FERMI NEWS

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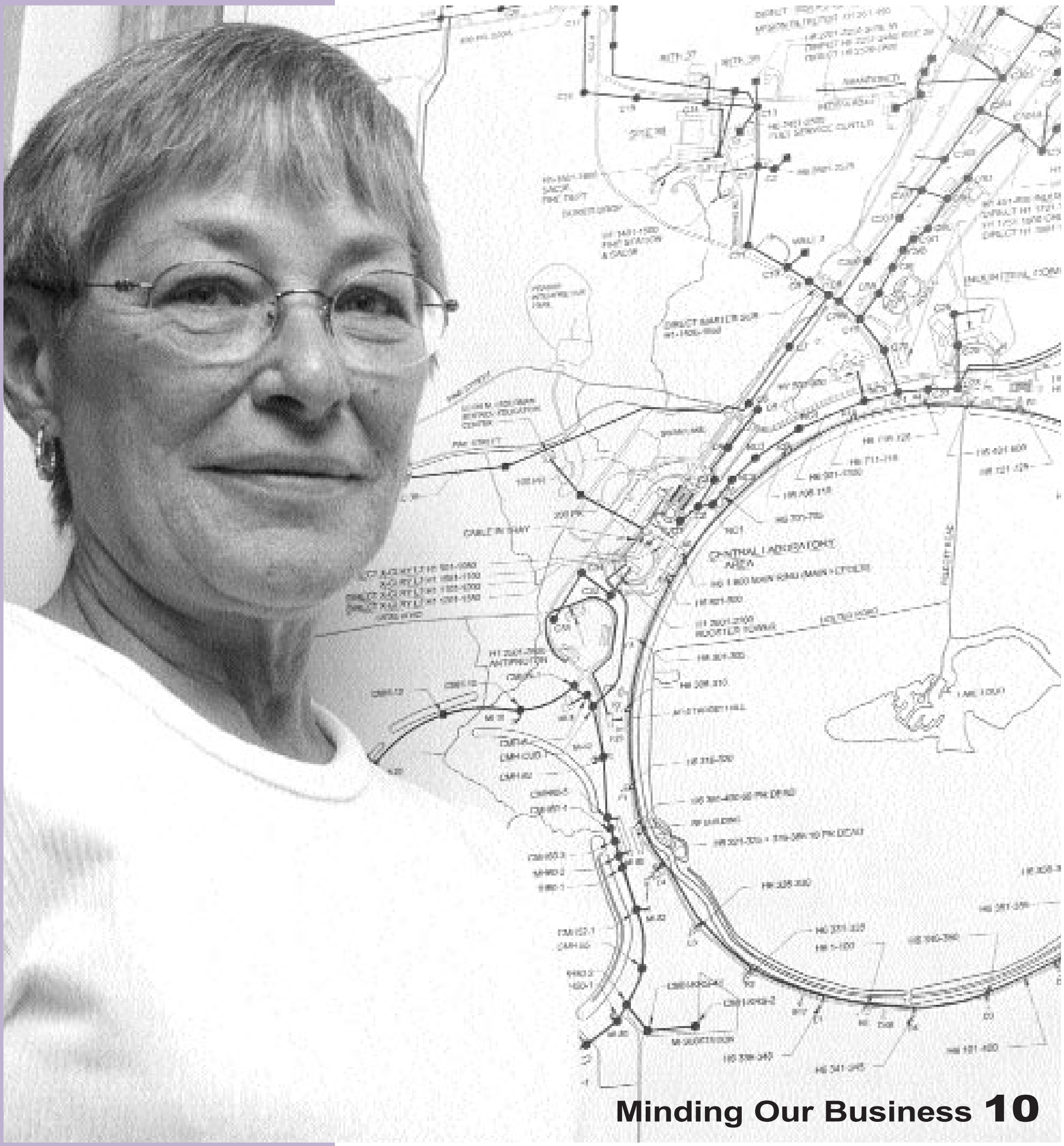

Minding Our Business 10

Photo by Reidar Hahn

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Number 22

INSIDE:

How to Make a NEUTRINO BEAM

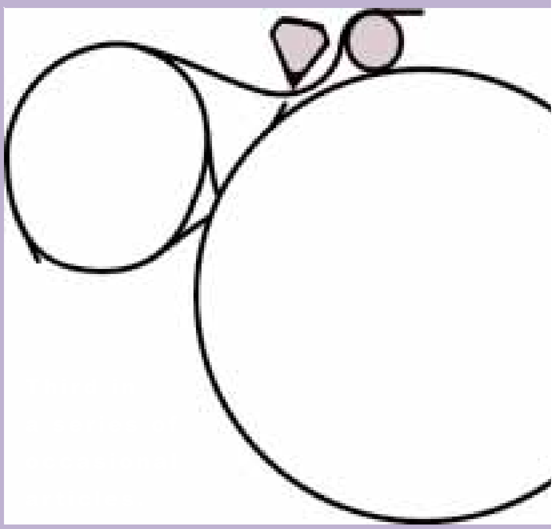
by Mike Perricone

Nobel laureate Frederick Reines, the neutrino's first observer, described this elusive subatomic particle as "the most tiny quantity of reality ever imagined by a human being."

Neutrinos are so asocial and secretive that their properties have evaded a thorough understanding by physicists ever since their prediction in 1930 by Wolfgang Pauli, and even following its discovery in 1955 by Reines and Clyde Cowan.

Despite tantalizing results more than a year ago from Japan's Super Kamiokande experiment, physicists still haven't conclusively demonstrated that neutrinos have mass. But the universe contains nearly an estimated one billion times as many neutrinos as protons (330 million neutrinos per cubic meter vs. 0.5 protons per cubic meter); if neutrinos do have mass, they would dramatically alter our picture of the universe, and of the Standard Model of Elementary Particles.

Follow THE PARTICLES



That's why the Neutrinos at the Main Injector program looms as such a major effort in Fermilab's explorations on the frontiers of high-energy physics for the 21st Century.

President Bill Clinton

Developments in neutrino physics are so significant, they become worldwide news events. Even the President of the United States takes notice, as President Bill Clinton did on June 5, 1998, referring to the previous day's Super Kamiokande results while addressing the commencement of the Massachusetts Institute of Technology.

"This discovery was made, in Japan, yes, but it had the support of the investment of the U.S. Department of Energy," the President said. "This discovery calls into question the decision made in Washington a couple of years ago to disband the super-conducting supercollider, and it reaffirms the importance of the work now being done at the Fermi National [Accelerator Laboratory] in Illinois."

President Clinton continued: "The larger issue is that these kinds of findings have implications that are not limited to the laboratory. They affect the whole of society—not only our economy, but our very view of life, our understanding of our relations with others, and our place in time."

Carrying the flag for this Presidential-endorsed scientific charge, NuMI will send a beam of neutrinos from the lab site in Batavia, Illinois, through the earth more than 450 miles to a 5,000-ton detector a half-mile below the ground in a mineshaft in Soudan, Minnesota.

The goal of this MINOS (Main Injector Neutrino Oscillation Search) experiment: determining whether neutrinos have mass, by observing whether they change (or oscillate) from one type (flavor) to another. The first step: creating a beam of neutrinos, for which the Lab is working to build its mass-production process.

