On the Road with the DZero Tracker

by Judy Jackson

It was a beautiful day for a road trip: cloudless blue sky, sun warming a cool dawn, light breeze blowing. The kind of day to fill ‘er up, put the top down and head for the highway.

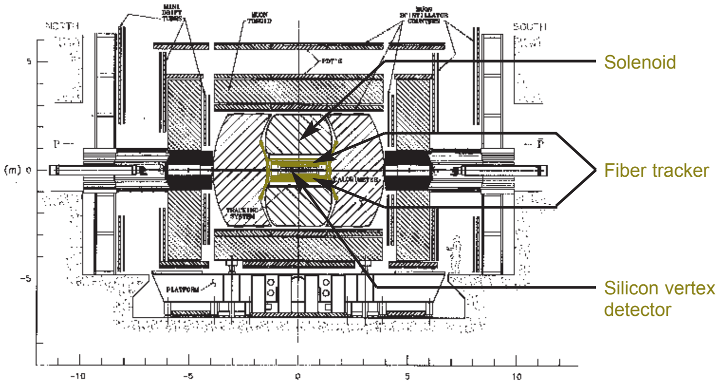
And at Lab 3 in the Fermilab Village, a unique road trip was just getting underway. At 10 in the morning of Thursday, June 29, a convoy, led by a Fermilab security car, lights flashing, pulled out of the hardstand parking lot. Behind the lead car, on the back of a flat-bed truck, the DZero fiber tracker slowly—very slowly—began the 2.4 mile trip from its birthplace in Lab 3 to its destination at the heart of the DZero detector. For the tracker, and for the people who had conceived, designed and built it, this final trip, on a beautiful summer morning, was the home stretch of a long road.

It had begun more than 10 years ago in the minds of Fermilab physicist Alan Bross and DZero collaborators. They had been thinking about the problem of tracking the charged particles that emerge by the billions from particle collisions deep inside the DZero detector. DZero and its sister detector, CDF, use an array of different technologies, all fitted together with the intricacy of a 5,000-ton Chinese puzzle, to observe and record the results of proton-antiproton collisions at the world’s highest-energy particle accelerator, Fermilab’s Tevatron. In Tevatron Run I, in the mid-nineties, the two detectors had found the top quark. For Run II, set to begin in March 2001, both detectors would have to be completely reinvented and rebuilt to keep up with a much higher collision rate from a newly souped-up Tevatron. For DZero, an important part of its new capability would be enhanced particle tracking. Bross and his colleagues set their minds to designing a tracker.

They based their idea for the new particle tracker on a flash of light. When a fast-moving particle from a collision interacts with a particle of a certain type of plastic, the interaction produces photons of visible light: the plastic scintillates. The scintillations, converted into electronic signals, can pinpoint a particle’s path through the detector, and hence its direction and momentum. Using computers trained to recognize the patterns of particles’ flight paths, experimenters can identify and analyze the particles themselves.

The plan for the fiber tracker envisioned a nest of concentric cylinders, 2.5 meters long and a meter in diameter, hollow at its center. It would fit snugly inside the larger cylinder of DZero’s new superconducting solenoid magnet. The hollow center of the fiber tracker, in turn, would hold another detection device, the silicon vertex detector.

The tracker would consist of eight cylinders of decreasing radius, nested together like Russian *matryushka* dolls. Each cylinder would be covered by thousands of scintillating plastic fibers, precisely aligned and connected at



Cross Section of DZero Detector

their ends to Visible Light Photon Counters. The VLPCs would convert the photons emitted by particle interactions with the plastic fibers to electronic signals. That was the plan. In principle, it would work. In practice, Bross said recently, it took every minute of the 10 years from its conception in 1990 to its departure from Lab 3 on the back of a truck on June 29, 2000 to make the fiber tracker work.

assembled, disassembled, reassembled, retested. It was the first and only large fiber tracker detector ever built. They didn't want to drop it.

"I remember the first fiber tracker group meeting," said Bross. "It was on September 7, 1991. At the time, we knew this project would push fiber detection technology. But as it turned out, the technology had much farther to go than we realized."

Photos by Jenny Mullins

Loaded securely on a truck (left) at Lab 3, and under the watchful eye of physicist Gaston Gutierrez (in glasses), the fiber tracker traveled by convoy (center) to the DZero assembly hall (right), where DZero denizens turned out to meet it.

The people who loaded the truck that June morning worked carefully. They took their time handling the 750-pound package, securely wrapped in its blue plastic traveling cover. The object they were loading had cost three million dollars. Hundreds of seven-day weeks and stay-'til-midnight shifts lay under its cover. It represented thousands of problems solved: new materials created, tested, rejected, reconfigured, heated, cooled, retested, glued, coated, molded, machined, rejected, redesigned, reworked, retested,

Again and again, as their project went forward, the tracker group discovered that the materials and devices that they needed for the tracker did not exist. Again and again, they had to learn to make them at Fermilab. The cylinders themselves are a good example.

On the Road with the DZero Tracker

"We decided to make the cylinders for the tracker out of carbon fiber," explained Fermilab physicist Gaston Gutierrez, who headed the Lab 3 assembly project for the tracker. "It was the strongest, lightest material we could identify. We had been told we could write a P.O. for these cylinders—just go out and buy them. But when we talked to vendors, we found only one who might be able to make what we needed. But the vendor's price was much higher than we could afford. We saw that we would have to make the cylinders ourselves."

Meanwhile, Bross and collaborators were working with Rockwell International Corp. on the VLPCs. Boeing bought out Rockwell, but work went on seamlessly. Eventually, six iterations later, the VLPCs met specs.

