Measuring the cosmological parameters with machine learning techniques.

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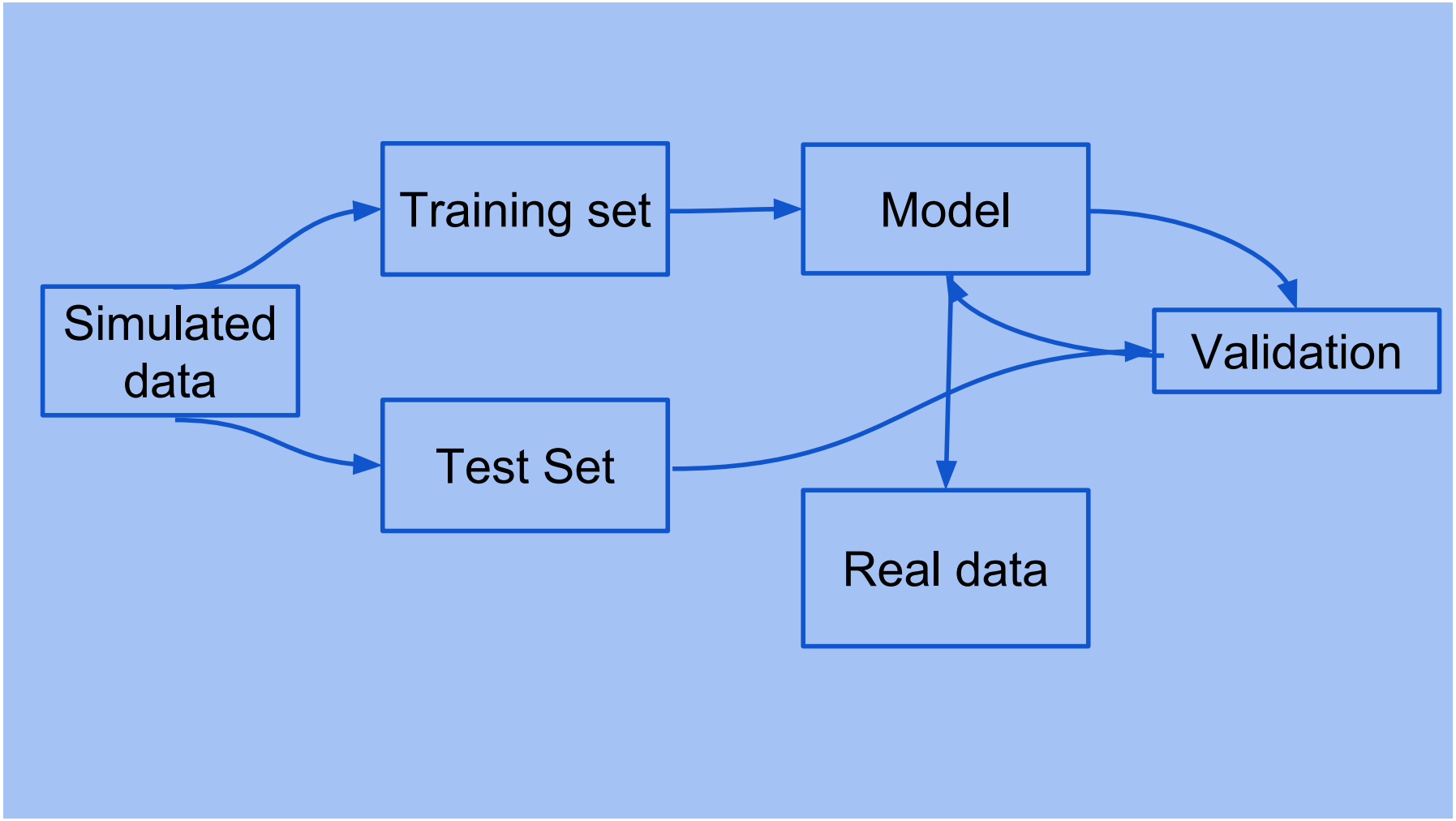
Supervised Learning.

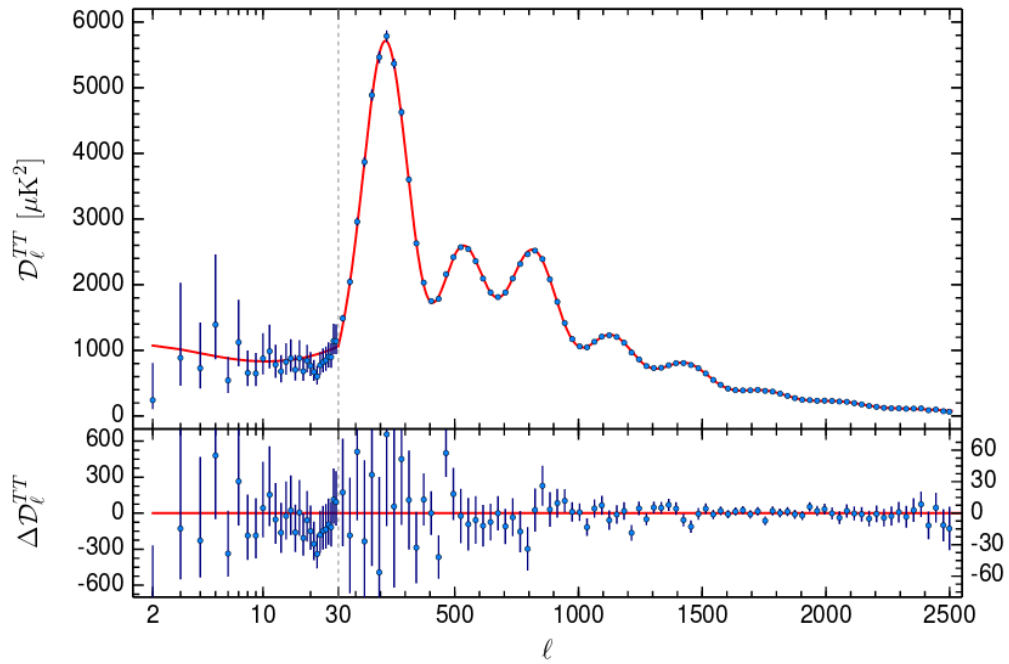


The Standard model.

