

Exploring Quantum Effects at the Terascale

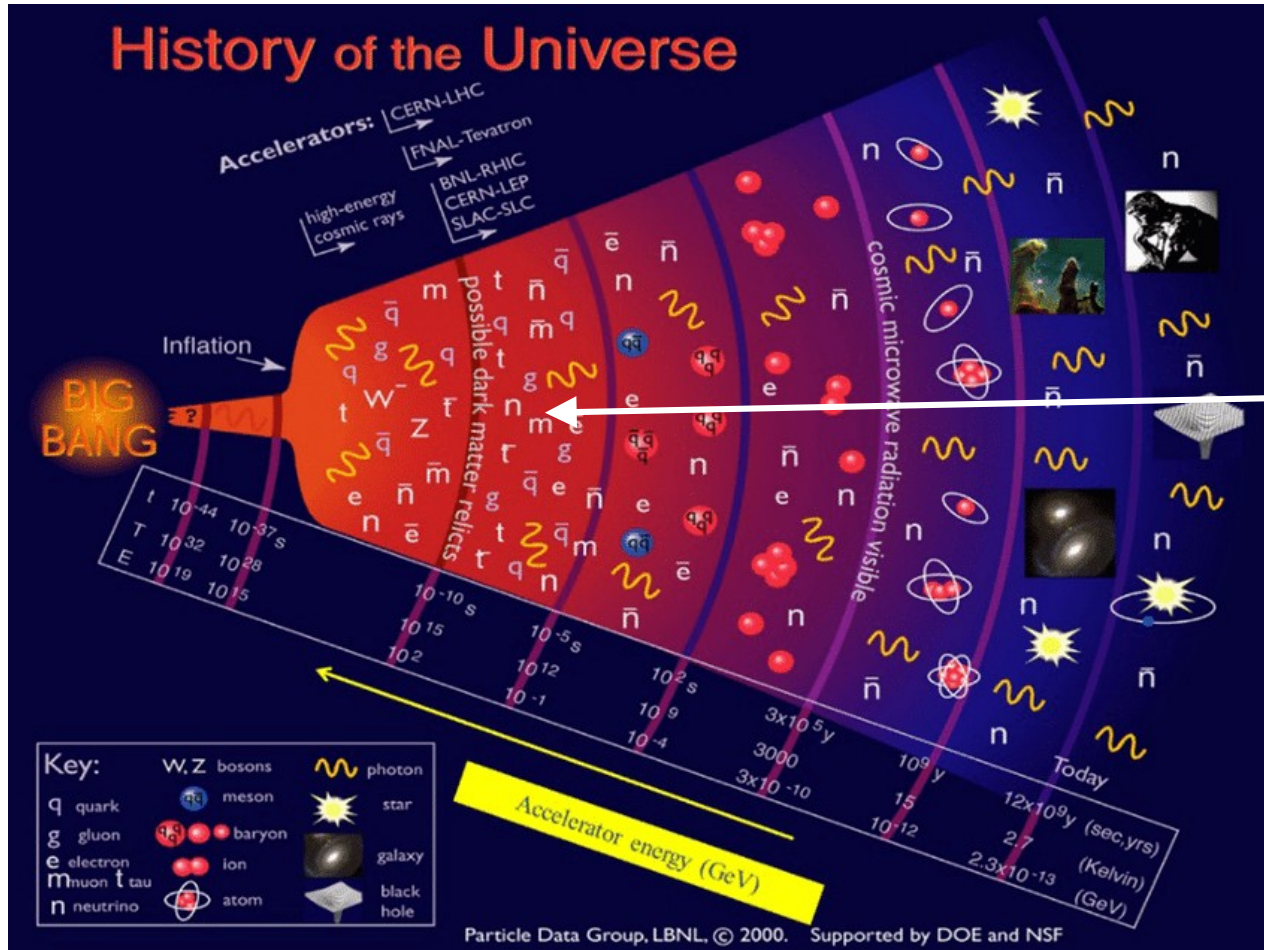
Rene Poncelet

LEVERHULME
TRUST