With both fibers and cylinders making good progress, it was time to address the problem of putting them together. The fibers would be arrayed in two-layer "ribbons," each containing 256 fibers in a strip about five inches wide, with a tolerance of only 25 microns, about half a hair. The ribbons

Photo by Fred Ulrich

Photo by Jenny Mullins

Photo by Fred Ulrich

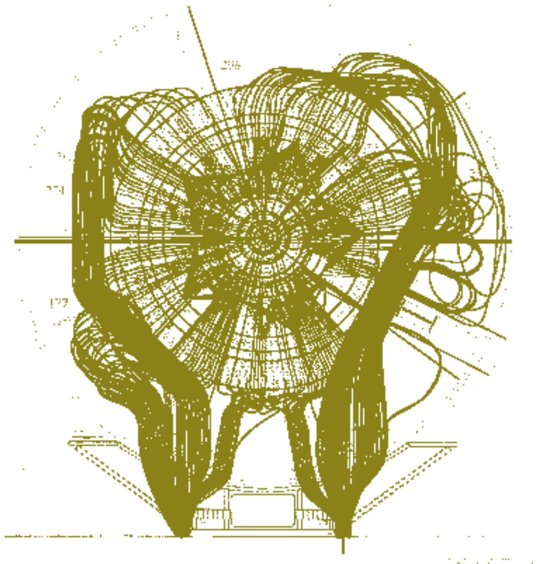
A crane maneuvered the tracker into position with the detector (left). Task manager Del Miller lined it up with the DZero solenoid (center). Gaston Gutierrez watched as the tracker slid slowly into place at the heart of the DZero detector (right).

The group began a self-taught crash course on carbon-fiber technology. They learned to wrap carbon fibers around steel mandrels. They brought an oven into Lab 3 and baked their creations. Their first efforts came out of the oven and promptly unraveled. They changed the recipe, learning from their mistakes. Eventually, many bakings later, they came up with a double-walled cylinder: strong, light, just what they needed. At less than half the vendor's quoted price.

would be attached to the outside of each cylinder, with one layer of ribbons running along the cylinder's long axis and a second wrapped helically above the first.

"When I came onto the project," said Fermilab engineering physicist John Krider, "it looked like the ribbons were a problem to be solved."

That was an understatement. Although prototypes had been made, no one knew how to hold the ribbons together, or how to attach them to the



Wave guides loop through the detector to transmit light from scintillating fibers to visible light photon counters for conversion to electronic signals.

cylinders. A special Teflon-like coating that made the fibers more efficient also made them almost impossible to glue; adhesives just wouldn't stick. Krider went to work.

Gutierrez credits Krider with much of the ultimate success of the fiber tracker project.

"John is a quiet guy who goes away and thinks about a problem. When he comes back, he has a solution, and it almost always works. His work is all over this tracker."

Krider consulted adhesives experts and tried dozens of glues. Ultimately, he came up with a flexible glue that held the ribbons together, didn't crack, and could be used in a pressure molding system, also Krider-designed, to produce ribbons with the tolerances the tracker required.

Now, how to hold the ribbons on the cylinders….

All the technical challenges had combined to make the fiber tracker something of a problem child for DZero. Every project review found their progress slower than their optimistic goals. In the detector upgrade project, they always seemed to bring up the rear. Finally, in the early fall of 1999, things began to change.

"The new lab director came to the detector collaborations, and asked us to tell him how much time we needed to be ready for Run II," remembered Gutierrez. "To answer that question, DZero planned another review. I brought the Lab 3 team together. I said 'We can make more promises, we can say we're making progress. Or, we can present a finished cylinder and not say anything.' I told them it was up to them. To finish a cylinder by the time of the review, we would have to work like crazy. We would have to work Saturdays, 12-hour days, there wouldn't be any vacations. I thought we could do it, but it was their choice. They were quiet when I finished, and someone asked about overtime pay. I thought, 'Oh no, if they are doing this just for the money, we'll never make it.' Then one of the technicians raised his fist and said 'Yes!' At that moment, I knew we would succeed."

The group produced a finished cylinder for the review and never looked back. They loaded the finished tracker.

For physicist John Kotcher, DZero's associate project manager for installation and commissioning, tracker moving day was both nerve-wracking and exhilarating. Together with Krider, from Lab 3, and task manager Delmar Miller, at DZero, Kotcher and his crew had gone over every detail of the transfer from Lab 3 to the DZero assembly hall. Using their safety hazard analysis as a guide, they had thought through every step, taken every precaution.

"I still had my fingers crossed," Kotcher said. "The transfer points, where we had to pick it up and move it, were the ones where I held my breath."

The move went flawlessly. An excited crowd of DZero faithful, (encouraged by Kotcher's broadcast promise that his colleague, associate project manager Hugh Montgomery, would give a quarter to anyone who turned out) met the truck as it arrived at the assembly hall. A crane lifted the tracker—slowly, slowly—off the truck and onto the floor. Next morning, after final preparations, another crane maneuvered it into place for insertion into the DZero solenoid at the detector's center. As the Vaseline jokes flew, the tracker slid slowly into place, with not a micron to spare.

Kotcher breathed out. Gutierrez smiled. Bross smiled. University of Rochester physicist Tom Ferbel asked Mont for a quarter.

It was the perfect end to a long, long trip. □

Photo by Reidar Hahn

In case of cost overruns, DZero is ready.

Users face a PARADOX

Users face a PARADOX

by Kurt Riesselmann

Joe Dehmer said it all: The high-energy physics community faces “the best of times and the worst of times.” Addressing the Fermilab Users’ Annual Meeting last month, Dehmer, director of National Science Foundation’s Physics Division, called it the “HEP paradox.”

“There is a truly spectacular discovery potential and excitement in high energy physics, met by unprecedented prosperity and public support for science,” he said. “Yet the path ahead is unclear. There is a downward pressure on physics budgets.”

In his address to users at the June 26-27 meeting, Fermilab’s Director Michael Witherell concurred. He summarized the central physics issues of current interest to the worldwide HEP community; topics that could revolutionize the current scientific understanding of the origins of the universe and lead to major changes in the Standard Model of particle physics.

