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Photos by Reidar Hahn

Bob Bernstein, right, and Sergey Avvakumov, from the University of Rochester, in the NuTev hall.

Heidi Schellman (left) and Lucy deBarbaro, from Northwestern University, and Bob Bernstein watch the monitors in the E815 control room.

A Day in the Life of NuTeV

Fixed-target experiment 815 searches for Standard Model fundamentals.

By Katherine Arnold, Office of Public Affairs

It's a fairly typical Monday in the control room of Experiment 815. In the morning the beam goes down for several hours for Booster repair, allowing Bob Bernstein, Fermilab physicist and spokesman for E815, to take a break from his shift and make a new shift schedule. By afternoon, however, the beam is back, and Bernstein looks intently at more than a dozen monitors and a number of data recorders, checking for any problems.

Bernstein sips his fourth double espresso of the day and looks quickly from monitor to monitor, checking beam intensity, detector efficiency, temperatures, voltages and searching for anything that could possibly go wrong. He spots a data point on a histogram that concerns him—something appears to be off in one of the calorimeters. He writes the problem down in the logbook so the equipment can be closely examined the next time the beam is down.

"Other than that, everything is running smoothly," Bernstein says.

He heads toward the detector, passing a handful of physicists and graduate students intently analyzing data or working on software. The spokesman walks past two well-used

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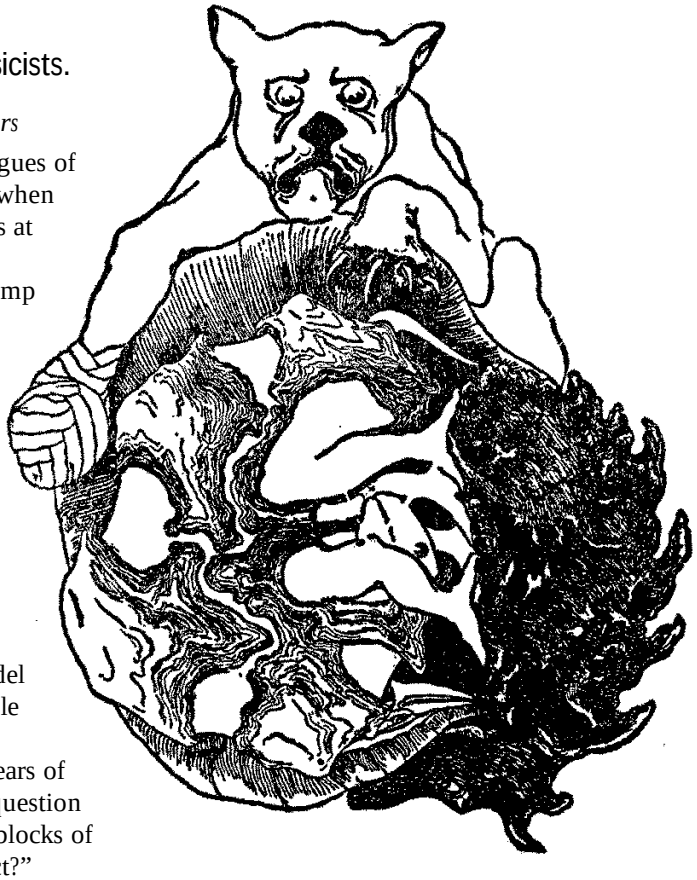
The Particle Scorecard

Was that a leptoquark? Probably not, say Fermilab physicists.



The theoretical particle called the leptoquark would share characteristics of both leptons and quarks. University of Chicago physicist and CDF collaborator Henry Frisch, below, compares it to the armadillo in Kipling's *Just-So Stories*. In the story, the armadillo resulted from the exchange of characteristics between the tortoise and the hedgehog, a process shown in Kipling's illustration at right.

By Judy Jackson, Office of Public Affairs

News travels fast in the major leagues of international high-energy physics, so when scientists working on two experiments at Hamburg's Deutches Elektronen-Synchrotron found an unexpected bump in the graphs describing data from particle collisions at their proton-positron collider last winter, the field was soon abuzz. Was DESY seeing the first signs of an exotic new particle called a leptoquark? If so, the science of fundamental particle physics would be a whole new ballgame.

A generation of particle physicists has grown up within the friendly confines of the Standard Model of Particle Interactions. Its comfortable theoretical framework describes with exquisite precision the results of 30 years of experiments aimed at answering the question "What are the fundamental building blocks of the universe, and how do they interact?"

Yet few particle physicists believe the Standard Model represents the full scorecard of elementary particles. It leaves unexplained, for example, the great differences in the particles' masses. Many theorists predict that there must be physics beyond the Standard Model—physics that requires the existence of new, undiscovered particles. Finding one of these new particles would be a revolutionary discovery. Did the bump in their data mean the DESY scientists had hit one out of the Standard Model ballpark?

The Standard Model sorts the known fundamental particles into leptons, like the electron, and quarks, the components of protons and neutrons. Atoms are made of electrons surrounding a nucleus, which is made of neutrons and protons, which are in turn made of quarks. The quarks differ from the leptons by feeling the nuclear, or strong, force.

Physicists have discovered six types of quarks and six leptons, but they do not yet understand why there are six of each, nor why they seem to form three groups, or "generations." In trying to organize the quarks and leptons into a unified framework, some theorists have proposed the existence of an exotic, heavy particle, the leptoquark, with the properties of both leptons and quarks.

Photo by Reidar Hahn

University of Chicago physicist and CDF collaborator Henry Frisch compares the theory of the leptoquark to Kipling's *Just-So Story* of the armadillo's creation by an exchange of characteristics between the tortoise and the hedgehog. Just so, says Frisch, the leptoquark would have the fundamental characteristics of both a lepton and a quark. If they should prove to exist, leptoquarks would introduce a previously unknown interaction between leptons and quarks, and perhaps help to explain why there are exactly six types of each.

