FermiNews

Fermi National Accelerator Laboratory

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Fermilab photos

Leon Lederman, spokesman for E288, and John Yoh, experimental coordinator, both then from Columbia University, seen here in 1977.

Stamp design by Rocky Kolb and Dawn Donahue

Commemorative stamp honoring *b* quark discoverer Leon Lederman, unveiled at a July 1 gala dinner honoring both quark and Lederman. Not available in post offices.

INSIDE

b Quark Turns 20, Lederman Turns 75

Celebrations and seminars honor the birth of the *b* quark and its discoverer.

by Katherine Arnold, Office of Public Affairs

Scientists summoned from all parts of Fermilab had gathered in the auditorium on the afternoon of June 30, 1977. Murmurs of speculation ran through the crowd about the reason for the hastily scheduled colloquium. In fact, word of a discovery had begun to leak out, but no one had yet made an official announcement. Then, Steve Herb, a postdoc from Columbia University, stepped to the microphone and ended the speculation: Herb announced that scientists at Fermilab Experiment 288 had discovered the upsilon particle. A new generation of quarks was born.

The upsilon had made its first and famous appearance at the Proton Center at Fermilab. The particle, a *b* quark and an anti-*b* quark bound together, meant that the collaboration had made Fermilab's first major discovery. Nobel laureate Leon Lederman, spokesman for the original experiment and former director of Fermilab, described the upsilon discovery as "one of the most expected surprises in particle physics."

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Texas Congressman Explores Energy Frontier

Rep. Joe Barton tours Fermilab's research facilities, gives talk to scientists.

by Donald Sena, Office of Public Affairs

In his first visit to the energy frontier of particle physics, U.S. Rep. Joe Barton (R–Tex.) explored the science research at Fermi National Accelerator Laboratory, while challenging the Lab's user scientists, many of whom are from Texas, to better explain the benefits of their endeavors to the nation.

Rep. Barton, a member of the Science and Commerce Committees in the U.S. House of Representatives, toured some of the Lab's facilities on June 23, and also gave a talk to a packed room of Fermilab scientists. No stranger to high-energy physics—Barton's home district includes Waxahachie, Texas, the home of the now canceled Superconducting Supercollider—the congressman said he supports basic research and its benefit to the country.

"We need to do basic research, and there needs to be an experimental component to it; it can't be all theoretical," Barton said during his talk to the scientists. "I do think for us to maintain our viability as a great nation, we have to make a national priority of funding the kind of activities that you folks are committing your careers to."

Lab tour

Barton spent his morning visiting some of Fermilab's experiments and facilities. Fermilab Director John Peoples presented an overview of the Lab and its work on Wilson Hall's 15th floor. Peering out the south window, Peoples explained how the Main Injector, Fermilab's newest accelerator now under construction, will aid research capabilities by providing increased luminosity, raising the rate of particle collisions. The congressman then visited one of the experiments that will benefit from the increased luminosity: the DZero collider detector. As a crane moved noisily overhead at the DZero assembly hall, physicist James White, from Texas A&M University, explained the various parts of the complex detector. White said the upgrade his detector is currently undergoing will allow DZero to keep up with the increased rate of particle collisions.

Barton also stopped at DZero's counterpart farther along the ring, CDF. Greeted by physicist Alan Sill of Texas Tech University, Barton stood at the base of the three-story physics tool, learning how the large detector found the top quark. Barton also heard about the various Texas universities' contributions to the CDF upgrade.

Last, Barton toured the KTeV experiment with physicist Marjorie Corcoran of Rice University. Unable to walk the detector hall because the particle beam was streaming through the beampipe, Barton saw the inner workings of the experiment's control room and

Rep. Joe Barton talks to scientists in One West.

Alan Sill, of Texas Tech University, and Rep. Joe Barton with the CDF detector.

discussed KTeV's goals. Corcoran explained CP violation, the asymmetry of matter over antimatter in the universe, and its implications for physics and the current theory of matter and energy.

Talk in One West

Barton opened his informal talk with scientists by saying that, at one time, he was one of the strongest advocates of high-energy physics research. The SSC, he said, was only five miles from his home in Texas.

Barton said he supported the project until the end, explaining, "One of the biggest disappointments that I will ever have was when they killed the SSC on the House floor."

He said after the cancellation, he was drained of high-energy physics talk; however, that changed six months ago when Barton learned that the U.S. Department of Energy wanted funding for a U.S. contribution to the Large Hadron Collider located at CERN, the European Laboratory for Particle Physics. The LHC, scheduled to be finished after 2005, will take the energy frontier away from Fermilab's Tevatron accelerator. The project caught Barton's attention, and he sought facts on the deal. Not happy with what he learned, the congressman said he set out to make sure taxpayers' money was not wasted on the project. According to Barton, one major difference from the SSC debate days is that the Texas representative, who was then a junior member of the minority party, is now a senior member of the majority party. As a result, he said he now had more influence on the proceedings, and he took his case up with the Science Committee, headed by James Sensenbrenner (R–Wis.).

Barton said the ultimate result of his, Sensenbrenner's and other Science Committee members' persistence with LHC concerns was a better deal for the U.S. at CERN. He said Martha Krebs, Energy Research director for DOE, sought and obtained much better terms from CERN than the original agreement provided. The general agreement now includes a cap of $200 million on the U.S. contribution to LHC construction, a cap on the detector contributions of $50 million and an agreement that U.S. scientists will have at least two observer positions on the CERN board. Last, Barton said the U.S. and CERN have a "touchy–feely" general agreement that in the future the CERN member nations will contribute to the next large U.S. high-energy physics project, if there is one.

