FERMI NEWS

FERMILAB A U.S. DEPARTMENT OF ENERGY LABORATORY

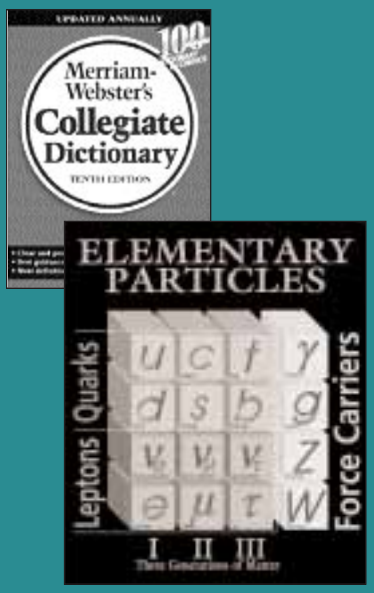
Photo by Reidar Hahn

Physics in the Snow **8**

Volume 23
Friday, March 10, 2000
Number 5

INSIDE:

PHYSICS in Plain*(ish)* English



by Judy Jackson

Communicating physics is like the weather in Mark Twain's well-worn phrase: everybody talks about it, but nobody does anything about it. In the case of physics, however, there are a few exceptions.

One of the most sustained efforts to translate the arcane language of particles, probabilities and picobarns into language the rest of us can more or less understand comes from Fermilab's DZero experiment. In 1997, the collaboration launched "Plain English Physics," DZero's commitment to explain their experiment and its scientific results in simple language. Three years later, the collaboration has persevered, despite the considerable challenge of putting forefront physics into low-jargon prose. Most recently, with the leadership of Fermilab physicist Boaz Klima, DZero has published **"Physics Highlights of the DZero Experiment, 1992-1999"** on the World Wide Web at **http://d0server1.fnal.gov/projects/results/runi/highlights/runi_summary.html**

The following excerpts from the 20-page "Highlights" discuss DZero's work on the top quark. Other sections, accessible on the Web, describe the detector, electroweak physics results, quantum chromodynamics, the physics of the bottom quark, and the search for physics beyond the standard model.

DZero experiment

explains results *WITHOUT* (much) JARGON

Physics Highlights of the DZero Experiment, 1992-1999

The DØ experiment was proposed for the Fermilab antiproton-proton Tevatron Collider in 1983 and approved in 1984. After 8 years of design, testing, and construction of its hardware and software components, the experiment recorded its first antiproton-proton interaction on May 12, 1992. The data-taking period referred to as "Run 1" lasted through the beginning of 1996. Collisions were studied mainly at an energy of 1800 GeV in the center of mass (the world's highest energy…. All results summarized below are based on these data, and on the dedicated and imaginative efforts of the undergraduate and graduate students, postdoctoral fellows and senior scientists involved in the program. Currently, the DØ Collaboration consists of more than 500 scientists and engineers from 60 institutions in 15 countries (see some of them in Fig. 1). Over 110 Ph.D. dissertations have been written so far on various aspects of DØ, and more are anticipated over the next two years, as the analyses of data from Run 1 wind down, and the next run, with both an upgraded detector and improved accelerator, commences.

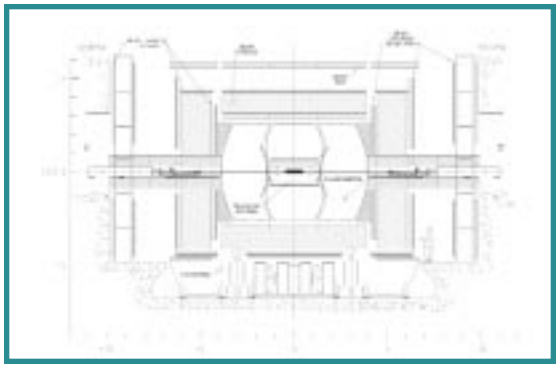
Among the highlights from Run 1 described in the following sections are the discovery of the top quark and measurements of its mass and production cross section; the precise determination of the mass of the W boson and the couplings of the electroweak bosons (photon, W and Z); numerous searches for new physics; measurements of bottom quark production; and extensive studies of the strong "color" force, quantum-chromodynamics (QCD). We have already published most of our results from the past six years; to date, over 80 papers have appeared in refereed journals. In addition, our publications are reprinted in annual collections that are available from the library at Fermilab. The published papers, as well as work presented in conferences, can be accessed from our web pages (see http://www-d0.fnal.gov/). … We have also prepared "plain English" summaries, intended for a more general audience, that can be found on the web at

http://www-d0.fnal.gov/public/pubs/d0_physics_summaries.html.

Physics of the Top Quark

The four lightest quarks (called "up", "down", "strange", and "charm") have been known to us for over 25 years; they come in pairs, with members of each doublet having internal "weak isospin" quantum numbers of ±1/2. In 1977, the "bottom" (or " b") quark was discovered, and found to have weak isospin of -1/2, thus requiring a partner called the "top" quark. Prior to the start of Run 1, the lower limit on the mass of the top quark had been pushed up to about 90 GeV by experiments at CERN and early data from CDF. Physicists had already begun to puzzle over what the large mass difference between the b quark (at about 5 GeV) and the top quark implied, suggesting the possibility of a special role for the top quark in the scheme of particle phenomena.

From the beginning, the search for the top quark was a very high priority at DØ. The Standard Model was explicit in predicting top-production and decay characteristics. Specifically, the production rate for top-antitop pairs could be calculated reliably from on QCD theory, once the top-quark mass was specified. Similarly, the decays of a top (or antitop) quark could be predicted because the top was expected to decay nearly all the time to a W boson and a b quark, giving rise to a final state with two Ws and two b-quark jets. The decays of W bosons (either into charged leptons and their neutrinos or into quark-antiquark pairs) were already well established. Thus the basic classes of final states arising from top and antitop production were the following: (a) six quark jets (four from the Ws and two from b quarks); (b) a lepton and neutrino, accompanied by four quark jets (two from one W and two b jets); or (c) two leptons and neutrinos and two b quark jets (see the diagram in Fig. 5).



