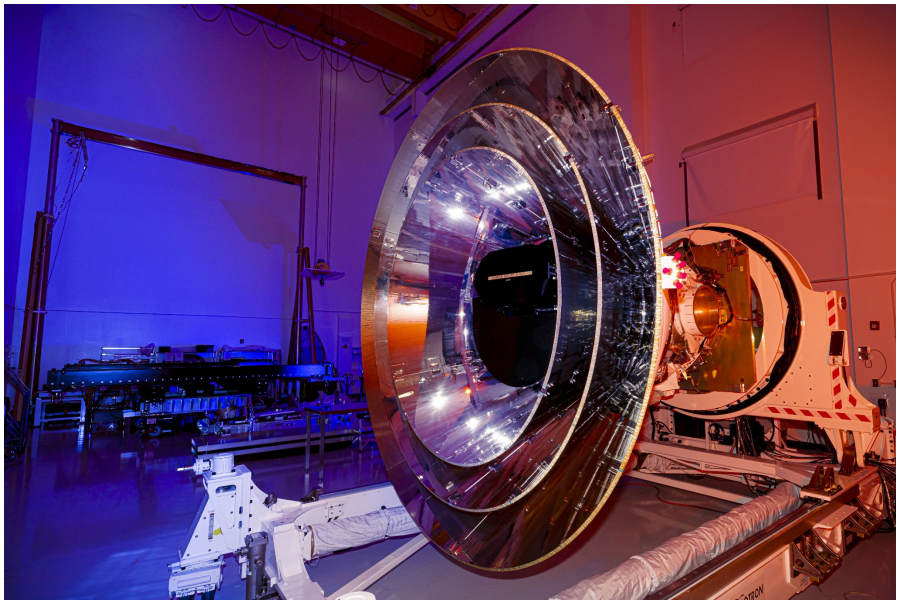
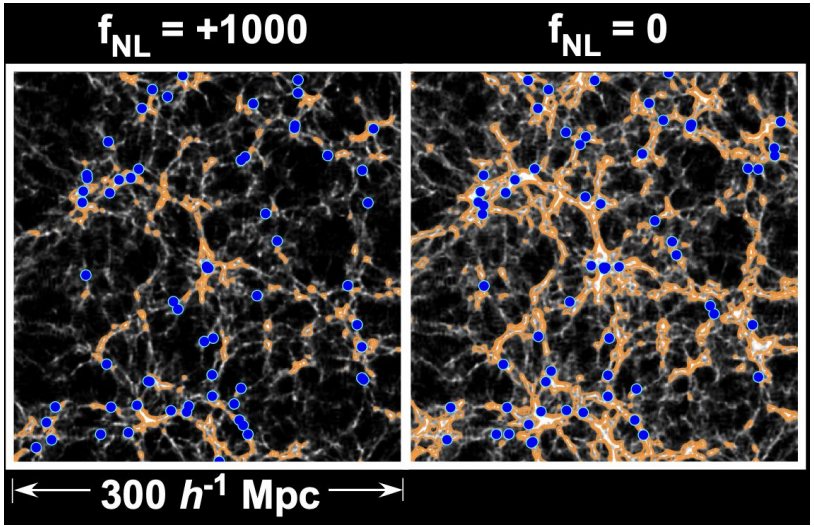
Optimizing a Neural Network Emulator for SPHEREx Galaxy Power Spectra

