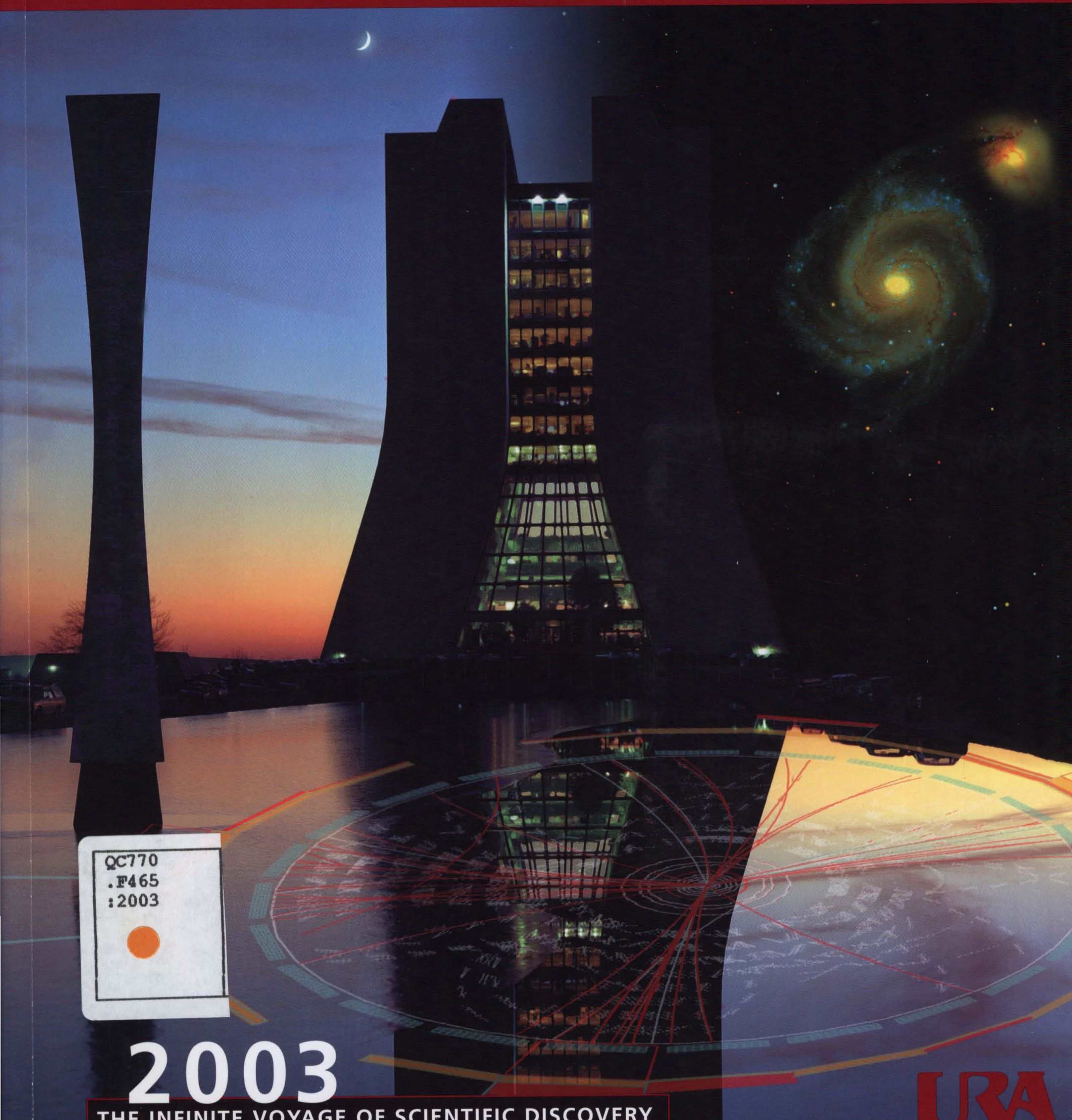
Universities Research Association, Inc.
ANNUAL REPORT



2003
THE INFINITE VOYAGE OF SCIENTIFIC DISCOVERY

URA: Serving Universities and the Nation through Science

URA is "an entity in and by means of which universities and other research organizations may cooperate with one another, with the Government of the United States, and with other organizations, toward the support and use of laboratories, machines, and other research facilities, and toward the development of knowledge in the physical and biological sciences."

It was created "...for research, development and education in the physical and biological sciences, including all aspects of the field of high-energy physics, nuclear energy, and their engineering and other applications; and to educate and train technical, research and student personnel in said sciences."

Physicists from 35 states and 29 countries use particle accelerators at Fermi National Accelerator Laboratory in Illinois for forefront research in particle physics.

In this aerial view of Fermilab, the 16-story Wilson Hall stands on the Illinois prairie adjacent to the 4-mile Tevatron accelerator ring. (center, left). Part of the 2-mile Main Injector ring appears in the background.

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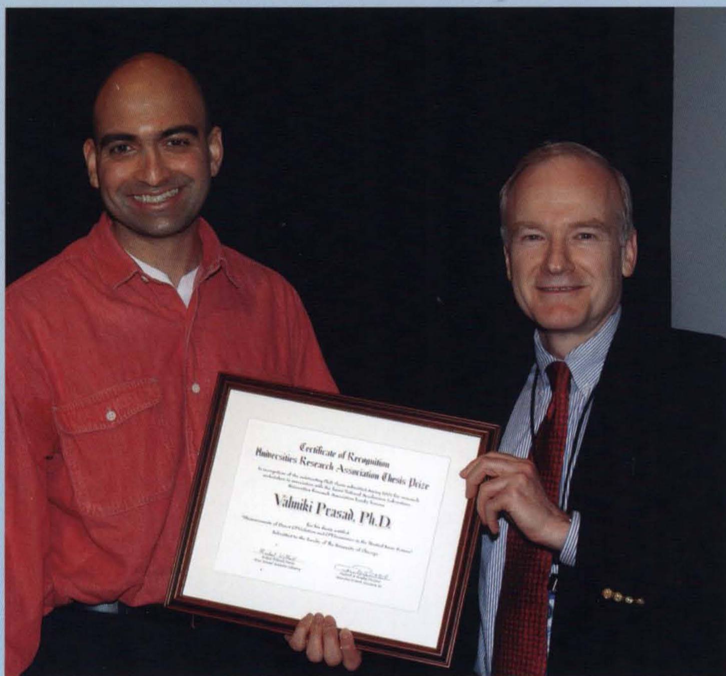
URA is a private not-for-profit corporation. A consortium of research universities, it serves as a contractor to the Federal government for the operation of major scientific facilities. This volume—updated annually with new financial and organizational data—provides the historical context for URA's structure and mission, as well as highlights of its contributions to science, technology, industry and education.

URA

MESSAGE FROM THE URA PRESIDENT



URA President Fred Bernthal (right) presents the URA Thesis Award to Valmiki Prasad, Ph.D., of the University of Chicago.

This past year has brought a large measure of challenging problems and exciting new physics for URA and its 90 member universities. Now into his fifth year at the helm of our flagship enterprise, Fermilab, Director Michael Witherell presides over an array of construction projects and planned experiments that is the most bold and most challenging since initial construction of the Laboratory 35 years ago. And the convergence of the fields of particle and astrophysics is nowhere more apparent than in the scientific programs at Fermilab.

Fermilab will remain the world leader at the high energy frontier of particle physics and associated sciences for most of the remainder of this decade, and the Laboratory has this year reported initial physics returns from its second multi-year period of experiments, "Collider Run II." The difficulties experienced by the Laboratory in achieving its planned beam "luminosity" projections has been a reminder that success at the frontiers of accelerator technology does not come easily. Meanwhile, Fermilab's scientific, technical, and management talent continues to lead U.S. participation in preparation for the expected 2008 startup of the *Large Hadron Collider* at CERN in Europe. Looking still farther ahead, Fermilab has joined with other laboratories in the U.S. to research and plan a next-generation electron-positron linear collider, in the hope that such a facility might be hosted by the U.S., and perhaps located at Fermilab.

The Laboratory is also on course to become the premier center for neutrino research, with civil construction nearing completion on the $170 million *Neutrinos from the Main Injector* (NUMI) project. The *MiniBooNE* experiment began taking data this year, in its bid to probe the mass characteristics of the elusive neutrino. The former Soudan iron mine in northern Minnesota, site of the long-baseline MINOS neutrino detector, is also host to a new laboratory which this year began taking initial data in a search for enigmatic "Cold Dark Matter" in the universe.

The *Sloan Digital Sky Survey* collaboration, with Rich Kron recently replacing Fermilab Director Emeritus John Peoples as its Director, has already produced spectacular data of truly cosmic significance. And in Mendoza Province, Argentina, the *Pierre Auger Cosmic Ray Observatory* is now in full construction, having completed and reported initial results from a highly successful shakedown run of its Engineering Test Array. With 15 participating countries, funding has been a constant challenge. But with strong support from the recent National Academy of Sciences Committee on the Physics of the Universe, prospects seem excellent for timely completion and operation of the Southern Auger array, to be followed by construction of the northern array planned for Utah.

Sometimes taken for granted is the educational mission of the Laboratory, which continues to produce the best of America's next generation of scientists and leaders. This year, work carried out at Fermilab led to 56 Ph.D. theses. We acknowledge this important measure of productivity and vitality by recognizing one individual each year with a URA Ph.D. Thesis Prize, and this year we inaugurated a similar annual Alvin Tollestrup award for outstand-

The URA paradigm for university-government-laboratory partnership

ing Postdoctoral research. Details on all of these undertakings can be found in the body of this report.

