FermiNews

Fermi National Accelerator Laboratory

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Digital photo enhancement by Donald Montoya for *Los Alamos Science*, No. 25, 1997

These phototubes from Los Alamos National Laboratory will be used in the MiniBooNE experiment to detect the oscillation of neutrinos and demonstrate whether the elusive particles have mass.

INSIDE

Last month, results from the Super-Kamiokande experiment measuring the number of atmospheric neutrinos prompted headlines around the world. Neutrinos have mass, newspapers proclaimed. Members of the scientific collaboration boldly stated in a press release that this was "the single most important finding about neutrinos since their discovery."

As impressive as Super-Kamiokande's data were, however, high-energy physicists say that there is still a long way to go to demonstrate conclusively that the elusive particles oscillate, and hence have mass. The spotlight is now on accelerator experiments like Fermilab's MiniBooNE and MINOS. *See story on page 2.*

Still Pursuing Those Neutrinos

Photo courtesy of University of Hawai'i

Physicists John Learned (standing), Shigenobu Matsuno (right) and Dean Takemori, of the University of Hawai'i, display a photomultiplier light detector, like one of the thousands lining the Super-K neutrino detector tank.

Photo by Reidar Hahn

A 1-kiloton detector in an underground mine in Minnesota is now employed in the study of atmospheric neutrinos. It will be modified for use in the MINOS experiment.

by Sharon Butler, Office of Public Affairs

The subject of scientific measurements for half a century, neutrinos are strange little particles produced when radioactive elements decay. Free of charge and antisocial, they rarely interact with other members of the subatomic world. They come in several varieties. In 1956, Fred Reines and Clyde Cowan observed the first neutrino interactions. Then in 1962, Leon Lederman, Mel Schwartz and Jack Steinberger discovered that muon neutrinos are different from electron neutrinos. Both discoveries produced Nobel prizes. A Fermilab experiment, DONUT, hopes to be the first to observe a tau neutrino directly.

Over the years, neutrinos have prompted some of the oddest experimental proposals in the annals of high-energy physics. To find them in nuclear explosions, Reines and Cowan once contemplated suspending a detector from the top of a tank in a shaft near ground zero, and releasing the detector just as the explosion took place. For two seconds, the experimenters estimated, they'd be able to "see" antineutrinos and record their signals. Meanwhile, the shock from the blast would rattle the tank, but not the plummeting detector. "When all was relatively quiet," Cowan said, "the detector would reach the bottom of the tank, landing on a thick pile of foam rubber and feathers."

Neutrinos have also prompted some of the biggest experiments. Super-Kamiokande—Super-K, for short—uses a 50,000-ton detector filled with 12.5 million gallons of ultra-clean water. The detector is lined with 13,000 photomultiplier tubes so sensitive to light that they can detect a single photon. The experimenters have been collecting data for almost two years now.

Size *does* matter, especially the size of the data set. That's where accelerator experiments come in. Capable of generating large numbers of events, they can get definitive and extended results.

"Cosmic-ray experiments have always provided important new observations in particle physics," said Tom Fields, project manager for MINOS (Main Injector Neutrino Oscillation Search). "But accelerator experiments—where scientists know precisely the composition and energy of the beam—have always been essential to a better understanding of the physics."

Do neutrinos oscillate?

At the Neutrinos '98 conference in Takayama, Japan, last month, scientists from the Super-K experiment presented their two years of data measuring the number of neutrinos in the Earth's atmosphere, generated by cosmic rays.

When high-energy cosmic rays, mostly protons, strike nuclei in the upper atmosphere, they produce a spray of high-energy pions, which decay to produce two muon neutrinos for every electron neutrino.

According to these well-studied physical processes, then, experimenters counting atmospheric neutrinos should find about twice as many muon neutrinos as electron neutrinos. But in separate experimental observations, the first in 1992, the ratio came closer to 1:1. Scientists began to refer to the "atmospheric neutrino anomaly" and put forth a number of explanations. There might be more electron neutrinos than physicists thought, perhaps from some unexpected extraterrestrial source. Calculations of the relative neutrino flux might be wrong. The water detectors might be faulty. The most intriguing explanation, though, was that the neutrinos had oscillated—in which case, neutrinos had mass. Confirmation was needed.

The Super-K experiment, with more data and better statistics, not only confirmed the anomaly, but went a step further. The scientists measured neutrinos coming into their detector from directly overhead (the "zenith angle") as well as neutrinos entering the detector from the bottom, traveling through the Earth an extra 10,000 kilometers and giving them a greater distance in which to change from one kind of neutrino into another and back again. Remarkably, the experimenters found an "up-down asymmetry"—a difference in the number of muon neutrinos depending on whether they took the shorter or longer path to reach the detector. After ruling out other possibilities, the collaboration proudly announced it had found "evidence for" neutrino oscillations.

Fields called Super-K "the best [atmospheric neutrino] experiment to date," but he cautioned that such experiments are "extremely difficult; that's why you can't put too much credence in one experiment." Before "evidence for" can become bona fide discovery, statistics need to be checked, more data amassed, defects in the detector ruled out. Other experiments need to weigh in and verify the results.

Appearance vs. disappearance

Super-K, like all atmospheric neutrino experiments, also has limitations.

"The real proof that neutrinos are oscillating is showing that one neutrino type changes into another as either the energy or distance changes from the source," said Mike Shaevitz, professor of physics at Columbia University and MiniBooNE collaborator.

The Super-K experiment addressed half of that equation: it measured the disappearance of muon neutrinos, a reduction in the number of neutrino interactions, but "what they disappeared into is anybody's guess," said Vernon Sandberg, a physicist at Los Alamos National Laboratory and another MiniBooNE collaborator.

"You can give all sorts of explanations, but you have to talk about what you can measure," he added.

In contrast with atmospheric and solar neutrino experiments, both categorized as "disappearance" experiments, MiniBooNE, MINOS and other accelerator experiments are "appearance" experiments. These start with a virtually unadulterated beam of muon neutrinos, say, and determine whether electron neutrinos (in the case of MiniBooNE) or tau neutrinos (in the case of MINOS) appear down the line—incontrovertible proof that neutrinos have oscillated.

Only the beginning

That's why the Super-K results have Bill Louis, cospokesperson for MiniBooNE, all fired up. Not only has the experiment strengthened the case for neutrino oscillations, he said, but it has given added impetus to accelerator experiments like MINOS and MiniBooNE. Only accelerator experiments can precisely measure the masses and mixings, or combinations, of neutrinos.