Grace Gibbins in collaboration with Dr. Tim Eifler, Joe Adamo, & Annie Moore

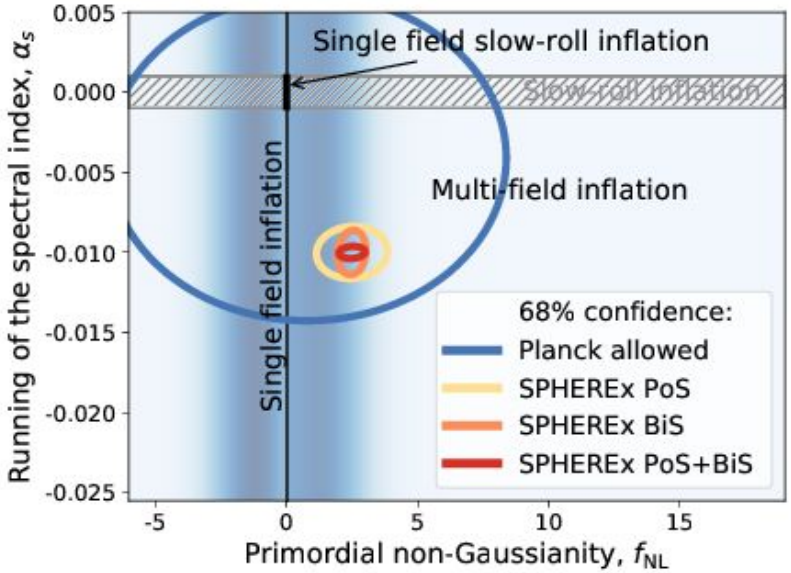
SPHEREx - Constraining Models of Inflation with f_{NL}

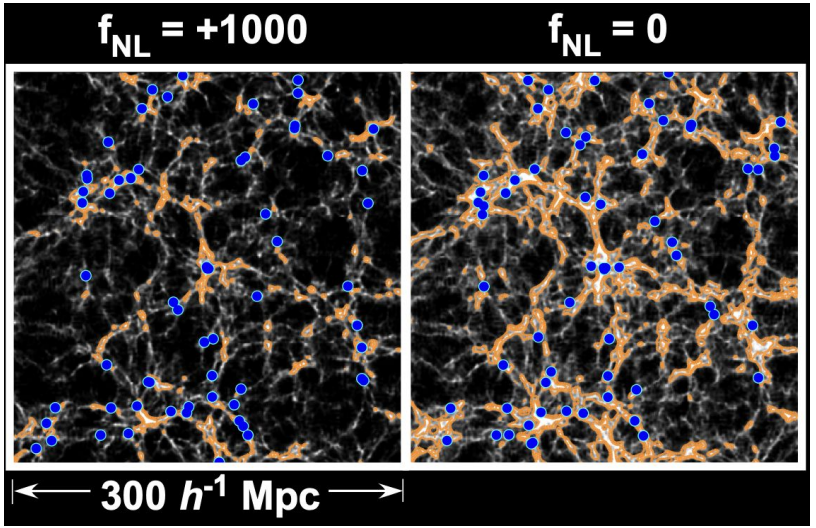




https://spherex.caltech.edu/image/spherex-observatory-assembled-side-view; Doré, 2015

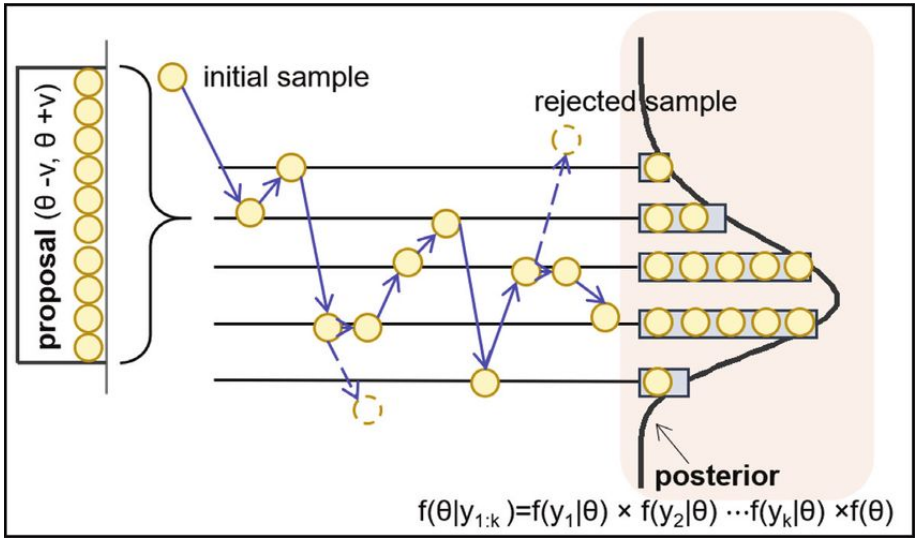
Primordial Non-Gaussianity: Density Distribution During Inflation



