Press release

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The largest particle accelerator in the world to become five to ten times more powerful, thanks to new high-tech components from Heraeus

• The Hanau materials specialist delivers intricate roll-clad strips for the expansion of CERN’s Large Hadron Collider

The Large Hadron Collider (LHC) at CERN in Geneva is the most powerful particle accelerator in the world, and the largest machine ever built by humans. To enlarge its discovery potential, CERN is expanding the LHC and increasing luminosity (the number of collisions per second) five to tenfold in a major new project. Technology group Heraeus is once again supplying the particle accelerator with high-tech components made from roll-clad stainless steel strips with copper. “An important part of the particle accelerator comes from Heraeus. Our high-tech components are used in the beam screen, which are emitter wall tubes in diameters from 44 to 74 mm,” enthuses Joachim-Franz Schmidt, head of production at Heraeus’ rolling mill. “As a long-time project partner with CERN, we are proud of the renewed contract because it is a testament to our extraordinary materials expertise in high-energy projects in cutting edge research.” Schmidt was also the responsible project head for the first major contract with CERN for delivery of 70 tons of roll-clad strips for the LHC. Production for the new components will run through the end of September at Heraeus’ roll-cladding shop in Hanau, and will total over four tons. “The CERN contract is a huge challenge. We typically make strips for the automobile industry, but manufacturing and optimizing very complex structures and forms is a part of our daily work,” says Schmidt.

Tenfold performance thanks to precisely shaped bands

This major upgrade is called the High Luminosity Large Hadron Collider, or HL-LHC for short. When it’s complete, eight years from now, it will be able to collide five to ten times the number of particles possible today. The CERN research laboratory aims to triple the precision and the amount of data collected. In order to do so, they need to retrofit the existing 27 km long LHC by 1.2 km. The retrofit will make the particle accelerator considerably more powerful, so that scientists can examine processes with higher precision and better statistics than in the existing system, which has been researching the final secrets of the Big Bang since it went into operation in 2009.

Heraeus gave the specially-produced steel for the accelerator's beam screen a copper coating of just a few micrometers thickness. The resulting high-precision tubes carry the radiation released from the particle collision in the finished module. “The entire production process for the new accelerator tubes is very time-intensive and will take approximately two years. We’ll benefit from our excellent project experience in collaboration with the various project partners, which we were able to gain during manufacturing of the first roll-clad strips,” explains Schmidt.
Milestones in the collaboration between CERN and Heraeus

- In 2005, during construction of the LHC, Heraeus supplied about 70 tons of customized roll-cladded strips with saw-toothed profiles. The researchers used these to guide the particle beam in the acceleration, or "beam screen," tubes, which are only a few centimeters in diameter (the smallest measures 45.4 mm).

- In 2008, research operations were set to begin, but damage to the cooling system led to an extended shutdown of the highly complex facility. The repairs took several months. It became clear to all involved that a repeated breakdown would lead to a yet longer standstill, as there were no further replacement parts available. As a result, Heraeus and other firms were commissioned to produce the needed components for the acceleration tubes.

- In 2012, physicists caused a global sensation with their experiments when they found proof of the so-called God particle (or Higgs boson). The researchers have been able to document the decay of these particles in collider experiments. Higgs bosons are responsible for giving material mass and are also the basis for the existence of the universe.

- In 2025, the retrofitted HL-LHC will begin work at ten times the performance of its predecessor, once again using high-tech components from Heraeus.

Background: Working under extreme conditions

The Large Hadron Collider (LHC) is the largest machine ever built by humans. Charged particles (protons and ions) are accelerated by very strong electrical fields almost to the speed of light and made to collide 100 meters below ground inside the 27 km long tunnel housing the LHC. For brief moments, this creates particles that could have been present shortly after the Big Bang. Highly sensitive detectors measure and analyze the radiation released as these particles decay. In the vacuum of the beam screen tubes, at temperatures close to absolute zero, 1232 superconducting magnets guide the particles along the correct path. The extreme conditions place special demands on the materials used in the production of the tubes. The roll-plated bands must maintain their special magnetic characteristics and mechanical stability even at -270°C, the operating temperature of the LHC. The HL-LHC will be available to more than 13,000 international researchers and will make possible even more discoveries starting in 2025. Researchers will be able to observe rare processes by precisely measuring elementary particles at levels of sensitivity that are not possible today. Measuring integrated luminosity (number of particle events per time and area) will be increased five to tenfold compared to the LHC.

Heraeus, the technology group headquartered in Hanau, Germany, was founded in 1851 and today is a globally leading, family-owned company. With technical expertise, a focus on innovation, operational excellence and entrepreneurial leadership, we constantly strive to improve our business performance. We create high-quality solutions for our clients and strengthen their competitiveness in the long term by combining material expertise with technological know-how. Our ideas are focused on themes such as the environment, energy, health, mobility, and industrial applications. Our portfolio includes everything from components to coordinated
material systems, and our products are used in a wide variety of industries, including the steel, electronics, chemical, automotive, and telecommunications industries. In fiscal year 2016, Heraeus earned revenues excluding precious metals of €2.0 billion and total revenues of €21.5 billion. With around 12,400 employees worldwide in more than 100 subsidiaries in 40 countries, Heraeus holds a leading position in its global markets. In 2016, Heraeus was named one of the Top 10 Family Businesses in Germany by the Foundation for Family Businesses.

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