Homogeneous and isotropic Universe $\rightarrow$ FRW metric

$ds^2 = dt^2 - a^2(t)[\frac{dr^2}{1-kr^2} + r^2(d\theta^2 + sin^2\theta d\phi^2)]$

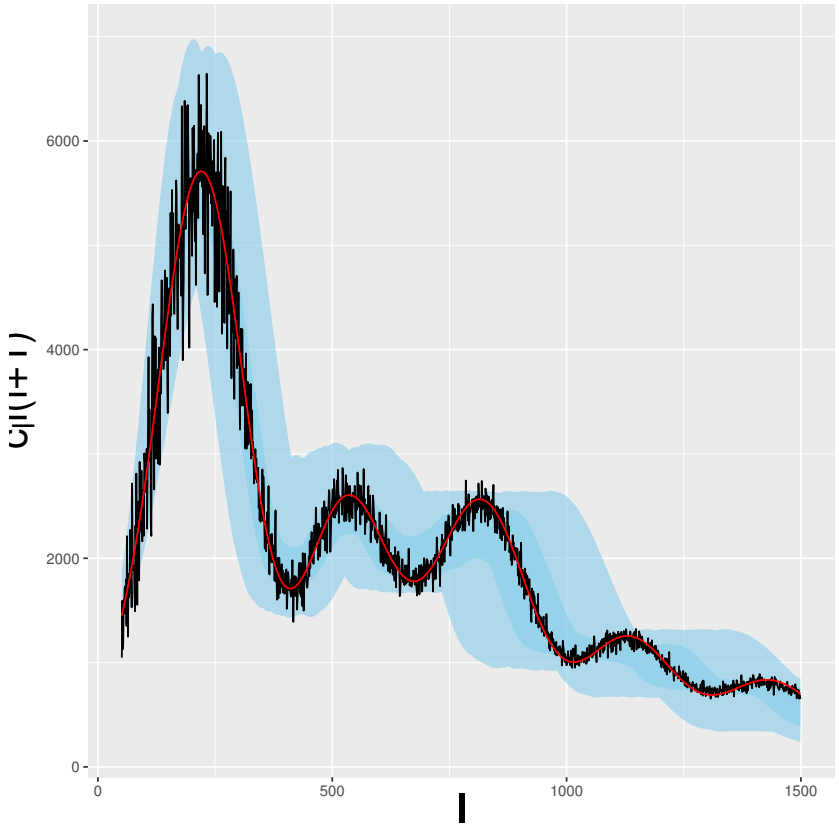
$(\frac{H}{H_0})^2 = \Omega_{rad} a^{-4} + \Omega_m a^{-3} + \Omega_\Lambda - Kc^2 a^{-2}$



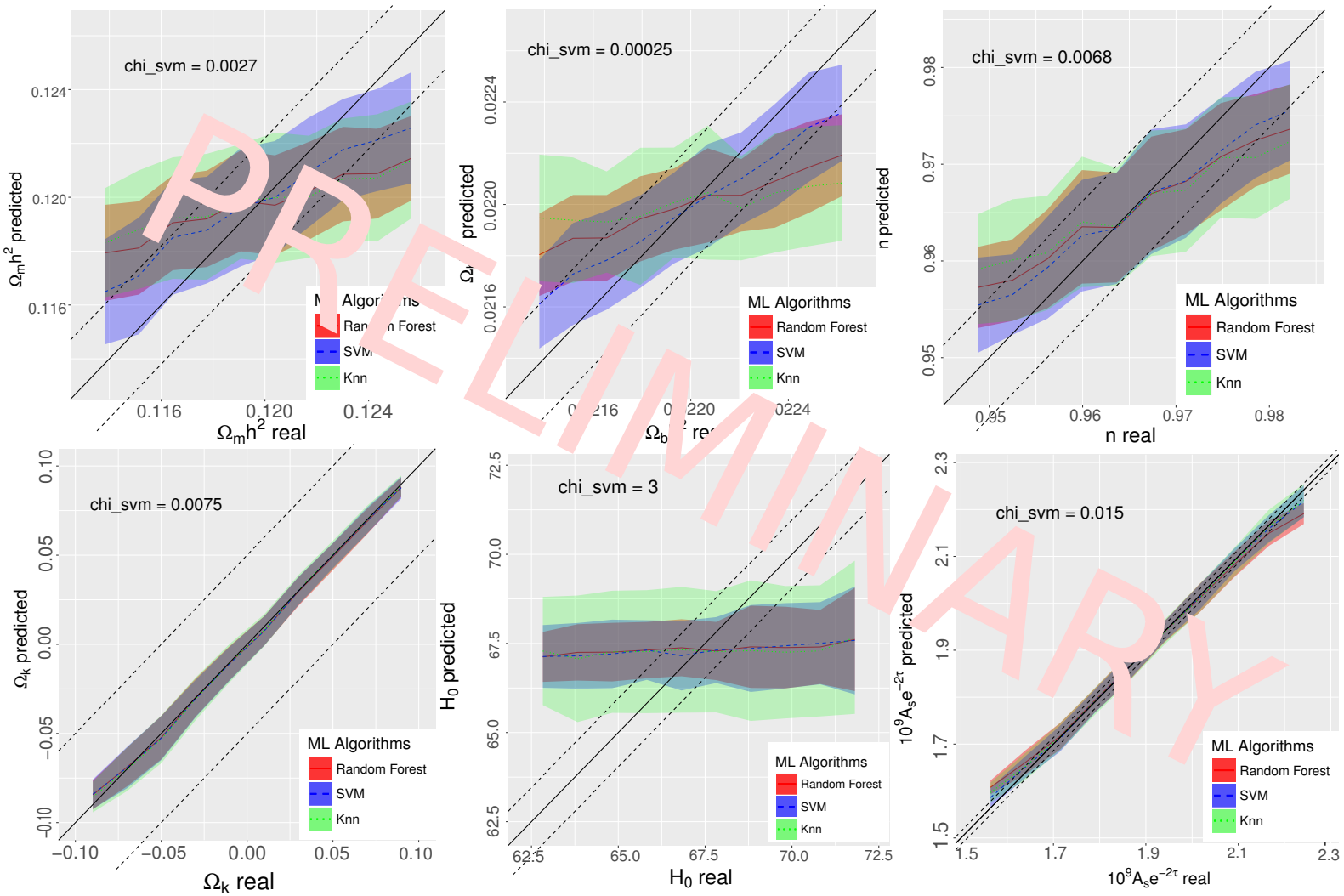
Planck Collaboration 2015 (1502.01589)

