Physicists Begin Quest for 'Higgs' Particle at European Collider

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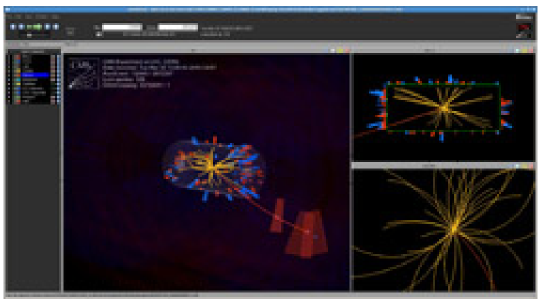

Last week's collisions were recorded from the CMS detector by a tool developed at UCSD. Credit: CMS Collaboration

(PhysOrg.com) -- More than two dozen UC San Diego physicists and technicians began their long-awaited quest last week in a research facility below the Swiss-French border to find a hypothetical subatomic particle that they hope will allow them to finally tie together the fundamental forces and particles in nature into one grand theory.

With cheers, applause and toasts of champagne, hundreds of physicists at CERN, the European Organization for Nuclear Research near Geneva, successfully collided beams of protons, moving in opposite directions at close to the speed of light, with an energy greater than has ever been produced before on Earth.

From the millions of subatomic particle collisions in this newly constructed collider, known as the Large Hadron Collider, or LHC, the scientists hope to generate tiny fireballs of pure energy, from which new particles never before seen on Earth emerge. That should provide them with clues to improve on and go beyond their basic theory of nature—what they call the Standard Model.

“It's taken us 25 years to build,” Vivek Sharma, a physics professor at UCSD now working at CERN, said of the LHC in a news conference last week that was reported in newspapers, magazines and broadcasts worldwide (see video here). “This is what it's for. Finally the baby is delivered. Now it has to grow.”

The LHC is the world’s largest scientific experiment, involving an estimated 10,000 individuals from 60 countries, including more than 1,700 scientists and engineers from 95 U.S. universities and laboratories. It will attempt to reproduce, on a miniature scale, some of the same conditions that occurred during the first fractions of a second after the Big Bang, when our universe is thought to have come into being some 14 billion years ago.

The main object or particle of the LHC’s search is the Higgs boson, hypothesized by physicists to have been created in the Big Bang’s fireball and to imbue particles with mass. It has never been detected by any of the world’s previously built colliders. And it is thought to exist at energy levels that only the LHC can reach.

“Finding the Higgs Boson will be a marathon challenge, not an easy sprint,” said Sharma, who will be living at CERN during the next few years to direct and coordinate the Higgs boson search for several hundred physicists at more than 38 countries and 183 institutes worldwide. “But we have set the traps with considerable thought and are confident that we will find it in not too distant future. The thrill of the chase is overwhelming and it will energize us through the course leading to its discovery."

Sharma and 27 other UCSD physicists and technicians have been shuttling between La Jolla and CERN during their sabbaticals and teaching breaks, for more than a decade now, to make sure that when the LHC is properly operating, data can be collected from one of the European collider's two big particle detectors—the Compact Muon Solenoid, or CMS.

"The CMS detector is 21 meters long, 16 meters in diameter and weighs around the same as 30 jumbo jets or 2,500 African elephants," said Sharma "And though it is the size of a small cathedral, it contains detectors more precise than Swiss watches."

Because of the huge volume of data expected from this experiment, the UCSD team has designed and built the largest data acquisition system in the world to analyze the more than 100,000 collisions per second that will be generated when beams of protons circulating at nearly the speed of light in opposite directions around the 27-kilometer LHC ring are brought together in violent collisions.

"When the two proton beams collide, they will generate, within a tiny volume, temperatures a billion times hotter than in the heart of our Sun," said Sharma.

Sharma said the detector itself is capable of operating like a 100 megapixel digital camera taking 40 million photos a second. And the 15 million gigabytes of data expected to be generated each year by the CMS experiment will produce the equivalent of 20 million CDs of data that will require the computing power of about 100,000 of the fastest PC computers.

While all of this hardware had been checked and rechecked, the situation was still tense last week, Sharma said, when the LHC's first three attempts at colliding beams failed in the early morning hours because of niggling hardware issues in the big collider. But these were quickly fixed, and when the collider started to collide protons at a rapid fire rate, some 60 times a second, Sharma said he and the other UCSD scientists felt a sense of relief and exhilaration for the discoveries that are sure to come in the near future.

"My heart stopped when the first event was splashed on the screen," he said. "The joy of watching CMS quickly and seamlessly take in all the LHC collisions and produce beautifully reconstructed events of proton-on-proton collisions is hard to communicate. LHC and CMS worked in tandem, like a dream machine."

Provided by University of California - San Diego