SPECIAL ISSUE Education

FermiNews

Fermi National Accelerator Laboratory

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INSIDE

It's not your ordinary classroom, but Fermi National Accelerator Laboratory provides extraordinary opportunities for science education.

Learning at the Energy Frontier

First graders roll balls down a ramp in the Science Education Center. Graduate students scribble in logbooks at 3 a.m. in an experiment's control room. An undergraduate builds a piece of a piece of a particle detector.

Part of doing science has always meant teaching science, and educating the next generation is a critical part of research life at Fermi National Accelerator Laboratory.

Despite funding cuts that have shut down many of the Lab's education programs, students continue to learn about science, thanks to fundraising, support from the Lab's managers, and increasing volunteerism by employees and users. Fermilab's managers and education staff speak of the education programs not as just a side benefit of the Lab, but as an obligation to the community—both the science community and the local community.

While some might wonder why the nation's premier particle physics laboratory would engage in activities for Kindergartners, Fermilab's education specialists say programs designed for kids expose students in their formative years to real science and allow access to preeminent scientists and cutting-edge research facilities not available to most school districts in the United States.

In this issue of *FermiNews*, students, teachers and scientists talk about teaching and learning in the unique environment of a particle physics laboratory on the energy frontier.

~ Donald Sena, Office of Public Affairs

Education Survives Budget Cuts

Fermilab's Science Education Center has raised new money to help bring technology into the classroom, but prospects for future funding are still uncertain.

by Sharon Butler, Office of Public Affairs

Morale at the Leon M. Lederman Science Education Center sank last year when Congress withdrew funding for the U.S. Department of Energy's education efforts, eliminating the Center's major source of funding and ending a decade of support for Fermilab's precollege programs.

To make matters worse, staff members had been expecting a large increase in funds for 1996: from $1.47 million to $2.0 million. They had planned on hiring a full-time computer specialist and discussed constructing a second building to house offices and conference space. They had thought, too, that they might finally realize a long-time dream: a physics playground with pulleys and levers alongside the usual swings and slides to teach children concepts of force, energy and motion.

The loss of DOE funds not only quashed those aspirations but also cut into the Center's existing programs.

In the end, the occasional gallows joke and a longstanding commitment to education at Fermilab enabled the Center to survive. Staff members cobbled together some new financing; cut here and trimmed there; consolidated a little, stretched a lot. Now, over a year into the budget crisis and amid signs from Washington of renewed interest in science education, the Center is even heading in new directions.

The budget squeeze

New and creative financing came from two sources.

First, Chuck Marofske, head of the Laboratory Services Section, which includes the Education Office, reestablished priorities and pulled together money to keep critical education programs afloat. These funds, part of Fermilab's research budget, plus support from the Director's office, resulted in a funding plan of $490,000 for the current fiscal year. In fiscal year 1996, a one-time $150,000 contribution from the Universities Research Association, Inc., helped pay the Education Office's program costs, which exceeded $600,000.

"Education is part of Fermilab's mission. ...[Sharing] the laboratory's intellectual talent with the educational community makes enormous sense," Marofske said, explaining the new allocations.

The other source of funding was Friends of Fermilab (FFLA), a not-for-profit organization that secures public- and private-sector grants for Fermilab's precollege education programs. While FFLA had long raised money to support the programs' participants, for the first time this year, Marge Bardeen, manager of the Education Office, asked the organization to include funds to support her own staff. So far, FFLA has raised $350,000, roughly $90,000 of which will pay for infrastructure.

Even so, total funding for programs and infrastructure this year is down about 46 percent from its near-peak in 1995, the last year DOE provided support. As a result, program cuts made in 1996 remain in effect. Staff members eliminated the Outreach Program, which

Photo by Reidar Hahn

A multi-media program designed by the Science Education Center offers instruction on wild life habitats.

provided assistance for science education in local minority schools, as well as the Topics in Modern Physics Summer Institute, the DOE National High School Honors Research Program and the DOE Science Bowl. They also scaled back Science Adventures, which includes hands-on courses, such as Insect Safari, for primary school children, and the Cryogenics Show.

In addition, Bardeen handed over to Jeff Appel, head of the Experimental Physics Projects Department, two other programs: the Teacher Research Associates Program and a program that brought Latin American college students to Fermilab for summer research. "We just didn't have anyone to manage these programs," said Bardeen.

The budget problems also forced staff reductions through attrition. Staff numbers fell from 14 full-time equivalents to 9. Those remaining took on added responsibilities, leaving little time for curriculum development.

"We've been in a maintenance mode," said David Abler, education specialist.

New directions with technology

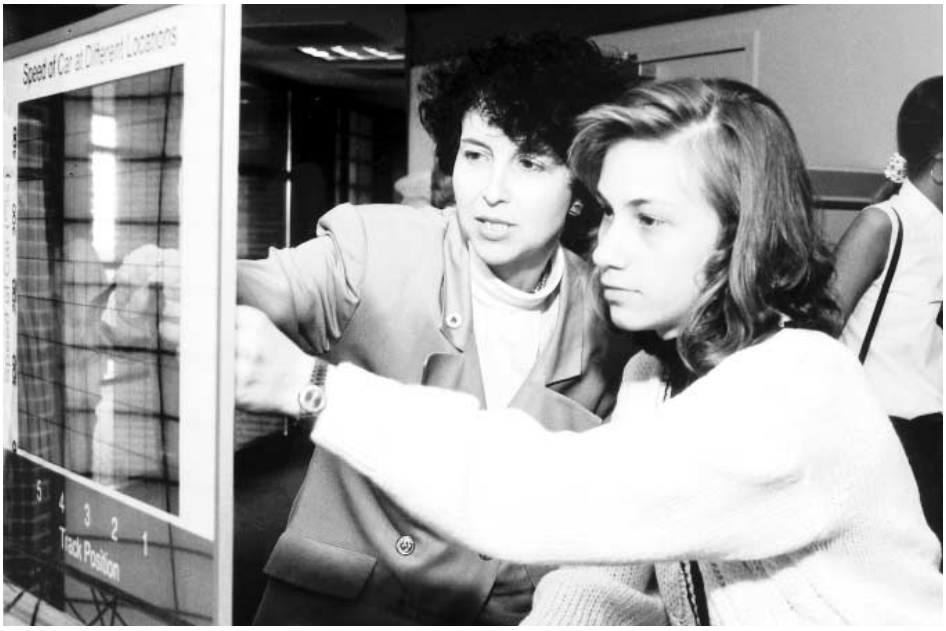
The FFLA grants this year are spurring activities in new directions, however.