The Annual Meeting of the URA Council of Presidents (our "shareholders") was held in late January 2003, with Henry Yang, Chancellor of the University of California at Santa Barbara, presiding and concluding his year as Chair of the Council. Council business was again combined with the traditional Policy Forum, this year featuring addresses by John Marburger, former Chairman of the URA Board of Trustees and now Science Advisor to President Bush; Hon. Sherwood Boehlert, Chairman of the House Science Committee; NSF Director Rita Colwell; and DOE Undersecretary Robert Card. Some 70 URA member universities were represented at this year's meeting.

URA continues to benefit from the help of many distinguished individuals, who voluntarily provide leadership on our Board of Trustees, on the Fermilab Board of Overseers, and in related oversight activities. We are pleased and grateful that Joe B. Wyatt, Chancellor Emeritus of Vanderbilt University, continues to serve as Chair of our Trustees; Robert Galvin, former CEO of Motorola continues to provide his wise counsel to URA as Vice-Chair of the Trustees; Emanuel Fthenakis, former CEO of Fairchild Industries, devotes his considerable experience and expertise as Chair of our Audit Committee; and Don Hartill, Professor of Physics at Cornell University, is the newly-elected Chair of the Fermilab Board of Overseers, replacing David Shirley, who retired to his new home in Kauai, Hawaii. And this year James Siegrist of Lawrence Berkeley National Laboratory again chaired the URA Visiting Committee's annual programmatic review of Fermilab.

This is just a small sample of the extraordinary talent that assembles voluntarily from around the country and the world to assist URA in its undertakings, which reaffirms the benefits that derive from the URA partnership between our national laboratories and our nation's research universities. This paradigm of university-government-laboratory partnership has been frequently emulated at DOE and elsewhere, to the considerable benefit of the research enterprise.

John Marburger, Science Advisor to the President and Director, Office of Science and Technology Policy, one of the guest speakers at URA's Council of Presidents 2003 Annual Meeting and Policy Forum.

As new chapters in the history of URA's scientific endeavors are written, our activities and plans remain grounded in the original URA Articles of Incorporation, key excerpts of which appear on the inside cover of this report. In keeping with that charter, URA remains ready to respond to other appropriate opportunities to serve the U.S. and international research community. We look forward to another exciting year of service to our university community and to the American people, as we continue the infinite voyage of scientific discovery.

MEMBER UNIVERSITIES

ALABAMA
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ARIZONA
Arizona State University
University of Arizona

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California Institute of Technology
University of California-Berkeley
University of California-Davis
University of California-Irvine
University of California-Los Angeles
University of California-Riverside
University of California-San Diego
University of California-Santa Barbara
San Francisco State University*
Stanford University

COLORADO
University of Colorado-Boulder

CONNECTICUT
Yale University

FLORIDA
Florida State University
University of Florida

HAWAII
University of Hawaii-Manoa

ILLINOIS
University of Chicago
Illinois Institute of Technology
University of Illinois-Champaign/Urbana
Northern Illinois University
Northwestern University

INDIANA
Indiana University
University of Notre Dame
Purdue University

IOWA
Iowa State University
University of Iowa

KANSAS
Kansas State University

LOUISIANA
Louisiana State University
Tulane University

MARYLAND
Johns Hopkins University
University of Maryland-College Park

MASSACHUSETTS
Boston University
Harvard University
Massachusetts Institute of Technology
University of Massachusetts-Amherst
Northeastern University
Tufts University

MICHIGAN
Michigan State University
University of Michigan
Wayne State University

MINNESOTA
University of Minnesota

MISSOURI
Washington University in St. Louis

NEBRASKA
University of Nebraska-Lincoln

NEW JERSEY
Princeton University
Rutgers University

NEW MEXICO
New Mexico State University
University of New Mexico

NEW YORK
Columbia University
Cornell University
University of Rochester
Rockefeller University
State University of New York-Buffalo
State University of New York-Stony Brook
Syracuse University

NORTH CAROLINA
Duke University
University of North Carolina-Chapel Hill

OHIO
Case Western Reserve University
Ohio State University

OKLAHOMA
University of Oklahoma

OREGON
University of Oregon

PENNSYLVANIA
Carnegie Mellon University
Pennsylvania State University
University of Pennsylvania
University of Pittsburgh

RHODE ISLAND
Brown University

SOUTH CAROLINA
University of South Carolina

TENNESSEE
University of Tennessee-Knoxville
Vanderbilt University

TEXAS
University of Houston
University of North Texas
Prairie View A&M University*
Rice University
Southern Methodist University*
Texas A&M University
Texas Tech University
University of Texas-Arlington
University of Texas-Austin
University of Texas-Dallas

UTAH
University of Utah

VIRGINIA
Virginia Polytechnic Institute
University of Virginia
College of William and Mary

WASHINGTON
University of Washington

WISCONSIN
University of Wisconsin-Madison

CANADA
McGill University
University of Toronto

ITALY
University of Pisa

JAPAN
Waseda University

**Associate member institution*

Fermilab users from around the world work with the Laboratory's employees to advance the frontiers of particle physics

FERMILAB

Fermi National Accelerator Laboratory, 30 miles west of Chicago, is a Department of Energy national laboratory with the primary mission of advancing the understanding of the fundamental nature of matter and energy.

Fermilab is the home of the Tevatron, the world's highest-energy particle accelerator. Particle beams circle through a ring of magnets four miles in circumference to generate experimental conditions equivalent to those that existed in the first quadrillionth of a second after the birth of the universe. This capability to recreate the energy levels of the Big Bang places Fermilab at the frontier of global particle physics research, providing leadership and resources for qualified experimenters to conduct basic research at the leading edge of high-energy physics and related disciplines.

Fermilab Director Michael Witherell

The Fermilab accelerator complex is currently composed of a chain of five machines that accelerate particles in sequence to increasing energy. The core of the Laboratory's experimental particle physics program involves large detectors that receive the particle beams in experimental halls at locations within, or adjacent to, the accelerator complex. The detectors are built and operated by large teams of visiting scientists and Laboratory staff.

Fermilab currently provides research facilities for about 2,600 particle physicists and their students, from 213 institutions in 34 states (plus the Commonwealth of Puerto Rico) and 30 foreign countries. Typically, the U.S. scientists' research is supported by DOE and the National Science Foundation, and in some cases by university funds.

EVOLUTION OF THE LABORATORY

Fermilab began operations in the early 1970s with a single beam of protons directed at fixed-target detectors and has upgraded its capabilities over the years to take successive steps into the interior of the atomic nucleus. The Laboratory's first major upgrade was the development of the Tevatron, the world's first superconducting synchrotron, with beam energies of approximately one TeV or one trillion electron volts. It operated initially in 1983, and in 1989 the National Medal of Technology was awarded to the leaders of its design and construction team. Another vital upgrade enabled the Tevatron to become a collider, accelerating antiprotons as well as protons to TeV energies, in beams traveling in opposite directions, to produce collisions at selected interaction regions. The first proton-antiproton collisions were achieved in 1985, and now two 5,000-ton detectors, CDF and DZero, track and record the subatomic particles that emerge from proton-antiproton collisions. The collaborations that use these detectors announced in March 1995 the discovery of the top quark, a fundamental particle with an electric charge two-thirds that of the electron, and a mass nearly equal to that of an entire atom of gold. In late 1997, the Laboratory ended Tevatron Collider Run I in order to make major improvements to the Fermilab accelerator complex and the two big collider detectors. Meanwhile, the last run of the Tevatron fixed-target program was completed in early 2000.

The Main Injector, completed in 1999, is the 120 billion electron Volt (GeV) accelerator that serves as an injector to the Tevatron and the driver for the production of the antiprotons collected by the Antiproton Source. With its increased beam intensity, the Main Injector allows Fermilab to increase the rate of antiproton production for Collider Run II. There have also been improvements in the rest of the accelerator complex since the end of Collider Run I. For example, technical modifica-

Fermilab's Wilson Hall is a landmark for both the local neighborhood and the high-energy physics community

Fermilab's two collider detectors have reinvented themselves for the new, higher event rate environment of Collider Run II

tions have been made to the Tevatron to allow 36 bunches of protons and antiprotons to collide, rather than the six bunches of the last collider run. The Laboratory continues to work on other systems for improving performance of the accelerator complex to achieve Run II goals.

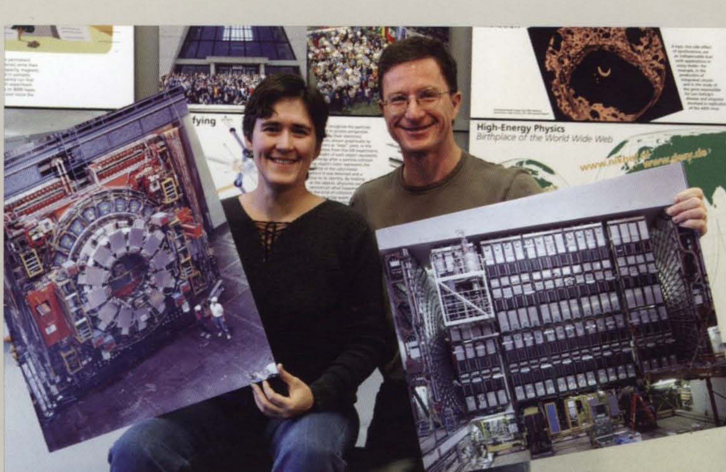
The Recycler, a storage ring located in the Main Injector tunnel, is expected to increase further the number of antiprotons available for colliding beams. The Recycler's successful operation also involves reducing the size of antiproton beams. The smaller and denser the antiproton beams, the larger the collision rate with the proton beams. Increasing the density of the beam is called cooling, and one way to cool a beam is to bathe it in "cold" electrons. This technique has been successfully used in relatively low-energy nuclear physics machines. In the Recycler the technique will be applied for the first time to higher energy (8 GeV) beams, pushing the state of the art for electron cooling. R&D on electron cooling is continuing in order to make the Recycler ready for operation in 2005.

