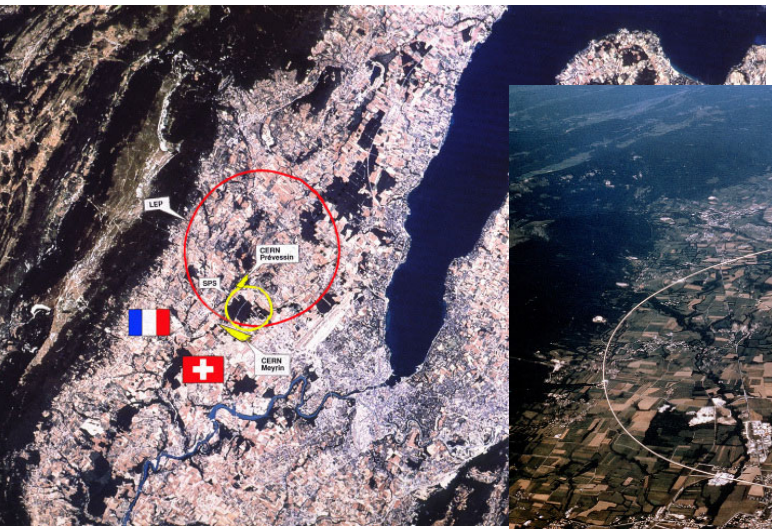
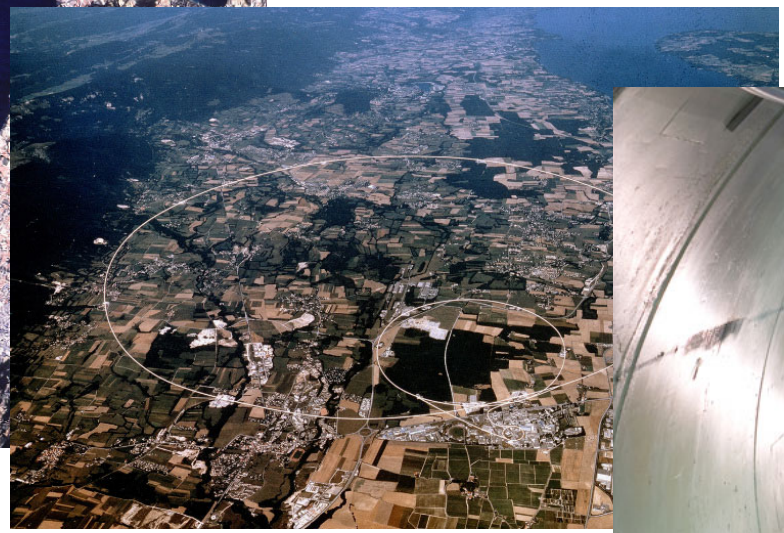
The LHC….work in progress!

