Local News

UCSC physicists part of international endeavor

In search of 'ultimate energy'

Group is set for a smashing good time at most powerful particle accelerator in world

By James Urton
Staff writer

SANTA CRUZ — A whole new world could be brewing in the Alpine border region between Switzerland and France, where physicists from UC Santa Cruz are working this year with an international team of scientists to smash subatomic particles and unlock the secrets of the universe.

The source of these smashing good times is the Large Hadron Collider, the world's largest and most powerful particle accelerator. The 17-mile-long underground ring structure, built by the European Organization for Nuclear Research (CERN) and partner agencies, took some time off for maintenance after the successful 2012 detection of the elusive but long-theorized Higgs boson — popularly dubbed the "God particle." But as the collider revs up this spring, proton beams should approach the collider's level of "ultimate energy," producing collisions of greater intensity and energy.

Haber

Seiden

"This is a new frontier," said Jason Nielsen, a physicist with UC Santa Cruz.

Particle physicists from UC Santa Cruz have been at the forefront of these advancements, particularly with

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upgrades to sensors on the collider's massive ATLAS detector. When the beams of subatomic particles fire up, these new sensors will let scientists peer closer than ever before at the high-energy collisions and ask fundamental questions about the building blocks of our universe on a scale never before achieved.

UC Berkeley professor and ATLAS experiment duty spokeswoman Beate Heinemann said the UC Santa Cruz physicists have "been one of the most important groups on the ATLAS experiment," particularly regarding new sensors.

The Large Hadron Collider uses a complex series of magnets to steer beams of protons — billions of them — toward one another. They travel through the ring tunnel at speeds approaching the speed of light, said Abraham Seiden, a physicist at UC Santa Cruz. When they collide, they can bounce, shatter and alter one another in ways that generate new particles that interact in new ways. The collider contains an array of instruments to record and analyze these collisions and their byproducts. But since 2006, Seiden has led a U.S. research and development team of scientists from 44 institutions to propose and develop new instruments for the ATLAS detector.

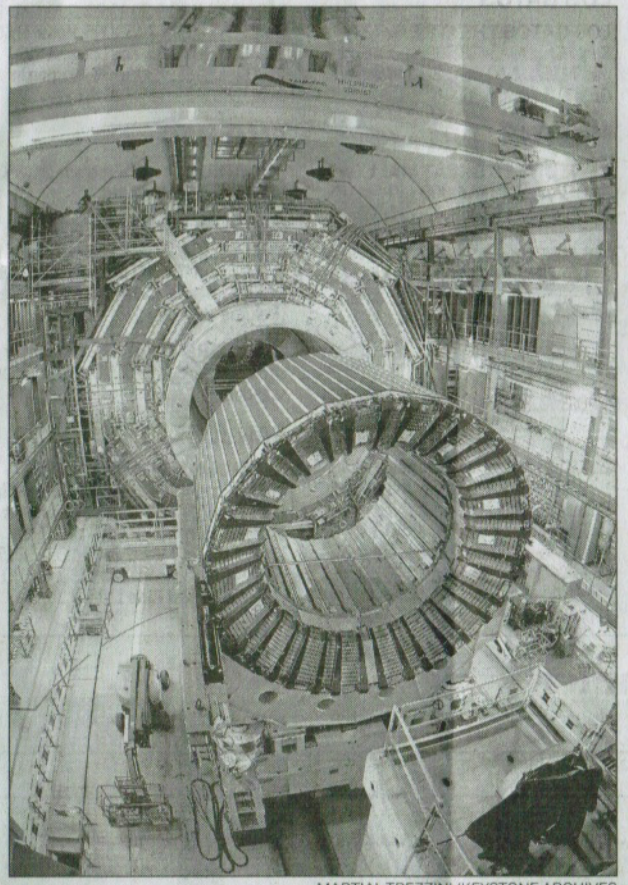
"The ATLAS detector is sort of like a cylindrical onion," explained Nielsen. "It has many layers of instruments."

New to the ATLAS onion this year is its innermost layer, a $4.5 million instrument that will monitor proton collisions from a cozy distance of about 1.2 inches.

"It's basically made up of pixel sensors," explained Nielsen. "Like the pixels in your camera."

Scientists with CERN and partner institutions, including UC Santa Cruz, will operate the collider, maintain equipment and collect data from the proton beams around the clock, Nielsen said. CERN shares data with partner institutions around the globe.

The new instruments should gather more precise information about high-energy collisions. Physicists hope that over the next two or three years, the collider could explain what types of particles make up our cosmos. One major mystery is the invisible substance that makes up over one-quarter of our universe, dark matter. Ordinary matter, including the atoms that make up planet Earth and our bodies, make up less than 5 percent.



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The magnet core of the world's largest superconducting solenoid magnet is shown in Geneva, Switzerland. Physicists from UC Santa Cruz are part of an international team that is working to extend the power of The Large Hadron Collider and unlock the secrets of the universe.

"We know that dark matter cannot be made of ordinary matter," UC Santa Cruz physicist Stefano Profumo said. "There's no known particle that behaves the way dark matter behaves."

Scientists are also eager to learn more about the new particle in town, the Higgs boson.

"We have this very broad brush picture of the Higgs boson, but these were crude measurements," said UC Santa Cruz physicist Howard Haber. "When we restart the collider, there'll be higher energy and higher intensity beams, which means you produce more Higgs bosons."

Beyond the mystery of dark matter and a better snapshot of the Higgs boson, physicists believe these new high-energy collisions could produce particles that scientists have never predicted. Theoretical physicists have even suggested that through these collisions they might detect new dimensions, according to Profumo.

"That keeps me on the edge of my chair," he added.

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