"So, because I was a hard-butt and willing to kill the whole thing, we got a lot better agreement," said Barton. "You folks will have a little better fair shake at CERN and, if and when the world community decides to do something bigger and better..., there is at least now, on paper, a commitment from the European member nations of CERN that they are willing to help us."

Funding issues

Barton said the LHC discussion got him "back in the hunt" for high-energy physics, saying he feels it's important work and a worthwhile career. However, he did point out that basic research is a hard sell in Congress and to the American people. This fact is reflected in the recent allocations to high-energy physics, which is "at best static." One reason for the squeeze on science, and all other discretionary

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James White, of Texas A&M University, leads Rep. Barton through the DZero detector.

Marjorie Corcoran, of Rice University, explains some of the monitors in the KTeV control room.

Photos by Reidar Hahn

Fermilab Director John Peoples explains Fermilab's accelerator to Rep. Joe Barton at the 15th floor beamline model.

DOE Conducts Fermilab's On-site Review

ES&H and community outreach are high on the agenda.

by Sharon Butler, Office of Public Affairs

In the wake of recent events at Brookhaven National Laboratory and a strong message from the Secretary of Energy that the pursuit of science cannot neglect safety and health, Fermilab officials emphasized two main issues at the Laboratory's recent on-site review: ongoing efforts to make the workplace safe and protect the environment, and a new draft plan to secure the public's trust.

In the last year, the Laboratory has initiated an in-depth study of its environmental monitoring program, Fermilab officials told the DOE delegation that conducted the review. Investigations are concentrating on older areas of the site where beam loss has occurred. Such attention to the environment, officials said, and the new plan to strengthen relationships with surrounding communities were intended not only to secure the safety of Fermilab's many employees, users and visitors but also to enhance public confidence in the Laboratory's operations.

Held on June 26, the all-day review of Fermilab's operations and research included presentations on four topics:

- efforts to address environmental, safety and health issues;
- a strategic plan for enhancing communication between the Laboratory and local communities;
- a project to repair structural defects in Wilson Hall; and
- commitments to future research.

Martha Krebs, director of DOE's Office of Energy Research, who headed the agency's delegation, was pleased to see "science and safety together" on Fermilab's agenda. She said it was "only a matter of time" before the energy research laboratories attracted the same kind of scrutiny as the nation's weapons laboratories, where extensive environmental clean-ups are now underway.

Elaine McCluskey, of FESS, displayed photographs of cracked concrete, exposed steel, and broken window panes in Wilson Hall—evidence of deterioration caused by the building's movement.

Committing to ES&H

In the past year, Fermilab has launched two major environmental, safety and health initiatives, Fermilab officials told DOE: the development of an Integrated Safety Management program, in response to a new DOE contractual requirement, and an investigation of potential ground water contamination.

William Griffing, head of the ES&H Section, told DOE, "[We] have worried about vulnerability [to environmental problems] for a long time—we have a good record."

Of 21 potentially contaminated locations on the Fermilab campus, the state has confirmed that 16 pose no hazard. Fermilab believes that the five remaining sites also present no health risk, but the state is still reviewing the data supplied by the ES&H Section.

In addition, no tritium has been found in the aquifer underlying the site, Griffing reported. However, Fermilab is investigating unexpectedly elevated levels of tritium in the glacial till beneath one of the fixed-target stations.

Martha Krebs, director of DOE's Office of Energy Research, advocated stewardship not just of the environment, safety and health at the nation's laboratories but of the excellence and relevance of high-energy physics research.

Building trust

Environmental problems, even unconfirmed ones, can strain relations with surrounding communities; so can misconceptions. Recently, a local resident asked why, according to her bank, Fermilab had demagnetized the magnetic strips on people's ATM cards, said Judy Jackson, head of the Office of Public Affairs. While Fermilab had not altered anyone's card, Jackson noted, the incident underlined the need to enhance communications.

Fermilab has long enjoyed a "cordial but 'live-let live'" relationship with its neighbors, according to Jackson. But how people in general perceive Fermilab remains unclear.

"We have data on quarks, but no systematic data on the surrounding communities' views, and no formal structure for dialogue," said Jackson.

Outreach, she said, was especially important in light of Fermilab's openness to communities for land use proposals and in light of a planned experiment that will send a neutrino beam along an underground route from Batavia, Ill., to a former iron mine in northern Minnesota. Jackson's new draft communications strategy details ways of averting fears about Fermilab's mission and activities and strengthening relations with communities off campus.

Preserving Wilson Hall

Back on campus, Fermilab is preparing a $17.7-million plan to restore Wilson Hall. Elaine McCluskey of the Facilities Engineering Services Section showed the DOE delegation several photographs of structural damage, including "cracks in the concrete caused by an underlying concrete beam that 'wants' to slide." Fermilab staff and contractors have made temporary repairs, but more permanent ones are necessary. In one place, McCluskey's photographs revealed an interim bracket that supported a steel beam but itself had no support.

"The buildings [at Fermilab], like all of us, are getting old," said Laboratory Director John Peoples.

Continuing research

As the day-long review turned from infrastructure to future research, the issue of tightening resources intruded. The money available for experimental operations and detector construction at Fermilab has been lower than anticipated, according to the Laboratory's draft institutional plan for fiscal years 1998 to 2003. In total, from 1989 to 1999, the purchasing power of Fermilab's base budget will have fallen by $38.6 million, or about 15 percent in fiscal year 1997 dollars.

"We're in a declining budget," said Peoples. "There's no question about it."

Hinging on adequate funds are research plans for the next decade, including, as Peoples noted, carrying the fixed-target program to a successful conclusion, preparing for and implementing Collider Run II, building and operating NuMI (Neutrinos at the Main Injector) and collaborating in the design and construction of parts of the Large Hadron Collider.