That's what excites Shaevitz also. "If Super-K is really seeing oscillations, then at least one neutrino has a finite mass and neutrinos with different masses must mix to form the electron, muon and tau neutrinos we detect," he explained. "To me, this is the greatest insight coming out of the Super-K results."

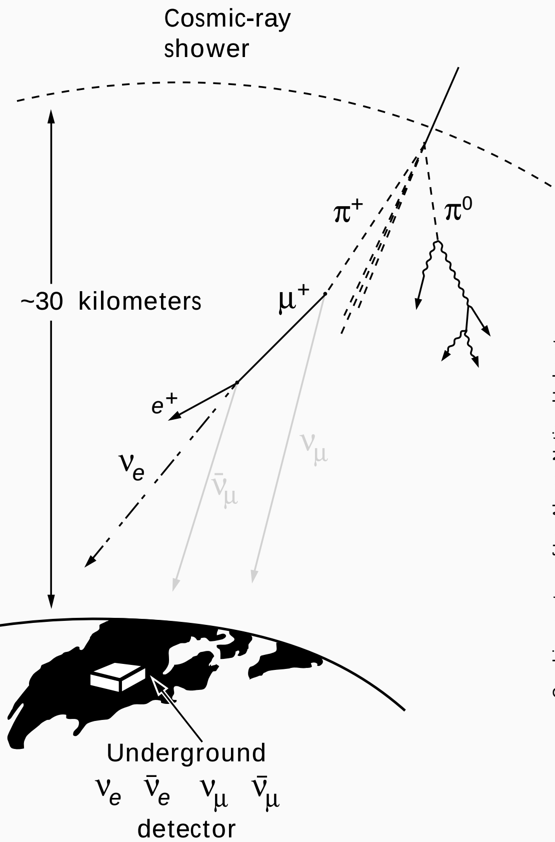
How neutrinos mix has immediate bearing on large and unresolved questions in particle physics: whether quarks and leptons are distinct families of fundamental particles or are instead related in ways suggested by a grand unified theory; why there are three generations of particles instead of two or four; why neutrinos are over a billion times smaller than their charged partners, the electron, muon and tau leptons.

"For over 20 years, we have been trying to understand how quarks are mixed," Shaevitz said. "Now we have a whole new arena to explore, the mixing of neutrinos." ■

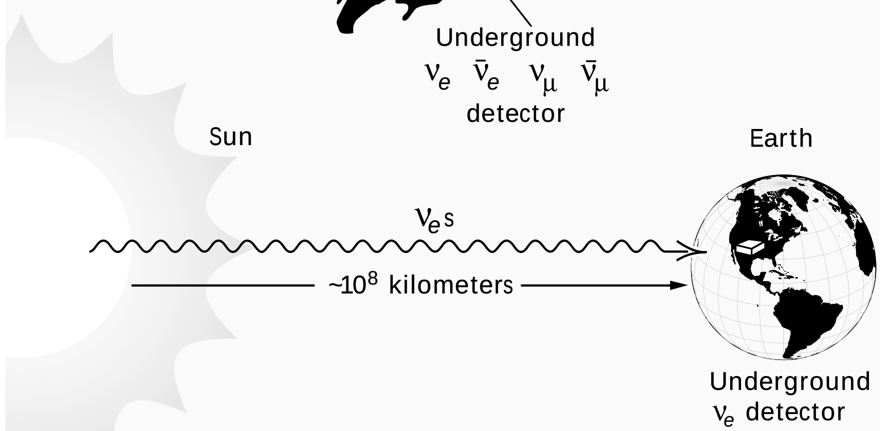
Different types of experiments to determine whether neutrinos have mass

Disappearance Experiments

Atmospheric neutrino experiments: Cosmic rays produce showers of high-energy pions, which ultimately decay into muon and electron neutrinos in a ratio of 2:1. However, physicists have found a much smaller ratio. This "neutrino deficit" is explained by the oscillation of muon to tau neutrinos.

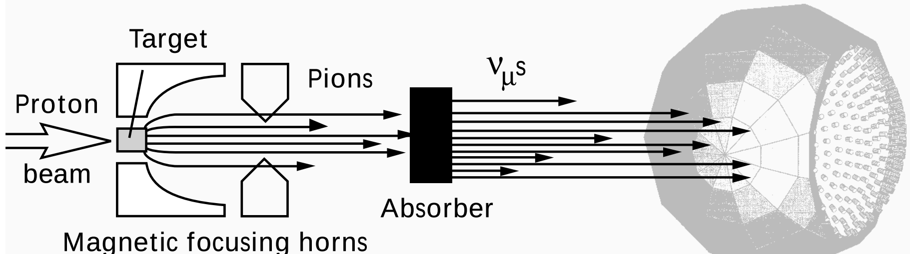


Graphics courtesy of Los Alamos National Laboratory



Solar neutrino experiments: Large underground detectors measuring the flux of electron neutrinos produced in the Sun's core have found fewer ν_es than physics would predict. The oscillation of electron neutrinos into other types of neutrinos might explain their disappearance.

Appearance Experiment (An Example)



MiniBooNE: Scheduled for commissioning in 2001, the MiniBooNE experiment will determine whether muon neutrinos oscillate into electron neutrinos.

