ABOUT CERN

VALENTINA LA GRECA 2.A

WHAT'S CERN'S MISSION?

At CERN, they probe the fundamental structure of the particles that make up everything around us.

Since CERN began, fundamental physics has been their core business.

The work here will help to uncover what the universe is made of and how it works.

The Laboratory, established in 1954, has become a prime example of international collaboration.

Their mission is to:

- provide a unique range of particle accelerator facilities that enable research at the forefront of human knowledge.
- perform world-class research in fundamental physics.
- unite people from all over the world to push the frontiers of science and technology, for the benefit of all.

Physicists and engineers at CERN use the world's largest and most complex scientific instruments to study the basic constituents of matter – fundamental particles.

Subatomic particles are made to collide together at close to the speed of light.

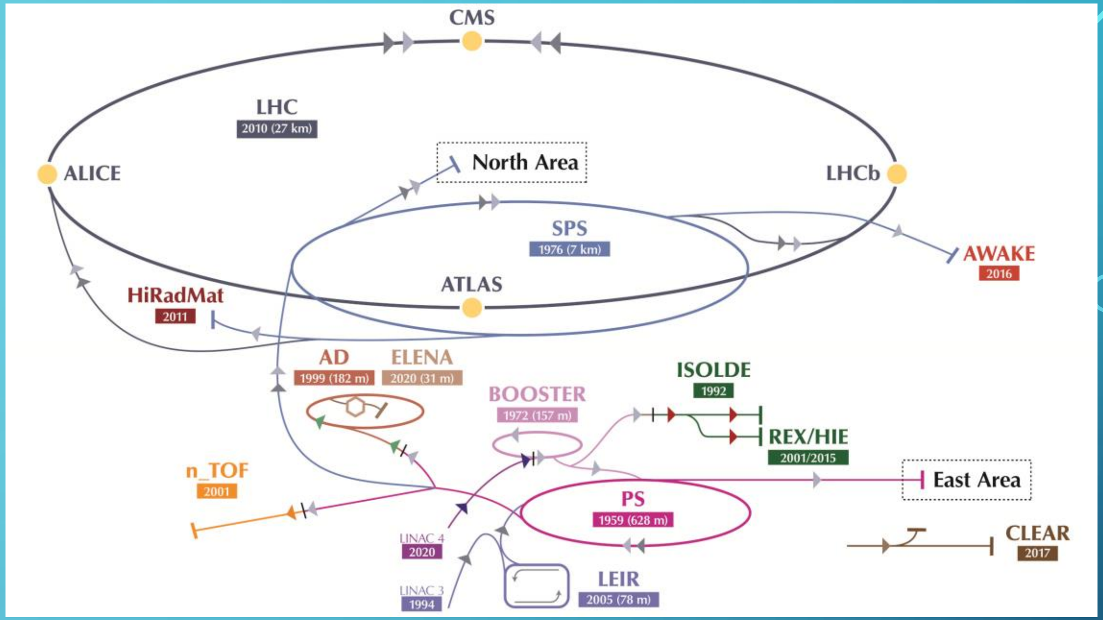
The process gives them clues about how the particles interact, and provides insights into the fundamental laws of nature.