Looking out over the long term, Krebs commented that "ultimately, we'll need another U.S.-based accelerator." But, Peoples responded that, with current financial constraints and resources trained on constructing the Main Injector for Run II, research on future accelerator designs—possibly a very large hadron collider or a muon collider—necessarily remains limited.

"In the contracting universe we're in, as far as the financial picture goes, we can't work on everything at the same time," Peoples said. "I'm disappointed. I'd like to do that, [but Fermilab has a responsibility to its users].... Our long-term future [has to be], in effect, a volunteer program."

At day's end, Krebs applauded Fermilab's initiatives in environmental safety and community outreach. She also enjoined her staff to find the budgetary means of supporting the renovations to Wilson Hall. But while recognizing the need for the U.S. to stay at the frontier of particle physics research, she offered no promises. Despite the merits of proposed research, she said, "clearly there is a big issue on whether the money can be found to support [it]." ■

William Griffing, head of the ES&H Section, reviewed ongoing efforts to monitor environmental problems.

Judy Jackson, head of the Office of Public Affairs, said that Fermilab will strengthen the base of communication with its neighbors.

Photos by Reidar Hahn

Scott Menary, associate scientist in the Beams Division, updated DOE on the NuMI project. To reduce the costs of one of NuMI's experiments, called COSMOS, Fermilab is proposing a collaboration with a similar experiment at CERN.

Photos by Fred Ullrich and Reidar Hahn

An uninvited guest explores a Fermilab warehouse… while one of its cousins leaves a trail of damage in a Proton Center portakamp.

Raccoons and Beavers and Deer, Oh My!

Wildlife interacts with technology at Fermilab.

by Andrew Shih, Office of Public Affairs

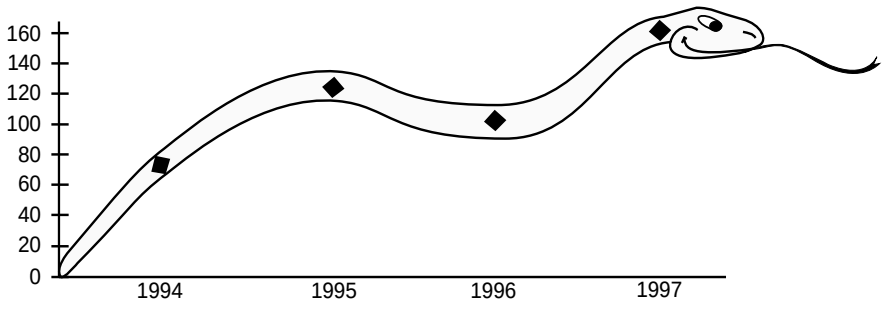
Rocky Raccoon looked up at the metallic monolith looming above him. As another cold blast of February chill assaulted him, he padded over to a small hole at the base of a wall where a plate had rusted away. He could sense the warmth on the other side. Squeezing through the hole, he sniffed the mysterious cables running through the darkness. Yes, this looked like a good place to curl up for a nap.

Bad move.

Rocky had found his way into an electrical feeder station and cuddled up with a 13,800-volt power line. He didn't last long, and neither did the feeder. His brief encounter with electricity shut down the accelerator for almost five hours earlier this year.

Wildlife Management Incidents

Annual Occurrence



With increasing frequency, animal encounters with human technology have resulted in losses for both the Lab and the animals that share its site. To protect both parties, Fermilab expends considerable resources to prevent and respond to such incidents. Yet despite these efforts, records document a rise in wildlife-related problems.

A growing problem

In 1994, the Roads and Grounds Department reported 74 wildlife management incidents. In 1997, that figure is projected to rise to 160. Those who respond to these occurrences attribute the rapid increase primarily to overpopulation.

"We have overpopulated groups that don't have the carnivores around that used to take care of their population," said Mike Becker, Roads and Grounds group leader.

David Nevin, head of Facilities Engineering Services, agrees. "Because they have no predators here on the Lab, [populations] have just gotten out of control."

Before the establishment of Fermi National Accelerator Laboratory, hunting and trapping helped limit the populations of deer, raccoons and beaver. Today, the Lab does not permit those activities. Human and carnivorous predation no longer keeps wildlife numbers in check, leading to a host of animal-related problems.

Fauna in the feeders

Earlier this year, a large hawk flew between two power lines. Its outstretched wings touched both conductors simultaneously, creating a circuit that killed the hawk and interrupted power. The lines in question have since been moved.

This unlikely and unpredictable event illustrates the diversity of problems that Fermilab employees must deal with. From electrical hawks to shelter-seeking raccoons, animals can injure themselves and give their human neighbors headaches.

Perhaps the most expensive of these headaches is the tendency of snakes and rodents to find homes in Fermilab's power grid. Rocky Raccoon is just one example of an all-too-frequent problem. During the colder months, the heat generated by electrical feeders and transformers attracts animals trying to escape the wintry weather.

"Mice, raccoons and rabbits crawl in there just to keep warm, and it's really difficult to keep them out," said Bob Mau, head of Accelerator Operations.

When these animals do get into electrical systems, the results can be costly. Such incidents shut down the accelerator once or twice each year, according to Mau.

Besides causing power failures, raccoons can also find their way into Laboratory buildings. They pull protective skirts off the bottoms of trailers and dig under portakamps. When they enter buildings, raccoons can cause extensive damage to experiments.

"We have to learn to become raccoon-friendly," said Kalina. "In other words, buildings out here need to be designed solid" enough to resist raccoon entry.