With a grant from the North Central Regional Technology in Education Consortium, one of six regional consortia funded by the U.S. Department of Education, the Center is designing an on-line version of its 80-hour LInC (Leadership Institute Integrating Internet, Instruction and Curriculum) course, among other projects. The LInC course teaches educators not only the basics of Internet technology—for example, how to create a Web page and how to find information—but also ways to use that technology in the classroom. Laura Mengel of the Computing Division, who helped design and teaches the course, explained that the Web is an ideal tool for promoting what in education circles is called "engaged learning," or learning by inquiry and problem-solving.

An on-line course can cost-effectively reach a potentially unlimited number of teachers all across the country, said Mengel.

Under two Science Literacy grants from the Illinois Board of Education and a grant from an anonymous donor, the Education Center is launching a new four-year program called ARISE (American Renaissance in Science Education), spurred by Director Emeritus Leon M. Lederman. The program will support the development of a three-year standards-based science curriculum at six Illinois high schools.

Finally, under the same grants, the Education Center will revisit all its courses, field trips and instructional materials in light of state and national education standards advocating engaged learning. According to Bardeen, the Center's programs need to be updated and improved, integrating effective use of the Internet and tapping into the resources Fermilab has available for learning-by-doing: its scientists and its research.



Hands-on exhibits in the Science Education Center demonstrate the laws of physics.

In the Science Adventures program, children learn about the fish and insect life found in a pond on Fermilab's campus.

Photo by Jenny Mullins

Preschoolers use colored sand to "paint" a pattern drawn by a pendulum of glue.

Funding prospects

The question remains: what of the Education Center's future prospects?

"The hope is that if we can survive a few years, [funding for education] will pick up again," said Bardeen.

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Eric Colby, Ph.D. student from UCLA.

Joint University-Fermilab Ph.D. Program Finds Success

Degree program trains accelerator physicists at the world's highest-energy particle accelerator.

By Katherine Arnold, Office of Public Affairs

Students will not find a book in the library called *How to Become an Accelerator Physicist*. Few college catalogs have entries for accelerator physics. But a growing list of people say accelerator physics is their occupation, and 16 of them got their training at Fermilab under a special joint university-Fermilab Ph.D. program.

This program started in 1985 as a way to create dedicated training for accelerator physicists at the world's highest-energy particle accelerator.

"Many become accelerator physicists by becoming particle physicists, then working their way into accelerator physics," said Roy Rubinstein, who has been involved in the administrative end of the Ph.D. program since its inception. "Accelerators have a physics of their own. We felt there should be more training available specifically for accelerator physicists."

Since Fermilab is not an academic institution, it cannot award academic degrees. Instead, the program works with universities in a joint agreement: Fermilab provides the research facilities and mentors to guide students through their research, while the students maintain relationships with their home institution's advisers, who provide support for the research and see the students through to earning their degrees.

The Fermilab facilities offer an incomparable opportunity to study accelerator physics, said Fermilab physicist Pat Colestock.

"The main benefit of the program is that we have unique experimental capabilities," Colestock said. "We can offer opportunities on physical systems that do not exist anywhere else."

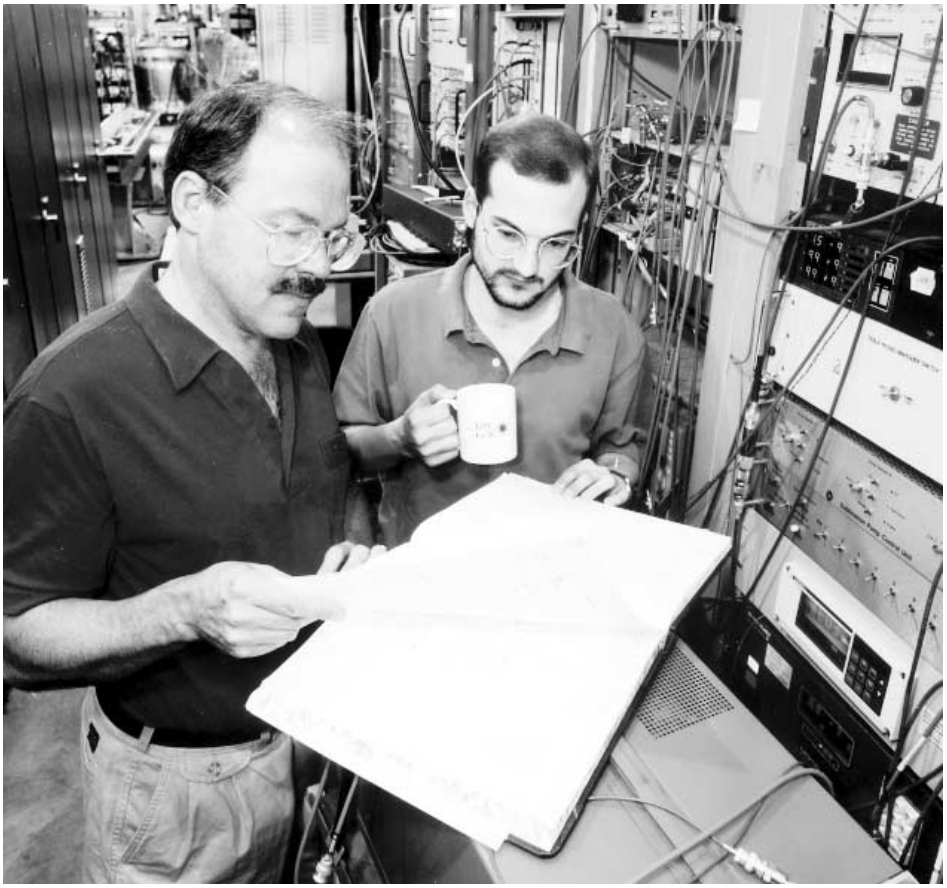
One of only a handful of programs of its kind, the accelerator physics Ph.D. program currently supports five students. Each student is paired with a mentor, who is traditionally a Fermilab physicist working on the same project. The mentoring responsibilities at Fermilab are similar to those of an academic adviser; the mentor assists with technical problems, determines what experiments need to be done, helps the student get access to needed equipment, and participates in preliminary exams as well as serving on the defense committee.