The training sample.

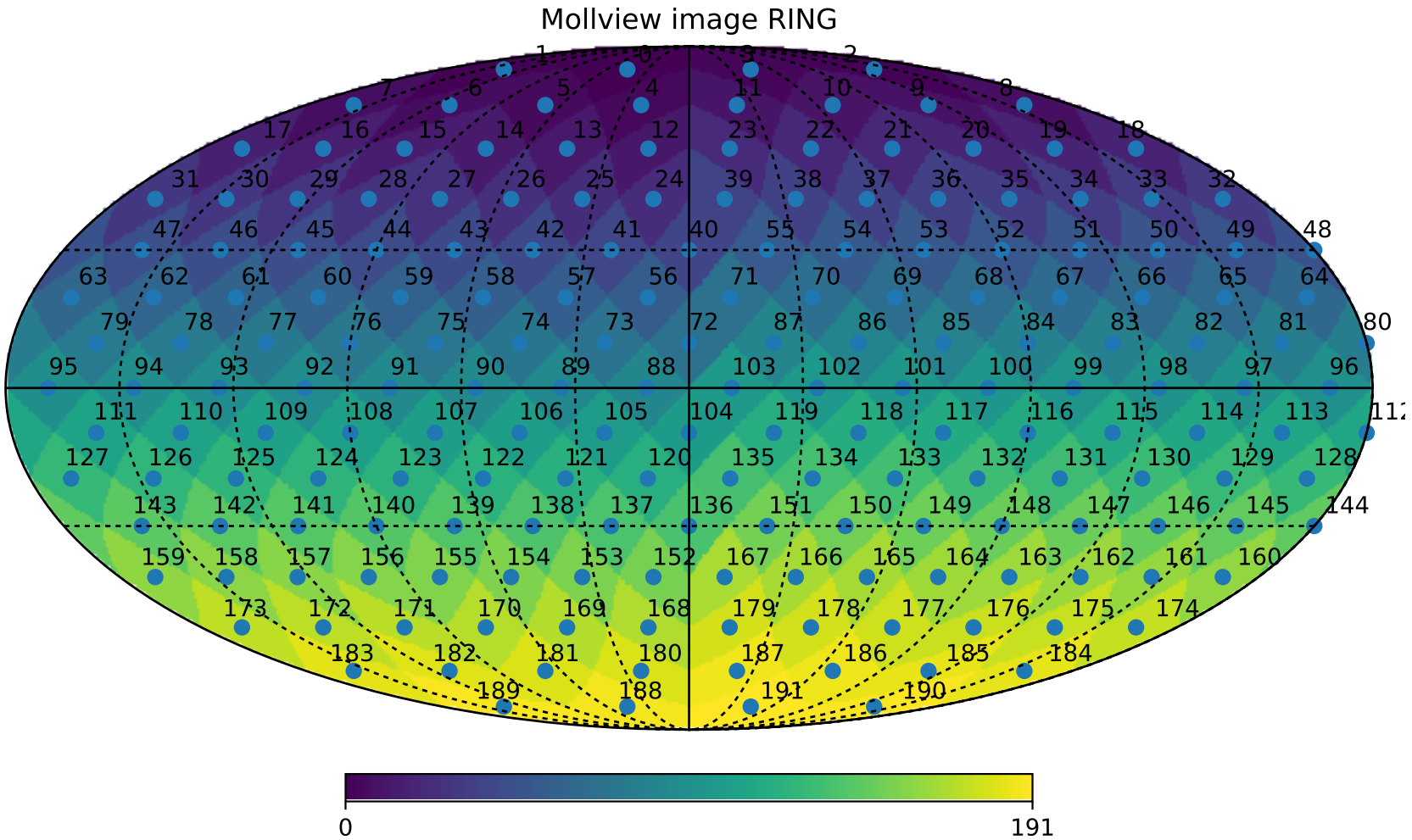
CAMB: Code for Anisotropies in the Cosmic Background



