FERMI NEWS

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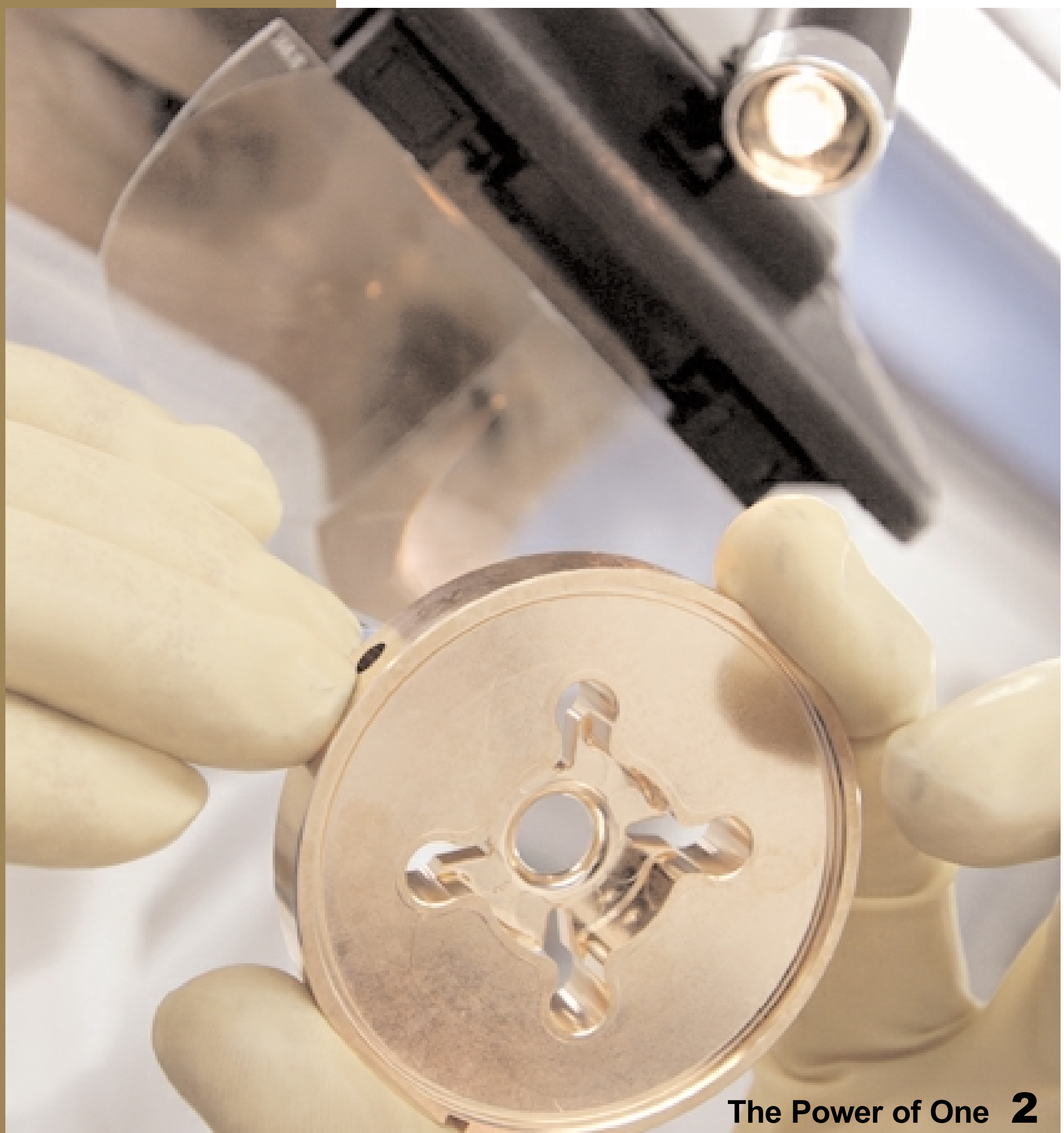

Photo by Reidar Hahn

The Power of One 2

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INSIDE:

The Power of One

Countries, particles, forces, fields: the Linear Collider aims to bring them all together

COVER PHOTO: Project Engineer Harry Carter holds one of the machined slotted disks to be used in the construction of FXC-005 for the NLC RF structures. The disks are made from OFHC copper. In the FXC series of structures, it takes 52 of these disks, each with slightly different internal dimensions, to build each structure. Enough of these disks were ordered to build five FXC structures, or a total of 260 disks, plus approximately 50 spares. The disks are machined by Lavezzi Precision, Inc. located in Glendale Heights, Illinois.

ON THE WEB:

ICFA
www.fnal.gov/directorate/icfa/icfa_home.html

American Linear Collider Physics Group
http://blueox.uoregon.edu/~jimbrau/LC/ALCPG

Next Linear Collider
www-project.slac.stanford.edu/nlc/home.html

GLC Project
www-jlc.kek.jp

TESLA Project
http://tesla.desy.de

by Mike Perricone

Plans and hopes for a Linear Collider chart a straight course toward unification.

Globally, the Linear Collider has united scientific communities in the Americas, Europe and Asia in the vision of an underground high-energy facility some 25-30 miles in length, functioning from the outset as a truly cooperative world laboratory. Its mission: exploring the world of the fundamental particles and forces with unprecedented precision by colliding electrons and positrons at an unmatched energy of one trillion electron volts (1 TeV).

Scientifically, the Linear Collider could bring physicists stealing to the borders of the realm of unification—and the Planck Scale, where relative distances are so small, and energies so high, that only quantum gravity could explain behavior there. At the Planck Scale, physicists hope for their first contact with high-energy conditions harking back to the unification of the forces, their first steps on a trail leading back to the common origins of the fundamentally dichotomous quarks and leptons. The Linear Collider will also provide the first experimental understanding of the nature of dark matter, building a unity of cosmology and particle physics.

Photo by Reidar Hahn

Marcela Carena

"This glimpse of Planck-scale physics is very crucial," said Fermilab theorist Marcela Carena. "Measuring 1-TeV physics with such high precision, we can see the evolving patterns of masses and couplings, and extrapolate them to the high-energy scale, the unification scale.

