# The Effects of Priors on Cosmological Analysis

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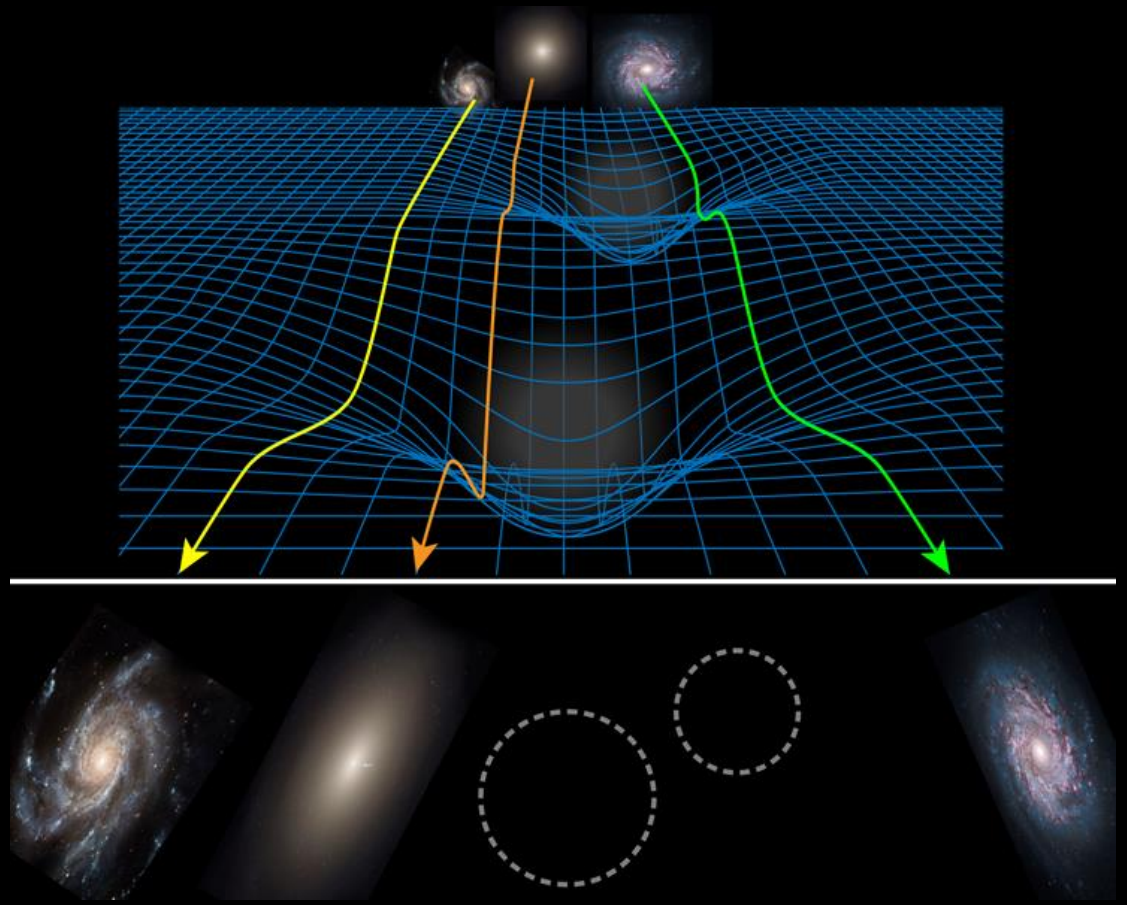
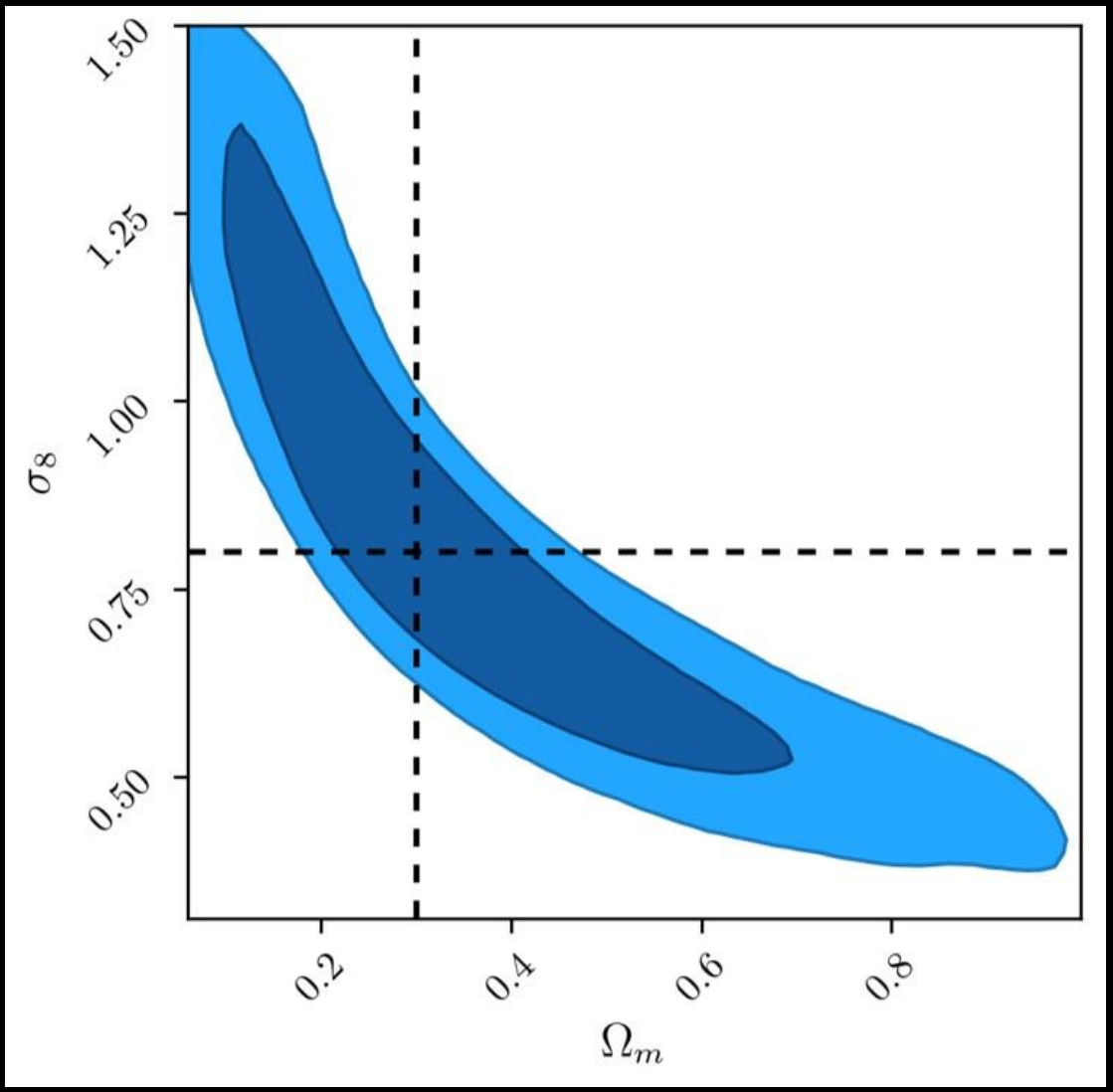
# Background: Cosmology

