FermiNews

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INSIDE

Building A Better Beam

A team in the Accelerator Division has raised the Tevatron's intensity and improved the quality of the beam with technical innovations known as dampers and bunch spreaders.

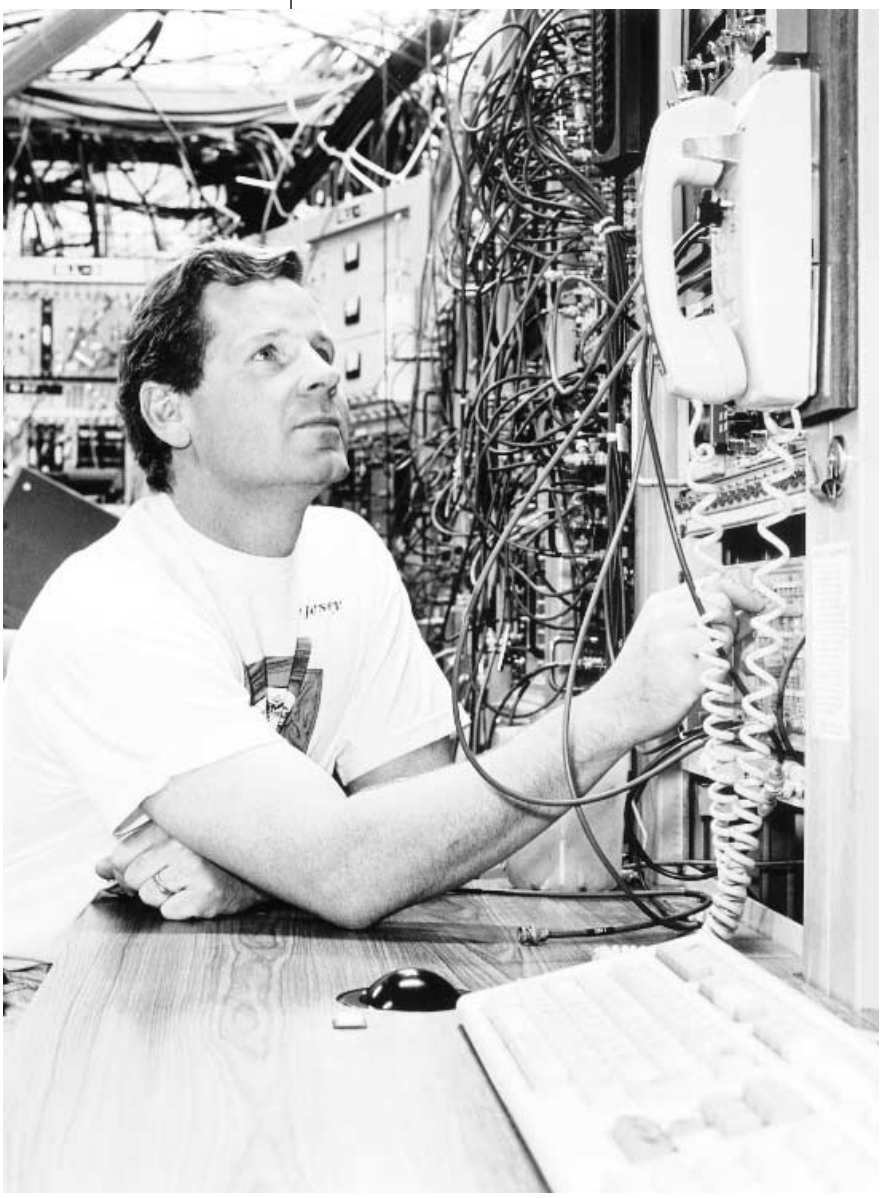

Photo by Ronald Hahn

Dave McGinnis, head of the Proton Source, and his team of engineers and technicians developed the newest generation of dampers and bunch spreaders, which have pushed the machine's intensity up and improved the beam's quality.

by Donald Sena, Office of Public Affairs

Before the present fixed-target run saw the first proton circulate around the Tevatron, Fermilab management presented the Accelerator Division with a challenge: Push the machine's intensity—or number of extracted protons—to a new record, allowing fixed-target researchers to accumulate more voluminous data at a faster rate than ever before.

The problem, however, is that higher intensity in the machine generally makes for an unstable proton beam, causing the beam to wander from its designated path and eventually blow out of the beam pipe. This, in turn, shuts the Tevatron down, bringing data collection in the fixed–target area to a halt.

The perplexing question, simply stated, is how does one raise the machine's intensity, while keeping a stable beam for experimentation? Dave McGinnis, head of the Proton Source in the Accelerator Division, and his team of engineers and technicians found the answer in two types of beam–enhancement devices: dampers and bunch spreaders.

Building upon other accelerator experts' past technological innovations and early versions of dampers and spreaders, McGinnis's team—engineer Jim Steimel and technicians Ken Koch and Gary Golinski—have spent much of the last few months developing, building and installing numerous dampers and two bunch spreaders in the Main Ring and Tevatron. As of this writing, the Tevatron has passed the old intensity record of 1.8×10^{13}, recording a 2.28×10^{13} on Nov. 2, on the way to the management-stated goal of 2.5×10^{13}.

"The only way to get that intensity is to build the beam dampers," said McGinnis, who has had previous experience with these devices,

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HIGH ENERGY PHYSICS

made painless

Magnets, Part I

Text by Hank Glass, Technical Support Section
Edited by Donald Sena, Office of Public Affairs

The experiment is ready and waiting. The researchers have calibrated each calorimeter crystal and adjusted the high voltages on every wire in the tracking chambers. Every one of the hundred thousand readout channels of the detector is primed to record the swift passage of hadronic jets, electrons, muons, and other debris ejected from a violent subatomic collision. All that the experimenters are waiting for now is the arrival of high-energy protons and antiprotons, streaming in from opposite directions to collide head-on in the center of the detector.

But how do the protons know where to go? They don't have a road map. They can't hop on a bus. They can't stop a random pedestrian and ask, "Hey, mister, do you know the way to CDF?"

The protons need magnets to show them the way.

The two main jobs of a particle accelerator are to raise the energy of the particles and to steer them in the right direction. These jobs are performed by different devices: RF cavities use electric fields to accelerate the particles, while magnets use magnetic fields to steer the particles. This article will explore some of the different kinds and uses of magnets in accelerators.