“You take high-energy protons,” says Fermilab theorist Stephen Parke. “You bang them into something. That makes lots of pions, as well as other things. You focus the pions and let them decay in a big pipe. The pions decay into muons and neutrinos, both coming out of the pipe. The muons get stopped in the earth. The neutrinos go on to the detector.”

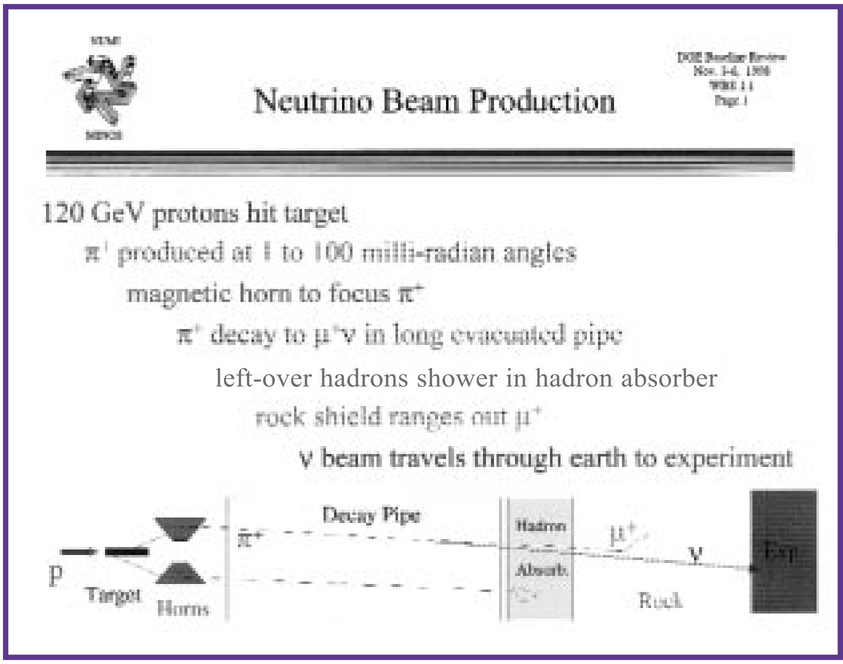
It’s that simple.

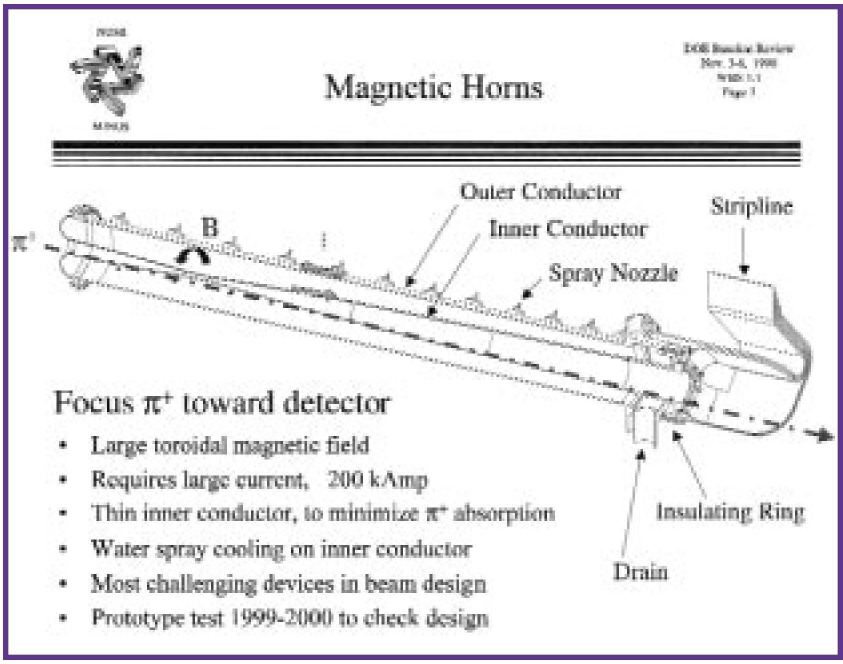
“The concept is pretty simple, but the execution is more complicated,” says Parke, with a bemused smile. “It always is.”

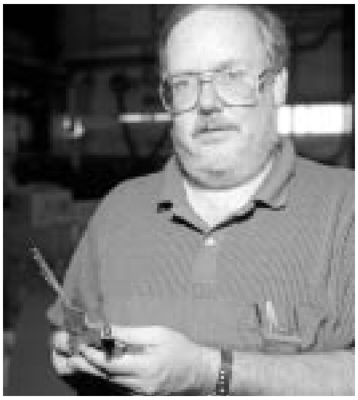
Protons, members of the hadron family, consist of three quarks (two up quarks, one down quark). When they collide with a graphite target, the protons produce pi mesons, or pions, which are matter-antimatter pairs of a quark with an anti-quark. The pi$^+$ (π^+) consists of an up quark and an anti-down quark, while the pi$^-$ (π^-) consists of a down quark and an anti-up quark.

The next step takes the production process down to the level of elementary particles. The pions decay into muons and neutrinos. The π^+ decay produces a positive muon and a neutrino, and the π^- decay produces a negative muon and an antineutrino. Neutrinos are in the lepton family, which also includes electrons, muons and tau particles.

Neutrinos come in three flavors—electron, muon and tau—each belonging to one of the three







Jim Hylen led the team which conducted target tests and will oversee neutrino beam production

generations of matter in the Standard Model. The MINOS beam will consist primarily of muon neutrinos—requiring the production of about four trillion (4x10^{12} or 4,000,000,000,000) muon neutrinos per second.

A prototype of the NuMI target, where proton collisions begin the production a neutrino beam. Note the comb-like configuration of the graphite target.

"Of those four trillion, scientists will see about one every hour in the 5,000 tons of detector in Soudan, Minnesota," says Jim Hylen, who will be overseeing the neutrino production and beam creation at Fermilab. "We have to produce a lot of neutrinos to see any of them interact. Basically, most of the beam goes straight through the earth, out the other side, and off into space. Neutrinos just don't interact much."

The neutrinos will start out the same way as all other particles at Fermilab: hydrogen gas zapped with 750,000 volts in the Cockcroft-Walton pre-accelerator (see "How to Make a Proton Beam," FERMINEWS, Jan. 22, 1999). The process moves on through the LINAC and the circular Booster accelerator, where the protons reach an energy of eight billion electron volts (8 GeV). With the major upgrades in Fermilab's accelerator complex, the protons will next go to the new Main Injector to reach 120 GeV in the new two-mile ring.

The protons will be extracted from the Main Injector and fired at a graphite target one meter long and just three millimeters thick, located in a vault 130 feet below the surface. The target looks like a comb with a row of one-centimeter teeth. That design was formulated by NuMI collaborators at IHEP-Protvino, Russia, to relieve stresses on the target from the innumerable proton impacts, and keep it from breaking. Hylen reports that recent tests ran very well with a prototype target and beam from the Main Injector.