When the scientists at DESY described their surprising collider results in a February 1997 news conference, they chose their words cautiously. They described an unexpected excess—the bump—in the number of violent collisions detected in a region that would correspond to a particle mass of about 200 GeV/c^2. (For reference, a proton has a mass of about 1 GeV/c^2.) One explanation for such an excess could be the appearance of a leptoquark, flashing into momentary existence before instantly decaying back into a positron and a quark. However, the DESY physicists were careful to say that leptoquarks were just one possible explanation for their results.

"HERA did a very nice and fair job of announcing their results," said Fermilab

physicist and DZero collaborator Greg Landsberg. "They didn't make any strong claims but merely notified us of possible explanations."

Because leptoquarks allow a direct interaction between leptons and quarks, it is natural to search for them in lepton-quark collisions like those occurring in DESY's positron-proton collider. But DESY's is not the only leptoquark game in town. If they exist, leptoquarks could also be produced in proton-antiproton collisions in Fermilab's Tevatron.

Two Fermilab experimental teams, CDF and DZero, have recently carried out searches for leptoquarks using the data from Tevatron Collider Run I, from 1992 to 1996. Perhaps, experimenters thought, the Tevatron data would reveal signs of the exotic particle. However, leptoquarks did not appear.

Since they find no evidence for leptoquarks, the Fermilab experimenters can set bounds on the rates at which such particles could be produced in proton-antiproton Tevatron collisions. (If the particles were produced at rates above these bounds, experimenters would almost certainly detect them.) The production rate is related to the mass of the particles—it is harder to make a heavy particle than a light one. Thus physicists can use the experimentally determined bounds to set lower limits on the possible masses of leptoquarks.

Using these methods, CDF and DZero have recently announced new mass limits for the first-generation leptoquark. (If leptoquarks exist, theorists predict they will come in three generations, like the quarks and leptons. Although proton-antiproton collisions at the Tevatron could produce leptoquarks of all three generations, DESY's proton-positron accelerator could produce only first-generation, or electron-type, leptoquarks.)

On May 13, at a conference at Vanderbilt University, CDF collaborator and University of Chicago physicist Carla Grosso-Pilcher announced CDF results indicating that leptoquarks are unlikely to exist with a mass of less than 210 GeV/c^2, if they decay in the pattern described at DESY. And on June 6 at a Fermilab seminar, the DZero collaboration announced a still higher minimum leptoquark mass limit of 225 GeV/c^2 for leptoquarks with this decay mode.

"The nice thing about these limits," said Landsberg, who presented DZero's latest results, "is that they have very small sensitivity to theoretical models. Whichever leptoquark model we choose, these limits hold up."

Both collaborations also announced new mass limits for leptoquarks that decay via a second possible mode.

"Combining the two experiments' newly determined limits will require experts from the DZero and CDF collaborations to understand the correlations between the two experiments' errors," said DZero physicist Boaz Klima. "However, an unofficial estimate would be that the combined limits for the pure electron-quark decay of first-generation leptoquarks should rise to about 240 GeV/c^2."

The new mass limits from the Tevatron appear to rule out a leptoquark explanation for the DESY bump.

"The Fermilab results do not mean that the DESY results are wrong," CDF's Frisch said. "They just mean that whatever they saw, if it is something new, it's not a leptoquark, at least not within the simplest models. Other possible explanations are either some combination of a statistical fluctuation with an imperfect understanding of the Standard Model predictions at these large masses, or, more exciting, some other new particle."

For the time being, then, it's back to the Standard Model. Physicists must trade visions of leptoquarks for real-world leptons and quarks—and unknown particles to be named later. But even now, scientists at DESY are taking more data, and Fermilab is building a better accelerator and upgrading the CDF and DZero detectors. As they say in the friendly confines of Chicago's Wrigley Field, "Wait 'til next year!" ■

Photo by Reidar Hahn

Fermilab physicist and DZero collaborator Greg Landsberg announced a new lower limit for the leptoquark's mass at a June 6 Fermilab seminar.

Photo by Reidar Hahn

NRC Chairman Discusses Technical Challenges for the Commission

Shirley Ann Jackson, former member of Fermilab's theory group, returns to Batavia for colloquium.

by Katherine Arnold, Office of Public Affairs

Of the thousands of scientists and students that come and go from Fermi National Accelerator Laboratory, the Lab hopes to leave its mark on all of them. Noted on that list is Shirley Ann Jackson, now the chairman of the Nuclear Regulatory Commission. Jackson, who spent two years at Fermilab after earning her Ph.D. from the Massachusetts Institute of Technology, recently returned to her postdoc stomping grounds in her new role, to address a crowd of scientists.

Jackson, speaking as part of the colloquium program, focused her discussion on the technical challenges facing the NRC, including the future of the nuclear power industry.

"The plants we have are aging," Jackson said. "Many of them are primarily 1960s and 1970s vintage. …Another big issue has to do with the proper storage and disposition of nuclear waste, particularly spent fuel. Spent fuel and [electric utilities] restructuring will have the biggest impact on the future of the nuclear industry."

She said there are currently 110 nuclear reactors licensed to operate in the United States, and the NRC's function in their operation is to review licensing, design and construction of the various nuclear facilities. The NRC recently gave its highest level of design approval to what Jackson described as the "next generation" of nuclear reactors, the GE Nuclear Energy Advanced Boiling Water Reactor and the ABB-Combustion Engineering System 80+ design.

A Foundation in Research

Jackson's history as a researcher and an educator leaves her well-suited to handle such compelling matters. She assumed her post as chairman in May 1995. Before her presidential appointment, she was a physics professor at Rutgers University. Jackson was the first African-American woman to receive a doctoral degree from MIT, and is the first African-American to be appointed chairman of the NRC.

"I think my experience can show people that there are women who come from scientific and technical backgrounds that can have successful careers," Jackson said.