Other animals also cause problems. Beavers dam up cooling water ponds. Woodchucks tunnel through berms. Deer cause about 15 car accidents annually. Snakes slither into service buildings. These encounters are at best inconvenient and at worst dangerous, and the Laboratory works hard to respond to (or better yet, prevent) them.

Prevention and response

Roads and Grounds employees keep busy with a steady flow of wildlife management calls.

"We get a call of some sort every day," said Becker.

To minimize these calls, Kalina, who handles most animal cases for Roads and Grounds, encourages "preventive maintenance," which includes regular building inspections and raccoon-proof construction.

Nevin has instituted a prevention plan to minimize snake nesting in the electrical systems.

"We have an active program of sealing all of the transformers against the snakes, and it seems to be working," he said.

When prevention is not enough, Roads and Grounds must handle wildlife situations "in the field," figuratively and literally. Raccoons discovered inside laboratory buildings are captured and released in remote areas of the site. When a snake takes down a feeder, someone must remove the snake. On rare occasions, groundskeepers must use traps to remove troublesome beavers.

Becker stresses an animal-friendly stance: "If they're not causing a problem [and] they're not in an area where they're going to hurt anyone, we just leave them alone."

In fact, wildlife personnel often find themselves helping animals in trouble. Fishing lines and hooks occasionally ensnare geese or herons, and fences can trip deer. When groundskeepers find an injured animal, they bring it to Willowbrook Wildlife Preserve in Glen Ellyn for rehabilitation. They are responsible not only for protecting the Laboratory from animals, but also for protecting the animals from detrimental human influence.

Long-term solutions?

As long as animal populations continue to grow, encounters with humans will occur with increasing frequency, resulting in further losses for both the wildlife and the Lab. Fermilab employees will continue to manage wildlife incidents in a manner beneficial to both the Lab and the animals.

Unfortunately, as Becker says, "there is no easy answer." ■

Photo by Bob Lootens

Senior Groundskeeper Jim Kalina frees a deer trapped in a frozen pond.

Fermilab photos

Walt Innes, Karen Kephart, Jack Upton, Frank Pearsall and Bruce Brown work on E288 in July 1977.

b Quark Turns 20

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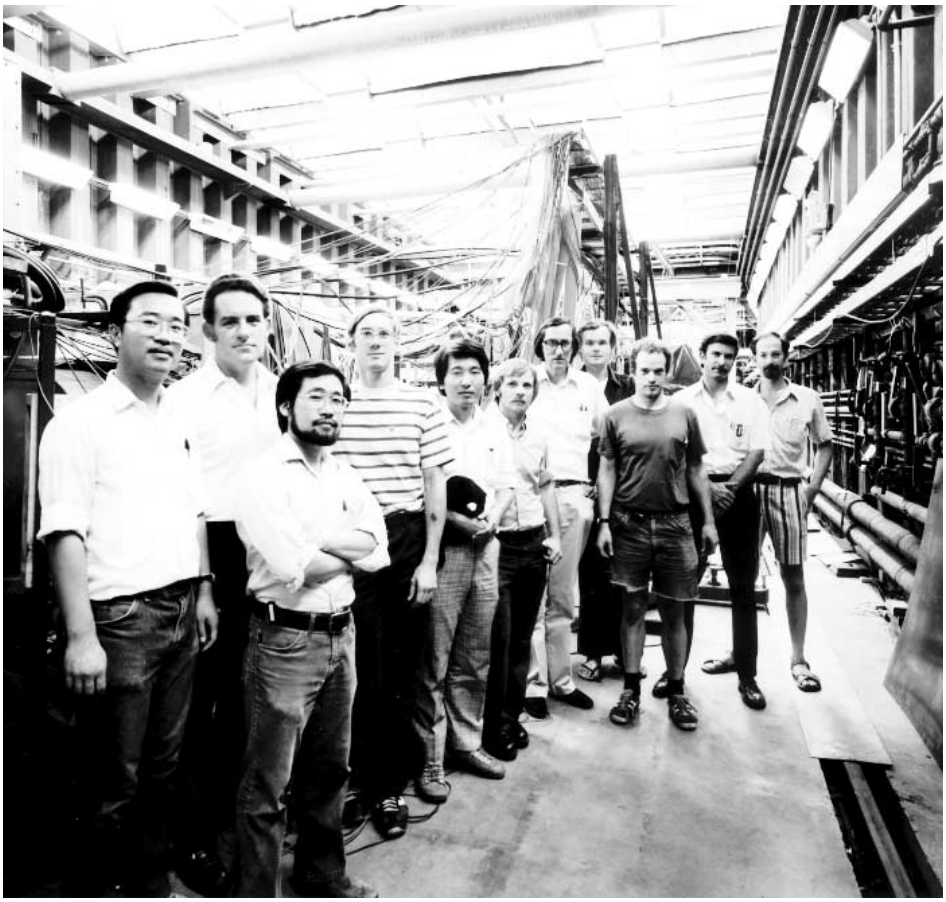
Twenty years later, almost 100 physicists gathered on June 29 at the Illinois Institute of Technology for a symposium, "Twenty Beautiful Years of Bottom Physics," to celebrate the birthday of the *b* quark, also known as the bottom quark or beauty quark.

The gathering brought together many of the original collaborators in the *b*'s discovery, as well as scientists who are currently working on the physics of the *b* quark. Not by accident, the symposium celebrating the particle coincided with the celebration of Lederman's 75th birthday.

"In 20 years there has been a tremendous explosion in what we know about the *b* quark," said Daniel Kaplan, associate professor at IIT and Fermilab visiting scientist. Kaplan was the only graduate student working on the experiment that discovered the particle. "In 1999 there will be five experiments ... focused on the *b* system, so it seemed like a good time to celebrate."