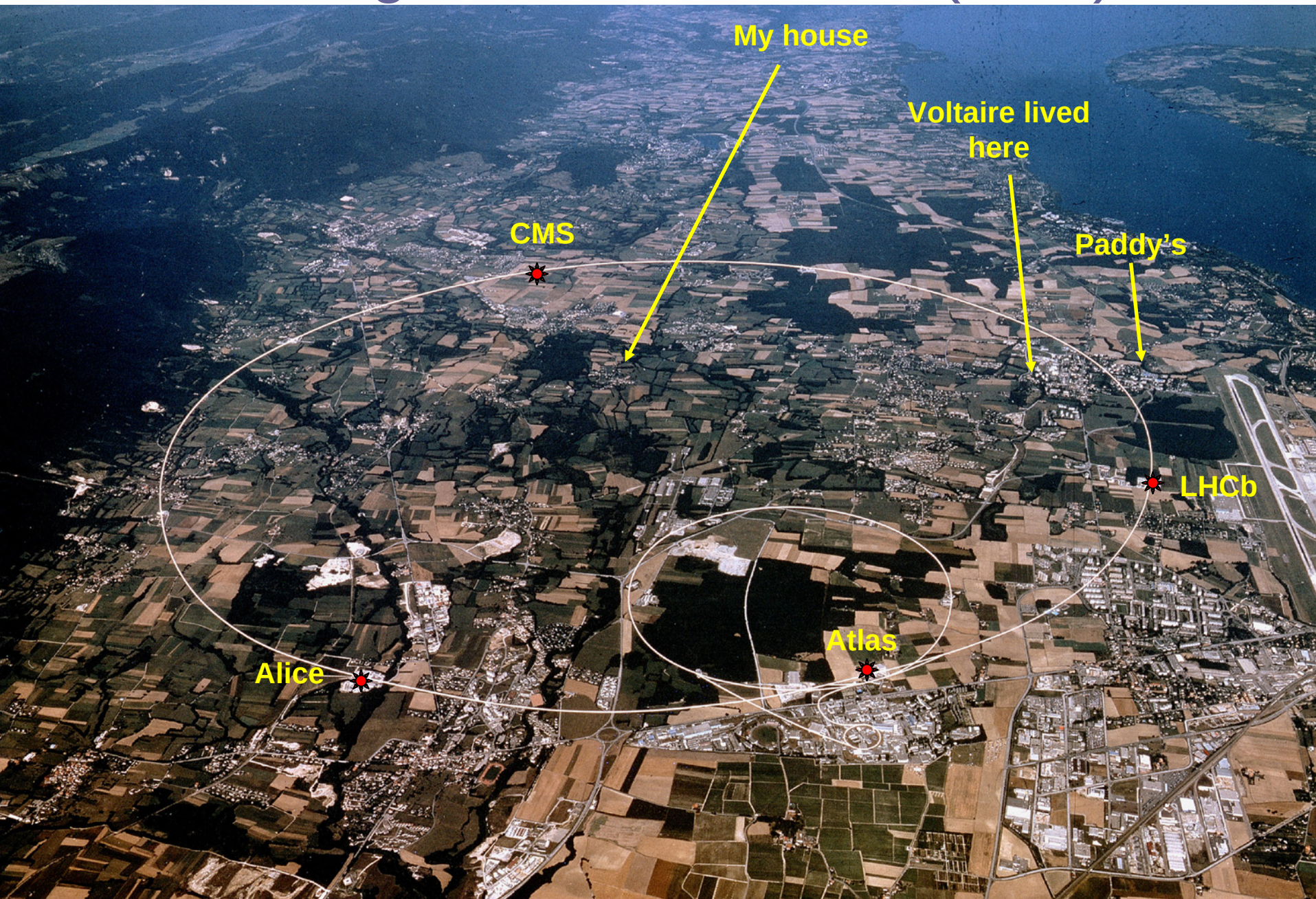




Two beams, each containing trillions of protons, will race around the 27km ring in opposite directions travelling at 0.999999991 times the speed of light…

Sometime soon!

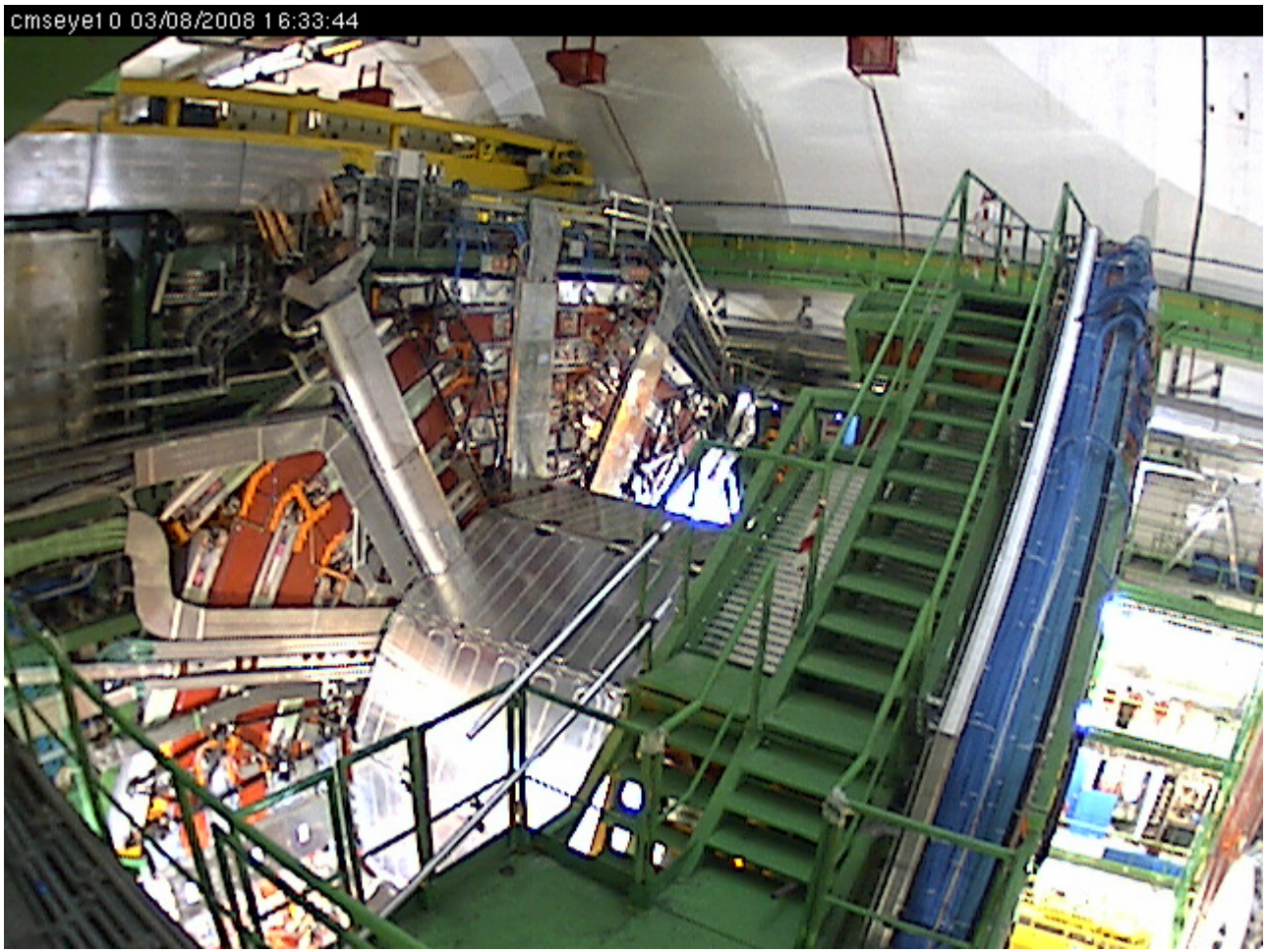
The Large Hadron Collider (LHC)