Her technical career includes two years at Fermilab, 1973 to 1974 and 1975 to 1976, split by a year of research at CERN, the European Laboratory for Particle Physics. Jackson worked in the theory group studying what was then called strong interaction physics, specifically multiperipheral models.

After leaving Fermilab, she conducted research at AT&T Bell Laboratories from 1976 to 1991 on topics ranging from charge density waves in layered compounds to channeling heavy ions in solids.

"[My years at Fermilab] launched my research career. It was my first post-Ph.D. job, and it really introduced me to the world of research at a high level," Jackson said.

Jackson also said laboratories like Fermilab play an important role in national research efforts.

"First of all, these labs are a repository of expertise at a high level that I think is useful to maintain in a country like ours," she said. "The second part is that they are home to very unique facilities that serve large user communities that allow many people to do research at a high level."

Chris Quigg, a physicist in the theory group at Fermilab, worked with Jackson in the 1970s, during what he called a time of "pioneer spirit." He said Jackson was here when particle physics was changing dramatically, creating a challenging environment and a source of inspiration.

"She coped well with the balance between being a scientist like everybody else and taking advantage of the opportunities for creative public service," he said.

It's a balance that Jackson said she looks forward to each day.

"The number and extent of technical policy and managerial policies continue to amaze me. I'm surprised at how much I enjoy [being chairman]," Jackson said. ■

Fermilab Photo

Some members of Fermilab's theory group in 1974. From left to right: Benjamin Lee, Mary K. Gaillard, Shirley Ann Jackson and Tony Pagnamenta.

Getting Down to the Science of Business

The Business Systems Group at Fermilab is set to complete the final phase of a five-year project to modernize financial software and hardware.

by Donald Sena, Office of Public Affairs

At a place like Fermi National Accelerator Laboratory, the hope for new insight and advancement in the field often rests on the development and implementation of new and better tools. That basic tenet of particle physics also applies to the science of doing business.

Within the next few weeks, the Laboratory's Business Systems Group will complete the final phase of a five-year project to upgrade software and hardware essential to Fermilab's financial management responsibilities. The systems that the group has overhauled include the general ledger, payroll, accounts payable, shipping and receiving and the old paper–heavy requisition process.

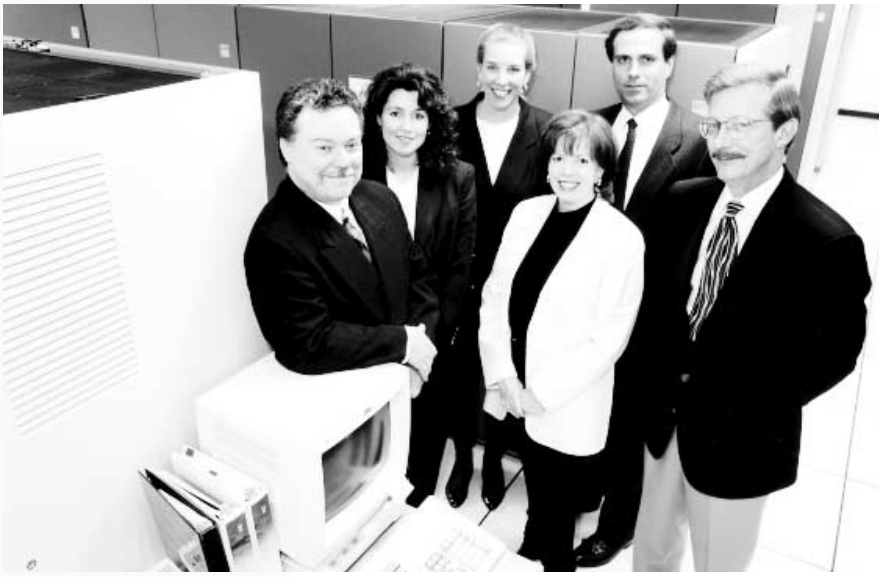


Photo by Reidar Hahn

Members of the Business Systems Management Committee with the old IBM mainframe computers. From left to right, Dan Freda, Colleen Farrell, Melissa Olufs, Shannon Mahoney, Richard Karuhn and Mike Lazarski. Robb Broome is not pictured.

"The work we have done over the last five years replaces all of the hardware, application software, networks and databases that were used to run the business processes here at the Lab for the last 25 years," said Richard Karuhn, manager of the Business Systems Group.

He added that the new systems support the Lab's mission by providing a reliable business environment for keeping employees and vendors paid, alleviating requisition bottlenecks and integrating processes that share similar data. Moreover, Karuhn said the hardware and software his team implemented will save Fermilab money by increasing efficiency in all business dealings.

Out with the Old...

For nearly a quarter century, Fermilab used software running on an IBM 4381 mainframe computer—state-of-the-art in its day, but clunky by modern standards. Most of the computer programs were "homegrown" and labor intensive to maintain and enhance. This forced Fermilab to rely on a select group of employees for maintenance and repair and limited the ability to consult with outside supporters on the software. Furthermore, at the end of 1993, IBM discontinued support for the operating system software Fermilab used to run the 4381, putting the Lab at risk for the last three-and-one-half years.

Through the years, the business team made mostly Band-Aid-type repairs, fixing glitches as they happened, but unable to anticipate problems or repair entire processes. Karuhn also said the business systems were burdened with "data redundancy." The situation created an interesting dichotomy at the Lab, with physics research at the forefront of its field and an obsolete business system infrastructure.

"The preamble here is that the organization had some serious exposures," said Karuhn.

...In with the New

In the early 1990s, Fermilab hired Karuhn along with a team of consultants to improve the Lab's business systems and processes. The team first improved the financial systems and general ledger, selecting standard commercial software, which allowed for better support and periodic upgrades. The general ledger includes budgeting, indirect cost allocation and DOE reporting, among other tasks. The Oracle software, running on Digital Equipment hardware, went on-line in October 1994.