Magnetic Personality

How are the magnets used at Fermilab different from the magnets you use to stick your grocery list to the fridge? Obviously they're bigger—a Main Injector dipole is 20 feet long and weighs 42,000 pounds, making them impractical for kitchen use. But they're different in another important way: unlike your kitchen magnets, in which the fields go around the outside of the magnet, an accelerator magnet has its field on the inside. Accelerator magnets have a pipe going through the middle of them where the protons travel; in Fermilab's magnets, the field is directed into that pipe to steer the particles, and very little field escapes outside the magnet.

Magnetic fields act in ways unlike any other force in nature. In a familiar force, such as gravity, all objects are accelerated in the same direction. We don't see some things fall up, some down, and others sideways. Magnetism is more complicated. First, it only acts on electrically charged particles; when humans, who are all electrically neutral, stand next to a magnet, they don't feel much (unless of course they've got a steel wrench in their pocket). Not only must the particle be charged, it must also be moving: a proton sitting in the middle of a strong magnet will just sit there and spin the time away, but another proton zipping in at high speed will get kicked by the field. The force exerted by a magnetic field on a moving particle not only depends on how fast it's going, but in which direction: one particle, travelling at high speed in the direction of the field (that is, along a magnetic line of force) will experience no force at all, but another particle, moving at the same speed but at right angles to the field, will be deflected by it.

Photo by Fred Ullrich

Steel laminations at one end of a dipole magnet for the Main Injector.

Magnet Types

A simple type of magnet is called a dipole, and consists of two poles. Magnetic lines of force emerge from one pole (North) and re-enter the magnet at the other pole (South). In the space between the poles, where the beam pipe resides, the field is nearly uniform. Magnet builders arrange these dipoles around the circumference of a circle, and have all their fields pointing straight up, which is just what is needed to get a beam of protons to circulate around the circle in a clockwise direction. Antiprotons, having negative charges, would circulate around these same magnets counterclockwise.

The dipoles are all Fermilab would need were it not for the fact that a beam of protons is a disorderly bunch. They're not all moving in exactly the same direction, but, instead, some want to drift sideways while others want to move up or down, away from the plane of the ring. To keep them in line, we need another type of magnet called a quadrupole, which means a four-pole magnet (two North and two South poles). The field in this type of magnet is zero at dead center, but grows linearly as you move further away from the center. This means that a well-behaved proton moving along the center, where it's supposed to go, will be left alone by the quadrupole. But an unruly proton, wandering off the beam axis, will be pushed back towards the center. The further away it is, the harder it gets pushed. This results in a focusing of the beam of protons, similar to what a glass lens does to a beam of light. ■

Next issue: Part II of Magnets, including magnet fabrication technology and superconducting vs. "normal" magnets.

Profiles
PARTICLE PHYSICS

Brenna Flaugher

Associate Scientist
Research Division

Employee I.D. #8987

by Leila Belkora,
Office of Public Affairs

Brenna Flaugher, Associate Scientist with the CDF collaboration, is always happy to put quantum chromodynamics in plain English. In the past year, she has talked about her field—the study of quarks and gluons, and how they interact to form more familiar particles like protons—to congressional representatives in Washington DC, to university groups around the country, and to dozens of reporters from newspapers and radio stations who have called her office in the CDF trailers. Most of the explanations she gave this year were about the discovery that some quark data do not match theoretical models, which suggested to some physicists that quarks might have sub-structure. Sometimes, though, she gives in to popular demand and chats with people about more general physics topics. "I give tours, like to groups of kids. Next week they've convinced me that I have to give one to a crowd of 5th graders. I did one where they brought me in to the Education Center as a 'real physicist.' That was sort of fun. You never know what they're going to ask."

Photo by Reidar Hahn

She's our 'alignment czar,'" says designated Research Division Head John Cooper.

Flaugher has been at Fermilab since 1986, when she was a graduate student enrolled at Rutgers University. Her contribution to the hardware side of the CDF experiment was to design part of the electronic trigger system. The trigger helps experimenters separate the most interesting, highest-energy collisions from those that don't provide any new insights. When it came time to analyze data, she had a choice of avenues: bottom quark physics, for example, or studies of the electroweak force between quarks and leptons. She specialized in quantum chromodynamics, or QCD. "The part I work on is jet physics. Jets are produced when quarks collide," said Flaugher. On computer screens that show the tracks of particles in a collision, jets look like a narrow bundle of lines.

When she's analyzing data, Flaugher has always concentrated on jet physics. Lately she has taken on hardware challenges, too. "She's our 'alignment czar,'" says designated Research Division Head John Cooper. "She's in charge of knowing where the detector is in space, relative to the Tevatron. The detector deforms due to its weight, and we need to know where it ended up at."

Flaugher's job is to make sure the parts of a new Silicon Vertex Detector line up. The new SVX is part of the effort to upgrade the experiment to take advantage of higher proton-antiproton collision rates that the Main Injector will provide in 1999. "The SVX is made out of long 'ladders,' and two end-pieces which are called bulkheads, and the ladders have to get installed in the bulkheads and aligned to very tight precision. I'm working with the engineers to do that," said Flaugher. "The ladder is the detector, made of silicon wafers. The wafers have a whole lot of little strips on them, like wires, but they're silicon. When particles go through, they leave a signal in one of those little strips. And it's very high precision, so that we can find very small displacements."

Cooper notes that Flaugher has worked on a number of facets of the experiment, aside from jet physics and leading a QCD analysis group within the CDF collaboration. She was Operations Manager during the colliding beam experiment known as Run I, coordinating the data-taking on a day-to-day basis with experimenters and members of the Accelerator Division. "She has done an outstanding job of moving from one thing to another—the trigger, alignment, daily operations, and the upgrade—and has had an impact on everything," said Cooper.

Although she has worked on a wide variety of projects, Flaugher sees communicating results from Fermilab to the global high-energy physics community as her most important job. Like other members of the CDF collaboration, she helps shepherd new results through the various stages from data analysis to publication in journal articles. Says Flaugher, "I see the papers as the output, the product of the lab. It's why we're here: to put our results out into the public domain. I spend a significant amount of time either helping students get their papers out and graduate, or taking over when they go on to other things. I think it's really important to get the papers out." ■

FermiTools:
Software Packaging 18 Months Later

by Ruth Pordes of the Computing Division's Online Systems Department, guest scientist Donatella Torretta and Donald Sena of the Office of Public Affairs.