"You always run into problems, but you work with the student as a colleague to try and solve them," said Colestock, who is a Ph.D. program mentor for Mike Fitch, a graduate student from the University of Rochester.

Fitch is working with Colestock on the AZero photoinjector, a short-pulse, high-intensity electron source. Fitch worked at AZero for a year before applying for the university-Fermilab Ph.D. program. After a year in the program, Fitch's research on laser technology for the photoinjector is well under way.

Eric Colby, a graduate student from the University of California at Los Angeles who is also involved in the Fermilab-university program, is halfway through his sixth year at Fermilab. He is finishing work on the design, construction and testing of an electron injector, which accelerates electrons in a linear acceler-

Pat Colestock (left) and Mike Fitch, a graduate student from the University of Rochester, check the logbook at the AZero photoinjector.



Photos by Reidar Hahn

ator. Colby hopes to complete his graduate work sometime in July.

Katja Langen, a graduate student from the University of Wisconsin, has used the program to further her research in neutron therapy. Working closely with Arlene Lennox, the head of the Neutron Therapy Facility at Fermilab, Langen investigated the feasibility of using boron neutron capture therapy in the NTF. Langen hopes to finish her degree by the end of the summer.

These projects represent the range of opportunities available to students going into accelerator physics. David Finley, head of the Beams Division, pointed out that many of the research projects the students work on are simply waiting for someone who can devote some time to working on them.

"There is just so much that needs doing," Finley said. "These students come in and can dedicate 150 percent of their time to a project, which is much more than anyone else on staff can."

James Rosenzweig, UCLA professor and Colby's university adviser, said he will recommend this program to future students, not only for Colby's type of work but also for training in accelerator physics.

"Aside from the actual physics and experimental technology, they learn how to deal with a big laboratory," Rosenzweig said. "A large lab is their main future employment prospect, so they get the best of both worlds."

Since the program began, as many as 10 students have been supported at one time, with enrollment usually hovering around five students. Shekhar Mishra, chairman of the joint university-Fermilab Ph.D. program, added that acceptance into the program includes housing, tuition reimbursement and a stipend.

The first student to work with the joint relationship was Mike Syphers, now the project manager for the polarized photon project in the Relativistic Heavy Ion Collider at Brookhaven National Laboratory.

Syphers began working at Fermilab in 1980 as an accelerator operator. He was the first to enter the Ph.D. program, and he worked in conjunction with the University of Illinois at Chicago.

"I wanted to go to school and write a thesis on accelerator physics, so it was natural to start in the program," Syphers said. Syphers' project involved redesigning the beamline connection between the Booster accelerator and the Main Ring accelerator. He saw the project through from the design stage to construction.

After earning his Ph.D. in 1987, Syphers continued to work on the Main Ring accelerator and early designs of the Main Injector. When the Superconducting Supercollider lab formed, he moved to Texas to head the accelerator theory group. When the SSC folded in 1994, Syphers went to Brookhaven. He credits his experience at Fermilab and early training on an accelerator with his success in accelerator physics.

"To go into a field of accelerator physics is normally kind of difficult," Syphers said. "But having the opportunity to work on an accelerator and study basic accelerator physics is such great experience."

Since the program began, 16 students have earned Ph.D.s and one student earned a master's degree. The caliber of students and training continues to escalate, in line with demands in the future of high-energy physics, Finley said.

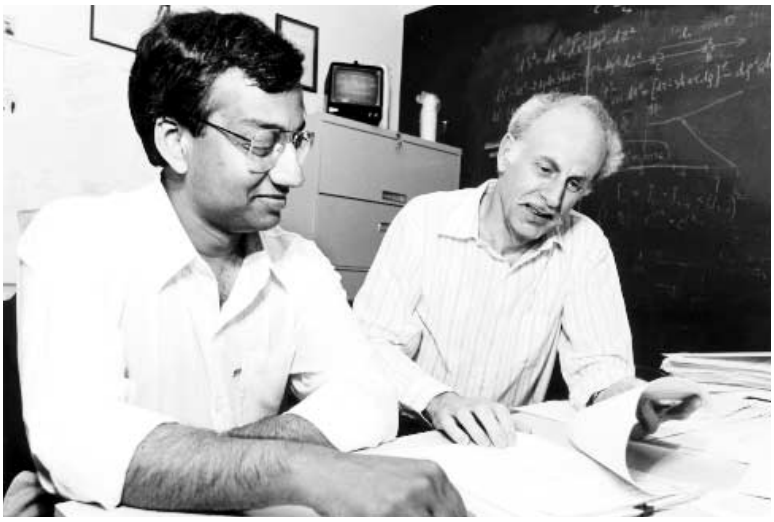
"The students that graduate today will be the ones building the professional grandchildren of today's experiments," he said. ■

[For more information about the Joint University-Fermilab Doctoral Program in Accelerator Physics, contact Roy Rubinstein at 630-840-4108 or at royr@fnal.gov.]

