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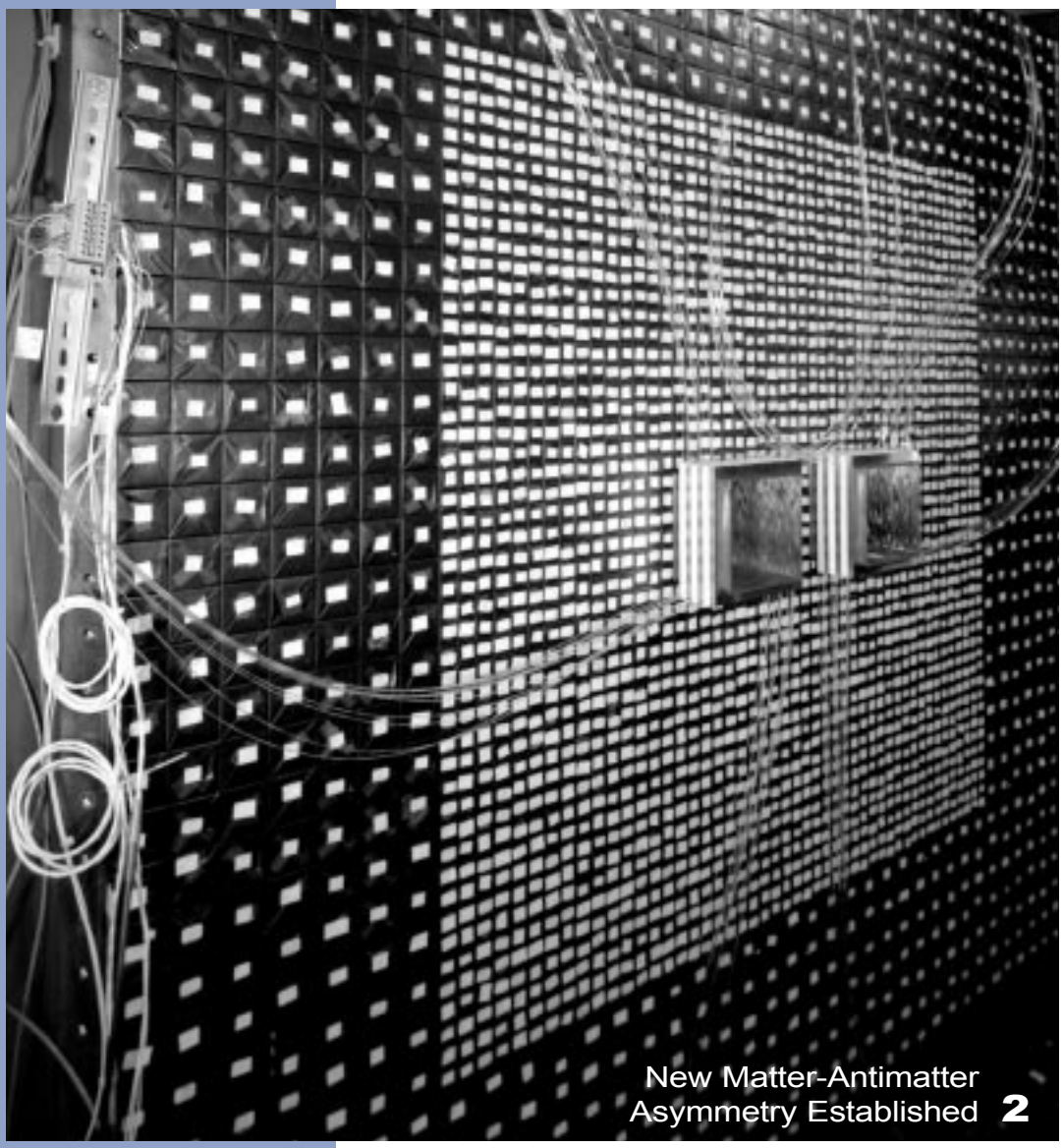

New Matter-Antimatter Asymmetry Established **2**

Photo by Reidar Hahn

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INSIDE:

NEW Matter-Antimatter

by Judy Jackson

Nature, ever chary of her secrets, is seldom more reticent than on the subject of antimatter. We creatures of matter inhabit a world apparently fashioned only of matter, yet we do not know why. Using particle accelerators, we can create the antimatter counterparts of matter's leptons and quarks, but when we study these particles of antimatter, we find that instead of behaving like mirror reflections of their material cousins, they can follow rules of their own.

Today, although antimatter remains one of the great mysteries of physics, it is slightly less mysterious than it was a month ago. Years of careful experiments by physicists at CERN and Fermilab have at last produced a significant advance in the understanding of the difference between the behavior of matter and antimatter. Moreover, physicists from Fermilab's KTeV experiment said they were "shocked" at the size of a long-sought result they reported to a standing-room-only audience at a seminar at Fermilab on February 24. Indeed, there was an audible gasp from the audience of physicists when University of Chicago graduate student Peter Shawhan gave KTeV's observed value for a phenomenon called "direct CP violation."

"Our result," Shawhan said, "is that epsilon prime over epsilon equals 28 plus or minus 4.1 times 10^{-4}."

KTeV physicists may have been surprised, but CERN physicists in experiment NA31 were elated.

"The CERN physics community offers its congratulations to their colleagues from the KTeV experiment at Fermilab for their exciting new data on the observation of direct CP violation in neutral kaon decays," wrote CERN Director-General Luciano Maiani. "The KTeV result of $(2.8 \pm 0.4) \times 10^{-3}$ is particularly pleasing as it is an important step forward in the understanding of CP violation and it confirms with greater precision the earlier result by the NA31 experiment at CERN. The NA31 result was published in May 1988 in *Physics Letters B* in a paper entitled 'First Evidence for Direct CP Violation' with a result of $(3.3 \pm 1.1) \times 10^{-3}$ for the relative decay amplitudes of CP violating to CP conserving decays."