Fermilab's Computing Division must constantly create innovative means to keep up with the array of experiments, voluminous data and other computing challenges posed by scientific research at the Laboratory. As a result, the computing team and other staff at Fermilab often develop software that is potentially transferable to government entities, commercial industries and scientific communities outside Fermilab.

To provide outside organizations the opportunity to take advantage of these innovations, the Computing Division launched the Fermilab Software Tools Program (FermiTools) about 18 months ago. Through this program, Fermilab provides the broad Internet community with software packages developed at the Laboratory that have applications relevant to other domains. Fermilab offers these packages with the goal of entering into collaborations with interested and committed users for the joint development, deployment and support of more software.

The FermiTools products reflect the diverse computing activities performed at the Laboratory, from the desktop to the central computing services to the experiment halls.

The software product providers have already incorporated valuable contributions from outside users into some of the products and redistributed them on the Internet. FermiTools developers have found that user-produced innovations to existing Laboratory software make a worthwhile trade-off for the added product support required from Fermilab.

"Feedback from the users has helped the Fermilab... developers to improve their products," says Paul Lebrun, leader of the Physics Analysis Tools group in the Computing Division.

The FermiTools working group, led by Ruth Pordes, head of the Online Systems Department, meets monthly to discuss and evaluate products proposed for inclusion in the project. FermiTools Librarian Donatella Torretta, a guest scientist, handles the program infrastructure and the coordination between the product users and supporters.

Products and Users

From the initial offering of five software packages, FermiTools has added 13 more products over the past year and a-half. About 1,000 people access the software files each month. The Internet domains that tap into Fermilab's software include commercial companies, education facilities and non-profit organizations. FermiTools customers include other Department of Energy institutions, the National Aeronautical and Space Administration, Northwest Airlines, Bell Labs and McDonnell Space and Defense Systems.

Some of the products include:

- **juke:** This product controls tape jukeboxes for data analysis, backups and other applications that require tape mounts that are inconvenient for human operators to perform.
- **NEdit:** Several hundred scientific institutions, universities and laboratories are currently using the most popular product, NEdit—a plain text editor for X/Motif systems.

Reaction

Positive reactions from commercial and educational users have come across the Internet.

"I just pulled down NEdit and I am very impressed. Our users have been wanting a motif-based editor for some time now and emacs (xemacs) was quite intimidating to some of them," said C. Luther of Inet Inc. in Texas in an electronic mail message to Fermilab.

Similar reactions have come from other areas. "Here at NASA Lewis Research Center, a project is nearing completion...I have been looking for plain-line plotting widgets and found the XYPlot widget in Histo-Scope to be quite nice," said J.W. Mitchell of NASA LeRC in an electronic mail message from late 1995.

"Using the juke system was a real benefit to SLAC, and I appreciate your making the software available," said B. Weeks of the Stanford Linear Accelerator Center in another e-mail.

FermiTools has made a good start, according to Pordes. As the program's visibility has increased at the Laboratory, Fermilab staff from other divisions have proposed their products for inclusion, as the Computing Division continues looking for quality software products that might benefit groups outside the Laboratory. ■

Photo by Reidar Hahn

Ruth Pordes (left), of the Computing Division's Online Systems Department, and guest scientist Donatella Torretta work on the FermiTools project.

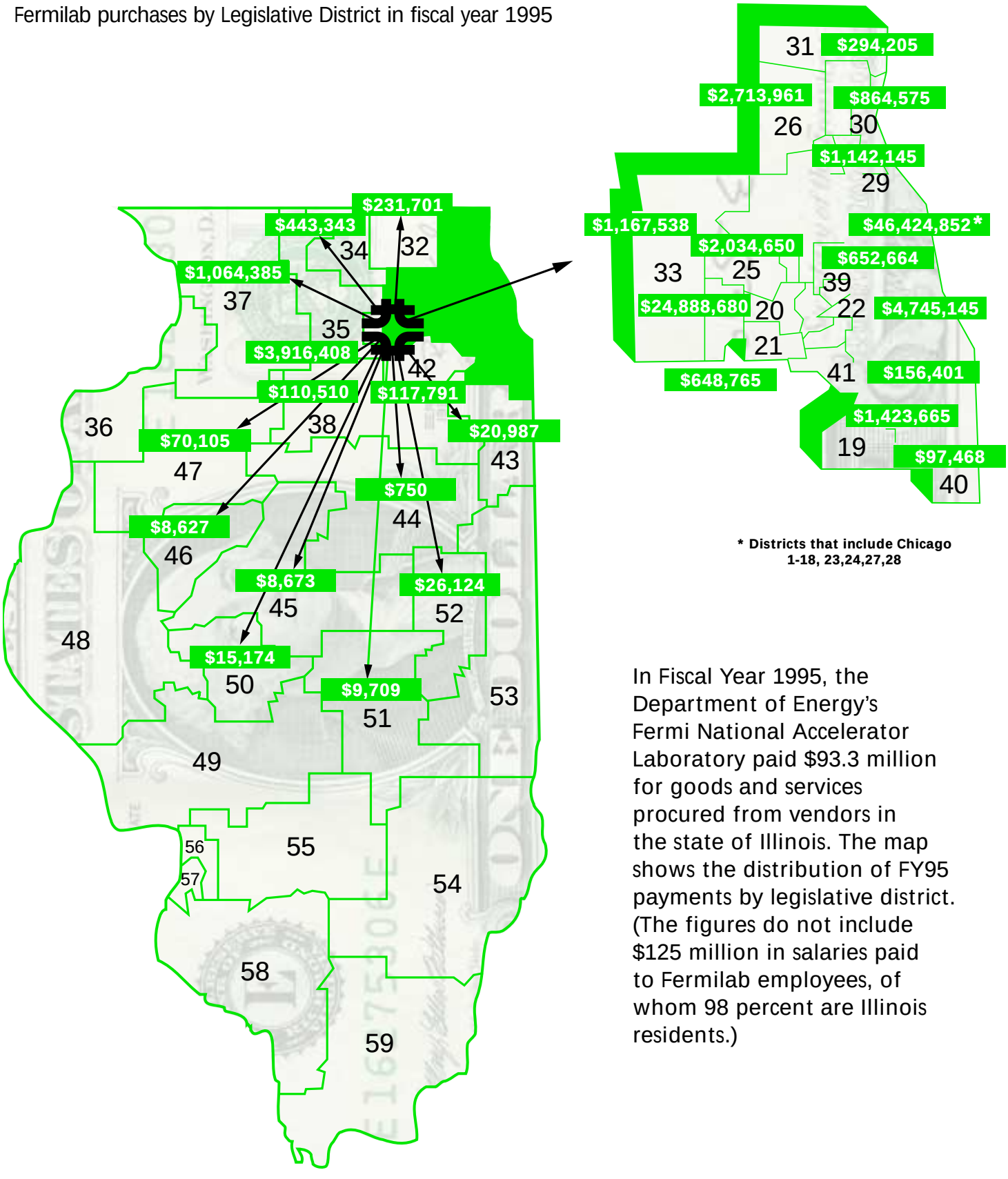
What are the FermiTools Products?