First dig somewhere to put the experiments

CMS – a few years ago

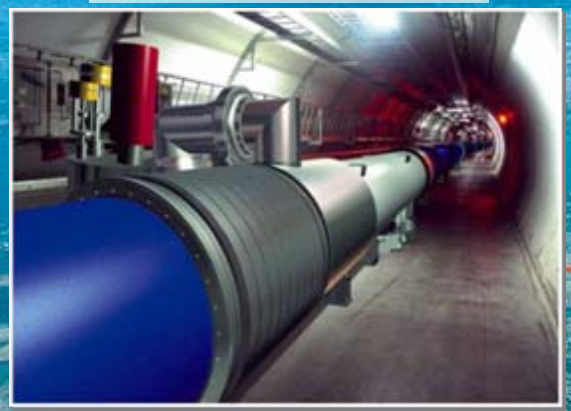
Today

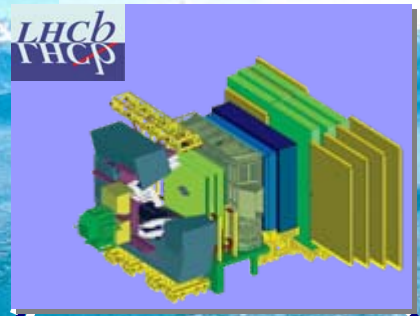


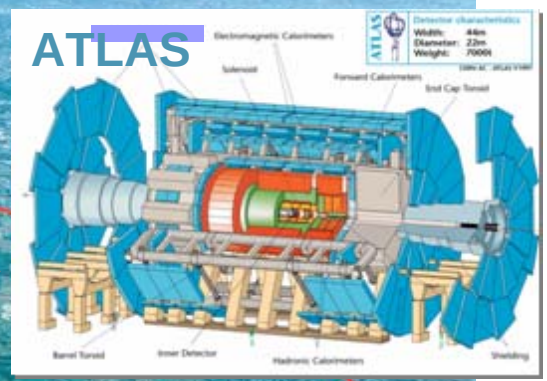
CMS today

pp, B-Physics,
CP Violation

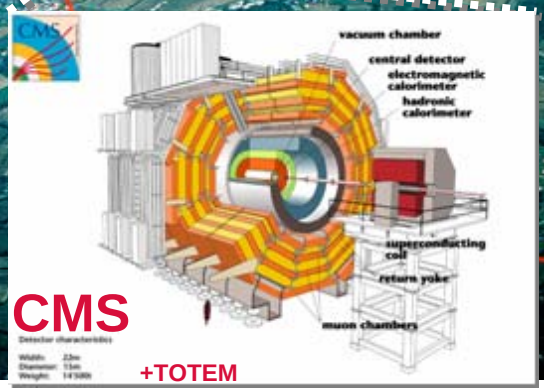
LHC : 27 km long
100m underground



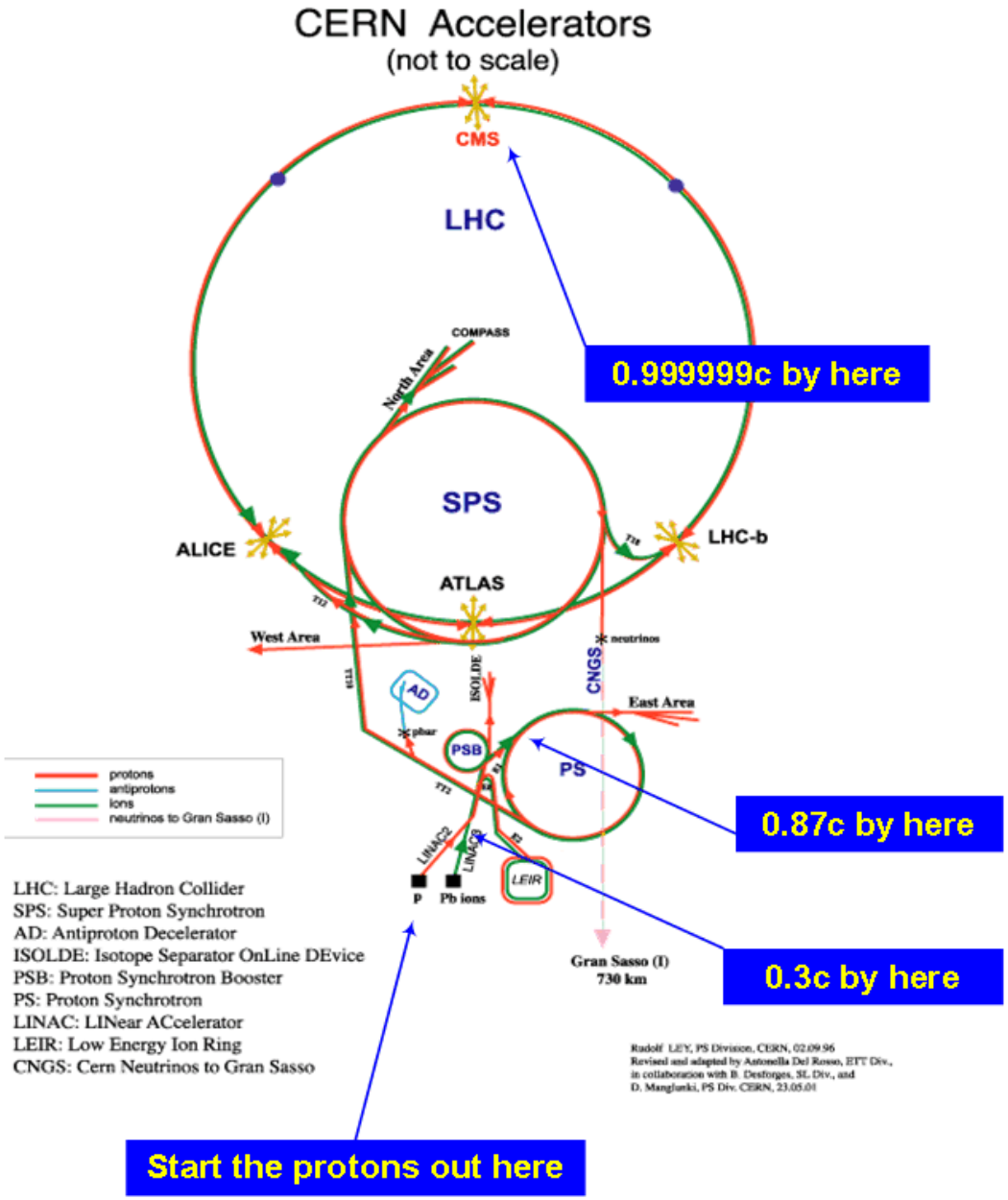




General Purpose,
pp, heavy ions



Heavy ions, pp

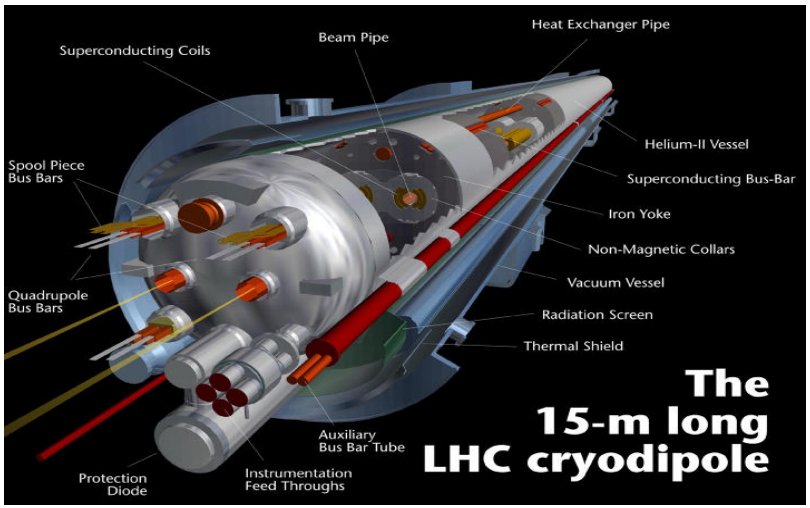

CERN Accelerators
(not to scale)
