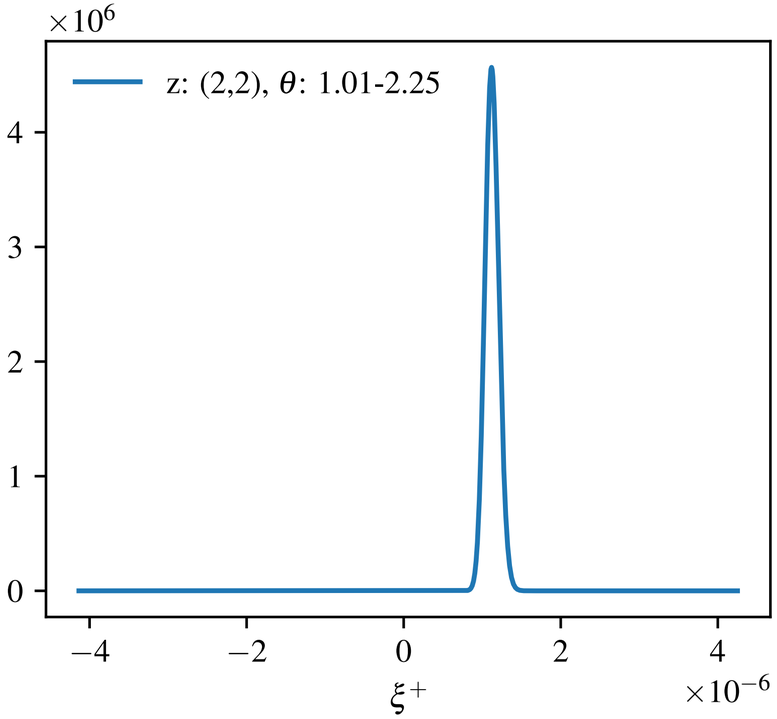
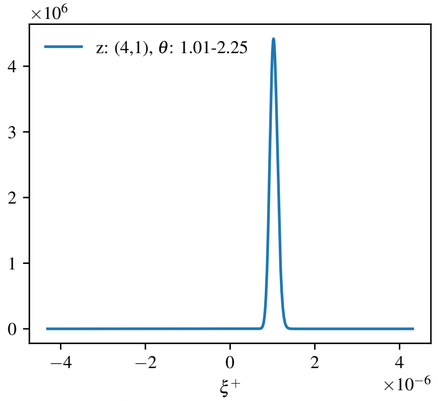
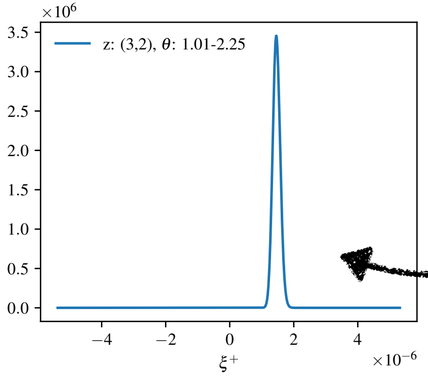
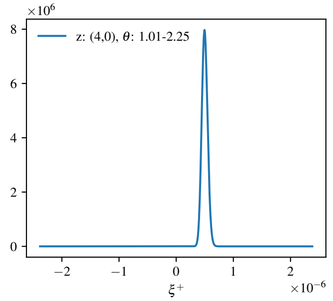
1D likelihood (marginal)









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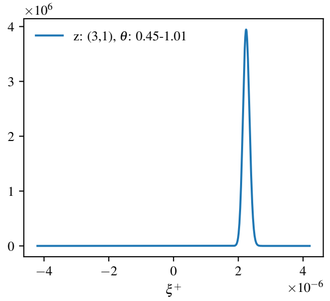

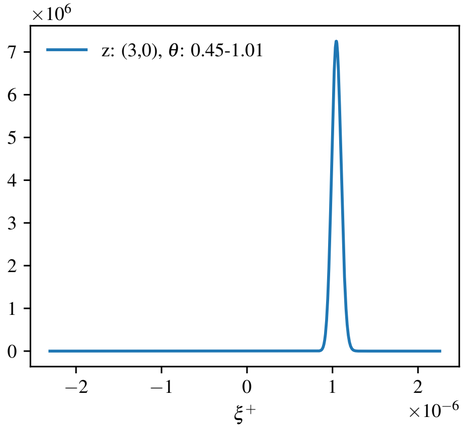

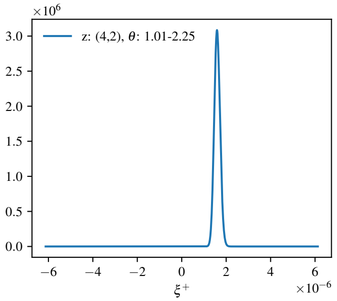

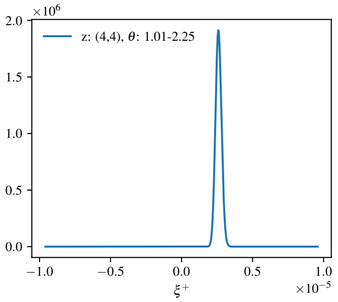

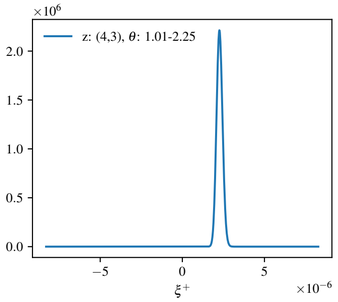

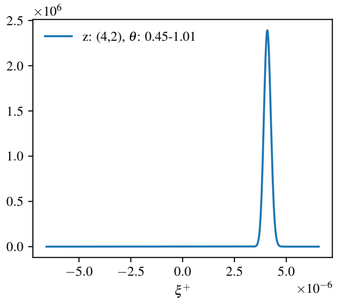

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Impact of Copula Likelihood on Posterior

(with exact marginals)

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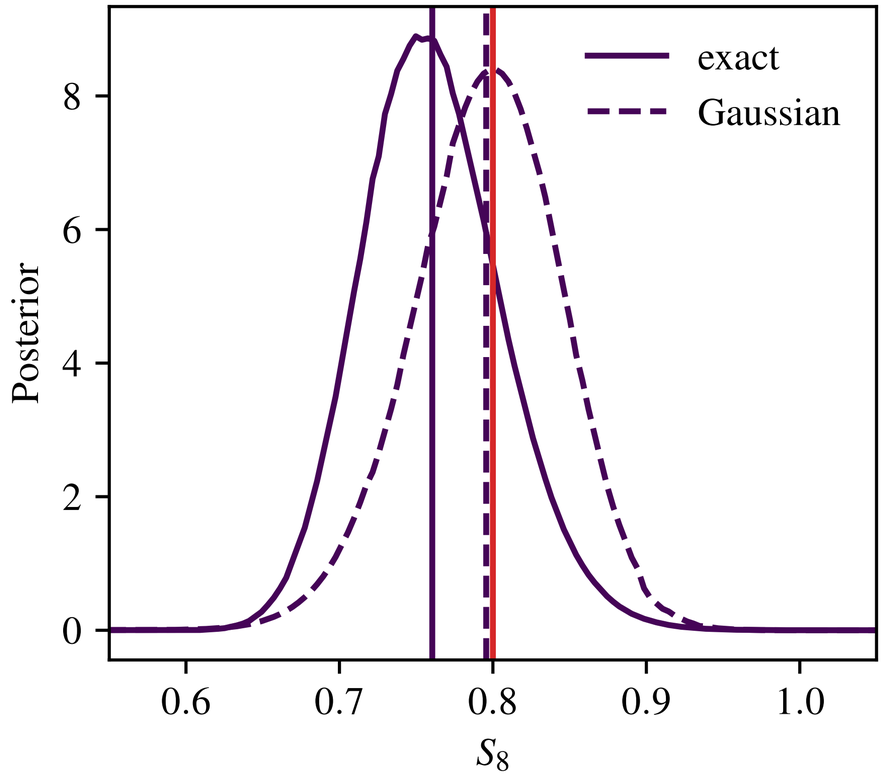

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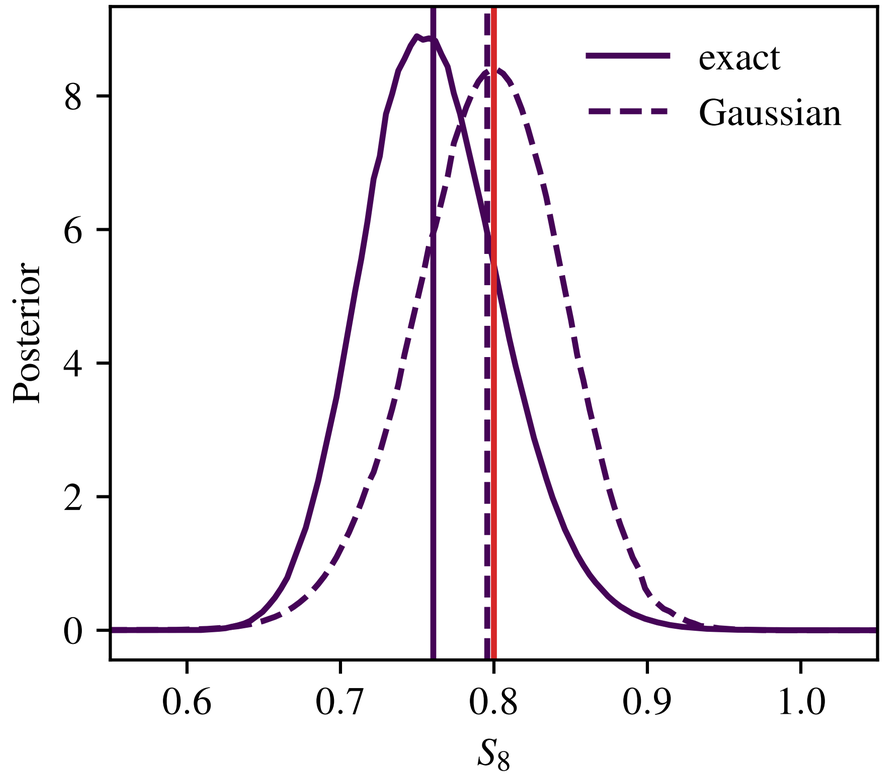

