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OPTIMIZING GALAXY SAMPLE SELECTIONS FOR WEAK LENSING CLUSTER COSMOLOGY

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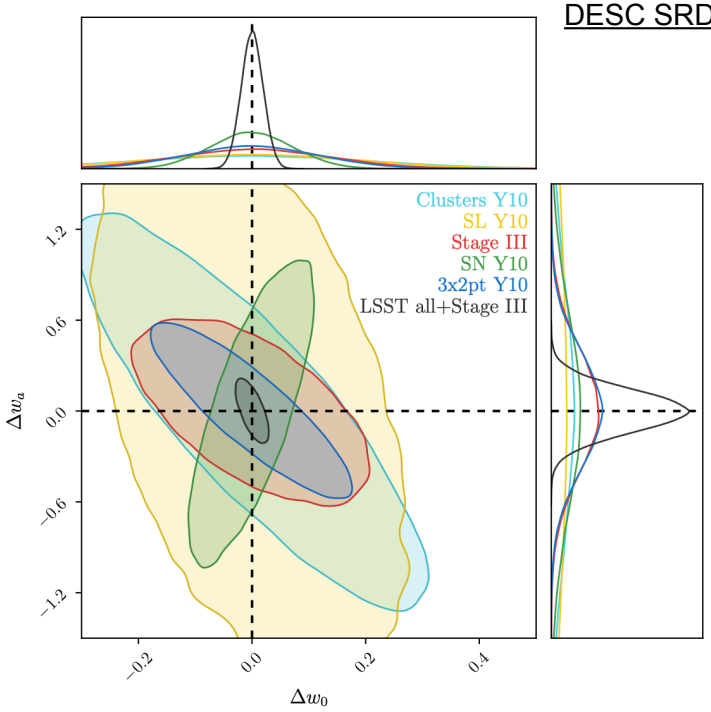
MOTIVATION

SCIENTIFIC GOAL: UNDERSTANDING THE DARK UNIVERSE

- Perform **reliable** statistical analysis to test Lambda-CDM, DE time evolution, and Modified Gravity
- WL Cluster Mass measurements vital for the LSST mission

DESC SRD arXiv:1809.01669



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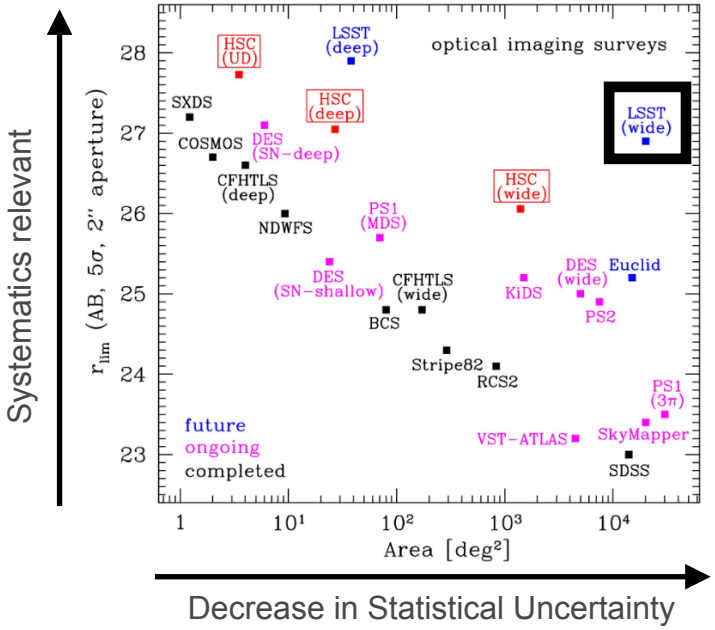