CMS
LHC
COMPASS
North Area
SPS
ALICE
LHC-b
ATLAS
West Area
neutrinos
CNGS
ISOLDE
AD
East Area
PSB
PS
protons
antiprotons
ions
neutrinos to Gran Sasso (I)
LINAC2
LINAC3
LEIR
P
Pb ions
Gran Sasso (I)
730 km
0.999999c by here
0.87c by here
0.3c by here
LHC: Large Hadron Collider
SPS: Super Proton Synchrotron
AD: Antiproton Decelerator
ISOLDE: Isotope Separator OnLine DEvice
PSB: Proton Synchrotron Booster
PS: Proton Synchrotron
LINAC: LINear ACcelerator
LEIR: Low Energy Ion Ring
CNGS: Cern Neutrinos to Gran Sasso
Rudolf LEY, PS Division, CERN, 02.09.96
Revised and adapted by Antonella Del Rosso, ETT Div.,
in collaboration with B. Desforges, SL Div., and
D. Manglunki, PS Div. CERN, 23.05.01
Start the protons out here

LHC – Install everything

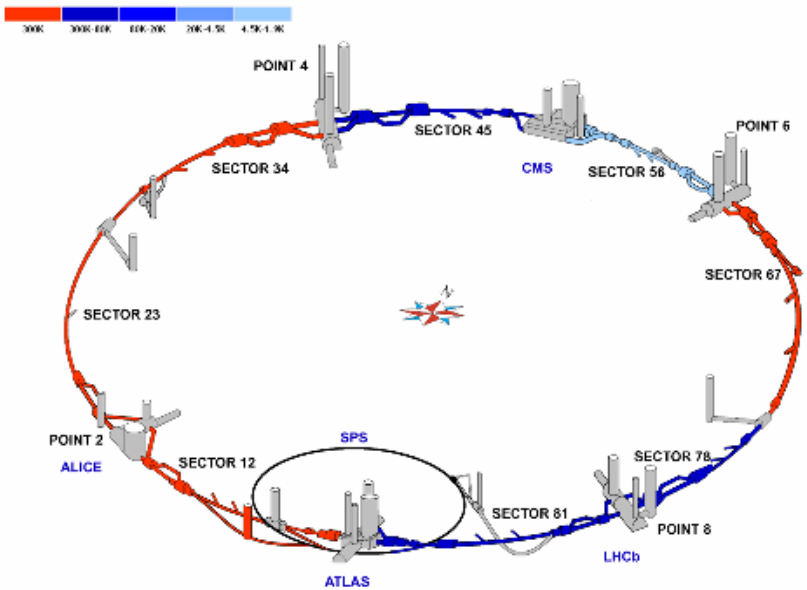
Join everything up

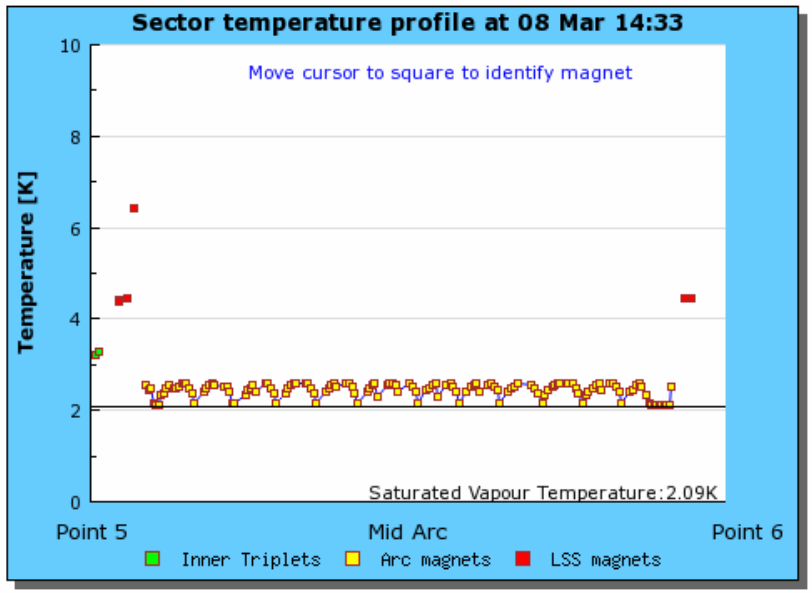
Underground

Cool everything down



x 1232



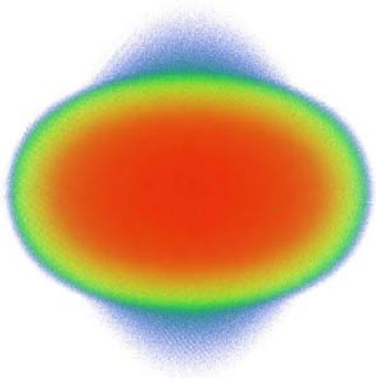


Beam later this year – we hope!