Mike Fitch, a student in the accelerator Ph.D. program.

" Accelerators have a physics of their own. We felt there should be more training available specifically for accelerator physicists."

~ Roy Rubinstein



Photos by Reidar Hahn

Shekhar Mishra (left) and Roy Rubinstein are both involved in administration of the joint university-Fermilab doctoral program in accelerator physics.

Photos by Reidar Hahn

Valerie Valdez, from the University of Rochester, listens as Jae Yu explains the fine points of data acquisition.

Summer Students Seek Scientific Success

Undergraduate programs provide education and experience.

by Andrew Shih, Office of Public Affairs

They're here.

Every summer, dozens of undergraduate students converge on Fermi National Accelerator Laboratory, eager to spend the summer working at one of the world's premier high-energy physics facilities. According to Joy Thomas, personnel administrator, 130 undergraduates work at Fermilab this summer. Of these, 36 arrived as participants in competitive programs offered by the Lab: Summer Internships for Physics Majors and Summer Internships in Science and Technology. These two programs combine education with hands-on experience to give the scientists of tomorrow a taste of science today.

Kim Garnier, from Bradley University, adjusts her instruments while inspecting a micro-detector.

Entering the world of physics

In 1979, Drasko Jovanovic, then Physics Department Chairman, started a program to employ some of the many undergraduates who applied for summer jobs at Fermilab. His creation has proven to be a solid success; about 300 students have completed the program, and several now hold tenured positions at research universities. Some are even current Laboratory experimenters.

Roger Dixon, program head, described his hopes for the summer physics students: "The idea is they're to come here and get experience working at a real research lab. ... I want them to see what doing science is really like."

Jovanovic, who remains involved in the program, agreed: "The central idea is not to worry about how they contribute to us, but to worry about how better they can benefit themselves."

By bringing a select group of undergraduates from across the nation together at Fermilab, Jovanovic and Dixon hope to groom a new generation of physicists for successful futures. From this once-in-a-lifetime experience, the students can move on to larger, more notable accomplishments.

"There's a good chance that some of our summer students will become important people in this field," said Dixon.

One of those future stars may be Joan Marler, a junior at Wellesley College. This summer, she's working in the Beams Division, helping construct a 50-foot interferometer. Her time at the Laboratory has provided a revealing glimpse into the scientific and social workings of high-energy physics.

"I guess it was a little more laid back than I expected," she said. "If something breaks, you know it's okay, [because] we're all learning."

Ricardo Vasquez, a junior at Purdue University, shares Marler's appreciation for the program. For his Lab assignment, he works on a prototype of a muon detector that will operate with the Large Hadron Collider at CERN. He will determine the proper tension in wires used

in one segment of the detector. Vasquez is particularly grateful for the support of his mentors here.

"They are willing to teach me what I don't know," he said.

Jovanovic is quick to deflect any praise for the program, however.

"I don't think the program should take credit for it at all," he said. "It just shows that it attracts very motivated people who are eager to [experience] the lab and learn something."

Listening to Kim Garnier, a sophomore at Bradley University, it's easy to understand Jovanovic's point of view. She's currently writing a program to test detector pixels in the Micro-Detector Group, a task that involves learning an unfamiliar programming language.

With a broad smile spreading across her face, she looks ahead to the rest of the summer and says, "I hope I figure this all out."

The all-around internship

Ryan Swain, undergraduate at Alabama A&M University, credits Fermilab with refocusing his career goals. In the summer of 1996, he found himself designing a method for measuring liquid helium levels at extremely low temperatures, which required more engineering work than he was accustomed to. Rising to the challenge, he discovered an appreciation for hands-on science.

"I came in thinking pure physics but came out thinking engineering physics. I was introduced to a whole new aspect of science, which I didn't even know had any relevance," he said.

Swain is one of over 500 students who have passed through the doors of Wilson Hall since 1972 as summer interns in science and technology. Sponsored by the Fermilab Equal Opportunity Office, the SIST program is targeted at undergraduate students from the minorities historically underrepresented in the sciences. Its goal is to provide these students with the opportunity to participate in cutting-edge physics research and to guide them toward scientific careers.

To achieve this goal, the program requires each student to complete oral and written reports based on a summer-long project.

"The projects that we do here are integral parts ... of what's really going on, so it gives [us] real-world experience," said Swain, now in his second summer at Fermilab.

Juan Jaramillo, a third-year student at the Rochester Institute of Technology, stresses another key aspect of the program, the generous support that Fermilab users and employees give to the students. He is currently working in the Computing Division, using object-oriented programming to design an interactive presentation for Laboratory visitors. When completed, this program will allow them to learn about Fermilab from a computer stationed in the atrium of Wilson Hall.

"They really care that we learn stuff here. It's not like most companies, where they throw you in an office and tell you, 'Hey, I want you to finish this by the end of the month,'" he said. "Here, they'll help you, they'll give you everything, they'll come around and look at you to see if you're doing well. It's really fun; you'll learn, and they'll help you a lot."