Fermilab's two collider detectors have reinvented themselves for the new, higher event rate environment of Collider Run II. The CDF and DZero collaborations began to tear apart their respective detectors after the end of Collider Run I, and then proceeded with a major rebuilding program. Foremost among the challenging schedule issues for both collaborations was delivery of specialized silicon sensors and readout chips for particle tracking. Collider Run II began in 2001, and scientists from U.S. universities and others around the world resumed using these more sophisticated, more technically agile and more powerful detectors to record data in the barrage of high-energy collisions created by the Tevatron. All of the accelerator improvements for Collider Run II combined are expected to provide proton-antiproton collision data sixty times that of Collider Run I.

The Laboratory is running its current fixed-target program, consisting of two forefront neutrino experiments, with 120 GeV protons from the Main Injector and with 8 GeV protons from the Booster (the injector accelerator for the Main Injector). It is planned to use a new experimental hall at the Tevatron's CZero interaction region for BTeV, a collider experiment dedicated to the physics of the B meson, including an exploration relevant to the matter-antimatter asymmetry in the universe.

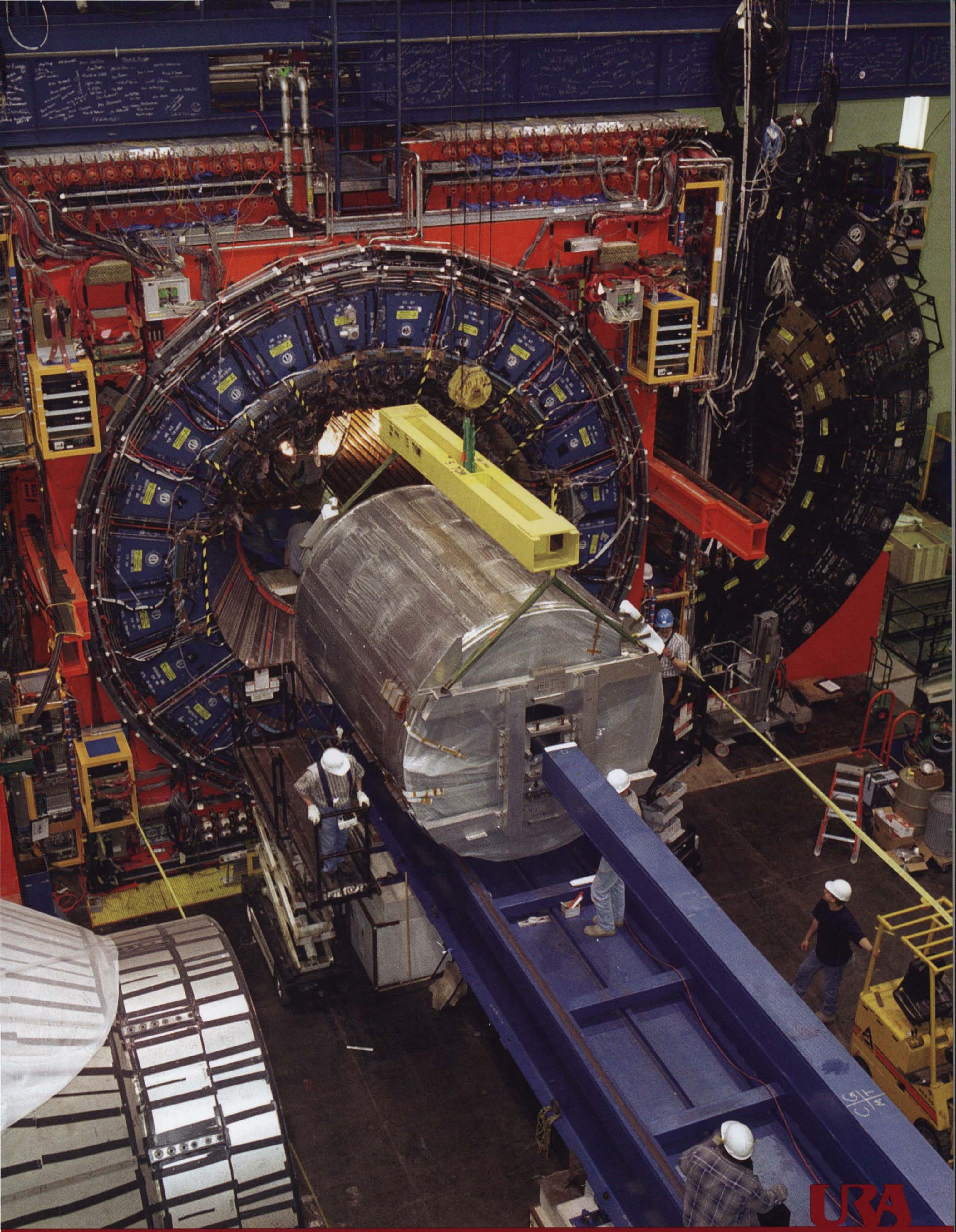
Experiment collaborations continue to analyze data and uncover new scientific results from preceding collider and fixed target runs. R&D continues on options for future accelerators. The Laboratory is moving ahead in its collaborations in three non-accelerator projects at the forefront of research in astrophysics: the Cryogenic Dark Matter Search; the Pierre Auger (Cosmic Ray) Observatory Project; and the Sloan Digital Sky Survey.

In addition, the Laboratory is the center of U.S. activity in preparing for the scientific program at the Large Hadron Collider (LHC), now under construction and at CERN, the European Laboratory for Particle Physics in Geneva, Switzerland. The LHC is currently scheduled to begin operations in 2007, and at that time, the high-energy frontier in particle physics will shift to Europe.

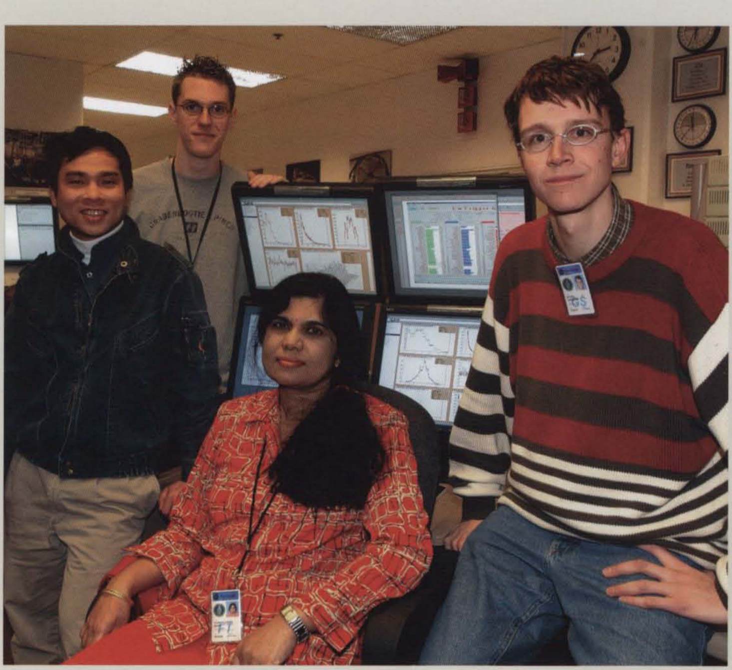


Husband-and-wife physicists Brenna Flaugher of the CDF experiment, and Tom Diehl of the DZero experiment "show the flags" of CDF and DZero, respectively.

Central Outer Tracker chamber being installed in CDF detector assembly for Collider Run II.



The Fermilab program is addressing important issues with new experiments



DZero physicist Pushpa Bhat, (seated center) viewing the DZero Global Monitoring System with university students Han Do, Jason Webb and Michiel Sanders in DZero Control Room.

THE FERMILAB RESEARCH PROGRAM AND THE FIELD OF PARTICLE PHYSICS

The remarkable progress of particle physics over the past few decades is well known and widely celebrated. The good news about the future is that the prospects for new fundamental discoveries in the next decade are as great as at any time in the history of the field. New experiments will be able to answer profound questions, some of which have arisen only within the last few years, and others which have been central to the field for some twenty years:

1. What sets the magic energy scale of about 200 GeV (about equivalent to the mass of one gold atom) that determines so many fundamental characteristics of matter?
2. Is there a new set of supersymmetric particles, one partner for every particle already observed, as one fundamental theory (string theory) predicts? Are there effects of extra space-time dimensions, at this scale?
3. Does the "Standard Model" of particle physics predict all manifestations of charge-parity (CP) violation, the asymmetry between matter and antimatter (which has allowed matter to predominate over antimatter in the universe).
4. Does the evidence for very small neutrino masses signal some new physical phenomenon at a very high mass scale, beyond that directly accessible in accelerator-based experiments?
5. What is the nature of the dark energy and the dark matter in the universe, and do they include new forms of matter, such as supersymmetric particles?

