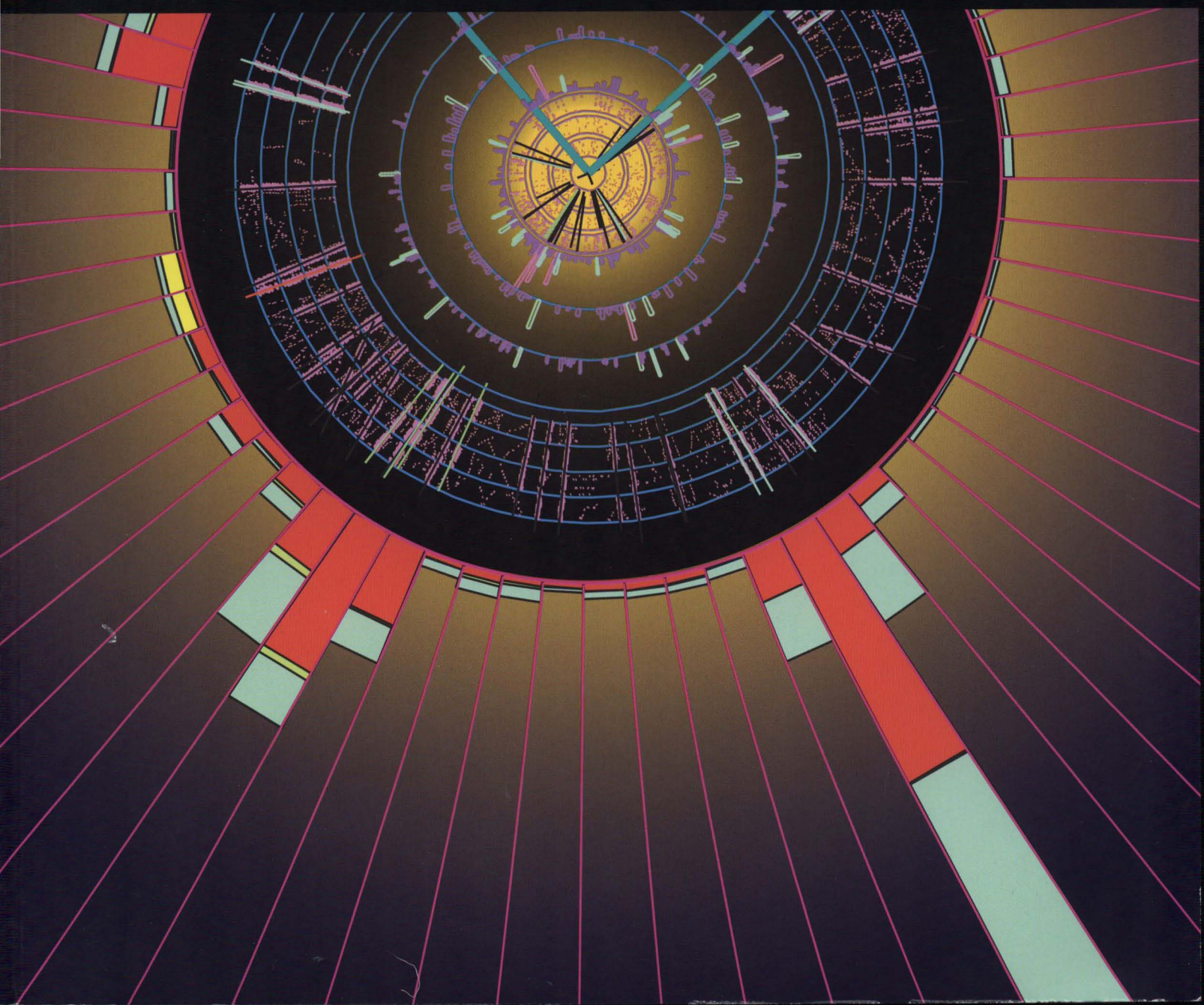
URA

Universities Research Association, Inc.