Amit Lath, from Rutgers University, checks the active scintillation counter regenerator inside the vacuum tank upstream of the KTeV detector.

Asymmetry Established

Antimatter has been surprising physicists since its discovery by physicist Carl Anderson, in the track of an antielectron, or positron, in a cloud chamber in 1932. The prevailing theory of the fundamental structure of matter, the Standard Model, holds that every particle of matter has a corresponding antiparticle of antimatter. It is believed that early in the evolution of the universe, matter and antimatter were equally abundant, but today antimatter has only been observed in cosmic-ray interactions—and in high-energy particle collisions at accelerators such as Fermilab's Tevatron.

Among the particles born in high-energy collisions are mesons. Mesons are short-lived pairings of a quark and an antiquark. Certain mesons, called neutral kaons, are combinations of a strange quark or antiquark and a down quark or antiquark.

In 1964, a group of physicists led by James Cronin and Val Fitch were studying neutral kaons in experiments at the Department of Energy's Brookhaven National Lab when they discovered a slight but definite asymmetry in the behavior of the neutral kaon and its antiparticle—an asymmetry called charge-parity, or CP, violation. Until that discovery, physicists had believed that particles and antiparticles behaved symmetrically, like mirror reflections of each other.

"We were attempting to make a much better test of CP invariance," said Fitch, who with Cronin was awarded the Nobel Prize for the discovery, "and it turned out not to be invariant."

This original CP-violating effect can be described as an asymmetry in the quantum-mechanical fluctuation, or "mixing" of the neutral kaon with its antiparticle. Other manifestations of CP violation have been clearly established at many laboratories in the years since its discovery, but they could all be traced to this original effect. Among the theories proposed to explain CP violation is the Superweak Theory, which posits only mixing effects, with no CP violation in the decays of neutral kaons into other particles.

Yet ever since 1964, scientists at physics laboratories around the world have been attempting to observe an asymmetry in the decay, rather than the mixing, of the neutral kaon. To do so, they have attempted to measure the ratio ε'/ε, "epsilon prime over epsilon," a double ratio of different modes of decay of neutral kaons and their antiparticles into pi mesons, or pions. If they found a value different from zero, it would signal a new—direct—form of CP violation.

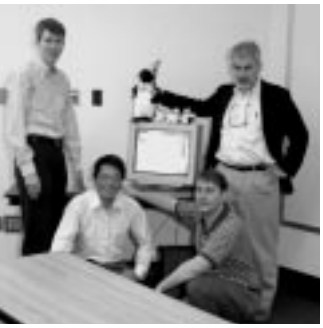
Photo by Reidar Hahn

KTeV physicist Yee Bob Hsiung, of Fermilab, inspects the half-built cesium iodine crystal calorimeter, the heart of the KTeV detector, during installation in the summer of 1996. The calorimeter measures the energy and position of kaon decay products.

"The Standard Model, if it correctly accommodates CP violation, predicts a non-zero, but small, effect," said University of Chicago physicist and KTeV spokesman Bruce Winstein. "But experiments up until now had not firmly established such an effect. An experiment at CERN, NA31, led by Heinrich Wahl, reported a significant effect, 23×10^{-4}, with a precision of 3.5 standard deviations, but that was not yet enough to say definitively that the effect was non-zero. And a previous Fermilab experiment, E731, reported a value of 7.4×10^{-4}, with a standard deviation of 1.25—an effect three times smaller than the CERN experiment, and not far enough away from zero to confirm the CERN effect. Most theorists who calculated ε'/ε in the Standard Model found very small values, closer to the Fermilab result or even smaller. As a result of this situation, both groups designed and constructed experiments aimed at much more precise determinations."

KTeV's new result establishes the existence of direct CP violation beyond reasonable doubt (almost 7 standard deviations). The finding

Matter-Antimatter



Left to right: KTeV collaborators Peter Shawhan, Yee Bob Hsiung, Peter Shanahan, and Bruce Winstein, just after posting the KTeV results on the Web, as the penguins look on. The penguin symbolizes "penguin diagrams," which are important in the Standard Model for CP violation.

definitively rules out the Superweak Theory as the sole source of CP violation. The value for ε'/ε was much larger than many experts had expected.

"One way of explaining the largeness of the effect, within the Standard Model, is if the strange quark's mass is smaller than is often assumed," said Andreas Kronfeld, a Fermilab theorist. For example if the strange quark has a mass of 70-80 MeV, as obtained by Fermilab theorists Kronfeld and Paul Mackenzie and collaborators, the Standard Model prediction for ε'/ε agrees well with KTeV's result.

Fitch, now professor of physics at Princeton University, summed up reaction to the announcement: "It is a most astonishing result. It is quite unexpected, and very, very interesting."

KTeV's Winstein pointed out that the new result, which is based on analysis of only about 20 percent of the collaboration's total data from a 1996-1997 physics run, is much more consistent with the earlier CERN result than with previous results from Fermilab.

"We are excited to have established direct CP violation," Winstein said. "We want to emphasize that CERN's NA31 experiment deserves a share of the credit."

To try to understand the difference from their previous results, the KTeV physics analysis team has intensely scrutinized the earlier Fermilab measurement, but, said Winstein, "we have found nothing that could account for the difference, other than an unlikely but still possible fluctuation. We are eagerly awaiting the next results from our colleagues at CERN in experiment NA48. That experiment has significant strengths that complement KTeV's, and we expect them to report soon on data they have already taken. And the physics community awaits the results of a completely different approach taken by the KLOE experiment at Italy's Frascati laboratory."