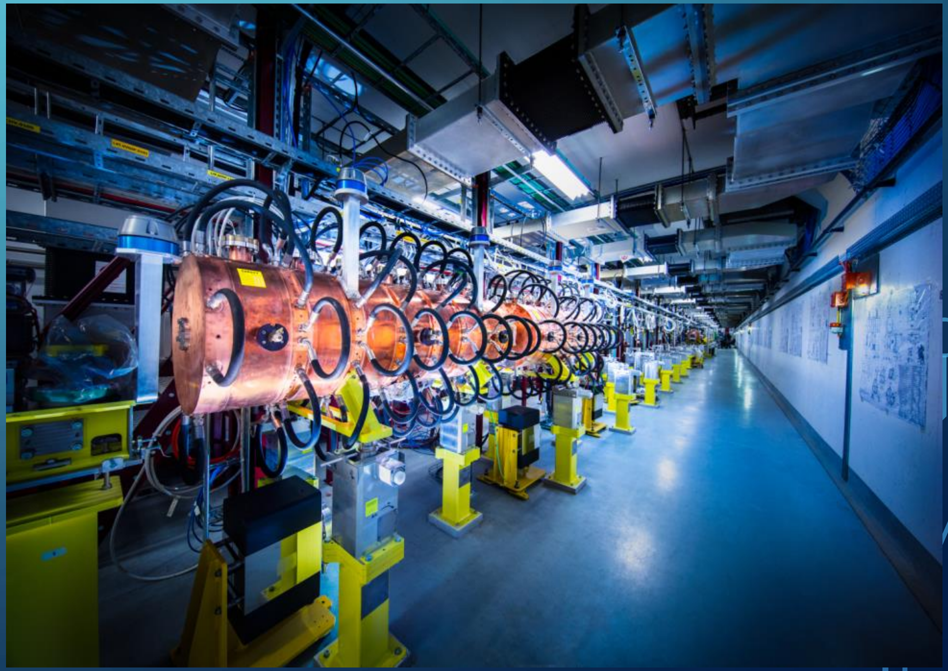
They want to advance the boundaries of human knowledge by delving into the smallest building blocks of our universe.

ACCELERATORS

An **accelerator** propels charged particles, such as protons or electrons, at high speeds, close to the speed of light

When the particles are sufficiently energetic, a phenomenon that defies the imagination happens: the energy of the collision is transformed into matter in the form of new particles, Universe. This phenomenon is described by Einstein's famous equation E=mc2 (is a concentrated form of energy, and the two are interchangeable)