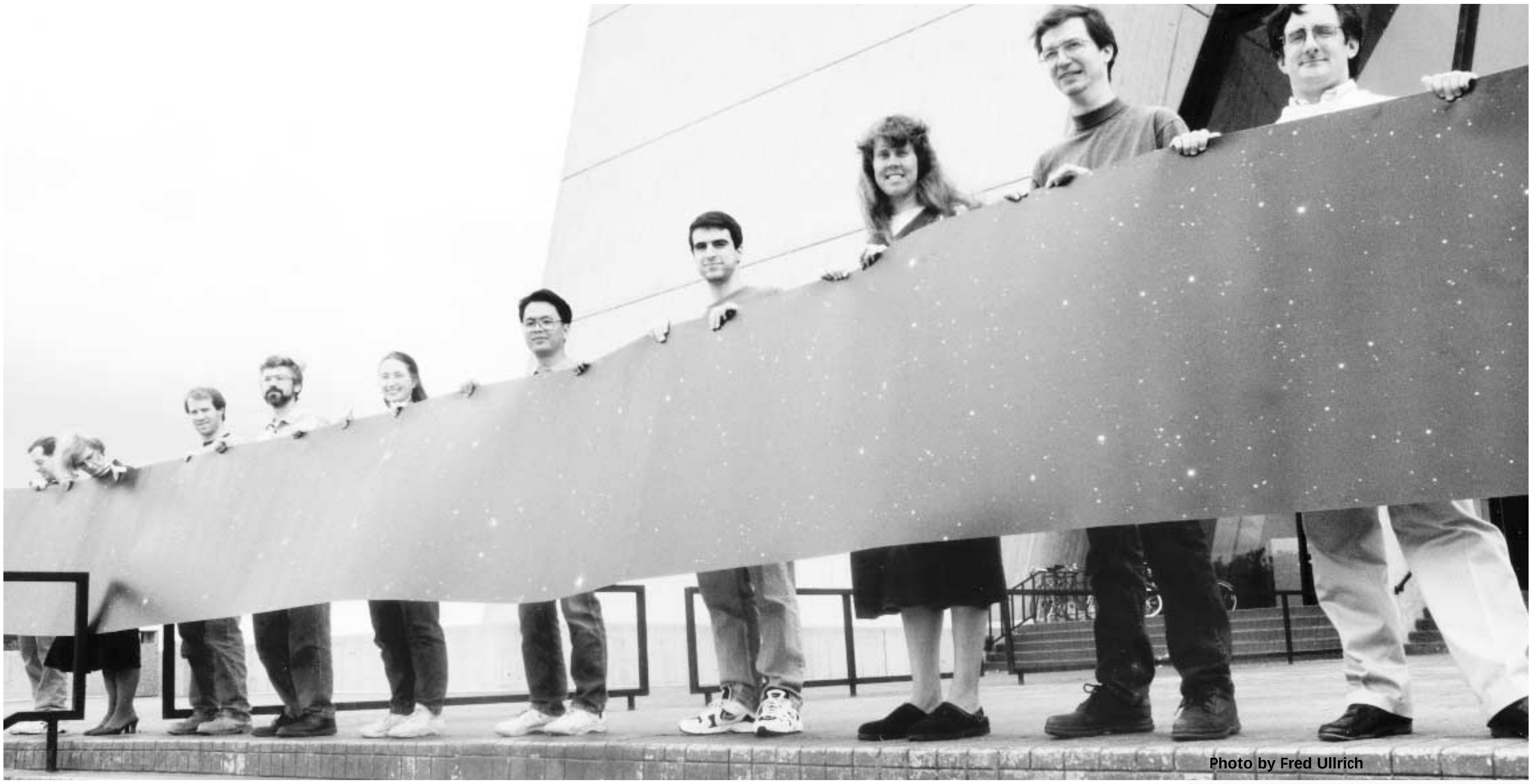


Photo by Fred Ullrich

Members of Fermilab's Experimental Astrophysics Group unfurl a 30-foot image of the sky from the first light of the Sloan Digital Sky Survey.

Answering the Call of the Sky

Fermilab's computing, technical and management skills helped the Sloan Digital Sky Survey get off the ground.

by Mike Perricone, Office of Public Affairs

Picture a map of the entire surface of the earth, with a resolution to 40 feet—detailed enough to show individual houses.

Now picture yourself viewing this high-resolution map in three dimensions: circling skyscrapers, dipping into valleys, soaring over mountains.

The Sloan Digital Sky Survey will spend the next five years producing that level of resolution to build a three-dimensional model of one-quarter of the night sky—the segment scanned by a 2.5-meter optical telescope, with its $6-million camera and 52 charge-coupled devices, at Apache Point observatory in New Mexico.

"The Sloan is like having a U.S. Geological Survey map of the sky, whereas before we had the equivalent of directions drawn on the back of a paper napkin," said Rich Kron, head of Fermilab's Experimental Astrophysics Group and scientific co-spokesman for SDSS. "We'll use something like a computer design program, where you can rotate things and see around them on all sides."

Fermilab scientists, computer professionals, engineers and technicians have designed, built and maintained some of Sloan's most critical components: complex data acquisition and processing systems; controls for telescope movement; mechanisms for changing the telescope's fiber cartridges eight times a night; technical support people on hand for troubleshooting at Apache Point; even the comparatively mundane process of shipping data tapes by courier from the telescope to the Lab's Feynman Computing Center.

"We've been able to draw on resources from throughout the lab, and the level of expertise and effort that Fermilab people have brought to the project has been incredible," said Bill Boroski of Technical Division, who maintained the project schedule as manager of Fermilab SDSS tasks.

Fermilab's original responsibility on SDSS was to build the large data handling system for such tasks as recording the positions and brightnesses of 100 million stars, and controlling and monitoring the instruments.

"It was soon clear that the scope of the software needed for the Sky Survey was much larger than anyone realized," said Ruth Pordes of Computing Division, an original contributor to the software design.

The data was to be organized into programs called "pipelines," designed to automate the processing of information and produce a coherent result. Computer

SLOAN DIGITAL SKY SURVEY

professionals schooled in high-energy physics confronted two immediate differences in astrophysics. First, the amount of data for an HEP "event" ran between 10 kilobytes and 250 kilobytes; the data in a "frame," an arbitrarily determined rectangular segment of sky, would run about eight megabytes. Second, each event in high energy physics is independent, and independently analyzed; scanning the sky, however, creates a steady stream of interrelated data, with frames that overlap to assure that no information is missed on the boundaries.

Don Petravick's computing group worked in four areas:

- the data acquisition system, which would be running at the telescope 1,500 miles away from the Lab;
- the software framework for data reduction and online quality checks, including the creation of a new imaging system called DERVISH;
- general software engineering, creating tools for writing all the software in the survey, including some standard Fermilab software adapted for Sloan, and some written specifically for Sloan that has been adapted for CDF in Run II of the Tevatron ("a very nice cross-fertilization," said Petravick);
- the offline computing hardware for the data reduction at the Lab's Feynman Computing Center.

A group headed by EAG's Chris Stoughton and Brian Yanny brought the pipelines together coherently, making the scientific judgment of whether the information flowing through the pipeline is correct, sufficient and consistently labeled throughout the process.

But the project's technical scope also proved much larger than anyone imagined.