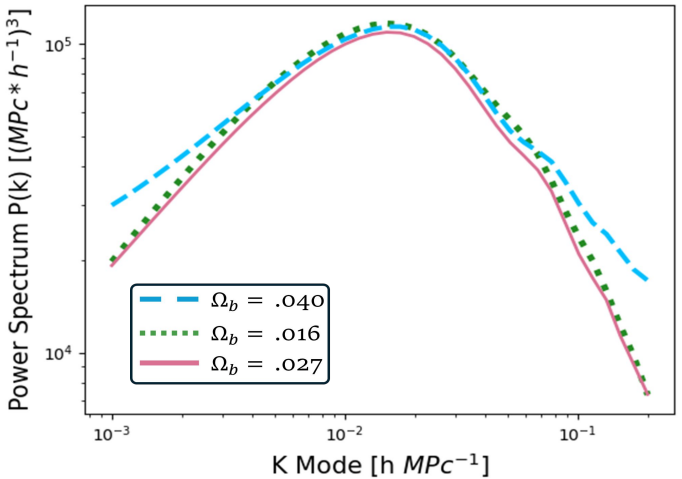


Planck; Doré, 2015

MCMC: Galaxy Power Spectra



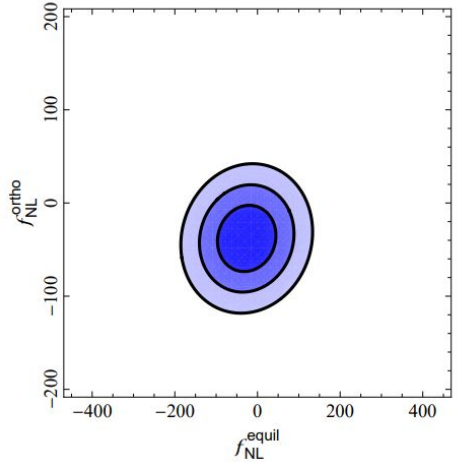
$[H_0, \Omega_m, \sigma_8, \ldots, b_1, b_2]$

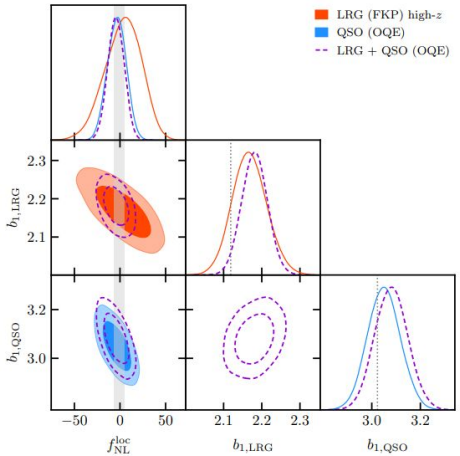


https://www.researchgate.net/figure/Markov-chain-Monte-Carlo-sampling-using-random-walk_fig1_331494053