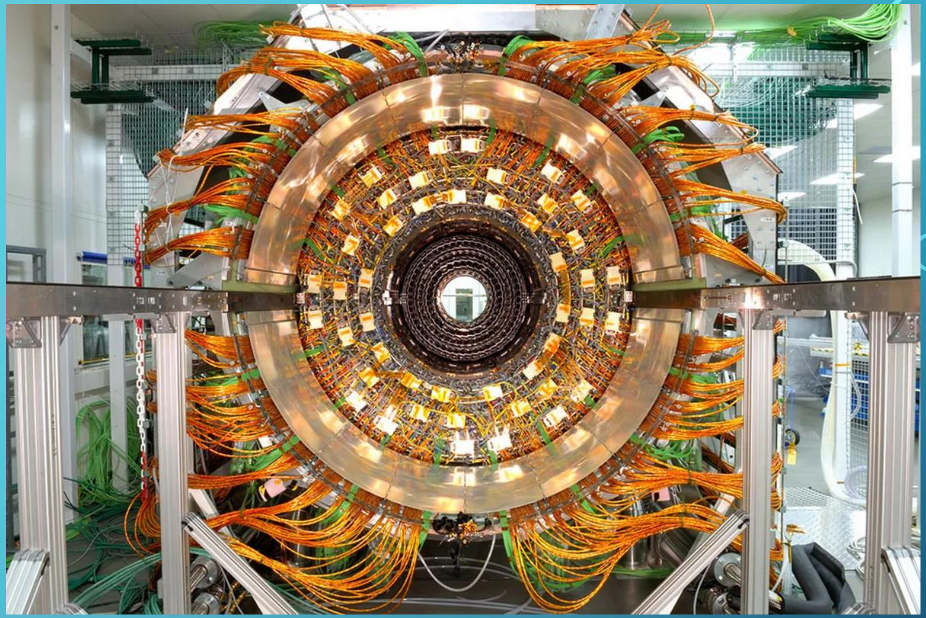


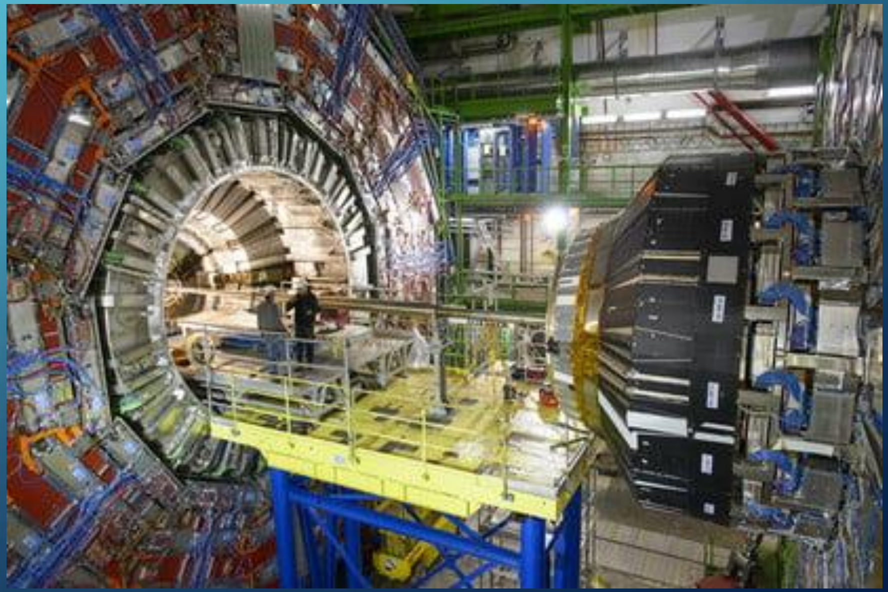


THE MOST POWERFUL ACCELERATOR

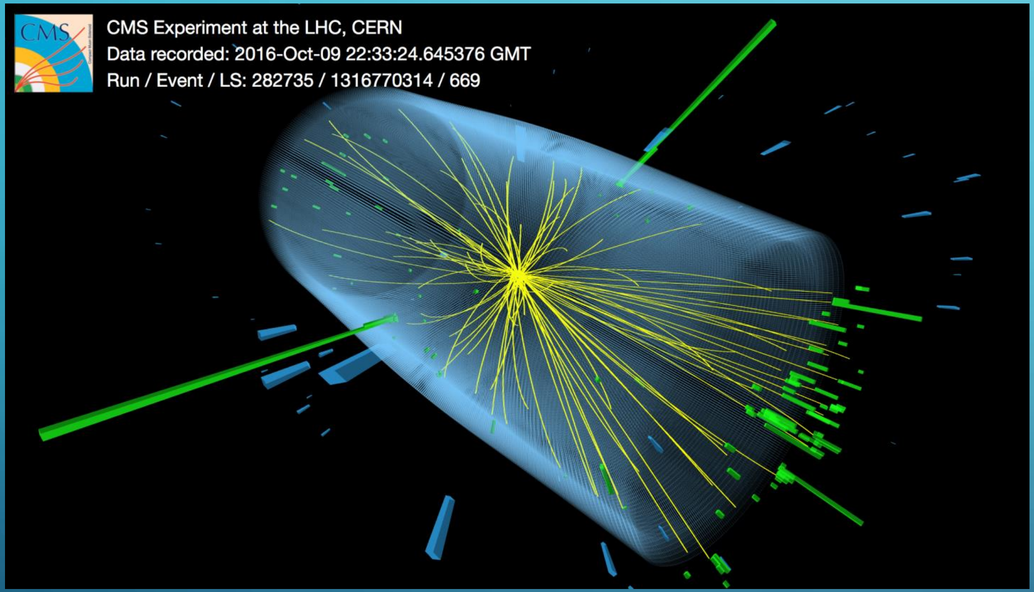
The **Large Hadron Collider** is the most powerful accelerator in the world. It boosts particles, such as protons, which form all the matter we know. Accelerated to a speed close to that of light, they collide with other protons.