1998 Annual Report



URA Serves University Scientists

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 34 states and 24 countries use particle accelerators at Fermi National Accelerator Laboratory in Illinois for forefront research in particle physics.

URA

UNIVERSITIES RESEARCH ASSOCIATION, INC.

Annual Report 1998

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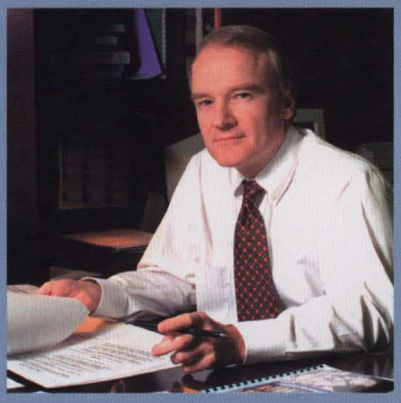
URA is a private not-for-profit corporation. A consortium of research universities, it serves as a contractor to the federal government for the operation of major scientific facilities. This volume —updated annually with new financial and organizational data—provides the historical context for the consortium's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

Message from the URA President



URA President, Frederick M. Bernthal

FOR URA, NOW WITH 89 MEMBER UNIVERSITIES, 1998 was a year of transition and progress in our mission of public service in the interest of science. Early in 1998 we began the search for a new director of Fermilab, following John Peoples' announcement of his intent to step down on July 1, 1999. With guidance from the Fermilab Board of Overseers, URA began a nationwide search for Dr. Peoples' successor, with the help of a distinguished search committee chaired by Prof. George Trilling of the University of California at Berkeley.

The director search culminated early in 1999 in the URA Trustees' appointment of Dr. Michael Witherell, professor of physics at the University of California, Santa Barbara, as the new director of Fermilab. Mike's spouse, Dr. Elizabeth Witherell, will bring her scholarly pursuits as editor-in-chief of the Papers of Henry David Thoreau Project to neighboring Northern Illinois University.

Fermilab and the nation's high-energy physics and astrophysics community owe a debt of gratitude to Dr. John Peoples, who has served with energy and distinction over the last 10 years. His foresight and persistence in planning for the Main Injector, even while the ill-fated SSC was under construction, have ensured Fermilab and U.S. preeminence in high-energy physics well into the next century.

The pastoral setting of Fermilab combines the qualities of environmental field laboratory, public park, and showcase of nature. In that bucolic setting, the Laboratory continues to deliver as world leader at the high-energy frontier of particle physics. Construction of the Main Injector, the Laboratory's newest accelerator, was completed on time and under budget in the fall of 1998. Further challenges lie ahead as the Laboratory seeks to bring the upgraded collider detectors on line in time for Tevatron Collider Run II, scheduled to begin in 2000.

The $136 million Neutrinos at the Main Injector (NuMI) project at Fermilab, an experiment designed to probe whether nature's elusive neutrinos have measurable mass, received its first DOE construction funding in 1998. When NuMI is completed, neutrinos produced at Fermilab will be seen by a detector located deep underground in the former Soudan iron mine in northern Minnesota.

Fermilab continues to serve as lead laboratory for U.S. participation in the European Large Hadron Collider Project at CERN. There U.S. scientists will work at the new high-energy frontier of particle physics beginning in the next decade, in experiments that we hope will presage a return of that frontier to the U.S. early in the next century.

Another URA milestone was achieved when the Department of Energy and the National Science Foundation agreed to fund the $7.5 million U.S. share of the first leg of the Pierre Auger Observatory Project, to be built in Mendoza province in Argentina. This $100 million project, led by Nobel-laureate Professor James Cronin of the

The URA paradigm for university-government-

University of Chicago, involves over 250 scientists from 19 countries, and will study cosmic rays of energy 10^{20} eV, some 10^{8} times greater than the energy that Fermilab is capable of producing!