“Fermilab’s research program is addressing all of these important issues with experiments that are the best or among the best in the world,” Witherell said. “During Collider Run II, to start in early 2001, there is a good chance for very important discoveries. But our current funding level is not sufficient to take advantage of all the scientific opportunities.”

Graduate student Bonnie Fleming gives SLAC Director Jonathan Dorfan (left) and DOE Associate Director Peter Rosen an update on the MiniBooNe construction during the Users’ Meeting tour.

Photo by Fred Ulrich

Finding a Vision

In what is becoming a Users’ Meeting tradition, the director of the Stanford Linear Accelerator Center also spoke to the Fermilab user community. SLAC’s Jonathan Dorfan agreed with Witherell’s assessment.

“We are significantly under-funded given the exciting prospects,” said Dorfan. “Maybe it’s time for a new way of planning. Ideally, we should be planning on a global basis. We should develop a long range roadmap, a 30-year vision.”

To help create that vision, physicists are planning Snowmass 2001, a field-wide meeting to be held in Colorado next summer. Its goal is to help the high-energy physics community converge on a path to the future. Snowmass organizer, Fermilab theorist Chris Quigg, spoke to users about its aims.

Nicola Bacchetta from the University of Padova, a member of the CDF collaboration, carries the youngest participant at the Users' Festa Italiana.

Pat LaVallie and Dianne Snyder, both working at Fermilab's Users Office and well known for the help they provide to scientific users at Fermilab, have dinner with participants of the Users' Meeting.

"Snowmass participants will undertake a thematic survey of our vision of particle physics and its future. We expect about 500 physicists, and we encourage international participation," he said. Quigg also expects conferees to connect with the public. "No person coming through the Roaring Fork Valley during Summer 2001 should leave without learning what particle physics is all about."

Dorfan also called for increased collaboration and emphasized to users the importance of "greater involvement of the university community in developing the tools of the future."

Tough Choices

Planning for the next generation of particle physics facilities and experiments is high on Fermilab users' list of priorities. Physicists are exploring several accelerator designs, but have not yet come to agreement on the path forward. In a Question & Answer session of the Users' Meeting, several users advocated first envisioning future discoveries and only then planning a machine. Others worried, however, that this could considerably delay the construction of a future accelerator, leading to an exodus from the field.

"The best bet is to make a major discovery in the next few years. This would increase the excitement in the field," said John Womersley, spokesman of DZero. "During Run II we have the great chance of finding the Higgs particle. The Directorate has to ensure that we put enough resources into this."

Womersley and collaborators hope that Fermilab can increase the number of collisions produced in Run II to a total of 30 inverse femtobarns, allowing for the possible discovery of a Higgs particle as heavy as 180 GeV.

Witherell assured users that the collider experiments have the highest priority.

"We will be giving special attention to the Run IIb luminosity upgrades over the next few years to help CDF and DZero to look for as heavy a Higgs as possible," he said.

If the two experiments detect signs of new physics, then other accelerator-based experiments, including the just-approved BTeV experiment (see story on page 8), will need to stand back. Witherell and Fred Bernthal, president of Universities Research Association, stressed the importance of the readiness of CDF and DZero detectors to begin data taking when Collider Run II starts in March 2000. Right now both experiments are on track.

At the meeting's end, Users' Executive Committee Chair Dan Amidei summarized:

"In high-energy physics our attentions are always divided between the intensity of the present and the challenge of the future. We need many opportunities to talk together, formally and informally, about the issues facing the field. The Users' Meeting is one big formal place to pull it all together." □

Jonathan Dorfan (left), director at SLAC, and John O'Fallon, of DOE, visit the main control room as they tour Fermilab.

Photos by Jenny Mullins

Dan Amidei (left) from the University of Michigan, chairman of the Users' Executive Committee, discusses budget perspectives with Jane Monhart and Peter Rosen, both of DOE.

BTeV Clears the Bar

New experiment will get to the

of CP Violation

by Mike Perricone

In less than a quarter-century, the field of B physics has moved from solitary exploration to mass exploitation of the family of ephemeral particles containing the bottom quark.

Now BTeV—the newly approved experiment in B physics at the Tevatron—hopes to reach toward major discoveries in the next decade, moving beyond experiments that have already begun operation. The experiment received the go-ahead from Fermilab's Physics Advisory Committee during its June 17-24 meeting in Aspen, Colorado.

The PAC report said BTeV, an "ambitious" experiment with "an elegant and challenging detector...could be the definitive experiment that ultimately clarifies the picture of CP violation," the difference in behavior between matter and antimatter holding the key to the composition of the universe.

Accepting the PAC recommendation, director Michael Witherell said: "Building on the contributions of the other B-factories, BTeV represents the most important experimental program that can be done in the U.S. program at the end of this decade before the completion of a new facility."

Photo by Reidar Hahn

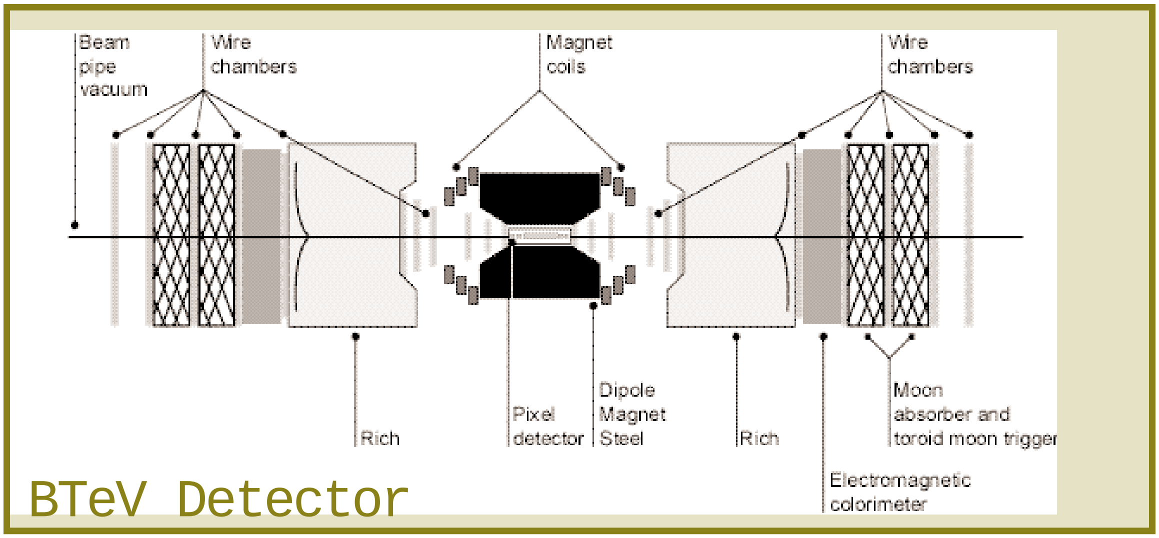
Members of the team who built the CZero hall contemplate what may someday be the home of BTeV.