These collisions produce massive particles, such as the **Higgs boson** or the **top quark**. These massive particles only last in the blink of an eye, and cannot be observed directly.

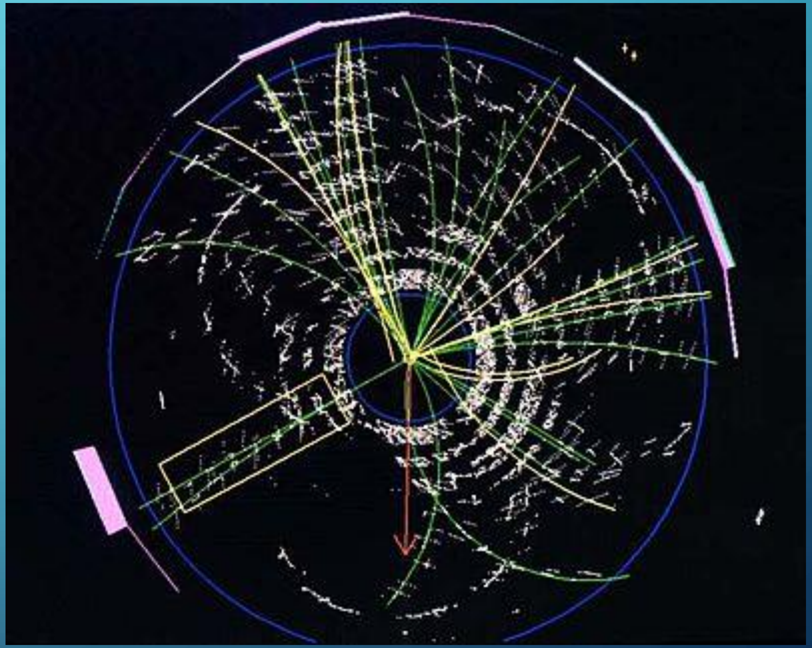




HIGGS BOSON



TOP QUARK

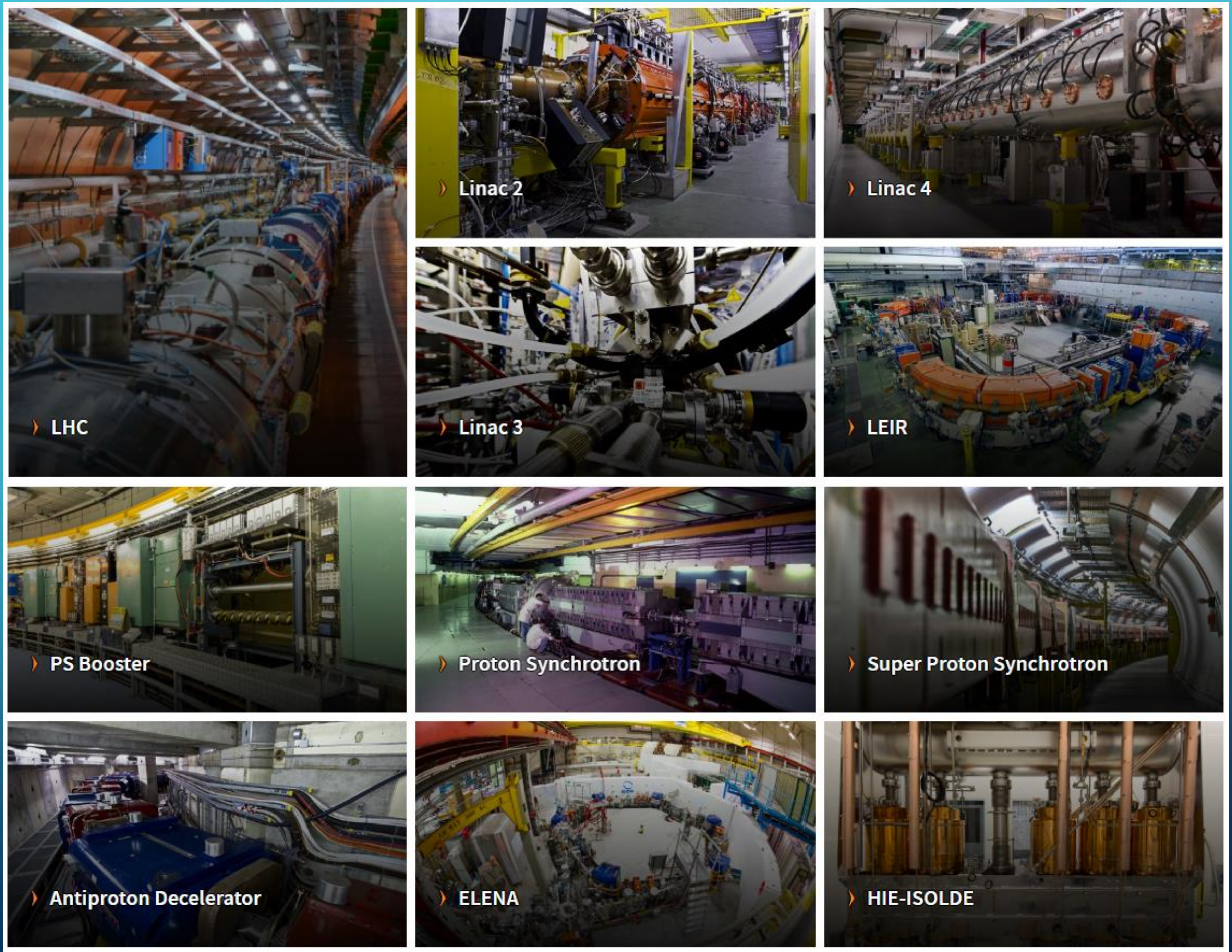


CURRENT ACCELERATORS AT CERN

CERN operates a complex of eight accelerators and two decelerators. These accelerators supply experiments or are used as injectors, accelerating particles for larger accelerators.

The accelerators are controlled by operators 24 hours a day from the CERN Control Centre.

- LHC
- Linac2 Linac3 Linac4
- LEIR
- PS Booster
- Proton Synchrotron
- Super Proton Synchrotron
- Antiproton Decelerator
- ELENA
- HIE-ISOLDE

