Forum features update on next-generation particle accelerator

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The particle accelerator known as the Energy Recovery Linac (ERL) -- now in planning stages at Cornell -- would open doors to new research in fields from materials science to biochemistry, said Georg Hoffstaetter in a lecture to faculty and staff in Cornell's Research Division, July 31. But if the ERL's scientific scope is wide, he said, its strength would be in shedding new light on the very, very small.

Hoffstaetter, associate professor of physics, gave a short course on the ERL project, from its historical context to its scientific potential (illustrated with liquid nitrogen-enhanced demonstrations), in the first semiannual Research Division Forum, held in Baker Laboratory. The forum, sponsored by the Office of the Vice Provost for Research, is intended to create networking opportunities and bring research staff and faculty up-to-date on projects across campus.

A Cornell-built prototype beam injector, built with a grant from the National Science Foundation, saw its first successful beam on July 7. Researchers plan to submit the first part of a proposal for the full ERL this year, with hope for construction to begin in 2011.

The ERL would accelerate electrons to nearly the speed of light in a linear accelerator (linac) made of two straight tubes about 1.3 kilometers (0.8 miles) long, then feed them into the Cornell Electron Storage Ring, Hoffstaetter said. After a single rotation around the ring, the electrons would return to the linac, where their energy would be recovered and used to accelerate the next batch of electrons.

Meanwhile, at various points around the ring, the Cornell High Energy Synchrotron Source would convert the electrons into ultra-bright, ultra-fast pulsing X-ray beams capable of imaging structures just a few atoms wide, and whose oscillations would be measured in femtoseconds (billionths of one millionth of a second).

Building the ERL at Cornell makes sense from a historical and practical perspective, Hoffstaetter said.

"Many things in building accelerators were first done here at Cornell," he noted, including the 1934 construction of the first cyclotron by physicist Boyce McDaniel; the first accurate measurement of synchrotron radiation in 1952 by Cornell President Emeritus Dale Corson; and the first measurement of synchrotron radiation spectrum in 1953 by the late Cornell professor emeritus of physics Paul Hartman.

The design of the ERL itself is based on a concept proposed by Maury Tigner, the Hans A. Bethe Professor Emeritus of Physics and director of the Cornell Laboratory for Accelerator-based Sciences and Education, in 1965.

"All these developments need major technical equipment, and we have facilities on campus that can really build major technical components," Hoffstaetter said. Cornell also has the expertise to design and manage the equipment, he said, as well as strong collaborative research centers that would benefit from its applications.

And while nobody can foresee the full scope of those applications today, he said, the ERL would give researchers new abilities to see how materials behave at ultra-high pressures, to analyze the structure and dynamics of such micromolecules as proteins and to watch, on the atomic scale, as atoms form chemical bonds.

"This just indicates what kinds of fields will be opened up," he said. "There is a lot of exciting science going on."

Provided by Cornell University