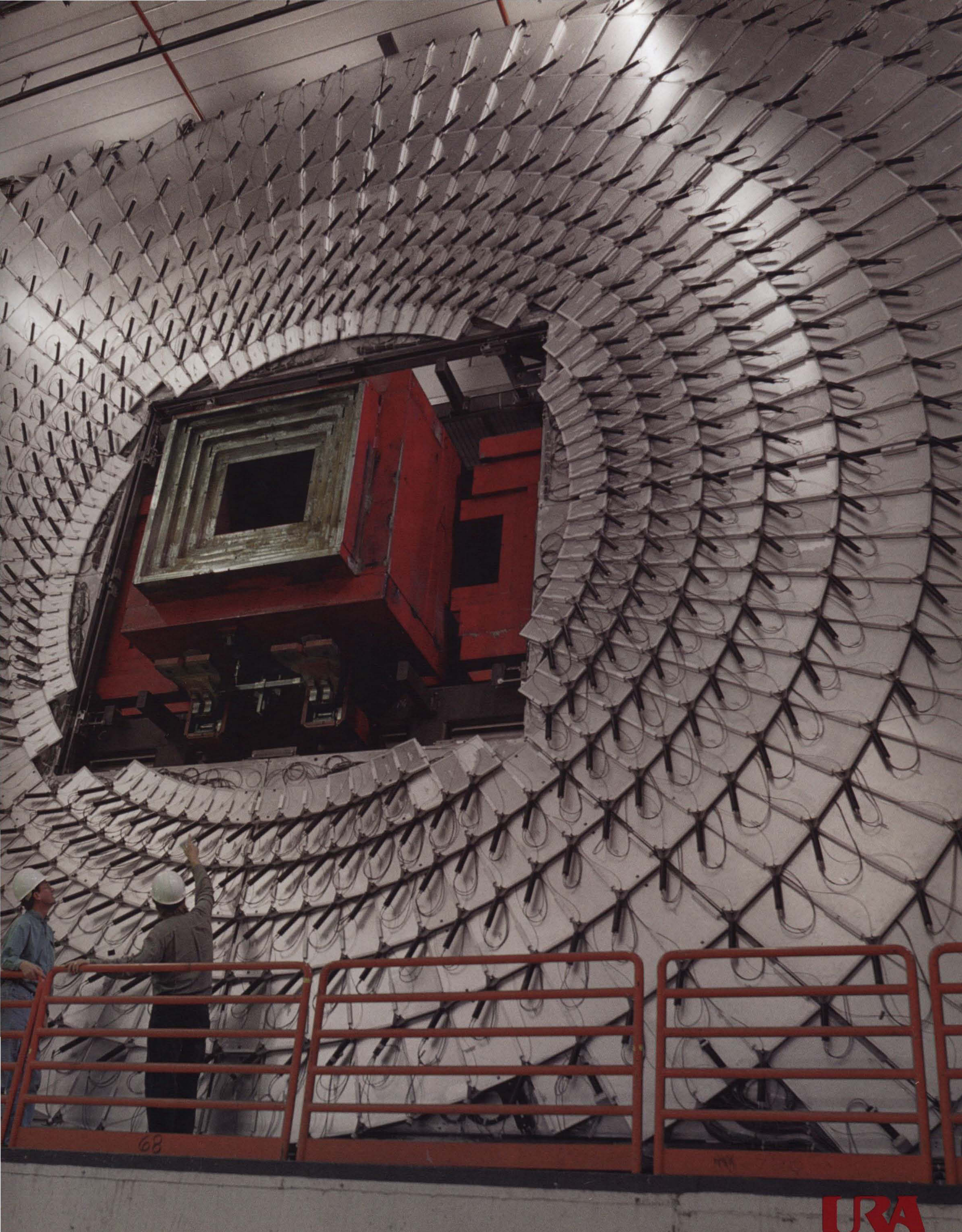
The Fermilab program is addressing all of these important issues with new experiments. The addition to the accelerator complex of the Main Injector has revitalized the experimental program; over the next several years, the Tevatron Collider remains at the center of the search for new physics at the highest energy available at any accelerator facility. For example, discovery of the predicted, but as yet unobserved, Higgs boson would lead to an understanding of what determines the masses of the elementary particles.

Fermilab has also developed a superb neutrino program that will contribute essential information on the puzzling question of neutrino masses and oscillations.

PARTICLE PHYSICS HIGHLIGHTS OF 2002-2003

Fermilab's Tevatron Collider now stands alone at the energy frontier until the LHC detector collaborations begin taking physics-quality data, and the CDF and DZero collaborations have an excellent opportunity for new discoveries, such as the Higgs boson, the lightest supersymmetric particles, and evidence for extra "dimensions" predicted by certain advanced theories. However, such discoveries require an aggressive program of further upgrades to the accelerator complex and the collider detectors over the next few years.

Members of the DZero Collaboration on a cat-walk in front of the 150-ton Muon Detector System of the upgraded detector.



The directors of seven major particle physics laboratories met with the press during the 2003 International Lepton-Photon Conference held at Fermilab (from left): Michael Witherell, Fermilab, (U.S.); Albrecht Wagner, DESY, (Germany); Yoji Totsuka, KEK, (Japan); Sergio Bertolucci, INFN, (Italy); Jonathan Dorfan, SLAC, (U.S.); Luigi Maiani, CERN; Robert Aymar, Director General-Elect, CERN; Mikhail Danilov, ITEP, (Russia).

Since the March 2001 start-up for operation of the new Collider complex, the Laboratory has been engaged in the technical challenge of steadily increasing Collider luminosity, a measure of the proton-antiproton collision rate. Although the luminosity has been increasing more slowly than originally planned, a sustained effort is underway to understand problems and implement solutions. Luminosity improvements are crucial for providing the 1000 physicists who make up the CDF and DZero collaborations with the quantity of data they require for new discoveries. On August 22, 2003, the Laboratory achieved its fiscal year goal for Tevatron integrated luminosity, a measure of the number of collisions delivered to CDF and DZero.

While most of the Laboratory effort in the past year went into continuing the construction of new experiments and improving the performance of the accelerator complex for Collider Run II, during 2002 the various collaborations of experimenters at Fermilab produced over 60 publications based on results from the final 800 GeV fixed-target run and from further analysis of data from Collider Run I. In addition, some 56 Ph.D. candidates completed theses based on research they carried out at Fermilab. These students go on to exciting careers in particle physics, as well as in related fields such as astronomy, computer sciences, and engineering.

With Collider Run II well underway, the CDF and DZero detectors are both taking data with high efficiency. The detector collaborations continued to report more precise measurements, both in support of leading theories and in the search for new phenomena beyond the current Standard Model. Some of these measurements provide the world's best limits on new phenomena.

Of great interest are ongoing analyses from the CDF and KTeV collaborations on the very small asymmetry in the behavior of matter in certain particle interactions, namely meson decays that violate what is called charge-parity or time reversal symmetry. This phenomenon is key to understanding how matter came to predominate over antimatter in our universe, because without this asymmetry, there would be no stable aggregations of matter in the form of stars, planets, and ultimately, life. Planning and R&D continues for the next generation of such experiments at Fermilab: CKM, a fixed-target experiment that will use 120 GeV beams from the Main Injector; and BTeV, an experiment in the Tevatron Collider.

Fermilab experiments will explore the question of whether neutrinos do, in fact, have a small mass

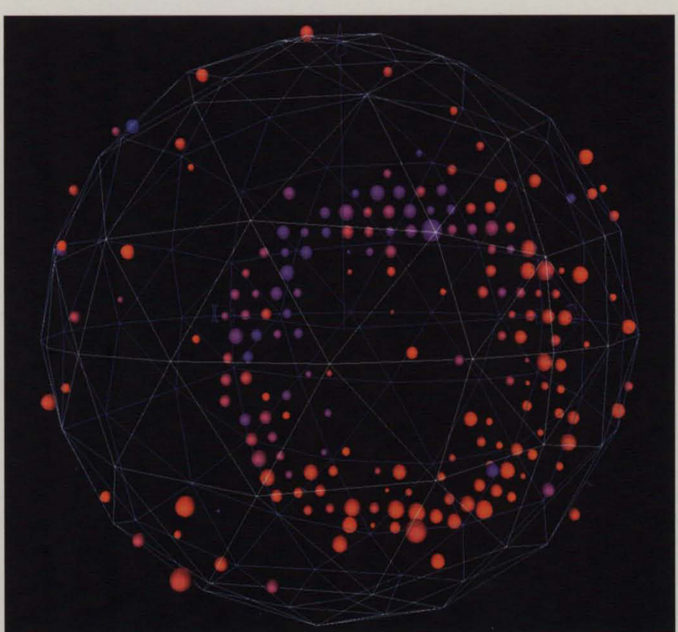
THE NEW NEUTRINO EXPERIMENTS

Scientists have discovered three different types, or "flavors," of neutrinos: electron neutrinos, muon neutrinos, and tau neutrinos. The particles play an important role in stellar processes, such as the creation of energy in stars as well as supernova explosions. Experimental results obtained over the last five years have observed that the evasive neutrinos switch back and forth among their three different flavors, while traveling through space and matter, suggesting that these particles have mass. Two new Fermilab experiments will explore in detail the phenomenon of neutrino mass through neutrino oscillations. Should these experiments, in conjunction with others around the world, confirm the existence of neutrino mass, the implications of such results would be profound. (Each cubic centimeter of the universe contains more than 100 neutrinos!)