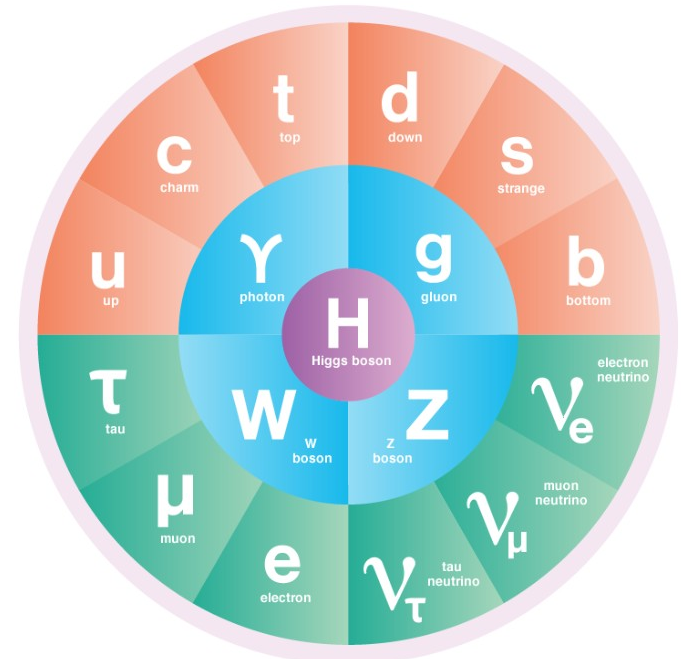


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What is the universe made of and where does it come from?