BTeV, with an estimated cost of about $150 million and a possible roll-in date of 2006, is aiming high.

"The dream, of course, is to defeat the Standard Model in some important way," said experiment co-spokesperson Joel Butler.

The Standard Model has structured scientists' view of particle physics since the 1970s. CP violation has been a fact of life for particle physicists since James Cronin's and Val Fitch's Nobel Prize-winning discovery in 1964 involving kaons, particles containing a strange quark. Experiments at Fermilab (KTeV) and CERN (NA48) have added significant advances in kaon CP violation, and Fermilab's CDF collaboration added a recent observation in B physics—significant as a sign of possible CP violation outside the kaon system.

The bottom quark was discovered at Fermilab in 1977. Mesons (quark-antiquark pairs) containing the bottom quark offer two great advantages in studying CP violation: first, they produce many possible decay modes to study; second, some of these decays show large and (potentially) easily measurable differences in behavior between the resultant particles and antiparticles.



The new experiments are called “B factories.” Billions of paired B mesons and anti-B mesons will emanate from high-energy accelerators like brand-name tools coming off assembly lines. In a sense, though, the Tevatron has always been a B-factory: its proton-antiproton collisions are a prolific source of B mesons. The CDF and DZero collider experiments are now learning how to use B’s effectively, but BTeV is specifically designed to use B’s to study CP violation.

“We can make the most comprehensive measurements, while examining the whole pattern of CP violation,” Butler said. “Are they all related, reinforcing the Standard Model? Or are they not related—meaning we’re seeing new physics.”

Several B factories are already operating: BaBar (using electron-positron collisions) at Stanford Linear Accelerator Center in California; BELLE (electron-positron) at KEK, the High Energy Accelerator Research Organization in Tsukuba, Japan; and Hera-B (electron-proton) at Deutsches Elektronen-Synchrotron in Hamburg, Germany. BaBar and BELLE will soon present their first results, and go on to precision measurements.

Another B-factory is planned: LHC-B (proton-proton), for the Large Hadron Collider being built at CERN in Geneva, Switzerland. This experiment would operate contemporaneously with BTeV.

So the BTeV collaborators had to make a strong case to the PAC. They did it by demonstrating their ability to measure some of the most difficult parameters of CP violation in the decays of B_d (containing a bottom quark and a down antiquark) and B_s (a bottom quark and a strange antiquark) mesons. These parameters will still be in question even after years of study by current experiments.

“What we tried to do in the PAC was to look ahead almost 10 years to the later stages of this program, and to ask what results would be needed to complete it,” said PAC member and eminent theorist Michael Peskin of SLAC. “I am sure that BTeV will have an important role to play.”

The BTeV detector, which will be located at the new CZero collision hall, has characteristics which experimenters believe can compensate for LHC-B’s energy advantage. BTeV uses a high-quality photon detector based on research and development at Fermilab for LHC’s Compact Muon Solenoid Detector-technology, which did not exist when LHC-B was designed and approved. BTeV also uses a pixel detector just six millimeters from the beam, with unprecedented computing power in its triggering. The decay vertices seen with this pixel detector will be applied to the first-level trigger—something no other experiment has accomplished.

Fermilab theorist and PAC member Andreas Kronfeld said BTeV would break new ground in the design of its trigger. He also noted the impressive BTeV presentation.

“We grappled with BTeV for most of my term on the PAC,” said Kronfeld, whose term ended after four years. “We held the bar very high. They just kept jumping over it, even if we moved the bar while they were still in the air.”

The PAC and Witherell both emphasized that the Tevatron’s first Run II priority is the search for the Higgs boson and other new physics at the highest energies. LHC will succeed the Tevatron at the energy frontier later in this decade, but BTeV can establish the Tevatron as a premier B factory.

“The collaboration is pretty pumped up,” Butler said. “BTeV has what it takes to do this kind of physics.” □

WEAVING the QuarkNet

by Kurt Riesselmann

At first nobody noticed it. It slowly grew, ensnaring physicists at a few U.S. universities. Then, it began to spread beyond the university world. Soon, it may capture teenagers in a high school near you.

QuarkNet is a network of dedicated particle physicists and high school teachers, providing high school students with first-hand experience in science, involving them in aspects of R&D and providing opportunities to interact with real-life scientists. QuarkNet aims at teaching junior and senior high school students introductory physics concepts and experimental methods by doing “the real thing.”

To start this network, Keith Baker of Hampton University, Marge Bardeen of Fermilab, Michael Barnett of Lawrence Berkeley National Laboratory and Randy Ruchti of University of Notre Dame recruited particle physicists from around the country to serve as coaches and mentors for local high school teachers. By 1999, they had established the basis for twelve QuarkNet centers. They hired four educators to coordinate the activities, to monitor and nurture the QuarkNet program, and to visit the QuarkNet teachers at their high schools, even sitting in on classroom sessions.

