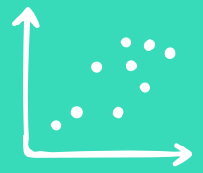
Fundamental Interactions in Particle Physics

Gallileo Gallilei Institute, Florence - January 2019

Topics and Lecturers

QCD and Collider Physics

Gregory Soyez (IPhT Saclay)



Statistics and Machine Learning

Gilles Louppe (Liege U.), Kyle Cranmer (NYU)

Effective Field Theory

Alex Pomarol (UAB & IFAE, Barcelona)

Axions

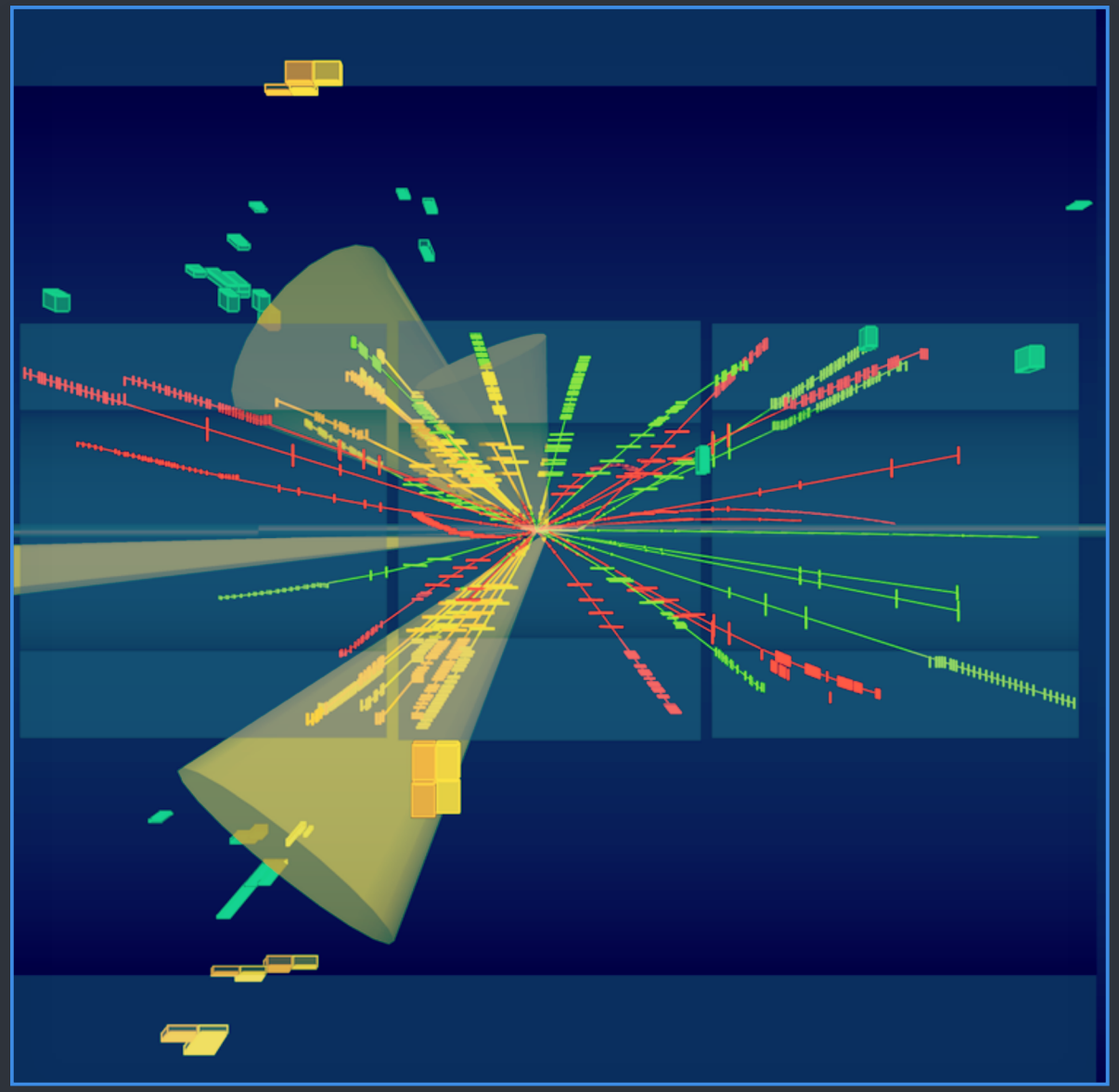
Javier Redondo (Zaragoza U.)