With a combination of education and on-the-job experience, SIST satisfies its students while providing the physics community with a diverse, bright crop of future scientists. Valerie Valdez, a junior at the University of Rochester, summarizes this success well:

"You get the experience, you work at Fermilab, you do your research project, and you're pretty much exposed to what you'll be doing in five or 10 years," she said. "It's the all-around internship program."

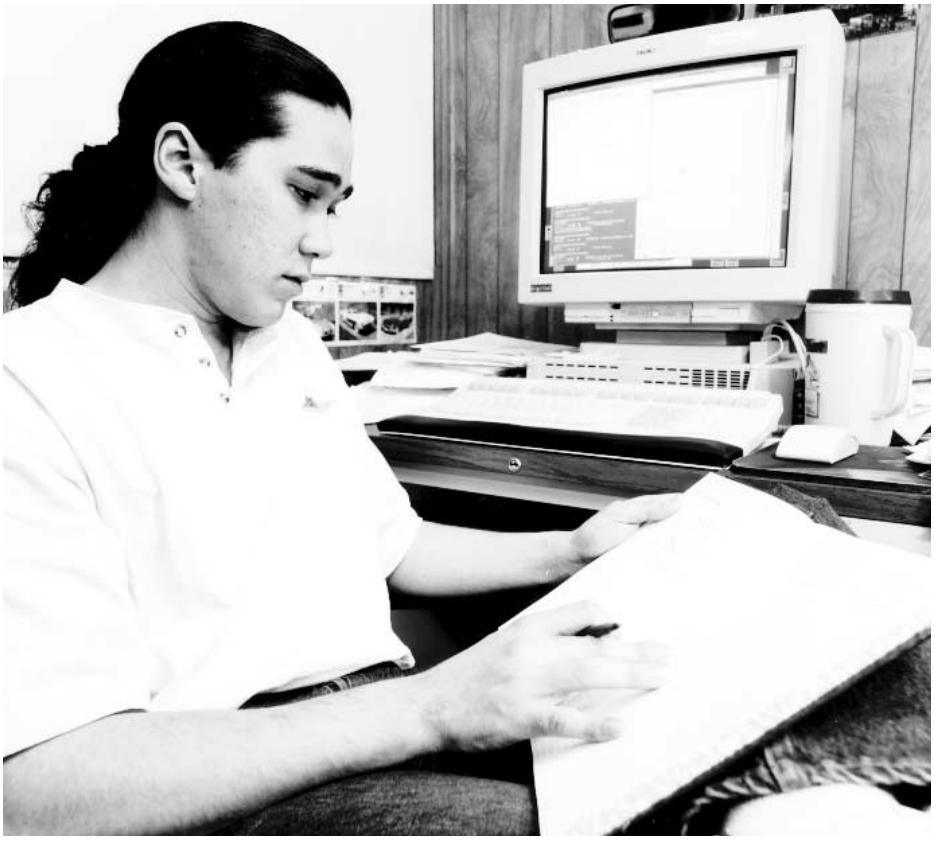
To infinity and beyond

These programs hope to continue their traditions of success for many years to come. Through decades of fluctuating support for the sciences, both Summer Internships for Physics Majors and Summer Internships in Science and Technology have managed to continue to provide real-world experience to undergraduates. The programs' efforts should guarantee a steady supply of eager young scientists for many years to come. And in the short term, the annual dose of youthful exuberance these students bring each June can't hurt, either. ■

Ryan Swain, undergraduate at Alabama A&M University, and his supervisor, Chandra Bhat, examine blueprints from the Main Injector.

Joan Marler, Wellesley College undergraduate, checks out her latest creation, an electromagnetic coil.

Sam Zeller, a graduate student from Northwestern University, checks connections in the NuTeV experiment hall.



John Crane, a graduate student from the University of Nebraska at Lincoln, has spent two years at Fermilab.

Photos by Reidar Hahn

Graduate Students Experience Real World of High-Energy Physics

Research and opportunity bring students to Fermilab from around the world.

By Katherine Arnold, Office of Public Affairs

When Eva Halkiadakis received a reporter's recent phone call regarding graduate student life at Fermilab, she politely asked if she could call back later. Halkiadakis, a graduate student from Rutgers University, and a co-worker at the KTeV experiment were in the middle of solving a tough problem. Her co-worker pointed out the irony of the situation: a graduate student too busy to talk about graduate student life.

Graduate students at Fermi National Accelerator Laboratory participate in almost every aspect of accelerator operations and research. Students are immediately indoctrinated into life on an experiment: running shifts, writing programs, fixing hardware and simply learning the ropes of high-energy physics.

About 600 graduate students work at Fermilab either on-site or at universities working on Lab-related projects, with about 400 coming from the United States and 200 from abroad. The variety of their backgrounds coupled with different degrees of classroom and experimental experience prompts many questions for graduate students as experiments continue. Halkiadakis, who has been at Fermilab since February, has found that talking to people is the best way to find the answers.

"It really is the most useful in learning something," Halkiadakis said. "And nine times out of 10, someone else has encountered the same problem."

Halkiadakis already knew some people on the experiment from her experience at the fixed-target experiment last summer. By now a veteran, she can answer questions for new students who are just starting out on the experiment.

Eva Halkiadakis, a graduate student from Rutgers University, works on a problem in the KTeV control room.

"But, of course, there is always more to learn," she added.

Culture shock

"I had been warned about the cold, but I don't think anyone is ever prepared for just how brutal Chicago winters can be," said Tacy Joffe-Minor, who just finished her Ph.D. from Northwestern University. Joffe-Minor has worked at Fermilab for five years. Before moving to the Chicago area to attend Northwestern, Joffe-Minor lived in Arkansas.