24 high school teachers from around the country are the latest additions to QuarkNet. Eventually, QuarkNet will embrace 720 teachers and educate approximately 100,000 high school students annually.

Presently, QuarkNet consists of 24 centers across the United States. 36 more centers will be established in the coming years. To join, universities must have a high-energy physics group participating in a hadron collider experiment.

Back to class

Before reaching out to students, high school teachers must learn "the real thing" themselves. In the summer of 1999, the first 24 teachers from across the U.S., two linked to each new QuarkNet center, received their initial training. They spent one week at Fermilab, learning about particle physics, getting tied into the QuarkNet. Next, they participated in seven weeks of research with their local QuarkNet physicists and mentors, building and testing detector components or developing software modules. They received financial support from QuarkNet funding provided by the U.S. National Science Foundation, the U.S. Department of Energy and participating universities and physics laboratories.

"QuarkNet is a very challenging physics program," said Texas teacher Darren Carollo, comparing it to other educational training programs. Carollo works with inner city minority students in Dallas and had just completed a week at Fermilab. "The math is the easy part for me. But the concepts and working with objects that I cannot touch, such as particles, are difficult for me. The talks by Fermilab's theorists have helped a lot in creating a visual picture."

Carollo has experience in software programming and Internet applications. For QuarkNet he will develop software to display data of particle collisions on computer monitors. As they learn new skills, Carollo and his colleagues bring their knowledge to the general physics courses they teach. Each teacher's research project is the stepping stone to provide selected students the pathway to real-life research experience.

Physics Ponzi scheme

2000 is the year when QuarkNet is set to snowball:

- Fourteen new universities, all with research groups in hadron collider physics, joined up as sites of future QuarkNet centers.
- The 1999 crop of teachers and scientists have selected associate teachers who are being trained.
- The 1990 round of teachers started working with their first QuarkNet students, as well as teaching regular high school physics classes, explaining introductory physics concepts using examples from cutting-edge physics research.

When complete, a QuarkNet center consists of two lead teachers, 10 associate teachers and at least two particle physicists, who act as mentors and provide access to research projects. The first two QuarkNet teachers of each center, after finishing their eight-week research assignment, recruit associate teachers, who receive a three-week training session the following summer at the local university. By 2005, this physics education "pyramid scheme" will result in 60 QuarkNet centers with a total of 720 teachers, reaching out to 100,000 students annually. Each year, about 5000 students will have the opportunity to be involved in a particle physics research project.

Photos by Jenny Mullins

Shannon Thorne-Brackett Vergara from Virginia joined QuarkNet this year.

WEAVING the QuarkNet

First Prize: One week at Fermilab

The two lead teachers of each new QuarkNet center receive their first week of training at Fermilab. This year's group of new lead teachers attended sessions from June 25 to July 1.

"Participating in the QuarkNet training session here at Fermilab, I feel like a kid in a toy shop," remarked Ken Taylor from Lake Collins High school in Dallas. Taylor has a Ph.D. in physics, not a pre-requisite for the program. He worked on federal research programs before he decided to become a high school teacher.


Photos by Fred Ullrich

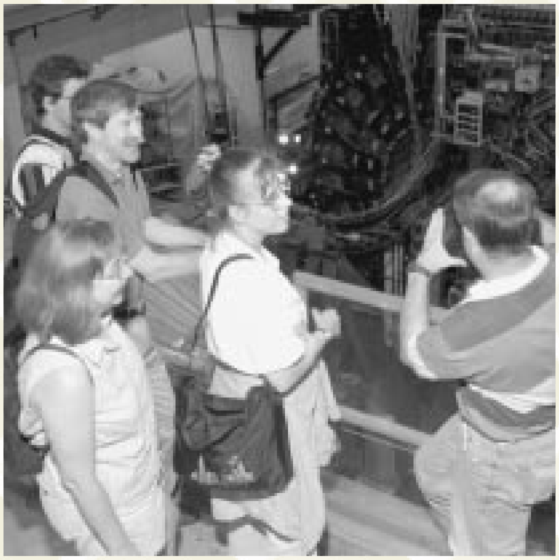
QuarkNet Staff member and high school teacher Patrick Mooney tells his QuarkNet students from South Bend about Fermilab's mission as they visit the laboratory for the first time.

"They really get us excited about particle physics," commented Shannon Thorne-Brackett Vergara, who learned about QuarkNet from Ken Cecire of Hampton University. She had her first particle physics contacts through the RECET program at the University of Virginia, sponsored by the National Science Foundation. But she found it was difficult to convert research experience to classroom teaching.

"With the QuarkNet program they allow us to gain basic knowledge about particle physics, provide research experience. Then we are working with the mentors at our local QuarkNet university to actually transfer the information from research projects into the classroom," explains Vergara. "The QuarkNet program has helped me to see my part in the whole research program, and it provides continuous support."

QuarkNet staff members Ken Cecire of Hampton University, Andria Erzberger of Lawrence Berkeley National Laboratory, Tom Jordan of Fermilab and Pat Mooney of Notre Dame organized the weeklong training session. In addition to intensive lessons, which included in-class data-reduction sessions, the teachers visited the detector and accelerator facilities. Lectures by well-known research physicists completed the program.

"The second day of training, I saw the teachers change from teachers to apprentice scientists. The transformation was amazing," Jordan said. "We gave them these data, and they had these meetings to discuss what they had to do with the data. They were arguing with each other, challenging each other and—thinking together."



CDF scientist Rob Roser (right) points out the characteristics of the CDF detector to high school teachers (from right to left) Jennifer Blaszak, Elizabeth Ramseyer, Rich DeCoster and Jim Vetrone. DeCoster joined QuarkNet in summer of 1999 and now helps Roser spread the QuarkNet gospel by recruiting and training additional teachers.

"I saw the teachers **CHANGE** from teachers to APPRENTICE SCIENTISTS. The transformation ***was amazing***."