Other final-state particles were expected from the interactions of the rest of the quarks and gluons in the colliding proton and antiproton, and also from the radiation of gluons from the interacting quarks. Neutrinos could be sensed only through the missing transverse momentum in the detector. Tau leptons are difficult to identify, and consequently the electron and muon channels turned out to be the preferred channels for studying leptonic final states….

The first portion of Run 1 (Run 1a) was completed in mid-1993 and yielded an accumulated collider luminosity corresponding to 14 events per 1 pb of production cross section (usually referred to as 14 pb^{-1}). From these data, DØ published its first search for the top quark in early 1994, using the single lepton, electron (e) and muon (μ) channels, and the ee and eμ channels. The selection criteria were set to optimize the discovery of a top quark with a mass of about 100 GeV. Three events were found: one em candidate, one ee candidate and one single-electron candidate, all with accompanying jets. The expected backgrounds were comparable to the number of observed events. Hence, a lower limit of 131 GeV at the 95% confidence level was set on mass of the top quark, based upon the SM calculations for the expected yield as a function of mass. This was the highest mass limit at the time (and, as it turned out, the last lower limit reported on the mass of the top quark!).

There was a spectacular event ("Event 417") in this sample, containing an electron, a muon, and missing transverse momentum, all above 100 GeV, together with two well-identified jets and a small third jet. The probability for background processes to produce this event was extremely small. Our publication reported an analysis of the mass, based on the assumption that this event was a top-antitop production, stating that: "The likelihood distribution is maximized for a top mass of about 145 GeV, but masses as high as 200 GeV cannot be excluded." This event survived subsequent signal-selection criteria that were even more restrictive and ended up in our final Run 1 top-quark sample.

With this mass limit in place, and in anticipation of much larger data samples from Run 1b later in 1994, DØ optimized the search for top at higher masses, and developed powerful techniques for determining its mass….

In late spring of 1994, the CDF experiment submitted for publication a publication showing evidence that the top quark may exist, with a mass near 175 GeV. The CDF excess of events corresponded to a cross section of more than a factor of two above the expected (and currently accepted) value. Although suggestive, these data were insufficient to claim discovery. At the same time, DØ presented its updated results at conferences.... The sensitivities of both the CDF and DØ experiments to possible top signal were very similar, but the DØ sample contained only a modest excess over background estimates (7 events with an expected background of 3.2 events), and the top-antitop production rate inferred was consistent with that predicted (and now confirmed) by the Standard Model.

At the beginning of 1995, data samples had increased by a factor of nearly three. On February 24, 1995, DØ and CDF simultaneously submitted papers announcing the discovery of the top quark. The DØ sample had 17 events with an expected background of 3.8, and the odds for the background to fluctuate to the observed sample were only 2 in 1 million. For this sample, the mass of the top quark was estimated to be between 167 and 231 GeV. The cross section was measured to be 6.3 ± 2.2 pb for a mass of about 200 GeV. The CDF results were consistent with those from DØ, favoring a somewhat larger cross section and a lower mass. The discovery of the top quark completed the roster of SM particles comprising matter, and underscored the special nature of the top quark — an elementary particle as heavy as a gold atom, and with a mass commensurate with the energy scale of electroweak symmetry

in Plain*(ish)* English

breaking. These CDF and DØ papers on the discovery of the top quark have now become the second most cited result in experimental high energy physics (after the papers on the J/ψ discovery). By the end of Run 1 in early 1996, DØ had recorded about 125 pb^{-1} of data. From the full data set, several more improvements were made in understanding the top quark. Searches for anomalous behavior in top production were sought, but none found. Searches for new particles in top decay, such as charged Higgs bosons, came up empty-handed. But several important advances were made in the measurement of the top-antitop production cross section and the mass of the top quark. …. The combination of all analyses of the top-antitop cross section yielded 5.9 ± 1.6 pb, for a top mass of 172 GeV, in excellent agreement with the theoretical prediction from QCD.

The mass analysis was improved in several ways. … [T]he final top mass from DØ analyses is 172.0 ± 7.1 GeV (an uncertainty of about 4%), far exceeding the initial expectation for precision, and making the top mass the most precisely known of all quark masses. Combining all mass measurements from both CDF and DØ, yields a mass of 174.3 ± 5.1 GeV (< 3% uncertainty) for the top quark.

The discovery of the top quark was a major achievement and the highlight of the DØ program in Run 1. Its very large mass suggests that it may well play a special role in the breaking of the electroweak symmetry, and could be partially responsible for the mechanism by which all particles acquire mass. It provides a probe for seeking new forces in which top and antitop quarks combine (annihilate) to make new particles, and a vehicle for the search for new massive particles in its decays. These are the themes that will dominate top-quark studies in the forthcoming Run 2, where at least forty times more top events are expected in a substantially improved detector with greater capability for deciphering these complex signals. □

Photo by Reidar Hahn

At center stage, inside the central bore of the DZero detector, is a new solenoid magnet, which will significantly extend the experiment's physics capability.

PHYSICS ON THE AIR

by Judy Jackson

David Kestenbaum

Particle physicists are used to dealing with the smallest things human beings have ever seen. Quarks. Leptons. The number of working journalists who truly understand experimental physics.

It's a small, small world; but in recent months the ranks of journalists who can tell a boson from a black hole in the ground have swelled by at least one. And if the new guy's particle physics background is in any way deficient, we have no one to blame but ourselves: we raised him. National Public Radio's newest science reporter, David Kestenbaum, began collaborating on CDF as a high-school student, spent his undergraduate and graduate careers at Fermilab, and wrote his thesis on the discovery of the top quark. His first science stories were assignments from *FERMINEWS*. This man knows from neutrinos.

The physics bug bit early. As a high-school physics student growing up near Philadelphia in the mid-eighties, Kestenbaum encountered University of Pennsylvania physicist Nigel Lockyer, a Fermilab experimenter who soon recruited him to work on the fledgling Collider Detector at Fermilab.

"They needed someone at CDF to work on alarms and limits of accelerator monitors," Kestenbaum recalled recently. "I was, what, seventeen? It was the most amazing thing. They actually depended on me. In those days, it took forever for the detector to turn on, one system at a time. If they couldn't turn on, they'd call me to come and help. It was such a thrill! At that time, I had no idea what a quark was."

Alarms and limits apparently weren't the only attraction at CDF.