"It really was a drastic change in culture, weather, and the sheer number of people that live here," Joffe-Minor said.

Joffe-Minor began her work at Fermilab on a hardware project for DZero with just a few other people.

"My first year here was very isolated," she said. "There were days when I would talk to only one other person."

Many graduate students face a similar scenario at the beginning of their work at the Laboratory, said John Crane, a graduate student from the University of Nebraska at Lincoln.

"A graduate student can often end up sitting alone on shift or working on a project," he said.

It can sometimes be a lonely life for a graduate student coming into an experiment such as DZero with its 450-plus collaborators and 80 or so graduate students. In an effort to mix the social with the academic, each Thursday evening in the Fermilab cafeteria, "The University of DZero" holds a pizza session for graduate students with invited lectures on a wide range of topics. At fixed-target experiment 815, Sam Zeller, a graduate student from Northwestern University, said she and some of the other graduate students from E815 all had their preliminary exams at the same time, so they got together to study and ask questions of each other.

"It was something small, but it helped," Zeller said.

Enter the GSA

Zeller, Crane and Joffe-Minor are all representatives or former representatives to the Graduate Student Association at Fermilab, formed about three years ago. Michael Begel, a graduate student from the University of Rochester, is one of the GSA's founding members.

"A lot of graduate students tend to come to Fermilab, go to their experiment halls and never leave," Begel said. "They don't know what's going on elsewhere."

The GSA aims to let students know what is happening at other experiments and provide a forum for students to meet each other and to exchange ideas about anything from research ideas to employment.

"We also want to answer questions about graduate students' concerns about life on-site," Begel said.

The GSA works to give a more formal voice to graduate students and to represent them at high-level meetings. In May, the GSA invited three people to offer their perspectives on job markets and to provide a forum for discussion about careers in high-energy physics.

"Soon after the SSC collapsed, a lot of students started to worry about their future in the field," Begel said. "One of the things people were looking for was skills to take into the workplace."

For the second year, the GSA is organizing a graduate student conference, which will take place July 17-18. Fermilab and UEC will sponsor the conference, called New Perspectives '97. It will give graduate students the opportunity to present their research in a formal setting, as well as give other students the opportunity to see what projects others are working on. Leon Lederman will be the keynote speaker for the conference at the opening address on July 17.

As another service to graduate students, the GSA is offering two summer school courses, one on collider physics, taught by Wai-Yee Keung, and another on the physics of particle detectors, taught by Dan Green. Course enrollment is limited to 80 students. This is the second year summer school courses are being offered.

The GSA also maintains a comprehensive job links page on the Internet that links to several other employment pages for high-energy physicists. Crane says this is a valuable tool for graduate students.

"There are very few pages (on the World Wide Web) dedicated to finding jobs in high-energy physics," he said.

Other GSA activities include meetings (usually every other month) and group outings. The organization is planning a trip open to all graduate students to the Museum of Science and Industry. The main purpose in organizing these events is to help graduate students get to know each other.

"Your first inclination is to assume everyone around you is a postdoc," Joffe-Minor said. "But there are a lot more graduate students around than people think." ■

[For more information on the GSA, see its Web page at http://www.fnal.gov/orgs/gsa.]

Profiles
IN PARTICLE PHYSICS

Maria Spiropulu

Graduate Student
from Harvard University
working on CDF

by Sharon Butler, Office of Public Affairs

In a cramped and darkened trailer office in the CDF parking lot, the computer screen shines like a stained glass window framing the world of cyberspace and data from the detector's latest run. Maria Spiropulu sits in front of her Silicon Graphics monitor in jeans and blacktop sneakers sipping Starbucks coffee. Like the particles she studies, the 27-year-old graduate student from Harvard is herself a bundle of energy measured in TeVs. At the moment, she is gushing about the sublime spheres of particle physics.

"It is like the ancient meaning of the word tragedy," she claims, her wide, kohl-rimmed eyes lighting up. First, there is the mimicking of significant events—the experiment. Then comes the catharsis, or the insight, and, finally, the wonder and exhilaration. "When you solve a problem, it is like a revelation or something," she says in precise English spiced with rich Greek accents. "It is really beau-tee-fool!"