Cronin, co-discoverer of CP violation in 1964 and professor of physics at the University of Chicago, confirmed the significance of the KTeV announcement. "It's been 35 years since CP

MATTER WITH A BAR Milestones in the Understanding of Antimatter

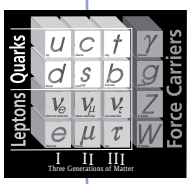
1929 Paul Dirac predicts the existence of antimatter.

1932 Carl Anderson sees the track of the first antiparticle, the antielectron, or positron, in a cloud chamber at Caltech.

1955 Emilio Segre and Owen Chamberlain observe the antiproton at the Bevatron accelerator at Lawrence Berkeley Laboratory.

1964 James Cronin and Val Fitch discover CP violation in the mixing of the neutral kaon and its antiparticle (indirect CP violation).

1976 John Ellis, Mary Kay Gaillard, and D. Nanopoulos calculate for the first time the size of ε'/ε in the Standard Model, getting a value of about 0.0022.



1979 Fred Gilman and M. Wise publish the first in long series of refinements to the calculations by many authors, leading to estimates of ε'/ε below 0.001.

Photos by Jenny Mullins

Peter Shawhan presented KTeV's results at a colloquium at Fermilab.

violation was discovered," Cronin said. "This is the first time that we have finally learned something new. It doubles our knowledge of CP violation—now there are two parameters instead of only one. Until now, we could explain everything in terms of slight kaon mixtures, but not any more. It's just sensational!"

The KTeV experiment (for Kaons at the Tevatron) is an 85-member collaboration of experimental groups from the University of Arizona, the University of California at Los Angeles, the University of California at San Diego, the University of Chicago, the University of Colorado, Elmhurst College, Fermilab, Osaka University, Rice University, Rutgers University, the University of Virginia, and the University of Wisconsin.

KTeV began construction in 1992 and first took data late in 1996. It used a beam of 800-GeV protons from Fermilab's Tevatron to create two parallel beams of neutral kaons to search for CP violation. An innovative particle detector constructed of crystals of cesium iodide gave experimenters unprecedented precision in making experimental observations, while other technological innovations allowed the collaborators to rule out background events and collect data at very high rates.

Now Nature has given up one long-held antimatter secret, but physicists around the world are preparing new experiments to elicit more revelations in the persistent mystery of antimatter.

KTeV engineer Elizabeth Pod, of the University of Chicago, prepares a single cesium iodine crystal bar in a dry clean room.

Photo by Reidar Hahn

Late 1970s

Fermilab, Brookhaven and, later, CERN launch experimental efforts to search for CP violation in neutral kaon decays at the level of the Standard Model.

1988

CERN's NA31 experiment reports first evidence for CP violation in decays of the neutral kaon ($\varepsilon'/\varepsilon = 0.0033$, 3 standard deviations).

1993

Fermilab's E731 experiment reports $\varepsilon'/\varepsilon = 0.00074$, 1.25 standard deviations from zero; CERN reports $\varepsilon'/\varepsilon = 0.0023$, 3.5 standard deviations from zero.

1993

Fermilab (KTeV) and CERN (NA48) begin constructing new, more precise experiments.

1999

KTeV announces a value of 0.00280 for ε'/ε, more than 6 standard deviations from zero, firmly establishing direct CP violation.

1999

Everyone awaits results from CERN's NA48.

A Homecoming for Witherell

Photo by Jenny Mullins

Michael Witherell and his wife, Beth.

by Sharon Butler

Thomas Wolfe said you can't go home again, but Fermilab's director-designate Michael Witherell has proved him wrong.

An experimenter here from 1978 to 1990, Witherell returned on March 5 when the Universities Research Association, Inc., formally announced that he would take the helm after current Laboratory director John Peoples steps down on June 30.

"I am looking forward to coming back to Fermilab as director," the 49-year-old Witherell told reporters, staff, URA and government officials, colleagues and friends. "I am coming with a lot of excitement and curiosity about the physics we have ahead of us; optimism about the future of the field and the Laboratory; and a great respect for Fermilab's staff and users."

URA timed the announcement of Witherell's appointment to coincide with a meeting of Fermilab's Board of Overseers. The director-designate spent the day fielding questions from journalists, posing for photographers, shaking hands with colleagues, and acknowledging welcoming applause at the Board meeting, a press conference, and a Lab-wide staff meeting in Ramsey Auditorium that was broadcast over the internal cable channel.

John Kennedy, acting manager of the U.S. Department of Energy's Chicago Operations Office, attended the official announcement for the press, in a show of support, and brought congratulations from Secretary of Energy Bill Richardson. Richardson commended URA for "finding such a highly qualified scientist to lead this great laboratory" and pledged to "work closely with [Witherell] to ensure that the U.S. remains a world leader in particle physics research."

Peter Rosen, associate director for high-energy and nuclear physics in DOE's Office of Science also sent words of praise and good wishes.

In an e-mail message that was read at the press conference and the staff meeting, Rosen said that Witherell "has the depth of experience, breadth of vision, and wisdom necessary to lead our premier laboratory into the next millennium, building upon the strong foundation laid by the present director."

The Search Committee that Fermilab's Board of Overseers appointed to identify candidates for the position of director may have worked for a year, but for Witherell, "things have been moving very quickly." Just two months ago, he said, he was faced with having to decide whether to enter the final stages of consideration for the position. He was clearly torn, for it would mean changing careers; leaving the excellent physics department and his colleagues at the University of California, Santa Barbara; and foregoing his involvement in SLAC's BaBar experiment, which will study CP violation in B mesons, a phenomenon of keen interest to physicists all over the world. The move to Fermilab would also disrupt the successful academic career of his wife, Beth, who heads a research project at the university to publish a new

Photo by Reidar Hahn

edition of the writings of Henry David Thoreau. Northern Illinois University has since eagerly agreed to be the project's new home.