"For example, in measuring the masses of the superpartners of quarks and leptons," Carena continued, "we can project them back to very high energies and see if they come to a place where they unify. We don't know how they originated, but we suspect it is some kind of Planckian physics. With the linear collider, we will be able to test this Planck scale physics from the lower energy spectrum "

In addition, the LC could bring cosmic evidence of dark matter into the realm of direct experimental investigation. Collider physics allows us to produce dark matter in the laboratory and study it under controlled circumstances.

"A linear collider is our best opportunity," Carena said.

A scientific certainty is the impact of the LC on results from the Large Hadron Collider, being constructed at CERN in Europe.

"With its precision, the linear collider will enrich the quality of the LHC results in a crucial way," Carena said. "It will greatly enhance the physics revenue of our investment in the LHC."

"Frontier Outpost at the Edge of a New World"

In its recently issued "Strategic Plan/20-Year Vision for the Future of Basic Research," the Office of Science of the U.S. Department of Energy has placed the Linear Collider at the top of its Mid-Term Priorities:

> *"High-energy physics has always been a frontier discipline in science, driving technological innovation (the World Wide Web was created to share data from accelerator experiments, for example) and pushing the limits of what we know in the disparate but interconnected worlds of cosmology and elementary particles. The Linear Collider could be considered the high-tech equivalent of a frontier outpost at the edge of a new world."*

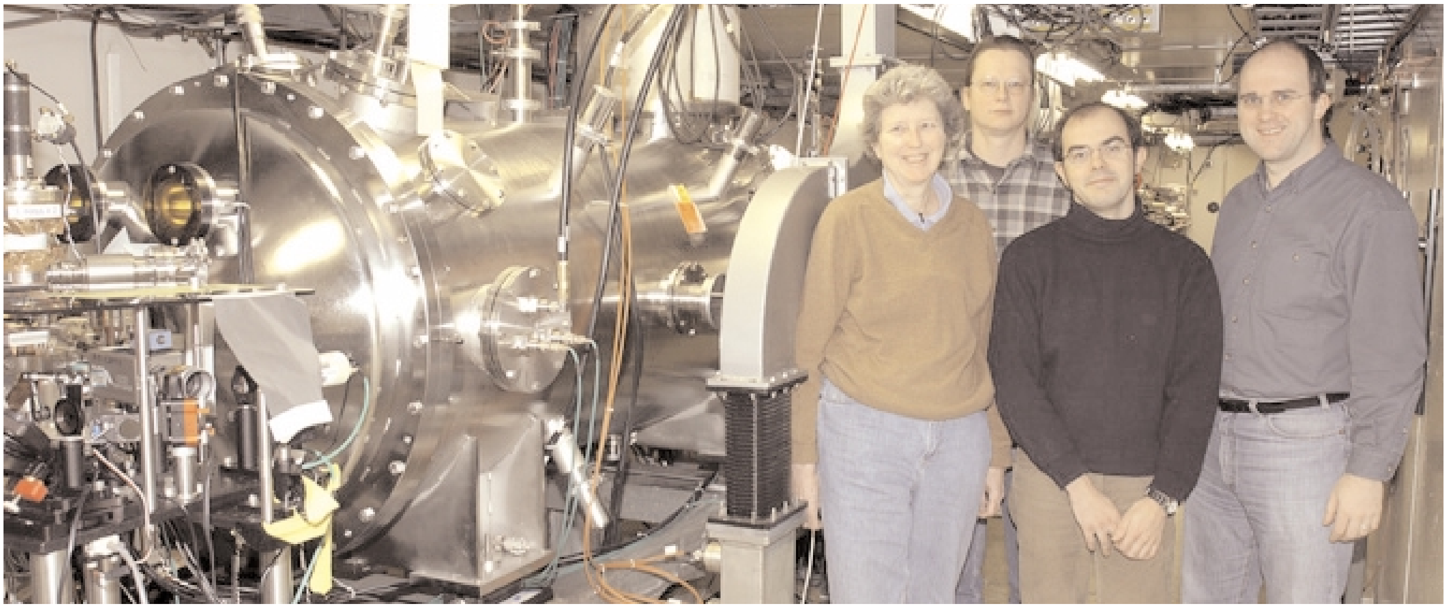


Photo by Reidar Hahn

In Fermilab's Photoinjector Lab at AZero, Helen Edwards (left), DESY postdoc Kai Desler, and Peoples Fellows Philippe Piot and Markus Huening work on the design of a superconducting RF cavity for TESLA. The photoinjector is a sister to the one at DESY and includes a TESLA cavity that has operated more than five years. Edwards' group hopes to install a second TESLA cavity in the coming year, to operate at a higher gradient than the present one.

It might have added: "…with the involvement of the entire world."

The International Committee on Future Accelerators (ICFA), founded in 1976, has formed a 12-member International Technology Recommendation Panel (ITRP) to report by the end of 2004 on the path of choice for Linear Collider technology: a "warm" or "cold" design, with the accelerating devices in the main linacs operating at normal temperatures or at superconducting temperatures, respectively.

The ITRP comprises representatives from the three major scientific regions: four each from America, Europe and Japan. The American members are Paul Grannis, of the State University of New York at Stony Brook and Fermilab's DZero collaboration; former Fermilab physicist Norbert Holtkamp, now head of the Accelerator Division of the $1.4 billion Spallation Neutron Source at Oak Ridge National Laboratory; Jonathan Bagger of Johns Hopkins University; and the chair, Barry Barish of the California Institute of Technology.

Leading the development of cold technology has been DESY, the *Deutsches Elektronen-Synchrotron* of Hamburg, Germany with its TESLA (Tera electron-volt Energy Superconducting Linear Accelerator) design. Leading the warm (or X-band) technology design have been Stanford Linear Accelerator Center, and the KEK laboratory in Japan, with the Next Linear Collider design. Fermilab is in a unique position, participating in both warm and cold efforts, though the majority of the work is focusing on warm technology in collaboration with SLAC and KEK.

"There's a pretty fair amount of work going on, trying to understand how this might work internationally," said Steve Holmes, Fermilab Associate Director for Accelerator Research and a member (along with Fermilab Director Michael Witherell) of the U.S. Linear Collider Steering Group, chaired by SLAC Director Jonathan Dorfan.