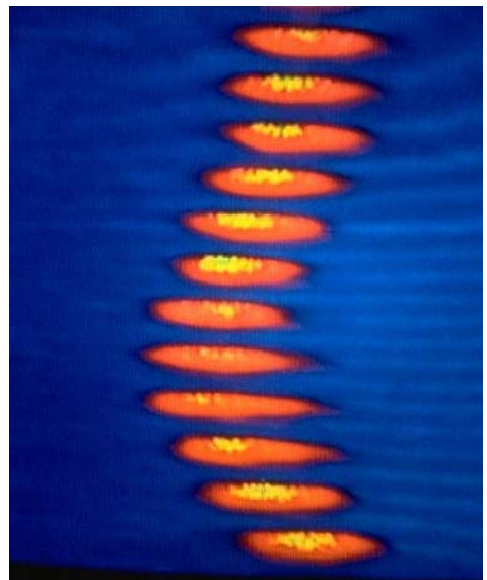
Beam

- For ease of handling the protons come in bunches
- Each bunch contains 100,000,000,000 protons
- We plan ~3000 bunches of protons per beam

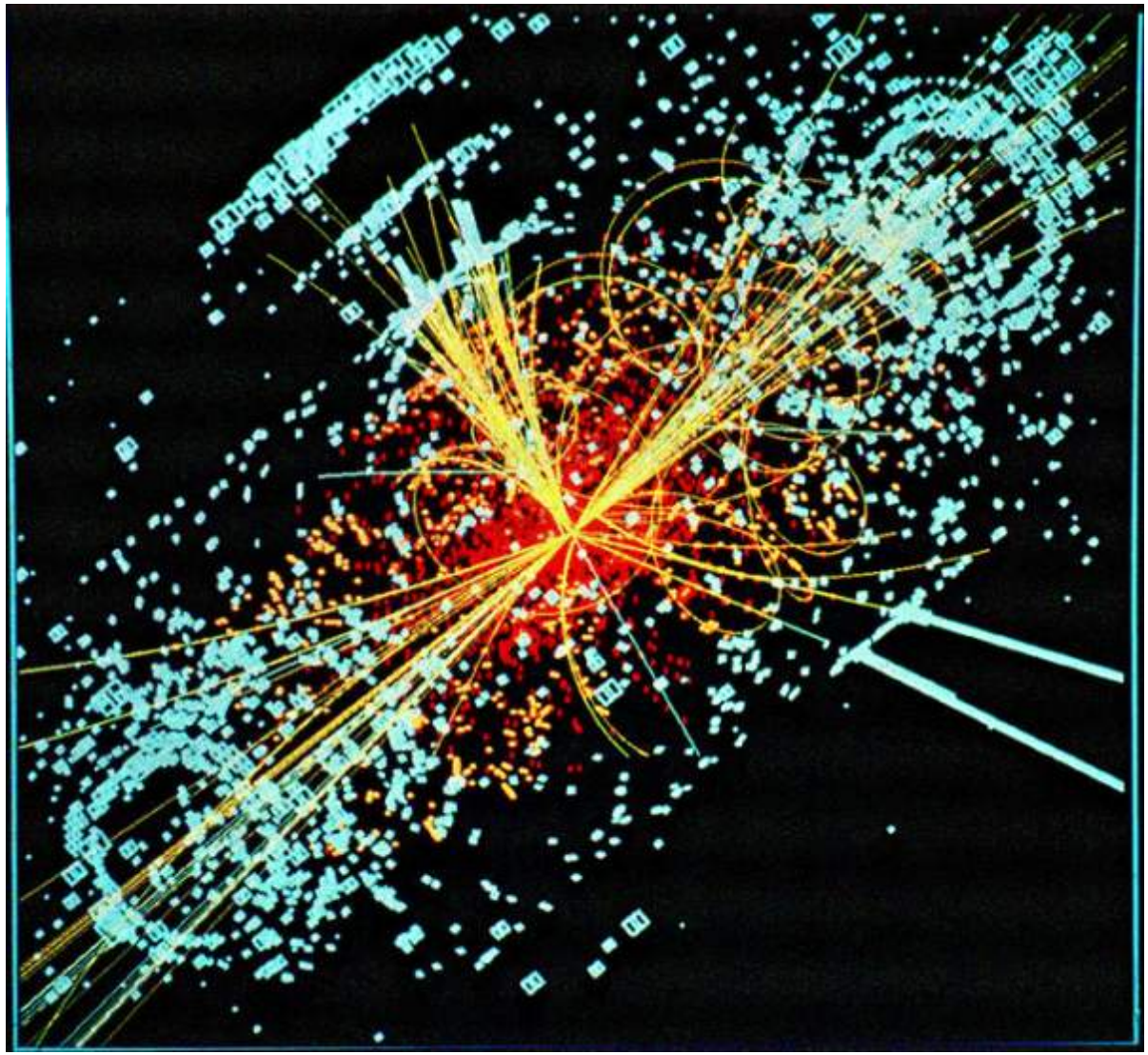
- When the protons arrive in the LHC they are going 0.999997828 times the speed of light
- At top energy are going 0.999999991 the speed of light