Panel discussions on 20 years of research in *b* physics and the future of *b* physics at colliders filled the schedule of the four-day symposium. Like all good stories, the symposium started at the beginning, with the history of the *b*.



Some of the collaborators in the E288 experiment hall in 1977. From left: Dave Hom, Chuck Brown, Al Ito, Bob Kephart, Koiji Ueno, Ken Gray, Hans Sens, H. D. Snyder, Steve Herb, Jeff Appel and Dan Kaplan.

The era

The year was 1970 and the Standard Model of Particle Interactions was a much thinner version of its current form. Four leptons had been discovered, while only three quarks had been observed. The symmetry that haunts every physicist was out of line. At least one more quark was out there. [The charm quark was yet to be discovered, and the top and bottom quarks were not much more than a jotting on a theorist's nightstand.]

In June of that year, Lederman and a group of scientists proposed an experiment at Fermilab (then the National Accelerator Laboratory) to measure lepton production in a series of experimental phases that began with the study of single leptons emitted in proton collisions. This experiment, E70, laid the groundwork for what would become the collaboration that discovered the upsilon, the bound state of the *b* and the anti-*b*.

The original E70 detector design included a two-arm spectrometer in its proposal, but the group first experimented with a single arm. E70 began running in March of 1973, pursuing direct lepton production. Fermilab Director Robert Wilson asked for an update from the experiment, so the collaborators extended their ambitions, planned for the addition of the second spectrometer arm and submitted a new proposal. The February 1974 proposal was a single-page, six-point paper in which the group promised to get results, "publish these and become famous."

Meanwhile, experiments at Brookhaven National Laboratory and at the Stanford Linear Accelerator were searching for the charm quark. These two experiments led to what is known as the November Revolution in physics. In November of 1974, both groups announced they had found a new particle, which was later proven to be a bound state of the charm quark. SLAC scientists named their new particle *psi*, while Brookhaven scientists named it *J*. So in an attempt to quell a potentially brutal argument, the bound state of the charm quark is aptly known as the *J/psi* particle.

Some semblance of symmetry had returned to the Standard Model with the discovery of charm. But in 1975, an experiment at SLAC revealed the existence of a new lepton, called tau. This brought a third generation of matter to the Standard Model, and was a solid indication that there were more third generation particles to be found.

The Fermilab experiment, now renamed E288, continued the work of E70, so much of the hardware was already in place waiting for upgrades. By the summer of 1975, collaborators completed construction on

the detector. Lederman invited a group from the State University of New York at Stony Brook to join the project, which began taking data in the fall of 1975.

One of the many legends in the saga of the *b* quark describes a false peak in E288's data. In the process of taking data, several events at an energy level between 5.8 and 6.2 GeV were observed, suggesting the existence of a new particle. The name upsilon was suggested for this new particle. Unfortunately, the signals at that particular energy turned out to be mere fluctuations, and the eagerly anticipated upsilon became known as "oopsLeon."

What happened next is perhaps best described in a 1977 issue of *The Village Crier* (*FermiNews's* predecessor): "After what Dr. R.R. Wilson jocularly refers to as 'horsing around,' the group tightened its goals in the spring of 1977."

The tightening of goals came with a more specific proposal for E288 and a revamping of the detector. The collaborators, honed by their experiences with the Fermilab beam, used the detectors and electronics from E70 and the early days of E288, and added two steel magnets and two wire chamber detectors borrowed from the Brookhaven *J/psi* experiment.

The simultaneous detection of two muons from upsilon decay characterized the particles expected signature. To improve the experiment's muon-detection capability, collaborators called for the addition to their detector of 12 cubic feet—about two metric tons—of beryllium, a light element that would act as an absorber for particles such as protons and pions, but would have little effect on the sought-for muons. When the collaborators had problems finding enough of the scarce and expensive material, an almost forgotten supply of beryllium in a warehouse at Oak Ridge National Laboratory came to the rescue. By April 1977, construction was complete.

Six weeks to fame

The experiment began taking data on May 15, 1977, and saw quick results. After one week of taking data, a "bump" appeared at 9.5 GeV (see sidebar, p.10). John Yoh, sure but not overconfident, put a bottle of champagne labeled "9.5" in the Proton Center's refrigerator.

But champagne corks did not fly right away. On May 21, fire broke out in a device that measures current in a magnet, and the fire spread to the wiring. The electrical fire created chlorine gas, which, when doused with water to put out the fire, created acid. The acid began to eat away at the electronics, threatening the future of E288. At 2 a.m. Lederman was on the phone searching for a salvage expert. He found his expert: a Dutchman who lived in Spain and worked for a German company. The expert agreed to come, but needed 10 days to get a U.S. visa. Lederman called the U.S. Embassy, asking for an exception. Not possible, said the Embassy official. Just as it began to look hopeless, Lederman mentioned that he was a Columbia University professor. The official turned out to be a Columbia grad, class of '56. The salvage expert was at Fermilab two days later. Collaborators used the expert's "secret formulas" to treat some 900 electronic circuit boards, and E288 was back online by May 27.