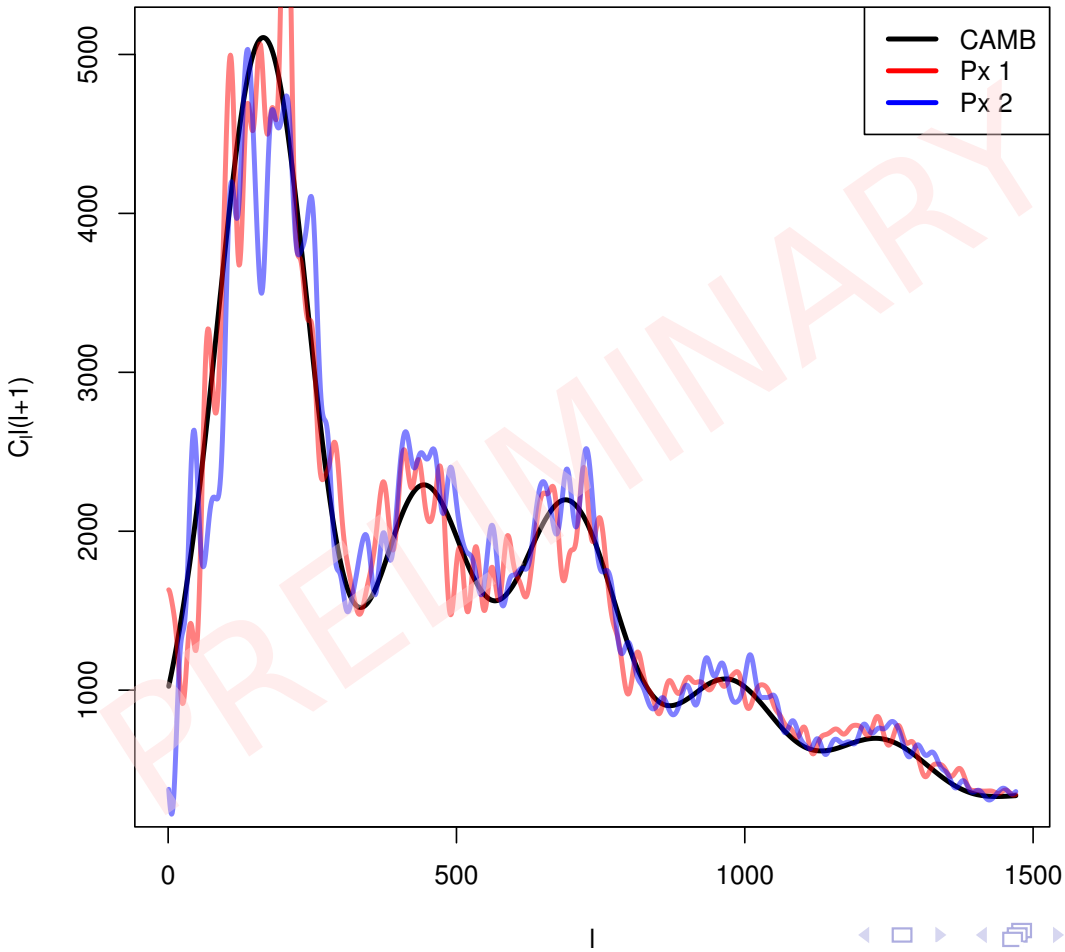
Studying different Machine Learning algorithms.



