LHC - The Large Hadron Collider

A machine designed to push back the frontiers of science and to bring us closer to the missing pieces of the puzzle of the Universe

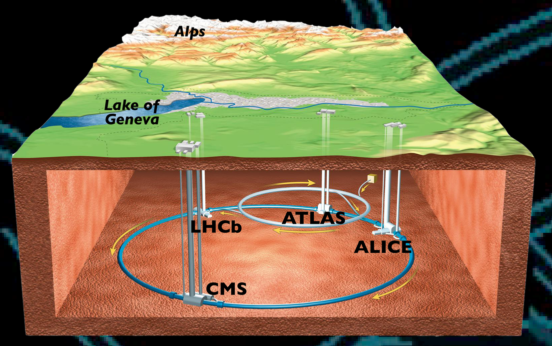
What is the recipe?

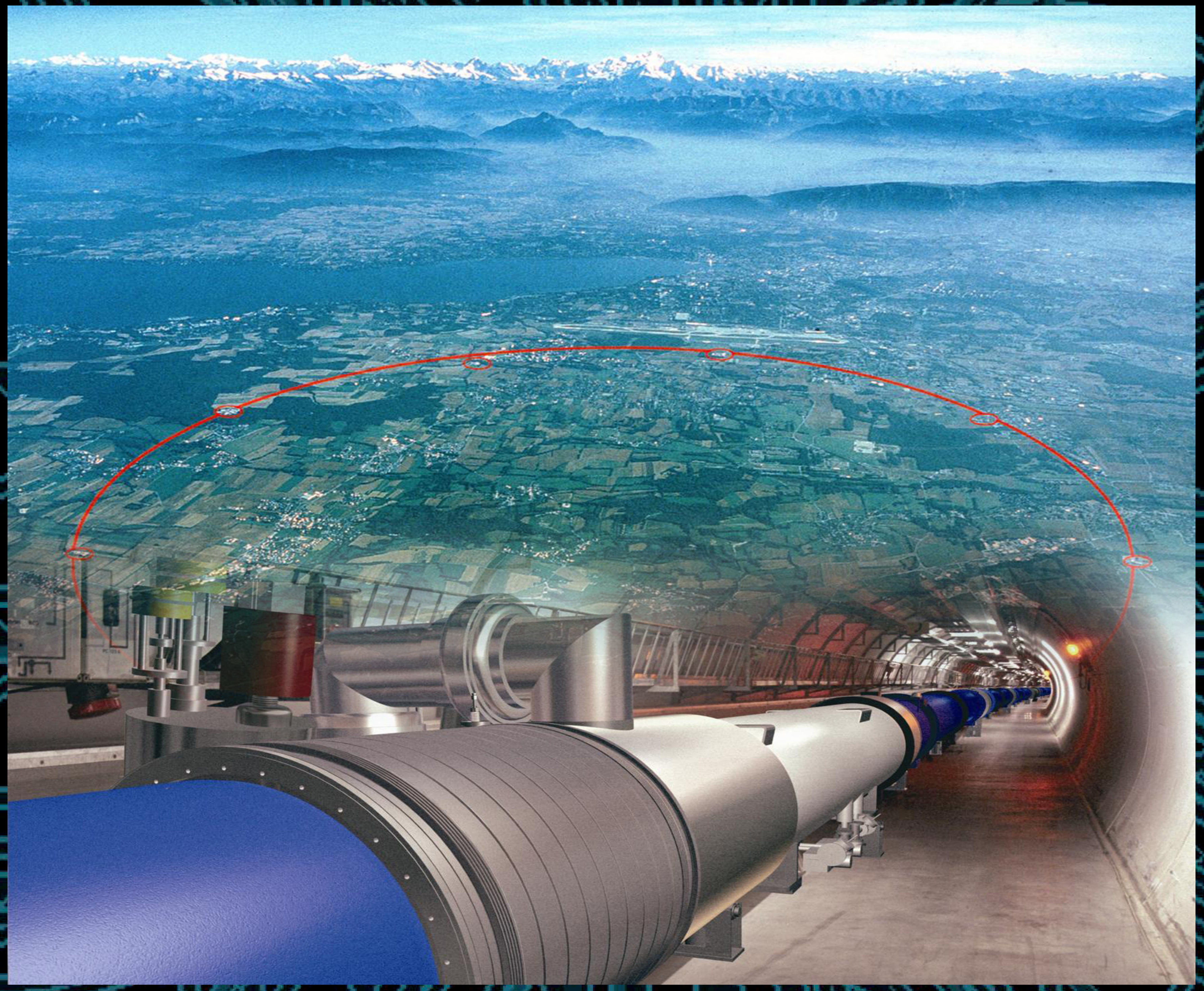
Take 100 billion protons from a hydrogen bottle, strip the electrons off and feed them into the pre-accelerators

Like a car that needs gears to accelerate, the protons are successively accelerated in 4 machines before they are injected into the LHC - the last 'gear' of the acceleration complex.