Holmes said certain areas of the LC, such as beam delivery and final focus, or interaction region, "mostly don't care if the machine is warm or cold." While the cold machine would apparently be about 30% longer than the warm machine, issues of selecting a site for the machine are not significantly different for the two technologies.

"Looming over all this is the technology decision," Holmes said. "In the interim, the world is pursuing warm and cold technologies in parallel, but with the expectation that the two efforts will be consolidated into a single effort about the end of the year."

ICFA hopes to establish an international design center by the time the recommendation is issued.

"Real work is going on here"

Shekhar Mishra also has a goal: to have Fermilab present accelerator physics research papers at the Linear Collider conference in Victoria, Canada in July 2004. Mishra, who led the commissioning of the new Main Injector in 1999, is now the coordinator of Fermilab's Linear Collider efforts.

"Real work is going on here, and a lot of it," he said. "We are concentrating on two major components of the Linear Collider: the linac and the damping ring. The range of topics in accelerator physics is very vast in those areas."

Photo by Reidar Hahn

Tug Arkan (left) and Harry Carter inspect an RF structure before sending it on to SLAC for testing.

The Power of One

Presenting Linear Collider-related research papers would be yet another example of the wide-ranging efforts around the laboratory, centered at the Industrial Complex of the Technical Division.

For the warm machine, Fermilab has a radiofrequency structure factory in Industrial Building 4. The lab has produced several versions of prototype high-gradient RF structures for NLC, and has delivered to SLAC the first RF structure fully meeting the NLC requirements for gradient and breakdown rate. In addition, 75% of the RF structures currently in the "8-pack" at SLAC's Next Linear Collider Test Accelerator have been fabricated at Fermilab. SLAC recently completed a highly successful test of the RF power systems (see *FERMINEWS, February 2004*, "NLC Collaboration Reaches Critical High-Power X-band Goal"). Fermilab is also moving ahead in structural support design, and on adjustable quadrupole magnets to steer the beam.

As a TESLA collaborator on the cold technology, Fermilab's Accelerator Division has built the modulators used in the Tesla Test Facility (TTF). The Technical and Accelerator Divisions are collaborating on the design of a superconducting harmonic cavity, an effort led for several years by Helen Edwards. In addition, the Fermilab NICADD Photoinjector Lab (FNPL), operated by Fermilab and Northern Illinois University, is furthering research with superconducting TESLA cavities. Fermilab built two RF guns, the sources of the electron beams; one was used at TTF for several years, Edwards said, and is now being replaced with a new DESY design. Peoples Fellows Philippe Piot and Markus Huening, and DESY postdoc Kai Desler are working at FNPL.

Fermilab is also working with nearby Argonne National Laboratory in key areas, drawing on Argonne physicists' experience with the Advanced Photon Source, the nation's premier x-ray synchrotron radiation facility.

"The accelerator physicists at APS are the world's leading experts in electron storage rings," said Argonne's Kwang-Je Kim. "We can contribute to the damping ring design. The APS accelerator physicists are very experienced in designing radiation devices, called undulators and wigglers. We are developing super-conducting wigglers that could be important for damping the electron or positron beams because of their powerful radiation properties."

Photo courtesy Argonne

Kwang-Je Kim

Physicists at the Argonne Tandem-Linear Accelerating System are working with Helen Edwards to construct a chemical processing lab at Argonne for the superconducting RF cavities. Physicists at the Argonne Wakefield Accelerator are developing a facility to test the performance of the high-gradient RF structures built at Fermilab.

"Argonne's future is closely tied with Fermilab's since we are within a half-hour's driving distance," Kim said. "We would like to work together to strengthen the prospects of hosting a Linear Collider at Fermilab."

"Delicious Accelerator Challenges"

George Gollin is on sabbatical from the University of Illinois at Urbana-Champaign to work on LC damping ring issues at Fermilab. He has also been one of the organizers of a university-based R&D program with funding from DOE, aimed at encouraging university involvement with the accelerator aspects of the LC.

"There wasn't much of a move at previously uninvolved universities to become engaged with the LC effort," said Gollin, who now spends several days each week at the lab. "We looked into it and we found absolutely delicious accelerator challenges out there, very good projects that were very well-suited for university groups. We can do smaller-scale things, like modeling, or working on instrumentation."

The damping ring is critical to LC operation, Gollin explained, because the bunches of positrons and electrons moving down the beam line are "hot," not behaving uniformly.

"They're little fiery clouds of stuff that you can't really focus well," Gollin said. "Damping rings reduce the 'temperature,' if you want to call it that, of the electrons or positrons. It forces them to travel more like a laser beam, in parallel, so you can focus the beam down very tightly."

The damping ring for TESLA loomed as a very long component—some 17 kilometers (10.2 miles) in length. Gollin thought he could shorten the length for the LC, but he couldn't clear the hurdle ("show-stopper," in physics-speak) of having the particles at both the front and back of a bunch experience the same magnetic "kick" to align them.

"One of my undergraduates actually solved one of the show-stoppers," Gollin said. "What this student did was solve the mathematical problem of how to select the parameters of the devices inside the kicker, so the experience of a particle at the front of the bunch was the same as the experience of a particle at the back of the bunch. It involved some mathematics that he was just better at than I was. It was delightful to have him solve it."

Gollin especially appreciated the chance for undergraduates to contribute to frontier science with basic physics knowledge.

"They haven't had quantum mechanics yet, but they've had classical physics, the physics of motion, and classical electrodynamics, the physics of electrical and magnetic fields," Gollin said. "Many of the accelerator challenges involve classical physics. So they have the opportunity to do great things in our lab using the classical physics that we've taught them."

"We want to take the leadership in science for the United States"

Mishra, for one, hopes to prompt similar surges of enthusiasm among colleagues for joining the Linear Collider efforts and positioning the lab as the machine's host, when the time comes to choose a site.

"We'd really like to get Fermilab physicists and users to be highly involved," he said. "This machine has been recommended as the No. 1 midrange priority for the DOE Office of Science. It's a highly supported project. We should do everything we can to make this machine a reality at Fermilab."