Primordial Non-Gaussianity: DESI & Planck

$f_{NL\ Planck}$ ~ -0.9 +/- 20-30

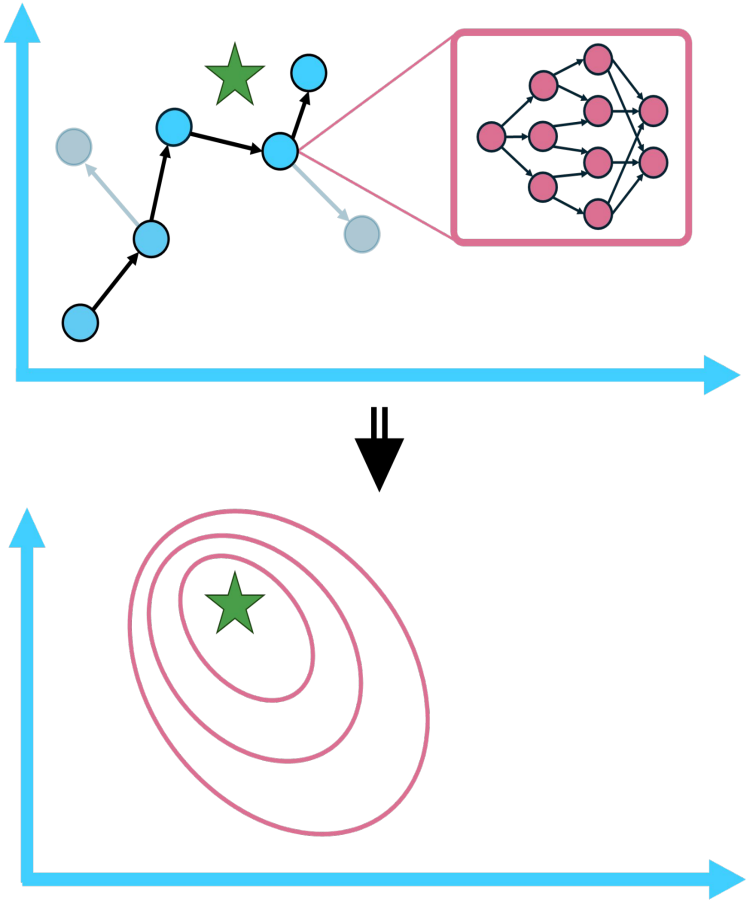




$\sigma_{fNL\ SPHEREx}$~ 0.5-1

$f_{NL\ DESI}$~ -3.6 +/- 7-11

Akrami, 2018; Chaussidon 2024 ;https://spherex.caltech.edu/page/the-origin-of-the-universe



Integrating a Neural Network into an MCMC

Accelerate model evaluation by 250x (1 second to 4 milliseconds)