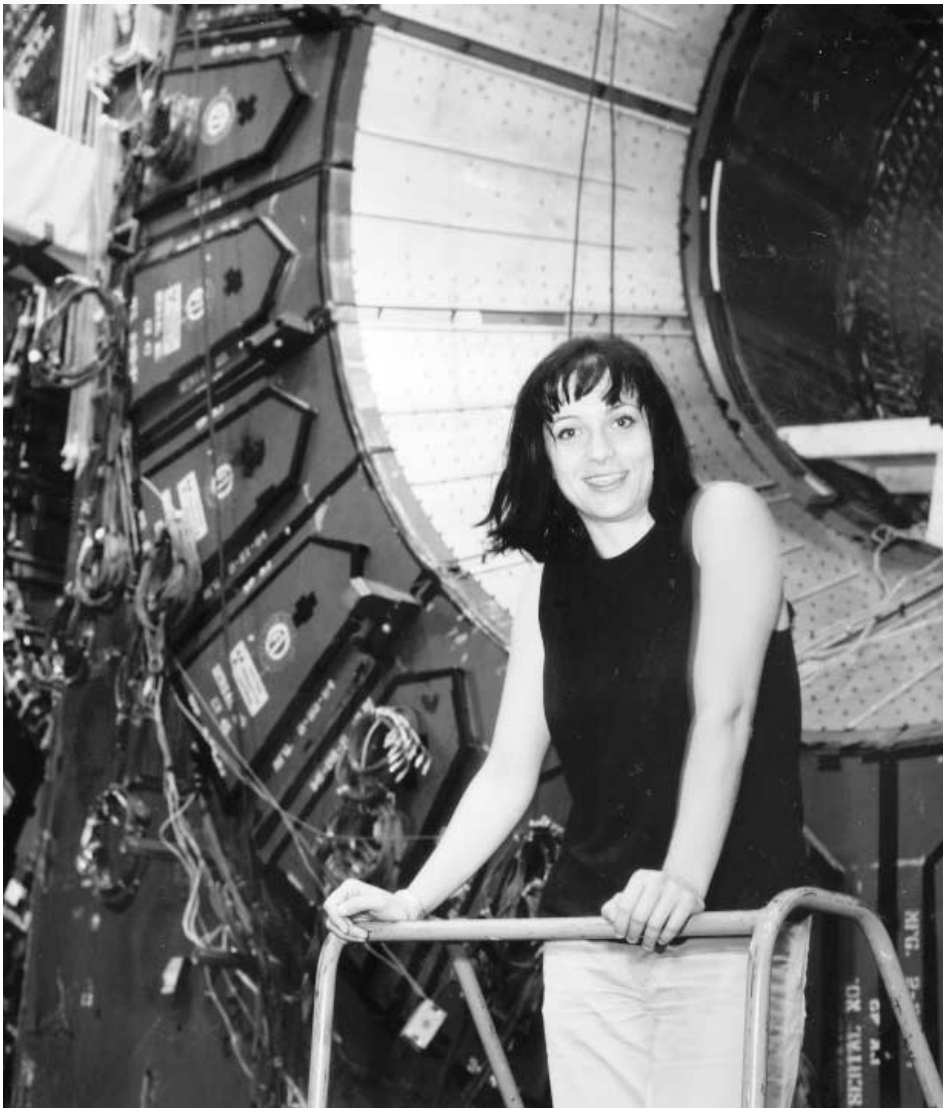


Photo by Reidar Hahn

Spiropulu does what she calls, with a grin, "dirty physics"—the physics of the complex interactions that occur when protons collide with antiprotons to create quarks and jets, a spray of multiple particles. While the CDF experiment at Fermilab stopped taking data in 1996, Spiropulu, like many other scientists, is busy analyzing the results from Run I. She is searching for the supersymmetric partners of quarks and gluons or, more precisely, for their trace: the telltale missing energy. "Missing energy is the only thing you see, or don't see," she says, catching herself in a curious contradiction. "I know it's crazy. I am searching for nothing."

In her four years of graduate studies, a year and a half of which was spent at Fermilab, that search has meant graveyard shifts and Christmas vacations tending the detector. Scribbles on the whiteboard in marker green attest to a recent all-nighter solving a difficult technical problem. She has built electronic modules for the upgraded detector's data acquisition system and set up a test stand for the silicon readout controller, all demanding complicated logic. The hardware part, though, was her obligation; physics, as she says, is her tragedy.

Graduate-student life hasn't been all work. She practices tae kwon do and plays drums for the Drug Sniffing Dogs, CDF's resident rock band. Her bookshelves may be heavy with physics and mathematics volumes, but in between them stand copies of *Ulysses* and *Genius* (Richard Feynman is her hero) and the program to *Master Class*. Tacked to the wall are posters of *The Double Life of Veronique*.

And right beside her computer is an 8x10 photo of an idyllic white-washed village tucked away in the soft blue mountains of northern Greece. This is Kastoria, where as a child she first tested the laws of gravity by attaching makeshift wings and, to her parents' horror, jumping from the tops of telephone poles.

To this day, she says, her father calls her a "coconut" for delving into the abstruse world of particle physics. He teases her that the field hasn't gone anywhere since Einstein's theory of relativity.

Never mind. One of the conveners of her research group, David Stuart, calls Spiropulu the "missing-energy guru." She concedes she may not find the supersymmetric gluinos and squarks she is looking for, but at least she will be able to define the outer limits on the masses and cross sections of the putative particles. And she will have advanced science by narrowing the search.

"It is great fun!" she exclaims, her eyes lighting up once again. "It is a tragedy!" ■

Photo by Reidar Hahn

High school physics teachers experiment with a wind tunnel.

Education Survives

continued from page 3

Indeed, Washington is showing renewed interest in education, albeit limited. In the mail is a $40,000 check from DOE for Fermilab's Summer Internships in Science and Technology Program, geared toward minority college students embarking on engineering and science careers.

Also, funding agencies are encouraging more involvement in education. NSF, for example, now requires that its principal investigators on research grants engage in education and outreach.

Support for precollege education programs, however, remains uncertain.

As Bardeen explained, politicians and public officials readily appreciate the value of summer research at Fermilab for college students. But they have difficulty grasping why children and school teachers need to be educated here.

Bardeen staunchly defended the value of Fermilab's precollege education programs: "[Children and school teachers] come here to emulate the process of scientific research. We present material so that kids and teachers become investigators." Here, she said, they can calculate the mass of the top quark from DZero data on the Web, identify *W* and *Z* particles using CDF data in an interactive computer game or ponder why the wind invariably wraps them around the curves of Wilson Hall. "They don't just follow a cookbook," Bardeen said.

With all the interest in engaged learning, Bardeen hopes Washington will finally come around. If it does, that physics playground staff members dreamed of may one day become a reality. And just in case it doesn't, the Education Center is already at work on a virtual one. ■

[For more information on the precollege science education programs at Fermilab, contact the Leon M. Lederman Science Education Center at 630-840-8258.]