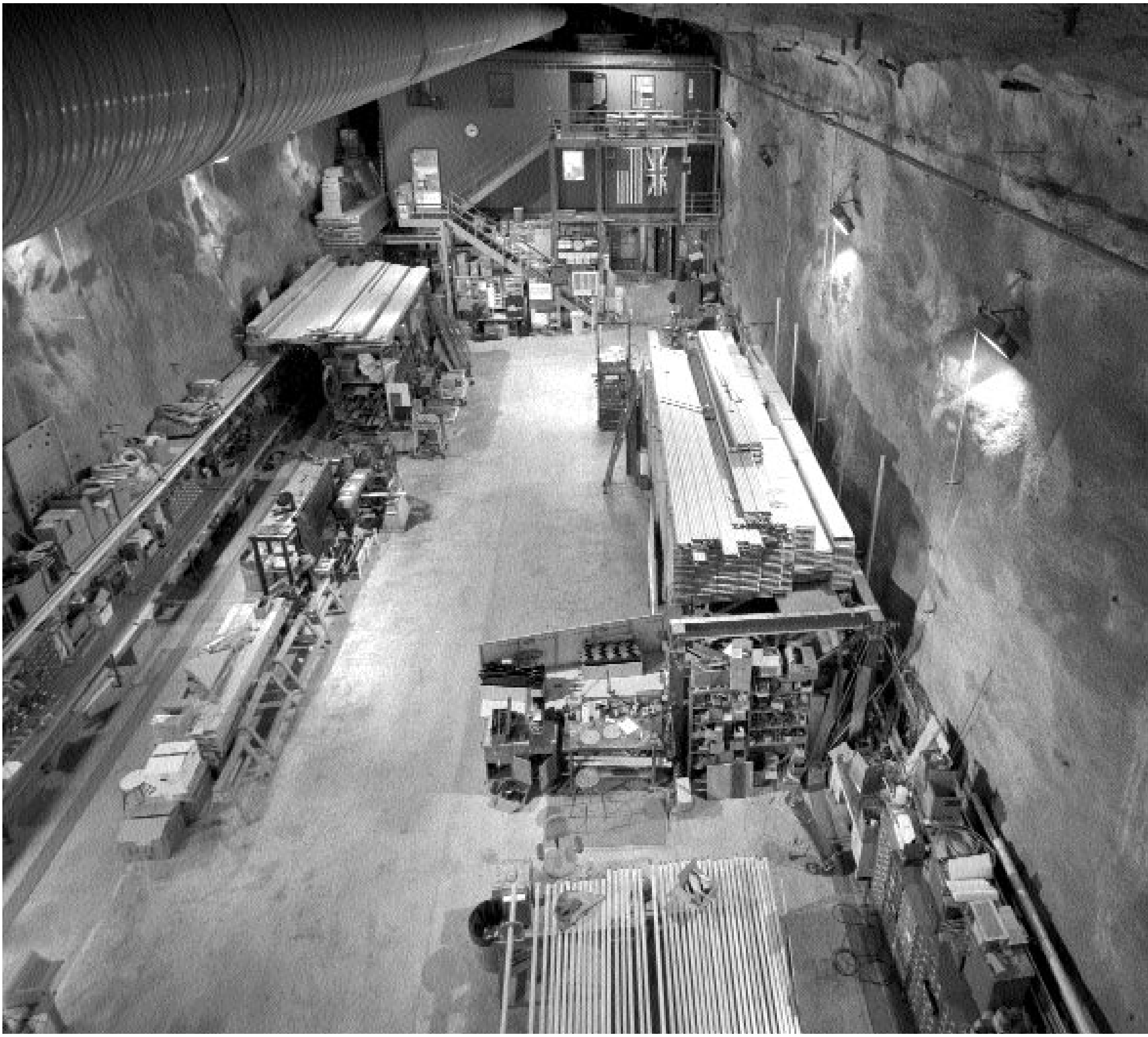
While the proton-graphite interactions produce many types of particles, the positive-charged pions are the main attraction. Because the pions are produced by collisions of positive-charged protons with neutral matter, somewhat more pi$^+$ are produced than pi$^-$. But the focusing of the beam has an even greater impact on its composition.

The pions emerge from the target at a wide variety of angles. They are focused and directed by intense magnetic fields in pulsed magnets called "horns." When the horns are set to focus pi$^+$ particles, they actually de-focus the pi$^-$ particles. The result is that far more neutrinos are produced than antineutrinos.

Hylen characterizes the horns as the most challenging devices in the beam design. The pion beam path penetrates through the horn's inner aluminum conductor, which must be thick enough to withstand millisecond-long pulses of extremely high current (200,000 amps), delivered every two seconds. But the the aluminum inner conductor also must be thin enough to prevent many pions from being lost by slamming into aluminum nuclei.

Fermilab's horns use a parabolic-shaped inner conductor that acts as a lens system. Just as a camera changes focus by altering the relative position of the lens to the film, the horn can change the focus of the neutrino beam. That means the energy of the beam can be changed, to different regions that seem promising for neutrino oscillations.

The pions drift through a short decay pipe (about 20 meters), then meet a second horn that finishes off the pion focusing—and that's the last time the beam is focused before heading off to Minnesota. The well-focused pions are aimed downward at a three-degree angle, setting their course for Soudan. They proceed down a decay pipe that is two meters in diameter and 675 meters long, a simple steel pipe surrounded by concrete shielding, with a vacuum of about 1/100 atmospheric pressure. In the pipe, the pions primarily decay into muons and muon neutrinos.



The neutrino beam will zip through the earth virtually undisturbed, destined for the detector a half-mile underground at Soudan, Minnesota.

The muons are quickly stopped, by a steel and concrete absorber and by the rock at the end of the pipe, about 270 feet below the surface. But once sent on their way, the neutrinos just keep going and going through the rock between Batavia and Soudan, as if nothing was in their path.

“The earth is transparent to neutrinos, just as glass is transparent to light,” Parke explains.

After leaving the decay pipe, a handful of the neutrinos stop at the near MINOS detector, about 1,000 tons of steel buried 330 feet beneath the earth. With several interactions per second, the near detector checks the beam focus and direction. That information can be used to make corrections in the horn focusing system.

If the detector in Soudan shows that the arriving neutrino beam has a different makeup than the original beam, then the neutrinos have oscillated, and Standard Model physics says that they have mass, answering a scientific puzzle of nearly 70 years.

As President Clinton told the MIT graduates: “…(W)e must help you to ensure that America continues to lead the revolution in science and technology. Growth is a prerequisite for opportunity, and scientific research is a basic prerequisite for growth.”