Currently there are 18 software packages. They include:

- **CAMAC:** UNIX CAMAC Software
- **CPS:** Cooperative Processing Software
- **DCS:** Drawing Control System
- **FISION:** VME (and other related busses) Access Software
- **FRC:** FASTBUS Readout Controller Software
- **FSCC:** FASTBUS Smart Crate Controller Software
- **Histo-Scope / NPlot:** Interactive Histogramming and Plotting Tools
- **juke:** Robotic Tape Jukebox Control Software
- **murmur-kit:** Distributed Error Reporting System
- **MXYZPTLK:** C++ Library for Automatic Differentiation and Differential Algebra
- **NEdit:** Mac-like plain text editor (X/Motif)
- **OCS:** Operator Communications Software
- **plot-widgets:** Motif widgets for graphing and plotting
- **Astronomical Data Analysis Framework**
- **SPUDS:** Single Platform Uniting Diagnostic Software
- **Transport:** Charged Particle Beam Transport Software
- **UCM:** Unix Code Management Software
- **UPS:** Unix Product Support

Fermilab Buys Goods and Services in Illinois

Fermilab purchases by Legislative District in fiscal year 1995



*** Districts that include Chicago**
1-18, 23,24,27,28

In Fiscal Year 1995, the Department of Energy's Fermi National Accelerator Laboratory paid $93.3 million for goods and services procured from vendors in the state of Illinois. The map shows the distribution of FY95 payments by legislative district. (The figures do not include $125 million in salaries paid to Fermilab employees, of whom 98 percent are Illinois residents.)

The Straight Poop o

by Leila Belkora, Office of Public Affairs

It's a winter sight at Fermilab that stops visitors in their tracks: five hundred or more Canada geese roosting shoulder-to-shoulder on the frozen surface of Swan Lake, heads tucked under their scapular feathers as protection against an icy wind. During extremely cold spells they may sleep like this for days, simply "sitting out" periods when snow covers the grass they depend on for food.

Even during milder weather, it appears that the 6,800-acre Fermilab site is like a Red Cross shelter for geese and other birds—a haven where there is more unfrozen water and green grass than in surrounding areas, thanks to the warmer temperature of the cooling ponds, whose function is to carry heat away from Wilson Hall, accelerator magnets or from the gases that cool superconducting magnets.

Visitors often remark on the large Canada goose population, and ask Fermilab biologists and birders if the situation has changed in recent years. "I get lots of questions about the birds at Fermilab, including the Canada geese," says physicist and bird watcher Peter Kasper. Kasper maintains a popular Web page about the birds of Fermilab (see sidebar). An e-mail from Clarence Hickey, a NEPA compliance officer at DOE who visited the Fermilab prairie and wetlands, posed a typical question:

"In your birds data [on the Web page] you discuss the Canada goose as a year-round resident. This is happening throughout the northeast and the midwest. Oak Ridge National Lab also has documented this there. And the geese are permanent residents here in Germantown, with nests around the onsite pond. I'm wondering why these birds no longer seem to have the instinct to migrate and whether there is some permanent change here within the species or its races. It is worrisome that this migratory animal is changing its life style. I wonder if you have any insight into this?"

In fact, says Kasper, we see two populations of Canada goose at Fermilab and around the Midwest. "There are resident geese, and a migratory population that moves through and doesn't stay here over the winter," he said. The resident race is predominantly the so-called giant Canada goose, or Branta canadensis maxima. The migratory birds are smaller, and do not breed with the giants. The twice-yearly overlap of the races is nothing new; flocks of the giant geese were year-round residents in the last century when settlers moved into Illinois, said Kasper, but their numbers dwindled and have only grown again in the last few decades.

The giants do not hang around because they have "lost the instinct" to migrate, says Chris Whelan, a bird ecologist at the Morton Arboretum in Lisle. "The geese do not have a genetic disposition to migrate; they learn the timing and routes from their parents. It's just like in the recent movie 'Fly Away Home,'" he said. The recent Columbia Pictures film is based on a successful 1993 experiment to "teach" a safe migratory route to threatened Canada goose populations in Ontario.

Whelan said he has the impression that the population of non-migratory Canada geese in the Midwest exploded in the late 1980s. Scott Craven, a wildlife biologist at the University of

Photos by Reidar Hahn

How do they survive the cold weather?

An article by the aptly-named Dr. David Bird in the 1996 issue of Bird Watcher's Digest lists several adaptations that ensure the survival of Canada geese during extreme cold temperatures. The birds avoid frost-bitten legs and feet by getting along with a mere trickle of blood supplying their extremities. Furthermore a "netlike web" of veins and arteries ensures that arterial blood flowing to the feet warms the venous blood on the return trip to the heart.

Bird claims that the geese can lower their body temperature by a few degrees to conserve energy when the ground is frozen and food is unavailable. Also, the birds apparently tense their breast muscles and shiver imperceptibly to generate body heat.

ermilab's Geese

Wisconsin in Madison, confirmed that in the region as a whole, the resident giant Canada goose population has grown tremendously since the 1950s. One reason is restoration programs, and the welcoming habitat that suburbs provide. "As recently as 1965, the race was thought to be extinct. But the bottom line is, big industrial sites, parks, golf courses, etc... bingo! Fantastic goose habitat. Goose heaven, we've created. There are no natural predators left around, and the Canada goose is a prolific, very flexible bird."

