UA Physicists Charged Up About Record Collisions in Large Hadron Collider

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A person stands in front of the huge ATLAS detector, one of six detectors that are part of the Large Hadron Collider near Geneva. Credit: Maximilien Brice, CERN

(PhysOrg.com) -- Now the research begins for the team of University of Arizona physicists who built pieces of the largest scientific instrument ever, the Large Hadron Collider.

At 4:06 a.m. Tucson time, two beams of protons smashed together inside the Large Hadron Collider at 7 trillion electron volts, or TeV-more than three times the energy previously achieved in a particle accelerator.

Today's collisions mark the start of a decades-long research program. Experiments conducted using the LHC will provide fundamental discoveries about the matter that makes up our universe.

Shortly after 4:15 a.m. Tucson time, UA-LHC team member Walter Lampl wrote in an e-mail from Switzerland, "The first collisions arrived only a few minutes ago. It pretty crazy here now...but it's great!"

The LHC smashes beams of protons together as they speed around a 17-mile tunnel beneath the border of France and Switzerland. When the protons collide, they break apart and elementary particles, the smallest building blocks of matter, will shoot off in all directions.

Lampl, an assistant research scientist in the UA department of physics, is permanently based at the European Organization for Nuclear Research, known as CERN, that operates the LHC. CERN is in Geneva.

UA-LHC team members in Tucson got up early or stayed up late to watch the Webcast of the event and see how their part of the LHC, a detector called ATLAS, was working. The UA is the only institution in Arizona involved with the LHC.

"I was checking periodically during the night and last checked just as the LHC declared stable beams. It was very exciting to watch the first collisions on the ATLAS event display. Over 99 percent of the ATLAS experiment is working!" team member Ken Johns, a UA professor of physics, wrote in an e-mail.

Michael Shupe, a UA professor of physics who has been working on the LHC for 16 years, also was up early.

"Compared to the lower-energy collisions seen in December 2009, these look like 4th of July fireworks," Shupe wrote in an e-mail. "These events are clearly reaching a new energy scale, with hundreds of particles pouring from the collision point, and high-energy jets showering into the energy-measuring sections (of ATLAS) known as calorimeters."

He added, "We are very eager to start analysis on a large sample of these collisions."

Shupe and his colleagues expect that collisions within the LHC will create subatomic particles no one has ever seen before.

One such particle is called the Higgs boson. Another is called a WIMP, or Weakly Interacting Massive Particle. The existence of WIMPs is predicted by a theory called supersymmetry.

WIMPs are considered to be the "dark matter particle." Dark matter makes up 25 percent of the universe.

Other faculty members on the UA-LHC-ATLAS team are Elliott Cheu and John Rutherfoord, both UA physics professors, and Erich Varnes, a UA associate professor of physics. The team also includes research scientists and engineers, postdoctoral and graduate students, technical and support staff. In addition, more than 20 UA undergraduates have worked on the UA's ATLAS team.

CERN will run the LHC for 18-24 months. Following this run, the LHC will shutdown for routine maintenance and to complete work needed to reach the LHC's design energy of 14 TeV.

As data begins to pour from the detectors, more than 8,000 LHC scientists around the world will sift through the flood in search of the tiny signals that could indicate discovery.

The ATLAS Collaboration, like the other pieces of equipment that make up the LHC, involves thousands of scientists. ATLAS, one of the largest collaborative efforts ever attempted in the physical sciences, involves 2,900 scientists from 37 countries.

American participation in the LHC is supported by the DOE's Office of Science and the National Science Foundation. More than 1,700 scientists, engineers, students and technicians from 89 American universities, seven U.S. Department of Energy national laboratories, and one supercomputing center helped design, build and operate the LHC accelerator and its four massive particle detectors.

The DOE's Brookhaven National Laboratory and Fermi National Accelerator Laboratory are the host laboratories for the U.S. groups participating in the LHC's ATLAS and CMS experiments.

The United States also is home to major national and regional computing centers that, as part of the Worldwide LHC Computing Grid, enable scientists in the United States and around the world to access the enormous amount of data generated by the LHC experiments.

Brookhaven National Laboratory and Fermi National Accelerator Laboratory, host to major "Tier-1" computing centers, are the first stop in the U.S. for data from the ATLAS and CMS experiments. The data are further distributed to smaller NSF and DOE-funded "Tier-2" and "Tier-3" computing centers across the country, where physicists will conduct the analyses that may lead to LHC discoveries.

Provided by University of Arizona