"Some of us on the technical committees for the project realized there was work that needed to get done and wasn't getting done," said Paul Mantsch of Technical Division, coordinator of Fermilab SDSS tasks. "We realized we had the capability to do it. Software was our main focus, but clearly, the telescope also had to work."

In 1994 the Lab helped the University of Washington begin fabricating the fiber mapper, a device used in conjunction with fiber plug plates, aluminum disks about 30 inches in diameter drilled with 640 tiny and precisely-located holes. Threaded into each hole is a fiber optic cable to record the light from a specific position in the sky and relay it to the CCDs. The mapper identifies which cable is in which hole. The telescope uses nine large cartridges holding these plug plates each night; more than 3,000 unique plates will be used over the course of the survey. Carl Lindenmeyer and the PPD Machine Development Group, under John Korienek, developed a sophisticated system of carts, racks and elevators to move the cartridges on and off the telescope and store them.

In 1996, the Lab offered to take on the telescope control system. The task soon grew to include telescope interlocks and various mechanical devices. Using expertise developed from accelerator interlocks, the Beams Division Interlocks Group implemented a state-of-the-art system. Hundreds of interlocks are used to sense telescope motions and stop actions that might damage instruments or equipment. Additionally, engineers from throughout the Lab have worked on mechanical devices including brakes that hold the telescope in position, counterweights that maintain telescope balance and latches that hold instruments safely and securely on the telescope.

When the Sky Survey achieved first light on May 27, it marked the culmination not only of the astrophysics, computing and technical efforts, but also of the kind of technical management effort that the Lab regards as a trademark from a long history of managing big science projects. Fermilab Director John Peoples now serves as chair of the Survey's management committee.

When Boroski joined the effort in August 1996, he teamed with astrophysicist Steve Kent, Fermilab's institutional co-leader of the project, and Mike Evans of the University of Washington to develop a project-wide schedule and task list. They spent months on the road interviewing collaborators at the various institutions to create a detailed project schedule. It worked.

"We hit first light within a couple of weeks of what the schedule showed," Boroski said.

But there's no scheduling weather. Sloan might encounter few suitable nights for viewing during its five-year mission.

"The current best guess is something like 1500 total hours of clear weather to get the required imaging data," Kent said. "That is indeed over the whole five years...we need perfectly clear skies with little turbulence and no moon."

When the "ON" button gets pushed, the telescope has to work. Angela Prosapio and Steve Bastian of the Particle Physics Division relocated to Apache Point Observatory in early 1997 to provide full-time support for Fermilab telescope activities. Bastian handles mechanical support duties, while Prosapio takes care of the electronics.

"I don't know anything about stars," said Prosapio. "But after all the work we've done on the project, it's really neat to see the images appearing from first light." ■

John Anderson and Glenn Federwitz (front) check the telescope's interlock system.

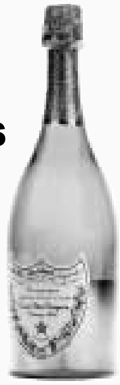
Photos by Reidar Hahn

Carl Lindenmeyer rolls the cart in place to change the mapping cartridge on the telescope at Apache Point.

For more information on SDSS, see www.sdss.org.

“Why should the U.S. remain a world lea

Essay Contest Winners



The judges have chosen the winning entries in the first-ever *FermiNews* essay contest. *FermiNews* received a total of 36 entries by the May 5 deadline. All were sent to the judges “blind,” identified only by letters of the alphabet, not by author. Contest judges were Robert Eisenstein, Assistant Director for Mathematical and Physical Sciences of the National Science Foundation; Peter Rosen, Associate Director for High Energy and Nuclear Physics of the Department of Energy; Curt Suplee, science writer and editor for *The Washington Post*; and Michael Witherell, Chair of the High Energy Physics Advisory Panel.

Photo by P. A. Moore

FIRST PLACE:
Glen Crawford,
Stanford Linear Accelerator Center

We watch with wonder the images beamed back to Earth by the Mars Sojourner probe: wonder at the fact that we are seeing pictures of a new, largely unexplored world. It is a great tribute to our spac program that we can see these pictures and wonder, that these images lead us to ask important questions about our place in the cosmos. Yet we are also exploring strange new worlds right here on Earth, worlds just as wondrous, worlds that require new and exciting technologies just to visit, worlds that ask and answer even more questions about how our universe came to be. These are the worlds of inner space, as far inside the structure of matter as we can see. Deep inside the atom there exists a world of tiny, invisible particles that are the building blocks of the universe;
this is the world of high-energy physics.

If we could send back pictures from this world, it would look far stranger than Mars. We would see particles arise out of nothingness, fluttering into existence for a billionth of a billionth of a second, and then disappearing back into the void. We would see a world of amazing order and predictability, yet one whose fundamental patterns and symmetries are mysteriously broken. And we know that some day this world will give us answers to fundamental questions, such as: Why do things have mass? Why is there so much matter and so little antimatter? And why are there so many of these tiny “elementary” particles, anyway?

When people ask why we should continue to do research about a world so removed, so different from our own, I say the reasons are just the same as in the exploration of space, or any other new frontier. The journey is in some ways an end in itself: you never really know what you’re going to find until you go. From Lewis and Clark to Aldrin, Armstrong and Collins we have explored new territories because they were exciting, challenging, and because we learned so many new things just getting there.

No one would have promoted building particle accelerators or detectors because it would save lives—yet much of today’s medical imaging is based on technology developed to detect invisible particles. No one would ever have claimed particle physics would change the way we communicate—yet it was particle physicists and their need to share large amounts of information in that gave birth to the World Wide Web.

At the beginning of this century, few would have expected scientific research to fundamentally change the world. But continued and consistent investments in science by the United States have helped make it the economic, technological and research leader of the world at the close of the century. As we head into the new millennium, few would doubt that scientific research will remake our world yet again. It is our choice whether we want to help make this new world or retreat from it. ■

er in the science of high-energy physics?"