Bunches are typically 1 mm wide and 30 cm long

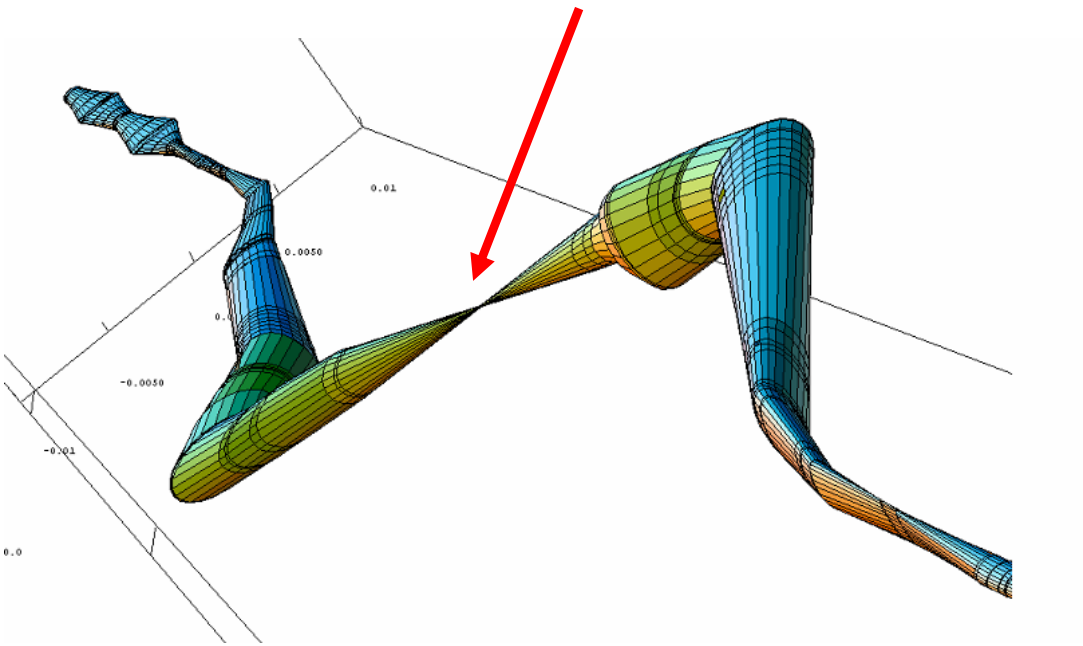


Aim of the exercise - events



Collisions

- Smallest beam size possible at the collision point.
- Even so… small things protons
- So although we squeeze our 100,000 million protons down to 60 microns…
- We get only around 20 collisions per crossing