The Cosmic Microwave Background

Raphael Flauger (UCSD)

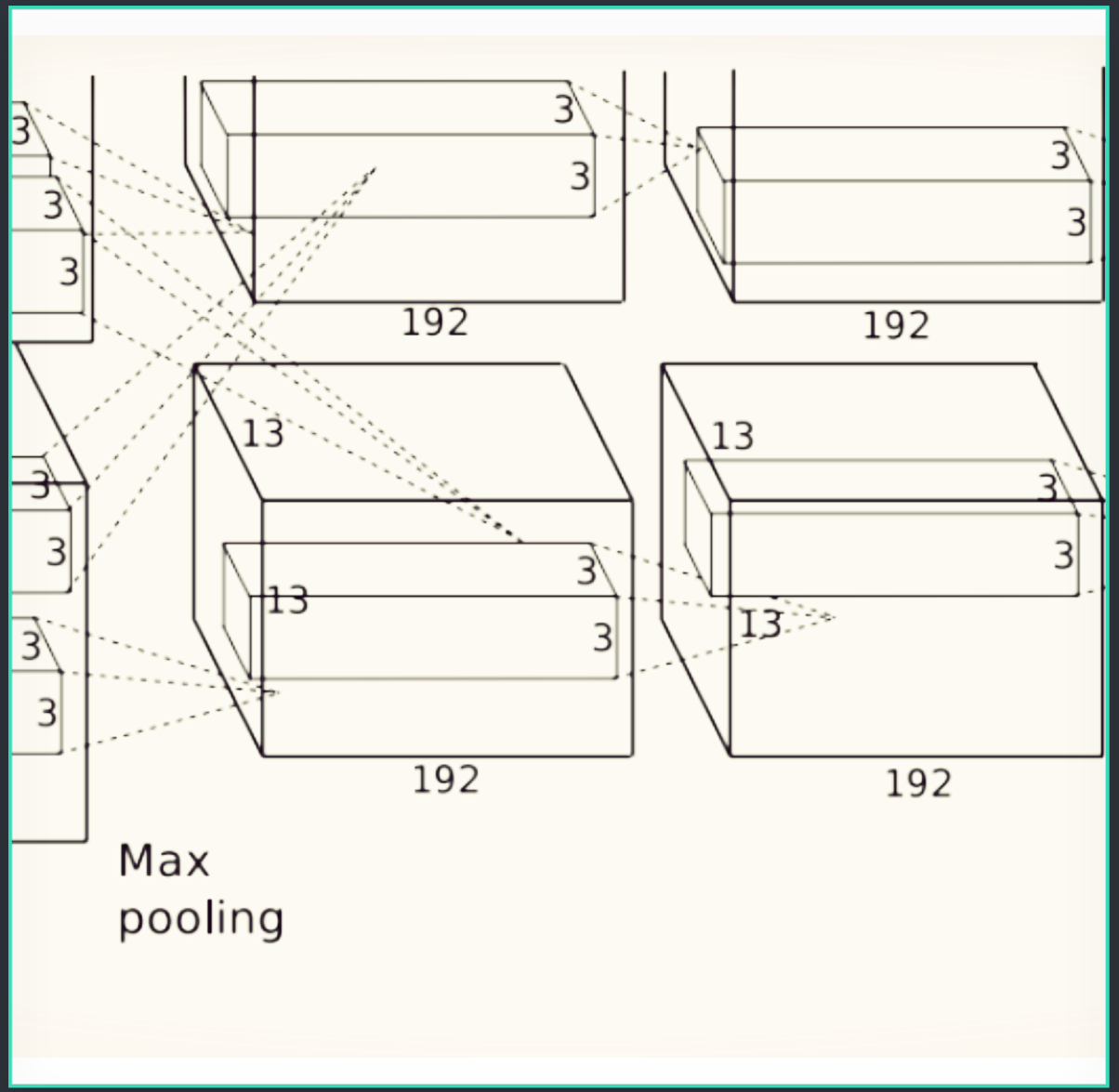
Flavour Physics and CP Violation

Jernej Kamenik (Llubjana U.)



