NICADD scientists develop detector technology for International Linear Collider

December 1 2006

Scientists at the Northern Illinois Center for Accelerator and Detector Development (NICADD) are celebrating the successful run of a prototype sub-detector for the proposed International Linear Collider (ILC).

“The brand new technology is extremely sensitive—it can detect single photons of light with high efficiency,” said Northern Illinois University Presidential Science Adviser Gerald Blazey, who serves as co-director of NICADD.

“Among scientists in the ILC detector community, this is a substantial achievement,” Blazey said. “And for the NIU physics department, the detector work complements the outstanding program in beam physics.”

The proposed linear, or straight-line, collider represents the next generation of particle accelerators, which smash together tiny bits of invisible matter to produce new particles. The experiments help researchers identify and understand the most basic building blocks of nature and the structure of the microscopic universe. The more powerful and efficient the accelerator, the more deeply scientists can probe into the subatomic realm.

Fermi National Accelerator Laboratory in Batavia is a leading site in contention to host the ILC, which would stretch about 20 miles underground. The collider would allow physicists to explore energy regions beyond the reach of today’s most powerful circular accelerators,

the Tevatron at Fermilab and the Large Hadron Collider, due to come online over the next two years at the CERN laboratory on the French-Swiss border.

“The ILC will be a precision machine that produces new physics that must be measured precisely and accurately,” said Vishnu Zutshi, a NICADD senior scientist who led the team of researchers on development of the prototype sub-detector. It would be one of many components comprising the overall detector system.

Members of the team included NIU graduate student Kurt Francis, undergraduates John Powell and Mike Smith, NICADD research scientists Alexandre Dychkant and Victor Rykalin and scientists from Fermilab and Germany.

Detectors are highly technical devices that must process millions of particle collisions and identify the most interesting new particles for storage on data tapes and thus further analyses. In large accelerators, detectors are massive devices; Fermilab’s DZero experiment detector is four stories tall.

Because the ILC is in the early planning stages, scientists must rely on simulations for testing of detector prototypes.

“We first determine what performance will be needed,” Zutshi said. “Then we design a detector that will deliver that performance. The detectors for the ILC must be unprecedented in their ability to evaluate the position and energy of the particles coming from the electron-positron collisions.”

The prototype sub-detector built by the NICADD-led team weighs 10 tons, roughly 1/50th of what the actual device would weigh. It was shipped by steamer to CERN, where it was tested this fall using various

types of particle beams. Scientists determine how well the device measures energy of particles striking the detector and how the energy is distributed throughout the detector.

“The early science is very encouraging,” Zutshi said. “The tests at CERN will achieve details that have not been reached before and will provide crucial input for taking the design of the ILC detector forward.”

The next step is to devise a way to make the device scalable. The prototype had about 320 channels, or independent sensors, whereas the actual detector would have millions of channels.

“Right now, constructing the sub-detector is very labor intensive,” Blazey said. “Now we have to learn how to mass produce it in a way that is both reliable and practical.”

Source: Northern Illinois University