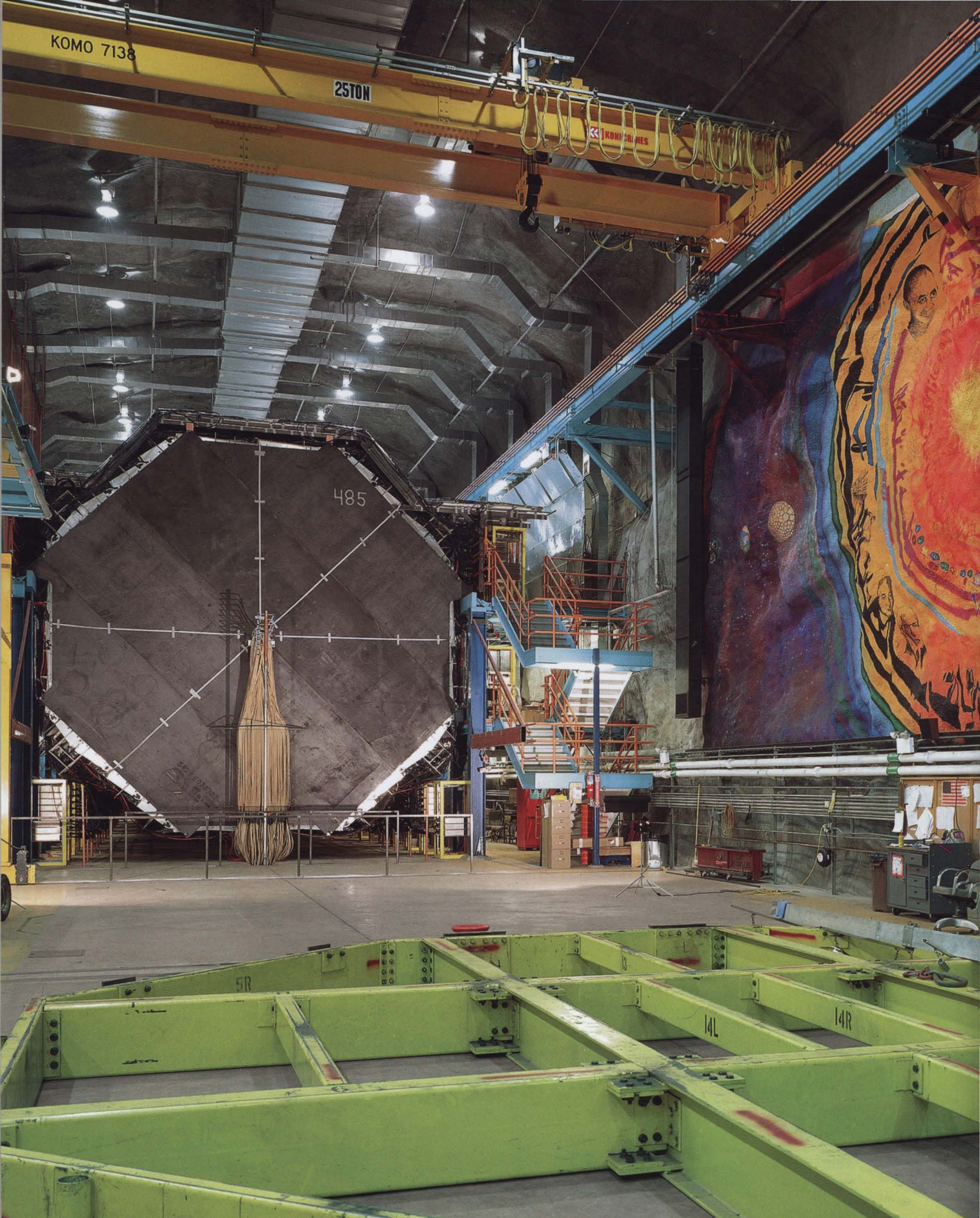
The MiniBooNE experiment uses a proton beam from Fermilab's 8 GeV Booster to produce a neutrino beam. The MiniBooNE collaboration is searching for the change of muon antineutrinos to electron antineutrinos, and will provide a definitive answer to questions raised by evidence for such neutrino oscillations observed in an experiment at Los Alamos National Laboratory. Construction of the MiniBooNE experiment began in October 1999, and the MiniBooNE collaboration has been taking physics data since late 2002. All beam and detector systems are working well. During 2003 the number of protons "on target" continued to increase, an important measure for collecting the data sample that the experiment requires.

In project NuMI (Neutrinos at the Main Injector), with its associated experiment called Main Injector Oscillation Search (MINOS), Fermilab will use the Main Injector to create a high intensity beam of muon neutrinos aimed first at the "near" MINOS detector, and continuing through the earth to the "far" MINOS detector, located deep underground at the Soudan Underground Laboratory, in a former iron mine in northern Minnesota. The MINOS experiment will directly confirm muon neutrinos changing to tau neutrinos during their 730-kilometer journey from Fermilab to Minnesota. Design and engineering work for the NuMI beamline began in late 1997. Civil construction activities began in 1999, both on the Fermilab site and at Soudan.

Excavation of underground NuMI enclosures on the Laboratory site, including the near detector hall, was completed in 2002. It is being followed by outfitting of the enclosures, construction of the service buildings, and installation of beamline components and the near detector during 2003 and 2004. Meanwhile, the MINOS far detector in the Soudan mine was completed in July 2003, and subsequently began official data-taking from neutrinos in the atmosphere. The entire project remains on the schedule and budget as rebase-lined in 2001. Full data-taking is scheduled to begin with both detectors when neutrino beam commissioning starts in early 2005.



The MiniBooNE experiment recorded this neutrino event at the beginning of project data-taking. The ring of light, registered by some of more than one thousand light sensors inside the detector, indicates the collision of a muon neutrino with an atomic nucleus.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The LHC will provide a unique and affordable opportunity for U.S. scientists to continue to work at the energy frontier

LARGE HADRON COLLIDER ACTIVITIES

As Collider Run II proceeds at Fermilab, the Laboratory also has a significant role in building the collider that will eventually overtake the Tevatron at the energy frontier. Through DOE and NSF, the United States is investing $531 million over eight years in the LHC accelerator at CERN and the two major LHC detectors. The U.S. is one of several non-CERN-member states, including Canada, Japan, India and Russia, contributing to the LHC.

When the LHC begins producing physics quality data sometime in 2008, it will reach a beam energy seven times the energy of Fermilab's Tevatron. The LHC will provide a unique and affordable opportunity for U.S. scientists to continue to work at the energy frontier, and it will allow Fermilab to develop the technologies for building the accelerators that will someday surpass the LHC's capabilities.

U.S. participation in the LHC has important consequences for Fermilab. The Technical Division's Jim Strait is the project manager for the U.S. contribution to the accelerator, leading a collaboration that includes Fermilab and the Brookhaven and Lawrence Berkeley National Laboratories. Most of the R&D for the advanced superconducting quadrupole magnets for the LHC's interaction regions has been done at Fermilab, and most of the fabrication of these magnets is also taking place at Fermilab. The U.S. LHC accelerator project is now well over 80% complete. Planning is now taking place for a continuing U.S. LHC Accelerator Research Program, and Fermilab has been appointed a lead laboratory role for this next phase of activities.

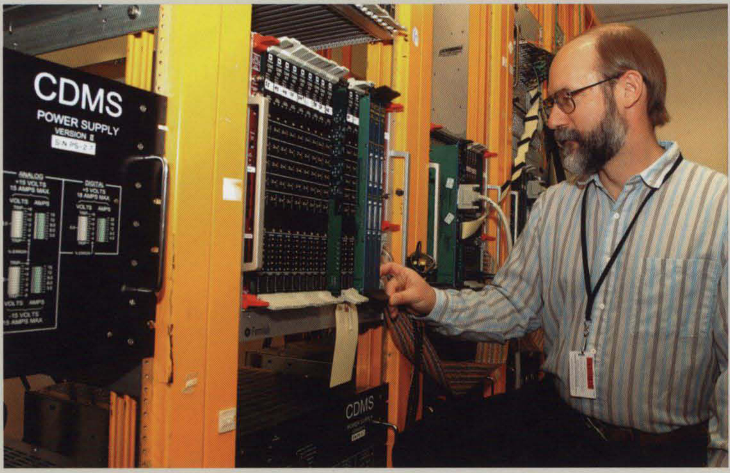
The LHC magnet project crew, standing in front of a completed special-purpose LHC quadrupole magnet in its orange cryostat enclosure.

DOE and NSF have also asked Fermilab to oversee project management for the U.S. contribution to the CMS detector, one of the LHC's two major detectors. Several years ago, the U.S. CMS collaboration asked Fermilab to serve both as one of its collaborating institutions and as its host laboratory, and Fermilab and URA agreed. The collaboration made excellent progress in the past year, and the U.S. CMS construction project continues to be on schedule and on budget. Fermilab has also been chosen to be the major U.S. CMS regional computing center, one of the few such centers around the world. Planning is proceeding for Fermilab's role as host laboratory for the physics research phase of U.S. CMS once the LHC begins operations.

The 100-foot-long MINOS far detector at the Soudan Underground Laboratory, consists of 486 massive octagonal planes, numbered 0 through 485 (seen in background). Lined up like the slices of a loaf of bread, the planes consist of sheets of steel about 25 feet high and one inch thick, covered on one side with a layer of scintillating plastic. The whole detector weighs 6,000 tons. The University of Minnesota Foundation commissioned artist Joe Giannetti to paint a mural (seen upper right) that is 59 feet wide and 25 feet high. The far detector assembly phase of the project was completed months ahead of schedule.

ASTROPHYSICS

All of the proposals for extending the domain of validity of the Standard Model of particle interactions predict new particles. If these particles are stable, then large numbers of them will have survived the moment of creation and will still be present. Should that be the case, they could make up a significant fraction of the mass of the universe. Searches for such particles of "cold dark matter" are underway. Fermilab is a member of the collaboration of twelve institutions in the Cryogenic Dark Matter Search (CDMS). These collaborators have developed very sensitive detectors that can detect the recoils of germanium or silicon nuclei if they collide with one of these massive particles. The CDMS collaboration has recently made public the most sensitive limits on such dark matter on the basis of the preliminary experiment at a shallow underground site on the Stanford University campus. Fermilab now has the project management responsibility for building a larger and more sensitive experiment, CDMS II, in the same Soudan Underground Laboratory that houses the far MINOS detector. Fermilab is also playing a key role in the electronics, data acquisition, and cryogenics systems for CDMS II. The dilution refrigerator for all cryogenics was in operation by December 2002. Two of the five detector towers have been installed, and the shielding, data acquisition, and electronics systems are nearly completed. The first low background data were taken in mid-2003, and the experiment is well on track to be fully operational by late 2004.



CDMS Project Manager Dan Bauer checks out the experiment's circuitry. Bauer, who has been working with CDMS since 1995, recently relocated from the University of California at Santa Barbara.