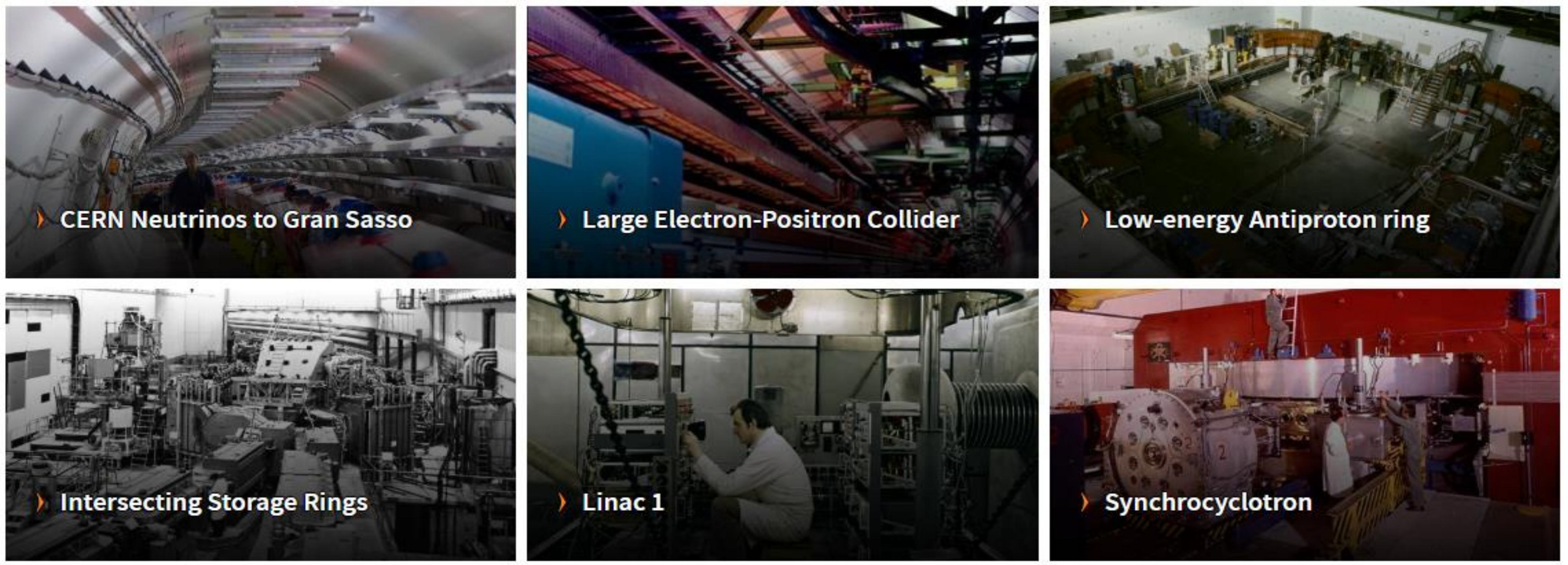

LHC
Linac 2
Linac 4
Linac 3
LEIR
PS Booster
Proton Synchrotron
Super Proton Synchrotron
Antiproton Decelerator
ELENA
HIE-ISOLDE

FUTURE ACCELERATORS

Since 2010, scientists have been working on the LHC's successor, the High-Luminosity LHC. Approved by the CERN Council in 2016, this second generation LHC is expected to start after 2025. CERN scientists are also working on accelerator studies for beyond 2040, such as the Future Circular Collider (FCC) or the Compact Linear Collider (CLIC). Work is also being done on alternative acceleration techniques for example with the AWAKE

PAST ACCELERATORS

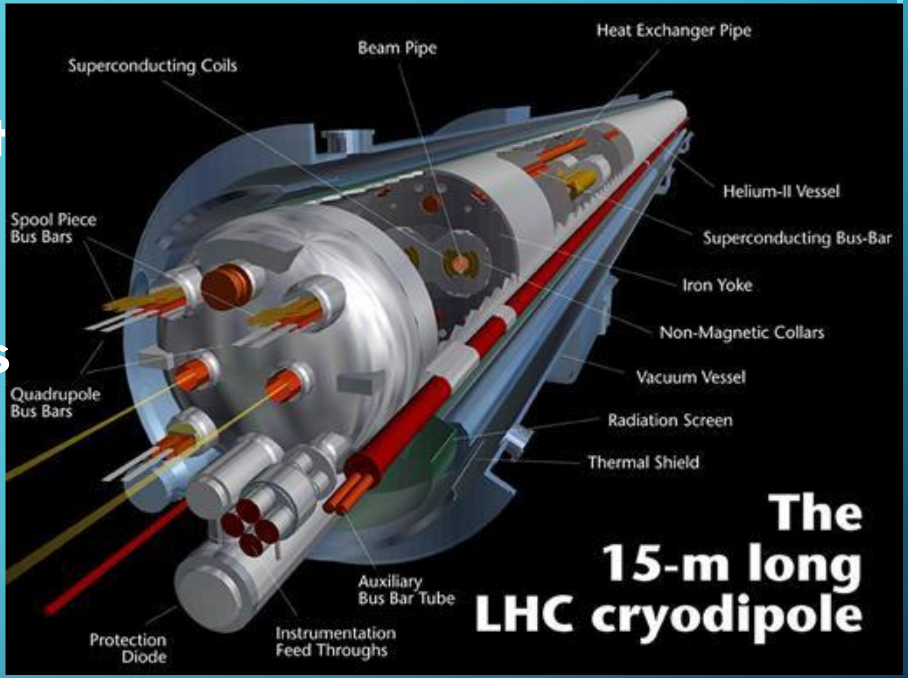
Many accelerators developed several decades ago are still in operation. The oldest of these is the Proton Synchrotron (PS), commissioned in 1959. Others have been closed down, with some of their components being reused for new machines, at CERN or elsewhere. Travel back into the past of CERN accelerators.