Phase II, a revamped payroll and human resources systems, came up in May 1996, using a standard PeopleSoft application. This system keeps payroll running reliably, serving every Lab employee.

On June 1, 1997, the Business Systems Group, in conjunction with more than 100 Lab employees spanning every division and section, integrated the new Materials Management

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DOE Reviews U.S. Effort on CERN Detector

Lehman review team commends technical progress, recommends management changes.

by Donald Sena, Office of Public Affairs

In an extensive U.S. Department of Energy project review, DOE's Dan Lehman and a team of expert consultants studied technical and management parameters and gauged progress of the United States' contribution to the construction of the Compact Muon Solenoid. The CMS is one of the two general-purpose detectors that will record results of particle collisions at the Large Hadron Collider (LHC), the particle accelerator now being built at CERN, the European Laboratory for Particle Physics.

While commending scientists for technical developments on the complex detector, the review team recommended improvements in the management structure of the US CMS project, calling for more stringent line responsibility and Fermilab oversight to keep the project moving forward.

"Although impressed with the technical progress of the project, the committee recommended changes in the plan for managing technical performance, cost and schedule for this project," said Dennis Theriot, chair of the CMS management subcommittee and a 17-year veteran of DOE reviews.

CMS organization and physics

After 2005, when the first particles circulate around the 27-kilometer LHC accelerator, the energy frontier will move from Fermilab to the Swiss–French border. Many American physicists say U.S. participation in the construction of the LHC and its detectors is vital for the health of the U.S. high–energy physics program. Helping to build the LHC and its detectors will advance critical U.S. technology. When the new accelerator begins operating, it will represent the only opportunity for U.S. physicists and students to work at the energy frontier.

The entire CMS collaboration consists of more than 1,400 scientists from 138 institutions in 30 countries. Fermilab is the host laboratory for the US CMS collaboration, comprising 327 scientists from 39 institutions in the U.S. These physicists and their students are responsible for building major parts of the detector, including the endcap muon chambers, the hadron calorimeter and the trigger / data acquisition system. Since the U.S. team's inception, Dan Green, a Fermilab physicist, has served as collaboration spokesperson for US CMS, while also assuming duties as CMS project manager for the hadron calorimeter and serving as DOE liaison.

John Womersley of Fermilab, as part of his presentation to the review committee on the physics goals of CMS, said the LHC and its detectors will allow physicists to stretch the boundaries of the current theory of matter and energy, while also probing for physics beyond the Standard Model. One goal of the LHC and its detectors is the search for electroweak symmetry breaking and the putative Higgs boson. The two collaborations would also carry out the experimental exploration of the theory

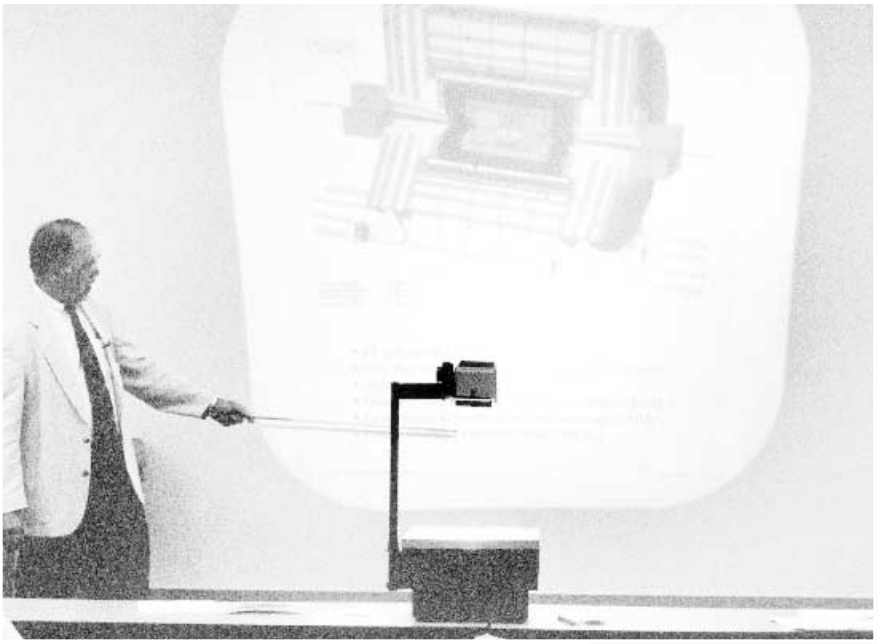

Photo by Jenny Mullins

Don Reeder, chair of the US CMS collaboration board, presenting the detector design at the review.

Photo by Reidar Hahn

DOE's Dan Lehman with CMS Deputy Spokesman T.S. Virdee, center, and US CMS collaboration spokesman Dan Green, right.

of supersymmetry, a theory that assigns every elementary particle a super partner, or sparticle, which would double the particle spectrum as scientists now know it. Last, Womersley said the detectors need to be ready for the unexpected.

"We don't know what we may find, so we need our detectors to be versatile and general purpose," Womersley said.

Extensive review for a large project

CERN scientist T.S. Virdee, deputy spokesman for CMS, said the U.S. contingent is a vital part of the detector development embedded in the larger international collaboration.

Don Reeder, board chair for the US CMS collaboration, said the CMS effort in the U.S. is comparable in complexity and cost to the combined upgrades of CDF and DZero, Fermilab's two collider detectors. The detector construction for the U.S. group will cost $168 million over eight years, making the US CMS effort larger than any detector project yet completed by U.S. high-energy physicists. Moreover, there is a congressionally mandated cap on funding for the project, requiring managers to be especially prudent in managing scope, costs and progress.

All of these factors led to a large DOE review team and scope. DOE convened 35 reviewers from about 15 institutions around the country, whereas a typical review team consists of five or six consultants. The reviewers, who spent four days at Fermilab, split into six subcommittees to learn of progress and plans and to make recommendations. The days ended with executive sessions on both the subcommittee and full committee levels. Five of the six subcommittees studied technical aspects of the detector, including the end cap muon system; the hadron calorimeter; the trigger, data acquisition and on-line computing system; the electromagnetic calorimeter and the tracking system. The last subcommittee, led by Theriot, reviewed common projects, cost, schedule and project management.