"David worked for me as a high school student," Lockyer remembers, "and for most of his undergraduate career at Yale. He babysat my kids at the Fermilab pool. He danced on the CDF trigger room table. Henry [Frisch, a University of Chicago physicist] chewed him out, and his reply was something like 'Cool it, Dad.' David was very popular after that."

When the time came for grad school, it was "between Penn and Melissa," he said. Melissa Franklin, a Harvard physicist who had herself worked on Fermilab experiments as a teenager, finally corralled him for Harvard, where she was his advisor.

At Harvard, Kestenbaum loved working with the engineers and technicians in the university shop, building CDF drift tubes to chart the flight of particles through the detector. Like many physicists, he enjoyed making things with his hands, creating things that no one had ever built before.

Along the way, Kestenbaum acquired a pretty good idea what a quark was. He began his Ph.D. thesis research at the time when, after nearly two decades of searches at accelerators around the world, Fermilab experiments were finally closing in on the top quark

"I wrote my thesis on one of the analyses of the top," Kestenbaum said. "I felt very lucky to be on CDF at the time of the discovery. People had been working for many years to get to that point."

And at about that time, Kestenbaum showed up at the *FERMINEWS* office and

KESTENBAUM BRINGS A PHYSICIST'S PERSPECTIVE TO

NATIONAL PUBLIC RADIO

hesitantly asked to try his hand at science writing. His first assignment, a story about the Fermilab Users' Annual Meeting of 1995, contained this prescient paragraph:

"The National Science Foundation's Robert Ely reported that grants from NSF would drop by a few percent as funding shifted to CLEO upgrades at Cornell. Perhaps Ely unconsciously illuminated what this means to physicists as, responding to a funding question, he absentmindedly removed a dollar bill from his pocket, nervously smoothed it, and then put it away in another pocket. He may have hit upon the metaphor for future HEP funding—one hand taking from the other, with tough decisions about where to put resources."

Even then, the kid had an eye for the fundamentals.

When Kestenbaum received his Ph.D. from Harvard in 1996, he decided to become not a scientist but a science writer.

"I had been doing experimental particle physics since I was seventeen," he said recently. "A lot of people treat physics like the priesthood. I *was* very grateful that I had a chance to do it. But I needed something else. I talked to Melissa. She encouraged me to go ahead and try being a writer."

After a stint as a freelance, and a science journalism internship at WOSU (Ohio State University) radio in Columbus, Ohio, Kestenbaum joined the staff of *Science* magazine in Washington, DC, where he covered such Fermilab stories as the discovery of the last of the B mesons. He liked *Science* ("They were like family."), but his stint at the radio station had convinced him that the air waves were his true medium; and after a year he joined the science staff at NPR. Now his broadcast stories prompt proud "Hey, I heard David this morning!" comments from Fermilab listeners arriving at work.

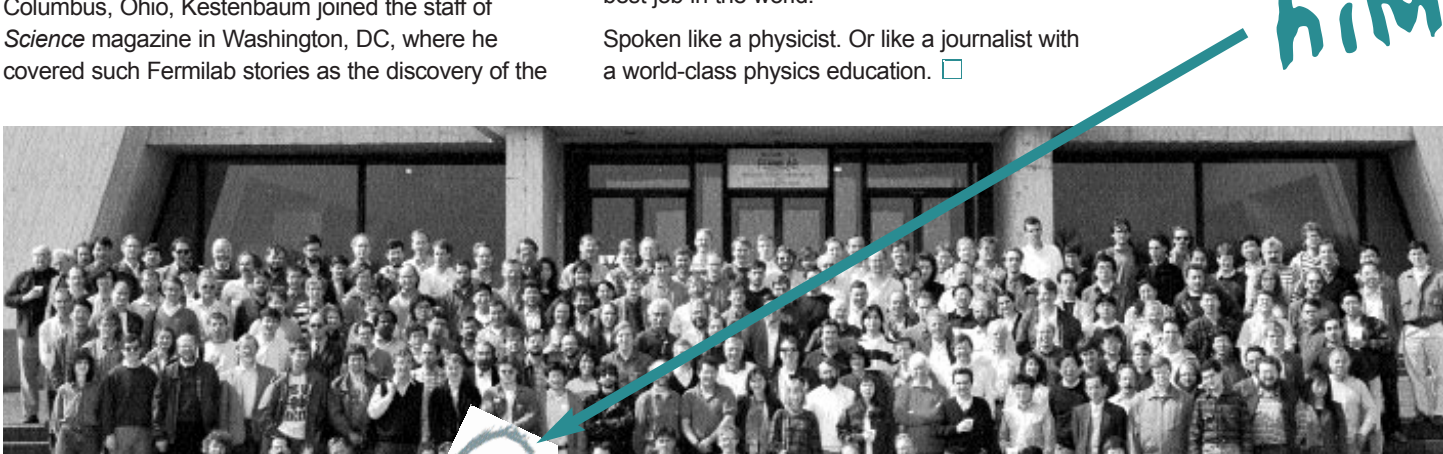
Four years after leaving Fermilab, does he miss physics? Any regrets about the choice he has made?

"When I first started writing for a living," Kestenbaum said, "I used to have dreams that I was building an accelerator in my apartment living room. I'd be ordering parts, and I'd be very worried about the effects on the beam from the vibrations from the apartment upstairs. Now, there are times when I am talking to a physicist who has done something cool and beautiful and simple, and I want to go to work for him. Sometimes I'm envious of people who are doing science. Once in awhile I feel like a parasite, as if other people are actually doing things, and I'm not, I'm just observing."

Mostly, though, he loves what he does.

"Two weeks ago, I was going in to work at NPR. It was about 9:30 in the morning, and I had biked to work. I was wearing jeans and sneakers, and I didn't feel like I was going to work at all. I feel perfectly suited for what I am doing. I have the best job in the world."

Spoken like a physicist. Or like a journalist with a world-class physics education. □



The CDF collaboration in 1994, moments after making the difficult collective decision to announce "first evidence" for the top quark.