–Tom Jordan

Data from particle detectors

Data used by QuarkNet teachers is based on real physics events recorded by the CDF and DZero detectors at Fermilab. Beginning in 2005, data from the ATLAS and CMS detectors at the Large Hadron Collider, now under construction at CERN, Switzerland, will also be available for classroom work. Students will be able to work along side scientists on the verge of discovering new particles and interactions.

"When students need to do a physics problem, they want to relate it to the real world," said Taylor, who is optimistic that he can use his QuarkNet experience in the classroom. "For example, when the curriculum requires the students to calculate a magnetic field, I can now relate this problem to the magnets of the Tevatron accelerator. QuarkNet also gives me useful examples for my computer lab classes."

Concepts like conservation of momentum and energy are an essential part of physics education. QuarkNet gives students the opportunity to learn these concepts while analyzing data taken by physics experiments at the frontier of science—experiments that teachers helped build.

The QuarkNet program can also help schools in the perennial search for more funding. Taylor's school district, impressed by the QuarkNet program, has already committed several thousand dollars to buying new physics equipment.

Student involvement at its best

Joe Martin and Amy DeCelles are QuarkNet students of Patrick Mooney at Trinity High School in South Bend, Indiana. His group of students, most of them seniors at various high schools in and around South Bend, recently visited Fermilab to learn more about the laboratory and to see the 40-foot-high DZero detector.

"This summer, every morning at 7:30 a.m., five days a week, students of our QuarkNet group are on shift at a science lab near Notre Dame to prepare optical fibers for use in waveguides as part of Fermilab's DZero detector," Martin said. "In the afternoon we have lectures on related physics aspects and how DZero will use the fibers we assembled. In addition to earning some money, we learn a lot."

"We get spools with 2,500 meters of fibers, and we check, bundle and shield them. Then we send the fibers to Fermilab, where they put connectors on the endings and install the fibers in the detector," DeCelles said. "It is our responsibility to identify fibers that do not work and replace them."

Yvonne Twomey, one of Fermilab's dedicated tour guides, explains to QuarkNet students how an accelerator works.

The QuarkNet program seems to be well on its way to achieving its goals, stimulating interest in science among high school students. Will they consider studying physics when they start college next year? DeCelles and her peer students didn't hesitate.

"Absolutely!" they said. They'd been caught in the QuarkNet. □

LETTER TO THE EDITOR

To *FERMINEWS*:

I enjoyed the articles on Fermilab's fixed target program, past and future, but the figure at the bottom of page 7 (*FERMINEWS* June 30, 2000) left me puzzled. It is titled "U.S. Experimental HEP Publications 1990 to 1999", and the percentages given for the 5 "bars" on the left indeed total to 100%. I would have thought that the "U.S. Experimental HEP" program would also have included HEP experiments at other US labs. Many of us think LSND at LANL had some bearing on high-energy physics. And there are HEP Cosmic Ray experiments, Fly's-Eye, Whipple, and Amanda, along with U.S. HEP Experimental programs elsewhere, including CERN, DESY, KEK, etc. Perhaps it was just the figure title that was misleading.

Cheers,

Gordon VanDalen
UC Riverside
(MiniBooNE)

Dear Gordon,

Indeed the title of the charts on Page 7 is too broad. What we, in fact, counted were experimental papers in refereed journals based upon data taken at the four US HEP labs: BNL, SLAC, Cornell and Fermilab. Non-accelerator results, and work at other non-HEP-funded labs, like LAMPF, were excluded. Early on we did count some of these papers, too. A sample from one journal (PRL) in 1990-3 estimates a contribution at the level of 6% for this class. In a similar period (1990-2) we counted all CERN and DESY papers as 150% and 30%, respectively, of the U.S. totals. We never tried, or even knew how, to break out the US contributions to those works.

The percentage chart summarizes the five categories we counted for the full period, (1990-1999). By itself it is, considering the title, misleading. We sincerely apologize.

Peter Cooper and Kurt Riesselmann

To *FERMINEWS*:

On behalf of the University of California and everyone at Los Alamos Laboratory, I would like to thank the staff of Fermi National Accelerator Laboratory for the support and assistance given us during the Cerro Grande fire. Although this was a devastating experience for us, it showed how communities, individuals and organizations can come together to help each other in a time of crisis. We were overwhelmed by the outpouring of aid and support from throughout New Mexico and across the nation.

Your help at this very difficult time was greatly appreciated, and will be remembered as we begin the process of recovery and renewal.

Sincerely,

John C. Browne
Director
Los Alamos National Laboratory

1999-2000 PH.D. RECIPIENTS

These students have been awarded their doctorates during the last 12 months, after submitting their theses from work on Fermilab experiments.

- **E-706: Direct Photon Production**
  Michael Begel, University of Rochester

- **E-769: Pion and Kaon Charm Production**
  W. David Dagenhart, Tufts University

- **E-781: Study of Charm Baryon Physics**
  Fernanda Garcia, University of Sao Paulo
  Henning Krüger, Max-Planck Institute
  Kenneth Nelson, University of Iowa
  Pavel Pogodin, University of Iowa
  Jürgen Simon, Max-Planck Institute

- **E-791: Hadroproduction Heavy Flavors**
  Shiral Devmal, University of Cincinnati
  George Fox, University of South Carolina
  Carla Gobel, Centro Brasileiro de Pesquisas Fisicas
  Scott Radeztsky, University of Wisconsin, Madison
  Ruth Weiss-Babai, Tel Aviv University

- **E-799/E-832 (KTeV): CP Violation**
  Ashkan Alavi-Harati, University of Wisconsin, Madison
  Stephen Bright, University of Chicago
  Gregory Graham, University of Chicago
  Kazunori Hanagaki, Osaka University
  Peter Mikelsons, University of Colorado
  G. Breese Quinn, University of Chicago
  Masayoshi Sadamoto, Osaka University
  Katsumi Senyo, Osaka University
  Peter Shawhan, University of Chicago
  Eric Zimmerman, University of Chicago

Photo by Jenny Mullins

Peter Shawhan won the 2000 URA Thesis Award.