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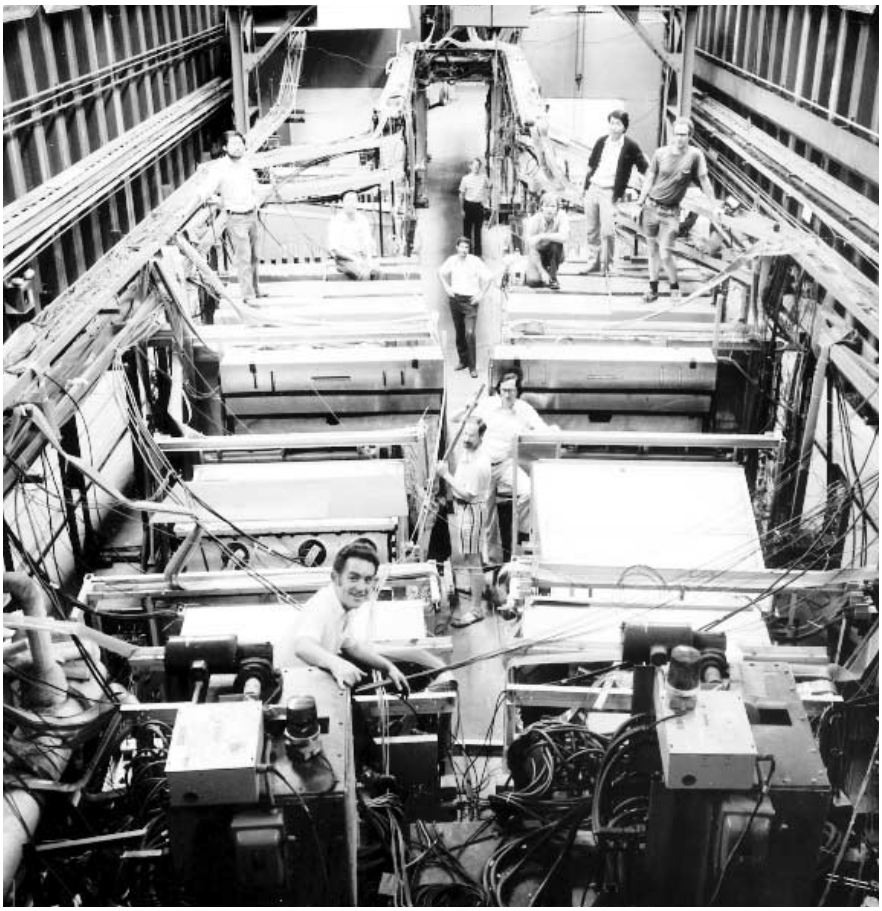
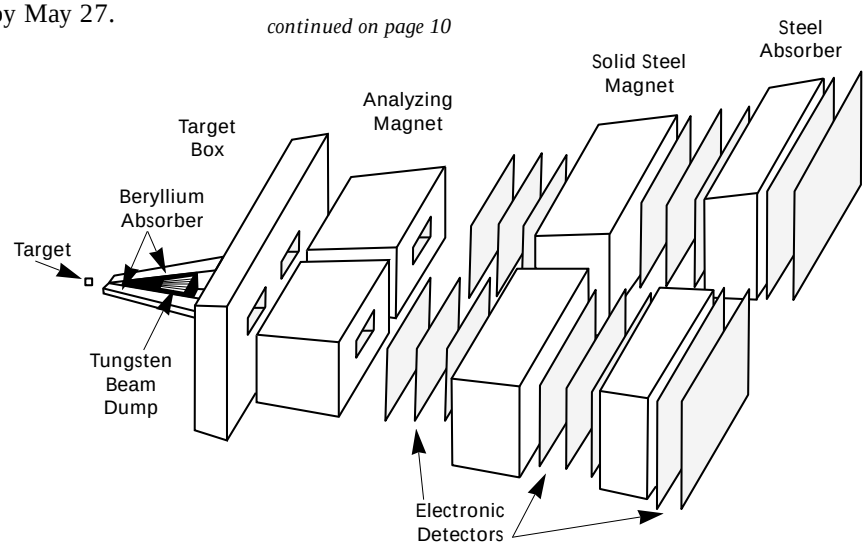


The muon spectrometers in the Proton Center's experimental pit.

The double arm construction of the detector.



b Quark Turns 20

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By June 15, the collaborators had collected enough data to prove the existence of the upsilon. On June 30, Steve Herb gave the official announcement of the discovery of the upsilon particle at a seminar at Fermilab, and on July 1 the collaborators submitted a paper to *Physics Review Letters*. It was published without review August 1.

Since the discovery of the upsilon, physicists have found several levels of upsilon states. Not only was the upsilon the first major discovery for Fermilab, it was also the first indication of a third generation of quarks. A bottom quark meant there ought to be a top quark. Sure enough, Fermilab found the top quark in 1995.

The Horizon for *b* Physics

Twenty years of *b* physics gave physicists something to celebrate, and the future of *b* physics gave them something to contemplate. The future for *b* physics is in the study of the phenomena of CP violation, an asymmetry between the behavior of particles and antiparticles.

"Part of the drive for *b* physics is CP violation," Lederman said. "Somehow *b* physics is almost a gift to clarify many of these questions in particle physics."

Both collider detectors at Fermilab, CDF and DZero, will improve their capability to do *b* physics in Collider Run II. In Run I, the tracking spectrometer and silicon vertex detector in CDF made *b* physics possible, said Joe Kroll, Fermilab associate scientist.

"When we began, no one thought we'd be doing *b* physics at the level we are," Kroll said.

Joel Butler, head of the Computing Division, is working with more than 50 other scientists on a proposal for a *b* physics detector at Fermilab, known as BTeV. Butler said the goal of the experiment is to do enhanced studies of CP violation. The hardware in the proposed detector would include a powerful tracking system and a particle identifier, with the capability to identify particles that emerge from the collision in the same direction as the beamline.

Butler said the main advantage such a detector at Fermilab would have over experiments at other particle accelerators is the Tevatron's ability to produce about 100 billion *b* events each year.