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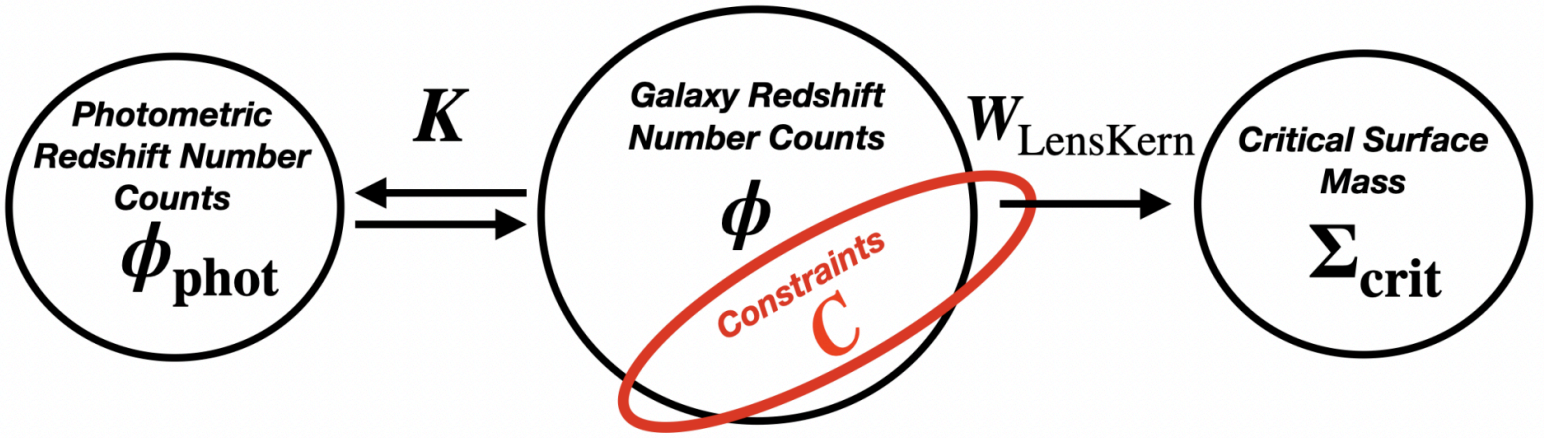
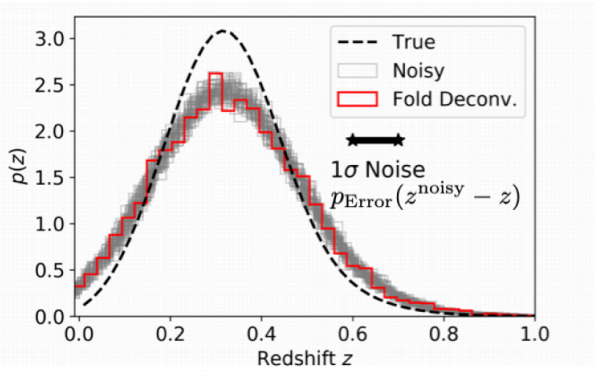


$$\langle \Sigma_{\rm crit} \rangle \propto \int_{z_{\rm Lens}}^{\infty} dz\, p(z) \left(\frac{D_d(z_{\rm Lens}) D_{ds}(z_{\rm Lens}, z)}{D_s(z)} \right) \qquad \langle \Sigma(r) \rangle_{r<R} - \overline{\Sigma}(R) = \Sigma_{\rm crit}\, \gamma_{\rm tan}(R)$$

- Inaccurate estimation of the sample redshift distribution $p(z)$ of the source sample propagates into biases in critical surface density $\Sigma_{\rm crit}$
- Systematic errors in $\Sigma_{\rm crit}$ map linearly to the `cluster mass'

