

# How to build a particle hunter

7 CMS is 80m underground in a huge cavern complex that could house \*\*\*\* people comfortably (ok not quite comfortably, all squeezed like sardines in a tin...)

The shafts and caverns were dug by a mechanical hammer and digger working continuously for \*\* years.



Before starting to dig the shafts and caverns, a river 50m underground had to be frozen with liquid nitrogen, diverting the flow with a wall of ice.

8 CMS has been designed and constructed by 2000 Scientists and engineers over 15 years from 155 universities and labs in 37 countries.

Hundreds of students have done their research projects on CMS



The largest part weighs 2000tonnes and the smallest parts are microscopic. Most of the million pieces were made and assembled by leading industrial partners. Building CMS has taken more than 6 years.

CMS will data for more than 10 years! We need young Scientists. Do you want to join in and explore Nature at the deepest level?



Contacts/more Info/links



Credits:  
Art, composition,  
edition, publishing

# CMS: Particle Hunter



Main cover image

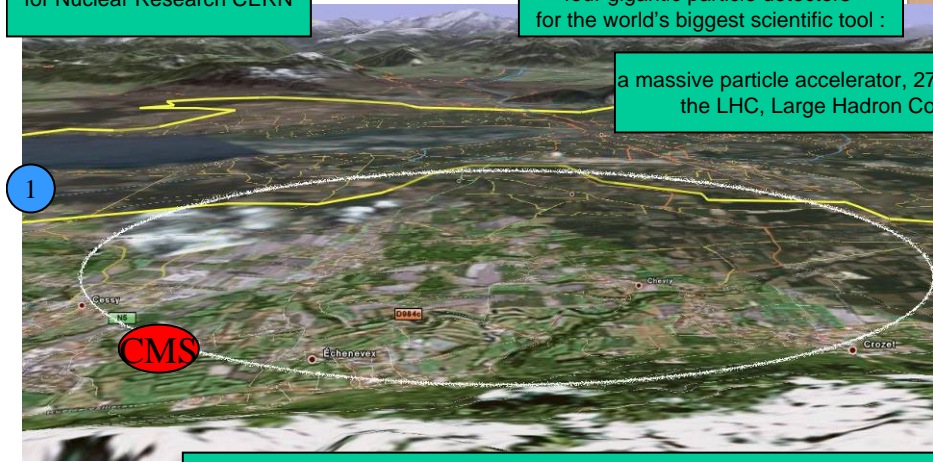
Using the world's most powerful microscope join us in asking Nature the oldest and deepest question in the Universe:

Just **WHAT** exactly are we made of?



# CMS: Investigating the deepest questions in the Universe

at the border between France and Switzerland. The European Center for Nuclear Research CERN



1

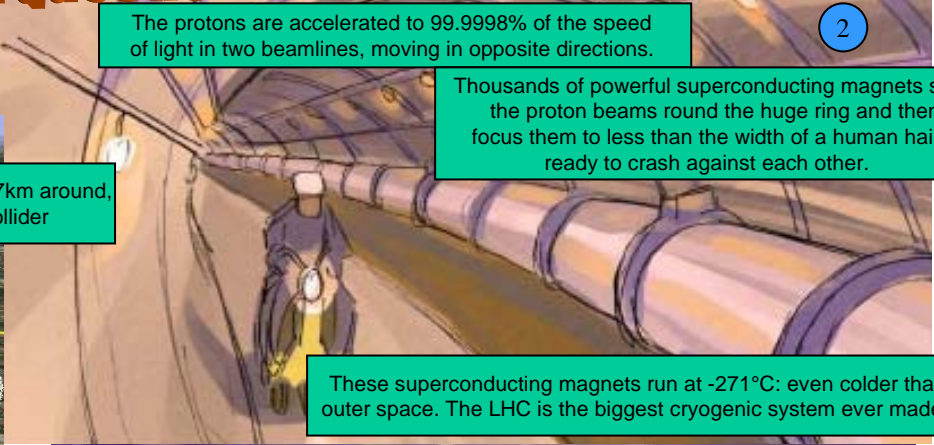
100 m underground vast cathedral-sized caverns house four gigantic particle detectors for the world's biggest scientific tool :

a massive particle accelerator, 27km around, the LHC, Large Hadron Collider

The protons are accelerated to 99.9998% of the speed of light in two beamlines, moving in opposite directions.