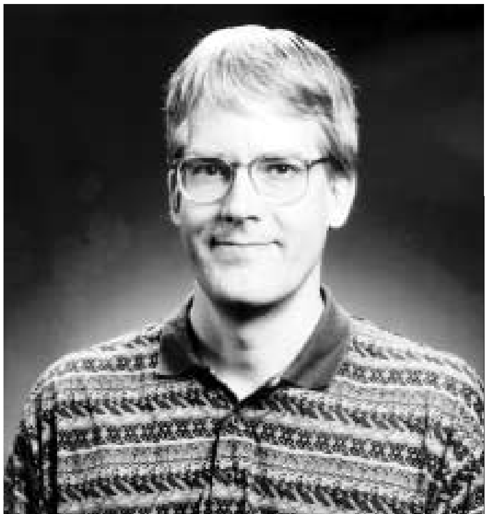


Photo by Reidar Hahn

SECOND PLACE:
Joe Lykken,
Fermi National Accelerator Laboratory

There are few today who would question the critical importance of basic scientific research. America's leadership in basic science sows the seeds of our future prosperity, ennobles our society with a higher purpose, and provides a common ground for peaceful cooperation with other nations. We depend upon basic science as a resource, mined from an inexhaustible mother lode of knowledge. The federal government acts as the primary custodian of this resource, ensuring a balanced and refined supply, freely shared by all.

High-energy physics has qualities and value that make it unique among the branches of basic science. Only high-energy physics seeks to articulate the fundamental character of physical law, and to identify the primary agents and constituents of physical reality. Physical events play out upon an underlayment of interwoven fields of energy and matter. High-energy physicists tug at the microscopic knots of this cosmic weave. They divine the symmetries that give it order and elegance, and untangle the dense woof of its complex dynamics.

This is the science of extremes: the smallest, the largest, the hottest, the densest, the most energetic. Ghostlike neutrinos stream through the earth and leave no effect, but quarks are trapped in tiny prisons by powerful nuclear glue. Some particles, left undisturbed, will live forever, but others wink in and out of existence in the most fleeting of moments. Gravity reaches across the universe to corral whole galaxies, while the weak force cannot even reach across a proton to grab a quark.

High-energy physics, more than any other human enterprise, tests the limits of our imaginations and the rigors of our intellects. Its role in science is not only to probe the nature of matter, energy, space, and time, but also to inspire young people with the sweep and depth of scientific endeavor. As a leader in high energy physics, the United States can more easily remain preeminent in science as a whole.

The spectacular progress in high-energy physics of the past half century has made this the most advanced and best tested of all scientific disciplines. This progress has also increased the expense and complexity of the U.S. program. But the money we spend is primarily an investment in people: thousands of highly-trained experimenters, theorists, students, accelerator physicists, computer scientists, technicians and engineers. U.S. high-energy physicists add to the intellectual vigor of a hundred universities, while our high-energy physics laboratories are magnets for the best minds from around the world.

High-energy physicists, by definition, work at the most far-flung frontiers of human knowledge. For each frontier settled, two new ones open up. In this sense, high-energy physics is a challenge particularly suited to the American spirit. To give up our leadership on these frontiers is to deny the bold ambitions, restless energies, and nimble ingenuity that have brought us so much success. If we go forward, there is no limit to what we can learn, and no limit to how this knowledge may affect our future. ■

We asked the judges to rank their top four choices in order. A first choice received five points, a second choice three points, a third choice two points and a fourth choice one point. The two essays with the most points won. First-place winner Glen Crawford, an experimental physicist from Stanford Linear Accelerator Facility, will receive a bottle of Moët et Chandon Dom Pérignon Cuvée 1990 champagne. Second-place winner Joe Lykken, a theorist from Fermilab, will receive a flag flown over the U.S. Capitol in his honor, presented by Representative Vern Ehlers (R-MI), a physicist and a member of the House Science Committee.

The Case of the Missing Copper

Slightly radioactive parts stolen from construction site

by Judy Jackson, Office of Public Affairs

There was some bad news, and there was some worse news. And there was some good news.

The bad news was that $23,000 worth of copper accelerator parts turned up missing, presumed stolen, from a Laboratory storage area in early June.

The worse news was that they were radioactive.

The good news was that the level of radioactivity was so low it was barely detectable—far below any levels that could pose a risk to anyone's health or to the environment. A person standing a foot away from the copper parts would absorb less than 0.02 millirem per hour, compared to 1 millirem (50 times that amount) from a commercial plane flight, Fermilab radiation experts said. The copper theft was not a danger.

"But it was an embarrassment," said Bruce Chrisman, Fermilab's associate director for administration. "We try to keep close tabs and inventory on any radioactive material. We tag [with a 'radioactive' label] virtually everything that's even slightly above background levels."

There was more bad news as well, but this time for the thieves: the copper parts, worth thousands to Fermilab as specialized accelerator components, would bring only about $250 on the scrap metal market, the usual destination of stolen metal materials. Most scrap dealers check metal for radioactivity before buying it. But, said Chrisman, "the pieces that were stolen had such a low level of radioactivity that they are unlikely to be detected by the kind of detection equipment scrap dealers would use. Their equipment just isn't as sensitive as ours."

The radiofrequency cavity components that disappeared in June weren't the first items ever stolen from the Laboratory. Copper and other metal parts have walked away from Fermilab before. A few thefts from the railhead, near the site's northern border, in the early 1990s prompted a $100,000 security upgrade to that area from 1991 to 1993. Razor wire, nighttime lighting and stepped-up patrols have stopped those thefts. Fermilab also runs its own scrap operation for separating, sorting and selling excess materials.

The Laboratory exercises particular care in safeguarding the low-level radioactive material generated by normal accelerator operations. Most radioactive materials are in accelerator tunnels behind lock and key, sequestered by an elaborate interlock system. For storage, most low-level radioactive materials, such as magnets and test equipment, are housed in a specially constructed, fenced-off building made of shielding block.

Unfortunately, the latest stolen copper wasn't stored in the secured area, but in the relatively open environment of Main Injector construction activity. The parts were awaiting re-installation in the re-assembled Tevatron RF cavity for Collider Run II.

"Clearly, we need to have better control of materials that are stored in these areas," Chrisman said. "This has been a very unfortunate incident, but I know we'll learn from it."

Fermilab officials alerted law enforcement agencies in Kane and DuPage Counties of the copper theft, and a Laboratory press release asked anyone with information about the possible whereabouts of the parts to call the Fermilab Office of Public Affairs. The bad news: So far, none of the tips received has led to the stolen parts.

Beams Division staff said the theft would not delay the completion and commissioning of the Fermilab accelerator complex for Run II. That, they said, was good news indeed. ■

Fenced and lighted, the railhead area provides secure storage for materials at Fermilab, including radioactive materials. But the stolen copper wasn't stored at the railhead.