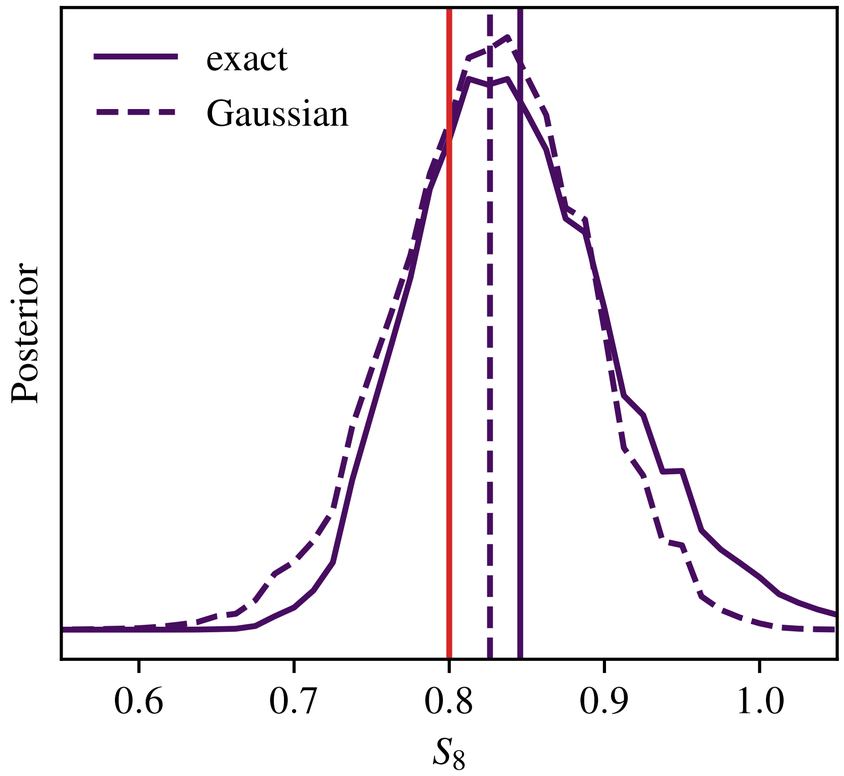

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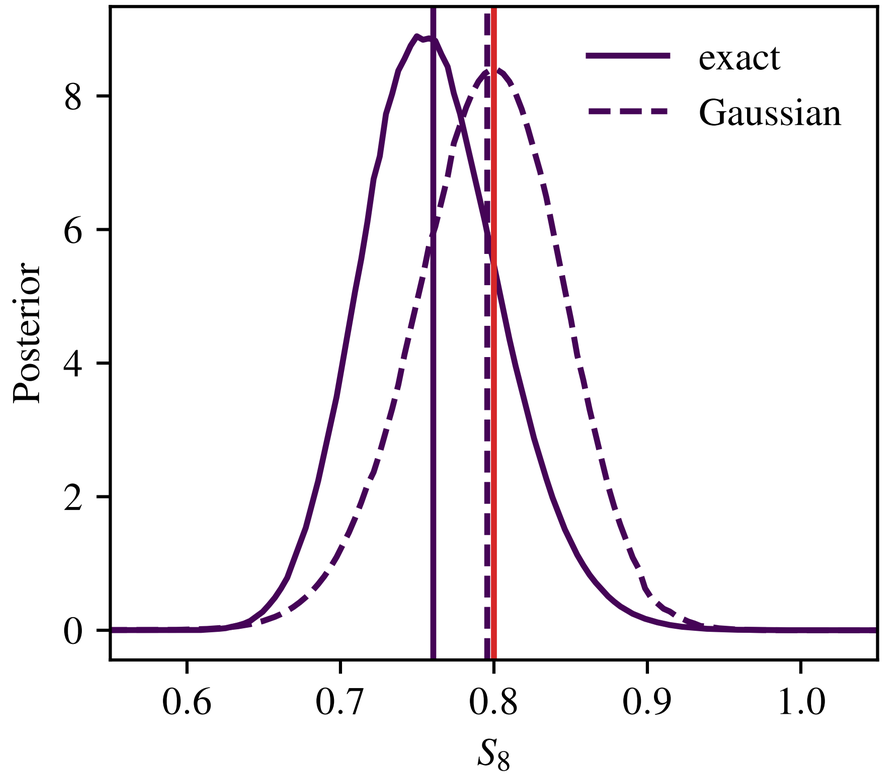
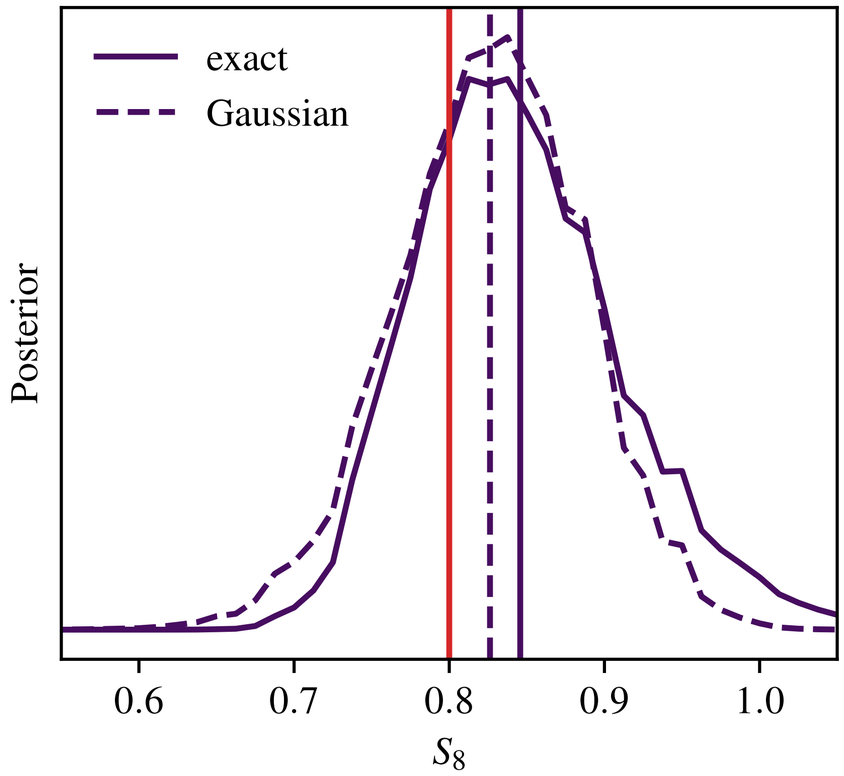
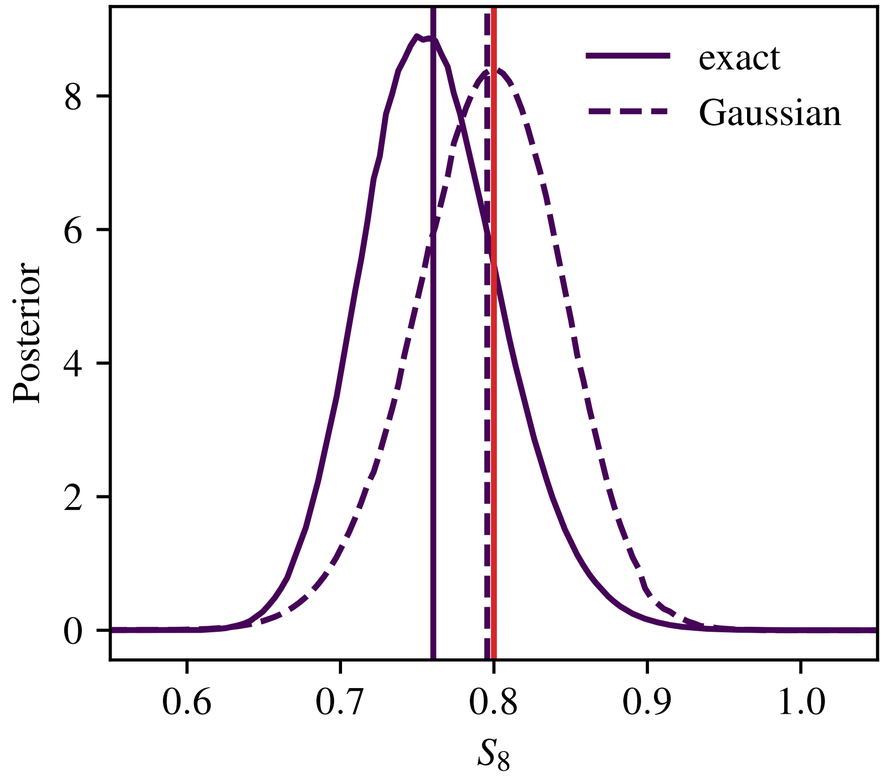