Chez Léon

MENU

Lunch served from
11:30 a.m. to 1 p.m.
$8 / person
Dinner served at 7 p.m.
$20 / person

For reservations call x4512
Cakes for Special Occasions
Dietary Restrictions
Contact Tita, x3524

Lunch
Wednesday
July 9

Closed

Dinner
Thursday
July 10

Closed

Lunch
Wednesday
July 16

Grilled Flank Steak
with Peapods
and Mushrooms
Strawberry Sorbet

Dinner
Thursday
July 17

Fresh Mozzarella and
Tomato Salad with Basil
Grilled Lamb Chops
Risotto with
Wild Mushrooms
Fresh Spinach
Vanilla Flan with
Raspberry Sauce

CLASSIFIEDS

FOR SALE

■ ’87 Toyota Corolla LE sedan, silver, excellent condition, 107K miles, 5-speed manual, nearly new tires, battery, exhaust, AM / FM cassette stereo, air, $3300. Call Rod, x2565 or (630) 365-5956.

■ Coleman 5000 Generator-120 / 220, 5,000-watt output, 10-hp engine, $400. Call Gary, x3712.

■ Hedstrom metal swing set with two swings, lawn swing, glider, and metal slide, $40; wood sand box with two seats, $5. Call Jerry, x4571 or (630) 801-9408, or e-mail JerryZ@fnal.gov.

■ Full-size firm mattress set with frame and traditional wood headboard and footboard, $200; crystal chandelier, two tiers w / crystal pendants. Uses eight 60-watt candelabra bulbs, $100; Panasonic microwave oven, full size, 600 watts, $50. Call Nan, x4550.

■ ’88 29-ft. Terry Tauras camper. Sleeps six, has living room / bedroom with queen-size bed, bathroom and kitchen (needs fridge). Air conditioning, gas furnace and hot water heater (propane). Attached to camper is a 10x24-ft. screen room on a 10x33-ft. deck. Camper is by a man-made lake. For more info, call Bill Carter, (630) 879–7567.

■ Three-bedroom ranch three blocks from Fermilab, 30W074 Dogwood Ct., Warrenville. Remodeled kitchen and bath, fresh paint, cozy fireplace, fenced-in yard and 1-car garage. Great offer in school district 200 Wheaton / Warrenville. Homeowners Association includes pool, tennis courts and club house. Asking $114,900. Call Karen, (630) 393–6657.

WANTED

■ Highly interactive, experienced childcare sought. Long-term position from July 1997 caring for a pleasant, musical 2-1 / 2-year-old girl five days / week, 9–5. Cognitive development training desirable; English fluency and car necessary. Salary very competitive. References please. Nicole Jordan, Warrenville, 393-3970.

LETTER TO THE EDITOR

To the editor:

In paragraph #5 of the subject article (*FermiNews*, June 20, 1997, page 2) it is written, “Physicists have discovered six types of quarks and leptons...”

On the other hand, in paragraph #1 of the May 2, 1997, *FermiNews* article, “Searching for the Standard Model Holdout,” we find the statement, “What reporters and even a few physicists forgot is that the elusive tau neutrino, while firmly entrenched in the Standard Model, has never been directly observed.”

Did I miss the announcement of results from E872 (presumably expected within 18 months of the May, 1997 article) or more importantly, did I miss the party?

~Dave Carlson

CALENDAR

JULY 11

International Film Society presents *Naked*, dir. Mike Leigh, GB (1993), 8 p.m. in Ramsey Auditorium, admission $4.

JULY 24

“The ‘New’ Hong Kong: Is ‘One Country, Two Systems’ a Workable Model?” Lecture by Dr. James A. Winship, Augustana College. Thursday at 8 p.m. in Ramsey Auditorium. Free.

JULY 25

Fermilab golf outing at the Blackhawk Golf Club (formerly Burr Hill). Scramble format. Greens fee with cart: $38. Scramble fee: $12 per team. Optional contests: $3 per person. Deadline for collecting fees is July 11th. To obtain more information, sign up, or pay fees, contact Bob Andree, x3703, or Don Arnold, x2871.

JULY 30

The Heartland Blood Center blood drive, Wednesday, 30 July, from 9–2 in the WH GF NE conference / training room. Any questions regarding donating, call x3232.

ONGOING

NALWO coffee mornings, Thursdays, 10 a.m. in the Users’ Center, call Selitha Raja, (630) 305–7769. In the Village Barn, international folk dancing, Thursdays, 7:30–10 p.m., call Mady, (630) 584-0825; Scottish country dancing Tuesdays, 7–9:30 p.m., call Doug, x8194.

LAB NOTE

Power outages shut down accelerator

Two short power outages on June 23 caused problems for several of the operations at Fermi National Accelerator Laboratory. A transformer explosion at the Commonwealth Edison substation in Elmhurst triggered a brief power glitch at 12:14 p.m. The glitch was enough to shut down the linear accelerator and instigate what would have been about two hours of down time.

But a second power failure at 1:26 p.m., which lasted for about 30 seconds, caused several accelerator systems to fail. The power shut down because a transformer went out at the Wayne, Ill., substation.

Bob Mau, head of accelerator operations, said the second power failure essentially shut down the entire ring. The magnets had to be cooled, which took about 12 hours, vacuum pumps had to be turned back on and the booster power supply for the kicker magnet had to be repaired, among other assorted problems. Down-time totaled about 30 hours.

MILESTONE

BORN

[redacted] Dana (TD / DTD) and PennyLou Cameron Walbridge [redacted]

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Fermi National Accelerator Laboratory

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The deadline for the Friday, July 18, 1997, issue of FermiNews is Tuesday, July 8.

Please send your article submissions, classified advertisements and ideas to the Public Affairs Office, MS 206 or e-mail ferminews@fnal.gov

FermiNews welcomes letters from readers. Please include your name and daytime phone number.

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