At Fermilab, that growth opportunity can originate with the tiniest imaginable quantity of reality. □

MUON storage rings would race against time to produce NEUTRINOS

by Mike Perricone

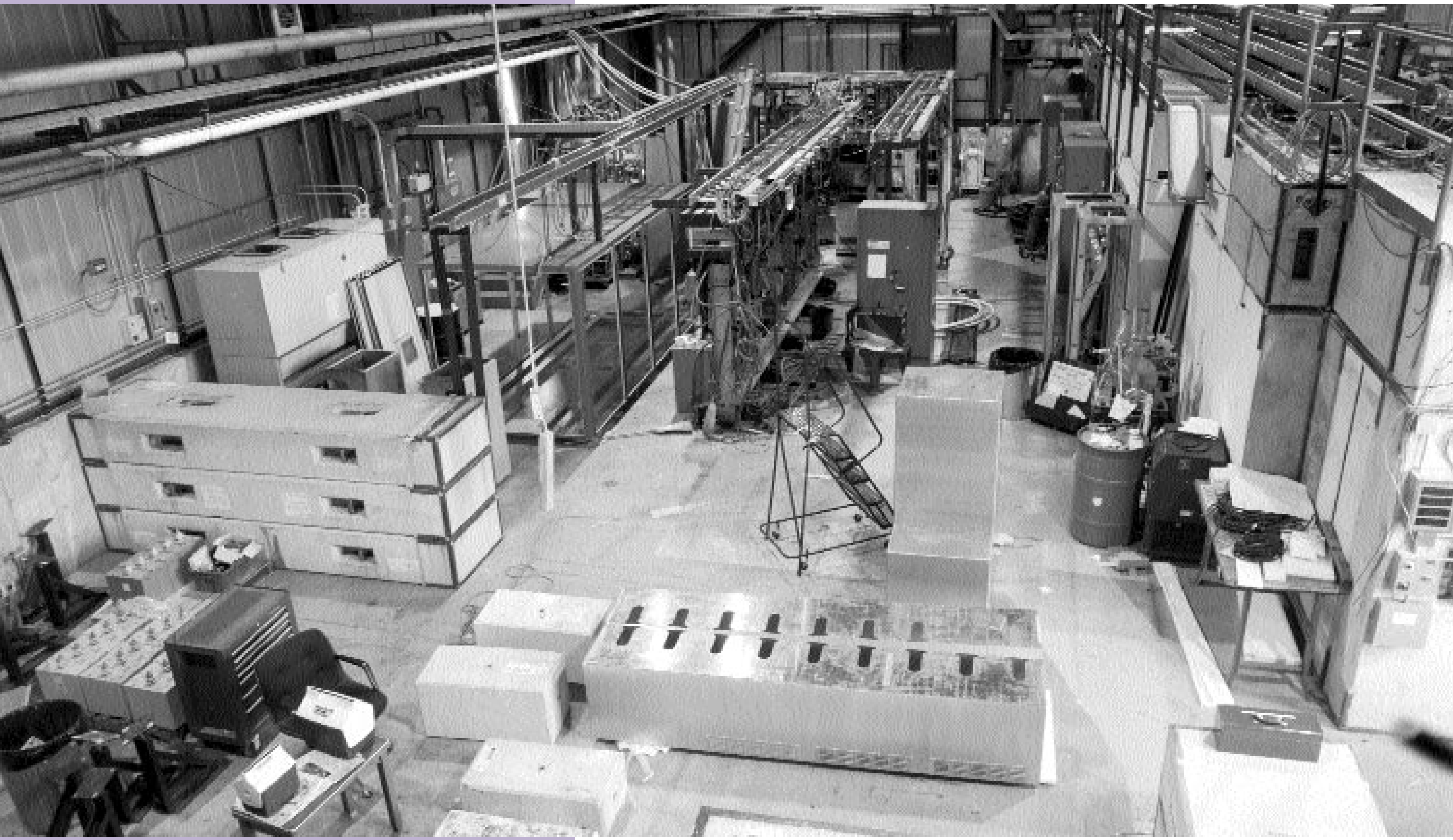
If you think there aren't enough hours in the day, imagine if your entire lifetime were measured in billionths of a second.

In the world of subatomic particles, time is unimaginably fleeting. Physicists often find themselves trying to hold back time to work with particles whose existence is measured in nanoseconds, or billionths of a second (0.000000001 seconds): James Dean-like particles, living fast and dying young.

A James Dean pion exists for 30 nanoseconds, or thirty billionths of a second. By comparison, a muon is a veritable Methuselah: it exists for two microseconds, or two millionths of a second, almost 100 times as long as a pion.

Both pions and muons take physicists down the road to producing neutrinos. But physics experiments depend on numbers: the number of particles

Research and development for a neutrino source and muon collider is being conducted in Lab G at Fermilab.



Norbert Holtkamp: Super Kamiokande results gave a boost to muon storage rings as neutrino factories. A muon storage ring would resemble a racetrack, with long straight sections where most of the neutrinos would be produced through muon decays.

produced, and the number of events observed. The greater the numbers, the greater the chances of success, and the greater the credibility for that success. Building those numbers is easier with particles that live 100 times as long as other candidates for the production process.

"You've got a much better chance of storing muons than you do of storing pions," explained Fermilab theorist Stephen Parke.

Many physicists believe that the future of neutrino experiments with large numbers of events, generated by high-intensity neutrino sources, lies in using muon storage rings as neutrino factories. The concept is under study both at Fermilab and at CERN, the European particle physics laboratory in Geneva, Switzerland.

"The idea of neutrino factories became an integral part of our future program because of the results with indications of neutrino oscillations from Super Kamiokande in Japan," said Norbert Holtkamp, of Fermilab's Neutrino Source and Muon Collider Collaboration, studying both the concepts and the systems and subsystems that would make up a future accelerator complex of this type.

The collaboration currently consists of about 100 physicists from 27 institutions. Holtkamp and Dave Finley, former head of Fermilab's Beams Division, are preparing a study on all aspects of the accelerator, from tunnels to magnets to cryogenics. A companion study, by Steve Geer and Heidi Schellman, is investigating the physics involved in different energies, intensities and experiments.

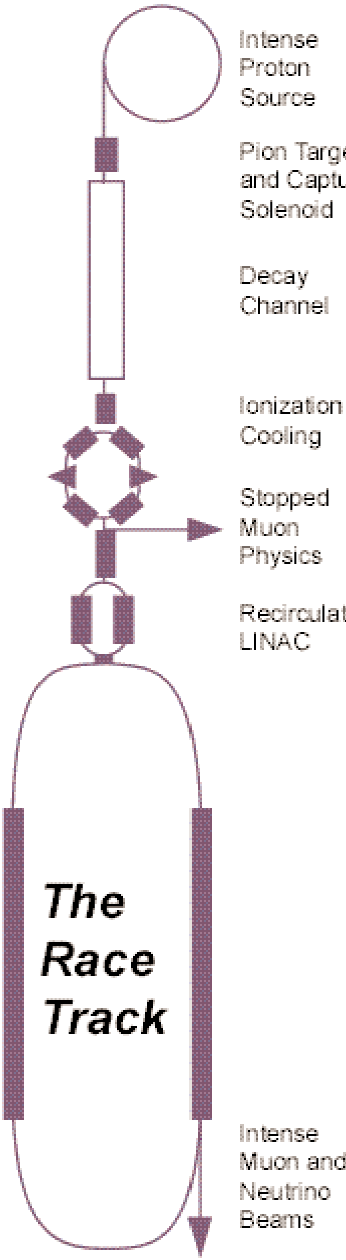
Basically, a muon storage ring will collect muons resulting from pion decays, cool them, and put them in a ring (more accurately, a recirculating linear accelerator) that looks like a racetrack: long straight sections with sharp curves at the ends. The muons would decay primarily into muon neutrinos, which would speed down the straightaway and essentially keep going, with small numbers of neutrinos coming out of the curves.