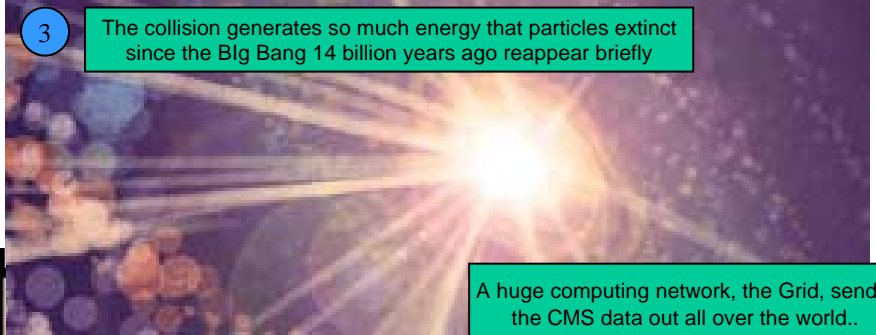
2

Thousands of powerful superconducting magnets steer the proton beams round the huge ring and then focus them to less than the width of a human hair... ready to crash against each other.



These superconducting magnets run at -271°C: even colder than outer space. The LHC is the biggest cryogenic system ever made.

These ancestral particles survive for only the tiniest fraction of a second before they disintegrate into cascades of more familiar particles

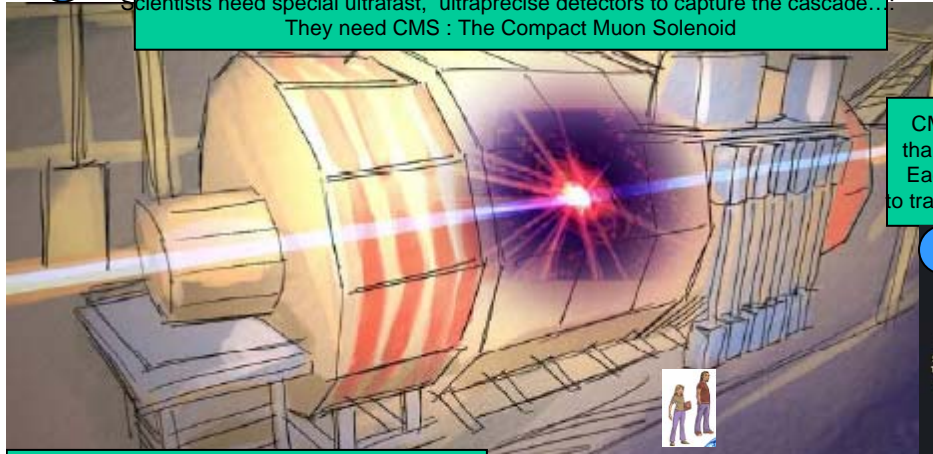


3

The collision generates so much energy that particles extinct since the Big Bang 14 billion years ago reappear briefly

4

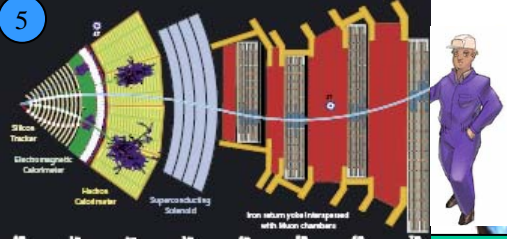
Only 1 collision in a billion is interesting. Scientists need special ultrafast, ultraprecise detectors to capture the cascade... They need CMS : The Compact Muon Solenoid



CMS is like a 12,500 tonne digital camera with 100 million pixels that takes a 3D picture of the LHC collisions 40 million times per second!

CMS has been assembled in layers from more than a million parts with watch-making precision. Each layer of detectors has a special job to do: to track and measure as many particles as possible.

5



A terabyte of signal data is generated in CMS every second. The names and addresses of the entire human race would probably add up to less than 1TByte. To crunch and swallow only the tastiest pieces of this much information is not easy! Powerful electronics filters and keeps only the best 0.001% collisions

A huge computing network, the Grid, sends the CMS data out all over the world..

6

A Physics student sat at their PC anywhere in the world can harness the power of thousands of PCs over the Grid ...



The LHC datagrid network

a student at their PC looking at a CMS event

The Higgs particle, if it actually exists, will be clearly visible in CMS, but maybe only once in every trillion collisions.

to search for rare collisions and New Physics..