- **E-815: Precision Neutrino/Antineutrino Deep Inelastic Scattering Experiment**
  Arturas Vaitaitis, Columbia University

- **E-831 (FOCUS): Heavy Quark Photoproduction**
  Eric Vaandering, University of Colorado

- **E-866: Distribution of $\bar{u}$ and $\bar{d}$ in nucleons**
  William Lee, Georgia State University

- **E-872 (DONUT): Tau Neutrino Experiment**
  Reinhard Schwienhorst, University of Minnesota

- **E-876: Hard Diffraction Studies in CDF**
  Koji Terashi, University of Tsukuba

- **CDF: Collider Detector at Fermilab**
  Nichelle Bruner, University of New Mexico
  Josh Cassada, University of Rochester
  Paul Chang, National Tsing Hua University
  James Done, Texas A&M University
  Eugene Guillian, University of Michigan
  Joao Guimaraes da Costa, University of Michigan
  Adam Hardman, Purdue University
  Todd Keaffaber, Purdue University
  Toshiaki Kikuchi, University of Tsukuba
  Armin Kongeter, University of Karlsruhe
  Kostas Kordas, McGill University
  Jinbo Liu, University of Rochester
  Christina Mesropian, Rockefeller University
  Stephen Pappas, Yale University
  Andrew Scott, University of California, Los Angeles
  Koji Terashi, University of Tsukuba
  Rocio Vilar, University of Cantabria
  John Wahl, University of Chicago
  Brendan Bevensee, University of Pennsylvania
  Christopher Holck, University of Pennsylvania
  Joseph Steele, University of Wisconsin, Madison

- **DZero: Study of Events in 1.8 TeV Collisions**
  Levan Babukhadia, University of Arizona
  Linda Coney, Notre Dame University
  Kevin Davis, University of Arizona
  Gervasio Gomez, University of Maryland
  J. McDonald, Florida State University
  Evgeny Popkov, Notre Dame University
  Harpreet Singh, University of California, Riverside
  Georg Steinbrueck, University of Oklahoma

CALENDAR

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

INTERNATIONAL FILM SOCIETY Presents

The Iron Giant, Dir: Brad Bird, USA 1999, 86 min. Aug. 11, 8:00 pm, Ramsey Auditorium, Wilson Hall, tickets $4. Based upon the 1968 story, "*Iron Man*," by the British poet laureate Ted Hughes. This highly entertaining animated film is about a giant metal machine that drops from the sky and frightens a small town in Maine in 1958.

ARTS SERIES Presents: Arlo Guthrie

July 29, 8 pm, SOLD OUT, Ramsey Auditorium, Wilson Hall. Arlo gave his first performance at age 13 and quickly became involved in the music that was shaping the country during the 1960's. Arlo's career soared in 1967 with the release of Alice's Restaurant, a song that helped foster a new commitment among his generation to social activism and consciousness.

Odetta

Saturday, August 19, 8 pm, tickets $16, Ramsey Auditorium, Wilson Hall. The Queen of American Folk Music recently celebrated her 50th Anniversary in show business.

ONGOING

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

■ NALWO coffee for newcomers & visitors every Thursday at the Users' Center, 10:30-12, children welcome. In the auditorium, International folk dancing, Thursday, 7:30-10 pm, call Mady, 630-584-0825.

■ The Recreation Office will again be providing children's swim lessons for employees, users and on-site contractor children ages 5-12. For information pick up a brochure at the Recreation Office, Users Office, Housing Office, or Children's Center. You may also get info from our website: http://fnalpubs.fnal.gov/benedept/recreation/pool.html Jeanmarie Guyer Recreation Office M.S. 126 P.O. Box 500 Batavia, IL 60510 Phone 630-840-2548 Fax 630-840-5207

LAB NOTE

1999 URA ANNUAL REPORT

In the next few weeks, each URA/Fermilab employee will receive a copy of the 1999 Annual Report of Universities Research Association, Inc., the consortium of 89 universities that operates Fermilab for the U.S. Department of Energy.

URA produces this well-illustrated, 36-page Annual Report to promote public understanding of URA's mission, organization, and governance. Descriptions of current activities at Fermilab are featured prominently.

The URA Corporate Office especially wishes Laboratory employees to have the benefit of the information in this publication. URA welcomes comments and suggestions on the Report, which can be transmitted to info@ura.nw.dc.us.

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

Dinner served at 7 p.m.
$20/person

Chez Léon MENU

For reservations, call x4512
Cakes for Special Occasions
Dietary Restrictions
Contact Tita, x3524
http://www.fnal.gov/faw/events/menus.html

LUNCH
Wednesday, July 26

Wild Rice and Chicken Salad with Tarragon

Raspberry Sorbet with Berries

DINNER
Thursday, July 27

Risotto Cakes with Shrimp and Mustard Sauce

Veal Scallopini with Morel Sauce

Hazelnut Pear Soufflé

F E R M I N E W S

F E R M I L A B
A U.S. Department of Energy Laboratory

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The deadline for the Friday, August 4, 2000, issue is Tuesday, July 25, 2000. Please send classified advertisements and story ideas by mail to the Public Affairs Office MS 206, Fermilab, P.O. Box 500, Batavia, IL 60510, or by e-mail to ferminews@fnal.gov. Letters from readers are welcome. Please include your name and daytime phone number.

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

CLASSIFIEDS

FOR SALE

■ '99 Harley Davidson Sportster Custom XL883C (Black) 3,000 miles. Asking $7,500. Contact Terry (x4572, skweres@fnal.gov) or Janine (none2compare@yahoo.com).

■ '99 Goldwing SE (Silver) with extras, 11,500 miles, $13,800. Call Terry x4572 or skweres@fnal.gov.

