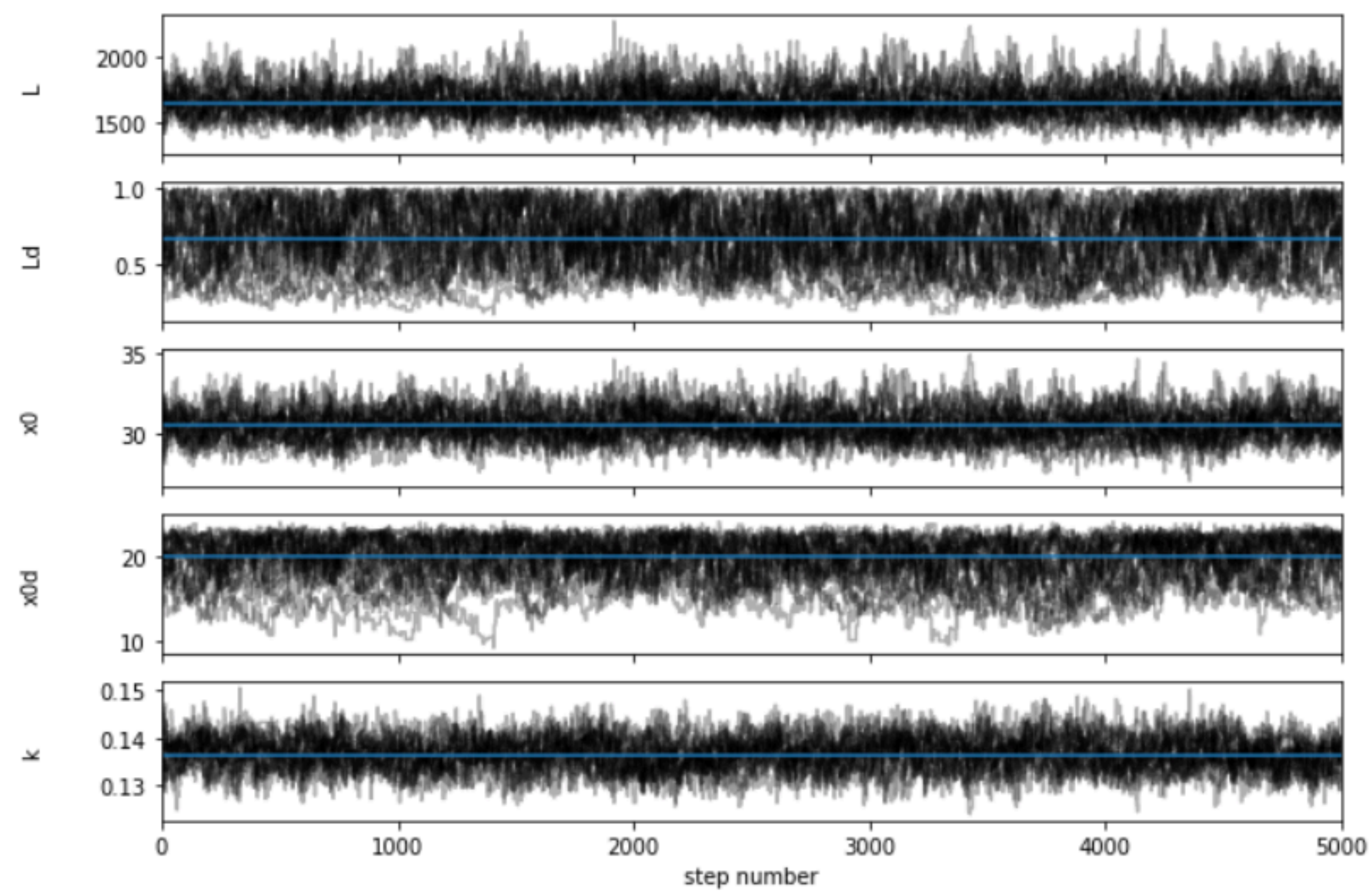
MCMC CONVERGENCE

How do we know the MCMC have converged?