Bringing the machine to Fermilab—even continuing the current production, and research and development effort—means bringing scientists to Fermilab from around the globe, furthering the heritage of particle physics as a truly international field. Mishra has been actively working with scientists from India, among other countries, to expand the collaboration.

But the enormous visa backlog for foreign scientists and students entering the U.S. looms as a challenge for U.S. (and Fermilab) hopes to host the LC. The international science community views the backlog as effectively limiting international participation and access. For example, if they weren't already here, Mishra (coordinator of the labwide effort and a native of India and Carena (co-author of the Linear Collider segment of the lab's forthcoming long-range planning report, and a native of Argentina) might face enormous and frustrating challenges traveling to and from the lab. Mishra cites the case of Kirti Ranjan, a postdoc from the University of Delhi in India, who has half of his time allocated to working on linear collider efforts. It took six months to get him to Fermilab. Many other scientists have stories of students or colleagues who have been frustrated by similar delays.

"I really hope the U.S. government can solve the visa problem," Mishra continued. "One of the discussions about hosting the LC in the U.S. is how the U.S. will allow scientists from other countries—and their families—to come and go freely, so they can work here. We want to take the leadership in science for the U.S., and for that our State Department and Department of Energy must work on a solution to the visa issue."

John Marburger, Director of the Office of Science and Technology Policy and science adviser to the President, has often expressed his agreement. He recently told the Council of Presidents of Universities Research Association, Fermilab's operating contractor: "The visa situation is very damaging. There is a deep desire to improve the process and to speed it up."

The political issue adds another level of uncertainty to the questions of how, when, where—and whether—the Linear Collider will be built. To scientists, however, uncertainty is familiar ground.

"Science is about exploration," Carena said. "If we knew where we were going ahead of time, the journey would not be nearly as exciting as it is."

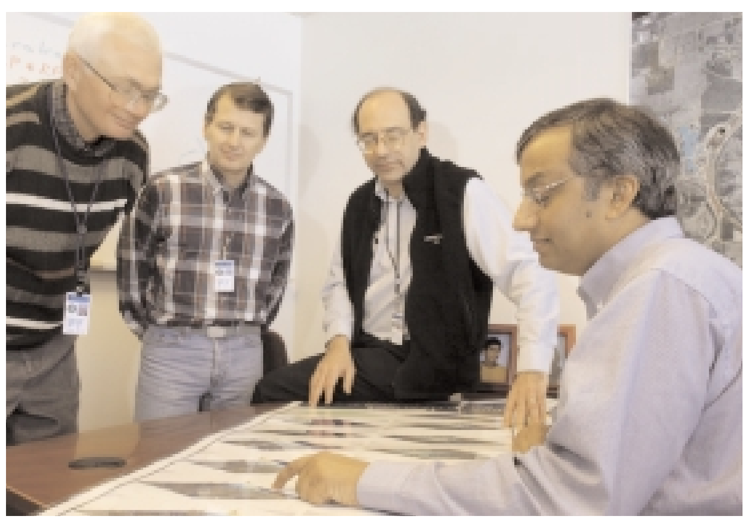


Photo by Reidar Hahn

Fermilab LC coordinator Shekhar Mishra (right) examines descriptions of sound waves propagating through copper used in the SLAC radiofrequency structure with (from left) Iouri Terechkine, Nikolay Solyak and George Gollin.

Good Neighbor Policy

Fermilab Community Task Force will identify common interests and values

ON THE WEB:

City of Aurora:
www.ci.aurora.il.us

City of Batavia:
www.cityofbatavia.net

City of West Chicago:
www.westchicago.org

City of Geneva:
www.geneva.il.us

City of Warrenville:
www.warrenville.il.us

by Katie Yurkewicz

In a major step toward strengthening relationships with its neighbors, Fermilab is forming a Community Task Force on Public Participation with about 25 representatives from DuPage, Kane and DeKalb Counties.

The mission of the Task Force is to develop a set of expectations for how Fermilab and the community should interact on issues that affect them both.

"I'm anxious for the task force to get started," said Fermilab Director Michael Witherell. "We're beginning a process that will continue for as long as the laboratory is here."

"Anything we do in the future will have an impact on our neighbors as well as on ourselves," said Steve Holmes, Fermilab's associate director for accelerators.

With an initial gathering in late March, the Task Force will meet over the next six to eight months to form its recommendations.

The Task Force grows from a simple principle: The best way to find out how the public wants to be involved is to ask. The task force will provide advice to the laboratory by answering three key questions: How can Fermilab identify the types of issues that need public involvement? For each type of issue, how would Fermilab interact with the public? How should Fermilab keep the community informed about each type of issue?

The final report of the task force's recommendations will guide the laboratory in drawing up a comprehensive public participation plan. Fermilab is mounting the task force effort in cooperation with the Illinois Center for Accelerator Research, Northern Illinois University, and The Perspectives Group, of Alexandria, Virginia. This independent consulting firm, with extensive experience assisting government, business and non-profit groups

Photo by Reidar Hahn

David Bidwell, consultant from The Perspectives Group, outlines plans for the Fermilab Community Task Force to an audience including (from left) Deputy Director Ken Stanfield, Director Michael Witherell and Assistant Director for Program Planning Jeff Appel.

with public participation, will provide facilitation support for the task force.

"The task force will address how Fermilab and its neighbors will interact on any issue—physical, environmental, economic or cultural—where the activities at the laboratory intersect with the surrounding communities," said David Bidwell, a consultant with The Perspectives Group. "They will learn about the spectrum of possibilities at Fermilab and set up priorities for community involvement."

Judy Jackson, head of Fermilab's Office of Public Affairs, said the laboratory is in an ideal time and situation to seek community advice on public participation. The laboratory has a good reputation in the community, and there are no specific proposals currently under consideration. Other laboratories have begun the public participation process only after an important issue arose that demanded community involvement.

"We're not doing this when we're forced to," explained Jackson. "We have the luxury of taking the time to ask the community how they would like to be consulted. We believe that Fermilab will make better decisions with the benefit of the participation of our neighbors."

The U. S. Department of Energy has encouraged Fermilab to begin a formal process of community involvement, while recognizing the laboratory's past successes in community outreach.