Standard Model of Particle Physics



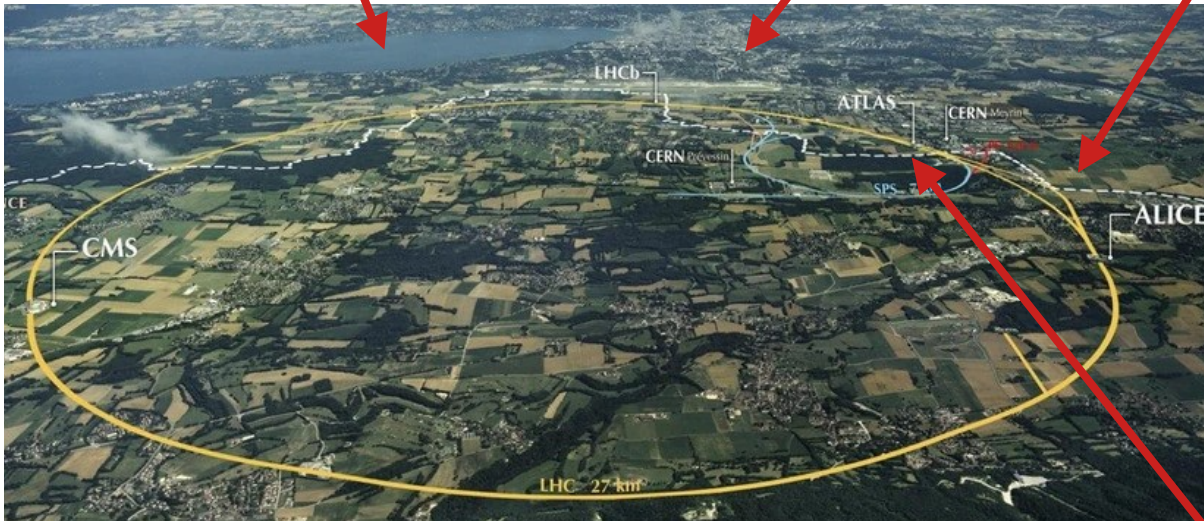
Credit: SymmetryMagazine

● QUARKS ● LEPTONS ● BOSONS ● HIGGS BOSON

CERN: The Large Hadron Collider

Geneva Lake

Geneva



27 km circumference



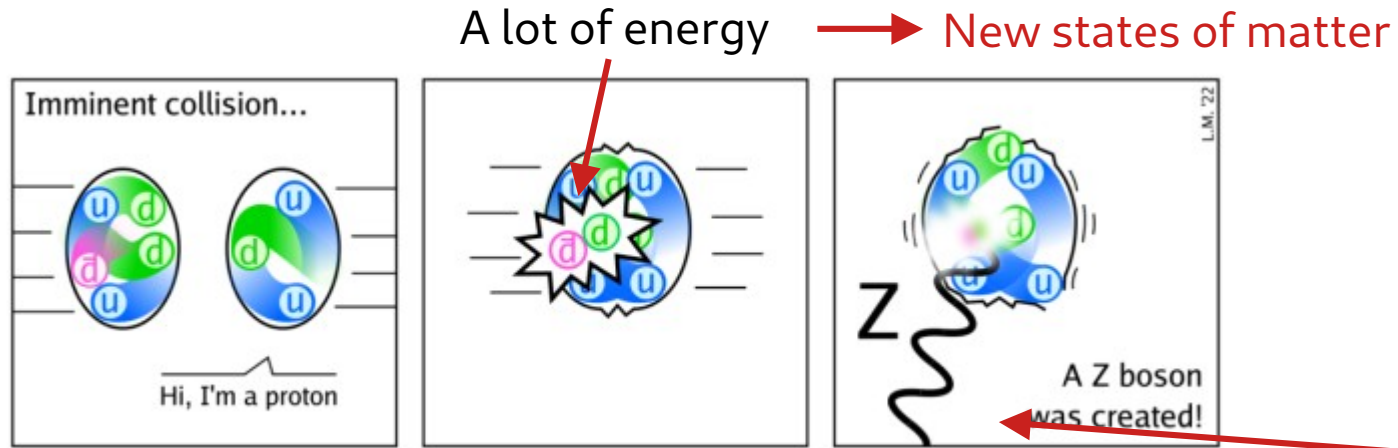
Accelerator



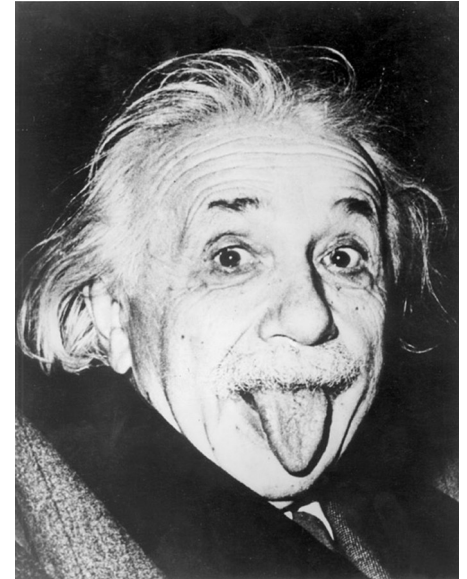
Detectors



High energy particle collisions



Credit: CMS



Credit: Geolino

$$E = mc^2$$

Quantum process → **probabilistic**

Inference: comparison of **predicted & measured** probabilities!