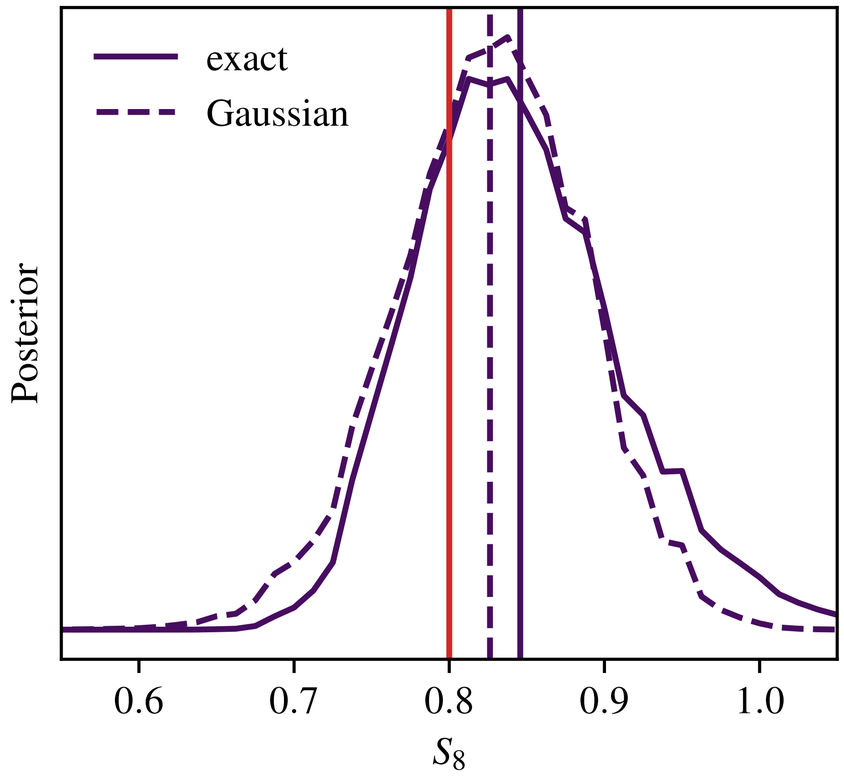
Single redshift-bin combination: S5-S5

Impact of Copula Likelihood on Posterior

(with exact marginals)



Multiple redshift-bin combinations



Single redshift-bin combination: S5-S5

Posterior and data dimensions

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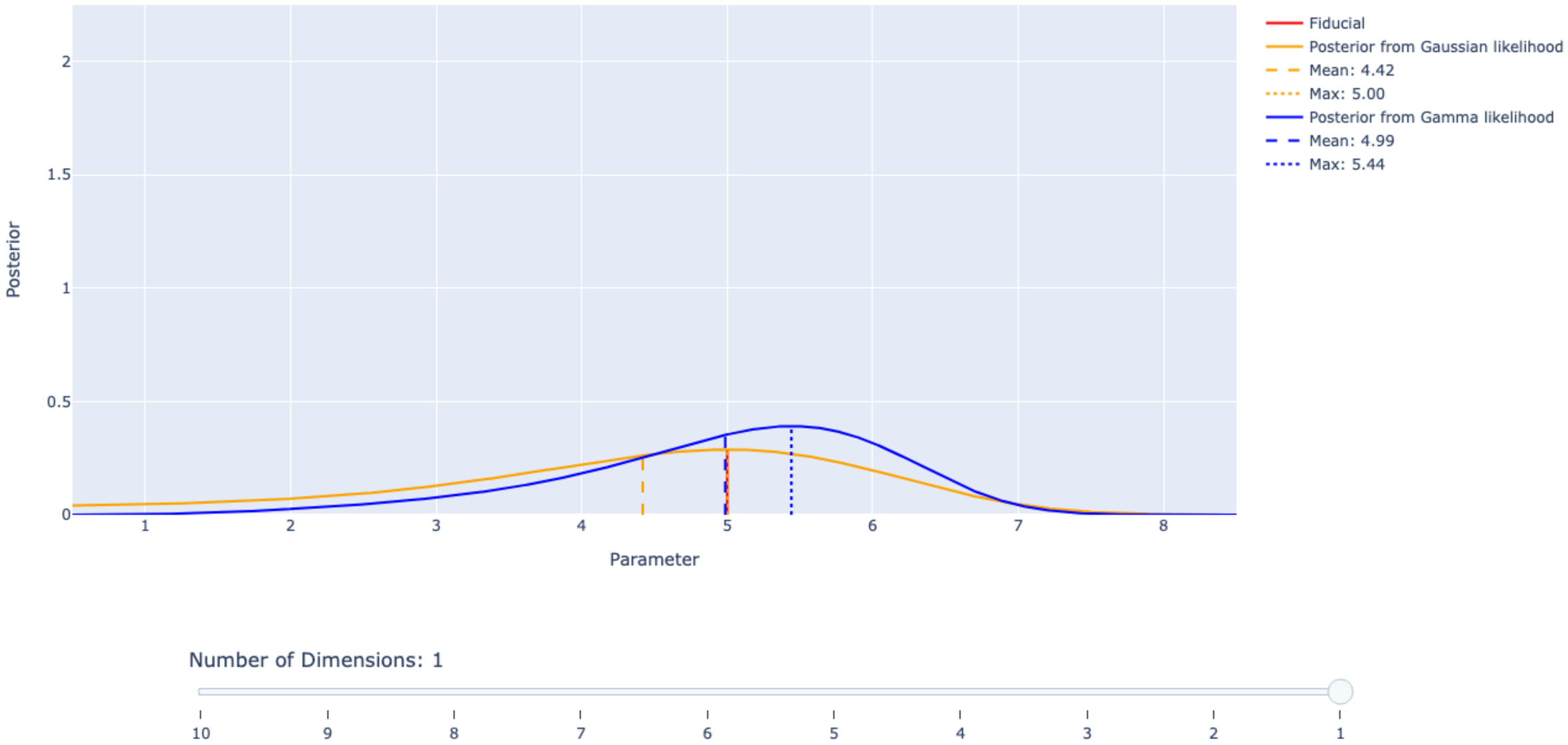
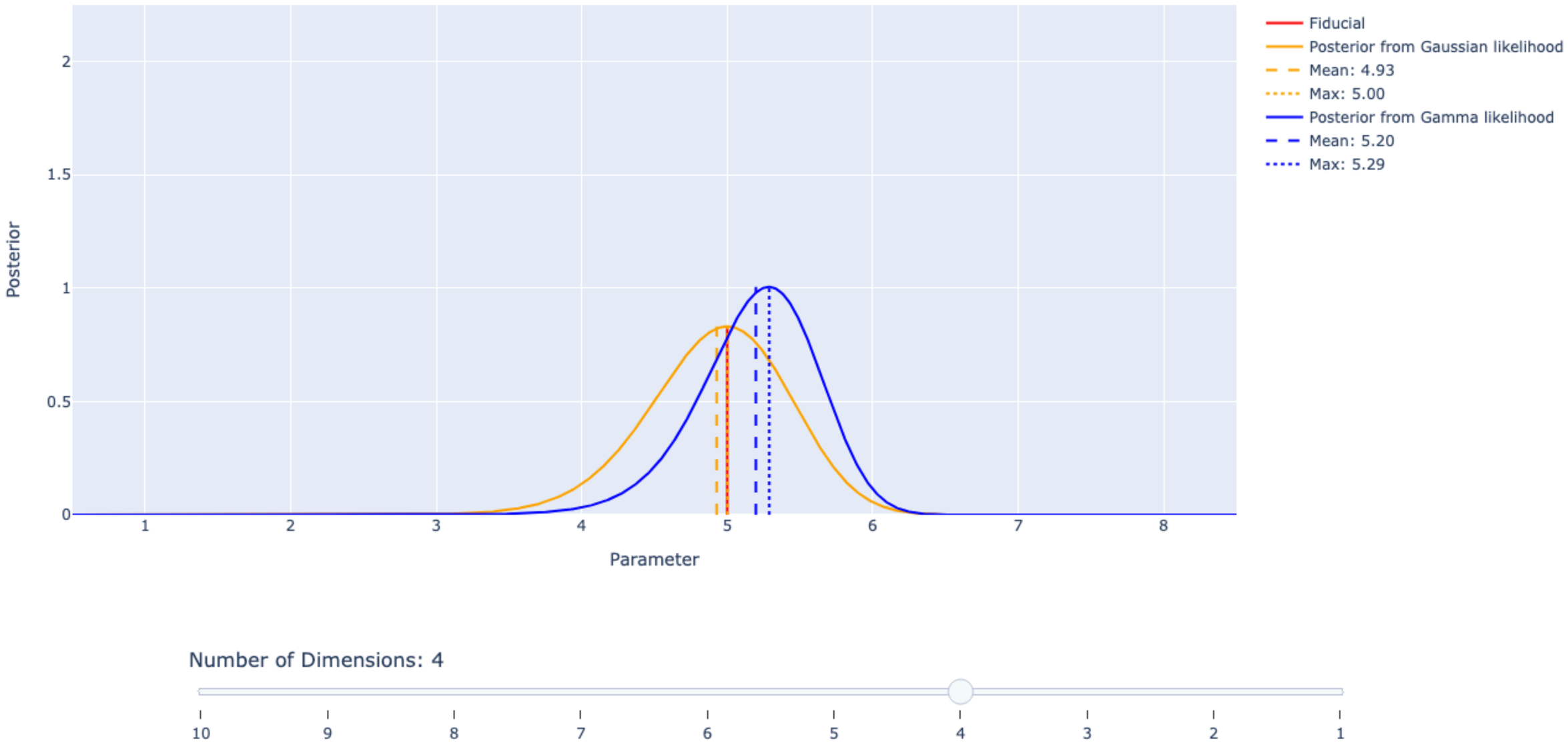