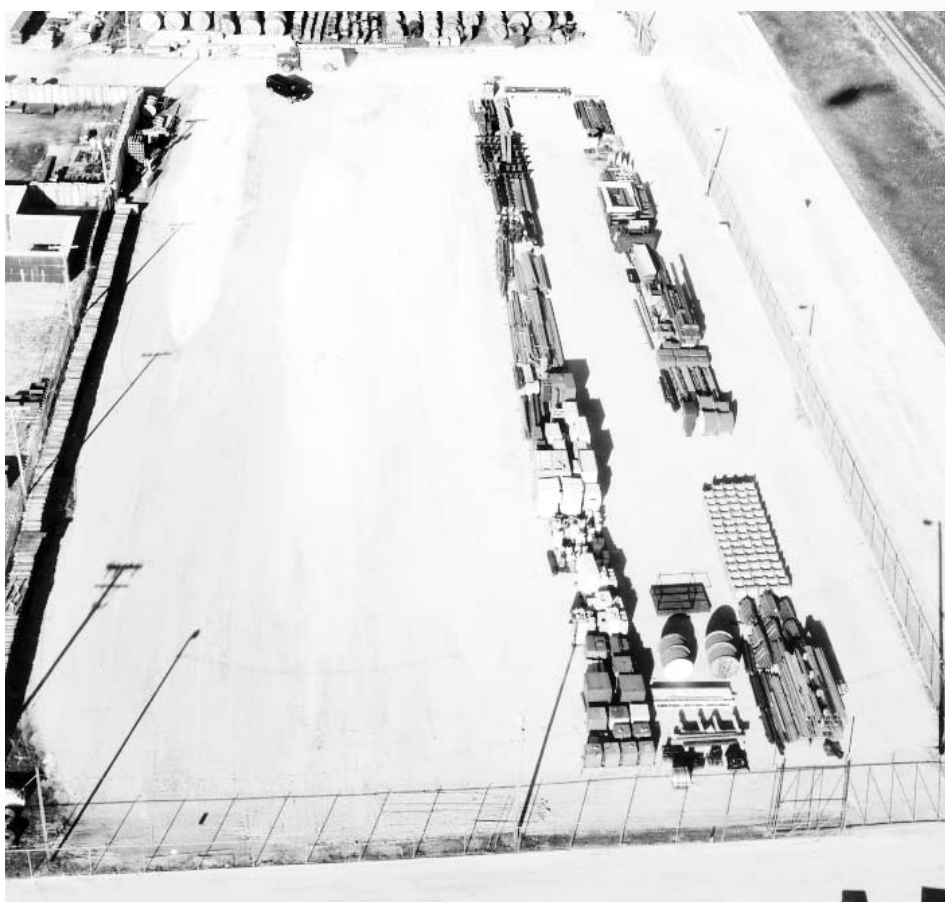


Photo by Reidar Hahn

From Industrial Zone to Technical Campus

The bubble chamber area gets a second life through adaptive reuse.

by John Scifers, Office of Public Affairs

Photo by Reidar Hahn

As the technical campus takes shape, integrated structures may replace the portakamps and debris now in the area (see inset photo). The master plan shows how the creation of associated space for engineers, technicians, and physicists in the area will allow them to stay close to their work which, in theory, results in a better product.

"It's [all] just kind of sitting out there rusting away," says John Cooper, head of the Particle Physics Division, describing the heap of rail cars, concrete blocks and machinery that clutter parts of Fermilab's fixed-target area. But the zone is evolving into a "technical campus" for PPD.

The 800-GeV fixed-target program is winding down with two final experiments scheduled for 1999. Consequently, many of the buildings in the area now do little more than house ancient equipment. The underuse of the structures has prompted a collaboration between PPD and the Facilities Engineering Services Section to revitalize the area. The work involves clearing the area before the buildings—described by Cooper as "big boxes...like Menard's"—are converted to construction space for future experiments.

In 1997, at the direction of Fermilab Director John Peoples, FESS engineers Steve Dixon and Ed Crumply worked with architect Gregory Splinter, from the consulting firm Fluor Daniel, to devise a master plan for the project. The plan solidified concepts put forth by PPD Deputy Head Stephen Pordes, PPD Associate Head Hans Jöstlein and Cooper. It calls for updating, or "adaptively reusing," existing buildings, with the addition of new structures to facilitate interaction between them. The budget-conscious plan permits growth as the needs of experimental programs dictate. Successive phases of construction will then match a long-range vision of how the area should develop.

Jöstlein, who coordinates the project, has already created usable space out of the jumbled area. Concrete blocks are now in storage. Retired equipment has also found a new home. For example, a hydrogen dewar, a storage tank constructed to work like a thermos bottle, has gone to the Texas Engineering Experiment Station. Some equipment, like the 100-ton magnet yoke for the Tohoku bubble chamber, is too costly to preserve. In these cases, Jöstlein arranges for scrap dealers to take the material in exchange for its removal.

Some previously unused labs have been converted into office space and clean rooms for silicon detector work. But renovation doesn't always make sense. Many of the portakamps, trailers originally intended for long-term temporary use, need considerable repair. By Cooper's estimate, the cost of portakamp renovation is half that of new construction, but the temporary structures would have a much shorter life. So Fermilab's money may go farther in permanent "real" space that provides a better working environment.

That's why PPD is constructing office space in a connecting hall joining labs C and D. The $500,000 project, supported by general plant project funds, will create both an enclosed hallway between the two clean-room labs and space for an additional 20 to 30 people. Its pitched roof will depart from the flat design of others at Fermilab, and the dark-blue roofing will blend with other buildings. The connector is scheduled for completion this October.

A landscaped area will serve as a courtyard between the renovated buildings. The area, about the size of a football field, will invite people to stroll across in favorable weather.

The whole area may one day have the atmosphere of a college campus for engineers, technicians and physicists. The area would provide both visual appeal and, more important, satisfaction to those who work there.

So, a technical campus will emerge piece by piece. As Cooper says, "I did my first experiment at Fermilab as a graduate student in this very area.... We can't just leave [its] clean-up for the next generation." ■

CRITICAL PATH

Pat 'n' Mike Save the Day

Photo by Reidar Hahn

Patrick Hurh inspects one of the 4,000 welds that were repaired in the LCW system.