Build a 27 km long tunnel 100 m below ground

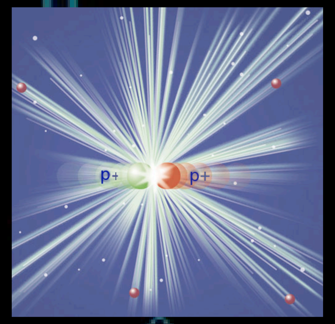
In this tunnel two counter-rotating beams of proton bunches circle around the ring in a vacuum beam pipe.





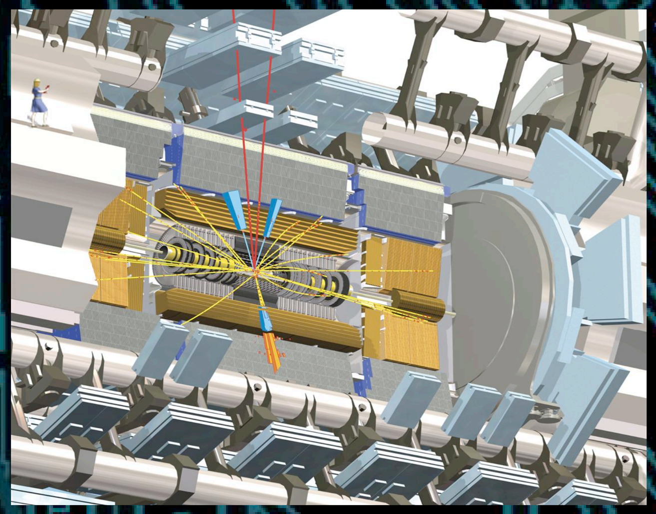
Accelerate the proton bunches up to more than 99.9 % of the speed of light

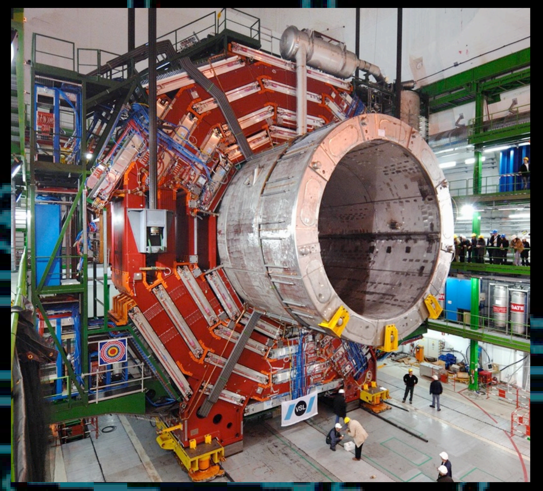
The energy of a single proton is 50 million times less than the kinetic energy of a golf ball. The big difference is that the proton holds its energy in a tiny space! If the proton would have the size of a grain of sand, the equivalent golf ball would be as huge as the sun. If we take a bunch of 100 billion protons together we obtain the same kinetic energy as a 200 tonne train travelling at 150 km/h!



Smash the protons together at one of the 4 collision points

Even though there are 200 billion protons crossing each other only around 25 collisions will happen in one crossing. This is because the protons are so tiny! But luckily we have enough bunches crossing each other - around 40 million per second - that we end up with one billion collisions per second!





Build a huge detector around each of the collision points to analyse the many particles produced by the collisions

4 detectors, some of them the size of a cathedral, enable physicists to deduce what happened in the collision. The produced particles fly apart in all directions and through the detector. The particles are too small to be seen by eye but they leave a trace in the detector. In the same way a hunter tracking his prey identifies it by the size, depth and form of its imprints, a physicist identifies the particles by the track and energy they leave behind them.

Bring more than 9,000 scientists together

Half of the world's particle physicists participate in CERN experiments. Scientists from over 100 nationalities have to collaborate.

What can we learn with the LHC?

- We don't know why some particles are very heavy while others have no mass at all. But we have a theory! It predicts a new particle, the Higgs Boson, which can be produced at the LHC.
- We only know 4 % of the matter and energy in the Universe. At the LHC we may find hints of the remaining 96 % which we call dark matter and dark energy.
- The antimatter is missing in our Universe! The LHC may shed some light on the question why antimatter disappeared after the Big Bang.
- Heavy ion collisions at the LHC will reproduce the state of matter like it existed in the early Universe and allow us to study it.

Why do we need the LHC?

- Only through research and fundamental curiosity it has been possible to reach our current standard of technology.
- As an example Faraday's great contributions to electricity were driven by curiosity and finally brought us the electric light.
- Fundamental sciences is a long-term investment, laying the foundations for future innovation and prosperity. *

* by former Director-General Robert Aymar

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