Posterior and data dimensions



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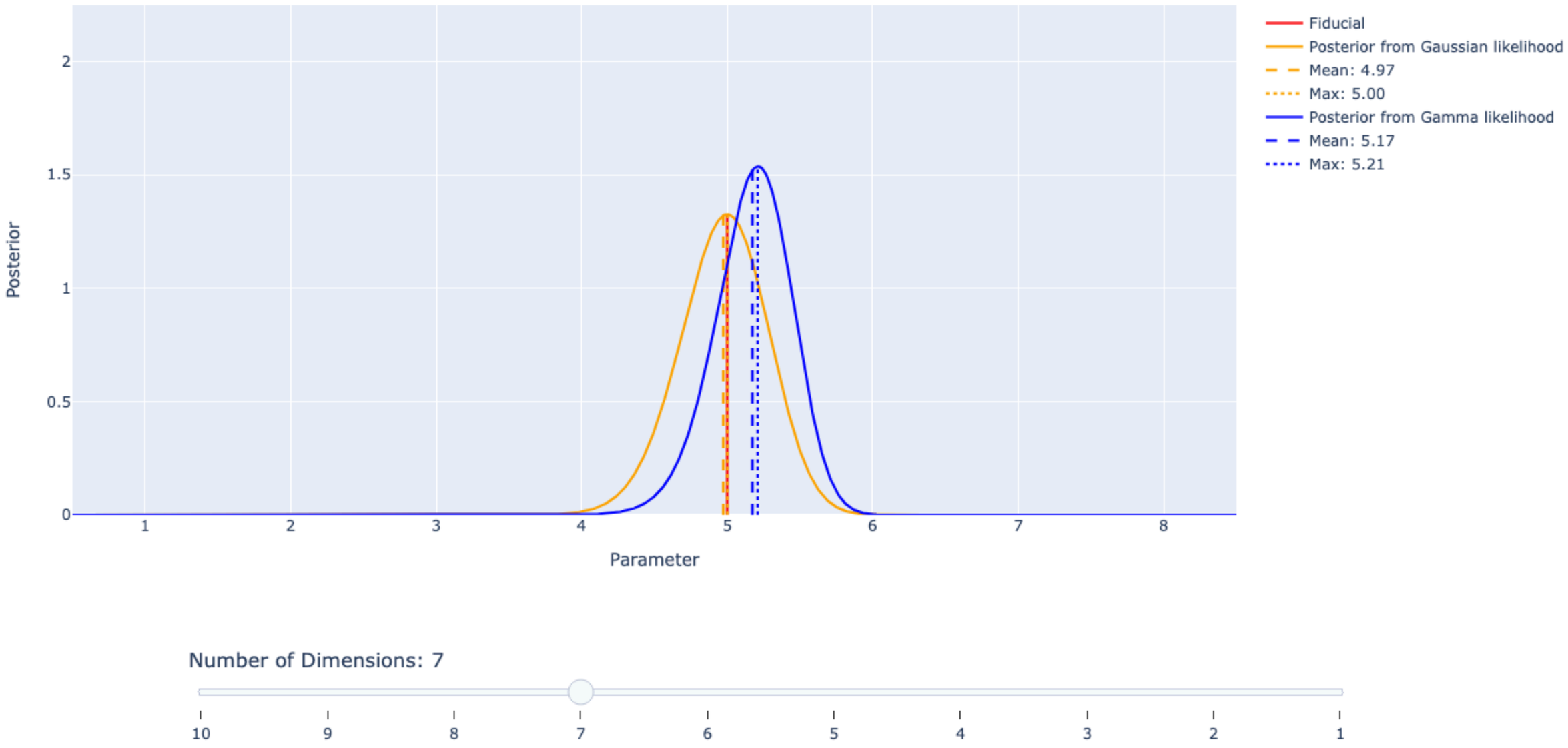
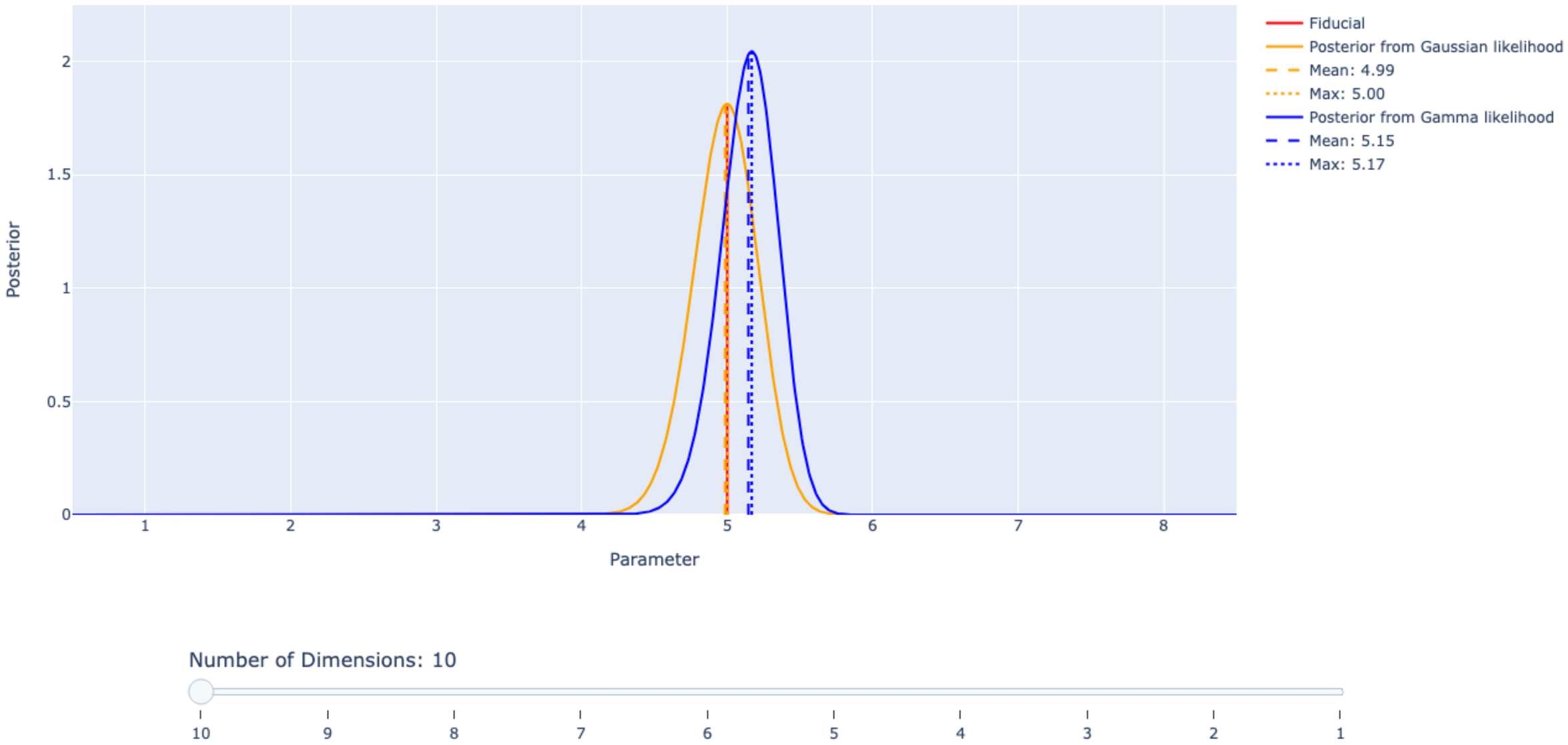