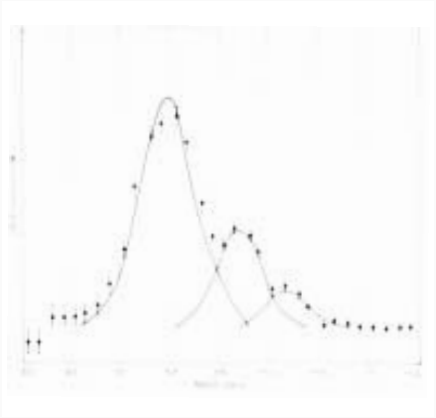
"We are a much more eclectic *b* environment," Butler said.

BTeV and b physics at the collider detectors, along with *b* physics at other particle accelerators, were all hot topics at the symposium. Many of the next generation of experiments will focus on *b* physics and search for CP violation. For instance, two complex machines, dubbed "*b* factories," are under construction in Japan and California. All of this comes from an industry that began at the Proton Center at Fermilab in 1977 with the discovery of the upsilon.

"It's not so easy to find such nice objects to study," Lederman said, "and *b* mesons turned out to be a bonanza of new physics. If one has control, one should only make discoveries that yield bonanzas." ■

Fermilab photos

An upsilon hooked rug was one of many embellishments in the experiment's portakamp. The sign below the rug reads: "The Upsilon is still alive! But now its mass is 9.5?!"



What was that bump?

"There was no known object that could explain that bump," said Leon Lederman, E288 spokesman and Fermilab director emeritus.

That bump he referred to occurs on the graph of the number of observed particle interactions as a function of particle mass, measured in GeV. Instead of a smooth downward curve, as the mass increases, the data from E288 showed an unusual number of events happening at a mass of 9.5 GeV. As soon as the "bump" in the data appeared, Lederman and his E288 collaborators concentrated on finding its cause.

E288 had discovered the upsilon, the bound state of a *b* quark and an anti-*b* quark. While the upsilon particle has a mass of about 9.5 GeV, the *b* quark on its own has a mass of about 4.5 GeV. At the time of the discovery, it was the most massive particle ever discovered.

Once the experiment had recorded significant data, it became evident that there was more than one particle involved in this high-mass discovery. The three peaks on the graph above indicate upsilon, upsilon prime and upsilon double prime, at 9.4 GeV, 10.0 GeV and 10.4 GeV, respectively.

Photo by Reidar Hahn

Max Chertok and Teruki Kamon, both of Texas A&M University, show Rep. Barton some inner components of the CDF detector.

Barton

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programs, is the current breakdown of the federal budget, according to Barton. Presently, about two-thirds of the entire federal budget goes toward entitlement spending and interest on the national debt. Five years from now, according to Barton, that number could reach 74 percent, or three out of every four dollars. Without entitlement reform, this choke on discretionary spending, where the nation's science programs reside, will continue, according to Barton. He mentioned entitlement reform is one of his priorities in Congress, saying the average entitlement program is growing at twice the rate of the federal budget, as many discretionary programs are being cut.

"Unless we do something to reform entitlements—and I don't mean reform as a pseudonym for elimination, just bring them into line with the rest of the country—it is going to be impossible to fund any big science project ever again. And it will even be impossible to keep any of the funds status quo," Barton said.

Project funding

He added that the mechanism for science funding is another area that holds potential for change. He said the Superconducting Supercollider is a case study on how not to fund big science, with the debate year after year of whether the project was worth the money.

"We should do big science projects like we [build] aircraft carriers," said Barton. "We vote on it, we put it in the budget, we appropriate long-term, we baseline and we match to the baseline. But we don't come back the next year and say, 'Should we build that aircraft carrier?' We should do it multiyear and appropriate from the [beginning] and then monitor. The second thing we should do is have international agreements lined up before the fact." ■

CALENDAR

JULY 24

"The 'New' Hong Kong: Is 'One Country, Two Systems' a Workable Model?" Lecture by Dr. James A. Winship, Augustana College. Thursday at 8 p.m. in Ramsey Auditorium. $5.

JULY 25

International Film Society Presents: *Denise Calls Up* - Dir. Hal Salwen, USA (1995). Admission $4 in Ramsey Auditorium, Wilson Hall 8 p.m.

JULY 30

The Heartland Blood Center blood drive, Wednesday, 30 July, from 9–2 in the WH GF NE conference / training room. Any questions regarding donating, call x3232.

AUGUST 1

NALWO Pot Luck Dinner at Kuhn Barn, 6 p.m. Everybody is welcome! Bring meat to barbecue and a side dish to share. For kids we have hot dogs and hamburgers. Soft drinks will be available and, for adults, wine and beer. For more information, call Martina, (630) 983–7021.

AUGUST 2

The Fermilab Arts Series presents South African-band Mahlathini and the Mahotella Queens. In 1965, producer Rupert Bopape connected the Makgona Tsohle Band with Simon "Mahlathini" Mkabinde, a member of one of the leading vocal groups, and the Mahotella Queens, a new singing, dancing female troupe. Mahlathini's low, loud voice and stealthy warrior's dance led some to believe he had supernatural powers. Paired with the lush, sunny harmonies and inventive dance steps of the Queens, the super group became a sensation throughout South Africa. After a hiatus in the late '70s and early '80s, the group returned to an aggressive touring schedule, which continues today. See the power of this music for yourself as Mahlathini and the Mahotella Queens come to Fermilab's Ramsey Auditorium on Saturday, August 2, 1997 at 8 p.m. Tickets and information, call (630) 840-ARTS.

MILESTONES

BORN

Katherine Elizabeth, to Steve (FESS / Engineering) and Lisa Dixon on June 27, 1997, at 10:30 a.m.