The number of neutrinos produced is proportional to the length of the straight section, a relationship first explored extensively by Geer—who is also an original proponent of muon storage rings and colliders as neutrino sources, along with Bruce King of Brookhaven National Laboratory.

Cooling the muon beam—minimizing the momentum spread among the muons in the beam—is the critical issue in building a muon storage ring, and using it to produce neutrinos. While muons have a long lifetime compared to pions, their lifetime is in turn quite short compared to the protons and antiprotons that constitute Fermilab's daily particle routine. The well-established stochastic cooling method used in Fermilab's Tevatron and Antiproton Source works over a span of milliseconds, or thousandths of a second—too slow for a particle whose lifetime is measured in billionths of a second.

Geer is part of a collaboration called MUCOOL, which is developing a new method called ionization cooling in which the beam is passed through an absorber material to reduce both longitudinal and transverse momentum. The longitudinal momentum is restored by re-acceleration, and the process is repeated several times.

"It's the only way to cool muons that's been suggested so far, because muons have such a finite lifetime," Holtkamp said. "Proving the feasibility of ionization cooling is a critical step toward building muon sources and neutrino sources." □



A Southern Gentleman Retires

by Sharon Butler


Jim Finks retired on September 30.

Twenty-six years, two months and nine days: That's how long Jim Finks, Jr., served at Fermilab, making such a deep imprint on the business end of building accelerators that Deputy Director Ken Stanfield said it would be hard to imagine writing checks now without him.

Finks officially retired as head of the Business Service Section on September 30, leaving behind a long career and a wealth of admiring colleagues. Under his tenure, the business office evolved into an efficient operation that, as one speaker at Finks's retirement party joked, made sure the Laboratory didn't spend itself into a black hole.

Finks, who grew up on a Virginia farm with chickens and pigs and boxwood, came to Fermilab in 1973 just as Wilson Hall, then called the Central Lab, was being completed. As business manager for Fermilab, working out of his first, and favorite, office in the old Director's Complex in the Village, Finks was amazed by the lack of any apparent attempt at budgeting, and quickly convinced Wilson and others to hire the Lab's first budget officer, Novill Jordan, now retired.

In the early days, too, Finks was always nagging Wilson for more modern storage space. "We had supplies in every barn and shed on the site," said Finks. "The leaking roofs and pigeons were hard on the stored equipment."

Wilson's eyes finally lit up when Finks said he could build a 40,000-square-foot prefabricated warehouse for a mere $10 per square foot. At the time, Finks said, buildings at Fermilab were costing $100-plus per square foot. These were the more exotically designed buildings, like the geodesic dome, constructed with 10-foot pieces of colorful reinforced fiberglass triangles and 120,000 publicly donated pop cans sandwiched in between. Wilson Hall itself cost $16 million—about a million per floor. Finks said his warehouse was just a cheap "plain Jane"—but it would be meet the Lab's needs.

Finks pulled all the forms together to purchase his warehouse and waited well past 5 p.m. one evening to corner Wilson after a colloquium for his signature. Wilson, pleased with the cost, but still hesitant to allow the construction of anything with so little architectural interest, reluctantly signed. But Finks, Wilson said, would have to do it without help; his engineers were all occupied. Finks, an engineer himself, accepted the challenge.

Wilson never praised Finks directly for his thriftiness. But the warehouse, completed for a mere $9 per square foot, still stands out near Fermilab's Fire Station. For years after it was built, Wilson would always grumble when any staff proposed a new structure: Why can't you make it as cheap as Finks's warehouse?

Finks remembers also retrieving two 4,000-horsepower Worthington compressors from government surplus stocks in California, which were used in the aerospace industry to liquefy oxygen to fuel rockets. Wilson wanted to use the compressors to liquefy helium for Fermilab's superconducting magnets. But Wilson didn't want just the compressor; he wanted the surplus building in which the compressors were housed.

Finks tried to convince Wilson that he could build one for a lot less than it would cost to transport that building all the way to Chicago, but Wilson wouldn't hear of it. Finks sent the project out for bid. Moving re-erecting the structure alone would cost around $175,000, he discovered. Then a foundation would have to be laid down, insulation installed, etc. Wilson buckled finally when Finks showed the cost of erecting a new, prefab building was only $100,000. That building is the present Central Helium Liquefier Building.

Finks found great satisfaction in his roles in the seventies as assistant head of the Energy Doubler Group and, then, as business manager for the Energy Doubler Project. The Energy Doubler would later become the Tevatron. Finks saw that the finances for the construction of the new accelerator were "adequate and kosher," said Bruce Chrisman, associate director for administration.

Dick Lundy, an engineer involved in building the Tevatron, remembers Finks guiding him and other staff, all of them naive in the business complexities of the task. Jim carried out his duty with all "the patience, tact, and skill that one would expect of a 'Southern gentleman,'" Lundy said. "And he must have done it well as I don't remember anyone going to jail."

Deputy Director Ken Stanfield bids farewell at Finks's retirement party.

Chrisman, who in the 1980s was the head of business services with Finks as his deputy, remembered with a smile, "We spent many an hour bemoaning how our director was spending us into a hole." His and Finks's job, he said, was to bail Fermilab out of the hole faster than the director put the Laboratory back in.

The house that Jim built: Warehouse #1.

Dave Carlson, who succeeded Finks as head of Business Services, has nothing but admiration for this unusual boss. "He crafted lots of changes, and accomplished huge things in business and administration here, but he never put himself in the limelight," said Carlson. "He was never threatened by people who worked for him; in fact, he wanted them to be informed, so that they could take on added responsibilities. He was happy to assign his staff authority, and never left them hanging out on a limb."

Carlson quoted a friend who told him, "If you have a bad boss, get another job." Carlson, who began working directly for Finks eight years ago, said he never had to do that.

Finks said he let his golf slip in the last few years because he "didn't feel he could get away from the job." After retiring, he immediately hit the greens in South Carolina, and he may soon head up to Wisconsin for some fly fishing.

But Rich Orr, a former colleague, warned Finks that retirement is not a time for rest. Finks may have won "the coveted Business Manager longevity record," Orr said, but now it's time for writing poetry. □

Minding our Business

by Sharon Butler

Dave Carlson, the new head of the Business Services Section, isn't big on mission statements, even though his group has one.

"But I know why we're here," he said. "We're here to serve the Laboratory's physics program. Very simple."

For Carlson, as for his mentor and predecessor Jim Finks, that means serving the staff and the outside scientists who conduct their experiments here—guiding them through, and sometimes protecting them from, the maze of government rules that regulate the purchasing of goods and services they need for their work.

COVER: Carolyn Hines, whose ID number is 47 (a sign of how long she has been with the Lab), is in charge of telecommunications, including voice-messaging and radio services.

Dennis McAuliff and Vanetta Readus keep things rolling in the mailroom and receiving.

But that philosophy means a lot more, too. After all, Business Services doesn't just procure. Groups within Business Services include:

- Legal Services, which issues eloquently worded opinions on everything from nuances in contract negotiations to the hanging of a sign at Fermilab's entrance;
- Records Management, which maintains and saves all of the Lab's important records;
- Accounting, which handles the Lab's payroll, accounts payable, financial reports, and travel vouchers;
- Support Services, which runs the mailroom, the stockrooms and the warehouses; ships and receives goods; maintains a fleet of 250 vehicles; overseas Fermilab property (equipment, etc.); and delivers packages on campus and off;
- Business Systems, which controls all the information technology for business management;
- Telecommunications, which oversees the web of phone lines and radio services for the whole Lab; and, of course,

Some **145 staff** mind Fermilab's business with **record efficiency**.