Posterior and data dimensions



Posterior and data correlation

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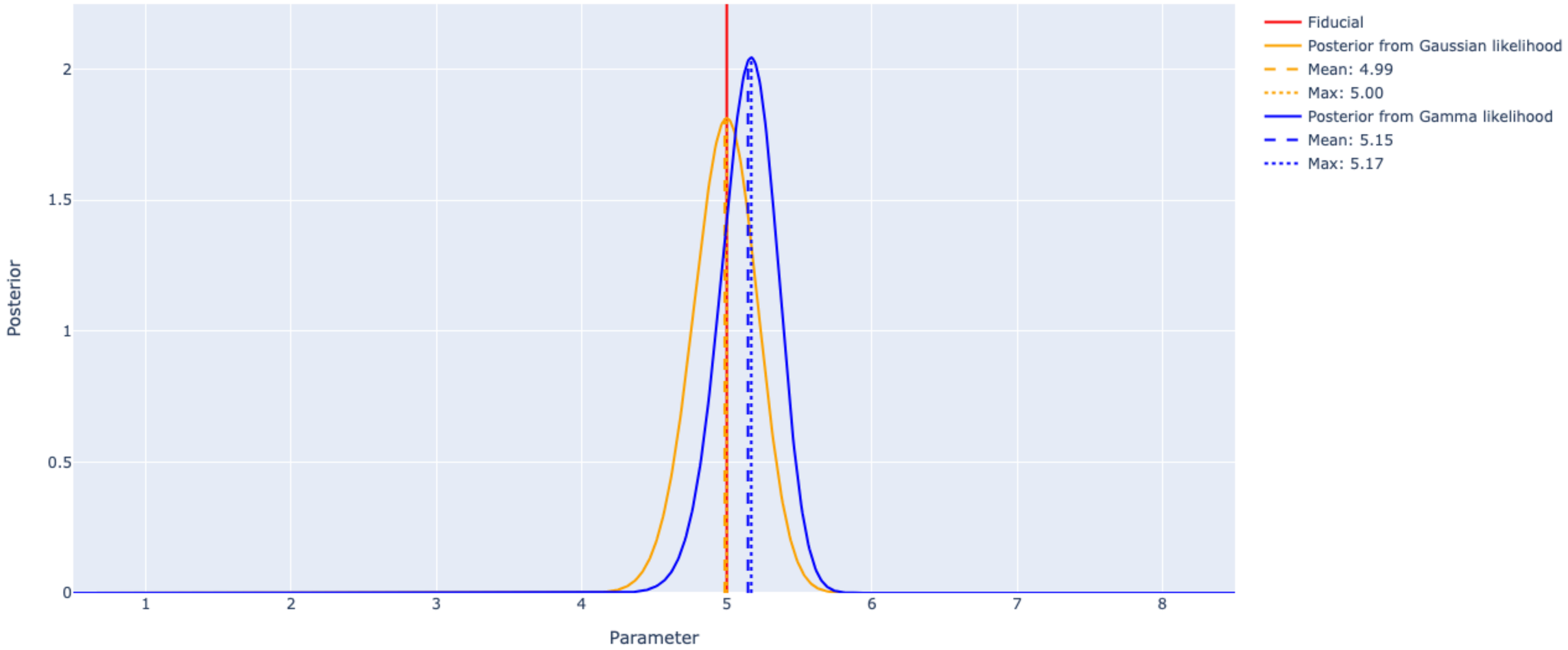

Correlation: 0.00

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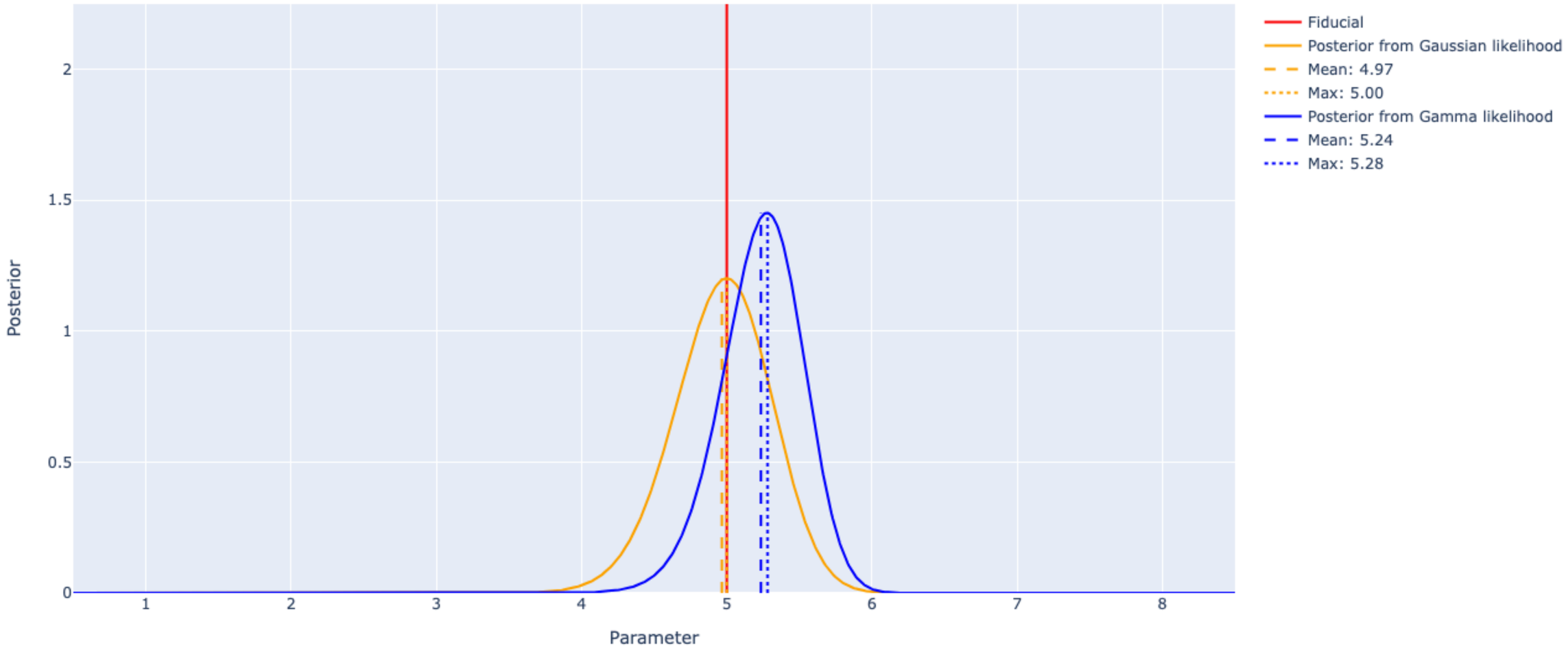
Posterior and data correlation



Correlation: 0.20

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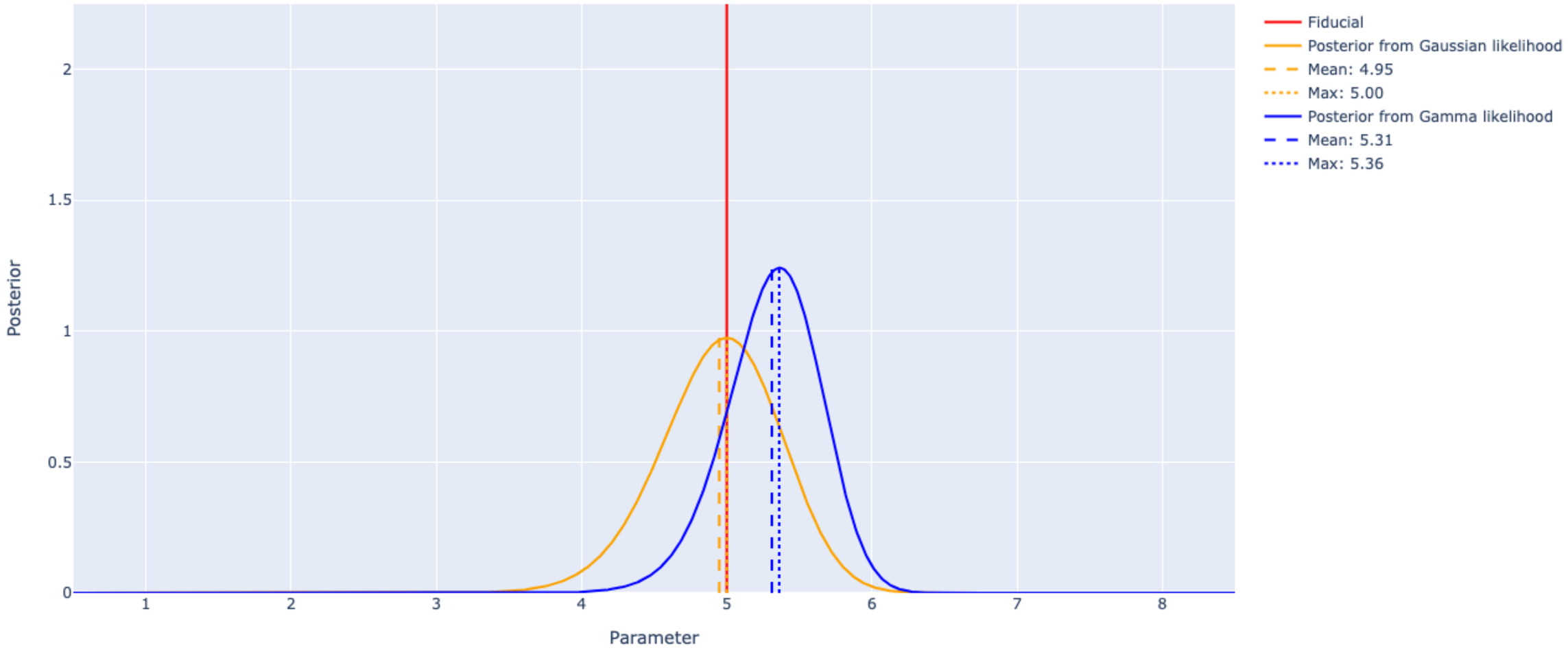
Posterior and data correlation



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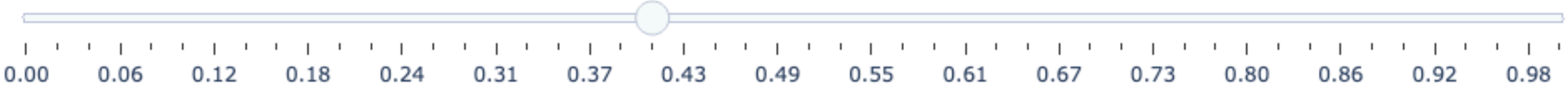