Photo by Reidar Hahn

Mike May displays the mechanical cleaning device he developed, using bocci balls.

by Judy Jackson, Office of Public Affairs

November 20, 1997 was a dark day for Fermilab's Main Injector project. That was the day when Beams Division staff discovered that bacteria in standing water had eaten holes in the stainless steel pipes of their brand new low-conductivity water system. The LCW system is a critical part of the cooling for Fermilab's newest accelerator, the Main Injector, now entering the home stretch of construction. And the LCW was leaking like a sieve.

For a while, it looked as if the whole $6 million system might have to be ripped out and replaced. The effects on the project's cost and schedule scarcely bore contemplation.

That's why, said Director John Peoples at a June 15 ceremony, it gave him particular pleasure to present recognition awards to two Fermilab engineers.

"We were confronted with a huge problem," Peoples said. "They led us out of the woods."

Together, with the benefit of a crash course in microbiology and the development of some unorthodox technology, Beams Division engineers Pat Hurh and Mike May found ways to clean the pipes, fix the leaks, kill the metal-chomping bugs and keep the Main Injector project on track—all for under a million dollars, far less than consultants' estimates.

"I don't think this is covered in any college textbooks," said Beams Division head Steve Holmes, who nominated May and Hurh for the Employee Recognition Awards. "Pat became an expert in things he didn't know much about," including the habits of pipe-dwelling organisms, "and Mike showed incredible ingenuity in inventing tools to fix the problem—including a device that used four bocci balls from Sportmart."

Bocci balls?

The clean-up required pulling Fermilab-designed cable-drawn devices through the contaminated pipes.

"In pulling something through a round pipe," May explained, "the best position for pulling is in the center of the pipe. In going around elbows and bends, we needed to force the cable into the center. We figured the best way to do that was with different-sized balls, progressing from small to large."

May hooked up a golf ball, then two wooden bocci balls drilled through the center. He used a standard bocci ball and a custom size of five and a half inches in diameter. May figures the whole assembly cost about $120.

The custom cleaner scrubbed out some of the system. A second contraption combined a flapper wheel with another Fermilab invention, an orbital drum guided by a robot TV camera, to scour the rest.

"Going around the elbows was tricky," May said.

It may have been tricky, but it was much less costly than chemical cleaning, a process some consultants recommended. Research by Technical Division physicist Peter Mazur demonstrated that mechanical cleaning was at least as effective, at less than one tenth the price.

Hurh, who boned up on biology to battle the bugs, managed welding repairs. He said that the long-term solution to bacterial problems involves heating the water in the system to a high enough temperature to kill the bacteria, a process that accelerator experts can accomplish by running the pumps in the system without the heat exchangers.

"We'll take biosamples about once a month," Hurh said. "But once we're running, the magnets will heat up the water, and the system might take care of itself."

Hurh and May have a mid-September deadline to complete their water work. Water is now flowing through one-sixth of the LCW system, with only one new leak discovered.

The two also want to spread the word on their repair methods. While water system problems are quite common in the nuclear power industry, Hurh said, "they don't want to talk about it. We don't know exactly how they fix things. But now, we know how to do it. We have created good, inexpensive cleaning and inspection tools. Now if people have these problems, we can provide answers." ■

CALENDAR

JULY 10

Potluck Supper at Kuhn (Village) Barn. This time please bring meat to barbecue as well as a salad, dessert or side dish to share. For kids, we have hamburgers & hot dogs, for everyone soft drinks, for adults wine & beer. We will start at 6.00 pm, the grill will be hot at 6.30 pm. Babysitting is not provided for the summer potlucks. For further questions, call Martina Erdmann (630) 983-7021 or Sherry Nicklaus (630) 761-3139.

Fermilab International Film Society presents: *The Atomic Cafe* Dir: Jayne Loader, Kevin & Pierce Rafferty, (USA). Film begins at 8 p.m., Ramsey Auditorium, Wilson Hall. Admission $4. (630) 840-8000.

JULY 13 & 14

Fermilab Annual Users Meeting.

JULY 16 & 17

The GSA annual graduate student conference, New Perspectives, from 9 a.m.- 3 p.m. There will also be a poster session following the Users Meeting on the 14th (Tuesday).

JULY 25

Fermilab Art Series presents: *Muzsikas with Marta Sebestyen*, $16. Performance begins at 8 p.m., Ramsey Auditorium, Wilson Hall. For reservations or more information, call (630) 840-ARTS.

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.

Web site for Fermilab events: http://www.fnal.gov/faw/events.html

LETTER TO THE EDITOR

FermiNews, Volume 20, Number 19 with its stories on the Main Ring and the Visitors' Day, is a collectors' item. To really appreciate what an accomplishment the Main Ring was, you have to move back a few years before Oak Brook in 1967. Fermilab was actually born in Berkeley with the "200-BeV Project". (That was in the early sixties, before BeV became GeV.) I was part of that project, and the last cost estimate we had for the facility was $330 million, with an additional $30 million for a large hydrogen bubble chamber. The design was very solid and would have worked beautifully at turn on. But there was also no way that its energy could be increased or that a second ring could be fitted in the tunnel.

Bob Wilson, being a Wyoming cowboy, was not above exaggerating the wild and woolly impression of Fermilab's genesis. The truth of the matter is that, when Congress only authorized $250 million for the project, he was faced with a $110 million (30 percent) shortfall. The money simply wasn't there to do a conservative design.

Although he had not built a large proton synchrotron, Wilson had built several electron synchrotrons, which are not essentially different, at Cornell. Since the money wasn't there, Wilson had to pick his experts, like Stan Livingston, Phil Livdahl, and Al Garran. He also had to choose his engineers, like Hank Hinterberger, Dick ______, Wayne Nestander.

It was an exciting time, and we all learned a lot. We especially had to learn to think things through, to understand a problem thoroughly before we brought it to Wilson. What appeared to be risk-taking oftentimes was a reflection of Wilson's insistence that we not cover our ignorance (or sloppiness) by throwing in some conservatism.


Photo by Reidar Hahn

Everyone remembers the magnet problem; it is easy to forget that, in context of the available budget, there was no way that we could have built even a properly conservative 200-GeV machine, let alone a 500 GeV machine with capability for addition of the Tevatron.

Thanks for recalling a great adventure. Would that the SSC had had such failures!

Tim Toohig
Boston College

PS: What is Andy Mravca looking at in the picture?