PHYSICS in the SNOW

FRIDAY, FEBRUARY 18, 2000

"For many years I was self-appointed inspector of snowstorms and rainstorms,

Photo by Fred Ullrich

MiniBooNE REVIEW:

FANFARE with horn

Even children's TV programming can be an inspiration for science, as we saw in the last installment on MiniBooNE's path to becoming a grown-up experiment *(see "The Teletubby Design," FERMINEWS, Vol. 17, No. 22, September 3, 1999).*

But as any scientist is well aware, there are many parts perspiration to each part inspiration, and the horn is no exception. The collaboration fac a major challenge in the design and production of this critical experimen component. A review will determine whether the next step is forward, or back to the drawing board…

by Mike Perricone

Take a piece of equipment with a long and storied history, and subject it to what can accurately be described as unprecedented abuse.

That's the plan for MiniBooNE's focusing horn, which will shape and direct the particle beam that produces neutrinos and hoped-for signs of neutrino oscillations.

"The design for the horn has to be as close to the edge as we can make it," said Eric Zimmerman, a Columbia University postdoc, whose perspiration is invested in the horn, along with that of project manager Ioanis Kourbanis of Fermilab, and Larry Bartoszek, a former Fermilab engineer who now has his own consulting firm in Aurora.

"The design for the horn," said collaboration cospokesperson Janet Conrad, "is a work of engineering art."

There are three primary conditions that make the MiniBooNE focusing horn unique in neutrino research:

- This horn will operate at five cycles per second (5 Hz), while other neutrino horns operate at less than one cycle per second. For example, the horn for Fermilab's long-baseline neutrino experiment, MINOS (Main Injector Neutrino Oscillation Search) will run at 0.5 Hz. The fastest horn so far, at Brookhaven National Laboratory, operates at 0.8 Hz.
- With its rapid repetition rate, this horn is designed for a lifetime of 100 million pulses. Each pulse consists of a jolt of 170 kiloamps of current lasting 150 microseconds. Historically, using somewhat higher current levels (200-300 kiloamps), neutrino horns have had a lifetime around 20 million pulses. When the MiniBooNE prototype is built, it will be tested for 20 million pulses; the testing process will thus be as long as the lifetime of previous horns.

- The short, rapid pulses leave the horn vulnerable to resonance ("ringing"), which must be damped. The high frequencies excite all the natural frequencies in the horn, which could leave the horn "ringing" when the next pulse hits it. Resonance would multiply the amplitude of the pulses, exaggerating the stresses on the horn and greatly increasing fatigue.

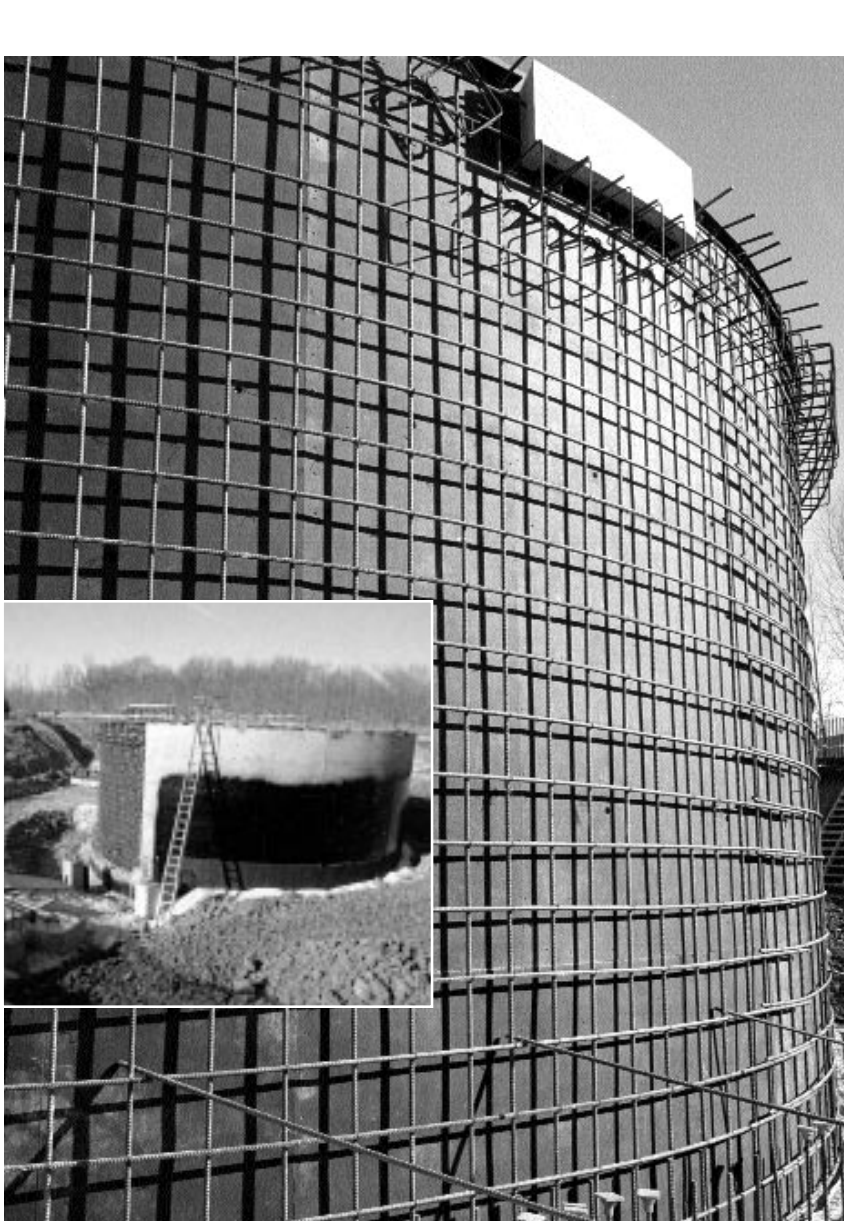
Factor in the heat and the magnetic forces generated by the current, and the complications added by welding and by spraying with cooling water, and the result is serious fatigue—not just fatigue for the designers handling all the details, but metal fatigue resulting from the repeated compression and tension in the six-foot-long, all-aluminum structure.

In his research, Kourbanis noted that one anticipated procedure had to be ruled out. Coating or anodizing the aluminum to protect against corrosion from the water spray, he discovered, would actually exacerbate the effects of metal fatigue.