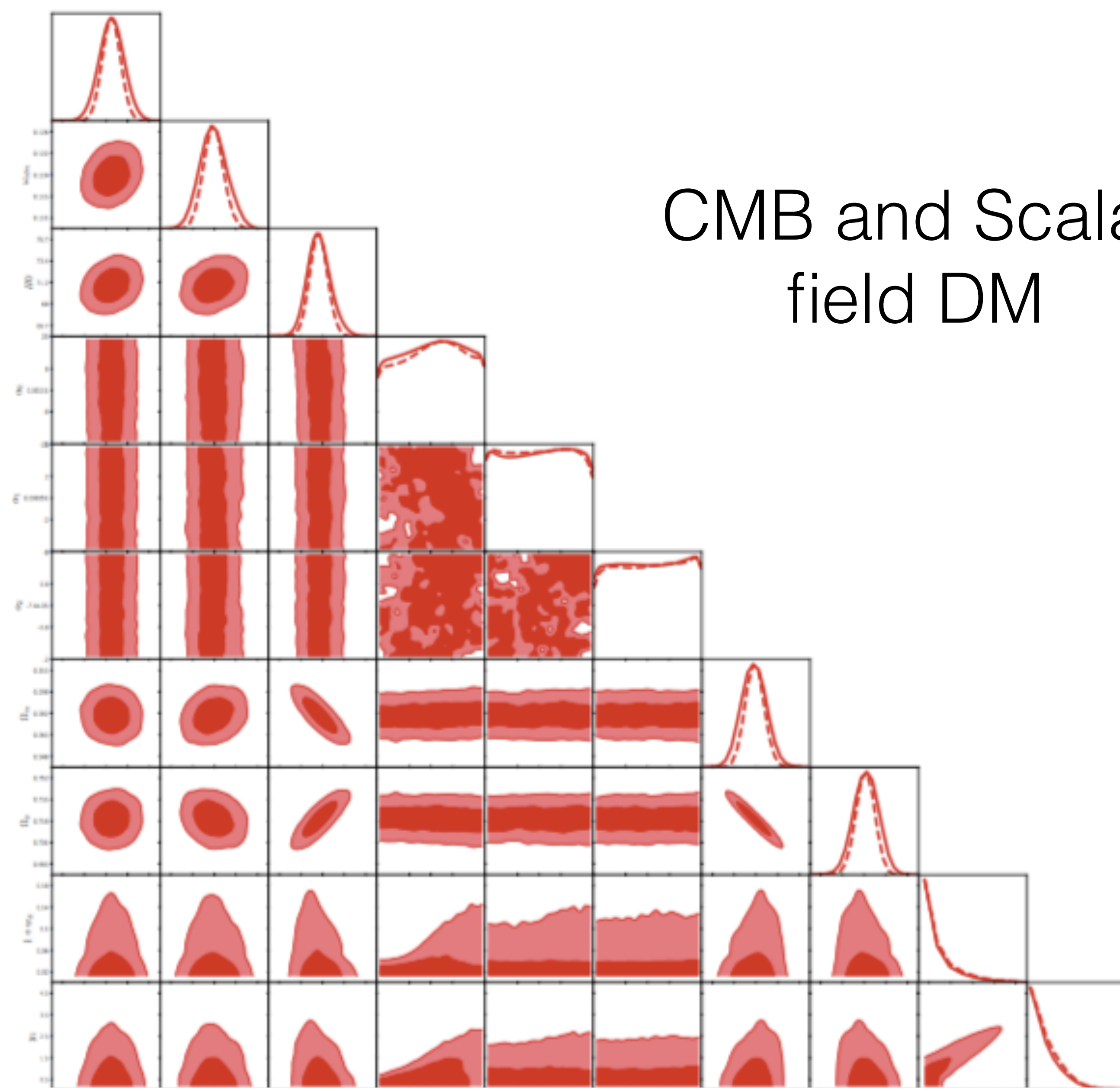
You can not demonstrate convergence, but you can look for evidence of it. Some things to look at:

- Check for low/high acceptance rates
- Run long chains
- Run several chains, initialized in different points of the parameter space.
- Look at the sequence of the chains.
- Different segments of the chain give the same result?



- Look for funny shapes of the posterior. Tails?
- Strong correlation between parameters?

- Useful libraries for triangle plots: corner (https://corner.readthedocs.io/en/latest/), getdist.py(https://getdist.readthedocs.io/en/latest/)



CMB and Scalar field DM

Gelman-Rubin diagnostic

https://projecteuclid.org/download/pdf_1/euclid.ss/1177011136

$$s_i^2 = \frac{1}{n-1}\sum_{t=1}^{n}(X_{it} - \bar{X}_i)^2$$

$$s^2 = \frac{1}{m}\sum_{i=1}^{m} s_i^2$$

$\bar{X}_i$ Mean from chain I (for a given parameter)

s_i Variance for chain i.

n Samples in a chain

m Chains

$\hat{\mu}$ Overall mean for a given parameter

Compute

$$\frac{B}{n} = \frac{1}{m-1}\sum_{i=1}^{m}(\bar{X}_i - \hat{\mu})^2$$

$$\hat{\sigma}^2 = \frac{n-1}{n}s^2 + \frac{B}{n}$$

s^2 and $\hat{\sigma}^2$ are both estimates of σ^2

$$\hat{R} = \sqrt{\frac{\hat{\sigma}^2}{s^2}}$$

when $\hat{R} \leq \delta$ for some $\delta > 1$ the chain might have converged