

A Smashing Good Time at the Wilson Synchrotron Laboratory Open House

By Larry Klaes

Buried forty feet under Cornell University's Alumni Field is a scientific device half a mile across that only nine other places on Earth currently possess: A major-league particle accelerator.

With this device, physicists at Cornell's Wilson Synchrotron Laboratory, part of the Floyd R. Newman Laboratory for Elementary Particle Physics (LEPP) have been smashing together the subatomic particles known as electrons and their antimatter counterpart particles called positrons at nearly the speed of light since the 1970s.

Tearing apart these incredibly minute pieces of matter in this manner allows scientists to explore the truly fundamental building blocks of existence. This activity also helps in the search for answers to such ultimate questions as how did the Universe begin, how will it end, and what is that stuff called Dark Matter and Dark Energy which permeates far more of the Cosmos than the "ordinary" matter we deal with every day?

With such important and exciting science going on right here in Ithaca, plus the fact that 2005 is the World Year of Physics – celebrating the one hundredth anniversary of Albert Einstein's contributions which revolutionized modern physics – the staff at the synchrotron lab decided to hold their first open house in two decades for the general public.

LEPP Associate Director Dr. David Cassell welcomed the hundreds of people who accepted the invitation to explore Wilson Lab on June 11 with a succinct explanation of why these Cornell physicists and engineers were conducting this joint celebration.

"Science in this lab depends critically on $E = mc^2$," said Cassell. "These instruments would not have a prayer of working without $E = mc^2$."

$E = mc^2$, or energy equals mass times the speed of light squared, comes from one of the legendary physicist's four research papers that created Einstein's "Miracle Year" of 1905. With it, Einstein proved that energy and mass are one and the same.

The heat and humidity of that Saturday afternoon did not stop visitors from being both educated and entertained by Cornell students and staff holding a variety of demonstrations throughout Wilson Lab and outside the facility.

A team of acrobats called the Vespertilian Jugglers taught audiences how physics plays a major role in allowing entertainers to perform such seemingly impossible feats as balancing on and riding unicycles while keeping numerous objects in the air at once.

Other students showed the public how different types of matter react to being inside a vacuum chamber or dunked in bitterly cold liquid nitrogen. Those who kept walking through Wilson Lab learned about the subatomic particles called cosmic rays that are constantly plunging through Earth – and all of us – from deep space every second. Volunteers showed people how sounds travel through waves by having them listen to a radio – with their teeth!

Lora K. Hine, the Educational Outreach Coordinator at Wilson Lab, said how the main funders of the facility, the National Science Foundation (NSF), were concerned about the “gap between the public and the sciences and wanted to build a bridge between the two.”

The revived open house is just one aspect of the Wilson Lab’s outreach commitment to both the NSF and the public. In September of 2001, LEPP hired Hine, a former middle school science teacher from Tucson, Arizona, to work with local schools that now require the study of the Standard Model of fundamental particle physics as part of their curriculum. Hine, who says she is “very comfortable with school age kids,” helps high school teachers explain the concepts of this branch of physics to their students. She also coordinates field trips to the lab for students to gain direct experience with the amazing science and technological work being done at Cornell.

One of the highlights of the day was a tour of the particle accelerator itself. Though the device had been shut off for a week in anticipation of the open house visitors, the accelerator itself was no less impressive to witness up close.

Filling a room that felt like the size of an aircraft hangar, the tour guides explained how the generated electrons and positrons are sped up to nearly the velocity of light (186,000 miles per second – you could reach Earth’s Moon in less than two seconds going that fast) with energies that eventually reach five billion electron volts. For comparison, the electron gun that creates the moving images in most pre-plasma television sets generates a mere 20,000 electron volts.

After zipping around the synchrotron in opposite directions over four thousand times in a fraction of a second to attain the right collision energy, the matter and antimatter particles are sent to another section where they smash into each other, breaking into even more fundamental particles that the physicists record and analyze from a nearby control room.

The particle smashing conducted at Wilson Synchrotron also makes for a useful tool for scientists conducting materials research that requires the use of high-energy X-rays, a by-product of particle collisions. Scientists both at Cornell and other institutions have used the x-rays from the synchrotron in such diverse fields as biomedical research and improving data storage on CD-ROMs.

To quote Dr. Csaba Csaki from his lecture as another of the public offerings from the Wilson Laboratory open house, there is a “bright future for particle physics and cosmology” from all the scientific research being conducted at Cornell and beyond. Part

of that “bright future” comes from having the public share in their knowledge and adventures.