Recommendations

Reviewers praised the collaboration for its technical achievements. Theriot said one major finding of the review was that the consultants identified no major technical obstacles, adding that ideas and plans for the detector components and subsystems stretched the boundaries of technology but were still achievable.

However, the proposed management of US CMS engendered several recommendations for improvement. According to a consultant, the DOE review team advised establishing a clear line of authority that begins with the two funding organizations, DOE and the National Science Foundation, through Fermilab management to the US CMS project manager and the second-level managers.

"The US CMS collaboration, as an institution, cannot be vested with line management authority," one reviewer said for this article.

The US CMS project manager and the Laboratory must hold that responsibility, according to the reviewer.

The reviewers also recommended separating the project manager and U.S. collaboration spokesperson roles, saying a combined role is not conducive to good project management. The reviewers said the project manager should be committed full time to the position and be sufficiently supported with scientific, technical and administrative resources. Moreover, the proposed method of distributing project funds to the many collaborating institutions concerned the committee. The proposed distribution of funds to the individual institutions would take too much funding control away from the designated project manager, the reviewers said. That factor is one Reeder addressed in his plenary talk.

"We have to reconcile the tension between independent university groups doing research and the mandatory requirement that there be a direct line of responsibility coming from the funding agencies all the way down," said Reeder. "It is this reconciliation that is necessary for the project to reach successful completion."

Last, the committee affirmed the importance of Fermilab providing substantial oversight of the project, as recently requested

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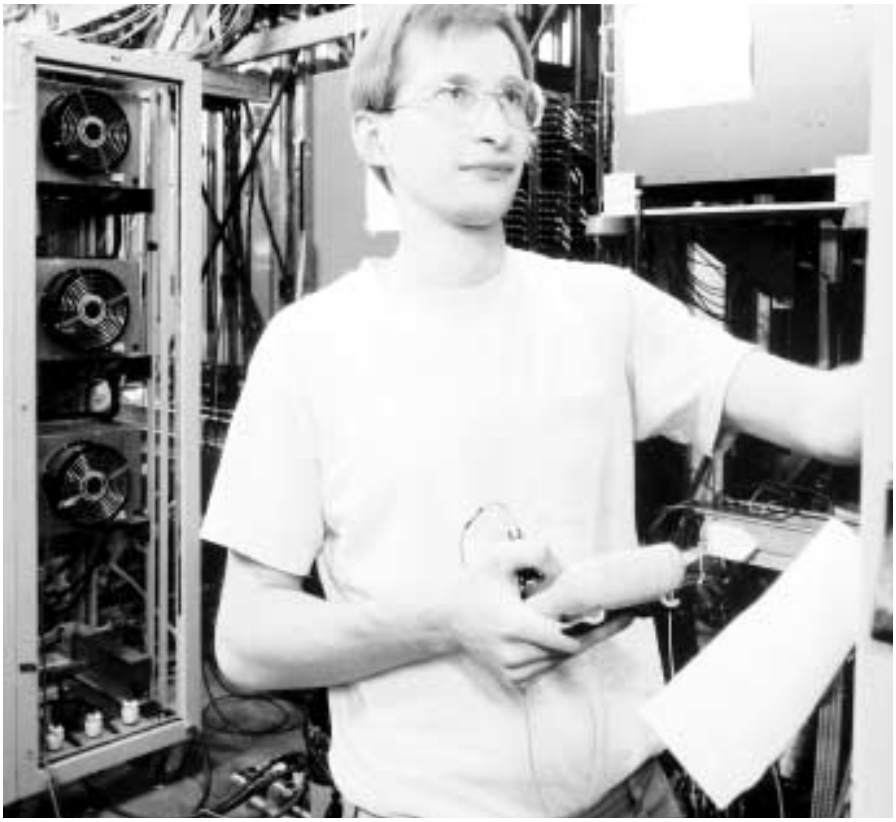
Photo by Jenny Mullins

The opening session of DOE's review of the US CMS project. Dan Lehman, director of the DOE Office of Energy Research's Construction Management Support Division, and John O'Fallon, director of the High–Energy Physics Program in DOE's Office of Energy Research, are at far left.



Sergey Avvakumov checks drift chamber voltages.

E815 (NuTeV)

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Photos by Reidar Hahn

Sally Koutsoliotas, a Bucknell College professor, catalogs test beam data. Behind her are the data summary tapes that have already been analyzed.

couches, popular spots for collaborators working long shifts at the experiment. Since the experiment is open 24 hours a day, seven days a week, it is not unusual for a person on the late night shift to turn the controls over to a colleague and catch a few minutes of sleep.

"People don't realize the hours put in down here," Bernstein says. "A typical shift is eight or 12 hours, but the graduate students can put in 16-hour days for weeks on end and just go home to crash."

In the detector hall, Bernstein walks quickly, checking the 62 gauges on the drift chamber gas supplies. After 13 years at Fermilab, he knows what he's looking for. All is well in the detector, so he heads back into the trailers to finish out his shift.

Back in the control room, Bernstein switches out the data tapes, frantic about the protons being wasted while the computers are not taking data. The phone rings four times in 20 minutes, interrupting his systematic analysis at the control panel. Someone asks how many toner cartridges they need for the printer. Someone else needs to get on a computer Bernstein is using to download some data. He answers all the phone calls, orders five toner cartridges, fills out a form to summarize his time on shift, turns the controls over to the next person and heads for the High Rise for meetings.

It's all in a day's work at NuTeV, one of nine fixed-target experiments currently running at Fermi National Accelerator Laboratory. E815 comprises about 30 scientists and students from 10 different institutions, a relatively small collaboration by Fermilab standards.