The aircraft industry offers exhaustive data on the properties of various alloys of aluminum. But as Kourbanis found, much of the data is compiled to indicate a 50 percent failure rate at a particular stress point; the MiniBooNE horn required a certainty of more than 95 percent before a selection could be made. Fortunately, the search was easily resolved with the selection of an alloy widely used in building airplanes (designated 6061-T6, if you're keeping score at home), one offering high resistance to fatigue.

Then came the design, which originally called for two horns, and called for their rapid production. On a tight budget, of course.

Bartoszek worked at the Lab for 10 years, including contributions to the E760 charmonium fixed-target experiment, and the Antiproton Source, before going solo in 1993. He has consulted on projects throughout the worldwide high-energy physics community, from Fermilab to Brookhaven to Jefferson Lab to DESY to CERN. He credits a project for MIT's Bates Linear Accelerator called OOPS (Out Of Plane



Photos by Reidar Hahn

Meanwhile…the MiniBooNE detector vault has been taking shape, with excavation beginning Oct. 15, 1999 for a cylindrical hole 40 feet deep and 50 feet in diameter. The base slab for the detector vault was completed Dec. 11 1999, with work continuing on the walls for the vault. When completed, the detector will house more than 1,000 photomultiplier tubes and will hold 239,000 gallons of mineral oil.

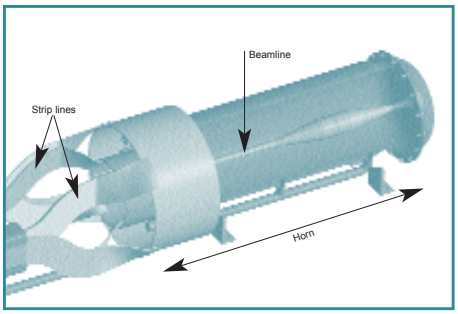


Illustration courtesy of Larry Bartoszek, Bartoszek Engineering

"Strip lines" bring in electricity to charge MiniBooNE's horn and create a magnetic field. The beamline passes through the center.

Spectrometer) with getting his consulting business off the ground. When MiniBooNE beckoned, Bartoszek brought a new view.

"I wanted to look at what the real needs were from the beginning, and see if we couldn't do it more simply and cheaply," he said.

Bartoszek, Kourbanis and Zimmerman developed a single horn to replace the two-horn system, reducing complications in the beam line and reducing costs without major penalties in physics capabilities.

To produce a neutrino beam, protons are fired at a fixed target to produce pions, which are positive-or-negative-charged matter-antimatter pairs of a quark with an antiquark. The charged pions are then focused by the horn, which acts as a lens and organizes the pions into a beam that moves through a 50-meter decay pipe where the pions break down to form neutrinos.

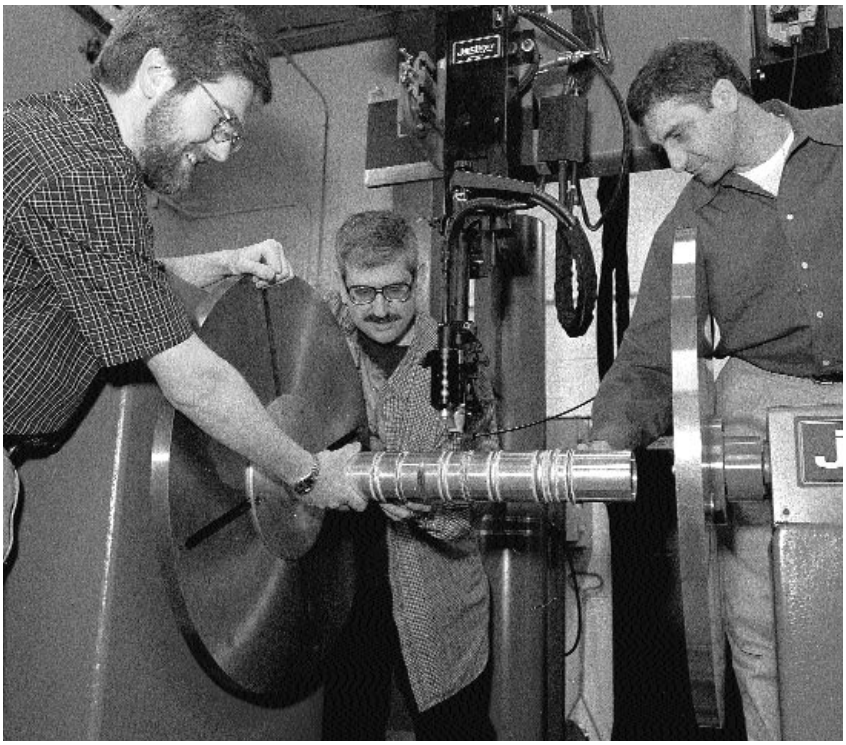


Photo by Reidar Hahn

Eric Zimmerman, Larry Bartoszek and Ioanis Kourbanis (left to right) examine welding samples at the computer-controlled machine that will weld the MiniBooNE and NuMI horns, at MI8.

The horn bears make-or-break responsibilities: it must carry a lot of current, and the inner conductor must be as thin as possible to allow the pions to pass through without being absorbed. Because MiniBooNE operates at a lower beam energy than many previous neutrino experiments, the horn is significantly shorter. Thus, the pions experience only a small amount of material during their transit. This means the conductor can be slightly thicker—about three millimeters instead of 1.5-to-2 millimeters—making it somewhat sturdier.

But how would the horn design play to reviewers?

Zimmerman and Kourbanis organized the review for Feb. 7-9. It was chaired by Paul Czarapata, head of the engineering department in Fermilab's Beams Division. The committee consisted of David Pushka from NuMI and the Beams Division; Bob Trendler of the Particle Physics Division; and two neutrino horn experts from other labs, Stephane Rangod of CERN, and Bill Sims of Brookhaven.

In addition to presentations on the MiniBooNE horn, and evaluations of the design and progress, the review offered an unusual feature. Rangod and Sims led a horn workshop, also attended by collaborators from the NuMI experiment. As Zimmerman explained, as enormous as the difference are between horns, the similarities are very important—as were the expert insights of horn veterans such as Rangod and Sims.

"This kind of interlab cooperation is a healthy thing, getting different labs to talk to each other," Conrad added.

The committee has not submitted its final report, but the review turned into a success story for MiniBooNE.