THE PHOTOMETRIC REDSHIFT PROBLEM

$p(z^{\mathrm{noisy}})$

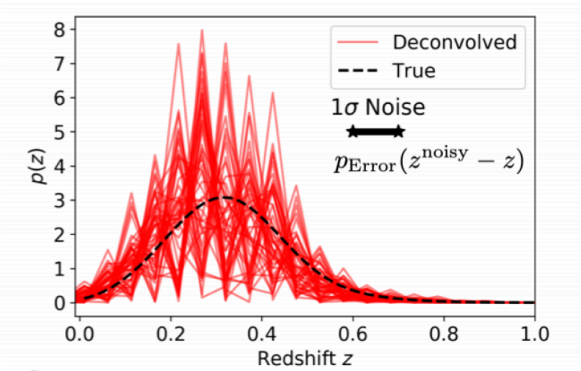


Smeared Space

Inverse Problem

Forward Problem

$p(z)$



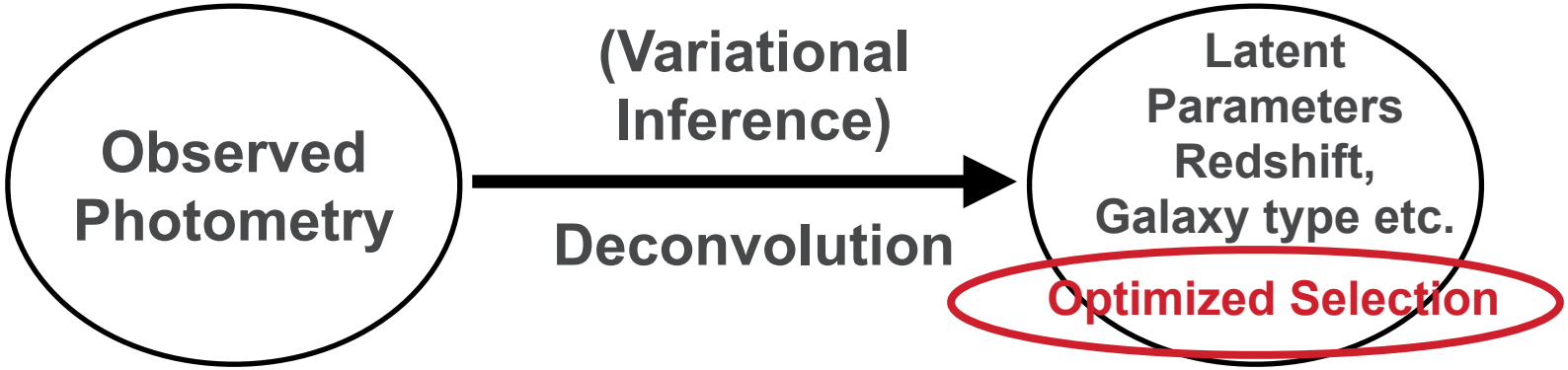
True Space

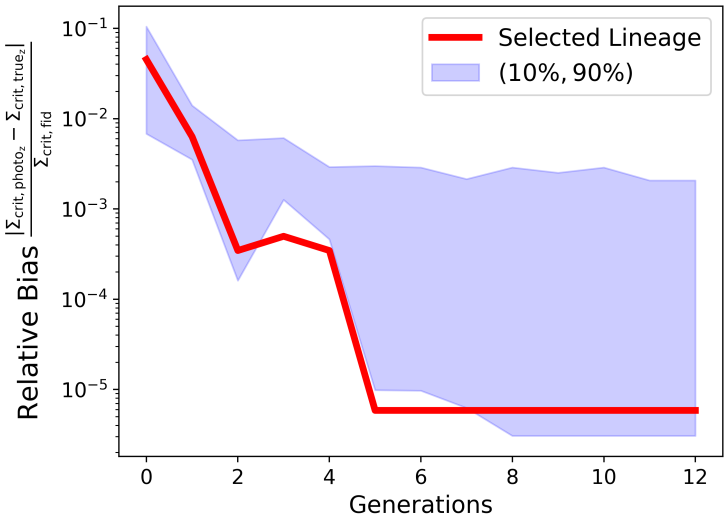
Classical Problem of deconvolving a density function smeared by (Gaussian) noise: optimal convergence rate of MISE $\propto (\log N)^{-k}$ where N is the sample size and k depends on smoothness of true density (Meister, 2009)

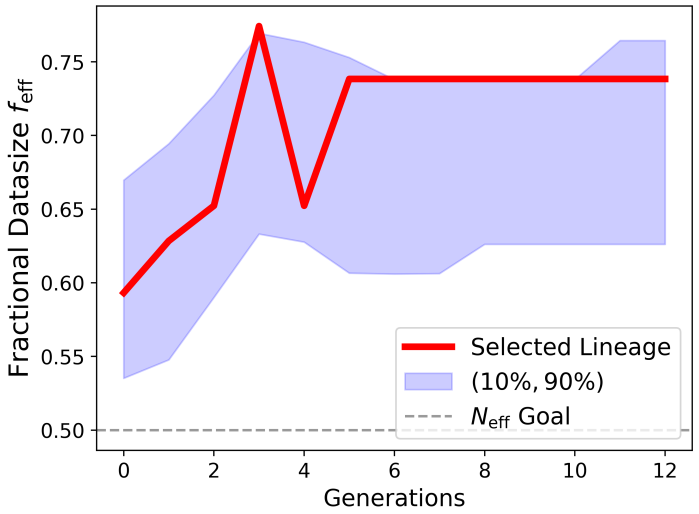
Challenges in PZ Estimation:

- Ill-conditioned problems, partial lack of identifiability, complex selection functions —> Strong sensitivity to model misspecification error
- Goal: Tradeoff Signal-to-noise with expected model misspecification error

SAMPLE OPTIMIZATION







Several orders of magnitude reduction in expected Σ_{crit} bias, while retaining 72% of the source sample!

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