The Physics of NuTeV

The cornerstone of this experiment is the precise measurement of the weak mixing angle. When a neutrino and a nucleon interact, they exchange either a *W* or a *Z* boson, which are the carriers of the weak force. The ratio of these exchanges is related to the weak mixing angle (see diagram). This information will tell scientists about the nature of the electroweak force, said Panagiotis Spentzouris, a postdoc from Columbia University. The electroweak force describes the unification forces of electricity and magnetism with the weak decay, which is responsible for natural radiation, including the light from the sun.

There are already measurements of the weak mixing angle, but experiments like E815 continue to narrow the margin of error, Bernstein said.

"The measurements are getting better and better and are pushing the error bars down because of higher energy, better beams, better detectors, and better input from other experiments," Bernstein said. This ratio will ultimately help reveal the relationship between photons and bosons in the Standard Model.

The experiment is also set up to study QCD, or the strong force interaction in the structure of nucleons. Bernstein likened this search to studying the structure of a watch. To study how that watch is put together (assuming it cannot be taken apart), one could fire a bullet at it and take a picture of the watch parts flying out from the collision.

"I know what a bullet is, and I know how the bullet hit the watch, and from where all the pieces come out I can reconstruct how the watch is put together," Bernstein said. This is what the physicists are essentially doing to study the structure of nucleons, specifically, how quarks and gluons are held together.

The Detector

As the Tevatron beam speeds through the switchyard and down the neutrino line, E815's detector waits to measure certain particle interactions. Neutrinos come into the detector hall, hitting drift chambers that track the particles' position in the detector. Most of the neutrinos will pass through the detector without being tracked. But about one in a

billion neutrinos will collide with a nucleon in the massive iron plates, and this collision produces a hadron shower of pions, muons, kaons and neutrons that release energy as they explode from the interaction. The particles hit liquid scintillation counters, which give off light when charged particles pass through them. The amount of light can then be converted into a measure of energy.

But the detector is not quite finished following the particles on their path. The last part of the detector, the toroid, is composed of 24 magnets and several drift chambers that bend muons coming out of the interaction. This bending measures the muons' energy.

Improving the Target

E815 has several improvements over the previous generation of similar fixed-target experiments. One change from prior experiments is the ability to separate neutrinos and antineutrinos in the beam. This gives new information about the relative strength of the interactions characteristic of the *W* and *Z* bosons, and allows the experiment to possibly uncover some parameters of the putative Higgs boson even before it is discovered. This process of using precision measurements to learn about undiscovered particles is an old technique. For instance, neutrino experiments, including the predecessors of E815, predicted the top quark mass to be 150 GeV or more long before the CDF/DZero discovery.

These electronics components record all the data and feed it into the computers back in the control room, where Bernstein or other collaborators monitor the progress. Jesse Goldman, a graduate student from Kansas State University, splits his time running shifts, developing software and working on the test beam alignment. When Spentzouris is not running a shift, he works on debugging the detector, writing on-line software and analyzing data. Collaborators have already analyzed about half of the data collected, Spentzouris said.

So while the scientists keep busy running shifts and working on their own projects, the computers are busy recording the data to be analyzed later by one of E815's collaborators. Because the collaboration is relatively small, the people involved in the experiment share many of the responsibilities. Spentzouris pointed out that while Kansas State's responsibility falls in the test beam alignment and Columbia collaborators focus on data acquisition and the calibration of the detector, all collaborators share their roles in the experiment.

"We're like a big family. …We sometimes fight like kids in a sandbox, but we usually love each other," he said. ■

Photos by Reidar Hahn

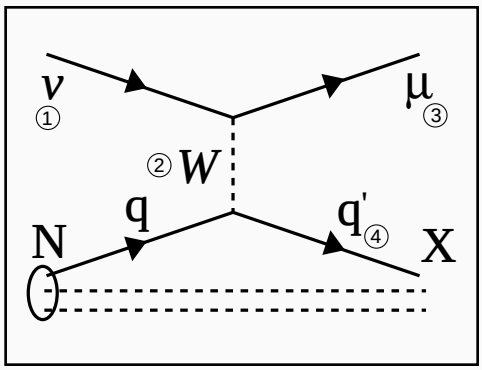
Lucy deBarbaro (above), a postdoc from Northwestern University, and Howard Budd, a senior research associate, fix a bad logic unit in the trigger room.

Sarah Case (left), an undergraduate from Columbia University, and Bob Drucker, a postdoc from the University of Oregon, analyze beamline monitoring.

Feynman Diagram

By studying the interaction below, researchers at E815 can compare the ratio of how many times a *W* boson is exchanged versus the number of times a *Z* boson is exchanged. This ratio is related to the weak mixing angle.

1. Neutrino beam enters detector.
2. A neutrino interacts with a quark (q) in a nucleon (N) from an iron nucleus, with the exchange of a *W* boson.
3. The neutrino changes into a muon.
4. The quark changes into a different flavor quark (q') as a result of the boson exchange. The X represents other hadrons from the interaction.



Science of Business

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System (MMS), also known as phase III. These processes handle purchasing, accounts payable, shipping / receiving and inventory. MMS also allows employees to use an electronic requisitioning process, eliminating paperwork and the need to shuttle forms from one office to another. Employees can find the electronic requisitions on Fermilab's Web site in the Business Services Section area.

The fourth and final phase of the project includes the smaller business applications and processes that are unique to Fermilab, such as the name and address system, property inventory control, telephone tracking and emergency call list. The Business Systems Group expects to bring this phase on-line July 1, completing the five-year project.

Karuhn said his team brought each phase to fruition on time and on budget, bucking the trend normally seen in information technology even within industry. Karuhn quoted statistics from the Standish Group International Inc. that state only nine percent of similar projects in the country will be completed on time and on budget.