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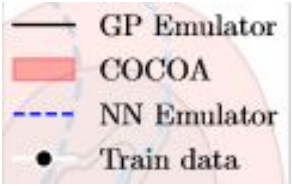
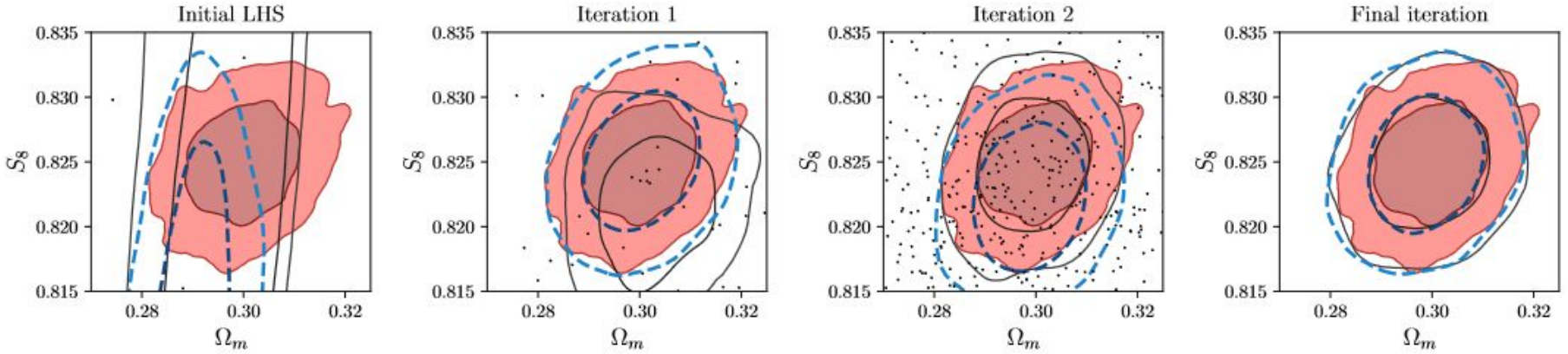
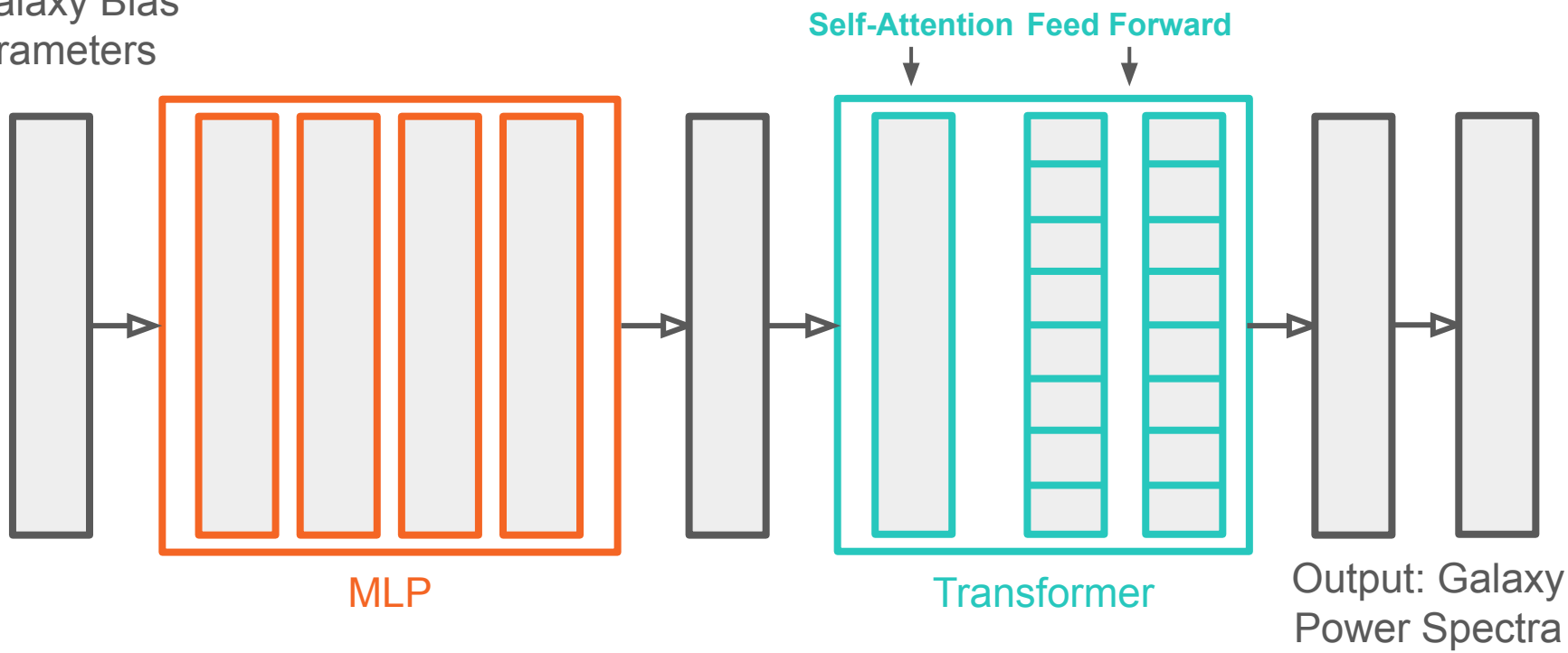
Neural Networks: Faster Supervised Machine Learning