Fermilab is also engaged in a collaboration that aims to find out how matter, both dark and luminous, is distributed. This project, the Sloan Digital Sky Survey (SDSS) is mapping in detail one-quarter of the entire sky, determining the positions, absolute brightnesses, and red shifts of more than 100 million celestial objects, including more than a million galaxies and a hundred thousand quasars. Among Fermilab's many contributions to this project has been the construction of the data acquisition system and the software and hardware to process the expected 10 to 20 terabytes of data that will be accumulated during the roughly five-year span of the survey. The SDSS collaboration, comprising twelve institutions, has built a 2.5-meter telescope and the associated instruments at Apache Point, New Mexico. On July 1, 2003, Richard Kron, a senior scientist in the Laboratory's Experimental Astrophysics Group, succeeded Fermilab Director Emeritus John Peoples as SDSS Director. Most recent scientific results include the discovery of three distant quasars at the edge of the universe, and a distant ring of stars circling the Milky Way Galaxy. A new study using SDSS data provides the most direct evidence yet that galaxies reside at the center of giant, dark matter concentrations that may be 50 times larger than the visible galaxy itself. In another study, researchers found direct physical evidence for the existence of dark energy, a result that complements observations of distant supernovae.

The Experimental Astrophysics Group is considering options for the post-SDSS future. A leading option would have Fermilab join a collaboration of institutions in a space-based mission to probe the nature of dark energy and the accelerating expansion of the universe. The Super Nova Acceleration Probe (SNAP) satellite experiment would detect and monitor several thousand "Type Ia" supernovae to determine the properties of dark energy.

As a member of an international collaboration of 15 countries, Fermilab is playing a major role in the Pierre Auger Observatory Project, which will explore the properties and mysterious origins of very-high-energy cosmic rays. *(See Separate Section on Pierre Auger Observatory Project.)*

Fermilab is also engaged in a collaboration that aims to find out how matter, both dark and luminous, is distributed

Richard Kron, new Sloan Digital Sky Survey Director, has a joint appointment at Fermilab and the University of Chicago.

FUTURE ACCELERATORS AND COLLIDERS

While scientists await new discoveries from Collider Run II at Fermilab, and later in the decade from the LHC at CERN, they must also plan how to advance the field in the future. For this it is necessary to perform R&D for the next generation of major accelerator facilities. Many in the community believe that Fermilab is the natural site for such a facility. As the largest U.S. laboratory for particle physics, Fermilab would provide a strong base of talent and infrastructure on which to build new facilities both on and near the present site. Working in both U.S. and international collaborations, Fermilab scientists are currently engaged in R&D for the following future accelerator systems: a 500-1000 GeV electron-positron linear collider; a muon storage ring-based "neutrino factory;" and the next generation, high-field superconducting magnets for LHC accelerator upgrades and for a future very large hadron collider.

The electron-positron linear collider is receiving the most focused effort around the world. Many scientists see it as a natural complement to the LHC in exploring new physics at the TeV mass scale. In a much anticipated January 2002 report, a DOE/NSF advisory panel on Long Range Planning for U.S. high-energy physics recommended that "the highest priority of the U.S. program be a high-energy, high-luminosity, electron-positron linear collider, wherever it is built in the world." Fermilab Director Michael Witherell is a member of both the U.S. Linear Collider Steering Committee, and an international linear collider working group under the International Committee for Future Accelerators (ICFA).

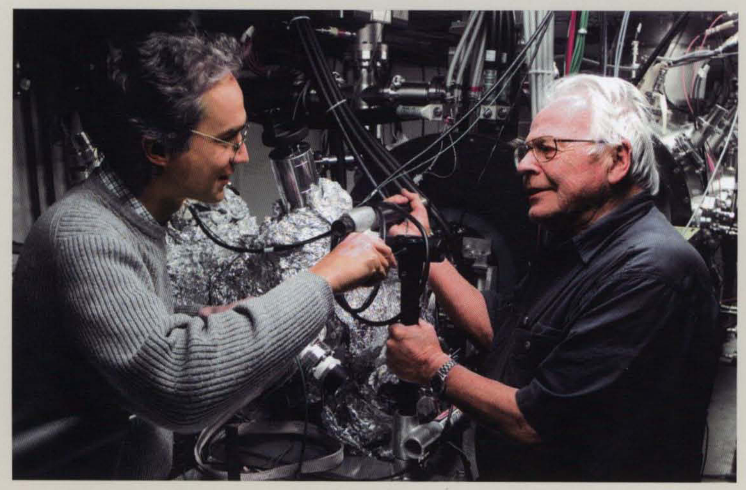
Fermilab is a member of the U.S. Next Linear Collider (NLC) collaboration, which includes Stanford Linear Accelerator Center (SLAC) and the Lawrence Berkeley and Lawrence Livermore National Laboratories. The NLC collaboration has formulated a 4-5 year R&D plan that if brought to a successful completion could support the construction of a linear collider. Major components of the Fermilab NLC R&D program include structures fabrication, an engineering test facility for the main linac, accelerator physics, permanent magnets, and analysis of nearby sites. In addition, Fermilab continues its collaboration with DESY, the German high energy physics laboratory near Hamburg, and other institutions on R&D for the "TeV Energy Superconducting Linear Accelerator" (TESLA). TESLA uses superconducting technology to accelerate particles in contrast to the more "conventional" accelerating technology of the NLC. Fermilab has contributed critical components for the TESLA Test Facility, used to develop and test the new superconducting technology. Fermilab is currently the only institution affiliated with both the NLC and the TESLA collaborations.

With interest high in neutrino physics, very intense neutrino sources are required for the next generation of experiments. Current accelerator sources at Fermilab produce secondary beams of neutrinos from collisions of high energy protons on

As the largest U.S. laboratory for particle physics, Fermilab would provide a strong base on which to build new facilities

stationary targets. A much more intense neutrino source could be formed using a muon storage ring. The collaboration analyzing this concept encompasses a number of laboratories and universities, with Fermilab and the Brookhaven and Lawrence Berkeley National Laboratories as lead laboratories. At this early stage, R&D is being performed on technical components for a muon cooling experiment to be located at Fermilab.

Fermilab is also collaborating with several regional universities that have initiated accelerator R&D efforts utilizing both State and Federal support. The Illinois Consortium for Accelerator Research (ICAR) consists of Illinois Institute of Technology, Northern Illinois University, Northwestern University, University of Chicago and University of Illinois, Urbana-Champaign. Supported at $2.5 million per year, the purpose of ICAR is to assist Fermilab with accelerator R&D for future facilities. The Northern Illinois Center for Accelerator and Detector Development (NICADD) began operations in 2002 at Northern Illinois University's DeKalb campus. NICADD projects envisioned for collaboration with Fermilab include creation of a particle detector research facility, establishment of a separate facility for development of the next generation of linear colliders, and joint operation of the Fermilab/NICADD Photoinjector Laboratory (FNPL), a laser-driven, electron beam research facility at Fermilab. Seven participating institutions are using the FNPL, with its superconducting radio-frequency (RF) cavity technology, for experiments on plasma and laser acceleration techniques, and for several investigations that could have an impact on linear collider design considerations. It is also planned to use the FNPL facility to test a superconducting RF cavity system for the proposed CKM experiment.



Fermilab scientist Don Edwards (right) and a Northern Illinois University student inspect a component of the beamline in the Fermilab/NICADD Photoinjector Laboratory.

Fermilab has developed two concepts for a new 8 GeV proton source facility, called the Proton Driver, to replace the aging Linac and Booster accelerators. With its enhanced performance, the Proton Driver would solve the associated problems of decreasing Booster reliability and the need for increased proton intensity for simultaneous operation of the MiniBooNE and NuMI/MINOS experiments. One of the Proton Driver concepts is a linear accelerator with superconducting RF.

EDUCATION, TRAINING AND FELLOWSHIP PROGRAMS

Fermilab's history of achievement in science education and teacher training programs is a tribute to physicists' love of learning and to students' responsiveness to real-world situations. Spearheaded by Fermilab Director Emeritus and Nobel laureate Leon Lederman, the education program gives special emphasis throughout to strengthening science education for under-represented groups.

The Leon M. Lederman Science Education Center, dedicated in 1992, drew attendance in 2002 of over 21,000 students and 5,600 teachers in K-12 education programs. The Center offers some 28 programs: teacher enhancement workshops and institutes, opportunities for research participation, development and distribution of instructional materials, a collection of teachers' resources, Laboratory

Alvin Tollestrup (left) presents the new URA-sponsored Tollestrup Award for Postdoctoral Research to Juan Cruz Estrada of DZero.

tours, special events, class field trips, and science shows. In 2002, the Center's education webserver received over 7,000,000 hits. Currently, 85 percent of the Center's funding is provided by Fermilab, and 15 percent comes from other Federal, State and private sources.

The Summer Internships in Science and Technology (SIST) program provides summer internships at Fermilab in physics, engineering and computer science to an average of 20 undergraduate students per year from minority groups traditionally underrepresented in the fields of science and engineering. Fermilab has sponsored the SIST program for over 30 years. SIST has the distinction of being the oldest operating program of its type in the U.S. and has served as a model for other laboratories and private industry.

Fermilab sponsors the Lederman, Peoples and Wilson postdoctoral fellowships at the Laboratory, and participates in a Joint University-Fermilab Doctoral Program in Accelerator Physics. In collaboration with other laboratories and U.S. universities, Fermilab serves as home of the U.S. Particle Accelerator School. The Laboratory also supports university faculty members in residence at the Laboratory through a guest scientist program.

URA sponsors two annual awards at the Laboratory. The Fermilab/URA Graduate Thesis Award honors the outstanding doctoral thesis written on research conducted at Fermilab or in collaboration with Fermilab scientists. The Tollestrup Award for Postdoctoral Research honors outstanding work conducted by a postdoctoral researcher at Fermilab or in collaboration with Fermilab scientists. URA also supports the awards for outstanding poster presentations at the annual New Perspectives Conference, organized each year by Fermilab's Graduate Student Association on behalf of young scientists at the undergraduate, graduate, and postdoctoral levels.