HONORED

Dianne Engram, in the EEO Office, for serving on a DOE review panel that presented workplace diversity awards to contractors and operations offices in May.

RETIRED

Richard Janes (ID #463, BD / BE / RF and Instrumentation Group) on July 16, 1997.

CLASSIFIEDS

FOR SALE

■ '90 Honda Accord EX 4-door, 5-speed, 101K miles. Maintenance current. Very clean, in good condition. Asking $7000 obo. Contact David, x4001, or e-mail dcc@fnal.gov.

■ '89 Ford E-150 conversion van V8, p/s, p/w, pdl, 4 captains chairs, center table, fold-down rear seat, tinted glass, CB, AM/FM cassette stereo, air. $4,800. Call Jim, x4076 or (630) 208-9131.

■ Master Volt 6-kv generator, 8-hp Briggs & Stratton engine; watt: max=6,000, rated=4,400; voltages: 120v (two duplex receptacles), 240v (two duplex receptacles); 60 cycle/single phase. New at Builders Square about $525. Will sell for $325 obo. Royal Sovereign 40-pint dehumidifier with automatic humidistat, frost control, and shut-off. Has hose attachment to avoid having to empty bucket. New at Builders Square about $200. Will sell for $80 obo. Sotz double-barrel wood-burning stove, very efficient, perfect for garage, work shop or basement, $125 obo. Call x2332 or (630) 393–9079 or e-mail pml@fnal.gov.

■ Dresser, $50; six-month-old box spring and mattress, $50; couch, $50; coffee table, $25; end table with built-in radio/alarm clock, $25. Negotiable. Must sell, moving August 15th. Call Eric, x3003 or (630) 778–1630, or e-mail efolz@adms21.fnal.gov.

■ Childcraft wooden crib and changing table set, like new. Paid $400, sell for $150. Pastel balloons crib bedding set (bumper pads, dust ruffle, diaper stacker), like new. Bought at Baby's Room for $150, sell for $35. Call Kathy, x2779 or (630) 232–4306, or e-mail kathys@fnal.gov.

■ GE gas stove, profile series, stainless steel, Natural gas and LP gas jets, sel-cleaning oven, sealed burners. Paid $1350 in Oct '96 asking $1100 only used for a few hours. Will deliver within a reasonable distance of the lab; Kenwood multi-component stereo system with cabinet. System includes linear tracking turn table, amplifier KA-94, synthesizer AM/FM tuner KT-54 (memory holds 14 AM and 14 FM stations), graphic equalizer GE-34, dual deck cassette recorder KW-64W, CD player DP-840, 2 4 way 150 watt speakers JL-840, $2000 obo. Air compressor 1-1/4 hp 3 gallon tank $200 obo; 8'6" couch with built-in recliners at each end and a rocker recliner $350; 16 ft. fiberglass DuoMarine boat needs work, hardware already removed and rough sanding completed $100 obo includes trailer. Call Terry, x4572 or e-mail skweres@fnal.gov

■ Beautifully updated home in Warrenville/Summerlakes. Four spacious bedrooms, large closets, MB walk-in and 1.5 baths. All-new light oak kitchen cabinets and new vinyl flooring. Freshly painted and airy. You will love the space and private yard with storage shed. Close to I-88, schools (District 200) and shopping. Clubhouse w/pool, tennis and gym. Call Barbara, (630) 393-2885.

FOR RENT

■ Sublet 1 bedroom in a 2-bedroom apartment either fall (Sept.-Dec.) or fall and spring (Sept.-May), $400/month, heat included. Naperville, on Rte. 59 just south of I-88. Close to lab, ~ 6 miles/15 minutes. Nice place; AC, microwave, dishwasher, new carpet and paint. Walking distance to Route 59 train station, and golf course. Near Fox Valley shopping mall. Complex has swimming pool, sand volleyball court, lighted tennis court, and free bagels every morning! Contact Andy, (630) 428–2310 (evenings), or e-mail apaullin@fnal.gov

WANTED

■ Highly interactive, experienced childcare sought. Long-term position from July 1997 caring for a pleasant, musical 2-1/2-year-old girl, five days/week, 9–5. Cognitive development training desirable; English fluency and car necessary. Salary very competitive. References please. Nicole Jordan, Warrenville, (630) 393-3970.

■ French tutor: I am French, and I help children and adults learn and practice the French language. Call Madame Ploquin, (630) 682–9048, or fax, (630) 690–7478.

■ Information on former farmers. Fermilab's archives staff asks anyone with knowledge of families who farmed the site before Fermilab arrived to share information for an upcoming recognition event. Please call A. Kolb, x2543.

LAB NOTE

FERMILAB OPEN HOUSE

Fermi National Accelerator Laboratory will host a Lab-wide Open House on September 13, 1997. All people from Chicagoland and beyond are welcome to visit the world's highest energy particle accelerator laboratory and explore experimental areas of the Lab not normally open to the general public. Visitors will also be able to attend science lectures, explore Fermilab's prairie and visit the Lederman Science Education Center, among other activities.

Fermilab employees and users are encouraged to volunteer. The Lab is expecting 20,000 – 30,000 visitors for the Open House, and volunteers are needed to give tours, give lectures, serve food and perform general coordination. If any employee or user wants to volunteer, please contact your section or division office. The Lab will provide lunch for the volunteers. All employees are also encouraged to invite family, friends and neighbors to the Open House, which will occur rain or shine from 10:30 a.m. to 4 p.m. on September 13.

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Please send your article submissions, classified advertisements and ideas to the Public Affairs Office, MS 206 or e-mail ferminews@fnal.gov

FermiNews welcomes letters from readers. Please include your name and daytime phone number.

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