Large Hadron Collider accelerates particles to record energy level

Bryan Dyne, Don Barrett
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Scientists at the Large Hadron Collider, the world's leading instrument for understanding the nature and structure of subatomic physics, announced March 30 that the LHC had collided particles to 7 trillion electron-volts, the highest energy ever achieved in such a device, although only half the energy the accelerator is designed ultimately to reach.

Seven trillion electron-volts smashes the record for particle accelerator energies produced by mankind, exceeding by far the energies of Tevatron at Fermilab near Chicago. By comparison, a spark from a household appliance imparts an energy to individual particles within it of a hundred electron-volts, a factor of 70 billion less.

The LHC, located in Geneva, Switzerland, represents the realization of the aspirations, theoretical work, and engineering designs of thousands of scientists supported by a consortium of the major European states. The accelerator has a circumference of 17 miles and cost $10 billion to build, and the project has had to overcome major technical and engineering problems.

Physicists collide particles together at extremely high energies to create conditions reminiscent of the first instants of the universe, when space itself seethed with high energy particles. Exotic particles are created and then tracked by scientific instruments to record their properties, all to better understand the origin of the current structure of the universe and its history.

Although the accelerator has reached half of its designed performance level, it is currently colliding beams with a smaller volume of particles and less control than it eventually will, resulting in far fewer collisions. The number of collisions is expected to increase threefold as engineers learn to control the instrument.

A major task for this accelerator is to detect a particle called the Higgs boson, whose existence some theories of physics predict as a manifestation of the mechanism that imbues all objects in the universe with the property of mass.

The collider's energies will be built-up very gradually in an effort to avoid the problems that produced a setback in September 2008. At that time, a misaligned magnet caused a beam to veer slightly off course, causing an explosion of helium within the accelerator ring.

When the project became more known to the general public, ill-formed criticism was aimed at the collider, claiming that so called micro black holes, subatomic versions of collapsed stars that have gravity that even light cannot escape, would be formed and (in the most fanciful version) swallow the Earth whole. In response, the leadership of the collider convened a committee to address the issue. The review, proceeding with an abundance of caution and the desire to educate, determined that any such micro black holes created would be so weak they will disappear the moment they are created. The committee also reminded critics that the collisions of the LHC are far less energetic than cosmic rays that collide with the Earth's upper atmosphere on a constant basis, indicating that if the micro black holes had the capability to destroy the planet, they would have done so long ago.

Opponents of the LHC have called into question the high cost of the experiment, claiming that the money could be put to better use elsewhere. Currently, the collider has a total cost of $10 billion, including $40 million to repair damages caused by the 2008 explosion. A single fully equipped US aircraft carrier, capable of killing masses of people but producing nothing of value, costs approximately the same.

Apportioned over the European population, the cost

of LHC is less than $12 per person. The rewards are an incalculable growth in understanding of the fundamental structure of the universe, rather than the destruction of even more life on Earth.

Once the focus of the beams reaches its maximum, the LHC is expected to run for another 18 months at the current energy before a scheduled year-long shutdown, during 2012, for maintenance, repairs, and upgrades. Then, in 2013, it will be restarted in an attempt to reach its maximum energy of 14 trillion electron-volts.

From here, it is expected to run for several years, collecting data that will lead to the discovery of the Higgs boson and other new physics. At that point, around 2020, long-term plans will come into play to upgrade the LHC to be able increase the number of particle collisions by a factor of 10. This project will require the collaboration of all the world agencies governing the collider, as well as the individual detectors, as the current detectors are not able to handle energies higher than 14 trillion electron-volts.

Over the next several months, the LHC will begin in earnest its discovery of the fundamental structure of the universe, a collaborative effort of some 60,000 scientists in the particle physics community.