"In the end," Witherell told staff members crowded into Ramsey Auditorium, "I was persuaded by the fact that nothing else is as important to the field as the future of Fermilab and that, [as director], I would be able to do what I could to shape that future."

Witherell said that he had two goals as director of Fermilab: "to advance high-energy physics in the U.S. and to have Fermilab continue to be a superb research facility." Those two goals, he said, were inextricably linked. "Fermilab is the largest and most important laboratory in high-energy physics, and the field will do well only if Fermilab does well."

He sees the director's job as divided into three parts: "managing this large and diverse lab so as to do the best science; working with the high-energy physics community to help lead a broad effort to plan the future program for our field in this country; and convincing the right people in Washington that what we are doing is worth funding."

With experiments either under construction or already under way addressing the central issues in high-energy physics today—supersymmetry, the Higgs particle(s), neutrino oscillations—Witherell declared that Fermilab was "in the perfect situation." But the "hard part in the next few years," he said, would be ensuring that "we take advantage of that position, while at the same time preparing for the future of the field."

Witherell Now…

Current director of Fermilab John Peoples and director-designate Michael Witherell at the March 5 press conference.

"I am coming with a lot of **EXCITEMENT** and curiosity about the physics we have ahead of us; **optimism about the future** of the field and the Laboratory; and a great respect for **Fermilab's staff** and **users**."

As Chair of the High-Energy Physics Advisory Panel, Witherell said, he had just written a letter to the director of DOE's Office of Science, Martha Krebs, explaining why the President's budget request of $697 million for fiscal year 2000 was inadequate.

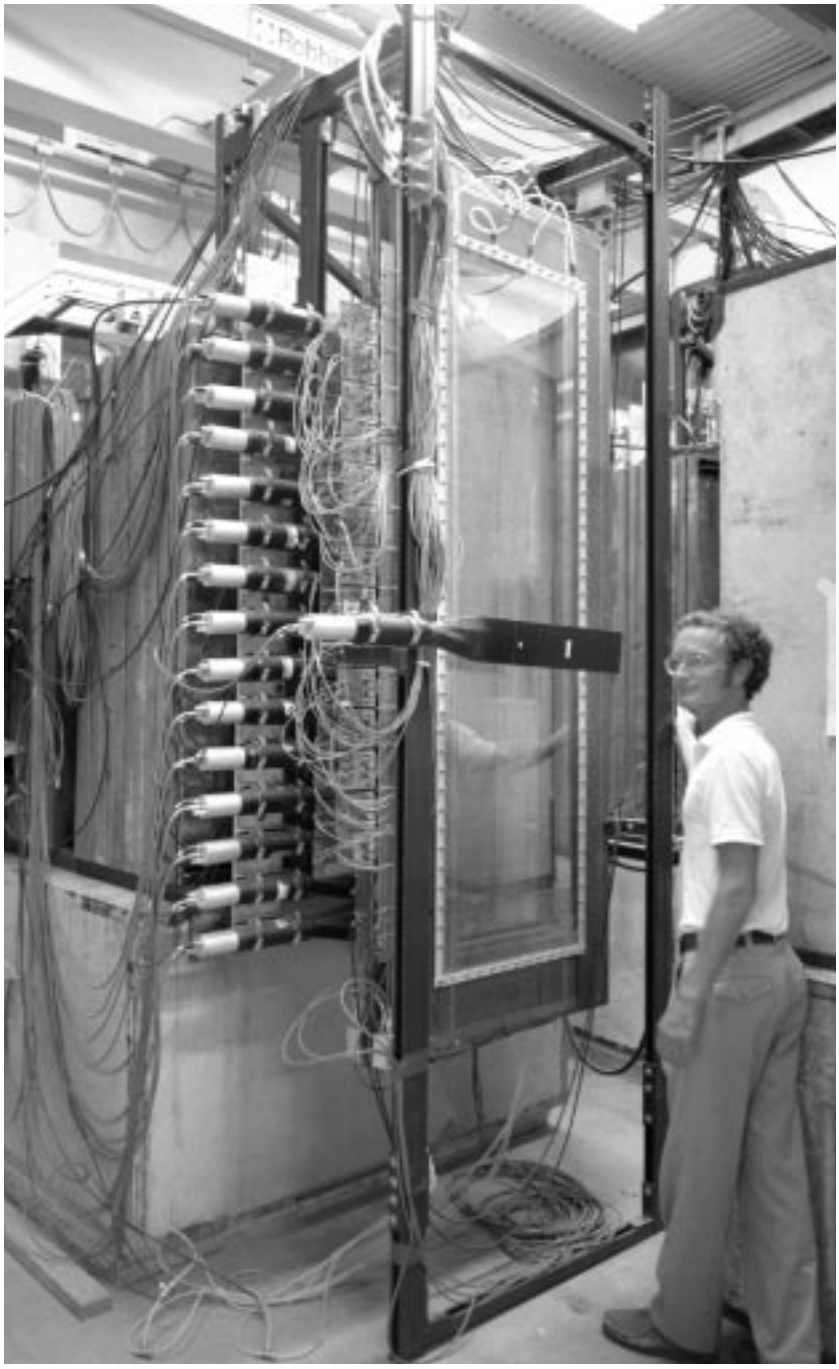
"The most important and most difficult issue for high-energy physics and for Fermilab is to plan how we are going to remain at the energy frontier in the long term," Witherell said. "For high-energy physics to remain strong in the U.S., as strong as it is today, we need to have a new facility at the energy frontier."