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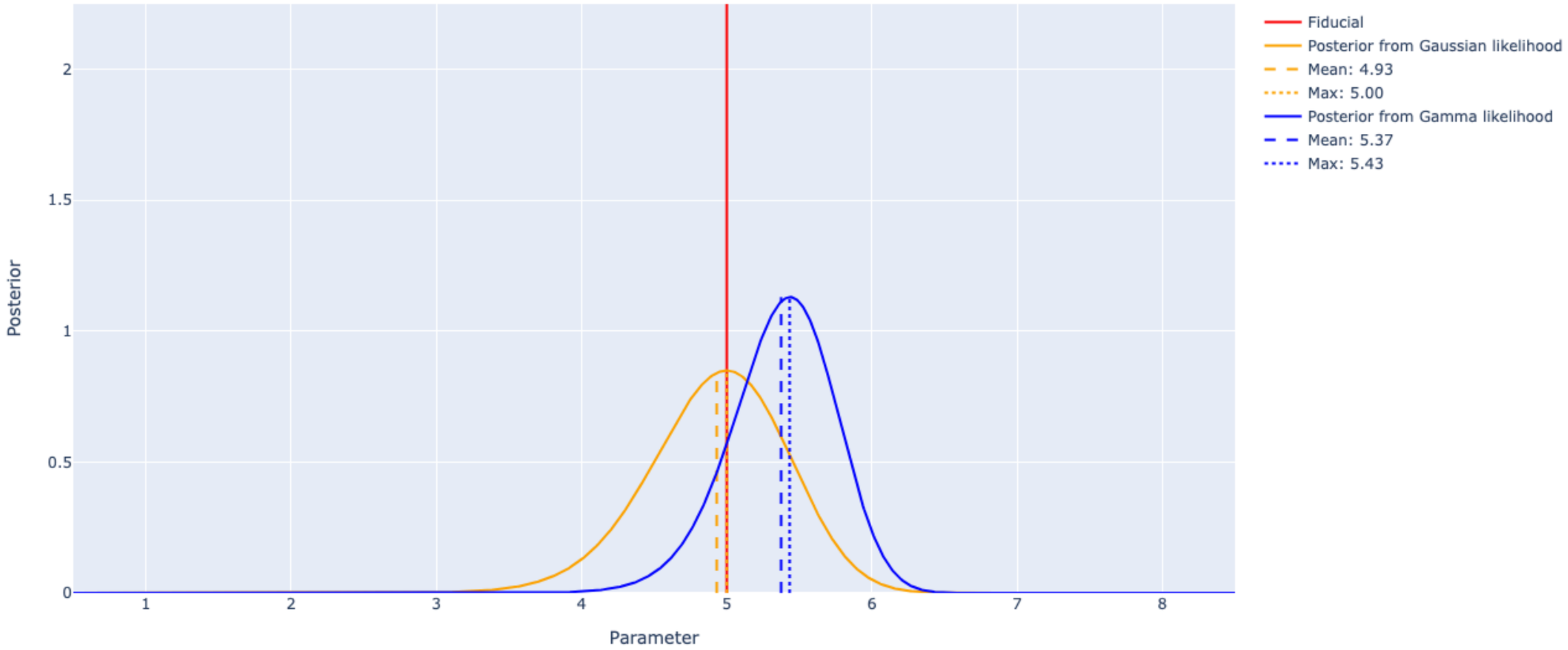

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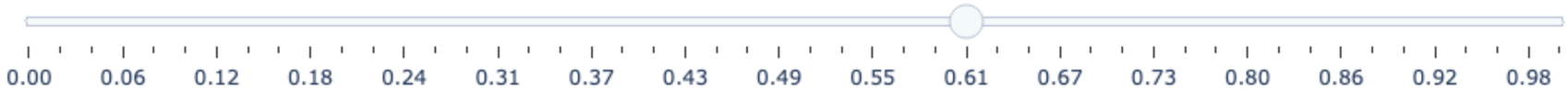
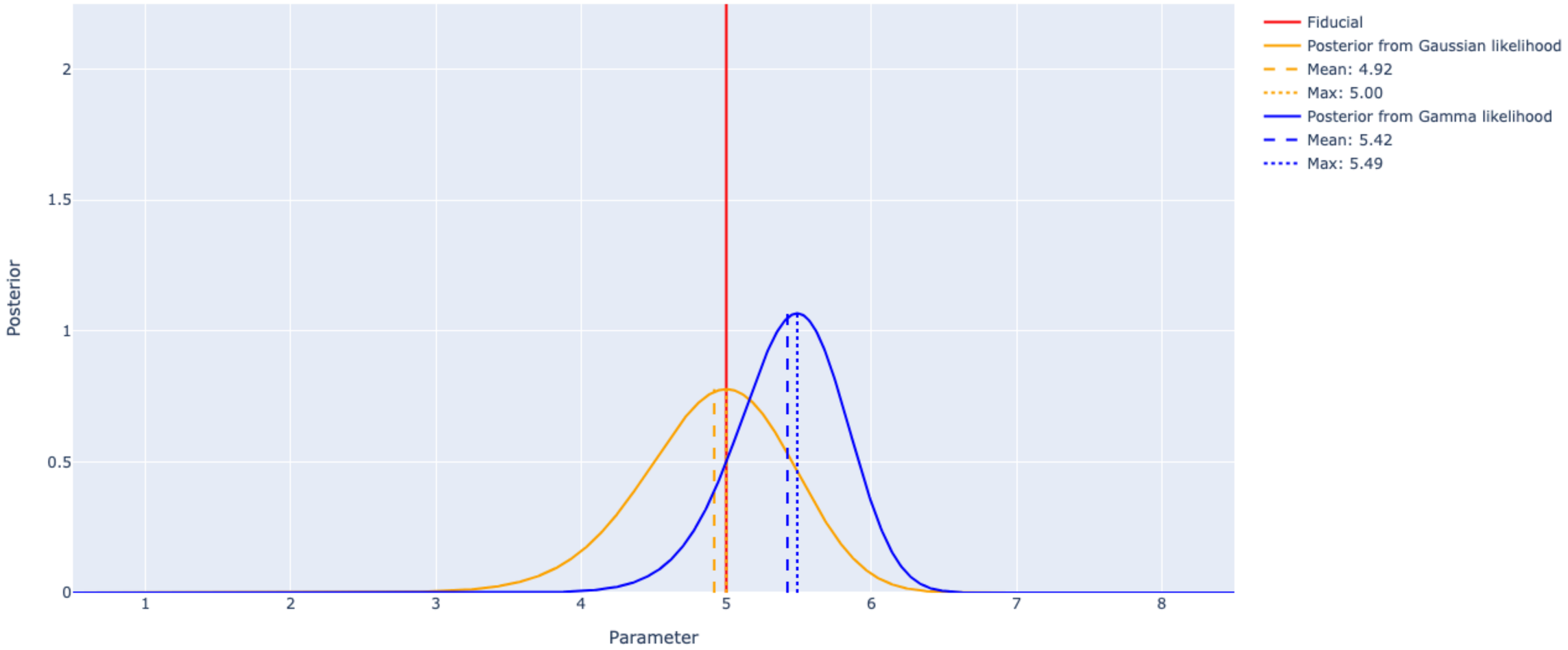