Supplemental feeding has also encouraged the geese. Geese normally eat grass, corn seed, and a bit of pond algae, according to Kasper. At Fermilab, they particularly like the buffalo pasture, and fallow corn fields. The ponds are important mostly for roosting.

Kasper believes that the resident goose population at Fermilab has been growing, but not as dramatically as many people think. "What you're really seeing is the weather; roosting places are concentrated when the weather is rough," he said. Kasper and other bird watchers participate in the Audubon Society's annual "Christmas Bird Count" at the Lab. Based on these counts, he said, "We have not been seeing a linear increase in the numbers; the highest count was in the late 1980s, when we had over 100,000 geese, but a couple of years ago, the numbers were way down."

The large resident population and massive influx of geese in winter pose some obvious problems for Fermilab. To walk along the road leading north from Wilson Hall, between Swan Lake and the cooling ponds, is to run a gauntlet of "goose-poop." Bird diseases are a potential problem too, notes Craven. When large numbers of birds converge, there is a danger of duck plague, for example, a virus affecting ducks, geese, and swans, or avian cholera, a bacterial disease that National Biological Service scientists say is spreading throughout the U.S.

Kasper says a mitigating factor at Fermilab is that the ponds are well aerated. "You can get the spread of diseases," he acknowledges, "usually in anaerobic water. The fountains [in the cooling water ponds] alleviate that problem."

Kasper dismisses the notion that the Canada geese are a nuisance at the Lab, but says it would be relatively easy to keep them away from the heavily traveled areas. "My own take is, it's not a problem," he said, gazing out his office window over the ponds and woods north of Wilson Hall. Because they nest on the ground the geese are sensitive to predators like foxes and weasels, and tend to avoid nesting in areas that have ground cover. "The geese don't like shrubs. We could control them by having shrubby areas around the lakes, so their nesting success would be low."

Ultimately, Fermilab's Ecological Land Management Committee will have the responsibility to solve any goose problems that emerge. The Committee consists of representatives from the Lab and Argonne, the US Fish and Wildlife Service, Morton Arboretum, the DuPage County forest preserve, and DOE. Bob Lootens of Fermilab's Roads and Grounds department, who chairs the committee, says the group's main effort to control the geese near the roads and parking lots has been to discourage people from feeding the geese there. "Swan Lake used to be a popular place to feed the geese—people used to bring their kids," he said. ■

Photo by Jenny Mullins

Physicist and bird watcher Peter Kasper scans Lake La

Great Egret (above), and Red-Tailed Hawk (below), on the Fermilab site.

Birding at Fermilab

"The birding here is as good as at any single site," says DZero physicist and avid bird watcher Paul Quintas, who was introduced to birding at the age of 14 by a family friend. "The Lab is great because there is such a variety of habitats."

Quintas and bird watchers in the Fermilab area rely on a Web page that Peter Kasper maintains to help them figure out what they should keep an eye out for at a given time of year, and also to establish whether an unusual bird is a first-time sighting for the Lab. The site (http://www.fnal.gov/ecology/wildlife/list.html) lists 260 species, along with a chart showing what time of year to expect them.

Bird watchers' landmarks at Fermilab are not the high-rise or the sculptures, but rather "the famous sparrow hedge near Lake Law" or "the pond near DZero where Tom Diehl saw the White Pelican, while he was driving back from lunch." When someone notices an uncommon bird, he or she usually calls or e-mails Kasper, and he passes on the news. Bird watchers also make use of the DuPage rare bird hotline at (630) 406-8111 to place or listen to messages.

Birders often visit the Lab from surrounding communities. The only constraint on their activities is that they should be accompanied by a Fermilab employee if they venture into restricted areas, such as the Main Ring road or ponds.

Better Beam

continued from page 1

having installed them in the Booster after the Linac upgrade. McGinnis said he asked Accelerator Division management for the chance to develop similar dampers for the Main Ring and Tevatron for the fixed–target run.

Many people around the Laboratory, from operators to experimenters, said they are glad that McGinnis and his team were given the chance. Accelerator operators attribute the machine's record–breaking performance to the dampers, while fixed–target researchers praise their enhanced data collection on the bunch spreaders.

"The intensity record we have achieved has been the result of [the dampers team] work," said Bob Mau, head of accelerator operations. "We could only reach about 1.2 or 1.3 x 10^{13} without the dampers, but with them, we are able to go up."

Damper Technology

The damper process is a system that determines where the beam is in the beam pipe, and corrects the path of the protons if they are off course.

A damper "is basically a feedback system that measures where the beam is, asks if it's in the right spot and, if it's not, puts it there," said McGinnis. "It's just feedback."

The beam of protons in the pipe is a current source. When the beam travels through the pipe, it leaves an electromagnetic wake behind it. When the beam travels across an impedance, such as a device that sits in the beam pipe, it leaves a voltage wake that "sits there and rings," according to McGinnis. The higher the intensity, the larger the wake. When the next particle bunch encounters the wake, the bunch could get a voltage kick, moving it out of position either horizontally, vertically or longitudinally. This problem is especially common in the Main Ring, as there are many devices located in the beam pipe. [McGinnis said developers of the Main Injector are working hard to ensure the machine has minimal impedance in the pipe, so operators can "stuff a lot of beam in there."]

The first component of a damper is the "pickup," a sensor that gauges the particle bunch's exact position in the beam pipe. The pickup sends the signal to an electronics system that determines if the beam is in the proper spot. If the beam is on course, no adjustment is made. If the beam has shifted from its designated path, the electronics send a signal to a "kicker," which adjusts the beam's path to its rightful place. The dampers, in essence, undo the effect of the voltage wake left in the beam pipe.

"If the beam starts to become unstable—starts poking its head above [where it should be]—then we immediately sense it and slap its head back down," said McGinnis.