Witherell also pledged Fermilab's close cooperation with SLAC in shaping the future of the particle physics program in the U.S. "We need to match the plans for designing and building new facilities to the capabilities of the existing laboratories, and we need to have Fermilab and SLAC working together to use the strengths of both labs in a way that best serves the field," Witherell said. "In the future the two labs must make their plans with the understanding that both labs need to prosper for the field to prosper."

At the press conference, Witherell reflected back to earlier days at Fermilab, when, as a 21-year-old physicist, he witnessed the building of the Main Ring. The design, construction and operation of the accelerator by dedicated Fermilab staff, and the support given by DOE, enabled Witherell to conduct the particle physics experiments he loved, experiments that broke new ground in the study of heavy-quark states.

He realized, he said, that his time had now come to serve other young scientists, and enable them to do the research that will deepen our understanding of the physical world.

Peoples, who will be returning to research, quickly interjected: "Not just younger scientists, I hope, but old ones, too."



Fermilab Photo

...AND WITHERELL BACK THEN

In 1979, Michael Witherell was cospokesperson for E567, an early fixed-target experiment at Fermilab to study charm physics in hadronic interactions.

PROFILE IN PHYSICS

Janet Conrad: *At High Speeds*

by Sharon Butler

Photo by Fred Ulrich

Janet Conrad, with a display of the detector for the MiniBooNE neutrino experiment.

If Janet Conrad were a particle, she'd be a photon.

Colleagues clock her pace at close to the speed of light and swear that time dilates around her—how else to explain all she accomplishes? One moment she is in New York, at Columbia University, teaching undergraduate physics classes, designing triggers, and analyzing data. The next she is in Batavia and elsewhere running collaboration meetings, lecturing on the physics of neutrinos, checking in on students, lobbying for resources for the MiniBooNE experiment—and, meanwhile, raising dahlias, indulging her love of photographic art, and, oh yes, meeting up with her husband, a physicist at New Mexico State University.

Some guess that, with a can of Diet Coke always in hand, Conrad must be chemically enhanced to keep up this perpetual motion. Her mother claims she is "nothing if not determined," and Conrad fully concedes she's "self-propelled."

Conrad has just won the prestigious Presidential Early Career Award, the highest honor bestowed by the U.S. government on scientists and engineers beginning their careers. The award comes with a $500,000 research grant, money that might go far for scientists working on tabletop experiments, but money that Janet has already spent. Some $40,000 will go to an education project to develop connections between physics and medical science. The rest she has committed to purchasing phototubes for MiniBooNE.

When Conrad was in fifth grade, *Star Trek* hooked her on astronomy, Soon she was helping her dad, an agricultural scientist, build radios in their basement workshop (that's how she learned to solder), and tagging along on business trips to tour particle accelerators and observatories.

In her second year as an undergraduate at Swarthmore, a course in quantum mechanics made her realize that particle physics, not astronomy, was her calling. The astronomy course on solar interiors (mostly thermodynamics) was boring in comparison. "Quantum mechanics is a totally different way of thinking than the structured world of mechanics," she explained. "It opens up all sorts of possibilities: If the universe is completely open and goes on forever, then there is some finite probability—very tiny, of course—that a purple unicorn will appear."

From the beginning, unlike most physics students, she wanted to be an experimentalist, not a theorist. "I like to build things; I really enjoy having something there when I'm finished," she said.

Conrad's career has soared. Last year, she gave the plenary talk at the world-famous International Conference on High-Energy Physics, followed by invited talks at universities in Sweden and Germany. Fermilab recently offered her half-time salary to conduct research at the Laboratory, freeing her from teaching responsibilities at Columbia. Just days after receiving the presidential award, she learned she had been promoted to associate professor.

Conrad can't imagine life getting any better than this ("I'm paid to do what I love to do," she said)—unless, perhaps, she becomes famous enough one day to have her portrait done by Annie Liebowitz.

A LITTLE MONEY Goes A Long

Mike Majewski of Commonwealth Edison in Chicago works on the re-lamping project in Wilson Hall.

by Mike Perricone

Some solid waste issues defy any ready solution.

"We did have someone ask us about all the Canada geese on the site, and the amount of waste they create," Rod Walton said with a grin. "There's not much we can do about that."

But in matters ranging from low-mercury lamps to refurbished 10-foot magnets, from recycled plastic pallets to separating out low-level radioactive waste, Walton is in a position to encourage creative solutions with funds from the Department of Energy earmarked for solving tricky waste problems or heading them off.

"We get a special block of money, a little over $2 million per year, to do anything that's waste-related," explained Walton, of Fermilab's Environment, Safety and Health Section. "It could apply to packaging waste, radiation waste, or chemical waste. Or it can be used to clean up the environment. Now part of that money is going to be allocated specifically to waste minimization and pollution prevention."

Walton estimates the available funds for waste minimization will be between $100,000 and $200,000 for next year. He identified two main goals: first, to minimize the amount of waste that the Lab produces, wherever possible preventing pollution and contamination before they start; and second, to use the funds as "seed money," investing in projects that will save money over the long term.

A case in point is last year's $30,000 project to replace the lighting fixtures on three floors of Wilson Hall. The old fixtures were removed and replaced by a smaller number of fixtures with lower mercury levels and sealed bulbs. The new lamps are easier and less costly to dispose of than the originals, since the lower mercury levels mean they are not subject to federal regulations. And there are fewer lamps to be disposed of.

Recycling equipment is not just environmentally responsible, but it can hold down the cost of an experiment. MiniBooNE, a neutrino experiment using Fermilab's Booster accelerator, demonstrated that principle by rejecting new dipole magnets in favor of 20 magnets that had once been used for fixed-target experiments, but were languishing in storage.