Posterior and data correlation



Correlation: 0.80

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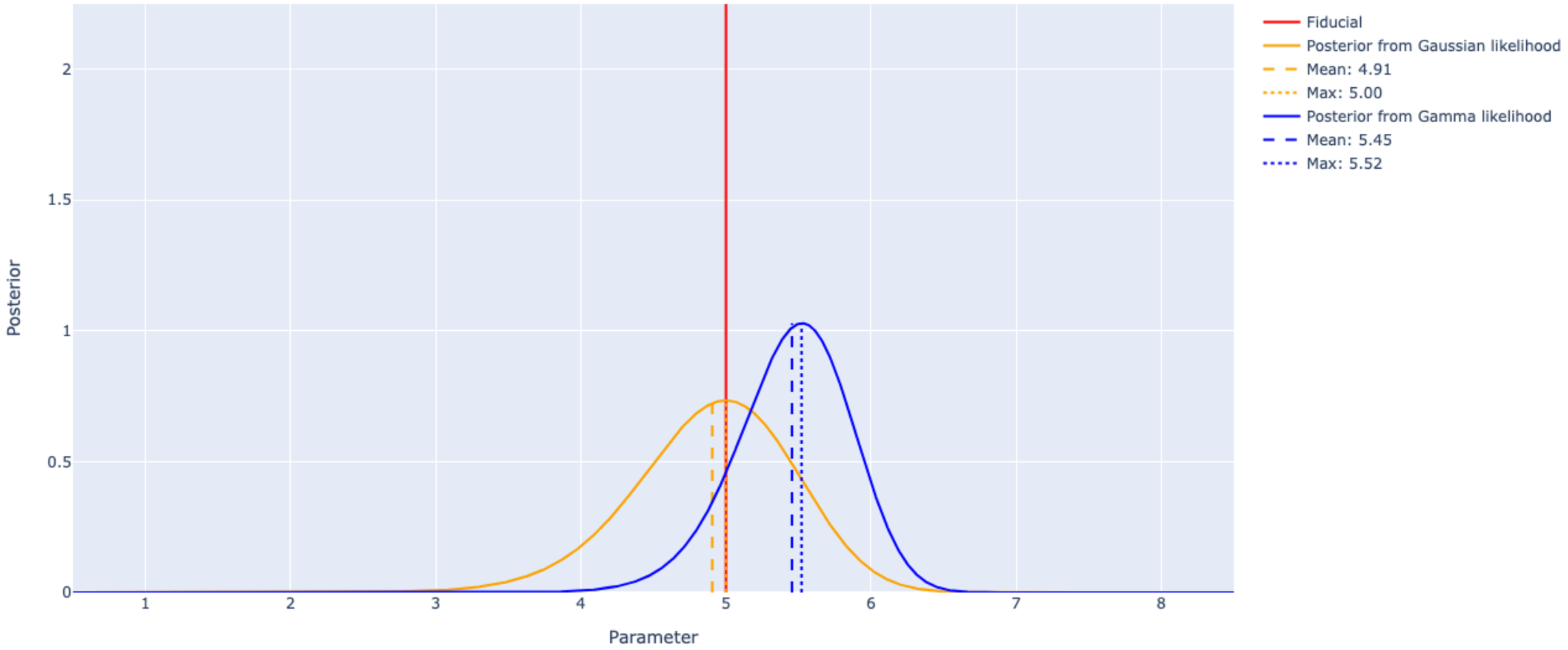
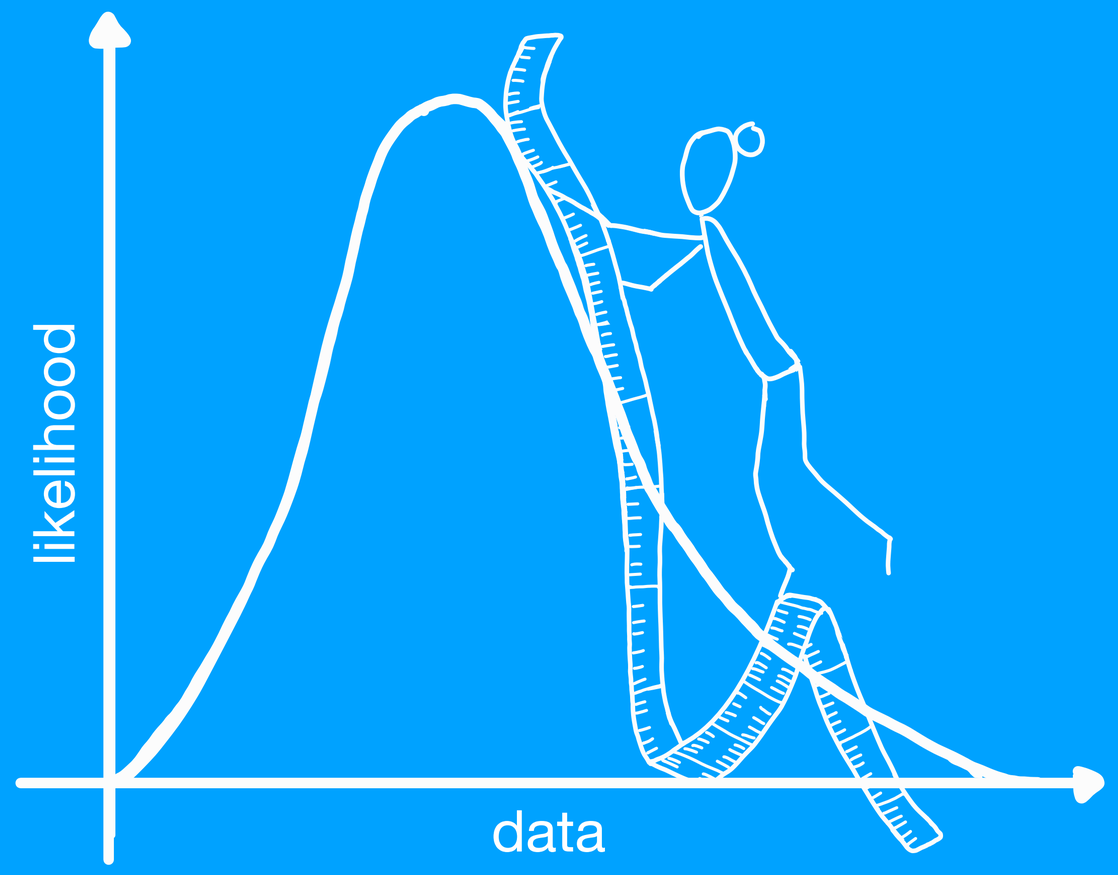
Posterior and data correlation