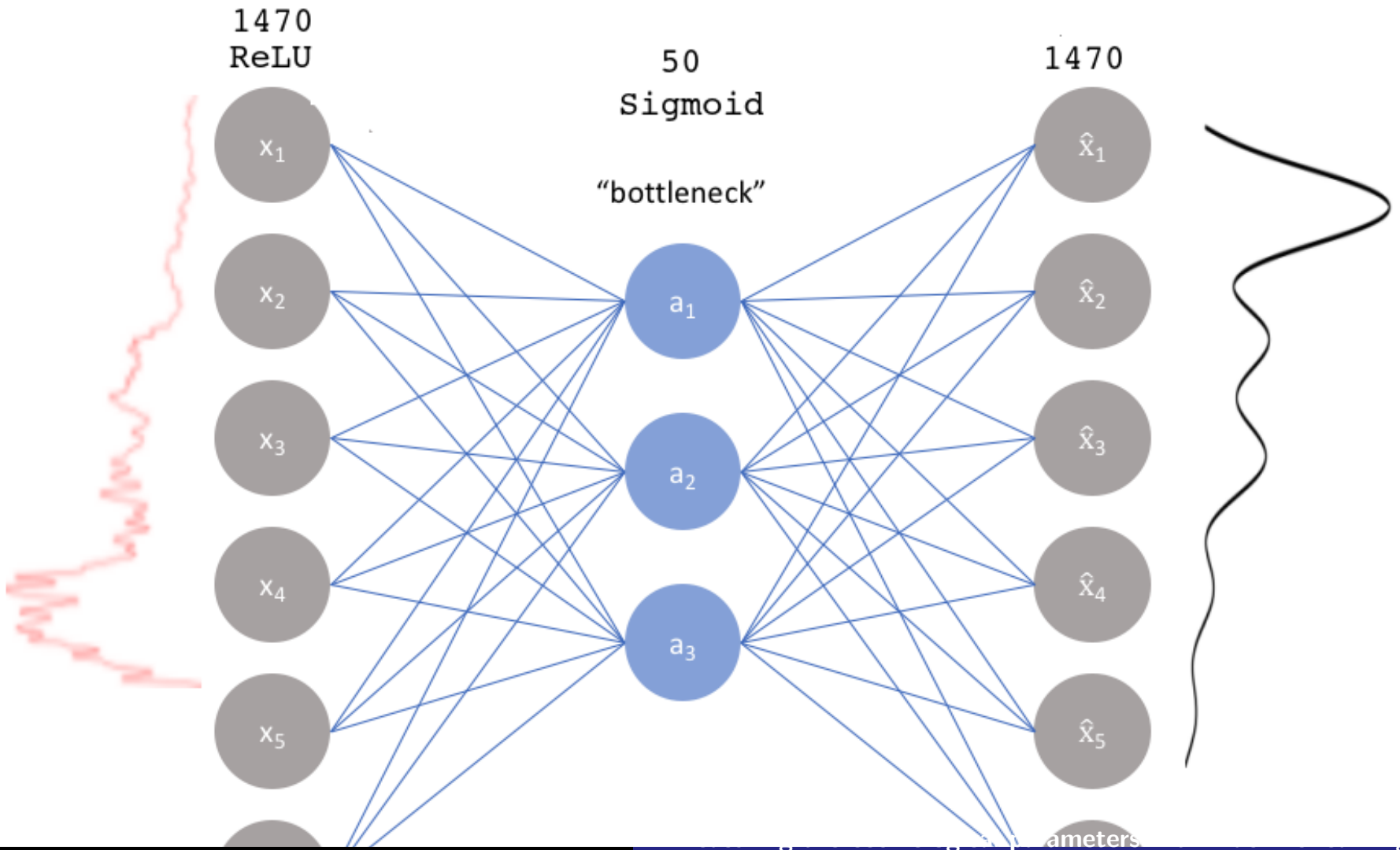
Measuring the cosmological parameters angular distributions.