- Procurement, which bought $129 million worth of goods and services last year, and another $8 million worth through its ProCard program.

Carlson happily boasts that the goal of the Business Services Section is to run itself like an efficient business, with periodic self-assessments and a conscientious effort to be "effective, efficient, timely and accurate," as he told Fermilab Director Mike Witherell in a briefing this summer.

"I chose these words carefully," Carlson said. "'Effective' to me is the most important. It means getting the job done at the right level—not overkill or underkill. We're not out to have the fanciest, slickest business systems in the world, just the ones that best serve the needs of the program."

As for its customers, Business Services aims to please, Carlson said: "We want to support and enhance the business climate here—make it easier for the staff and users to accomplish their work when they need to buy something, get an item from the stockroom, or ship a package in from overseas."

With a budget of $12.2 million, down 10 percent since 1992, (in current dollars) and a staff of 145, down 15 percent, Business Services Section is a lean operation whose commitment to efficiency and service has paid off handsomely for the Lab even as demand for its work has increased.

In particular, Carlson said, "Business Services re-invented procurement away from the federal norm." Here at Fermilab, no one snickers about the "low bidder" because the policy, as procurement manager Joe Collins describes it, is "best value." In 1995, the Department of Energy reformed its rules for procurement, allowing its contractors to award contracts on the basis of best commercial practices and value, not just on the basis of cost or technical ability. The reforms, Collins said, enabled the Laboratory to "cut the red tape" and "get a technically superior product," whether piping or geographical surveys or magnet parts. Business Services has taken advantage of the reforms very aggressively.

Richard Karuhn manages the Information Technology group, which designed and implemented three major new business systems, coming in with their projects on time and on budget.

Under Finks, Business Services achieved record efficiency: Fermilab can now buy a dollar of goods or services for about a penny. "That's world-class performance," said Carlson, citing a report by a benchmarking organization called the Hackett Group.

One of Business Services innovations is the ProCard program, instituted in 1996. It enables staff to make small purchases without having to go through the procurement office, saving time and reducing paperwork.

Another innovation: Jeff Irvin, executive assistant in Business Services, came up with the idea of purchasing an in-house voicemail system in 1997 to replace the service Fermilab had long subscribed to through the local phone company. The new system saves the Laboratory between $100,000 and $150,000 a year, based on the number of voicemail boxes. "It has already paid for itself many times over," said Carlson.

Business Services has also expanded Fermilab's recycling program, which brings money into the Laboratory each year through sales of scrap metal.

For the future, Carlson hopes to restart efforts to create a Labwide project accounting system (staffing constraints caused it to be shelved in January 1999). Currently, Carlson said, every Fermilab project, whether upgrades for the CDF or DZero detector or the construction of a tank for the MiniBooNE experiment, has to come up with its own method of tracking costs, and tie those costs with **record efficiency**.

Joe Collins, manager of Procurement, scoffs at the notion of "lowest bidder." At Fermilab, it's "best value."

Dave Carlson, who first came to Fermilab in 1978 as a rent-a-tech, is now head of Business Services.

Photo by Jenny Mullins

Jim Shiltz, manager of Accounting, has numbers at his fingertips.

Photos by Reidar Hahn

Ron Haynes (left—"I'm the good lookin' one," he said), manager of Support Services, and driver Dan Nelson are proud of their latest purchase, a taxi for transportation around this 10-square-mile campus. The taxi includes access for the handicapped, and, noted Dave Carlson, head of Business Services, "you don't have to be a contortionist to get inside."

into Fermilab's accounting system, as well as the Work Breakdown Structure required of all large Department of Energy-funded projects.

"There's no easy way now to take our accounting and business systems and make them do project accounting," said Carlson. A system that would do that could save time and money. The whole project management system would not have to be reinvented each time; aligning costs with the Work Breakdown Structure could be automated.

Carlson also wants to automate the travel voucher system. Right now, travel vouchers are all done by hand. And because one of every three vouchers has an error, they all have to be audited. The most common errors are arithmetic mistakes, use of the wrong per diem, and incorrect calculation of the trip's duration. Automation could take care of all these problems, reduce the need for audits—and allow staff to be reimbursed sooner.

So, Business Services isn't just pushing paper and punching numbers. Sure, it has to negotiate the Department of Energy's book of bureaucracy. "There are always new rules and new interpretations of rules," said Carlson. "But Business Services gets involved in some crazy projects: like importing a giant solenoid from Japan, flying it in on a charter aircraft and escorting it through customs."

The business staff may have to count the number of computers on campus. But they are always eager to challenge the status quo, said Carlson, and push the outside of the envelope. □

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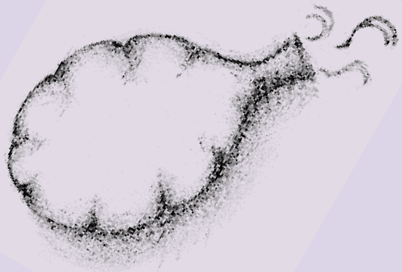
Whoopee! It works!

Tara Templeton, a senior at Mountain View High School in Mesa, Arizona, needed help with a school science project. Tara turned to her dad, Don Templeton. And her dad turned to Fermilab.

From: Don Templeton AKA Dad
To: Judy Jackson
Subject: Need help with daughter's project: mouse trap powered race car

Hello! I am trying to help my daughter Tara with her H.S. physics class project. She is trying to devise a mouse trap-powered car, home-built. I can help with car, but am blanking at how to use the energy supplied by the mouse trap to power the vehicle. time is of the essence. even a few simple illustrations could get us on track again. We are bogged down with the how instead of the why.

Thanks,
Bewildered Dad (aka Don)



From: Judy Jackson
To: Don Templeton
Subject: Project proposal

Dear Dad,

I brought your daughter's mousetrap problem to a table of physicists in the Fermilab cafeteria. They had a number of ideas, but I thought this one, from Fermilab theorist Chris Hill, was the best and the simplest. Mount a large mouse trap on the car, which is large enough to also hold an inflated Whoopee cushion. Make the mousetrap close on the Whoopee cushion.

Voila! Jet propulsion.

Let us know how it goes.

Judy Jackson
Fermilab Office of Public Affairs

From: Don Templeton AKA Dad
To: Judy Jackson
Subject: TA DA!! TA DA!! THE RESULTS ARE IN!!

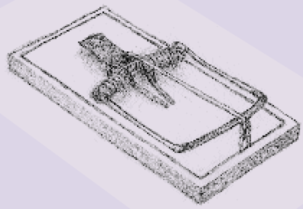
I am happy to announce that Tara came in 4th overall out of 15. She had the 4th best overall distance (5+ meters) and time. Her car wouldn't win any awards for "Looks" but it was very functional. Frame consisted of two pieces of 1″ x 2″ fir strip approx. 9″ long. Front wheel was the lid of a relish jar. The rear tires were made from CD's, a pair for each side. She also used a couple of pieces of the 1x2 for spreaders to keep the frame sturdy. It was ugly but she passed and showed those boys she was a force to deal with!!