- 5 „main“ Parameters:
  - $\Omega_m$ – dark and baryonic matter density ~ 0.308 $\pm$ 0.012
  - $\Omega_b$ – baryonic matter density ~ 0.0491 $\pm$ 0.0005
  - $\sigma_8$ – density fluctuation amplitude ~ 0.830 $\pm$ 0.015
  - $n_s$ – scalar spectral index (variance of density fluctuations with scale) ~ 0.968 $\pm$ 0.006
  - $H_0$ – Hubble parameter (expansion rate). Takes different values depending on method (between ~ 67 and 74 km $MPc^{-1}\,s^{-1}$)
- Weak lensing: $\Omega_m$ and $\sigma_8$

Numbers taken from: C. Heymans, The Dark Universe, physicsworld, 2017

# The *Banana*






APS/Alan Stonebraker; galaxy images from STScI/AURA, NASA, ESA, and the Hubble Heritage Team

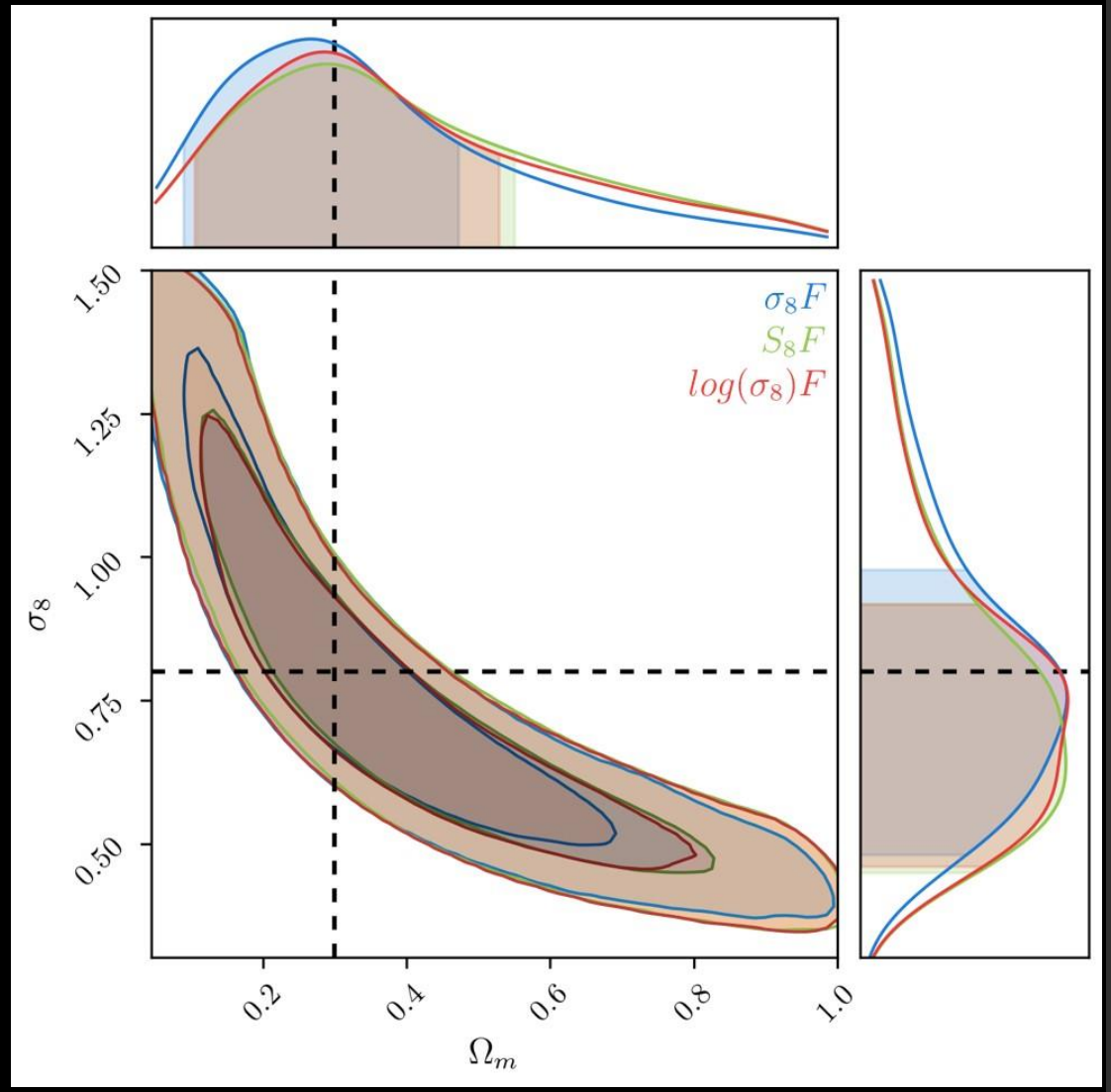
# Introduction: Bayes‘ Theorem

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

Image: Bayes' theorem at the offices of HP Autonomy, by mattbuck.
URL: https://en.wikipedia.org/wiki/Bayes%27_theorem#/media/File:Bayes'_Theorem_MMB_01.jpg

