



Particle Physics at Discovery's Horizon

The US and the Large Hadron Collider



Image © CERN

The LHC is the largest, most complex and most powerful particle collider ever built. It will operate at CERN near Geneva, Switzerland in a 17-mile circular tunnel about 300 feet underground. The LHC will create 600 million proton-proton collisions per second at an energy of 14 trillion electron volts, using beams of protons seven times more energetic and about 30 times more intense than those ever before produced.

At the heart of the LHC are superconducting magnets made of niobium-titanium. Cooled to nearly absolute zero by superfluid helium, the coils of these magnets conduct electricity without resistance. The LHC's thousands of magnets guide opposing beams of speeding protons or lead ions in circular orbits, and focus them into hair-thin beams that collide within the 4 LHC experiments. Cryogenic, electronic and information systems of unprecedented scope and complexity support the LHC's 'round-the-clock' operation.

US contributions to the design, construction, operation, and future R&D for the LHC are supported by the Department of Energy's Office of Science. More than 150 US accelerator physics personnel from four national laboratories and one US university participate in the LHC project.

The Large Hadron Collider

Highest-energy particle collider ever built

Proton beam energy: 7 TeV

Circumference: 16.565 miles

Turns per second: 11,245

Collisions per second: 600 million

Total number of magnets: 9,593

Number of superconducting dipole magnets: 1,232

Dipole operating temperature: 1.9 K (-456°F)

US LHC Accelerator Construction Project

Participants: Approximately 150

Institutions: 3 national laboratories

States represented: New York, Illinois, California

Cost: \$200 million

Construction contributions:

Final-focus magnet systems

Superconducting beam separation dipole magnets

Cryogenic and power feed boxes

Specialized absorbers

Production and testing of superconducting cable

Contributions from U.S. industry: \$88.5 million in specialized materials and components

US LHC Accelerator Research Program

Participants: Approximately 130

Institutions: 4 national laboratories and 1 university

States represented: California, Illinois, New York, Texas

Cost: \$12 million per year

R&D activities: Developing and demonstrating a new type of technology for superconducting magnets for possible use in LHC upgrades; monitors and feedback systems for the LHC; support for US accelerator physics personnel at CERN