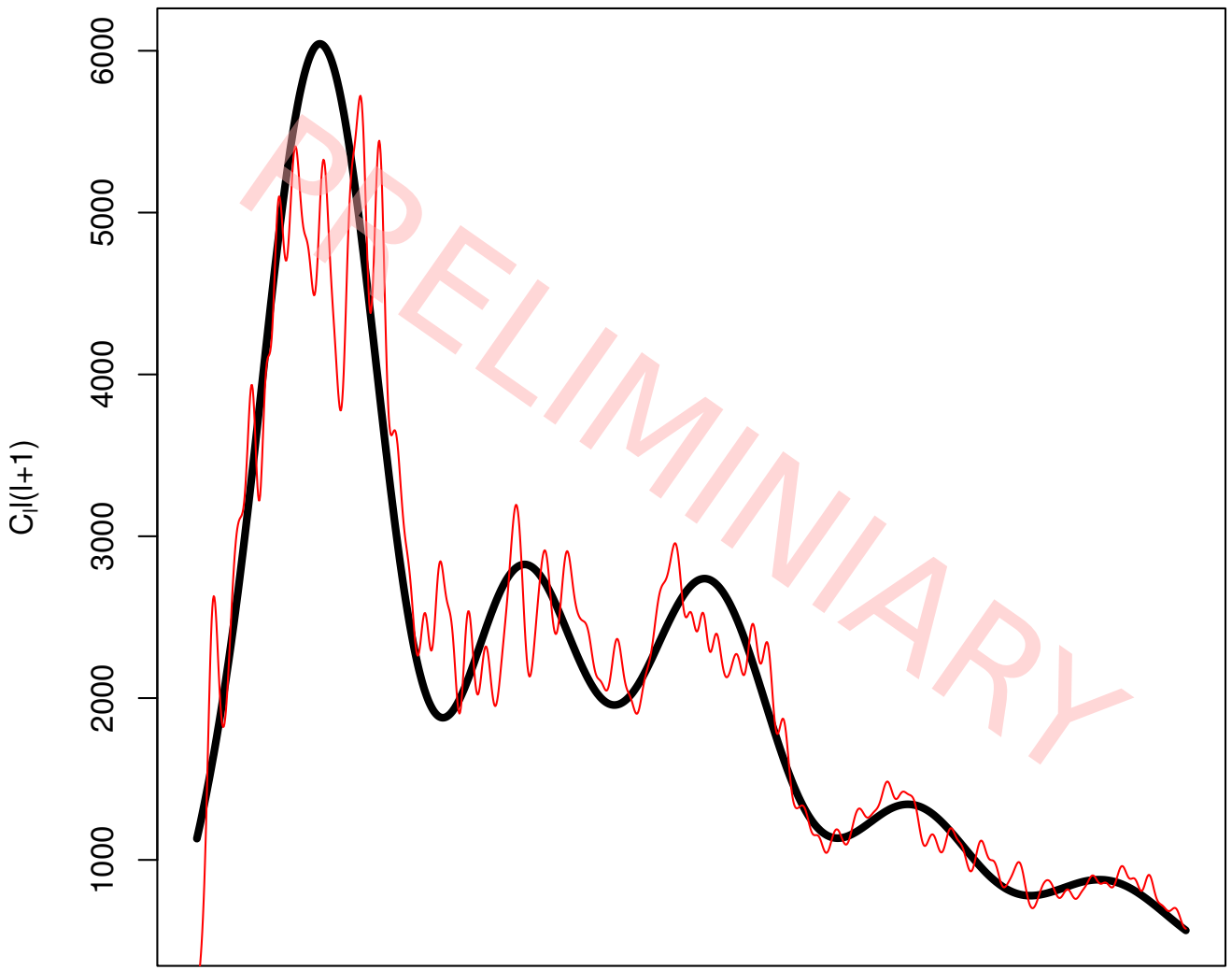


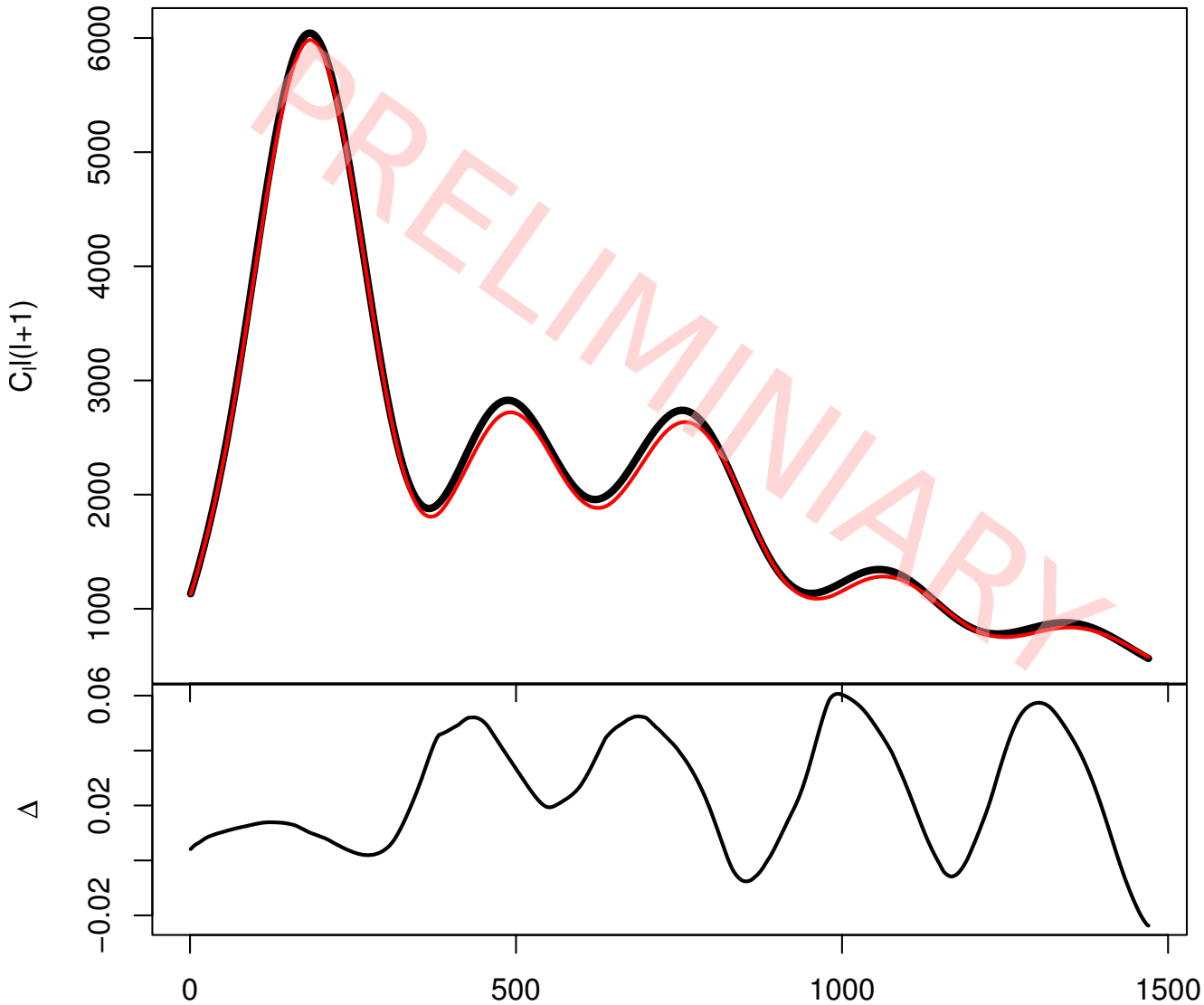
Measuring the cosmological parameters angular distributions.