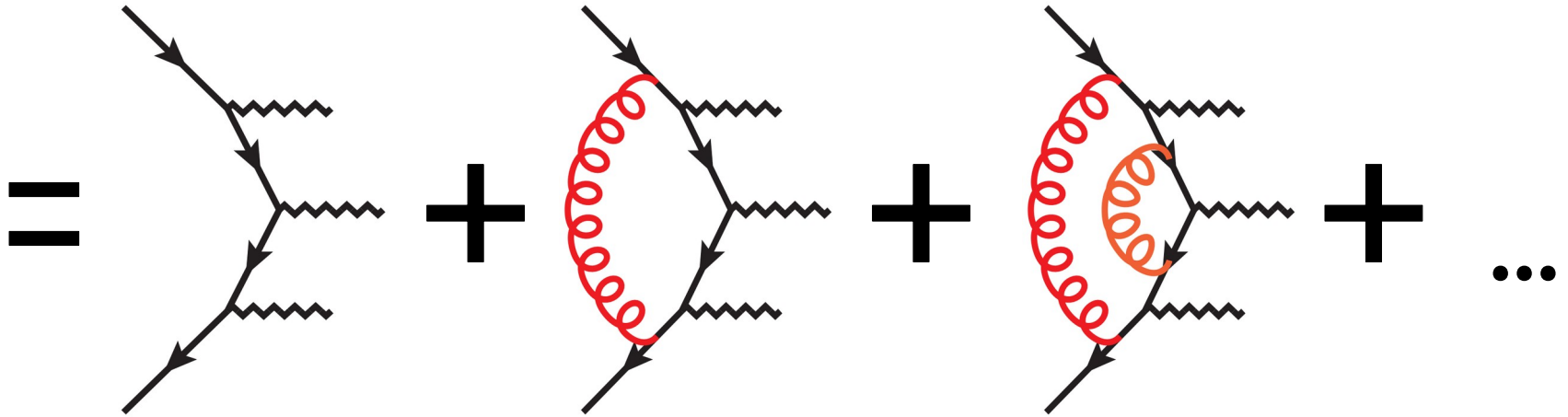
Theory
(Standard Model of Particle Physics)

Experiment
(e.g. LHC)

Quantum corrections

Predicted
Production
Probability

(Here 3 photons)

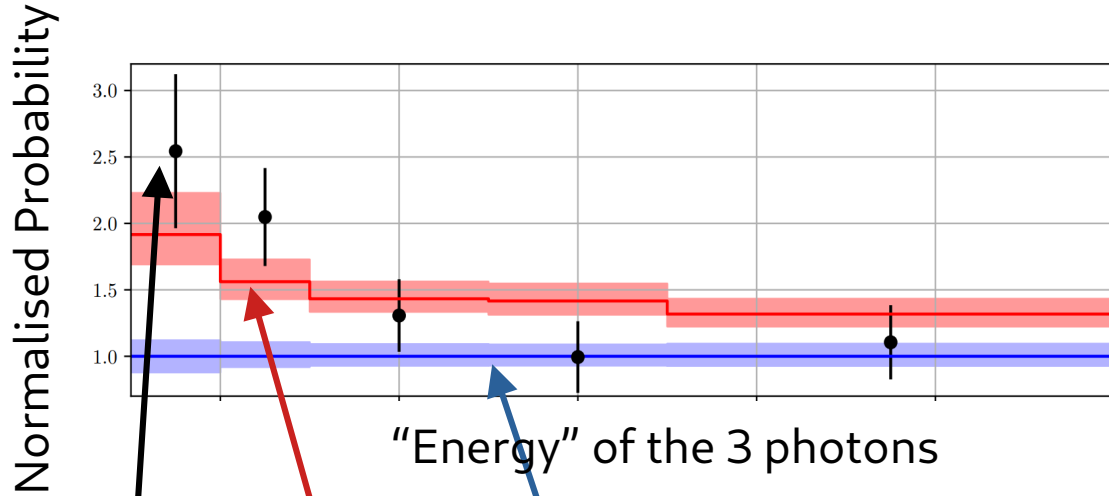


Quantum corrections

More “loops” → smaller corrections → better predictions
but **more complicated!**

*The “NNLO QCD Revolution”: pushing the boundary of
perturbative QCD*

Quantum corrections needed to understand the data!



10k – 10M CPUh
→ needs super-computer



Credit: eshopper.co

high tea

<https://www.precision.hep.phy.cam.ac.uk/hightea>