"At our laboratories, we want to be good neighbors," said Jane Monhart, area manager at the Department of Energy's Fermi Area Office. "We are not going to be successful in our science mission without public support. Historically, Fermilab has had good relationships with the community, but that doesn't mean we can't do better."

The initiative has had a good reception from neighboring communities.

"I think it's an idea whose time has come," said Batavia Mayor Jeffrey Schielke, who hopes the task force will suggest "creative ways to allow the public to have a better interaction with the laboratory."

For the public participation process to be meaningful and accepted by Fermilab's neighbors, task force members must represent all facets of the diverse community. Northern Illinois University's Center for Governmental Research has been conducting extensive interviews with people in the surrounding communities to identify task force candidates. Members will include elected officials, educators, environmental and business advocates, senior citizens, high school students and Fermilab employees.

"A lot of people have a stake in Fermilab and in Fermilab's future," said Jackson.

In order to stay on the cutting edge of high-energy physics, Fermilab expects to face big decisions in the years to come. Understanding the community's needs for information and involvement will be essential for achieving the kind of future the laboratory and its neighbors would like to see.

The Sensitive Giant

At CERN, ATLAS effort emphasizing people skills

by Matthew Hutson

CERN's Large Hadron Collider, set to begin operations later this decade, will boast four new detectors around its 16-mile ring. Fermilab is heavily involved in the Compact Muon Solenoid, but the LHC is constructing another huge multipurpose detector in competition for discovery of the Higgs particle and several other fundamental targets: ATLAS, A Toroidal LHC ApparatuS.

The quantity and diversity of the expected physics reflects the makeup of the ATLAS team itself: 1,850 physicists, from 150 institutions, in 34 countries. That's like two DZeros and a CDF combined.

How does one not get lost in the crowd? The design sensitivity of the detector in operation is something of a model for the goal of management sensitivity in building the detector. U.S. ATLAS Deputy Project Manager Howard Gordon, of Brookhaven, points to separate teams handling magnets, the silicon detectors, the computers, which are broken into still-smaller groups.

"The individual is actually contributing to something," Gordon said. "He is doing something that he can handle."

Bridging the teams are an Executive Board, Collaboration Board, Technical Coordination Team, and other groups. Spokesperson Peter Jenni of CERN said the collaboration is trying to use more modern management tools than in previous experiments, adding: "Of course we're still trying to preserve the spirit of a particle physics collaboration. We all share, after all, a common motivation: The exciting physics discovery potential of LHC. That is certainly the driving force."

The discovery potential includes supersymmetry. The principle first theorized in 1970, positing a hidden world of "superpartners" for those particles observed so far, has not coughed up any experimental evidence in three decades of focused research. But Gordon said supersymmetry observations "could come out of the LHC in the first few weeks of data."

And that's not all: "It would be easy to see evidence of extra dimensions if they exist," Gordon added.

ATLAS stretches 45 meters long, 25 meters high, and 25 meters wide. (At 7,000 tons, it's actually lighter than CMS's 12,500 tons, but has much more volume.) On the very inside, ATLAS uses pixel detectors. Three layers of about 100 million silicon pixels, most 50 by 300 microns, will wrap around

Eighteen stainless steel feet, each 5.3m tall, will support the ATLAS detector.

In Greek legend, Atlas supports the weight of the heavens and earth on his shoulders.

ON THE WEB:

ATLAS at CERN
http://atlas.web.cern.ch/Atlas/

U.S. ATLAS collaboration
http://www.usatlas.bnl.gov/

Photos courtesy CERN

Preparation of the ATLAS detector hall. The cavern measures 53m long, 30m wide, and 35m tall.

the beam tube to track particle locations. With this resolution, they can tell whether a particle came from the primary collision point or from a second decay only fractions of a millimeter away.

As particles plow through all the other layers of the detector—each layer designed to count the momentum, location, and charge of a different set of particles—the detector must be quick-witted enough to know which events to watch. The colliding proton beams will produce a billion collisions per second inside the detector, and ATLAS's trigger will disregard all of them except the 100 or so it finds most interesting.

ATLAS and CMS share physics goals, but diverge on a number of technologies. The electromagnetic calorimeter near the center of the detector, which tracks electrons, positrons and photons, takes a different form in each experiment. CMS uses an array of lead tungstate crystals, and ATLAS uses layers of lead plates separated by liquid argon and electrodes. ("I'm a liquid argon bigot," Gordon said.) Gordon worked on DZero's liquid argon calorimeter and says liquid argon allows finer segmentation and more stable calibration. But the CMS crystals excel in measuring energy fluctuations. "We have different camps about the best way to measure the physics prophecies that we expect from the LHC," Gordon said.

Perhaps the biggest challenge the ATLAS camp faces comes from its decision to use air-core toroidal magnets. Eight huge race-track-shaped coils of cable-filled pipe surround the detector's calorimeters. These toroids apply a magnetic field to muons escaping this far and help the muon detectors, on the very outside, measure their momenta. Unlike CMS, this feature gives ATLAS a muon measurement independent of the inner trackers. But new technology always poses problems. "The toroids themselves are beyond the state of the art," Gordon said. "They're a very challenging device."

The sheer size of the magnets poses its own problem for the "ship-in-a-bottle" underground installation. Workers must lower fragments down two narrow shafts from the surface and piece the detector together in its cavern.

"All these detector components have been pushed either beyond what was previously known or are new," Jenni pointed out. "For example, the radiation hardness for many of the components and the electronics, or the size of the cryomagnets. And the computing is a whole new world."

At one megabyte per stored event, ATLAS will offer scientists a petabyte of data a year—plenty of data to go around.

"The physics output of the LHC is so rich," Gordon said, "that we need lots of people because there are so many diverse channels to analyze. We will try to use the immense intellectual potential in this large collaboration. That's the main goal."

The group goal also highlights the individual.

"The idea is to empower the individual researcher," said Gordon, "and make sure that any individual who's in the experiment will have the opportunity for discovery."

Twists, turns as MINOS Near Detector goes underground

DANCE OF THE Planes

by Kurt Riesselmann

At the end of February the test stand of the MINOS data acquisition system at Fermilab recorded the first cosmic rays. Niki Saoulidou (left, Fermilab), Simona Murgia (Stanford University) and Geoffrey Pearce (Rutherford Laboratory) are some of the scientists who've worked on setting up the installation.