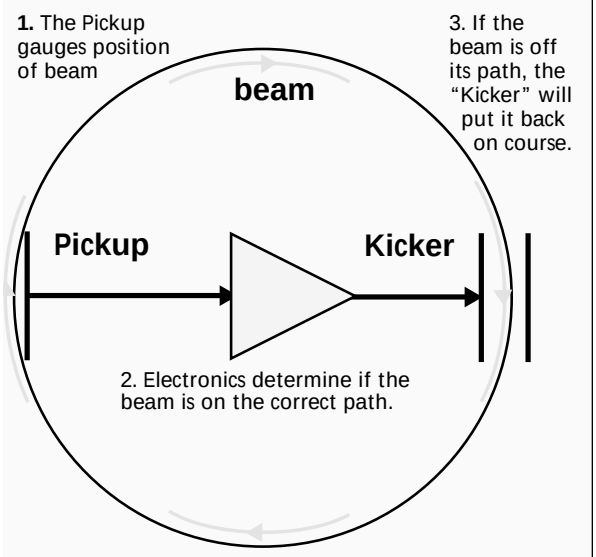
That explains the process, but why the name? McGinnis said the name "damper" is a misnomer. When beam is injected into an accelerator on the wrong orbit, the beam oscillates around the correct orbit. Dampers were first used to remove the injected oscillations—accelerator specialists referred to this process as the "oscillation being damped." McGinnis said a better name for his devices would be "beam stabilizers," but once accelerator nomenclature has been established, it is hard to change.

McGinnis also said non–operators have asked why beam enhancement devices like these didn't get much attention in the collider mode. The reason is that accelerators used for collider physics do not have very high intensities. For example, there are only six proton bunches in the Tevatron at any one time during collider operations. Fixed–target physics, on the other hand, has about 1,000 bunches in the machine at one time.

Furthermore, McGinnis is quick to point

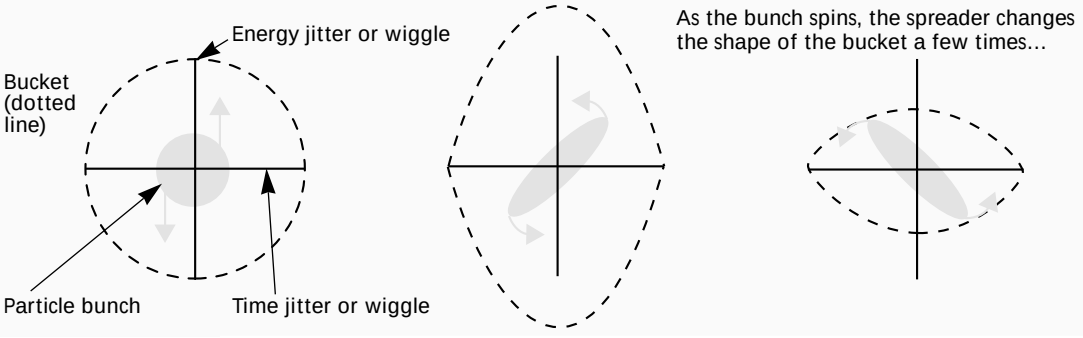
Dampers

Dampers gauge where the beam is positioned and corrects it if it has moved off course.



The Bunch Spreader

The bunch of particles is "fattened" to fill more of the bucket, thus any wiggle in the beam will have less of an effect on the bunches. The spreader also reduces "super bucket" problems, or some buckets having more particles than others.



out two important factors. First, he said he doesn't want people to blow the importance of the dampers out of proportion. He said the dampers are just one part of a big chain of software, hardware and hard work that makes the machine run. Secondly, McGinnis said he wants to withhold his excitement for the innovations until the Accelerator Division has reached their goal of 2.5×10^{13}.

Bunch Spreader

While the operators have praised the dampers, experimenters have noticed the biggest impact from two newly installed bunch spreaders. McGinnis said he is surprised by the attention the spreaders have received around the Laboratory, saying the dampers constituted weeks of labor and the spreaders were installed in a day.

"The dampers laid the groundwork down so we can actually play around and put in little cute things like bunch spreaders," said McGinnis.

McGinnis said he found out about problems with the quality of the beam indirectly from experimenters. He heard that some bunches had more particles in their buckets than others (a bucket is the boundary that represents how far out particles can spread before being lost, such as water in a bucket). These "super buckets" or "super bunches" were causing problems for the experiments. McGinnis also said a related problem has to do with beam movement. The beam tends to wiggle, and, if the beam is compact, a slight wiggle will be proportionally large, affecting extraction. By making the bunch "fatter," the same wiggle has less of an impact. The bunch spreader, in essence, blows the beam up in a stable, controlled manner (see diagram below).

"I never even really knew that there was a problem with the beam quality. It got to me by word of mouth that the experimentalists were unhappy with the slow spill—that it was ratty," said McGinnis. "According to all of our dampers, we had the beam as tiny as it can be in the machine. We had it nice and scrunched down and all in the right spot. So, we said, 'if the experimenters don't like the beam tiny, they must want the beam chubby."

After the team built the first spreader a few weeks ago and installed it in the Tevatron, they turned it on just before a weekend run and didn't tell anyone to see if researchers would notice a difference.

"From what I heard, [the experimenters] showed up Monday morning, saying they were very pleased with the reduction in super buckets and overall improvement of beam quality," said McGinnis.

Queried by email, Peter Kasper, a researcher with E831 (FOCUS), said he is withholding his final judgment of the innovations until more time has passed, but the spreaders' initial impact has been positive.

"Our experiment was greatly helped by the addition of the bunch spreader, but, as the machine intensity has gone up, the spill structure problems have returned, but to a lesser degree of severity," said Kasper. "The addition of the bunch spreader immediately increased our data taking rate by about 20 percent and, more importantly, enabled us to start taking data at higher beam intensities. It also resulted in an improvement in the quality of the events as well."

Photo by Reidar Hahn

The dampers/ bunch spreader team at the spreader's control rack. From left to right: Jim Steimel, Ken Koch, Gary Golinski and Dave McGinnis.

As the intensity increased recently, the super bucket problem showed up again, but not as bad. To combat the super buckets at high intensities, the team commissioned a new spreader in the Main Ring, which has improved beam quality even further and has eliminated most of the remaining super bucket problems. ■

Updates

October 24—November 6

ACCELERATOR

The Accelerator Division continued to push the intensity of the machine higher over the last two weeks. The owl shift on Nov. 1 performed some fine tuning of positions in the Switchyard in an effort to decrease losses down the lines. The other effort involved increasing the intensity of the machine as the losses improved. Early Friday morning, the Accelerator Division reached a new record intensity of 2.27 x 10^{13}.