Karuhn credits his team for the smooth implementation of the systems. The team includes Robb Broome, manager of new applications; Colleen Farrell, manager of human resources and payroll; Melissa Olufs, manager of administration and training; Mike Lazarski, former manager of financial systems who is now in a technical role; and Dan Freda, manager of technical services. Many of these managers said they are delighted to see these projects making Laboratory operations more reliable and efficient.

"By moving toward technology, we're making business functions more accessible and less intrusive," said Olufs. For instance, "any Fermilab employees with access to a Web browser will now have up-to-the-minute information available on their requisitions. That's progress." ■

Fixed-Target Updates June 1—June 1

Collaborators provided this update on fixed-target experiments.

E799 / E832 KTeV "Since the last FermiNews update, KTeV has continued to perform well. Our biggest problem continues to be failures of QIE chips, which are used in the readout of our CsI calorimeter. We are experiencing approximately two failures per day, which results in a 5–10 percent loss of livetime. The KTeV experiment is currently configured to collect data for the measurement of direct CP violation (E832)," said Elliott Cheu, from the University of Arizona.

E866 NuSea "E866 is currently taking data on W and Be targets to measure J / Psi production at negative X_F. Expected X_F coverage will be from about -0.25 to +0.10, and we expect to run in this mode for about one month. In addition to the J / Psi nuclear production dependencies, these data will allow studies of low-mass Drell-Yan production. Data analysis of the antiquark ratios of the proton is going well, and preliminary results have been presented at recent conferences," said Donald Isenhower of Abilene Christian University.

E835 Charmonium "E835 has continued to take data in the region of the eta_c. The antiproton source has managed to bring stacks of more than 20 mA below transition and this has been a big help, although it has also seen some reliability problems. Some issues of the beam energy calibration have been cleared up and the experiment will resume its work to confirm the 1P1 state in about a week," said Stephen Pordes of Fermilab.

E871 HyperCP "We've been working hard to improve our data collection efficiency. The spectrometer is working well, and we've increased our average beam request, while driving the DAQ as hard as possible. At our current pace, HYPERCP will write about 18,000 8mm data tapes by September 15th," said Chris White, from the Illinois Institute of Technology.

E781 SELEX "SELEX is continuing to take data in our study of charm baryon production. The most significant change to occur recently is the addition of a second computer to filter data on-line. This second computer allows us to obtain a larger charm sample by loosening cuts in our current filter program. We have also been studying the effect of higher primary proton intensities on our experiment. In addition we are implementing a new trigger to study hyperon production and decays," said Erik Ramberg, from Fermilab.

E862 Antihydrogen "For the past few weeks, the Accumulator has run at low energy for E835's scan of the eta_c. E862 is looking forward to running at higher energy and higher luminosity in the near future," said Dave Christian of Fermilab.

E815 NuTeV See story, page one.

E872 Donut "We are now, I'm happy to say, in very smooth running mode and taking data has become routine and...what's that alarm!? The first warm day of year had us struggling with overheating electronics and power supplies. I knew there was a reason why I didn't like summer," said Fermilab's Byron Lundberg. Vittorio Paolone, from the University of Pittsburgh, added, "Our observed rate of neutrino interactions is what we expected. Early next week (June 18) we'll be installing the fourth of our emulsion modules."

E831 FOCUS "Our high daily charm yields reflect the quality of the delivered beam. Barring a major accelerator catastrophe, we are easily on track to exceed our 10E687 charm baseline. All detector components have been working so well that we are preparing the higher level monitoring tasks associated with the time dependence of all detector parameters. We are about to begin a trial run of our first pass data analysis in order to check these parameters and tune our reconstruction algorithms," said Jeff Wilson, from the University of South Carolina.

Photo by Jenny Mullins

Ken Stanfield, Fermilab's deputy director, will lead management oversight for the US CMS project.

CMS

continued from page 7

by DOE and NSF. The committee cited Fermilab's proven record of successfully carrying out complex construction projects of both accelerators and detectors, according to Theriot.

Fermilab Director John Peoples announced during the opening session that the responsibility for providing management oversight for the project had been delegated to Deputy Director Ken Stanfield.

"We will take all necessary measures to ensure ourselves, the DOE and NSF that the project has a good plan and the project is managed to that plan," Stanfield said.

At the closeout, Stanfield also said Fermilab will help the US CMS collaboration meet its goals by strengthening the project management and implementing the review committee's recommendations. He added that one of the first priorities will be to get the project "baselined," in terms of cost and schedule —a goal that will require another review.

"These reviews are typically quite stressful but also very necessary," said Green, US CMS spokesperson. "The committee members are to be thanked for contributing their time and sharing their wisdom with us. We understand the importance of the concerns raised because US CMS is a project with a new set of 'boundary conditions.' Thus, we accept the need for remedial action in the area of project management before we can go ahead. However, we are pleased to see that the great R&D and preproduction work done in the US CMS collaboration subsystems was recognized and noted down. Now we need to complete the transition from an R&D effort to a DOE/NSF project." ■

LAB NOTES

SEWS Testing

The Sitewide Emergency Warning System (SEWS) is scheduled for testing on 7/1/97 at 10 a.m.

In areas that experienced problems in the previous test, the ES&H Section is seeking help from other divisions/sections in verifying the correct functioning of their emergency warning units. This should be accomplished by assigning individuals to listen for the warning at a representative number of units, then reporting the results to their Safety Officer.

As with all SEWS tests, cancellation could occur in the event of severe weather or an actual emergency.

HEPIC

The High Energy Physics Information Center (HEPIC) is a web-based information server that contains much HEP-related information, search capabilities, and links to various HEP Resources throughout the world. HEPIC exists to aid the HEP researcher in locating information quickly and efficiently. It is intended to be the "Server of Servers" for the HEP community.

A few services are: (1) the HEP Virtual Phone Book, the most nearly complete physics phone book in existence; (2) many newsletters; (3) Global HEP Search, providing fast unified searching of HEP information across multiple experiments and locations; and (4) comprehensive information on experiments, conferences and more. Please take a look at http://www.hep.net.