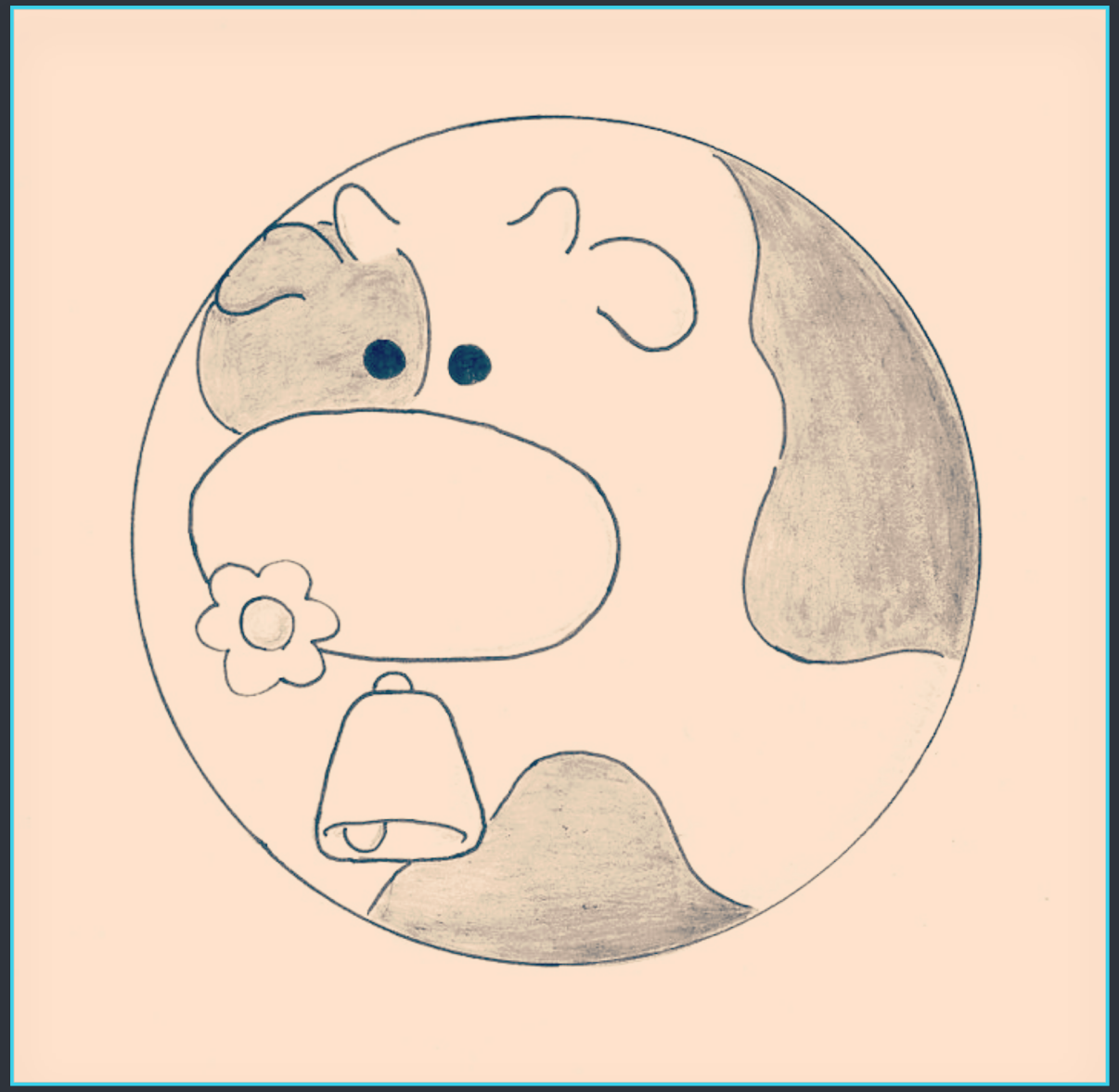
QCD and Collider Physics

- Jet Algorithms
- Parton Distribution Functions
- Monte Carlo Generators
- What can we learn from the LHC?