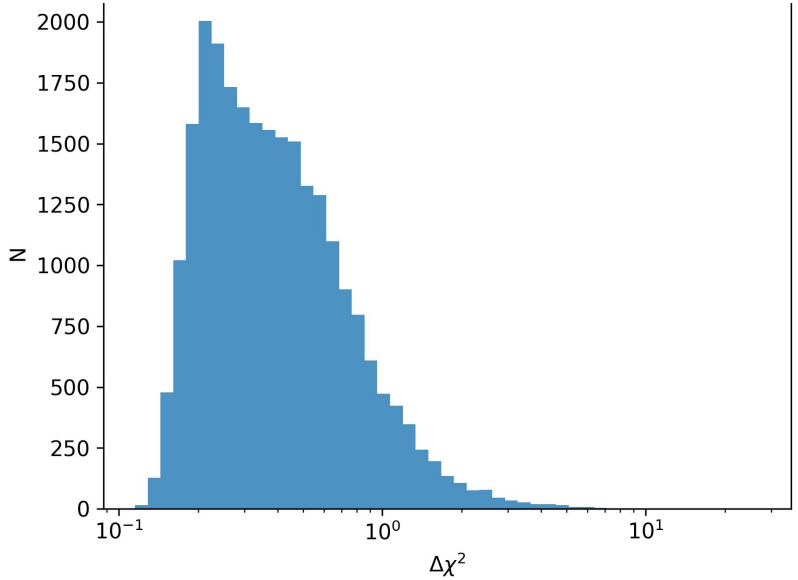
Supranta 2021 https://arxiv.org/abs/2203.06124

Network Architecture



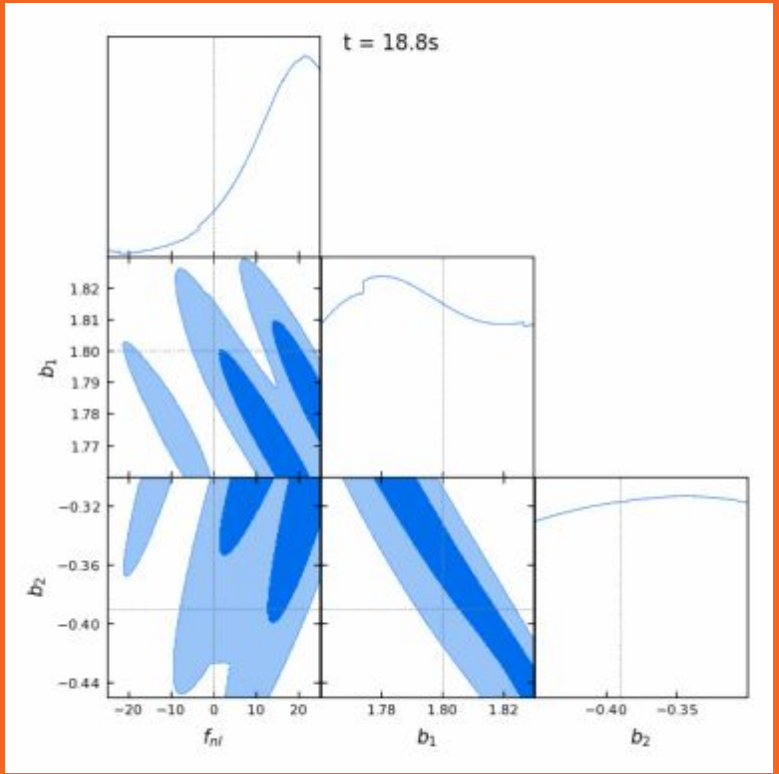
https://arxiv.org/abs/2403.12337

Optimizing the Emulator: Adjusting Hyperparameters



Hyperparameters
Training Set Size
Learning Rate
Batch Size
etc.

Current Status: Single Tracer Single z-Bin Works! Yay!



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Summary

- SPHEREx: All sky spectroscopic survey launching later this month.
- Science Goal: Measure primordial non gaussianity, f_{NL}, from galaxy power spectra.
- Project Goal: Accelerate forecasts by integrating a neural network emulator into the MCMC.
    - Neural network inputs cosmological and galaxy bias parameters and outputs galaxy power spectra.

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