The weekend of Nov. 1–4 saw a very reliable proton beam with 63.25 hours of high–energy physics out of a scheduled 72 hours. On Saturday, Nov. 2 in the evening shift, the Accelerator Division reached yet another intensity record, hitting 2.28 x 10^{13}. Accelerator operations continued its smooth run with 21.75 hours of high–energy physics out of 24 from 8 a.m Nov. 4 to 8 a.m. Nov. 5. The only downtown in that stretch was due to a Tevatron quench during the early morning hours of Nov. 5.

During the early part of the week, antiproton source personnel were performing deceleration studies.

FIXED-TARGET

Collaborators provided this update on fixed-target experiments.

E835 Charmonium "Since the last report, we have had one run at the chi-2 resonance, accumulating about 2 inverse picobarns of good data. We are now waiting for the antiproton source to complete its deceleration studies," said Stephen Pordes.

E799/E832 KTeV "Finally, we are taking physics quality data on tape for E832 with lots of CP–violated Kaon to two pion decays. We hope to continue the current data taking mode until Christmas,"according to Fermilab physicist Bob Hsiung.

E862 Antihydrogen The Pbar group has been working on deceleration ramps, so the experiment hasn't had any beam time recently, according to Dave Christian, E862 spokesman.

E866 NuSea "E866 continues to take data smoothly. For the past few weeks we have been quite satisfied with both the beam intensity we are getting, and also the performance of our spectrometer. Soon we will be changing our spectrometer setting in order to shift our acceptance to a different mass range," said Eric Hawker, a graduate student from Texas A&M University.

E815 NuTeV "E815 has now reached 5E17 protons and is continuing to accumulate data. Our test beam analysis is beginning to show interesting results for the toroids that we were never capable of seeing before," said Bob Bernstein.

E872 Donut "The prompt neutrino beam is completely installed and the performance of our new magnets meets the design specifications. We are now in the process of debugging our detectors and the beamline. We think we can be finished with this work by Thanksgiving. Stay tuned," said Byron Lundberg, cospokesman for E872.

E781 SELEX "SELEX is busy with the exciting job of understanding our data. The software is working, and we're trying to nail down real data rates, efficiencies and signals," said Jim Russ.

E831 FOCUS Erik Gottschalk, a collaborator from the University of Illinois at Urbana–Champaign, said that the FOCUS collaboration is consolidating its software efforts to make the most of the available computing resources. For example, he mentioned the high-level software diagnostics that are used to continuously monitor the E831 detector. "The goal is to use the charm data that we record every hour to provide rapid feedback on the state of the experiment," said Gottschalk.

E871 HyperCP "E871 is starting up. We got beam on target and are in the process of understanding the beam tune in more details. In parallel with beam tuning, we are plateauing and timing in trigger counters," said collaborator Kam-Biu Luk.

Award for Prairie Consultant

Bob Betz, Fermilab prairie consultant, won the George B. Fell award at the recently completed Natural Areas Conference held in St. Charles.

According to Natural Areas News, the newsletter of the Natural Areas Association, "The George B. Fell award is presented by the Natural Areas Association in recognition of outstanding and sustained individual accomplishments in the areas of natural areas identification, protection and management."

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

Wednesday
Lunch
November 20

Calzone Filled with
Ratatouille, Basil
and Three Cheeses
Poached Pear w/Bitter
Chocolate Sauce

Thursday
Dinner
November 21

Shellfish Chowder
w/Fresh Thyme
Grilled Duck Breast
w/Orange Gran
Marnier Sauce
Beet Risotto
Apple Strudel
w/Cranberry Sauce

Wednesday
Lunch
November 27

Cheese Fondue
Mediterranean Salad
Grapefruit Slices
in Rum w/Candied Rind

Thursday
Dinner
November 28

Closed

LAB NOTE

FERMILAB TALENT SHOW

Calling all talented Fermifolks! Dust off your dancing shoes and blow the cobwebs out of that old trumpet—it's time to strut your stuff at the Fermilab Talent Show on Saturday, January 25 in Ramsey Auditorium. Performers must include at least one person who is a Fermilab employee, user, contractor or graduate student, and performances will be limited to 7 minutes. No audition necessary, but we will need a description of your performance. To find out more information, pick up a form from Kathy at the Wilson Hall Atrium Desk or e-mail Janet MacKay at MacKay@fnal.gov.

LETTER TO THE EDITOR

Dear Editor,

We want to thank everyone who is involved with *FermiNews*. I'm sure that many of the readers glance at it and give it the heave-ho; to those people, I say you don't know what you have. You see, I'm not a physicist, don't work in "high" tech and I can hardly tell you the difference between a proton and a neutron, and, unless you guys come up with a Lucky Charm, I wouldn't know what to do with it. But please understand this: as a consumer, I see the results and the products that the "hands" of Fermilab have created. I would joyfully remind you all to step back from time to time from the micro-cosmic and see the macro-cosmic effect you are having on our world (from refrigerators we plug in to our car lighters to curing cancers). Enjoy your look around.

I promise you that when you do, you will again see what brought you to your individual fields in the first place. Remember your first lesson in physics class: for every action there an equal and opposite reaction; so lighten up on your co-workers. You may be working with big machines, but you're still little people, and we all benefit from your work faster when you get along. We can't wait to see how your next "find" will affect our lives. I would like to also let you know that *FermiNews* is passed along to the local high school, where I hear it is quite a teaching tool, especially the section on "Painless Physics." (So don't throw yours away; take it home, give it to your kid or your neighbor's kid.)

Lastly, you keep pushing for new science and we'll keep pushing for new funding.

~ Pastor Jeff Hauser
Elliott, Iowa

Pilot Program Wins Award From Vice President Gore

by Leila Belkora, Office of Public Affairs

In October 1996 Secretary of Energy Hazel O'Leary presented one of Vice President Al Gore's National Performance Review Hammer Award Plaques to the Business Management Oversight Process (BMOP) team. Associate Director Bruce Chrisman, a BMOP team member, will be honored at a ceremony later this month for individual team members.

The Hammer Award recognized efforts by governmental teams or agencies to make government work better and more cost effectively. The hammer in the award—an actual $6 hardware store item—is a tongue-in-cheek reference to the Defense Department's expenditure (in about 1990) of $600 for an ordinary hammer. The team award is a hammer in an aluminum frame, while individual team members will receive lapel pin hammers.