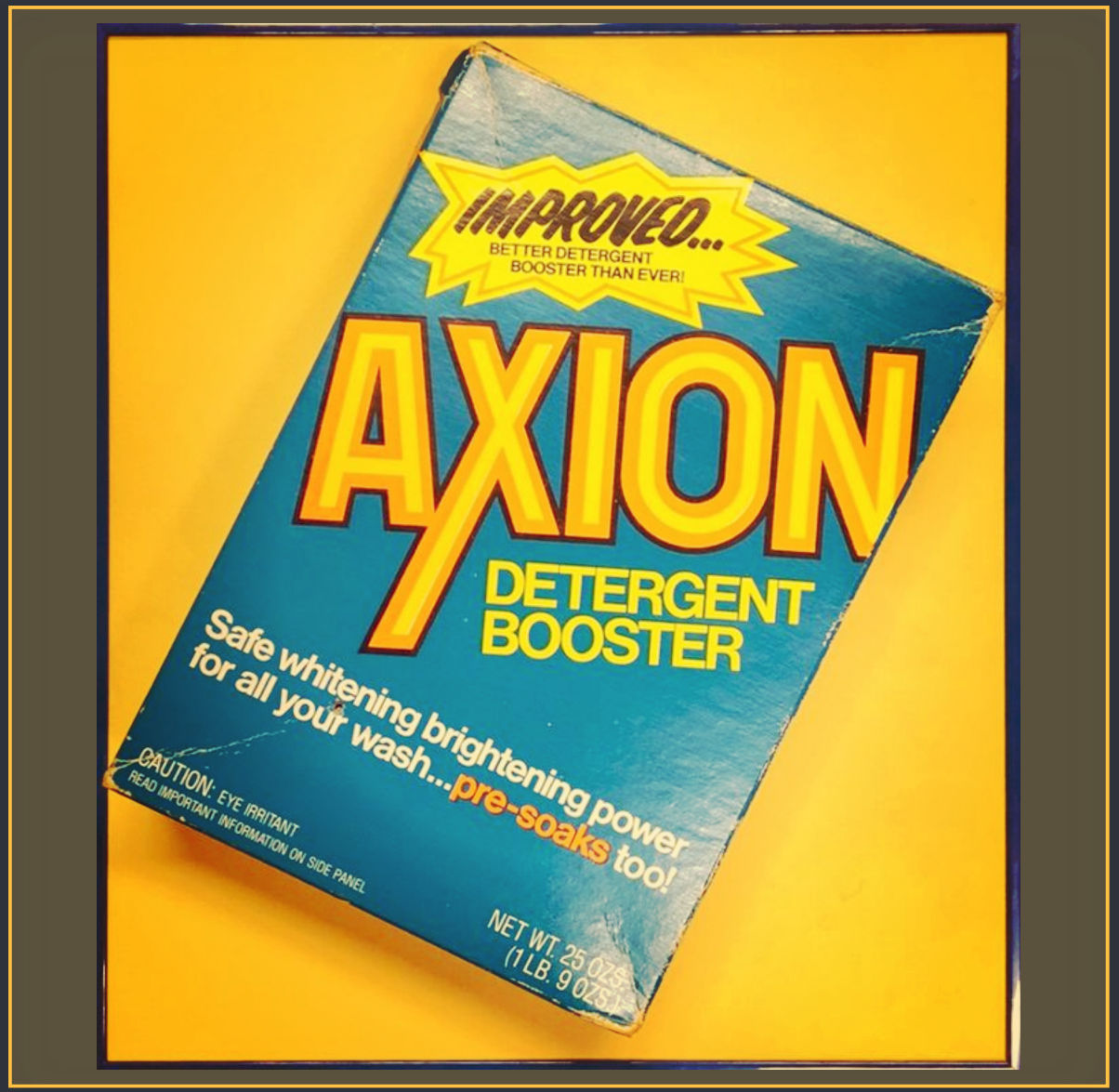
Statistics and Machine Learning

- How do we discover things in particle physics?
- Interpreting a constraint plot
- Building a statistical Model
- Applications and Implementation of Machine Learning (**Python**)
- Likelihood Functions and Stochastic Gradient Descent