Less than four years after breaking ground at Fermilab for an underground complex consisting of 4,000 feet of tunnels and two experimental halls, scientists of the Main Injector Neutrino Oscillation Search collaboration are preparing for the first components of a 1,000-ton neutrino detector to go underground. Technicians will lower the first of 282 octagonal-shaped detector planes—each weighing more than a pickup truck—down a 350-foot shaft on the Fermilab site in March.

The new detector will be the second massive detector assembled by the international MINOS collaboration. Last year the collaboration finished the installation of a five-times-larger 'far detector' half a mile underground in a mine in Soudan, Minnesota. Scientists will use the two detectors to unravel the mystery of neutrino oscillations by measuring the evolution of a man-made neutrino beam traveling 450 miles through rock from Fermilab to Soudan.

The MINOS detector planes, made of steel and scintillating plastic, collect flashes of light produced by neutrino collisions. Technicians produced the planes for the near detector over the course of 8 months in 2002. Since then the planes, each 12 feet high and 20 feet wide, have been stored in a hall about four miles from the MINOS access shaft at Fermilab. Moving the planes to their final location will follow a well-choreographed script of lifting, turning and lowering, going back and forth between vertical and horizontal position. Safety, of course, is of utmost importance as the "dance of the planes" proceeds.

"In the last couple of months our technicians have practiced every single step required in handling the planes," said MINOS physicist Catherine James. "Last August we determined the truck route to bring the planes from the storage location to the shaft. We expect to bring over a truckload a day, escorted by security vehicles."

On March 4, Fermilab will assume responsibility for the detector hall. Until then, Ragnar Benson, Inc. and its construction workers are finishing the interior of the underground halls. The biggest jobs underground have been the plumbing and specialized air-handling units for the tunnels. Sump pumps

ON THE WEB:

NuMI-MINOS Homepage:
www-numi.fnal.gov

Photo by Reidar Hahn

The 282 detector planes for the MINOS near detector are in storage in a large experimental hall at Fermilab. Scientists are currently practicing the setup of the data acquisition system on nine of the planes.

remove 300 gallons of water per minute from the tunnels. Because of the good quality of the water, Fermilab has begun to use it as cooling water, supplementing other water sources.

“Ragnar Benson has been a great contractor to work with. We met all project deadlines without a problem,” said Fermilab engineer Elaine McCluskey who supervised the $20.4-million Ragnar Benson construction contract, which also includes the construction of a 6,900-square-foot service building on top of the MINOS access shaft. “The deployment of the detector can proceed as planned.”

Beginning in April technicians will install up to five detector planes per day, arranging the planes like the slices of a loaf of bread. During the evening shifts scientists will test the functionality of each plane and hook them up to the MINOS data acquisition (DAQ) system.

“The whole collaboration will take shifts,” said Fermilab’s Peter Shanahan, one of more than 200 physicists from six countries that are part of the collaboration. “We will have a lot of experts coming in from other institutions.”

Shanahan and a group of scientists have practiced connecting detector planes to the DAQ system using nine of the planes in storage. At the end of February the test setup recorded its first cosmic rays, extraterrestrial particles that penetrate the earth’s atmosphere with high energy.

The MINOS detector, when complete, will rely on neutrinos produced at Fermilab rather than cosmic rays. Neutrinos are particles without electric charge that barely interact with matter. As a matter of fact, neutrinos can traverse the entire earth without causing a single collision. Scientists so far have identified three types of neutrinos called electron neutrino, muon neutrino, and tau neutrino.

The MINOS experiment will focus on bursts of muon neutrinos produced by Fermilab’s Main Injector accelerator. Every two seconds, the accelerator slams a package of 120-GeV protons into a graphite target, producing a wealth of secondary particles. A fast-pulsing magnet, called a focusing horn, selects the right types of particles to produce an intense beam of muon neutrinos. The neutrinos will travel about 1,000 feet through

Photo by Reidar Hahn

The infrastructure of the NuMI target hall is almost complete. Mike Petkus (left) and Mike Mascione are already working on the details of moving the NuMI focusing horns underground. The horns are essential components for producing an intense neutrino beam.

DANCE OF THE Planes

rock before entering the MINOS near detector. A tiny fraction of the particles will produce a signal inside the detector, just enough for scientists to verify the composition of the muon neutrino beam. The rest of the beam will continue its journey close to the speed of light straight through the earth to Soudan, Minnesota.

The far detector will also record signals from the neutrino beam, about two thousandths of a second after the neutrinos have left the near detector. Comparing the results, scientists can precisely determine how many muon neutrinos have "oscillated" into electron neutrinos or tau neutrinos, a process allowed according to quantum theory. Reports of neutrino oscillations have come from several experiments, including Super-Kamiokande in Japan and the Sudbury Neutrino Observatory in Canada. The MINOS collaboration will examine the intricacies of the mixing process in greater detail, providing crucial pieces of information to solve the neutrino puzzle.

Work on the beam line for the MINOS experiment has progressed well. The project has stayed on schedule since the completion of the excavation in November 2002. Technicians have finished the installation of approximately twenty large magnets that are necessary to extract protons from the Main Injector and to guide the charged particles to the neutrino-producing target, a distance of about 1,200 feet.

"Except for three kicker magnets, all the major magnets are installed," said Nancy Grossman, deputy head of the Neutrinos at the Main Injector (NuMI) department. "We are now working on shielding, instrumentation and small correcting magnets."

Lowering 20-foot accelerator magnets and other equipment down a long, narrow shaft into a tunnel has been a first for Fermilab and its technicians. All other accelerator tunnels at the lab are only tens of feet below the surface. In contrast, the NuMI target hall is about 150 feet underground.

"It's a non-trivial task," Grossman said about the beam line installation. "We had a few problems with the cranes, which we have resolved. We plan to be done with the main shielding of the target hall in March. The focusing horns will go underground around May. If we fall behind in schedule, we have a contingency to go to two shifts."