Denoising Autoencoders

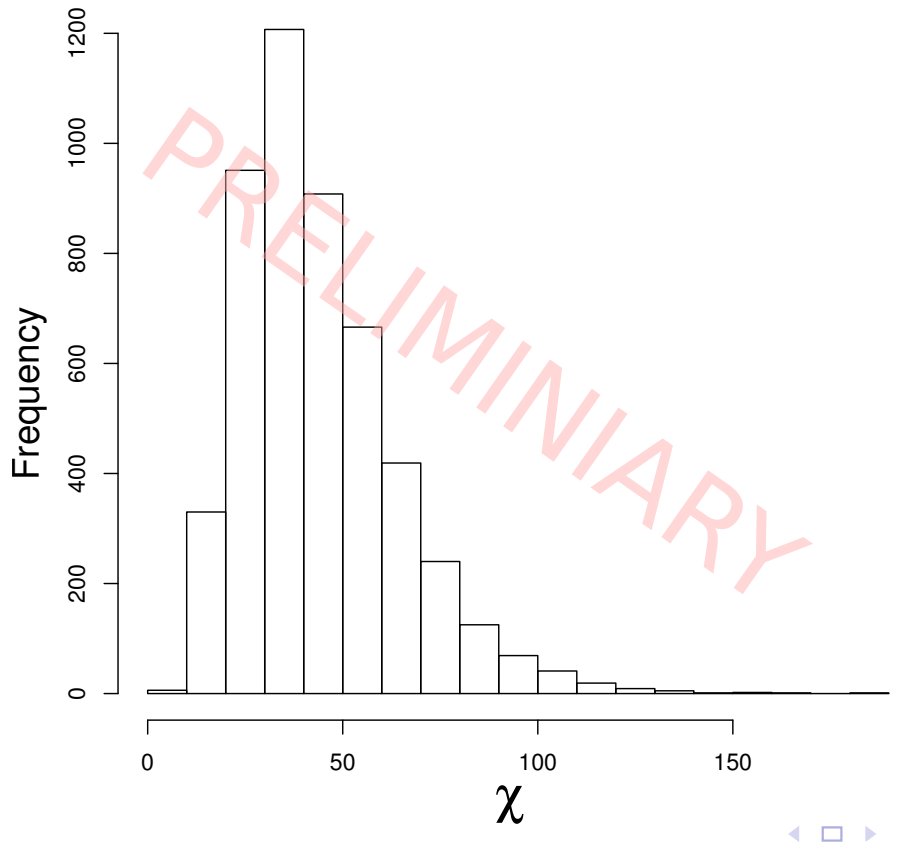


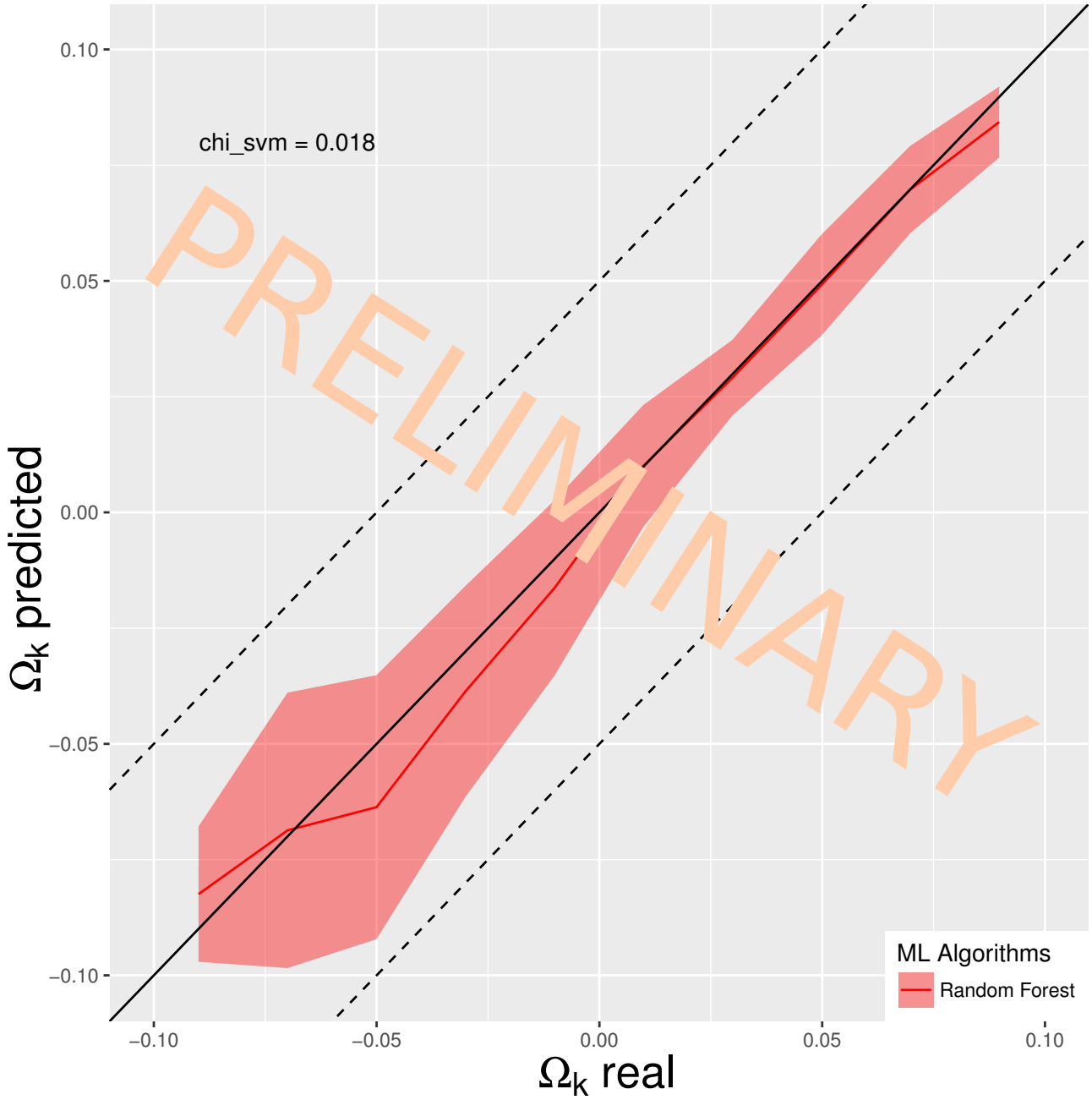

ps reconstruction
PRELIMINIARY
C_l l(l+1)
1000
2000
3000
4000
5000
6000

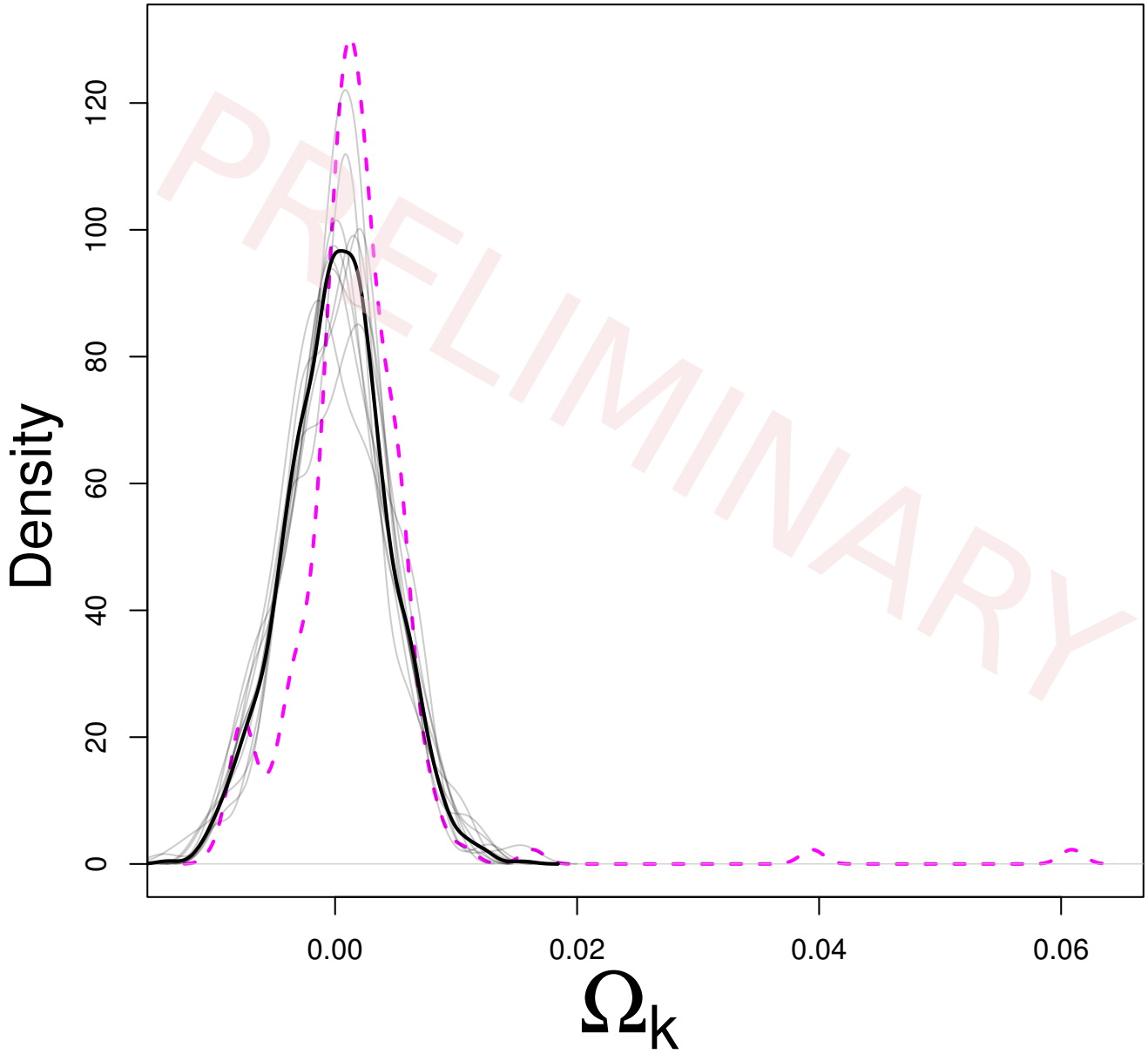

ps reconstruction
PRELIMINIARY
C_l(l+1)
1000
2000
3000
4000
5000
6000
Δ
−0.02
0.02
0.06
0
500
1000
1500

Measuring the cosmological parameters angular distributions.

$$\chi = \frac{\sum_{i=1}^{npix} |C_{l,real} - C_{l,rec}|}{npix}$$




chi_svm = 0.018
PRELIMINARY
0.10
0.05
0.00
−0.05
−0.10
Ω_k predicted
−0.10
−0.05
0.00
0.05
0.10
Ω_k real
ML Algorithms
Random Forest


PRELIMINARY
Density
0
20
40
60
80
100
120
0.00
0.02
0.04
0.06
Ω_k

Final Remarks

- We developed a machine learning technique that estimate the cosmological parameters using CMB information.
- This technique can be easily extended to use more cosmological information as features (BAO, correlation function, SZ emission, etc.).
- As a first application we are studying the angular distribution of the cosmological parameters.
- We developed a machine learning technique that reconstructed the power spectra from pixels.
- We do not found any significant curvature departure from what is expected in an homogeneous and isotropic universe, with the exception of some pixels that are in the galactic plane.
- We will extend the parameters space and add polarization information.


THANK YOU!!

Changing the minimum mutipole.