"These are 10-foot magnets that will be used to direct the beam from the 8-GeV transfer line through the Booster enclosure and on to the MiniBooNE target horn," said Al Russell of the Particle Physics Division, who is coordinating the renovation work. "We have to make sure the cooling path is open, verify the electrical integrity and make magnetic field measurements. We're also replacing the manifold and connections at the ends of the magnets to make them more consistent for hooking up with cooling and power connections in the tunnel."

The contribution of $20,000 from the minimization would barely meet the price of one new magnet.

Way Toward WASTE MINIMIZATION

"In dealing with just about anything in high-energy physics," said MiniBooNE collaboration member Ray Stefanski, "the cost issues become paramount very quickly."

Issues of cost are paramount not only in experiments, but in the experiments' aftermath. What do you do with a calorimeter after its useful lifetime?

"We had a 15-foot steel frame with an estimated 4,000 pounds of steel and 21 tons of lead," said T. J. Sarlina of the Particle Physics Division. "It wasn't radioactive. If we had scrapped the whole thing together, the lead would have brought four cents a pound. Separating it out would bring us 20 cents a pound for the lead."

The waste minimization fund paid for the labor to do the separating, bringing in $8,000 for the scrap instead of the first estimate of $2,000. Even with the added labor cost, Sarlina estimated the Lab came out $4,500 ahead.

Another project was even more fruitful. Removing more than 200 chambers (each 78 inches by 80 inches by two inches) from the CDF collision hall resulted in a mixed bag of aluminum, fiberglass, copper, wires and connectors. The problem was a small square (17 inches by 17 inches) in each chamber that was slightly radioactive.

"If we had tried to dispose of it all together as radioactive waste, that would have cost us about $13,000," Sarlina said.

Instead, waste minimization funds paid for the labor and tools (primarily saw blades) needed to cut out the contaminated sections, which could be disposed of separately while the rest of the material was sold at various salvage prices. The result: about $16,000 in net savings for the Lab, instead of $13,000 paid out for disposal costs.

But not all costs and savings are figured strictly in bottom-line dollars.

Rudy Dorner, who manages the warehouse for Fermilab's Business Services Section, noted the stacks of big, solid concrete blocks that were stored on wooden skids outdoors after being used in experiments for shielding. What he noticed was that the wooden skids deteriorated in two to three years, meaning the concrete blocks had to be re-stacked on new skids—with the resultant threat of injury, from lifting and possible tip-overs, to the people who did the re-skidding.

Dorner proposed using skids made of recycled (and recyclable) plastic, which last for an expected seven to 10 years. An $8,000 outlay bought more than 100 skids, which are now replacing the wooden skids for outdoor storage.

"In the long run, the economic impact is important," Dorner said. "But in the short run, reducing the number of times we have to move these concrete blocks by hand is an even bigger consideration."

Walton expects the requests for funds soon will exceed the available funds. The ES&H Section and the Environmental Protection Subcommittee are formulating procedures for peer reviews in an award system based on merit.

"The plan is to go out and talk to people who actually do the work," Walton said. "They have some good ideas."

Now about those geese….

Photos by Fred Ullrich

Scott Borton of the Business Services Section works on re-stacking concrete blocks atop one of the new pallets made of recycled plastic.

San Martin New Manager of DOE's Field Office

Laboratories in the DOE Chicago Operations Office

by Mike Perricone

Secretary of Energy Bill Richardson cited Robert San Martin's "broad background" in naming him the new manager of the Chicago Operations Office, and a broad background is necessary for managing the two multi-purpose laboratories and five single purpose laboratories operated from the Chicago office.

The Chicago Operations Office is responsible for about $1.7 billion a year in DOE research, development and other programs. The office oversees a large share of the Office of Science's agreements with educational institutions for basic research, and lends its experience and expertise in competitive procurement agreements with business and industry.

As manager, San Martin will oversee operations for

- Fermilab, the world's highest-energy particle physics facility;
- Princeton Plasma Physics Laboratory, the only national lab dedicated to the development of fusion energy science;
- Ames Laboratory, which focuses on materials research, high-performance computing and environmental science and management efforts;
- Argonne, in nearby Downers Grove, with diverse basic and applied research programs in mathematics and the physical and biological sciences;
- Brookhaven, another multi-purpose laboratory;
- New Brunswick Laboratory, which performs measurements of nuclear material and serves as the federal certifying authority for nuclear reference materials; and
- Argonne-West, located in the Idaho desert, which deals with nuclear safety.

San Martin, a 20-year DOE employee, assumed his new responsibilities for this diverse grouping of labs on March 15. He takes over for John Kennedy, who has been serving as acting manager. Kennedy will return to his former position as group manager, Technical and Administrative Services, at the Chicago Operations Office.

"Bob San Martin's broad background in managing various research and development programs within the department and the academic community is an excellent addition to the department's field operations," said Secretary Richardson. "I also want to express my appreciation to John Kennedy, who has been serving as acting manager, for his contributions and excellent work."

San Martin, who holds his bachelor's, master's and doctorate degrees in mechanical engineering from the University of Florida, is a former professor of mechanical engineering at New Mexico State University. He has served as director of the New Mexico Solar Energy Institute and the New Mexico Energy Institute. He has also served as a consultant for the White Sands Missile Range, the Los Alamos Scientific Laboratory and several private corporations.

the talk of the lab

Letter from Washington

All the high-minded pledges of congressional support for doubling the science budget have not translated into more funding for science—at least not for particle physics. The President's fiscal year 2000 budget request of $697 million for the high-energy physics program is nearly the same as the 1999 budget.