URA's most visible public event was the Annual Meeting of the URA Council of Presidents, held this year in early February of 1999, with Ray Bowen, president of Texas A&M University, presiding and concluding his year as chair of the Council. Continuing our practice of combining Council business with a Policy Forum, the program featured addresses by Congressman James Sensenbrenner, chair of the House Science Committee; Dr. Neal Lane, President Clinton's new science advisor; Dr. Rita Colwell, new director of the National Science Foundation; and DOE Office of Science Director Dr. Martha Krebs. Some 70 URA member universities were represented, and the University of California, Santa Barbara and the University of Nebraska, Lincoln were elected new URA members.

URA benefits from the help of many unusually capable and distinguished individuals who provide leadership on our Board of Trustees, the Fermilab Board of Overseers, and in oversight activities. Joe B. Wyatt, chancellor of Vanderbilt University, continued in his second year as chair of the URA Trustees. Robert Galvin, chair of the Executive Committee of Motorola, has greatly assisted the cause of science and the national research enterprise at DOE, at NSF and at the Academies of Science and Engineering. He also provides his wise counsel to URA as vice-chair of the Trustees. John McTague, former vice-president for Technical Affairs at Ford Motor Company and former science advisor to the President, continued to serve as chair of the Fermilab Board of Overseers. To help ensure continuity in the pending transition in leadership at Fermilab, Prof. Frank Sciulli of Columbia University agreed to chair for a second year the Visiting Committee's annual review of Fermilab.

As these new chapters in the history of URA scientific programs unfold, our activities and plans remain grounded in the original URA Articles of Incorporation. The extraordinary talent that assembles voluntarily from around the country and the world to assist URA in its undertakings attests to the benefits of this partnership between our national laboratories and research universities. The URA paradigm for university-government-laboratory partnership has been frequently emulated, not only in DOE's activities, but in other agencies as well. We look forward to another successful year of service to the university community and to the American people, in the vital enterprise of scientific discovery.

laboratory partnership

Resolution of the Fermilab Board of Overseers In recognition of John Peoples Jr. Fermilab Director, 1989-99

JOHN PEOPLES JR. HAS HAD A LONG AND distinguished career at Fermilab, joining the Laboratory staff in 1972 and subsequently serving as head of the Proton Laboratory, head of the Research Division, project manager of the Antiproton Source, deputy head of the Accelerator Division, deputy director, and director.

Dr. Peoples, during the first half of the 1980s, led the Laboratory's development of the antiproton production technology that enables the head-on collision of protons and antiprotons in the Tevatron Collider experiments.

As Laboratory director from 1989 to 1999, he led the Fermilab community through a decade of extraordinary scientific and technical accomplishments, including discovery of the top quark and other phenomena at the frontiers of particle physics, a series of upgrades to the accelerator complex culminating in the completion of construction of the Main Injector and the innovative antiprotron recycler ring, initiation of the NuMI and MiniBooNE projects for the exploration of neutrino mass, establishment of a lead role for the Laboratory in U.S. participation in the Large Hadron Collider project, and increasing Laboratory involvement in particle astrophysics and related astronomical sciences.

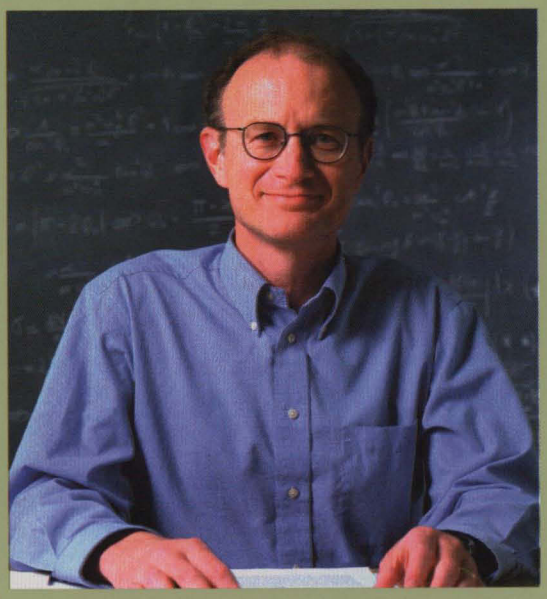
As Laboratory director, he also provided leadership for improved performance in environment, safety and health, for enhanced activities in public information and community outreach, and for continued excellence in science education through the establishment of the Leon M. Lederman Science Education Center. He also contributed to the particle physics community by serving in other leadership roles, such as chair of the International Committee on Future Accelerators and as director of the SSC Laboratory during that project's termination.