Graduate students must devote so much time to participating in experiments at the Laboratory that they often have difficulty taking needed classes at their home institutions. Therefore, URA also provides financial support for graduate courses at Fermilab.

Fermilab has been designated a National Environmental Research Park by the Department of Energy

ENVIRONMENTAL ACTIVITIES

In addition to its research in high-energy physics, Fermilab has been designated a National Environmental Research Park by DOE. The Laboratory diligently oversees restoration and preservation of the site's ecosystems. Over the years, the Laboratory has restored more than a thousand acres of the native tallgrass prairie that once covered the Fermilab site. The prairie is actively managed, including annual prairie burns to help maintain the system's natural cycles. In 1998, Fermilab became a member of Chicago Wilderness, a consortium of nearly one hundred public and private landholders in the Chicago area committed to careful and responsible management of the remaining habitat in the region.

The Laboratory's deer management program is yielding good results in the management of Fermilab ecosystems. Vegetation studies show a substantial recovery in the forest vegetation, along with fewer signs of deer browse damage. It has been recommended that efforts to manage the deer population should continue in order to ensure the protection of plant communities, especially wooded areas.

In 2002, under an Illinois Environmental Protection Agency (IEPA) approved schedule, the Laboratory began monitoring at two of the open solid waste management areas currently located at Fermilab. All solid waste management units at Fermilab have been deemed to pose no adverse threat to health or the environment. Also, discharges from the NuMI tunnel were plumbed into the Laboratory's industrial cooling water system to supplement that system, which can reduce the need for pumping from both on-site wells and the nearby Fox River.

Fermilab's Pollution Prevention Initiative consists of a Restoration and Reuse (R&R) Program and a Waste Minimization (reduction before and after generation) Program. Under the R&R program, a major fixed target area was cleaned out for future use. Recovery of materials during this operation was highly successful, and approximately 4,100 metric tons of material composed primarily of concrete, steel and lead shielding was removed. Of that amount, 1,050 metric tons was specifically earmarked for other uses on site or for recycling. The remainder of the recovered material was placed at the Laboratory's railhead for future use.

In addition, under the Waste Minimization Program, Fermilab installed a new compressed natural gas (CNG) vehicle refueling station. The Laboratory's motor pool fleet currently has twenty-six bi-fuel gasoline/natural gas vehicles that can now utilize natural gas, which is cleaner burning and cheaper than gasoline, as an alternative fuel source. Reduction of gasoline consumption is estimated at 18,000 gallons annually.

Jim Shultz, Fermilab employee and local Cub Scout leader, assists a member of his Cub pack harvesting seeds for further prairie restoration on the Fermilab site.

Graduate student Jen Raaf and post-doc Eric Hawker of University of Cincinnati looking at particle production data on the MiniBooNE event display.

Vicky White, new head of the Computing Division, is leading Fermilab's participation in the development of international Grid computing enterprises.

TECHNOLOGY TRANSFER

While Fermilab is dedicated to basic physics research, the Laboratory is eager to share its science, technology and know-how by working cooperatively with U.S. industry to encourage economic development. Fermilab has unique capabilities in designing and operating accelerators, managing very large cryogenic systems, developing and operating fast electronics, creating hardware architectures and software for massively parallel computing systems and operating industrial-scale applications of superconducting technology. Sometimes advances in these technologies at the Laboratory have applications beyond high-energy physics research, and Fermilab can transfer new technology to industry to foster economic development. Fermilab's Directorate-level Office of Research and Technology Applications (ORTA) facilitates the transfer of technologies developed at the Laboratory.

ACCELERATORS IN MEDICINE

Between 1976 and 1985, the National Cancer Institute funded clinical trials at Fermilab to explore the effectiveness of fast neutrons versus photon therapy in the management of radioresistant tumors. Over 2,600 patients have received treatment at Fermilab's Neutron Therapy Facility (NTF). About 25 percent of these patients reside outside Illinois, including individuals from Canada, Greece, Haiti, Mexico, Pakistan, and the Philippines. The NTF was most recently (1995-2003) operated under contract with Provena Saint Joseph Hospital of Elgin, Illinois.

Beyond the borders of Illinois, the NTF has served as a model for more recently built neutron therapy facilities in Michigan, South Africa, and France. Fermilab also built a 250 MeV proton accelerator for the hospital of Loma Linda University Medical Center in California, which began treating patients in October 1990.

Fermilab laboratory staff volunteer in sponsorship of cultural activities and conduct tours for visitors

In one of Fermilab's community programs, Bob Betz, 30-year champion of the 1,100 acre Fermilab Prairie Restoration Project, provides guidance to these volunteers from local community schools. Prairie seed harvesting has become an annual fall event.

COMMUNITY PROGRAMS

Fermilab's role as a key element of the Illinois High Technology Corridor is complemented by its sponsorship of cultural activities to which the public is invited. Laboratory staff volunteer in supporting an arts series, physics colloquia, films and an art gallery. Fermilab also conducts public tours for visitors and briefings for local citizens on Laboratory initiatives. With the cooperation of DOE security officials, the Laboratory has been pleased to be able to continue most of its public events and guided tours in the wake of post-9/11 security concerns at Federal facilities.

LABORATORY DIRECTORS

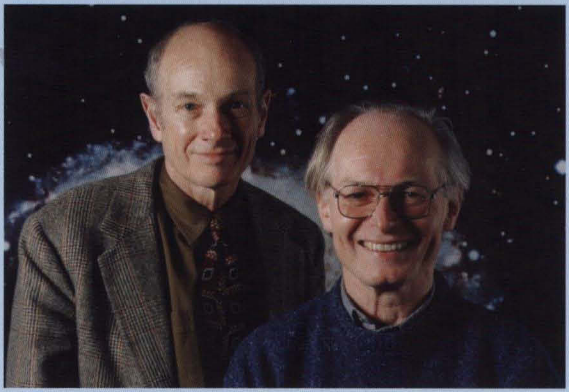
On March 5, 1999, URA announced the appointment of Michael Witherell as Fermilab's fourth director, effective July 1, 1999. Dr. Witherell succeeded John Peoples Jr., who led the Laboratory from 1989 to 1999. Dr. Peoples continues at Fermilab as a senior scientist, where he has played a key role in the Sloan Digital Sky Survey. Leon M. Lederman, a 1988 Nobel laureate, directed the Laboratory from 1979 to 1989 and is a member of the URA Board of Trustees. Dr. Lederman is currently Resident Scholar at the Illinois Mathematics and Science Academy; his contributions to science education are known worldwide. Fermilab's founding director, the late Robert R. Wilson, served from 1968 to 1978, and subsequently served as a member of URA's Fermilab Board of Overseers. Dr. Wilson provided continuing guidance for the aesthetics of buildings and grounds, including sculpture that he created.

For further information about Fermilab, visit the Laboratory's website at http://www.fnal.gov.

PIERRE AUGER OBSERVATORY PROJECT

Cosmic rays are high-energy particles from space—either electrons or the nuclei of atoms—that constantly bombard the Earth from all directions. The majority are single protons—the nuclei of hydrogen atoms—but some are much heavier, ranging up to the nuclei of lead atoms. A small fraction of cosmic rays are the most energetic particles ever observed in nature. Direct measurement requires locating detectors above most of the Earth's atmosphere, using high-altitude balloons and orbiting satellites. About 60 years ago, French physicist Pierre Auger discovered that cosmic rays can also be detected indirectly on the surface of the Earth by observing the showers of secondary particles they produce when colliding with atmospheric molecules.

The Pierre Auger Observatory Project is a broad-based international effort to make a detailed study of ultra high-energy cosmic rays (about 10^{20} eV, or 100 million times greater than the energy of the protons accelerated by Fermilab's Tevatron). The Project was initiated by Dr. James W. Cronin, Professor of Physics and Nobel Laureate at the University of Chicago. Currently, the Pierre Auger collaboration is led by Dr. Alan A. Watson, Professor of Physics at the University of Leeds in the United Kingdom, and by Dr. Hans Bluemer, Director of the Institute for Nuclear Physics at Forschungszentrum Karlsruhe in Germany. Thus far, the collaboration includes over 250 scientists from Argentina, Armenia, Australia, Bolivia, Brazil, China, France, Germany, Greece, Italy, Japan, Mexico, Poland, Russia, Slovenia, United Kingdom, USA and Vietnam. The U.S. collaboration comprises nine universities plus Fermilab, home of the project manager, Dr. Paul Mantsch.



James W. Cronin (left) of the University of Chicago and Alan A. Watson of the University of Leeds are co-founders of the Pierre Auger Observatory Project.

Los Leones is the first of 4 fluorescence detector buildings at the southern hemisphere Auger site in the Province of Mendoza, Argentina. The communications mast collects data from surface detectors, as well as fluorescence detector data from Los Leones, for relay to the data acquisition center on the Auger campus.

Because the highest-energy cosmic rays are so rare, scientists must cast a huge net to capture even a few. The Pierre Auger Observatory will be the first to combine two different methods for the detection of cosmic ray events in a hybrid approach: surface detector arrays to record the showers of particles produced when cosmic rays strike the earth's atmosphere; and fluorescence detectors to observe the atmospheric flares produced during the air showers. The Observatory will include two giant surface arrays, each consisting of 1600 particle detector stations spaced 1.5 kilometers apart and covering about 3000 square kilometers, an area about the size of the state of Rhode Island. In order to get a complete view of the heavens as seen from the earth, one array will be located in the northern hemisphere and one in the southern hemisphere. In November 1995, the collaboration selected a site in the Province of Mendoza, Argentina for the southern hemisphere array, and in September 1996 a site in Millard County, Utah for the northern hemisphere array. The total project cost is approximately $100 million.