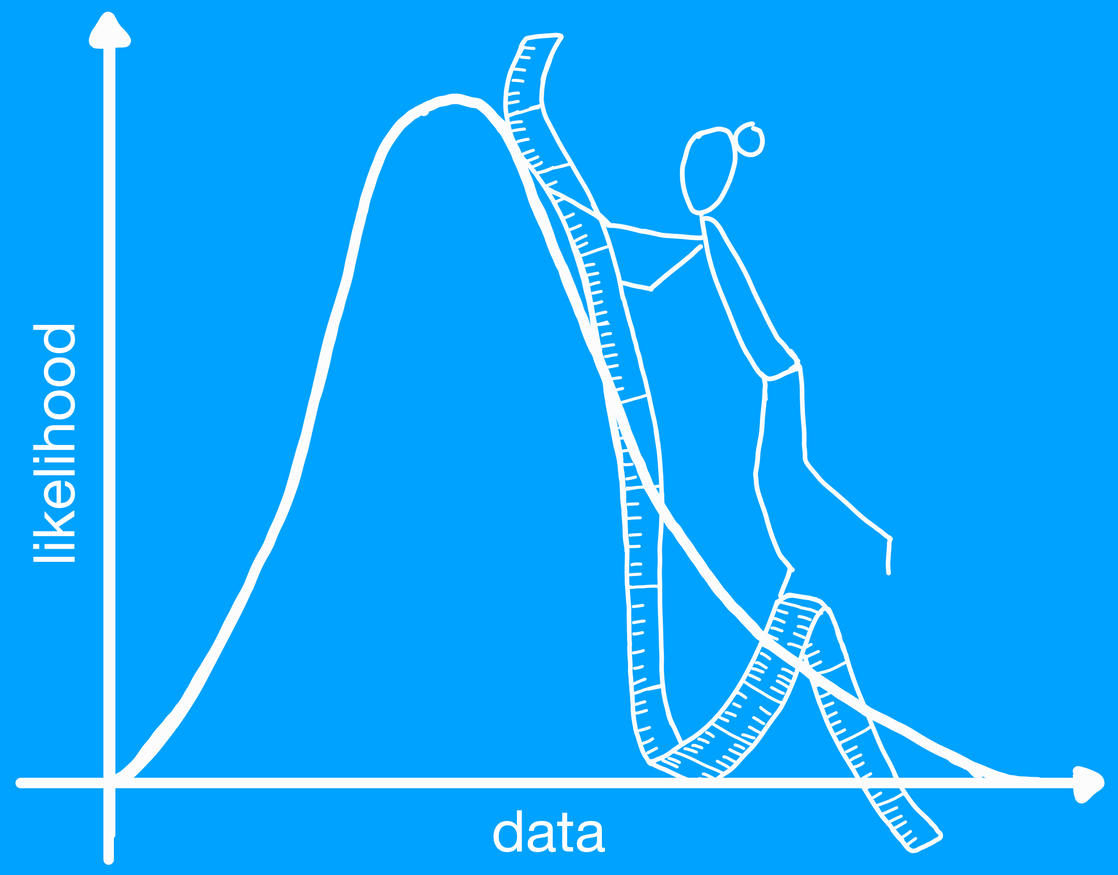


Correlation: 1.00



ETH zürich

Veronika Oehl veoehl@phys.ethz.ch



The detailed shape of the likelihood impacts your posterior

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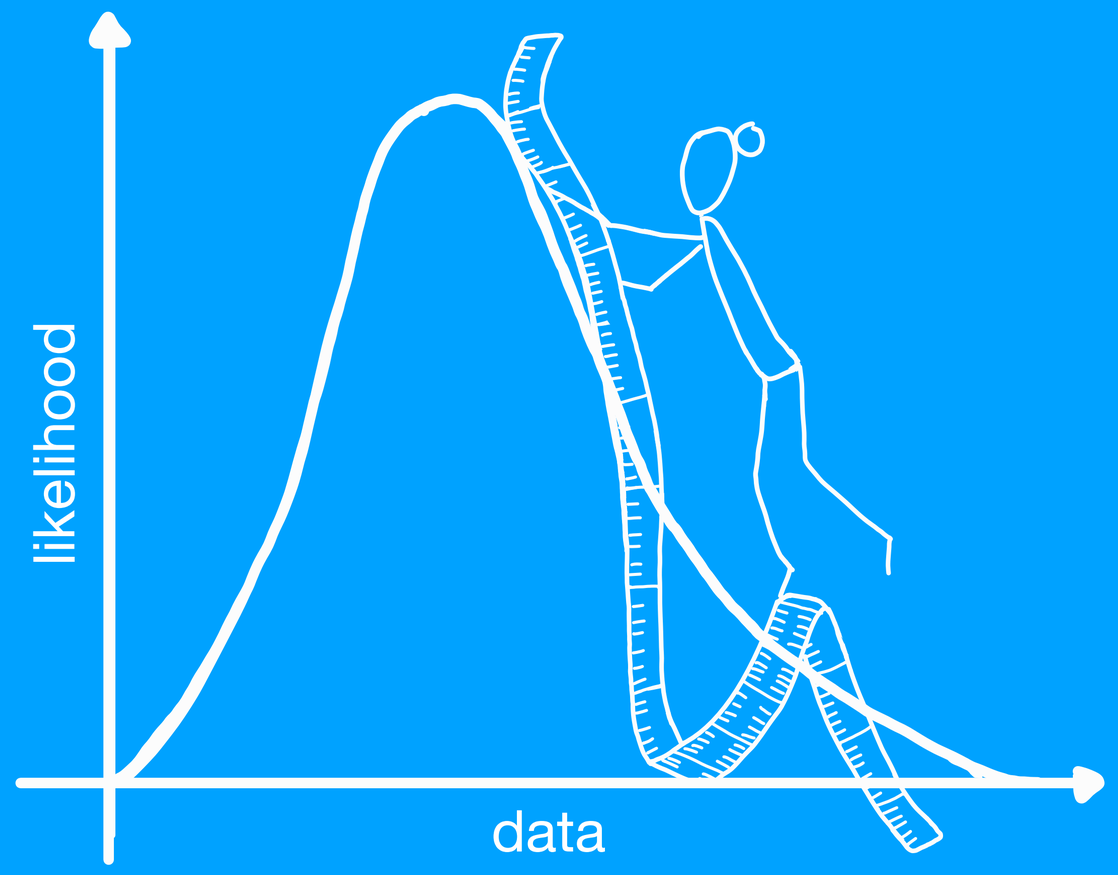

The detailed shape of the likelihood impacts your posterior

Watch out for parameter choices and correlated data

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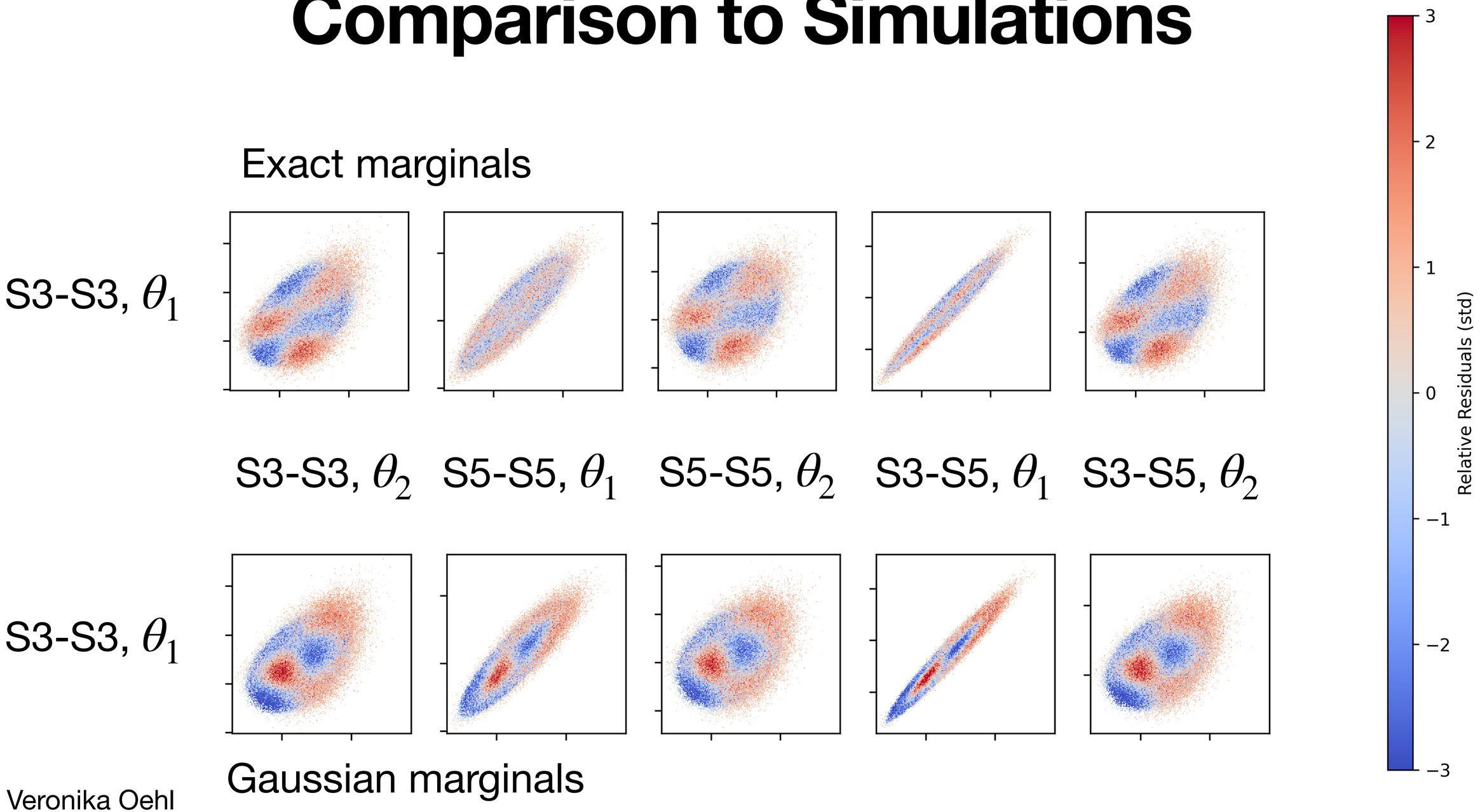
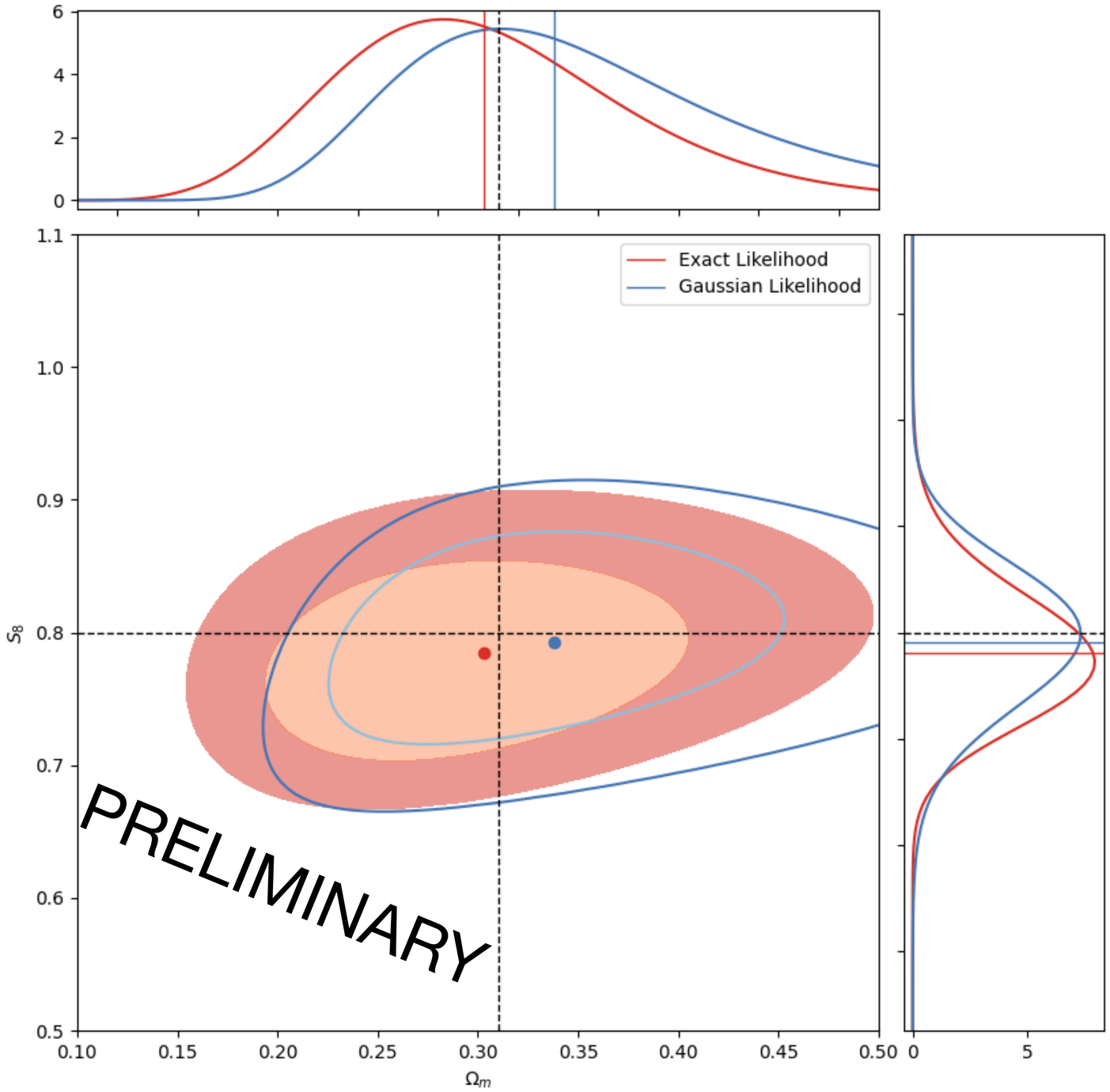
Comparison to Simulations





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