Large Hadron Collider luminosity upgrade project moving to next phase

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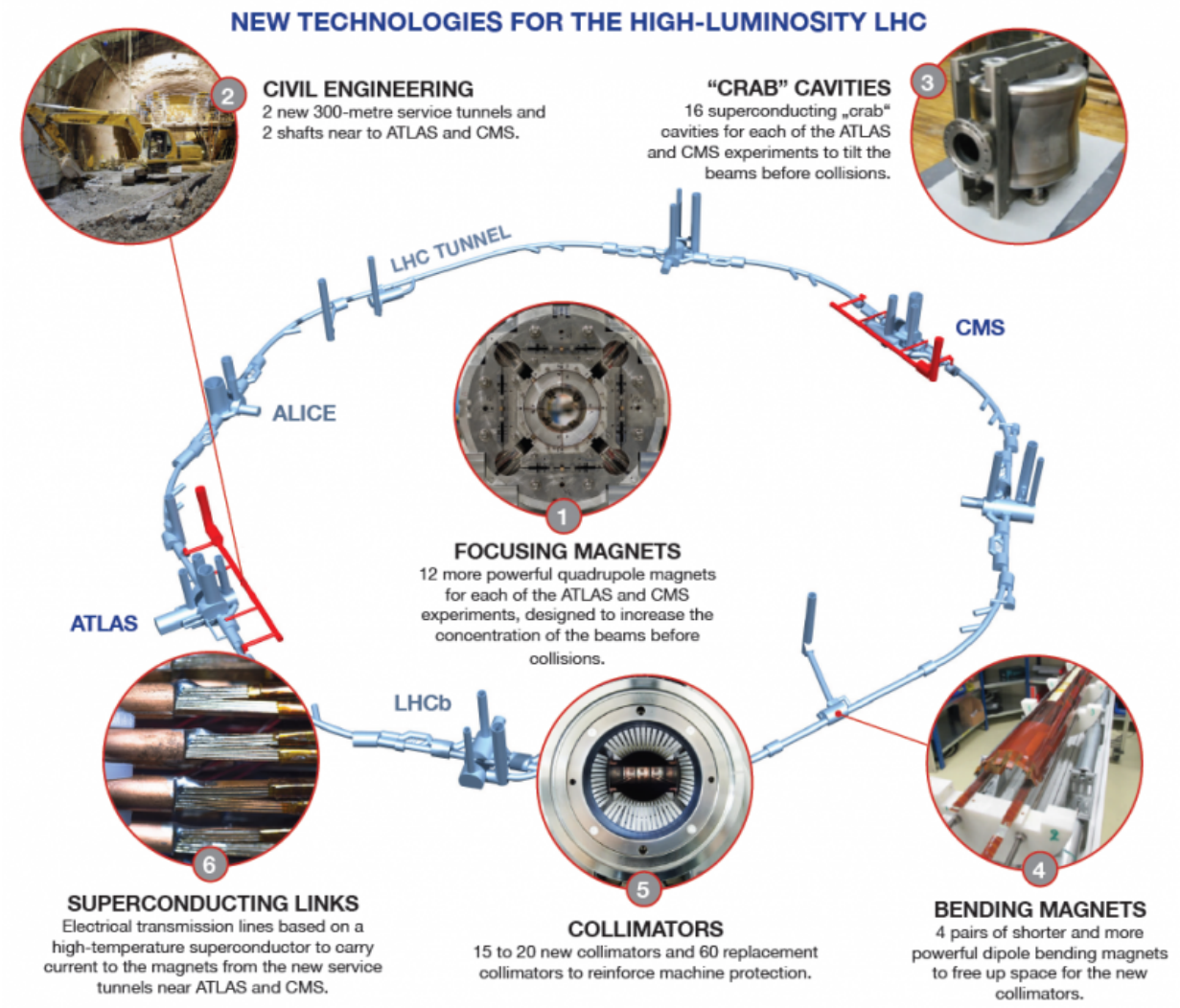

This week more than 230 scientists and engineers from around the world met at CERN to discuss the High-Luminosity LHC – a major upgrade to the Large Hadron Collider (LHC) that will increase the accelerator's discovery potential from 2025.

After a four year long design study the project is now moving into its second phase, which will see the development of industrial prototypes for various parts of the accelerator.

Luminosity is a crucial indicator of performance for an accelerator. It is proportional to the number of particles colliding within a defined amount of time. Since discoveries in particle physics rely on statistics, the greater the number of collisions, the more chances physicists have to see a particle or process that they have not seen before.

The High-Luminosity LHC will increase the luminosity by a factor of 10, delivering 10 times more collisions than the LHC would do over the same period of time. It will therefore provide more accurate measurements of fundamental particles and enable physicists to observe rare processes that occur below the current sensitivity level of the LHC. With this upgrade, the LHC will continue to push the limits of human knowledge, enabling physicists to explore beyond the Standard Model and Brout-Englert-Higgs mechanism.

"The LHC already delivers proton collisions at the highest energy ever," said CERN Director General Rolf Heuer. "The High-Luminosity LHC will produce collisions 10 times more rapidly, increasing our discovery potential and transforming the LHC into a machine for precision studies: the natural next step for the high energy frontier."

The increase in luminosity will mean physicists will be able to study new phenomena discovered by the LHC, such as the Higgs boson, in more detail. The High-Luminosity LHC will produce 15 million Higgs bosons

per year compared to the 1.2 million in total created at the LHC between 2011 and 2012.

Upgrading the LHC will be a challenging procedure and relies on several breakthrough technologies currently under development.

"We have to innovate in many fields, developing cutting-edge technologies for magnets, the optics of the accelerator, superconducting radiofrequency cavities, and superconducting links," explained Lucio Rossi, Head of the High-Luminosity LHC project.

Some 1.2 km of the LHC will be replaced by these new technologies, which include cutting-edge 12 Tesla superconducting quadrupole magnets built using a superconducting compound of niobium and tin. These will strongly focus the beam to increase the probability of collisions occurring and will be installed at each side of the ATLAS and CMS experiments.

There are also brand new superconducting radiofrequency cavities, called "crab cavities", which will be used to orientate the beam before the collision to increase the length of the area where the beams overlap. New electrical transfer lines, based on high temperature superconductors , will be able to carry currents of record intensities to the accelerator, up to 100,000 amps, over 100 metres.

"The High-Luminosity LHC will use pioneering technologies - such as high field niobium-tin magnets - for the first time," said Frédérick Bordry, CERN Director for Accelerators and Technology. "This will not only increase the discovery potential of the LHC but also serve as a proof of concept for future accelerators."

All these technologies have been explored since 2011 in the framework of the HiLumi LHC Design Study - partly financed by the European

Commission's FP7 programme. HiLumi LHC brought together a large number of laboratories from CERN's member states, as well as from Russia, Japan and the US. American institutes participated in the project with the support of the US LHC Accelerator Research Program (LARP), funded by the U.S. Department of Energy. Some 200 scientists from 20 countries collaborated on this first successful phase.

The meeting this week marks the end of this hugely complex and collaborative design phase of the High-Luminosity LHC project. The project will now focus on the prototyping and industrialization of the technologies before the construction phase can begin.

More information: home.cern/about/accelerators/h … arge-hadron-collider

Provided by CERN