Therefore, be it resolved that the Fermilab Board of Overseers hereby recognizes John Peoples' past twenty-seven years of dedicated service to Fermilab, URA and the international physics community, especially for his ten years of outstanding leadership as Fermilab director, and wishes him continued success in his scientific endeavors at the Laboratory.

Adopted unanimously by the Fermilab Board of Overseers–June 11, 1999

Michael Witherell
Fourth Director of Fermilab

ON MARCH 5, 1999, URA ANNOUNCED THE appointment of Michael Witherell, professor of physics at the University of California, Santa Barbara, with a distinguished career in experimental particle physics, to succeed Fermilab Director John Peoples Jr., on July 1, 1999.



Dr. Witherell earned his Ph.D. from the University of Wisconsin in 1973 and has since pursued an academic career, conducting experiments at every major particle physics laboratory in the country, including Fermilab. He was an assistant professor at Princeton University from 1975 to 1981 and then moved to the University of California, Santa Barbara, where he was appointed professor in 1986.

Dr. Witherell's work in the 1980s on an experiment at Fermilab studying charm quarks brought him the prestigious W.K.H. Panofsky Prize in Experimental Particle Physics in 1990. He was elected to the National Academy of Sciences in 1998, one of the highest honors accorded a scientist in the United States. In electing Dr. Witherell, the Academy noted his pioneering work in the application of two new technologies to the study of particle physics: silicon vertex detectors and high-speed data acquisition systems. Both technologies, now far more advanced, are extensively employed at Fermilab and other high-energy physics laboratories to study the fundamental structure of matter. Dr. Witherell's work, the Academy wrote, "profoundly influenced all subsequent experiments aimed at the study of heavy-quark states."

More recently, Dr. Witherell's research has focused on understanding the source of the asymmetry between matter and antimatter known as CP violation. Since 1993, Dr. Witherell has been working on the design and construction of the BaBar experiment at the Stanford Linear Accelerator Center. The experiment, to begin operating this year, will measure the asymmetry in decays of B mesons, particles composed of a bottom and an anti-bottom quark. Although CP violation was first discovered in neutral kaons, scientists expect to gain further insight into the phenomenon by studying B particles.

Prior to his appointment as the next Fermilab director, Dr. Witherell served for three years as chair of the High Energy Physics Advisory Panel, which advises the U.S. Department of Energy on funding priorities for particle research.

Member Universities

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ARIZONA
Arizona State University
University of Arizona

CALIFORNIA
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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

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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
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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
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UTAH
University of Utah

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

WASHINGTON
University of Washington

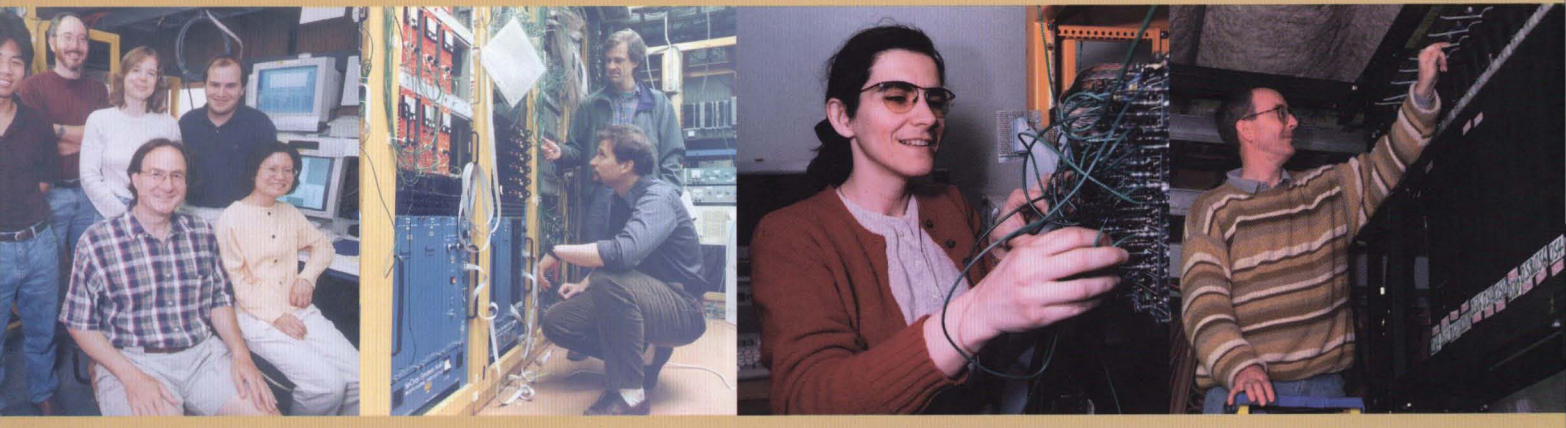
WISCONSIN
University of Wisconsin-Madison