Said Czarapata: "The work done on the horn has been most impressive. It was a general feeling that no previous horn had been so well engineered in terms of stress calculations, material fatigue issues, water erosion, and structural resonance."

And now: on to the building and testing of the prototype, with MiniBooNE on target to begin operations and data-taking late in 2001. □

the

Hello Young Lovers. Welcome to Fermilab.

As a honeymoon destination, Fermilab may not be Niagara Falls, but for physicist and science writer Phil Schewe of the American Institute of Physics and his wife, it was close enough.

During the 1970s, as a Michigan State University graduate student, Schewe worked on Fermilab experiment E319, Deep Inelastic Muon Scattering. After he received his Ph.D. in 1978, the newly minted Dr. Schewe went to work for the AIP in New York. When Schewe and Californian Andrea Soder got engaged in 1981, they decided to hold their wedding at Schewe's grandparents' house in Chicago, midway between Schewe's new home in New York and the bride's home on the coast.

"The day after the wedding, which was on, ah, May 23," Schewe said recently, checking the engraving inside his wedding ring to verify the date, "we were supposed to fly to New York for a big reception. We needed a place in Chicago, close to O'Hare, to stay on our wedding night."

What could be better than Fermilab? The couple booked a room in Aspen East, where the atmosphere was quiet, the accommodations were historic, and the price was right. After the wedding, Schewe brought his new wife to Fermilab, where he showed her around his old experiment in the Muon Lab. Her reaction to this exciting interlude has not been recorded. Later, following their return from dinner at the Little Owl in nearby Geneva, Illinois, the couple watched the sun set over the A.E. Sea.

"It was beautiful," Schewe said.

When night fell, the lure of the Fermilab swimming pool, newly filled for the season, proved irresistible; and the two climbed over the fence for a memorable skinny dip.

"I got about thirty mosquito bites," Schewe recalled.

As the couple approach their twentieth anniversary in 2001, Schewe is considering the idea of returning to Fermilab to celebrate. Mr. and Mrs. Schewe could still stay in Aspen East, and the Little Owl is still serving dinner at the old stand. The sun still sets over the A. E. Sea. And who knows? This time Fermilab might even throw in a bottle of mosquito repellent.

—Judy Jackson

---

of

The recent issue of FERMINEWS dedicated to Robert Rathbun Wilson (Vol. 23, No. 2, January 28, 2000) drew responses from many readers who were impressed by Wilson's achievements, and touched by his outlook on life and work. Here are a few samples:

Humility, confidence and creativity

Dear *FERMINEWS*:

I had the pleasure of meeting Dr. Robert Wilson and interviewing him twice, in connection with a book on the development of the Proton Treatment Center at Loma Linda University (the book still hasn't been finished). I worked (and still do) for Dr. James M. Slater of Loma Linda University, who spearheaded the development of the proton facility and asked me to interview Dr. Wilson. Dr. Slater knew Dr. Wilson and told me—and I agree—that he was the single most impressive person he ever met.

I was deeply impressed—awed is not too strong a word—by Dr. Wilson. His achievements, both scientific and artistic were impressive enough, but what struck me most was his combination of humility and confidence. Your quote from Dr. Lederman captures it: "the Whole Man."

the

Dr. Wilson lived in a home literally "far above Cayuga's waters" in Ithaca, New York. I visited him in autumn, when the colors of upstate New York are at their best. I remarked on this. Wilson, who was, I suspect, a westerner at heart, replied, "Yes, it is lovely. You know, most of the year you'd be crazy to live here, but at this time of year you'd be crazy to live anywhere else."

Later in the interview, I noted all that he had done, remarking particularly on his scientific and artistic creativity. He said, "I always thought if I wasn't being creative, I was just wasting my time."

We at Loma Linda will probably pay some sort of tribute to Dr. Wilson, perhaps in our Proton Treatment Center newsletter, perhaps with a more formal observance. His vision of what proton therapy could become has been largely achieved, we think, at Loma Linda, but I'm sure Dr. Slater would say, as Wilson undoubtedly would, that the search for a yet better way is never over.

—William Preston
Loma Linda University

More Wilsons needed

Dear *FERMINEWS*:

I barely know the difference between a particle accelerator and a hole in the ground, but I felt a profound sense of sadness at the loss of Robert Wilson.

Reading about his achievements, his passions and his viewpoints, I imagine him to be the rare individual that knows no boundaries. He displayed remarkable talents in many fields—science, art, nature, politics. But from reading your descriptions I get the impression that he was really best at one thing—being human. We could use more Robert Wilsons in the world.

—Jeff Kauffman

A good neighbor

Dear *FERMINEWS*:

I live in Batavia and I enjoy the many benefits of having Fermilab as our neighbor. I regularly jog on the campus and genuinely appreciate having the open space for this exercise.

I'm writing to commend you for the issue of *FERMINEWS* that was a tribute to Robert Wilson. Although I am not a scientist, and often find the articles well beyond my knowledge level, I still find your publication of interest. The issue on Robert Wilson was exceptionally well done and Batavia is certainly fortunate to have the influence of such a great scientist serve to enhance our community.

Special commendations to photographer Reidar Hahn for capturing in a creative way some of the beauty of the campus.

One small issue: the caption under Broken Symmetry states the weight as a 212-ton (42,000-pound) structure. I think maybe that is 21-ton (slight typo). I think my math teacher said a ton was 2000 pounds. Maybe we could call this year 2000 the "Year Ton."

Anyway, thanks for the many benefits you provide to our community.

—Donald Moll

(Editor's Note: Thanks for pointing out the typo. The correct weight is indeed 21 tons, or 42,000 pounds. But we have no comment on "Year Ton.")

An enormous personality

Dear *FERMINEWS*:

I usually at least scan *FERMINEWS*, but had to stop and read all of the Wilson memorial issue. It's a beautifully written, nicely varied, affectionate collection of stories about an enormous personality.

—Sylvia Wright
News Service,
University of California, Davis

Special breed of leader

Dear *FERMINEWS*:

Your magazine is always interesting reading, even for an utter nonphysicist. But the edition devoted to Robert Rathbun Wilson was unusual. Elizabeth Hollander, who was Chicago Commissioner of Planning under Mayor Harold Washington, commented when Washington died: "I worked for a man who always encouraged my best instincts." You make Wilson sound like the same special breed of leader. Thank you for letting me get to know him a little.