■ '96 Honda Accord EX, automatic, 4 door, moonroof, CD, AC, loaded, 46K miles, well maintained. $15,700 obo.

■ '92 Honda Accord EX, automatic, 4 door, moonroof, loaded. Some rust, some work needed, but runs well. 172K miles. $3,000 obo. For both: Martha at x3511 or martha@fnal.gov.

■ '90 Honda Civic LX, 4 door, 135K miles, manual 5 speed, power windows/locks, Aquatred tires, AM/FM cassette. $2,200. Call x2248 or mieland@fnal.gov.

■ '90 Plymouth Acclaim 4-dr, 137K, asking $1,175 obo. Jim x4889 or catalan@fnal.gov.

■ '90 Ford Taurus GL wagon (blue) - 82K miles, original owner, automatic, loaded with options: A/C, power door locks, windows, drivers seat, aluminum wheels, 3rd seat, rear window defroster/wiper, cruise control, luggage rack, AM/FM stereo tape, premium sound. Good condition. $3,200 obo. call Simon x2329 or swalk@fnal.gov.

■ '90 Mazda 626 DX sedan : one owner, new tires, excellent condition, 120 k miles air conditioning, AM/FM Cassette, power steering, power brakes $3600 obo. Usha x6016 or 630-961-3292.

■ '89 Olds Regency, 89k miles, new brakes and tires, loaded, runs great, no rust, some cosmetic bodywork needed. $3,000 obo. Dan, x3916, 708-488-9884 (evenings), kaplan@fnal.gov.

■ '88 Honda Accord DX; 5 Speed Manual Transmission Cruise control, Dark red, 138k miles, very little rust, everything works, runs great. $2000. Joanne 630-964-6998 or Merle x3958.

■ '86 Honda Accord DX; 5 Speed Manual Transmission Dark red, 128 k miles, very little rust, everything works, runs great. $2,000. Joanne 630-964-6998 or Merle x3958.

■ '84 Ford F-150 pick-up, 4WD, 4 speed manual, 6 cyl., 8 foot bed, Good Condition 130K miles. $1,650 obo Call 630-406-8020 or squires@il.freei.net.

■ '77 Honda Goldwing 1000, excellent condition with Vetter fairing and packs, 66K miles. Lots of extras. Asking $1,200 or best offer. Contact Gary at 896-6196 evenings.

FOR SALE

■ 2.3 wooded acres with custom built home. For details and photos go to www.chicagofsbo .net and select ad#6274. Or call 877-536-3726. Refer to above ad# and info will be faxed or mailed to you.

■ Men's 23″ 10 speed bicycle. Old, but in good condition. $40 contact Joe at 393-7722 or steele@fnal.gov.

■ Guitar effect pedal, compression, Marshall ETC-1new. $50, Curtis x2394 or crawford@fnal.gov.

■ Nordic Track Machine $125 or offer, King size waterbed frame $30, Futon Frame (wood) $35. Terry x4572 or skweres@fnal.gov.

■ Storm windows 36″x54″, $30 for 14 windows, storm door 36″x84″ $5, bed frames $3 each, roofing shingles 10 bundles $25, bicycles Columbia girls, $20, Fugi men's $120. Jim x4889 or catalan@fnal.gov.

■ KODAK Carousel Slide trays;140 slide $5 each, 80 slide $3 each. CB radio, new never used, $15. 7″ Reel-to-Reel tapes $3 each. 48″ dia wood (dark pine) table $20, REALISTIC PA 40watt $20. Call Ed Dijak x6300 or dijak@fnal.gov.

FOR RENT

■ Independent floor living, sharable one-car garage, use of kitchen and laundry, in calm residential Naperville. $395./month. Call 840-2574.

■ Spacious 4-bedroom townhouse to share. Close to Fermilab and Illinois Prairie Path, at Butterfield and Eola. Clean and furnished. Excellent for short-stay visiting scholar. No lease required. $400/month + low utility cost sharing. Call Calvin 499 -1955 or cmshih@lucent.com.

■ Sublet now to August 31st: unfurnished 1 BR apartment in Naperville. 1st floor (garden), CAC, DW, W/D, 5-10 minutes from Fermilab. $800 for the full period. Gustaaf x4269 or gusbroo@fnal.gov.

WANTED

■ Room to rent in home, private home or otherwise. August 4th to August 18th. Approximately 2 weeks total. Rent is negotiable. Contact Mathieu at mooky34@hotmail.com or x3003.

■ Room to rent in Batavia or Aurora. Contact doina@fnal.gov.

TUTORING

■ Adult bilingual woman science tutor/teacher is looking for work. Contact Teodora: doina@fnal.gov.

BIBLE STUDY

■ The 12 o'clock (noon) Bible Study in the Huddle meets every Wednesday. All are welcome. Contact Jeff Ruffin, x4432, or ruffin@fnal.gov.

MILESTONES

ELECTED

■ JINR Director and former Fermilab experimenter Vladimir Kadyshevsky, as Academician of the Russian Academy of Science, the highest rank in Russian scientific community. Such physicists as Cherenkov, Landau, Saharov were Academicians. Kadyshevsky visited Fermilab in April, meeting with our director Michael Witherell and with DZero and CDF management. JINR collaborates on many of the Fermilab experiments.

HONORED

Former employee Jack Webber, who retired to Pentwater, Michigan, for his many contributions to civic life in that community.

RETIRING

■ James Engelbrecht, ID 1283, PPD-Technical Centers, last day of work July 21.

■ Robert Haring, ID 430, PPD-Engineering & Tech Teams, last day of work July 21.

■ Donald Hendricks, ID 4555, DC-Distribution Computing, last day of work August 31.

■ Don Carpenter, ID 456, PPD-Technical Centers, last day of work July 28.

DIED

■ Anne Zimmerman, ID 4414, TD, on July 7.

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

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