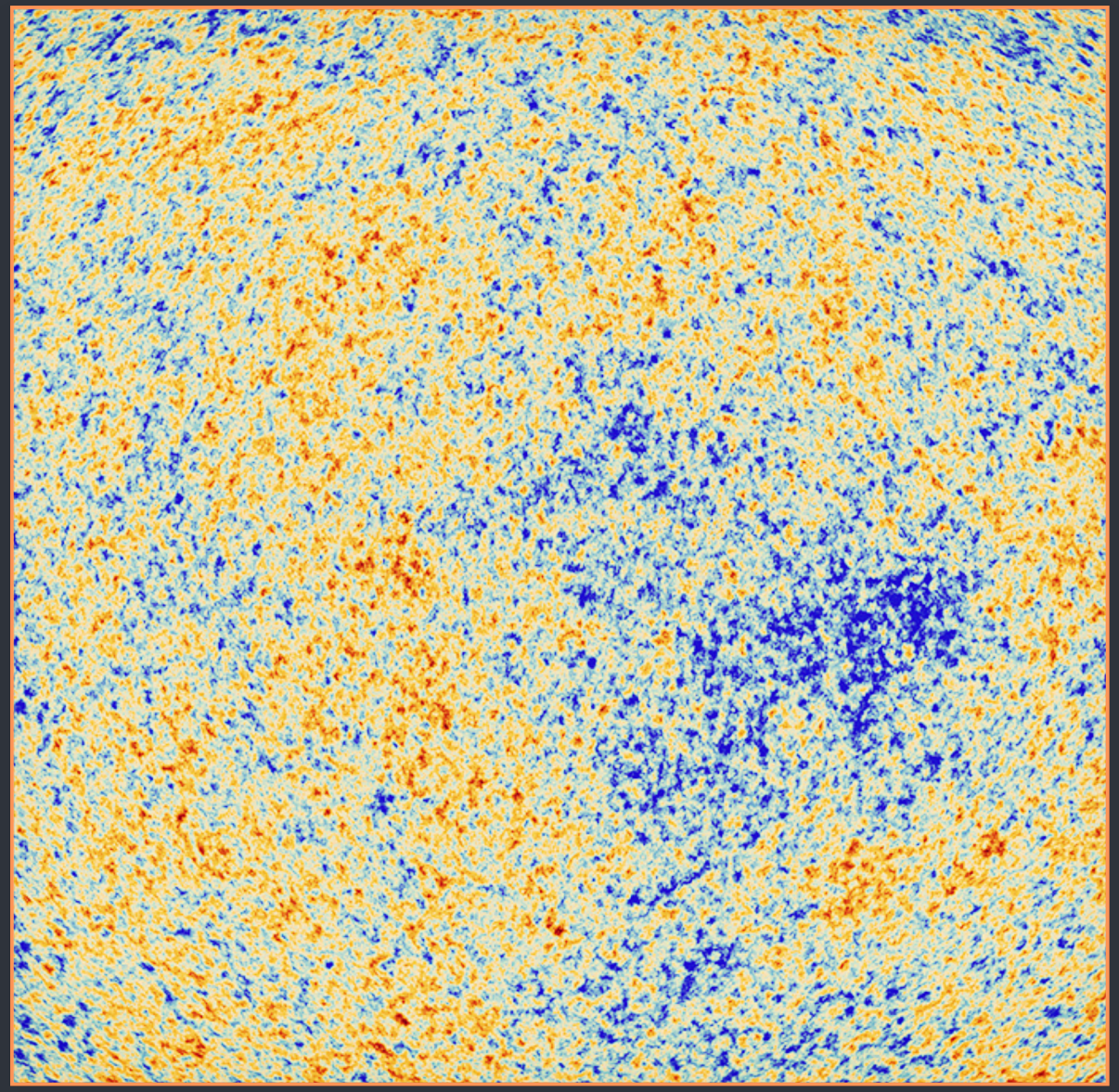
Effective Field Theory

- Accidental Symmetries
- Standard Model as an EFT
- Effect of Higher Order Operators
- Lepton mass problem and possible solutions
- Hierarchy Problem