The beam line will see its first particles at the end of the year. MINOS scientists expect to see the first man-made neutrinos in early 2005, catching on average four neutrinos per day in the far detector.

"It is wonderful to see the project, with input from so many people, come together like this," said Stanley Wojcicki, physics professor at Stanford University and cospokesperson of the MINOS collaboration. "We can hardly wait to see the first neutrinos and to begin detailed studies of their mysterious nature."

BUDGET TALKS

URA Council of Presidents confronts issues of money, visas and competing the Fermilab contract

by Elizabeth Clements

WASHINGTON, D.C. – Flat budgets, visa roadblocks, contract competition and the search for a new director stood out as the hot topics at the Universities Research Association's annual Council of Presidents meeting on February 4 at the National Academy of Sciences. And with the unveiling of the Department of Energy's FY05 budget request only days before the meeting, it came as no surprise when funding concerns took center stage.

Senator Lamar Alexander, former Education Secretary and current Chair of the Senate Subcommittee on Energy, led off the day with a key message about his views on science and education. Focusing on the powerful combination of the research university and the national laboratory, Alexander argued that supporting science leads to a direct increase in the number of jobs in the country.

"As I look at our country, our universities combined with our research labs are our secret weapons. They have supplied half of the jobs since World War II, and technology gives us our standard of living. We need to continue to make strong investments in science, " he said.

When it comes to increasing the DOE Office of Science budget, Alexander recommends taking advantage of the election year. "Achieving an increase in funding takes persuading the president that the key to increasing jobs depends upon strong investments in the physical sciences," he said. "And now is a very good time to work on it."

Alexander is not alone in seeking ways to increase the Office of Science budget. "We have had the same budget of 285 million for 2002, 2003 and 2004," said Fermilab Director Mike Witherell. "We are doing less work toward the future and renewing our infrastructure than we should be doing."

At last year's meeting, John Marburger, the Director of the Office of Science and Technology Policy and chief science advisor to the President of the U.S., found himself in an unusual position because the FY04 budget had not been announced yet. "With no budget last year, I could do nothing but compare numbers," he said at this year's meeting. "This year I'm prepared to speak about the budget."

After several years of flat budgets, the President's FY05 budget request asks for just a 2% increase for the Office of Science, which would not cover the effects of inflation.

"During the past year, I have been trying to lower expectations about the budget," Marburger said. "President Bush's three priorities are protecting the homeland, the war against terrorism and improving the economy."

Photo by Elizabeth Clements

Senator Lamar Alexander argued that the key to increasing the Office of Science budget is convincing the President that supporting the physical sciences leads to a direct increase in jobs. "They have supplied half of the jobs since World War II, and technology gives us our standard of living," he said.

ON THE WEB:

Universities Research Association:
http://www.ura-hq.org/index.html

DOE FY2005 Budget Request:
http://www.mbe.doe.gov/budget/05budget/index.htm

Blue Ribbon Commission Report on the Use of Competitive Procedures for DOE Laboratories
http://www.seab.energy.gov/publications/brcDraftRpt.pdf

BUDGET TALKS

Photos by Elizabeth Clements

John Marburger, the Director of the Office of Science and Technology Policy, discussed the FY05 budget request and the current visa situation. “The visa situation is very damaging,” he said. “There is a deep desire to improve the process and to speed it up.”

Marburger continued: “Looking back, it has been a good run for science. In my opinion, science is very healthy. The science community does have important challenges, but there is a funding envelope that makes the U.S. the science envy of the world.”

Marburger showed several graphs tracking the long-term pattern of Federal funding for science, and concluded: “It is very clear that other countries will have a very hard time catching up.”

In addition to addressing budget concerns, Marburger also discussed the current visa delays and backlogs faced by foreign scientists attempting to enter the U.S.

“The visa situation is very damaging,” he said. “There is a deep desire to improve the process and to speed it up. Very few people are actually rejected; the problem is that the screening process takes a very long time. Congress has to get this message. Perhaps you can help by bringing it to the attention of your Congressional representatives.”

Fermilab Director Michael Witherell

Witherell stressed that the international nature of Fermilab is crucial. “One of the biggest problems is visas, and it is common to the universities too,” he said. “DOE lab directors don’t have as much say. University presidents should take this on as an issue.”

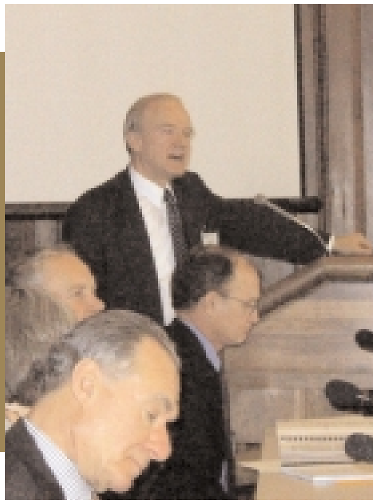
Next to funding and visas, the recent announcement about the DOE’s decision to compete contracts for ten of its laboratories, including Fermilab, created the most interest. The Fermilab contract expires on December 31, 2006 and will be competed instead of being automatically extended as in other years. URA President, Fred Bernthal, addressed several issues and concerns raised by URA members.

“The DOE Blue Ribbon Commission on Contracting has accepted the idea that competition is good,” Bernthal said. “The DOE announced a couple of weeks ago that it will compete the contracts of 10 of its labs, including Fermilab and Thomas Jefferson National Accelerator Facility.”

In the case of Fermilab, Bernthal stated: “Any contractor, whoever it might be, must enlist the same set of universities to make the laboratory work the way that it is intended to work.”

Office of Science Deputy Director Jim Decker provided some insight into the DOE’s reasons for competing contracts and summarized the Blue Ribbon Commission’s recommendations.

“There has been a lot of attention to this issue, and Congress has pressed us for an increase in competition,” he said. “The Blue Ribbon Commission Report recommended that long-term contracts are beneficial to the DOE, but the prospect of competition can promote high-quality performance. Somehow we have to find our way through this with Fermilab, and I share your concern.”



URA President Fred Bernthal

Office of Science Deputy Director Jim Decker

Chair of the Fermilab Board of Overseers Don Hartill

Bernthal encouraged members of the URA to focus on Fermilab's scientific mission and the tasks at hand. On October 3, 2003, Witherell announced his plan to step down as Fermilab director in July 2005.