Dad is very pleased.

Thanks for all your help and suggestions. She is also going to steal some ideas from the boys and substitute a wire frame for the 1x2's and try to hollow out the CD's for rear wheels.

Her next project is a toothpick bridge, 12" long that will support 30 pounds! She is getting help from her drafting teacher and her mechanical engineer grandpa!! Never a dull moment here!

Thanks,
Don Templeton aka Dad



From: Judy Jackson
To: Don Templeton
Subject: Congratulations!

Dear Don,

Congratulations to you and Tara! I took Tara's results back to the theorist who proposed the whoopee cushion (he was at lunch once again), and he sends his congratulations as well. I'm sure he wishes all his theoretical ideas had such happy experimental confirmation.

Good luck with the bridge!

Judy Jackson
Fermilab Office of Public Affair

Note: Tara has earned an in-state tuition waiver for four years at any of Arizona's three state universities, Arizona State University, the University of Arizona, or Northern Arizona University. She plans to study architectural engineering.

When all the stars are shining

How old is the universe? How big is it? How fast is it getting bigger?


E. P. Hubble

The answers to those questions all depend on the Hubble constant (H_0), combined with the average total density of the universe. But the Hubble constant itself has historically raised questions, with two reported values differing by a factor of two.

So when someone tries to shed new light on setting a value for the Hubble constant, as Wendy Freedman of Carnegie Observatories did in a recent Fermilab Colloquium, the questions and answers draw a large audience from beyond the specialty of astrophysics, and including all the areas of physics represented at the Lab.

Particle physicists have more on their minds than their personal focus on particular particles, and they're always ready for a good lecture. Add in the fact that "no article in the lay press on the age of the universe fails to quote" Freedman, as Colloquium host Dave Carey said in his introduction, and the result was a capacity audience in Wilson Hall's 1W conference room.

Nobel laureate Leon Lederman, Director Emeritus of Fermilab, had a front-row seat as Freedman discussed efforts to accurately measure the expansion rate as what is defined as a Key Project of the Hubble Space Telescope.

Lederman's reaction: "Wendy's talk was great physics, showing that astrophysics is a quantitative science. And since the connections to particle physics is why we have an astrophysics group at Fermilab, it is obviously a draw."

Experimenter Herman White, searching for CP violations in kaon decays with Fermilab's KTeV (Kaons at the Tevatron) collaboration, was drawn by the opportunity to look outward on the grand scale of the cosmos.

"Even though I try to attend all the colloquia when possible, I thought this topic would be especially interesting," White said. "We can obtain a lot of information in a precise measurement of the Hubble parameter. Besides the fact that this speaker is known to be present this topic well, I think that many in this audience were naturally curious about the newest information on the age of the universe, and the rate of expansion of the universe. Besides more precise measurements of the distances to galaxies, I was curious to see if the Hubble telescope observed any new galaxies, and if they contribute to a better measurement of the Hubble parameter.

"It was a good lecture," he concluded.

Theorist Andreas Kronfeld, chairman of the Colloquium Committee, knows a good story when he sees one, as well as a good speaker.

"Attempts to measure the Hubble constant get a lot of press," Kronfeld said. "For many years different groups got different results—different by a factor of two. [Freedman] is a major player."

But Kronfeld also appreciated Freedman's focus on precision measurements, which he feels isn't always the case in astronomy issues.

"From a scientific point of view," Kronfeld said, "what was impressive was that she and her group have made a serious attempt at estimating the uncertainties associated with their measurements. Such analyses were lacking in the past, but you cannot claim to be doing hard science unless you do so. It was refreshing to see an astronomer admit that her field may have been sloppy in reporting numbers in the past, and to go on and do things scientifically."

—Mike Perricone

LAB NOTES

CHARITIES PROGRAM

The Charities Program has a new procedure this year. Check out the Fermilab at Work web page for directions & instructions how to properly fill out your form. If you have any questions, concerns, need assistance or do not have access to the web you may request paper forms by phoning Equal Opportunity Office At x4633, http://www.fnal.gov/faw/charities/charity.html

URA SCHOLARSHIPS REQUIRE SAT TEST

Universities Research Association (URA) scholarships are awarded on the basis of SAT (Scholastic Aptitude Test) scores. High-school seniors are reminded to sing up for a fall testing date if they have not already taken the test.

URA awards a number of scholarships to regular, full-time employees, children who are currently high school seniors and who will begin a four-year college degree program the next fall. The maximum amount of the scholarship is $3,000 for tuition and fees and is renewable for four years if the student is in good standing. Scholarship applications will be available after the first of the year and are due March 1, 2000.

FERMILAB LECTURE SERIES presents:

THE ANTARCTIC OZONE HOLE Dr. Mario J. Molina, 1995 Nobel Laureate in Chemistry Institute Professor of Chemistry, Massachusetts Institute of Technology, Friday, January 7, 2000 at 8:00 p.m. Tickets are $5.00. For more information call 630-840-ARTS.

HAPPINESS is cutting down your own fresh Christmas Tree at Marmion Abbey. You can cut your own tree any day, Sundays included, beginning Saturday November 20 December 23, from 9:00 am until dusk. There are no lights in the field so come early enough to find your tree in the daylight. Thousands of beautiful trees are ready to be cut by yourself. Please come prepared: warm clothing, gloves, boots. Bring your own small bow saw or rent one of ours for a deposit of $10 which is part payment on your tree. Also available, wreaths, door swags and crosses made from fresh boughs.

BENEFIT NOTES

The annual maximum contribution into a Supplemental Retirement Account will increase from $10,000 to $10,500 effective January 1, 2000. The general rule for Fermilab's voluntary supplemental retirement plan is 25% of total compensation or $10,500 whichever is less.

If you want to make a change to your SRA contributions, you must complete a new salary reduction agreement form. Forms are available from the Benefits Office, 15WHNW.

Payroll changes for 2000

The Social Security Administration has announced that the 2000 social security wage base will be increased to $76,200 from the 1999 wage base of $72,600. All wages without limit are subject to the Medicare tax. The FICA rate (combined social security rate of 6.2% and Medicare rate of 1.45%) remains at 7.65% for 2000. Other changes: The standard business mileage rate for transportation expenses beginning January 1, 2000 increases to 32.5 cents per mile, up from the 1999 rate of 31 cents per mile. The American Payroll Association offers complete details on these and other year-end developments at its web site: http://www.americanpayroll.org/

MILESTONES

ELECTED

Dr. Herman B. White Jr. has been elected to the North Central College Board of Trustees. Since 1994 White has taught at the College where he is a Corridor Fellow in physics. A Fermilab scientist since 1974, White's current research involves the study of CP-violation, rare kaon decays and tests of CPT symmetries incorporating the design and development of detector and beam systems for the physics.

BORN

[redacted] Elizabeth I. Kershisnik (ES&H) and Timothy D. Draper.