—Jim Ford
Assistant Director
Northeastern Illinois Planning Commission

CALENDAR

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

MARCH 22, WEDNESDAY

HEARTLAND BLOOD CENTER blood drive will take place between 9am to 2pm in the WH GF NE training room. For further information contact the Medical Office x3232, or Sharon Koteles 630-840-3598 fax 630-840-3053 koteles@fnal.gov.

INTERNATIONAL FILM SOCIETY

Friday March 24

Life is Beautiful (LaVita e Bella) Ramsey Auditorium, Wilson Hall 8:00 p.m. $4.00. Dir: Roberto Benigni, Italy (1997) 114 min. Guido uses comedy to create an elaborate fiction to protect his young son from the horrors of the Nazi concentration camps.

ART SERIES

Saturday March 11

Mick Moloney's Irish Music and Dance Festival. Ramsey Auditorium, Wilson Hall, tickets are $18. A brilliant repertoire of Irish tunes and songs performed by five outstanding musicians, not to mention four championship step dancers!

Saturday March 25

8:00 p.m. Musicians from Ravinia's Steans Institute. Ramsey Auditorium, Wilson Hall. Tickets are $15. This performance features the strongest musicians of 1999's institute performing in a chamber ensemble with faculty member and violinist Miriam Fried.

ONGOING

NALWO is pleased to announce the free morning English classes in the Users' Center for FNAL guests, visitors, and their spouses have been expanded; The new schedule is: Monday and Thursday, 9:30am - 11am beginners (Music Room) and intermediates (Library) Monday and Thursday, 11am - 12:30pm advanced, emphasizing pronunciation and American idioms (Music Room)

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;

BARN DANCES

All dances are taught and people of all ages and experience levels are welcome. Admission is $5, children under 12 are fre (12-18 $2). The dance is sponsored by the Fermilab Folk Club. For more information, contact Lynn Garren x2061 garren@fnal.gov or Dave Harding x2971 harding@fnal.gov, or see http://www.fnal.gov/orgs/folkclub/.

Free Tickets to *now then again*

The producers of the play *now then again*, a relativistic love story set at Fermilab, have announced that the play's run will be extended, at the Mainstage at the Ivanhoe Theatre (750 W. Wellington in Chicago). Playwright Penny Penniston writes:

"Since you have been so helpful, I'd like to give you 100 tickets to use for any show during the first two weekends. These performances include:

"Saturday March 18 at 5 pm or 9 pm, Sunday March 19 at 5 pm, Friday March 24 at 8 pm, Saturday March 25 at 5 pm or 9 pm, Sunday March 26 at 5 pm.

"The only requirement is that I get the names at least 48 hours ahead of show time. This will give me time to get the info to the box office so that the tickets will be waiting."

If you'd like tickets to *now then again*, e-mail topquark@fnal.gov with the following information: Your name, date & time of show, number of tickets to reserve.

MILESTONES

BORN

Hannah Lei Yeung on Tuesday, February 15, 2000 to Linda and David Kwok-Wai Yeung (FESS/Eng).

RETIRING

Barbara Edmonson, PPD-Support Service Team, ID 4431, effective March 31.

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, MARCH 15

Spicy Italian Sausage
Polenta with Three Cheeses
Sauteed Greens
Poached Pears in Red Wine

DINNER
THURSDAY, MARCH 16

Mussels with Garlic, Thyme and White Wine
Grilled Duck Breasts with Red Currant Sauce
Wild Rice with Currants and Pecans
Vegetable of the Season
Profiteroles

LUNCH
WEDNESDAY, MARCH 22

Fish Cakes with Horseradish Cream
Pasta Primavera
Lemon Tart

DINNER
THURSDAY, MARCH 23

Steamed Artichokes with Maltaise Sauce
Veal a la Saltimbocca
Fettucine Carbonara
Green Beans with Red Onions
Hazelnut Torte

FERMINEWS

FERMILAB
A U.S. DEPARTMENT OF ENERGY LABORATORY

FERMINEWS is published by Fermilab's Office of Public Affairs.

Design and Illustration:
Performance Graphics

Photography:
Fermilab's Visual Media Services

The deadline for the Friday, March 24, 2000, issue is Tuesday, March 14, 2000. 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) with extras. Price lowered to $1,500 less than Kelley Blue Book (01/18/00 $16,500) Priced at $15,000- 11K Miles - excellent condition and runs great Must Sell - Will even store for the remainder of the winter. Has Markland Receiver Hitch and (5 pin) OEM trailer wiring kit, Markland floorboards, foam grips and extra windshield. Also have 2 headsets for the intercom one full-face helmet model and one that can be used either on a full-face or open-face. Still has 2 yrs on original as of Nov. 5 (Unlimited Miles) Warranty. Can get another 3 yrs extended (Unlimited Miles). Call Terry X4572 or e-mail skweres@fnal.gov

■ '97 Honda Civic DX 4dr., 36K miles, air, automatic and CD player. Asking $10,999 obo. Call 630-466-1959 for more info.

■ '95 Mitsubishi Mirage 2dr coupe, 100k, red, automatic trans, AC, p/s, p/b, AM/FM, dual air bags. New: tires, battery, timing belt. Good condition. $2900 obo. Oleg Kurnaev x4308 or 630-784-0048 or e-mail Kurnaev@fnal.gov.

■ '94 Hyundia Excell GS 3 door hatchback, 5 speed manual trans, 65K am/fm/cassette, new tires, excellent condition. 630-377-3412 or x3044, or rapids@fnal.gov.

■ '91 Chrysler LeBaron, 102K, dark-red, dark-red leather interior and wood, 4 dr, sun roof, A/C, automatic, power seats/locks/windows/doors, Tilt/Telescope Wheel, AM/FM-Cassette, cruise control, $ 2,900, home (630)548-9850 or x6510 or ursulam@enteract.com or malzache@fnal.gov

■ '91 Honda Civic DX, 3 door hatchback, AC, stereo, manual trans.,108k, well maintained, no rust or leaks, $2500 obo Volker Sander, sander@mcs.anl.gov, 630-985-1995 (h) 630-252-7497(w) Argonne National Laboratory Fax: 630-252-5986.