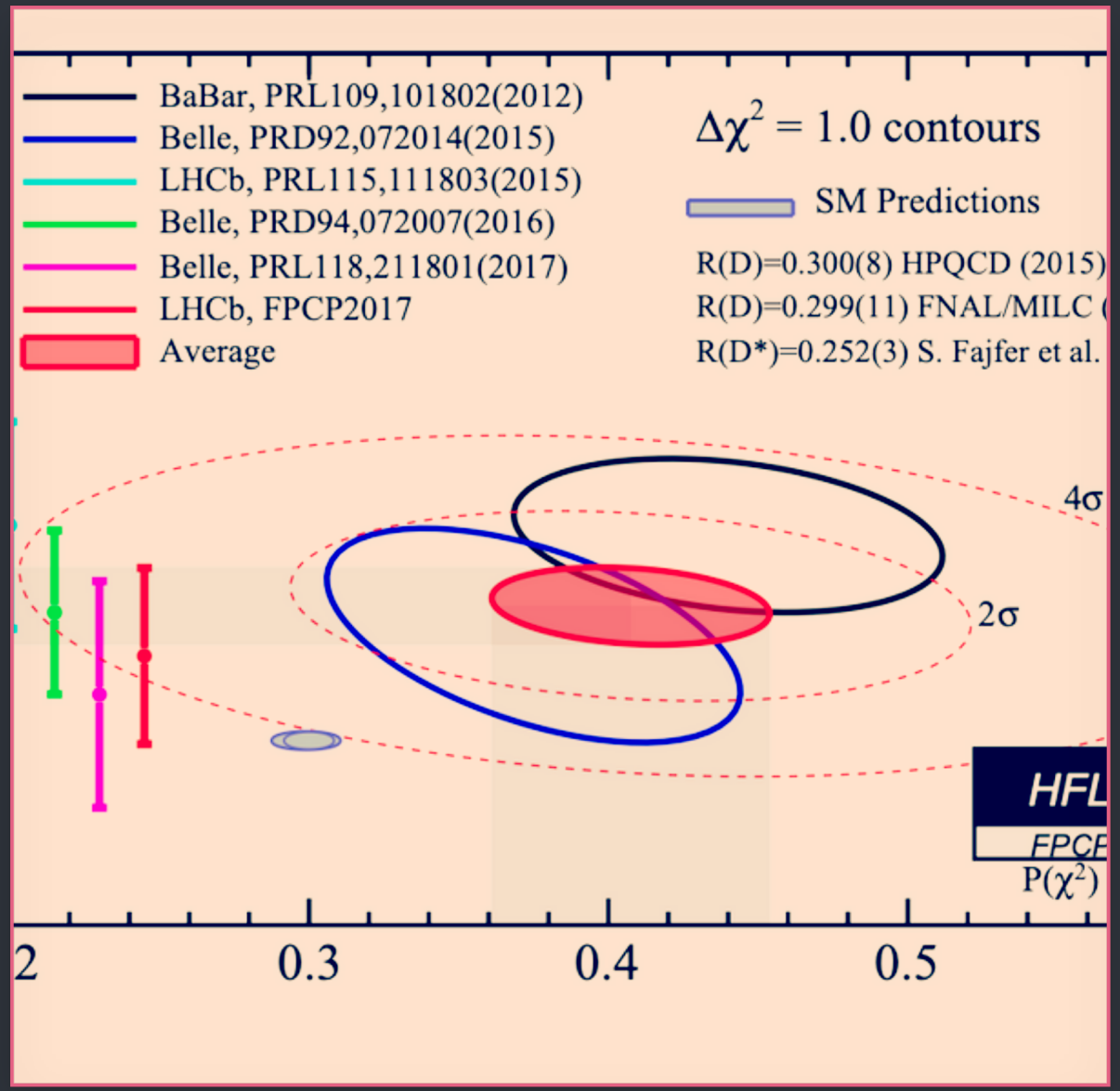
Axions

- Missing Meson Problem
- Strong CP Problem
- QCD Vacuum Structure
- Axion Cosmology
- Detection Possibilities



The Cosmic Microwave Background

- Kinematic Effects
- Calculation of the Power Spectrum
- CMB Statistics
- CAMB, CLASS, HealPy



Flavour Physics and CP Violation

- Accidental flavour symmetries
- CKM Matrix and CP Violation
- Testing unitarity
- Where can we find new physics?
- Lepton flavour-blindness?
- B anomalies

PROGRAM

Schedule (PDF)

Lectures and topics

KYLE CRANMER (NYU)
Statistics and Machine Learning video
Slides
GILLES LOUPPE (Liege U.)
Statistics and Machine Learning Tutorial video
Lecture 1: Fundamentals of machine learning
Lecture 2: Neural networks
Lecture 3: Generative models
GitHub

RAPHAEL FLAUGER (UC San Diego)
The Cosmic Microwave Background video
Slides lecture 5

Resources

Notes, slides and videos are available online

GGI Homepage

YouTube Lecture Videos