The National Performance Review began in March 1993 with the twin missions of making government work better and cost less. Said Vice President Gore, who leads the effort, "The National Performance Review can reduce the deficit further, but it is not just about cutting spending. It is also about closing the trust deficit: proving to the American people that their tax dollars will be treated with respect for the hard work that earned them. We are taking action to put America's house in order."

The motivation for the Business Management Oversight Process pilot program, says Chrisman, was complaints from DOE labs that the oversight audits were intrusive. Then-undersecretary Charles Curtiss put a moratorium on business reviews and set up pilot programs to make them more efficient." Fermilab Director John Peoples asked Chrisman to participate in the pilot team.

Chrisman said the team met for three days in Washington, DC and came up with a pilot program. For example, DOE would only be allowed to come in for two weeks. The review should be heavily based on the contractor's or lab's self-assessment. This would be the basis for the review.

Argonne National Lab was the first to test the pilot program. Fermilab had its first review under the pilot scheme in January 1996.

"The program was declared a rousing success, and it was expanded to non-lab contractors" said Chrisman.

Chrisman says the new oversight process "saves effort and time rather than money," although it also saves DOE overseers money in reduced travel costs. ■

CLASSIFIEDS

FOR SALE

■ Sears garage door opener. 1/3 HP motor. Works great! Includes: one transmitter, outdoor key switch, one receiver and an additional push button. $35. Call Rich at (630) 897-8125.

■ Snowmobile, Arctic Cat 1995 Puma Deluxe. 340 cc f/c with electric start and speedo. Only 600 miles in Northern Wisconsin. Deep purple in color and in like-new condition. $2,500 o.b.o. Call Len Davis at x2238 or (630) 466-1561.

■ Whirlpool washer, $200 (original $398) and electric dryer $175 (original $345), 1991, large capacity, great cond. Call x5489 or (630) 820-6741, or chou@fnal.gov.

■ 1994 Honda Accord LX, 5 spd., 4 cyl. engine, 4 dr., white exterior/tan interior, ex. cond. 35K miles. Power: windows, locks, brakes, steering, mirrors, cruise control. A/C , AM/FM radio with cassette. Have had the oil changed and tires rotated every 5,000 miles. Never been in an accident. No major repairs. Asking price $15,500, will negotiate. Please call (630) 879-6381 after 8 p.m.

■ Loose diamond .59 ct., brilliant cut. Appraisal papers upon request. $900. o.b.o. Call Karen at x5427.

■ 1966 Ford Thunderbird for restoration or parts. From Oklahoma, body panels in good condition. 400 cu. in. V8, 2 b carb, automatic transmission. 103K miles. Was in running condition until rats ate engine wires when parked in barn in 1977. $500 firm. Call Russ at x2888.

■ Sofa, 6-piece sectional, reclines at both ends, brand new, $800/best. Call (630) 365-6927.

■ 1985 Toyota MR2, 5 spd., well maintained, 145k miles. $2000 o.b.o. Call Marilyn at x8781, (630) 961-0885, or marilyn@fnal.gov.

■ 1992 Ford Taurus GL, 4 door Sedan, ex. cond., A/C, power: steering, brakes, windows, mirrors, seats. AM/FM cassette, cruise control. $8,000. Call x2426 or (847) 982-0429.

■ Electric lawn tractor, General Electric Elec Trak, model 8-36. Manufactured in the 1970s. Not used in years, stored inside, looks new, sell as is. $150 o.b.o. Call Jerry at x2271.

WANTED

■ Interactive childcare sought: in-home care from July 1997 for pleasant, musical 2 1/2 year old girl 5 days a week, 9 to 5. Salary competitive. English fluency and car necessary; references. Call Nicole Jordan, Warrenville at (630) 393-3970.

■ Housemate wanted for nice house in Warrenville, very nice area, 1/2 mile from Fermilab. Own bedroom, living room, bathroom, dining room, kitchen and study room share with one single, $300 plus utilities. Call Chen at x8381 or (630) 778-1107, or email chendi@fsgi01.fnal.gov

FREE

■ Free affectionate, older female cat. Spayed and declawed. Long hair, sable with black stripes. Better for a family without young children.
Call (630) 365-6927.

CALENDAR

NOVEMBER 16

William Windom performs THURBER at Fermilab's Ramsey Auditorium on Saturday, November 16 at 8 p.m. Tickets are $15 and available through our box office at (630) 840-ARTS. Probably best know for his Emmy Award-winning role in the lead of NBC-TV's 1969-70 series, "My World and Welcome To It" based on the writings of James Thurber, William Windom will be bringing his one-man show back to Fermilab. Coming up: BEAUSOLEIL on January 18, 1997 for $17.

NOVEMBER 19

Blood Pressure Screening from 11:30 a.m. to 1 p.m. in front of the Users Office.

NOVEMBER 22

Fermilab International Film Society presents Romeo & Juliet. "A beautiful version of the Shakespeare classic. Zeffirelli creates a stunning adaptation with more action, humor and sexiness than has ever been seen in the tale." Directed by Franco Zeffirelli, U.K./Italy (1968) 152 minutes.

DECEMBER 6

NALWO Potluck at the Village Barn, 6 p.m. Bring a dish to serve 12, or $3 to cover costs. $1 additional cost for adults consuming alcoholic beverages.

ONGOING

English lessons, Thursdays in Users Center, call Jeanette Antoniuk at 769-6518. German lessons, Tuesday evenings in 20 Nequa, call Angela Jostlein at 355-8279. NALWO coffee mornings, Thursdays 10 a.m. in the User's Center, call Mary Brandt at 961-5194.

MILESTONES

AWARD

On October 24, the Chicago Charter Chapter Association of Energy Engineers presented an award to Steve Krstulovich for Energy Professional Development.

BORN

Luisa, on September 30, to Jurgen Engelfried (Physics Section) and Aurora Orozco.

BENEFIT NOTE

DEADLINE TO ENROLL IN FERMILAB'S FLEXIBLE BENEFITS PLAN

The deadline to sign up for one or both of the Health Care Reimbursement Account and the Dependent Care Reimbursement Account is by the close of business on November 27, 1996 in the Fermilab Benefits Office. If you need forms or information, call the Benefits Office at x3395, 4362, or 4361 or stop by 15WHSW.

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The deadline for the Friday, December 13 issue of FermiNews is Tuesday, December 3.

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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