SUPERCONDUCTING ELECTROMAGNETS

The Large Hadron Collider (LHC) is currently operating at the energy of 6.5 TeV per beam.

At this energy, the trillions of particles circle the collider's 27-kilometre tunnel 11,245 times per second.All the magnets on the LHC are electromagnets. The main dipoles generate powerful 8.3 tesla magnetic fields – more than 100,000 times more powerful than the Earth’s magnetic field.

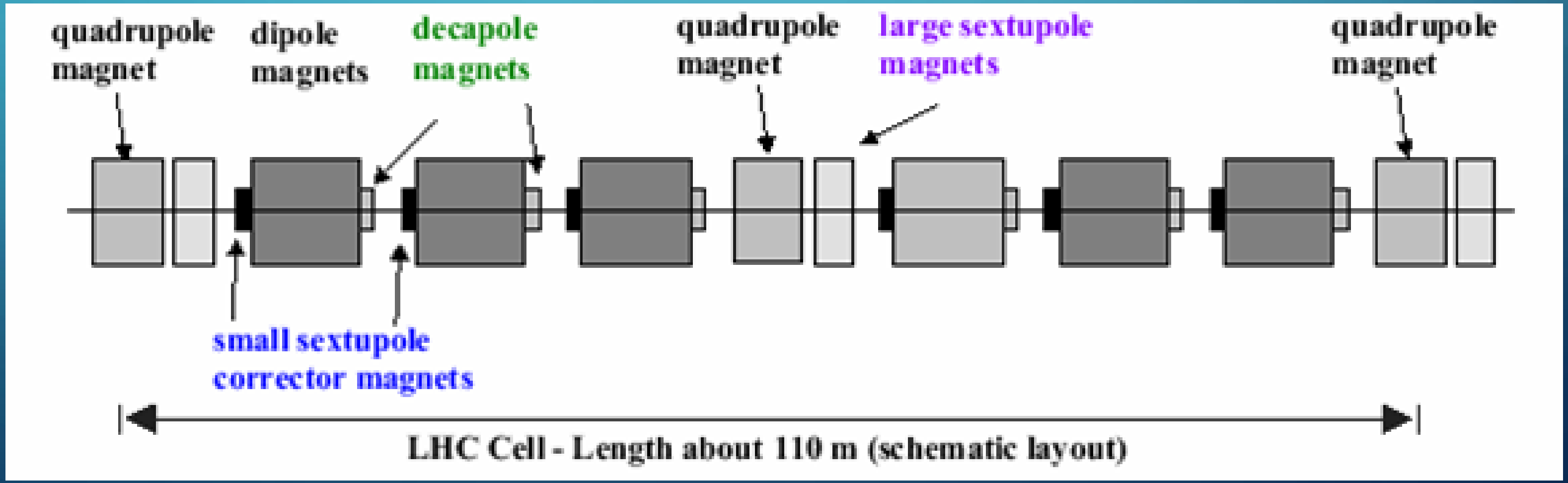


The electromagnets use a current of 11,080 amperes to produce the field, and a superconducting coil allows the high currents to flow without losing any energy to electrical resistance.

LATTICE MAGNETS

Thousands of "**lattice magnets**" on the LHC bend and tighten the particles' trajectory. They are responsible for keeping the beams stable and precisely aligned.

There are 1232 main **dipoles**, each 15 metres long and weighing in at 35 tonnes. If normal magnets were used in the 27 km-long LHC instead of superconducting magnets, the accelerator would have to be 120 kilometres long to reach the same energy. Powerful magnetic fields generated by the dipole magnets allow the beam to handle tighter turns.