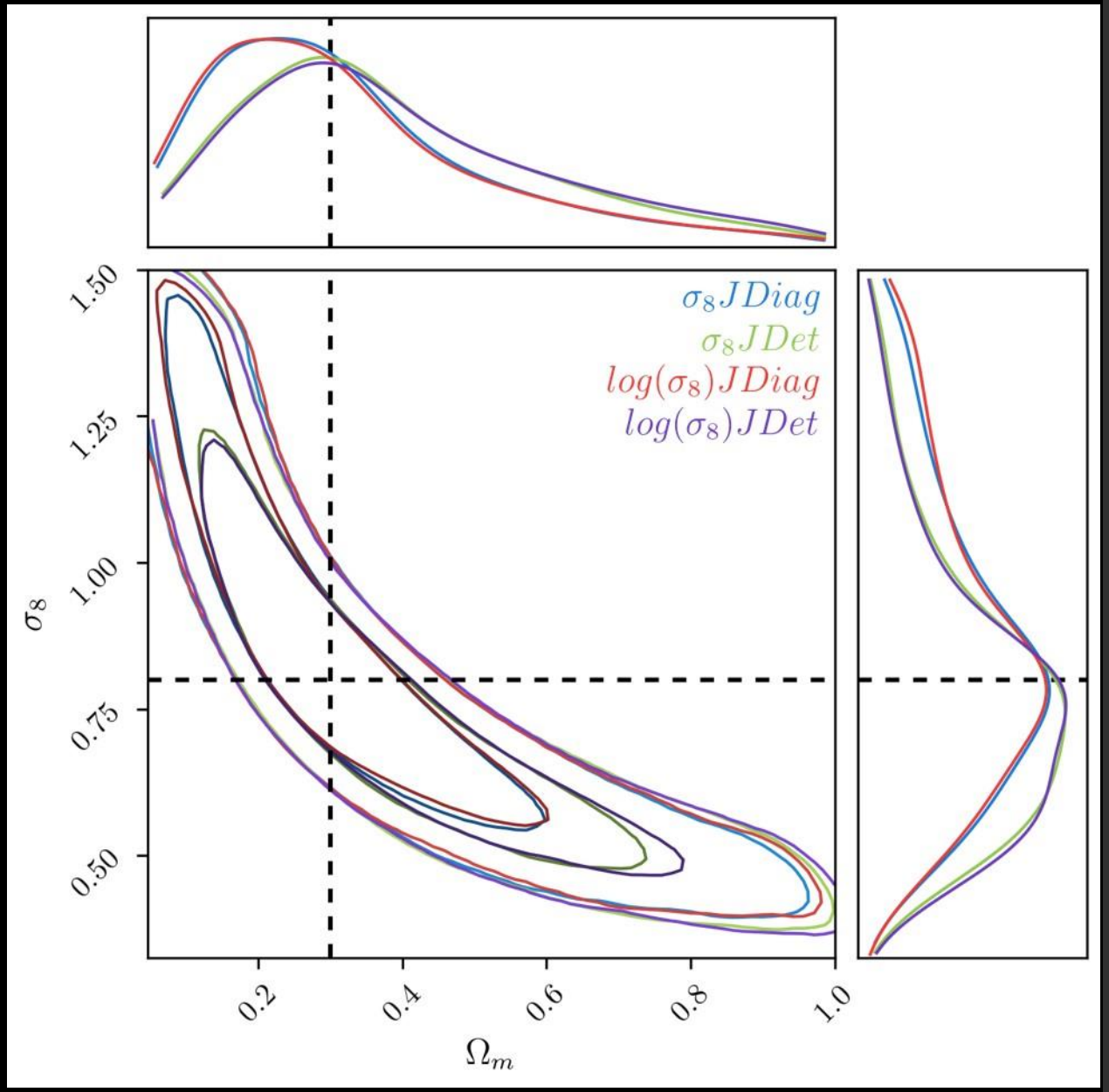
# Motivation

- Problems with Flat Priors:
  - Are Informative
  - Don‘t work well under parameter transformation
- Jeffrey‘s – Solves transformation problem
- Reference – Solves informative problem



# Jeffrey‘s

- Computed from Fisher Matrix (describes how sensitive Likelihood is to the parameters)
- Either root of determinant or of product diagonal
- Jdet agrees with Jdet, Jdiag with Jdiag



# Reference

- Maximises Divergence between Prior and Posterior
- Hard/impossible to do analytically, take a different approach
- Choose priors and calculate Divergence to find the „best“ one