In an interview with George E. Brown, Jr., of California, the ranking Democrat on the House Committee on Science, the *New York Times* asked how skilled scientists and researchers are at presenting their case to Congress. Brown answered, "Very unskilled." He said that, in general, scientists and researchers "have too great a faith in the power of common sense and reason. That's not what drives most political figures, who are concerned about emotions and the way a certain event will affect their constituency. If you're going to work in a political environment, you have to know the reasoning of the people you're dealing with. You have to talk to them realistically. It does very little good to appeal to high principle, although I would not say that's insignificant. The vast majority of politicians think they are functioning on high principle."

The *New York Times* also asked Brown whether the appointment of Rita Colwell, a microbiologist, as head of the National Science Foundation signaled a change in the agency's direction. His answer was not heartening. He said that her appointment "could portend a new direction in the support of science in the United States. Her achievements reflect the direction science funding is going into in the future. In other words, jobs and industrial opportunities are going to stem more from the biological sciences than from chemistry and physics."

Colwell herself might take issue with that, however. She is concerned over a dramatic shift in the last 25 years in the distribution of federal research funds. In 1970, 50 percent of federal research dollars went to engineering and the physical sciences. That's down to 33 percent today. Meanwhile, support for the life sciences has risen from 29 percent of federal research spending in 1970 to 43 percent now.

Colwell, who admits she'd be "the first to tell you about the great things that are happening in biomedical fields," also acknowledges that "society cannot live by biomedical bread alone." Indeed, revolutions in medical treatment and diagnostic tools—laser surgery, CAT scans, fiber optic viewing, ECHO cardiography—often depend on advances in the physical sciences and engineering.

—Sharon Butler

ARISE, and put physics first

At Whitney Young High School in Chicago, Angela Dumas is helping students to learn science the way scientists learn science.

Dumas is the team leader for Whitney Young's ARISE program, which reverses the conventional high school sequence of biology, chemistry and physics. The ARISE format, championed by Fermilab Director Emeritus Leon Lederman, starts with physics and continues on to chemistry and then biology.

In his recent "white paper" on the physics-first sequence, Lederman wrote: "The sequence of high school study in science—biology, chemistry and physics—was set out in 1894 on the basis of a prestigious national commission (The Committee of Ten)."

There is also widespread belief that the sciences were simply listed in alphabetical order to form the sequence. Lederman believes that physics builds the foundation on which the other two sciences rest, and teaching them in the conventional order produces confusion and rote memorization.

"To pursue this mismatch of the biology-chemistry-physics sequence a bit more," Lederman writes, "consider the following statement: 'The transmission of sodium and potassium positive ions through cell membranes is crucial to the functioning of nerve impulses.' In this one sentence are essential physics and chemical concepts applied to a vital element of biology. If students do not know physics and chemistry, they are forced to memorize a description of nerve impulses. Without prerequisites, it's the best that can be done.

"The science of biology strives for explanations of important processes at the level of cellular events rather than for mere descriptions. That a prerequisite of high school levels of physics and chemistry could provide such explanations is the essence of students learning science like scientists learn science. This teaches the science way of thinking."

At Whitney Young, the ARISE sequence is offered as an alternative to the conventional sequence, not a replacement for it.

"The acceptance by students has been excellent," Dumas said. "We have been able to recruit as many students as we wanted so far. And the teachers in our department are not threatened by the program. We do not promote it as the better way to teach science, just an alternative for those who are like-minded. Depending on our success we may expand the program but will not likely replace the traditional sequence with the ARISE program."

Dumas said the ARISE sequence makes sense because it helps students make sense of biology. She pointed out that most incoming students at the city's West Side magnet school either have taken algebra or are taking it concurrently with physics, so they are prepared for the level of mathematics required in physics. Dumas noted that since the program was instituted last academic year, the performance of freshman students taking physics first hasn't differed significantly from older students concluding with physics.

"The physics teachers have both said that their standards and methodology are very much the same for the freshman and upperclassmen classes," Dumas said. "The freshmen seem to work a little harder, and the teachers may treat them a bit more gently. Having analyzed four classes of freshmen in physics, they seem to be doing a very good job. Their averages are just a bit below the classes of juniors and seniors, though this can probably be attributed to their lack of experience in a magnet high school setting where (self) organization is essential and expectations are high."

Still to come are the results in chemistry and biology for students moving on. But Dumas already has witnessed a notable level of enthusiasm among the teachers involved in the unconventional sequence.

"In praise of the program," Dumas said, "we teachers have all marveled at how inspiring and supportive this professional development experience has been. We feel that ARISE has truly made a difference in the way we teach science."

—Mike Perricone

LAB NOTE

The Fermilab Golf League at Phillips Park is looking for players every Thursday night from early May-August. A league meeting is scheduled on Wednesday, March 31 at 11:30 in the Snakepit, WH2NE. For more info contact Steve Baginski, x3721, Baginski@Almond.fnal.gov or Joe O'Malley, x2504.

SAFETY TIP

From Fermilab's Fire Department: Daylight savings time begins Easter Sunday, April 4th. When you change your clocks, please change the batteries in your smoke detectors—it could save your life.

LETTER FROM THE DIRECTOR

I am writing to you here so that I can comment on the February 22 issue of *FERMINEWS*. While it contained several very important articles—most notably the coverage of the annual meeting of the URA Council of Presidents, a meeting that was informed by the thoughtful speeches of Rita Colwell, Martha Krebs and James Sensenbrenner—it also contained an article that disturbed a number of people. This article covered an exhibit of the work of several art students, who presented their ideas of how to communicate to diverse audiences the abstract concepts of particle physics using the tools of advertising. One such idea attempted to convey the concepts of Einstein's theory of special relativity in an ad in a men's magazine. I regret that the design, and its appearance in *FERMINEWS*, was offensive to some of our readers. I am assured that the editors of *FERMINEWS* never intended to cause any offense or insult.