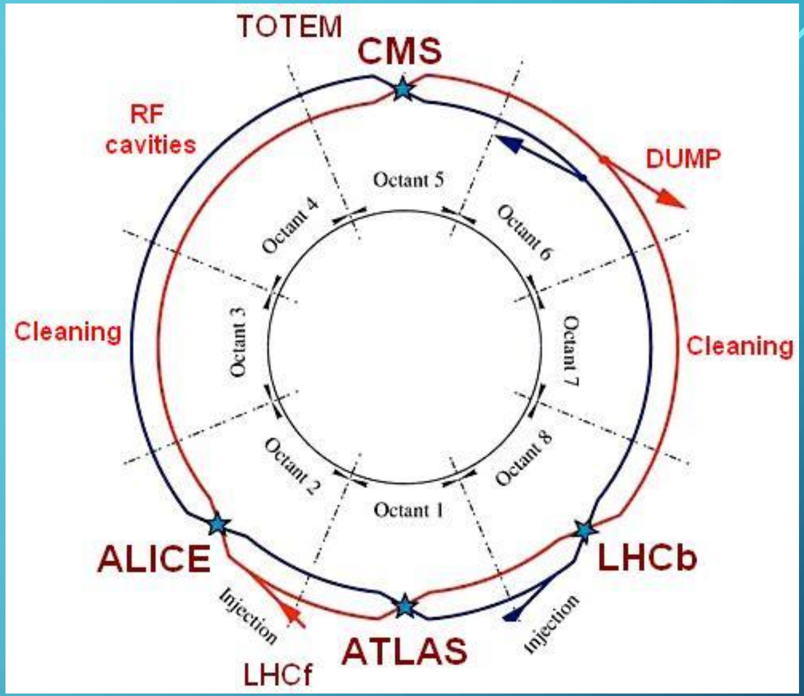


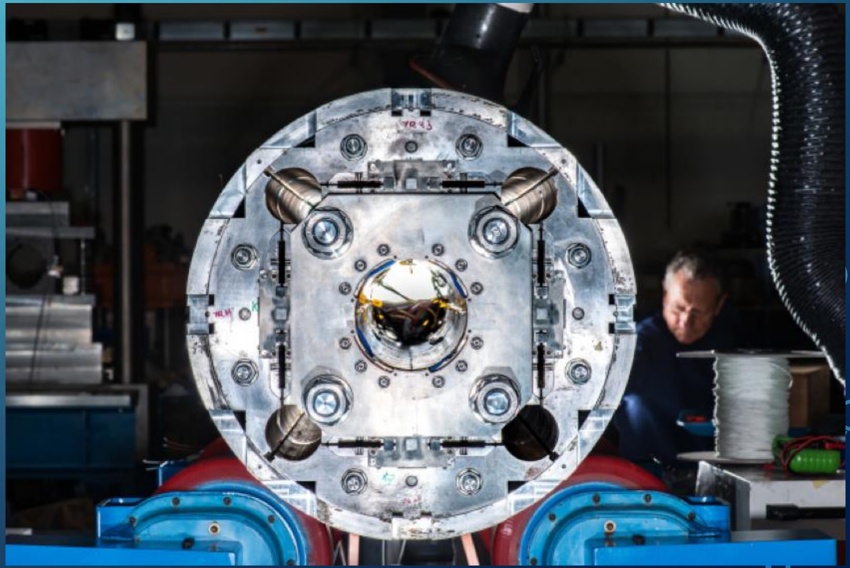
INSERTION MAGNETS

When the particle beams enter the detectors, insertion magnets take over.

Particles must be squeezed closer together before they enter a detector so that they collide with particles coming from the opposite direction. Three quadrupoles are used to create a system called an inner triplet.

There are eight inner triplets, two of which are located at each of the four large LHC detectors, ALICE, ATLAS, CMS and LHCb. Inner triplets tighten the beam, making it 12.5 times narrower – from 0.2 millimetres down to 16 micrometres across.





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