RETIRING

S. Miller, ID #4290 will retire effective November 20, 1999, her last of work.

LUNCH SERVED FROM
11:30 A.M. TO 1 P.M.
$8/PERSON

DINNER SERVED AT 7 P.M.
$20/PERSON

Chez Léon MENU

FOR RESERVATIONS, CALL X451
CAKES FOR SPECIAL OCCASION
DIETARY RESTRICTION
CONTACT TITA, X352
HTTP://WWW.FNAL.GOV/FAW/EVENTS/MENUS.HTM

LUNCH
WEDNESDAY, NOVEMBER 24

Cheese Fondue

Baby Greens with Raspberry Vinaigrette

Pineapple Slices with Rum Sauce

DINNER
THURSDAY, NOVEMBER 25

Happy Thanksgiving

F E R M I NEWS

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The deadline for the Friday, December 3, 1999, issue is Monday, November 22, 1999. Please send classified advertisements and story ideas by mail to the Public Affairs Office MS 206, Fermilab, P.O. Box 500, Batavia, IL 60510, or by e-mail to ferminews@fnal.gov. Letters from readers are welcome. Please include your name and daytime phone number.

Fermilab is operated by Universities Research Association, Inc., under contract with the U.S. Department of Energy.

CLASSIFIEDS

FOR SALE

■ '99 Goldwing SE (Silver) under 11K Miles - Runs Great Must Sell - Will even store it for the winter. Asking $16,000. Lots of extras. Call Terry X4572 or e-mail skweres@fnal.gov

■ '93, Toyota Corolla Standard 4-Door Sedan, 44K original owner, $5,500 obo.
For more information treend@fnal.gov.

■ '91 Civic CX - 4 speed, hatchback, base model, metallic blue, blue/gray interior, AM/FM cassette, 1st owner, 86 k miles, no rust, serviced by dealer (all stamps), oil every 6 months, only premium gas, recent exhaust and brakes, good tires, all records, excellent condition. $3,200. Rafael, X-8311, rafael@fnal.gov.

■ '89 Mercury Tracer, auto, wgn, am/fm,a/c,new battery,79k,great condition $1,600 obo. Junye X4511 or wangjy@fnal.gov

■ '89 Ford Taurus 4Dr GL Sedan Sandalwood, 94k miles, auto, loaded, original owner, good condition, new brakes, $2,300. Mail to chou@fnal.gov or call x5489.Older refrigerator with top freezer and gas stove – both avocado color. Must sell my November 30th. $50 each, good working condition. Ken x4225.

■ 3 Goodyear P225/75R15 light truck tires, good condition, $30 total takes them. One Goodyear P225/75R15 passenger tire, good condition, $10. Call Mike x47551

■ Boy's 6-drawer dresser (needs refinishing) $50 obo. Green/Gold Plaid couch, love seat and ottoman chair, asking $200; great for family room (815) 726-2301 after 7:00 p.m. or ext. 2326 or carriveau@fnal.gov.

■ Early American cabinet, $25; Aero Cycle bike $25. Air powered drill (New) $35; impact wrench (New) $45. x4264 or 896-3211.

■ Piano, Baldwin Acrosonic $800 made in USA in the 1970's call Cliff (630) 859-8441

■ Retro furniture. Late 60s and 70s period furniture. 1 Couch yellow floral $75, 2 chairs one yellow velvet one pea green velvet $25 ea., 2 end tables med brown wood $20 ea., 2 sets stack tables $10 ea., dining rm set w/4 chairs & 2 leaves $250 obo, 2 twin beds mattress and box spring frames and headboards, $25 ea. kitchen stuff. All in good condition. Make me an offer. Contact treend@fnal.gov.

■ Leather Furniture by Lazy Boy, hunter green, less than 3 years old, original $4,000 will sell for $2,000. Sofa has 2 recliners, loveseat has 2 recliners. Call Cliff (630) 859-8441

■ 1.PC 386, 33Mhz,130MB, 8MB RAM, Math Processor, Windows 3.11, Microsoft Word, Excel, games and more! Viewsonic color monitor. Panasonic Matrix Printer KXP1123 Works great. $190 obo. Mail to chendi@fnal.go or call (630) 355-1253.

■ IBM 486 14″ monitor, speakers and color printer-3 years old. $175 obo Ralph (630) 443-1976

■ Condo for rent Downers Grove, 2 bedrm 2 full bath. 75th and Fairview Streets, 2nd floor w/balcony, laundry facilities in building, club house/swimming pool, ponds, very well maintained property, security entrance to building, pretty area. Heat and water included-$800. 20 minutes to Argonne Lab, 25 min to Oak Brook. treend@fnal.gov.

■ Apartment (1 Bedroom) for rent, Oak Park, direct access to I290 and blue line, very nice location, $650/month, vangemme@fnal.gov or x8592

■ Individual seeking ride to and from Fermi Mon thru Fri from Wheaton. Will share expenses. Please contact Roger x8257 or rkramme@fnal.

CALENDAR

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

DECEMBER 4
Fermilab Arts Series Presents:
Windham Hill's Winter Solstice Concert featuring Liz Story, David Arkenstone, Lisa Lynne & Sean Harkness Saturday, December 4, 1999 at 8 p.m.

Tickets for the Windham Hill Winter Solstice Concert are $25. For further information or telephone reservations, call 630/840-ARTS weekday from 9 a.m. to 4 p.m. At other times an answering machine will give you information and a means of placing ticket orders. For more information about this and other Arts Series presentations, check out our web site at www.fnal.gov/culture/.

DECEMBER 10
Fermi National Accelerator Laboratory Women's Organization

All Fermilab women are welcome to come to NALWO's Annual Winter Holiday Tea. Hosted by Beth Witherell at her home at Site 29, just south of the lab's Pine St. exit. Friday, December 10, 1999. Please bring a favorite dessert or appetizer from your tradition or country to share; but if you cannot bring a treat, please come anyway! For additional information or directions to Site 29, contact Rose Moore, 208-9309 or cmoore@fnal.gov, Linda Olson-Roach, 840-3082 or lor@fnal.gov; Sue Mendelsohn, 840-5059 or mendel@fnal.gov; Mady Newfield, 584-0285 or MadyNewfld@aol.com.

SUNDAY, NOV. 21
Afternoon barn dance in the Kuhn Village Barn from 2 to 5 p.m. Music provided by Danny Miller and Friends. Calling will be by Paul Ford. All barn dances are taught and people of all ages and experience levels are welcome. Admission is $5, children under 12 are free (12-18 $2). The barn dances are sponsored by the Fermilab Folk Club. For more info, contact Lynn Garren, x2061 or Dave Harding, x2971.

ONGOING
English Classes, Thursday at the Users, Center 10-11:30, free classes. NALWO coffee for newcomers & visitors every Thursday at the Users, Center, 10:30-12 children welcome. In the auditorium, International folk dancing, Thursday, 7:30-10 p.m., call Mady, (630) 584-0825;

Skydivers: Looking for that excuse to make your first jump? Or are you a current student or experienced skydiver just interested in getting together with a group of fellow employees and taking advantage of group rates? We are lookir for people for a proposed new club. Contact either Paul x4495 or Rod x2565.

Scottish country dancing Tuesdays, 7:30-9:30 p.m., call Doug, x8194 or e-mail folkdance@fnal.gov.

http://www.fnal.gov/directorate/public_affairs/ferminews/

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