Sincerely,

John Peoples, Jr.

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 x4512 Cakes for Special Occasions Dietary Restrictions Contact Tita, x3524

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

Lunch
Wednesday, March 24

Grilled Marinated Flank Steak

Zucchini and Lemon Risotto

Orange Napoleon

Dinner
Thursday, March 25

Lemongrass Chicken and Cellophane Noodle Soup

Indonesian Pork Satay with Peanut Sauce

Golden Jasmine Rice

Braised Shitake Mushroom and Snow Peas

Tropical Fruit Sorbet

Lunch
Wednesday, March 31

Cheese Fondue

Assorted Field Greens with Mustard Vinaigrette

Cantaloupe Slices with Strawberries

Dinner
Thursday, April 1

Salad Nicoise

Grilled Swordfish with Pineapple Salsa

Vegetable of the Season

Apple Walnut Cake with Calvados Creme Chantilly

FERMINEWS

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The deadline for the Friday, April 2, 1999, issue is Tuesday, March 23, 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.

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CLASSIFIEDS

FOR SALE

- ’95 Mercury Tracer, 4 dr sedan, white, 34K miles, auto, a/c, dual airbag, am/fm cassette, PM. Runs great! $7,000 obo. Sasha, x4734 or amakarov@fnal.gov

- ’90 Dodge Caravan SE, charcoal gray, 3.0L V-6, 4 spd auto, ac, ps, pb, pl, cruise, tinted, stereo/cass, luggage rack, 110k mostly hwy miles, exc. cond., 1 owner, garage kept. $3,300 obo. Call Mike, x2191or (630) 305-8131 (eve.)

- ’89 Toyota Camry, 4 dr, auto, air, cc, powder blue, blue int, 4 cyl, 125k miles, ready to sell. $1,800. Call Bill x4173.

- ’88 Toyota Corolla, auto, new battery & radiator, 98K miles, 2nd owner w/records, $2,800. Monique, srivasta@fnal.gov,

- ’87 Volvo 240DL sedan, 4 dr, auto, air, gray, tan interior, good condition, cc, original owner, 160k miles, ready to sell. $2,500. Call Bill x4173.

- House in Bartlett. Popular Amber Grove subdivision. Nicely landscaped, 5 yr old home, great family neighborhood. Close to park, & new elementary school. Low Cook County taxes. 4BR, 3 bths, formal dining & living rm w/ceiling fan. Huge master BR suite w/walk-in closet, arched ceiling w/ceiling fan. Master bath has step up oval soaking tub, w/dbl sink vanity & a skylite. Whitewashed cabinets throughout house. Sliding glass door opens to a lg concrete patio. Full viewfront storm door, 2 car finished grg. Malibu lighting & outdoor wooden play gym. A must see! $194,900. Call Kathy or Mike (630) 830-3346.

- Home, brick & cedar ranch, 3 br, 2 ba formal living & dining rm, family rm w/fireplace, finished basement, updated country kitchen w/hardwood floors, heated garage, lot w/mature trees & well landscaped, $189,900. Located ~ 20 miles west of Fermilab. Call (630) 557-2280.

FREE

- A 2-year old Russian Blue male cat is free to a good caring family. His name is Quantum. This affectionate & beautiful cat is neutered, de-clawed, & litter-trained. He has all vaccine shots. We have to give our pet away due to allergic reaction of our son to cats. Please call Mike x2191, or e-mail hope@fnal.gov.

CALENDAR

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

MAR 21
Barn dance in the Kuhn Village Barn, 2-5 p.m. Music by Jordan & Friends, calling by Bill Sudkamp. All dances are taught. People of all ages & experience are welcome. Admission is $5, children under 12 are free (12-18, $2). Sponsored by the Fermilab Folk Club. For more info, call Lynn Garren, x2061 or Dave Harding, x2971.

MAR 24
Heartland Center blood drive 9-2 in the WHNE ground floor Practical Factors ES&H training room. Questions? Call Elaine Brown, x3232.

MAR 26
International Film Society presents: *My Life in Pink (Ma Vie en Rose)*, dir: Alain Berliner (France 1997, 88 mins.). Film at 8 p.m. in Ramsey Auditorium, Wilson Hall, $4. (630) 840-8000.

MAR 27
Fermilab Art Series presents: *Nrityagram (Odissi Dance Ensemble of India)*, $17. All performances begin at 8 p.m. in Ramsey Auditorium, Wilson Hall. For tickets or more information call (630) 840-ARTS.

March 30
The Graduate Student Association (GSA) at Fermilab presents an evening of talks on career options: From 6-7 p.m. in 1 West, tentatively, two employees of Sapient, one of whom is a former physicist, will speak. At 7 p.m. in the Users’ Center, a colleague who has left industry to return to physics research as a post-doc at the Lab will describe his experience. And at 8:30 p.m., as an added bonus, to kick off National Poetry Month, John Green will give a poetry reading in the Users’ Center Music Room. Pizza will be served. For an update, see http://www.fnal.gov/orgs/gsa/.

ONGOING
English conversation group for foreign visitors, 10-11:30 a.m., Users Center. No charge. For more info, call Betty Fernandez (630) 208-9728. NALWO coffee, Thursdays, 10:30 a.m. in the Users’ Center, call Selitha Raja, (630) 305-7769. In the barn, international folk dancing, Thursdays, 7:30-10 p.m., call Mady, (630) 584-0825; Scottish country dancing Tuesdays, 7-9:30 p.m., call Doug, x8194. Sundays 11-1:30, classical ballet classes for teens and young adults, 12 & over, free, in Ramsey Auditorium on stage. For more info, call Irina Polubotko, (630) 208-9529.

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