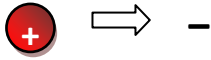


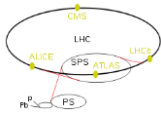
# LARGE HADRON COLLIDER (LHC)

The world's largest and most powerful particle collider

2. The charged protons **start to move**, attracted by other electric charges (an electric field).



5. These very fast protons are then injected from one ring into another larger ring. **Bigger accelerators mean higher energies.**

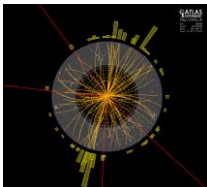


7. The LHC protons have to travel in a **vacuum** (very empty space) to stop them hitting things and changing direction.

C. The LHC boosts the energies up to **6.5TeV** (where the T stands for 1,000,000,000,000), or speeds of **99.9999991%** of the speed of light

9. The LHC has **two vacuum tubes** in which protons travel - one for a 'clockwise' beam and another for an 'anticlockwise' beam, so that the **protons can collide** head-on!

11. When protons collide, **new particles are formed**, with distinctive tracks.



**CMS & ATLAS** are general-purpose detectors used to investigate a wide range of physics, from Higgs bosons to extra dimensions and particles that could explain dark matter

The LHC is located at **CERN**, on the border of Switzerland and France. It is built between 50-175m underground in a giant circular tunnel 27km (12 miles) long. It is used to **study elementary particles and their interactions.**

3. The protons **accelerate** towards electrically-charged rings that change charge (RF cavities), **so they go faster and faster.**

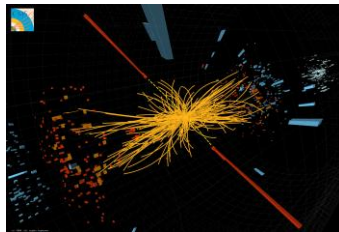


6. Protons in the SPS have energies of 450GeV, and travel at 99.9998% of the speed of light. They are then injected into the LHC ring which works at 6.5TeV & **99.9999991% of the speed of light.**

B. The **Super Proton Synchrotron (SPS)** is a 7km long ring which **boosts the energies of the protons ready to be injected into the LHC.**



10. The two proton beams are brought together at a few '**crossing points**' in the LHC ring - where the main experiments take place - at the **CMS, ATLAS, ALICE** and **LHCb** detectors.



**CMS (Compact Muon Solenoid)** is one of two general-purpose detectors. These use different detector subsystems and a different magnet-system design.

1. The story of LHC particle collisions starts when a **Hydrogen Atom** is **ionised** i.e. has its electron removed, leaving a charged **proton.**



4. To keep the protons contained, **magnets** are used, which **make charged particles move in curved paths** - round in **large circles!**

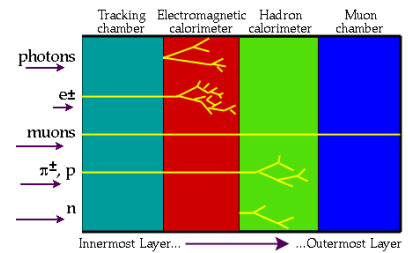
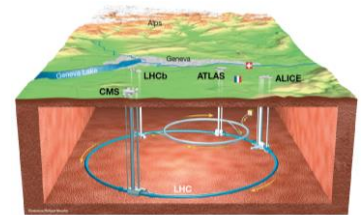


A. The **Proton Synchrotron (PS)** is where the LHC charged particles come from. It is a 628m long ring.



Using the SPS as a proton-antiproton collider, the **W and Z bosons** were found in 1983.

8. The LHC uses 1,600 (**very cold**) **superconducting magnets** spaced around the ring. These work at a temperature of **-271°C (1.9K)** i.e. just above **absolute zero.**



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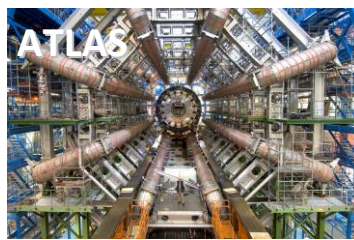
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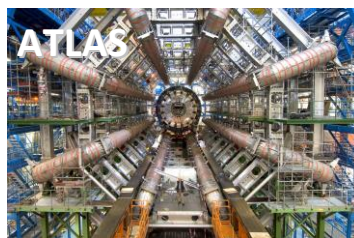
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**ATLAS** is a general-purpose detector. Six subsystems, in layers around the collision point, record the paths, momentum & energy of particles to identify them.



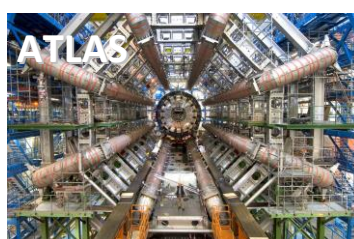
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