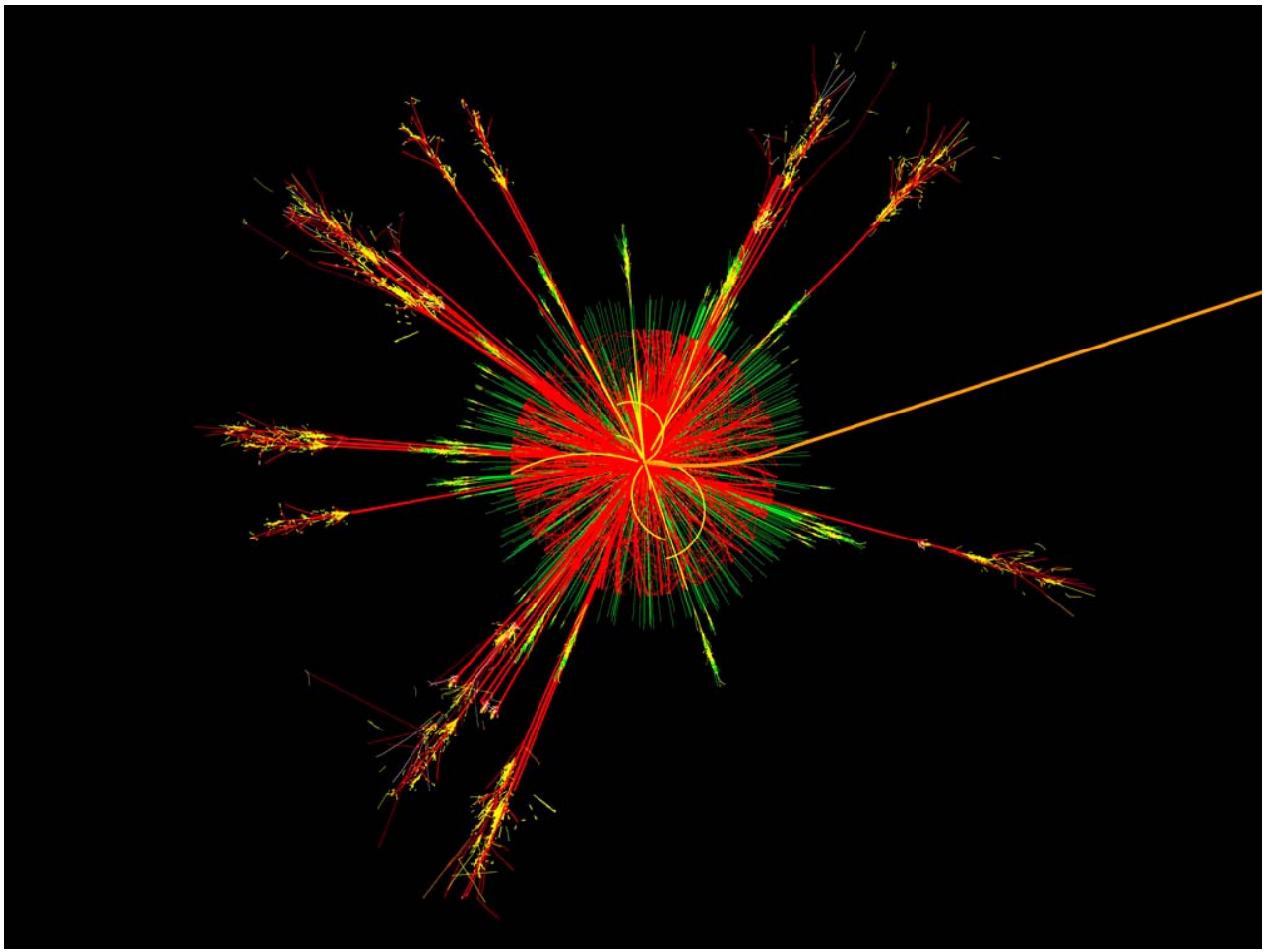


Bunches cross so often we end up with 600 million collisions per second

Most protons miss each other and carry on around the ring time after time.

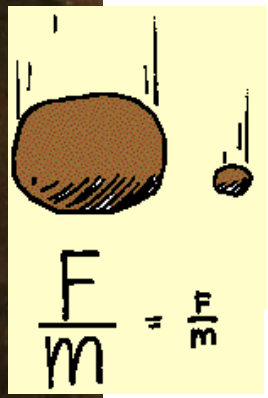
The beams are kept circulating for hours.

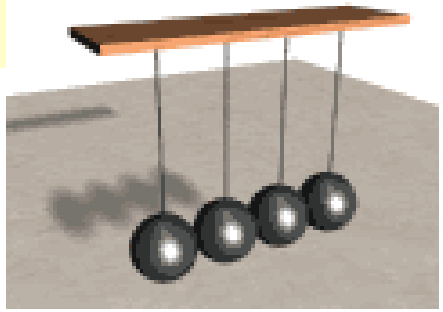
Higgs, supersymmetry or maybe even a black hole in Atlas?



Watch this space (and time)!

Acknowledgements



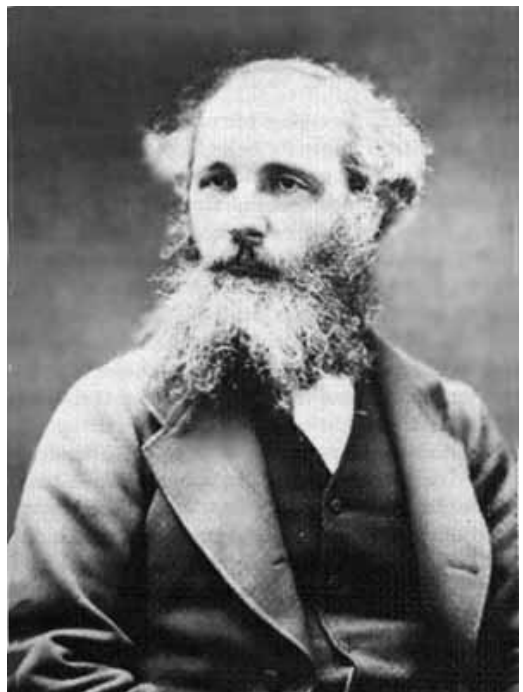


$$\nabla \cdot E = \frac{\rho}{\varepsilon_0}$$

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

$$\nabla \cdot B = 0$$

$$c^2 \nabla \times B = \frac{j}{\varepsilon_0} + \frac{\partial E}{\partial t}$$



$$E = mc^2$$

"The speed of light is the same for all inertial observers, regardless of the motion of the source."