"We need to get on with the task of recruiting a new director for Fermilab," Bernthal said. "We have many commitments for the laboratory, and we need to move forward with our research ambitions."

The URA has formed a Search Committee for a new director, chaired by Neal Lane, University Professor at Rice University. Bernthal and URA Vice President Ezra Heitowit outlined their plan for recruiting a new director.

"A charge has been drafted for the Search Committee," Bernthal said. "A description of the characteristics sought will be in the charge."

Since the search will be "full field," Heitowit explained that classified ads would be placed in the appropriate journals. The Search Committee will submit a short list of candidates to the Fermilab Board of Overseers, and the final candidate must also be approved by the Secretary of Energy.

Bernthal also reiterated that the DOE contract competition would not affect the planned procedure in the search for a new director.

"We hope to close the search process by late this summer," said Don Hartill, Chair of the Fermilab Board of Overseers. "That will give Fermilab nearly a full year of overlap with the new designated director."

A full day of discussing budgets, visas, and contracts ended with a big lift as Witherell described the recent improved performance of the Tevatron.

"Collider performance has been better than ever," Witherell said. "We have established that the Recycler can store antiprotons. Integrated luminosity is right where we hoped it to be, and unexpectedly good Tevatron reliability overcame the losses from the shutdown in December. The Booster distributed more protons than ever to MiniBooNE, and this week we had a record store. The morale for people working on the accelerator is very high right now. We are very optimistic that we are getting as much out of the accelerator as possible over the next few years."

F N E E R W M S I

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CHOREOGRAPHER'S SHOWCASE

featuring Gus Giordano Jazz Dance, Tommye Giacchino and Gregory Day, Ballroom Dancing

Saturday, March 13, 2004
Tickets - $18 ($9 ages 18 and under)

Founded in 1962 as Dance Incorporated Chicago, the company was the first jazz dance troupe to tour the Soviet Union in 1974. This focus on jazz dance led to a new name – Gus Giordano Jazz Dance Chicago – and its current mission to develop and preserve the indigenous American art form of jazz dance.

MANYA: A LIVING HISTORY OF MARIE CURIE

Written and performed by Susan Frontzcak

Saturday, April 17, 2004
Tickets- $15 ($8 for ages 18 and under)

Madame Marie Curie (née Maria Sklodowska) - changed our world through her discovery of radium and radioactivity. Through her own passion and perseverance, Marie Curie opened the doors of science to women world-wide. Manya not only celebrates the scientist, but also the human side of Marie Curie, who felt more daunted by the chemistry of the kitchen than the laboratory.

SAM BUSH

Saturday, May 15, 2004, 2004
Tickets- $25 ($13 for ages 18 and under)

Sam Bush has become synonymous with the Telluride Bluegrass Festival. Founder and driving force behind the legendary New Grass Revival, Bush's ability to make music that exceeds all expectations is evident from two projects just in the past year. *Bluegrass Mandolin Extravaganza* and *Short Trip Home* were nominated for Grammy Awards as Best Bluegrass Album and Best Classical Crossover Album, respectively.

FERMILAB LECTURE:

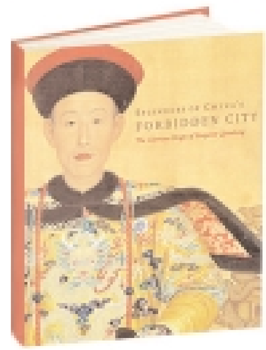
The Last Golden Age of Imperial China: The Emperor, The Economy, and The Arts in the 18th Century

Dr. Bennet Bronson, Co-Curator,

"Splendors of China's Forbidden City" Exhibit, Field Museum

Friday, March 26, 2004 at 8:00 p.m.

The Reign of Emperor Qianlong (1735 - 1795) during the Qing Dynasty marked China's pinnacle of wealth and power. It was under the guidance of Qianlong that China made remarkable strides in



literature, art, and in establishing peace between feuding western territories. The Field Museum has partnered with the Palace Museum of Beijing to present an unprecedented exhibition entitled *Splendors of China's Forbidden City: The Glorious Reign of Emperor Qianlong.* Never before seen outside of China, this exhibit includes approximately 400 artifacts, including a throne room, musical instruments, the emperor's funeral throne, a banquet setting, the wife's chamber and objects from the emperor's private Tibetan Buddhist shrine. Dr. Bennet Bronson, Co-Curator of this exhibit, will discuss the exhibit, and implications of the artifacts on display in his talk.

Chez Léon MENU

Lunch served from
11:30 a.m. to 1 p.m.
$10/person

Dinner served at 7 p.m.
$23/person

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

Lunch
Wednesday, March 3

Turkey Enchiladas Adobe
Baked Corn Pudding with Chilies, Onions and Cheese
Tropical Cheesecake

Dinner
Thursday, March 4

Scallop Chowder
Veal Paprikash
Steamed Green Beans
Warm Crepes with Hazelnut Brown Butter

Lunch
Wednesday, March 10

Cheese Fondue
Romaine & Red Onion Salad
Pears Poached in Red Wine Sauce with Cardamom & Orange

Dinner
Thursday, March 11

Borsch
Sauteed Scallops with Hazelnut Vinaigrette & White Bean Puree
Hazelnut Torte with Frangelico Cream Angelis

Lunch
Wednesday, March 17

Red Roasted Halibut with Jalapeño Vinaigrette
Angel Hair Pasta with Vegetables
Blueberry Lemon Cake

Dinner
Thursday, March 18

Onion Flan with Tomato Sauce
Duck with Five Spice Sauce & Rice Noodles
Oven Roasted Vegetables with Herbs
Pear Frangipane

Lunch
Wednesday, March 24

Chicken Marbella
Curried Rice with Cauliflower, Bell Peppers, And Green Onions
Strawberry Mascarpone Trifle

Dinner
Thursday, March 25

Sopa Azteca
Rib Lamb Chops with Chili Sauce
Lemon Rice
Grilled Vegetables of the Season
Honey & Date Cake

http://www.fnal.gov/pub/ferminews/

Fermilab

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