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

Fermilab Director,1989-99, John Peoples Jr.

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.

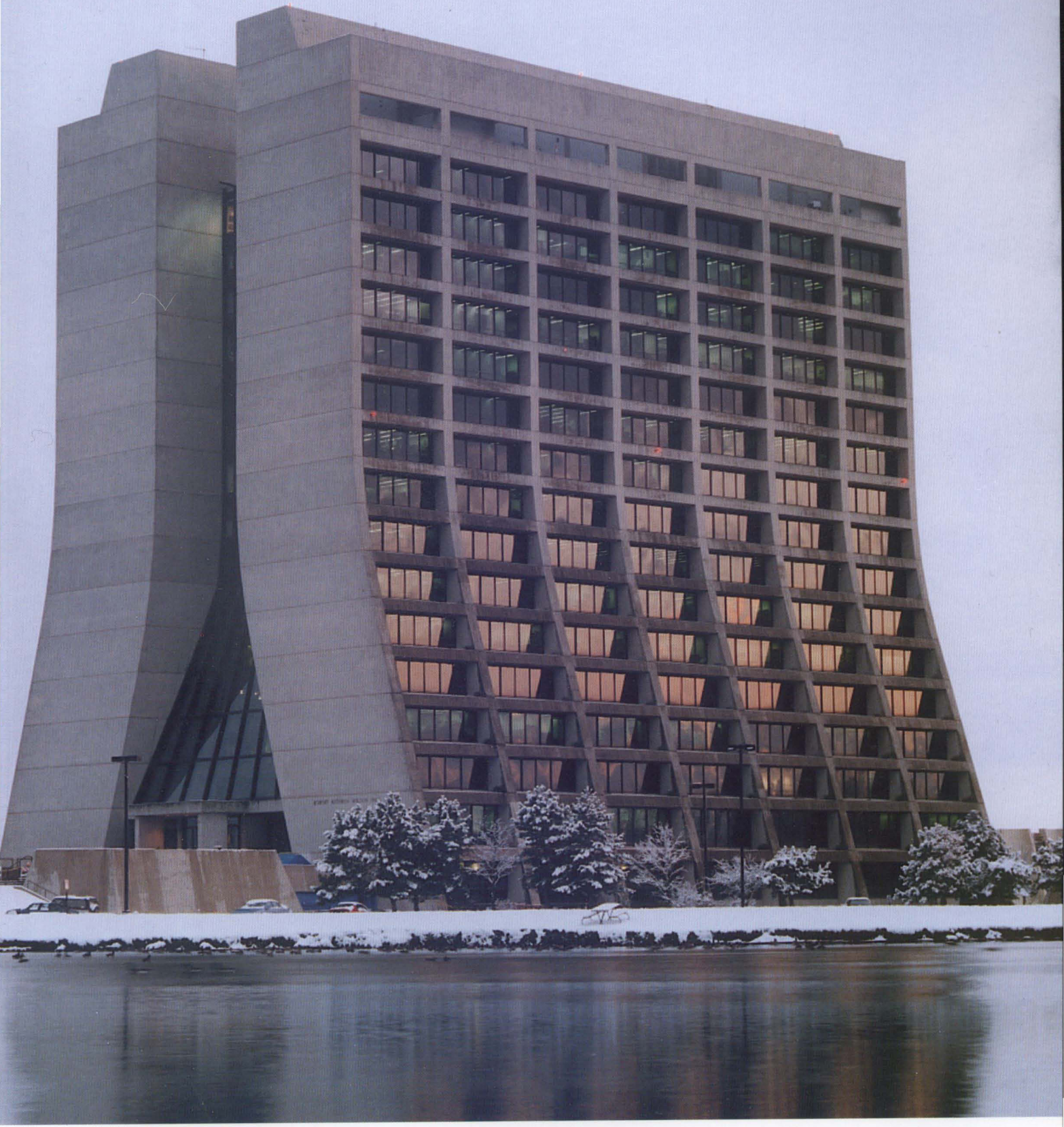
Circling through rings of magnets four miles in circumference, particle beams generate experimental conditions equivalent to those that existed in the first trillionth of a second after the birth of the universe. This capability to recreate the energy levels of the Big Bang places Fermilab at the frontier of global 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 is the home of the world's highest-energy particle accelerator, the Tevatron, which can operate as a proton-antiproton collider or as a source of high-energy beams for fixed-target experiments.