Calling All Creative Writers

Poets, novelists, essayists and playwrights at Fermilab are coming together to share our work with each other for constructive comment. We are in the process of becoming an officially recognized club. If you are interested, we'd like you to join us! For more information, contact Sara Tompson in the Library (x6014, or sarat@fnal.gov).

MILESTONES

BORN

Morgan May, on Memorial Day, May 26, to Bert (PPD/CDF) and Patricia Gonzalez at Mercy hospital.

HONORED

Fermilab, for its environmental programs, by DuPage County. See plaque below.

Chez Léon

MENU

Lunch served from
11:30 a.m. to 1 p.m.
$8/person
Dinner served at 7 p.m.
$20/person

For reservations call x4512
Cakes for Special Occasions
Dietary Restrictions
Contact Tita, x3524

Lunch
Wednesday
June 25

Ham and Cheese Quiche
Mixed Salad
Chocolate Cake

Dinner
Thursday
June 26

Tex-Mex Stuffed Peppers
Beef Tenderloin
Roasted Potatoes with Dill
Vegetable of the Season
Fresh Fruit Tart

Lunch
Wednesday
July 2

Closed

Dinner
Thursday
July 3

Closed

CLASSIFIEDS

FOR SALE

■ ’88 VW Fox for parts, doesn’t run, new clutch and heater core. $500 or best offer. If interested call Dan, x4674.

■ ’88 Burro Camper Trailer. Sleeps 2, 2 burner LP stove, domestic refrigerator freezer, runs on propane or electric. City water hook up or fresh water tank. Must see—many extras. (630) 665–2917.

■ ’85 Ford T-Bird, V6, auto, ps, pb, new tires, red. Good cond., $1000 obo. (630) 665–2917.

■ ’79 Ford Bronco, 4wd, 90k miles, 351 V8 runs great! $2000 obo. Call Paul, (630) 393-3796.

■ MTD 20" lawn mower w/mulching kit, VG cond., $75, x3178.

■ Johnson Outboard 9 1/2 HP rebuilt in ’95; 16 ft. Fiberglass DuoMarine Boat needs work, hardware already removed and rough sanding completed $100 obo; GE gas stove, profile series, stainless steel, natural gas and LP gas jets, self cleaning oven, sealed burners. Paid $1350 in October asking $1100, will deliver within a reasonable distance of the lab; Kenwood multi-component stereo system w/cabinet. Includes: linear tracking turn table, amplifier, AM/FM tuner, equalizer, dual deck cassette recorder, CD player. Call for details, make an offer. Call Terry, x4572 or email skweres@fnal.gov.

■ Home in Plano, nicely landscaped tri-level, three bedroom w/large living room and vaulted ceiling. Sliding glass doors in kitchen leads out to large deck and stone patio. Big yard w/jungle gym set, storage shed. One block from grade school. Only 6 years old. Call (630) 552–1320 for appt. to view it.

FOR RENT

■ House for rent, $1075/month, 3 bedroom, 1 bath, 2.5 car garage single family ranch home, fenced yard 2 miles west of Rt. 59, 2 blocks south of 83rd. Call (630) 653-1900 x251.

WANTED

■ English schoolboy, 17, planning to study physics at Cambridge from ’98 would like to spend about 2 weeks here in exchange to being host in England to similar boy. Ideally one-week term (school experience) and one week vacation each. Please contact Mike ALBROW@FNALD.FNAL or x8618.

■ 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, 393-3970.

CALENDAR

JUNE 21 & 22

The Fermilab Barnstormers Radio Control Model Club will host the 8th annual Anthony Frelo Memorial Helicopter Fly-In. Everyone is invited.

This is the second Barnstormers Summer event, which includes two days of model helicopter flying fun. Pilots of all skill levels are encouraged to participate, with everything from trainers to scale models. Factory representatives will be on hand for demonstrations and advice on all aspects of the hobby. New this year will be representatives from Lite Machines, manufacturers of the LMH-100 a small and inexpensive helicopter, and JR Inc. Also, many championship winning flyers will attend and demonstrate their fantastic flying abilities.

Guaranteed fun for all! Pilots must have Association of Model Aeronautics license. Spectators are welcome and refreshments will be available. For more information, call Jim Zagel, x4076.

JUNE 27

NALWO Potluck dinner at Kuhn Barn 6 p.m. We will offer barbecue and everybody is asked to bring their own meat to barbecue as well as a salad or dessert to share. For the kids we will offer hot dogs and hamburgers. For adults we have beer and wine, for everyone soft drinks. For more information call Martina, (630) 983-7021.

International Film Society Presents: *Bliss* - dir. Ray Lawrence, AUS (1985) 8 p.m. in Ramsey Auditorium, Admission $4.

JULY 4

An international potluck picnic with dance music is the Fermilab International Folk Dancers’ idea of a great way to celebrate our nation’s independence and its multicultural identity. From 2–9 p.m., the group will hold its annual Independence Day picnic at the Fermilab Village Barn. Jutta & the HiDukes will provide live music during the day. Suggested donation is $5 per adult or $10 per family, along with something to eat, as the event is potluck. Call Mady Newfield at (630) 584-0825 for more information.

JULY 25

Fermilab Golf Outing at the Blackhawk Golf Club (formerly Burr Hill). Scramble format. Green fees with cart: $38. Scramble fee: $12 per team. Optional contests: $3 per person. Deadline for collecting fees is July 11th. For more information, to sign up, or to pay fees, contact Bob Andree, x3703, or Don Arnold, x2871.

ONGOING

English lessons, Thursdays 10–noon in the Users Center, call Janet Antonio, (630) 769-6518.
NALWO coffee mornings, Thursdays 10 a.m. in the Users’ Center, call Selitha Raja, (630) 305-7769.
In the Village 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.

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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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