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
http://www.fnal.gov/faw/events/menus.html

Lunch Wednesday July 8

Closed

Dinner Thursday July 9

Closed

Lunch Wednesday July 15

Portabello Mushrooms
stuffed with
Spinach Frittata
Baby Green Salad with
Bacon Balsamic Vinaigrette
Lemon Cheesecake
with Glazed Summer Fruit

Dinner Thursday July 16

Booked

CLASSIFIEDS

FOR SALE

■ ’94 SE Mercury Cougar XR7, fully loaded, 50K miles, 4.6L V8, antilock brakes, traction control, dual airbags, p/s, p/b, power mirrors, locks, windows, antenna, & driver’s seat, prem. sound, cruise, A/C, rear defroster, keyless/lighted entry, remote trunk release, 2-tone paint, leather steering wheel, alum. wheels, new brakes, 1 yr old tires, 7/70 ext. factory warranty. Reduced-$10,500. Lauri, x2214 or (630) 406-6941.

■ ’92 Lincoln Continental Signature Sedan, 87K miles, loaded, 10 changer CD, moon roof, keyless entry, etc. $7,000 obo. Greg Lawrence, x3011 or (630) 557-2523.

■ ’91 Saturn SL2, 4-dr sedan, auto, A/C, ABS, CD player w/prem. audio & EQ, tilt, cruise, p/s, p/b. Original owner, well maintained, new brakes, tires, battery, alternator & accessory belt, 89K miles. $5,400 firm. Darren, x3530, (630) 778-6957, darrenq@fnal.gov.

■ ’91 Dodge Grand Caravan, 103K miles, red, good shape, clean interior a/c, power windows, privacy glass, roof rack, upgraded radio/cassette, full size spare. Rebuilt transmission, new radiator, new water pump. $4,000 Kelley, x4499 or kfreytag@fnal.gov.

■ ’90 Honda Civic DX, 2-dr hatchback, 1.5L 4-cyl, fwd, 4-speed auto, a/c, power steering & brakes, tilt steering wheel, rear defroster, 1 owner, runs great, 119K miles, $2,900 obo, x3817 or (630) 584-1429.

■ ’88 Toyota Corolla FX, well maintained., garage kept, very dependable, auto, a/c, p/s, p/b. 1 owner, new battery, exhaust, brakes, tires, 93K miles, $1,890; Bill, x4597, (630) 983-0279 p.m., ng@fnal.gov.

■ ’84 Corvette, black, glass top, 60K miles, new paint & tires. Very good running order. Best offer, (630) 852-2475.

■ Queen size sleeper sofa w/Serta spring bed. Exc. cond., rarely used, $350. Call (630) 717-5781.

■ Garage sale, July 11 & 12, (8:30-4) 42W848 Robin Lane, Hampshire, off Plank Rd (approx. 3/4 mi. east of Rte 47, north on Meadowlark 1 blk. left on Robin Lane). Collector series plates, Ski’s, Nordic Track exercise ski machine, dive equipment, artwork, microwave, lamps, subzero fridge/freezer 5.1 cu. ft. (qty. 2), queen size waterbed, light oak (1.5 yr. old), boating items, wood lathe (incld chisels & cabinet w/drawers), Ryobi detail carver w/case & 5 chisels, clothes, children’s items, & more. Call Terry x4572 or e-mail skweres@fnal.gov.

■ Misc. items, women’s 12 spd bicycle, $50; white vinyl corner kitchen set, seats 7, $50; Panasonic microwave oven; $50; Pfalzsgraff dinnerware for 8, white, $50; Tiffany ceiling fan w/light, 52", $40; Stereo bookcase, $20. Carmen Rotolo, x3834 or rotolo@fnal.gov.

■ Creme colored Schweiger sofa & oversized ottoman. Less than 1 year old, $400. Mixed floral pattern (mostly burgundy) Rowe sleeper-sofa w/innerspring mattress, 3 years old, $350. Nordic track ski machine, $250. White ’87 Ford Mustang, 110K miles, runs good, $1,400. John x2237 or scifers@fnal.gov.

■ Townhouse, Aurora Butterfield subdivision, 3 bdrms, den w/vaulted ceiling, 1.5 baths, recently painted inside, 2 car garage w/overhead storage loft, AC, water softener. All appliances stay, patio w/land-scaping, common area adjoins Big Woods Forest Preserve, school district 204, Naperville, $114,900. (630) 978-8634 or emr.61@inil.com.

■ Home, 3 bdrm w/living rm, family rm (fireplace) & kitchen. Fenced yard next to large park. Exc. cond., nearly new carpet, vinyl flooring, vinyl siding, & landscaping. Cul-de-sac location, quiet/nice neighborhood near Orchard Valley Golf course, west side of Aurora. Mins from shopping & I-88. $97,000 ($800/mo mortgage & taxes). Call Lee, x8236 or (630) 897-8643 for appointment.

RENT

■ 3 bedroom, 1-1/2 bath single family ranch style home in Summerlakes. $1,025/mo. Available to buy or rent w/option to buy. Short lease may be considered. Call Henry Schram x3377, ehschram@fnal.gov or p-0141.

WANTED

■ Day Care for 18 month old boy, mornings two or three times a week. Russian or English native language. Adults only. Please contact Julia Yarba, (630) 859-3463, or x8366, or e-mail yarba_j@fnal.gov.

■ Squash players, for Fermilab court or other nearby. No beginners, please. Call Gustavo, x8762 or e-mail cancelo@fnal.gov.

FREE

■ 40 gal. gas water heater. Used, works fine. You pick up, very close to Lab. Call Henry Schram, x3377, ehschram@fnal.gov or p-0141.

MILESTONES

BORN

■ Katharine Marie Schram to Henry (PPD) and Joyce on June 9, at Central DuPage Hospital in Winfield.

■ Samantha Jane Walter to Pennie Hall (TD/DTD) and Robert Walter on March 5, at Delnor Community Hospital in Geneva.

HONORED

■ Margaret Bingham, Mary Clifford, Sharon Gatz, Cheryl LaMaster, Stephen Meehan and Sharon White, by the Association of Science and Technology Centers, for working on Fermilab’s LInC Online with the Leon Lederman Science Education Center. The 1998 Honor Roll of teachers awards recognized teachers who have worked in cooperation with science centers across the nation to improve science education.

RETIRING

■ Donald Olson, I.D. #342, on July 17, from TD/Engineering & Fabrication. His last work day was June 25.

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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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