Fermilab currently provides research facilities for about 2,100 particle physicists, from 200 institutions in 34 states and 24 foreign countries. Typically, the U.S. scientists' research is supported by DOE and the National Science Foundation, and in some cases by university funds.

Fermilab began in the early 1970s with a single beam of protons directed at a fixed target 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 trillion-electron-volt 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 temporarily interrupted taking data at the frontiers of particle physics in order to make major improvements to the Fermilab collider complex and the two major collider detectors.

Fermilab completed a most successful year in 1998. During this year, experiment collaborations uncovered new scientific results from preceding collider and fixed-target runs, and the Laboratory completed important accelerator-related projects to produce new physics in the next few years. R&D and planning continued on new experiments and on options for future accelerators. In addition, the Laboratory continued its collaboration in three important projects at the forefront of research in astrophysics.

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



In the year 2000, when Collider Run II begins at Fermilab, scientists from U.S. universities and others around the world will resume probing the smallest dimensions that humans have ever examined. These scientists will have the world's best opportunity to make important discoveries that could answer some of today's great questions, not only in elementary particle physics, but also in the exploration of the earliest moments of the universe. For example, discovery of the Higgs boson would lead to an understanding of what determines the observed masses of elementary particles. Another example would be definitive observations in support of supersymmetry, the theory that predicts that for every fundamental particle there should exist another related and as yet undiscovered new particle, and that shows how three of the four fundamental forces in nature can be unified.

Fermilab scientists will have the world's best opportunity for discoveries.

HIGHLIGHTS OF 1998

In 1998, the various collaborations of experimenters at Fermilab produced a total of 96 publications based on results from the 1996-97 800-GeV fixed-target run and from further analysis of data from Collider Run I. Major physics results reported during 1998 and early 1999 include first indications at CDF of charge-parity violation (matter-antimatter asymmetry) in the decay of neutral B-mesons, the discovery of the B_c (the last remaining unobserved meson, or quark-antiquark pair), more precise measurements by CDF and DZero of the W-boson mass, a direct observation by KTeV of time reversal violation in the behavior of neutral kaons, and the firm establishment, also by KTeV, of direct charge-parity violation in the neutral kaon system.