■ '90 Chrysler LeBaron, 85K, burgundy, dark-red leather interior and wood, digital tacho, 4dr, A/C, automatic, power seats/locks/windows/doors, Tilt/Telescope Wheel, AM/FM-Cassette, cruise control, 2 new tires, new brakes, good cond., $3,400, home (630)548-9850 or x6510 or ursulam@enteract.com or malzache@fnal.gov

■ '90 Toyota Corolla Deluxe Wagon 5D, automatic, AC, power steering, cruise control, AM/FM stereo and cassette, 92k miles, new tires, new battery, new exhaust system. Runs very well. The car is in very good condition due to regular maintenance. Small amount of rust. Kelly Blue Book retail value of more than $5,000. Asking $4000 obo. For more information: mishra@fnal.gov x4094.

■ '90 GMC V1500 Jimmy, SLE 92K, vgood cond't inside & out. 5.7 Litre V8, auto transmission, AC, security system. $9,575 obo. waw.fnal.gov, or x3169, home 630-325-4608.

■ '89 Dodge Colt, Red-150k. Moonroof, am/fm stereo, manual transmission, new brake system, cellular phone included. $1,590 contact Juan Pablo Fernandez x8630 or fernand@fnal.gov.

■ '89 Ford Taurus 4Dr GL Sedan Sandalwood, 94k miles, auto, loaded, original owner, good condition, new brakes, $2,300, chou@fnal.gov or x5489.

■ '87 Jeep Cherokee Laredo, navy, 6 cyl. 4.0 l, 4WD, auto transmission, tilt, AC, 2 dr, power locks & windows, AM/FM stereo/cassette, 165k miles, good condition, very little rust. $2,800 obo. Marek x2373 or 630-983-8635, marek@fnal.gov.

■ '87 Nissan Stanza , 128k miles. Automatic, 4 door, AC, etc., no rust or leaks , good condition, $1550 obo , call Li 840-2444(w) 840-3055(h) or lizhou@fnal.gov

■ '84 Porsche 944, silver/black, 135K miles, original owner, 5 Spd, sun roof, A/C, new tires, good condition, maint. records, $4,500 obo e-mail bartlett@fnal.gov or (630)377-3917. Fritz Bartlett MS 357 x4058.

■ "The Pro" Nordic Track - electronic speedometer/chronometer which monitors distance, time, speed and calories burned - like brand new $400 obo Linda x3082.

■ 1″ x 60' roll of new copper tubing...new $98 sell for $50 Dijak@fnal.gov or Ed x6300.

■ Heathkit GR-8000 projection TV, with stereo TV tuner, stereo audio amplifier, infrared remote. Identical model retailed fully assembled under Zenith brand name. Includes GR-8000 manual and schematic set. Composite video, antenna and stereo audio input/output. $500 or best offer. I am happy to demo the unit if you are a serious buyer. John Urish, x3017; urish@fnal.gov, or view it at http://www-pcs.fnal.gov/urish/home

■ Moving sale: Black Sharp microwave $45, small food processor Hamilton Beach $15, toaster $5, Hoover vacuum with 15 bags $10, small Eureka vacuum $15, coffeemaker Krups with gold filter $15, coffee grinder $1, phone white $10, black mini stereo CD/Cass. system $25, 2 halogen lights ea. $8, Fan $8, iron $2, ironing board $3, IKEA book case $40, queen airbed with pump+2 pillows $15, mirror $5+$2, cookware-set 4 pieces $18, PIER 1 tableware for 5 $60, wicker shelf 60"high $5, small kitchen utensils, glasses, grill and much more. Most electric stuff, dishes, book case less than a year old and half price, home 630-548-9850 or x6510 or ursulam@enteract.com or malzache@fnal.gov.

■ Guitar Amplifiers, Marshall VS65R. 65 watts. Tu Preamp. $ 250. Marshall AS80R 80 watts. 3 channel. Acoustic. $375. Curtis x2394 crawford@fnal

■ German woman, 18 years old, just finished sch speaks good English, wants to spend one year wit US family with (small) kids. Contact Maria 231-504 or n.holtkamp@worldnet.att.net.

■ Adams Tight Lies 5 metal wood w/stiff flex steel shaft Adams Tight Lies 3 metal wood w/still flex ste shaft. One year old $65.00 ea or both for $125 x22 located @ Proton Assembly Building Dwight Featherston.

■ Duncan Phyfe (drop leaf) mahogany dining tabl with triple pedestal and 4 matching chairs with lyre backs, circa 1940. Need refinishing. Asking $325. Contact Shelley at ext. 5809 or krivich@fnal.gov

■ Electric organ, Conn model 626M Rhapsody, contemporary style, has two 61 note independent manuals and 25 note pedalboard. Made -1964. $150 obo Jim Engelbrecht x4073.

■ Used tires for sale: (2) P225/60R16 Goodyear EAGLE GA $5 each (1) P195/75R14 Goodyear INVICTA $5 Dijak@fnal.gov or Ed Dijak x6300

HOUSES FOR SALE

■ Batavia - West side $197,000. 3 bedrooms, 2.5 baths, 2 car garage, partial basement, large lat enclosed deck, stone fireplace. 630-761-0221.

■ Charming Bungalow in Wheaton $157,000. 2 bedroom, 1-1/2 bath, living room, dining room, eat-in-kitchen, playroom/3rd bedroom, loft. Walk to town, train, schools, Prairie Path. Jim Kerby 630-690-1288, or x3595.

FOR RENT

■ Coach House for rent in West Chicago. 2 bedro 1 bath situated on 2-1/2 wooded acres, on the edg of Fermilab property leave message 847-446-4957 Ye Olde Sign Shoppe.

■ Room for rent in private home in St. Charles. Quiet environment, kitchen and laundry privileges, separate phone line. Available March 15. Call Mary 630-377-0862 (evenings).

GOLFERS

■ Have an urge to hit something with a stick? The Tuesday Prestbury Golf League has openings for singles or teams. For more information contact Dean Sorenson deans@fnal.gov, x8230 or Rod Kl rklein@fnal.gov, x4682.

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

FERMILAB
A U.S. DEPARTMENT OF ENERGY LABORATORY

Office of Public Affairs
P.O. Box 500, Batavia, IL 60510

First-Class Mail
U.S. Postage
PAID
Bartlett, IL
Permit No. 125