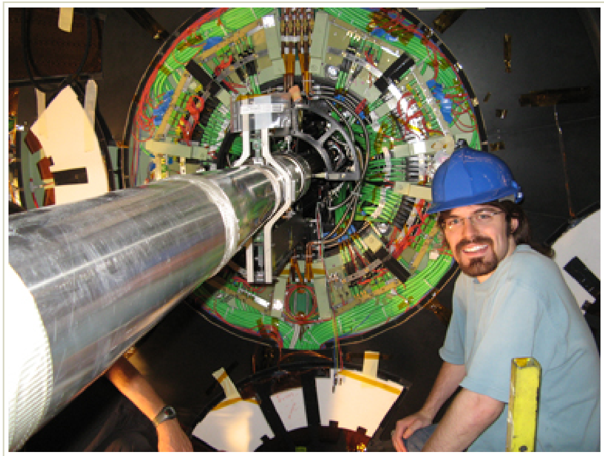
Start of the World's Largest Particle Accelerator LHC at CERN: Dawn of a New Decade of Research for UTK

Physicists from the University of Tennessee, Knoxville, celebrate the first particle beams in the Large Hadron Collider (LHC) of the European Laboratory CERN in Geneva, Switzerland

September 10, 2008

University of Tennessee physicists became part of history early this morning when the most powerful particle accelerator ever built began operations. The Large Hadron Collider (LHC) came online at 3:30 a.m. Eastern Time at the European particle physics laboratory CERN in Geneva, Switzerland. The scientific community expects new and potentially surprising insights into the building blocks of matter and the creation of the universe. Scientists hope the experiments will lead to an unambiguous detection of the elusive Higgs particle, which is believed to be responsible for giving mass to everything, will shed light on dark matter, will uncover hidden symmetries of the universe, and will possibly find extra dimensions of space.

UTK physicists are among those working on the Compact Muon Solenoid (CMS), one of two general-purpose experiments at the LHC. The CMS collaboration comprises about 2,000 scientists from more than 170 institutions and 36 countries. The CMS is located along the 17-mile-long ring-shaped accelerator, 100 meters below the Earth's surface. Here protons, the nuclei of hydrogen atoms, collide head-on at unprecedented energies, thereby creating almost half a billion miniature Big Bangs per second. The CMS detector, which is the size of a cathedral and weighs almost 30 percent more than the Eiffel Tower, will allow scientists to capture and measure the fragments that fly out of these proton collisions.



Matt Hollingsworth helping to install radiation detectors near the beam pipe.

Associate Physics Professor Stefan Spanier describes the experiment as using protons like a microscope to look deeper into matter.

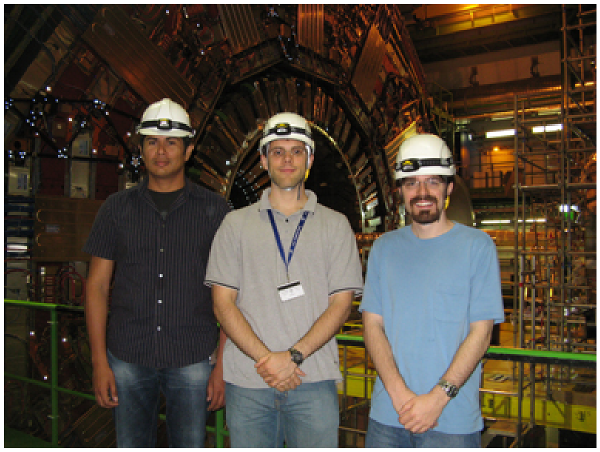
"The experiment is expected to make groundbreaking discoveries," he said. "It will be a flagship experiment of particle physics for a decade or more. The results from the experiment will define the future of particle physics and perhaps more."

The proton beams are kept in vacuum pipes in an underground tunnel between the French Jura mountains and Lake Geneva. As the protons accelerate in opposite directions to nearly the speed of light, they are kept on the circular trajectory by 1,200 superconducting dipole magnets with magnetic fields 100,000 times stronger than the Earth's magnetic field. The magnets are cooled down to -271 degrees Celcius, which is almost close to absolute zero.

UTK researchers and students (both undergraduate and graduate) followed the LHC start both at CERN in Geneva—where physics graduate student Andrew York sat in a control room—and also via computer connections on campus. In fact, the UTK group was among the first to see the beam since the group is part of a small collaboration designated to install radiation sensors that help steer the beam safely through CMS. They also decide when the detector can be switched on or has to be off, as even a small fraction of beam lost somewhere in the accelerator can be harmful. The beam's energy is equivalent to a small aircraft carrier weighing 10,000 tons traveling at 20 miles per hour. In one second it can dump as much energy in a single spot as is needed to power 4 million light bulbs, thereby probably vaporizing any detector material along its path.

Spanier explained that it takes less than 100 microseconds for the beam to make one turn and that it can be stopped, if necessary, before it makes two.

"In critical situations we can even dump the beam at a safe location," he said.



Jose Lazoflores, Andrew York, and Matt Hollingsworth
in front of the CMS detector before it closed.

The data volume recorded per second in CMS corresponds to 10,000 sets of the *Encyclopedia Britannica*. The data recorded during the 10-to-20 years of the LHC lifespan will be equivalent to all the words ever spoken by humankind. The computing power required to search for new phenomena in these data is equivalent to 100,000 conventional desktop computers. To tackle this challenge, a completely new infrastructure with worldwide-distributed computing resources had to be invented. Simply referred to as “the Grid,” it will allow scientists all over the globe to share computer power and data storage capacity over the Internet. It is expected to be the next breakthrough after the World Wide Web, with potentially an even greater impact on everyday business. Nodes of the Grid are located in facilities all over the world. The High-Energy Physics Group has installed one such node at UTK that connects with a dedicated high-speed network to Fermilab, Chicago, and the GRID world. It also serves as a prototype for scientific computing at UTK with shared resources. The group's involvement with CERN, the birthplace of the World Wide Web, integrates naturally into the university’s “Ready for the World” initiative. Matt Hollingsworth, who earned a bachelor’s degree in physics in 2008, spent time at the LHC as an undergraduate and is continuing his work while pursuing a Ph.D. with UTK.

“It is empowering to know that many people can come together and make something like this happen that one person couldn’t ever do alone,” Hollingsworth said.

The members of the UTK High Energy Physics group who participate in the CMS experiment are Associate Professor Stefan Spanier (Principal Investigator), Professor Thomas Handler, post doctoral researcher Jose Lazoflores, graduate students Giordano Cerizza, Andrew York, and Matt Hollingsworth, undergraduate student Andrew Ayres, and researcher Gerald Ragghianti. The experimental group is supported by the theory group of Professor George Siopsis.

More information is available from the United States LHC Web site at http://www.uslhc.us and CERN’s LHC first beam page: http://lhc-first-beam.web.cern.ch/lhc-first-beam/Welcome.html.