In order to get a complete view of the heavens as seen from the earth, one array would be located in the northern hemisphere and one in the southern hemisphere

In a grant to URA on behalf of the U.S. Project participants under Dr. Cronin's continuing leadership, the National Science Foundation and the Department of Energy are providing $7.5 million over four years toward the U.S. share for the construction of the southern hemisphere array. This is planned to be followed by construction of the northern hemisphere array.

URA serves as the sponsoring organization for the U.S. participants, and as such oversees those activities currently funded by the U.S., such as component R&D and production. In addition, DOE and NSF have designated URA to be the agent on behalf of the U.S. on the Project's international oversight board.

In March 1999, an international agreement was signed in Argentina for the organization, management and funding of the Pierre Auger Observatory, and the southern hemisphere site was inaugurated at Malargue in Mendoza Province. In November 2000, construction was completed for the Detector Assembly Building at the Central Campus in Malargue and for the first fluorescence detector building. In December 2000, the project received a gift of $1 million from the University of Chicago for the construction of the Central Campus Office Building. The "Engineering Array," which consists of forty surface detector stations and a fluorescence detector telescope unit, was deployed in 2001. With the data collected from early 2002 to the present, the Engineering Array has shown that the Observatory will perform better, and will have greater discovery potential, than originally expected. With the experience gained from the Engineering Array, construction of the entire southern hemisphere array is now underway.

There is great interest in the mysterious origin of the ultra-high energy cosmic rays that the Observatory will be analyzing. Theorists have suggested such candidate sources as the black hole cores of quasars, ultra-magnetic neutron stars, and super-heavy dark matter clumps. As a measure of the scientific importance attached to the Observatory, a 2002 report of the National Research Council's Committee on the Physics of the Universe recommends "that the United States ensure the timely completion of the Southern Auger array."

This photo shows two of the 1,600 surface detectors that are being deployed for the Southern Auger array. The surface detectors are spaced about 1.5 kilometers apart.

FUTURE URA ENTERPRISES

URA has a broad charter for the management of research and educational activities in the natural sciences. The Corporation has been engaged in long-range planning to explore potential new management responsibilities that would be of value to the university research community. As part of this planning, URA has been considering bids on management contracts for selected national research centers and facilities that serve a broad base of national and international users.

HISTORY 1965 - 2003

The creation of URA marked a milestone in government-university cooperation for the management of Federal laboratories. Until 1965, individual universities and regional consortia had built and operated facilities under Federal sponsorship. It was the unique character of particle physics research—which often involved collaborations among scientists from many institutions—that created the need to establish a truly national management organization. The Federal government consulted with the National Academy of Sciences on how to accomplish this goal. The President of the Academy then convened the presidents of the U.S. universities engaged in particle physics, to consider management options for national facilities. Following that meeting, 25 attendees agreed to form a consortium leading to the incorporation of URA.

Nobel laureate Norman Ramsey, a past president of Universities Research Association, Inc., was a recent speaker at a Fermilab Colloquium.

This concept of fully national, and now increasingly international, cooperative efforts between the Federal government and research universities was developed to address the needs of many fields of science. Since 1967 URA has been contractor to the Department of Energy and its predecessor agencies for the design, construction, management, and operation of Fermilab. URA's success in building and operating Fermilab led to its selection as contractor for the nation's next major particle accelerator, the SSC. After the project was canceled in 1993, URA managers and staff assisted with the termination activities, which were essentially concluded by the end of 1996.

Currently, the Fermilab program and its associated scientific and technological enterprises, and U.S. participation in the Pierre Auger Observatory Project represent the core of URA's mission. As appropriate opportunities arise, the corporation will consider submitting proposals to the Federal government, or elsewhere, for the management and operation of other facilities and programs in science and engineering.

On May 16, 2003, Andy's Pond was officially dedicated on the Fermilab site, in memory of the late Andy Mravca, who served as DOE's Fermi Area Office Manager for 20 years. During his tenure, Mr. Mravca worked in partnership with Fermilab Directors Robert Wilson, Leon Lederman and John Peoples. Mr. Mravca's skill and dedication contributed greatly to the development and operation of the Laboratory. His family is shown here at the dedication ceremony behind a Memorial Plaque. Andy's Pond is seen in the background.

The creation of URA marked a milestone in government-university cooperation for the management of Federal laboratories

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Deputy Director

Laboratory Staff: 2,200

Pierre Auger Observatory Project

James W. Cronin
(University of Chicago)
U.S. Principal Investigator

CORPORATE STRUCTURE

MEMBERSHIP AND GOVERNANCE

As a non-profit corporation, URA acts under the authority of its governing body, the Council of Presidents of its 90 member universities. The Council is analogous to the shareholders of a public corporation. A Board of Trustees, elected by the Council, has the fiduciary responsibilities for the corporation and deals with corporate policy and planning issues. The Trustees appoint boards of overseers for each URA research enterprise. The headquarters office of URA in Washington, D.C. coordinates the activities of the Council and boards, and is responsible for oversight and governance of Fermilab and for corporate relations with the Federal government, industry, academe, and the general public. The Internal Audit Manager for Fermilab reports to the URA Headquarters Office.

The Fermilab Director is selected by the Board of Trustees with the approval of DOE. Daily operations are coordinated directly between Laboratory management and the DOE Chicago Operations Office or DOE headquarters. The total number of URA employees at corporate headquarters and at Fermilab is now about 2,210.

URA member universities are divided among seven geographic regions within the United States to ensure that the boards reflect the organization's national character. URA has expanded these regions to include its international members. The Council of Presidents elects one Trustee from each of the seven regions; each Regional Trustee is president or equivalent chief executive officer of a member institution in the region. There are up to nine At-Large Trustees. Similarly, there are seven regional members and up to eleven at-large members of a board of overseers.

URA board members over the years have included university presidents, chief corporate executive officers, Nobel laureates, and directors of other major research laboratories. Regional group secretaries, who are faculty members at URA member universities, help to identify candidates for election to the boards of overseers.

Robert Wilson did the welding himself for Mobius Strip, *mounted atop Fermilab's Ramsey Auditorium. Wilson welded 3"x5" pieces of stainless steel to a tubular form eight feet in diameter.*

In lieu of annual dues, URA may assess its member universities as special needs arise. Since the formation of the corporation in 1965, assessments have totaled $30,000 per member. Newly elected members are assessed the amount of the most recent prior assessment.

HEADQUARTERS OFFICE

Corporate officers include leaders of the URA governing bodies (Council of Presidents and Board of Trustees) and executive officers at URA headquarters in Washington, D.C. Headquarters officers are the President, Vice President/Secretary, Chief Financial Officer/Treasurer, and General Counsel.

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1 **Kam-Biu Luk,** University of California, Berkeley
2 **Kenneth J. Heller,** University of Minnesota
3 **Sally C. Seidel,** University of New Mexico
4 **Randal C. Ruchti,** University of Notre Dame
5 **Paul D. Sheldon,** Vanderbilt University
6 **Bruce A. Barnett,** Johns Hopkins University
7 **Michael Tuts,** Columbia University

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FERMILAB BOARD OF OVERSEERS

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URA VISITING COMMITTEE FOR FERMILAB

Term Expires

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Lawrence Berkeley National Laboratory

Douglas Cowen 2005
Pennsylvania State University

Sally Dawson 2004
Brookhaven National Laboratory

Gerald Dugan. 2005
Cornell University

Lawrence Gibbons 2004
Cornell University

Yorikiyo Nagashima. 2004
Osaka University

Meenakshi Narain 2004
Boston University

Rene Ong 2004
University of California, Los Angeles

Stephen Peggs 2004
Brookhaven National Laboratory

FROM THE FERMILAB BOARD OF OVERSEERS

Donald Hartill. 2003
Cornell University

Thomas Weiler 2005
Vanderbilt University

Robert Wilson modeled the spiral staircase of Fermilab's Proton Pagoda on the DNA double helix.

FERMILAB PHYSICS ADVISORY COMMITTEE

Term Expires

Robert Cousins, Chair 2003
University of California, Los Angeles

James Alexander 2005
Cornell University

James Brau 2006
University of Oregon

Takahiko Kondo. 2006
KEK

Andrew Lankford. 2005
University of California, Irvine

Joseph Lykken 2004
Fermilab

Daniel Marlow 2007
Princeton University

Hitoshi Murayama 2006
University of California, Berkeley

Michael Peskin 2003
SLAC

Ronald Poling. 2003
University of Minnesota

Natalie Roe. 2004
Lawrence Berkeley National Laboratory

Heidi Schellman 2005
Northwestern University

Dong Su 2007
SLAC

Paul Tipton 2005
University of Rochester

Tejinder Virdee. 2004
CERN

Scott Willenbrock. 2007
University of Illinois at Urbana-Champaign

Jeff Appel
Secretary (Fermilab)

PHOTO CREDITS:
Fred Ullrich, Reidar Hahn and Jenny Mullins
Fermilab Visual Media Services

FINANCES

Universities Research Association, Inc.
OPERATING STATEMENT
Year Ended September 30, 2002

Total Revenue	$ 345,481,007

EXPENSES:

Salaries, wages and benefits	$ 164,881,868
Subcontracts and purchased services	49,169,860
Materials and supplies	23,678,399
Electric power	16,580,766
Travel, relocation and other employee allowances	7,266,312
Inventory usage	3,940,587
Fermi National Accelerator Laboratory support	281,945
Scholarships	159,500
Other	458,777
Total Operating Expenses	**$ 266,418,014**
Cost of property, plant and equipment constructed for DOE	**$ 78,588,561**
Total Expenses	**$ 345,006,525**

Flags of nations representing Fermilab's international user community fly in view from the front of Wilson Hall. High-energy physics has long been a leader in international scientific collaboration. Future progress will require even greater international cooperation to build accelerators and detectors to reach new energy frontiers.

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