The 1996-1997 fixed-target run was historic not only for the physics performance it achieved, but also because it is the last of its kind at Fermilab. Although the Laboratory plans to run a 120-GeV fixed-target program in the future, this last series of 800-GeV experiments will in many ways close a very important chapter in the history of Fermilab. A limited six-month 800-GeV run with the Tevatron is scheduled in 1999 for two of the fixed-target experiments, KTeV and HYPERCP, to complete "unfinished business." KTeV is bringing unprecedented precision to the study of matter-antimatter asymmetry in the behavior of kaons. HYPERCP has the goal of observing the direct manifestation of the forces between particles and their antiparticles. In addition, a program to study charmonium production is scheduled to resume taking data in the antiproton accumulator in late 1999. Even during this six-month run, however, most of the Laboratory's resources will be concentrated on completing the Main Injector project and the upgrades of the two collider detectors, CDF and DZero, and on preparing for collider physics.

MAIN INJECTOR

In keeping with Fermilab's mission to provide facilities for frontier research in high-energy physics, the Laboratory continued its projects to improve accelerators, detectors and supporting facilities during 1998. The Main Injector is a new 120-GeV accelerator that will serve as an injector to the Tevatron and the driver for the production of the antiprotons collected by the Antiproton Source. When it begins operating, it will allow Fermilab to increase the rate of antiproton production. The Recycler is a storage ring that will allow the recapture of most of the antiprotons that have heretofore been discarded at the end of each collider store, to increase the number of antiprotons available for colliding beams. All of the planned improvements combined will provide 10 times more collisions per hour of operation than in Run I, the previous collider run at Fermilab. FY1998 marked the final year of funding for the $260 million Main Injector project. By early 1999, six of seven commissioning goals had been achieved, and the project was on target for completion on schedule and on budget. The first phase of Recycler commissioning was also moving forward.

Civil construction for the Main Injector project

Although the Main Injector project got most of the limelight, Fermilab also used the shutdown that began in September 1997 to make improvements in the rest of

In keeping with Fermilab's mission to provide

the accelerator complex, including improved performance of the Tevatron, completion of a major rebuild of the Antiproton Source, and improved performance of the Booster and Linac. Technical modifications are being made to the Tevatron to allow 36 bunches of protons and antiprotons to collide, rather than the six bunches of the last collider run. In addition, construction work was nearly completed for a new experimental hall at CZero. It has been proposed to use the new hall for an experiment dedicated to the physics of the B meson, including an exploration of the matter-antimatter asymmetry in the universe.

CDF AND DZERO

Fermilab's two collider detectors must also reinvent themselves for the new high-luminosity environment of Run II. In late 1996, the CDF and DZero collaborations began to tear apart the detectors that observed the top quark. Now the tearing apart is done and the rebuilding is under way. In the year 2000, these more sophisticated, more agile and more powerful detectors will be ready to extract new data from the barrage of high-energy collisions created by the Tevatron at the rate of a petabyte (10^{15} bytes) of data per year. (It would take a billion floppy disks to hold a petabyte of data.) The Run I data sample of 40 terabytes per detector will be dwarfed by this prodigious new technological challenge.

Both the CDF and DZero upgrades have made significant progress toward the goal of being ready for physics in the year 2000. Foremost among the challenging schedule issues has been delivery of silicon sensors and readout chips for particle tracking. However, both detectors are currently expected to roll into the beamline by late summer or fall of the year 2000.

Steve Blusk of the University of Rochester views the cooling test stand for chip and ladder assemblies to be used at CDF.

facilities for frontier research in high-energy physics, the Laboratory improved accelerators, detectors and supporting facilities during 1998.

Physicist Bob Wagner with the silver replacement spool for the central tracking chamber for the upgraded CDF detector.

THE LARGE HADRON COLLIDER

As Fermilab prepares for its next collider run, the Laboratory also has a

A Fermilab experiment will explore the question whether neutrinos are massless, or actually have a small mass.

significant role in building the collider that will eventually overtake the Tevatron at the energy frontier. On December 8, 1997, U.S. government and CERN officials signed an agreement under which the U.S. will help build a proton-proton collider, the Large Hadron Collider at CERN, the European Particle Physics Laboratory. Through DOE and NSF, the United States is investing $531 million over eight years in the LHC and two of its associated 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 operating sometime after 2005, it will reach an 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 energy.

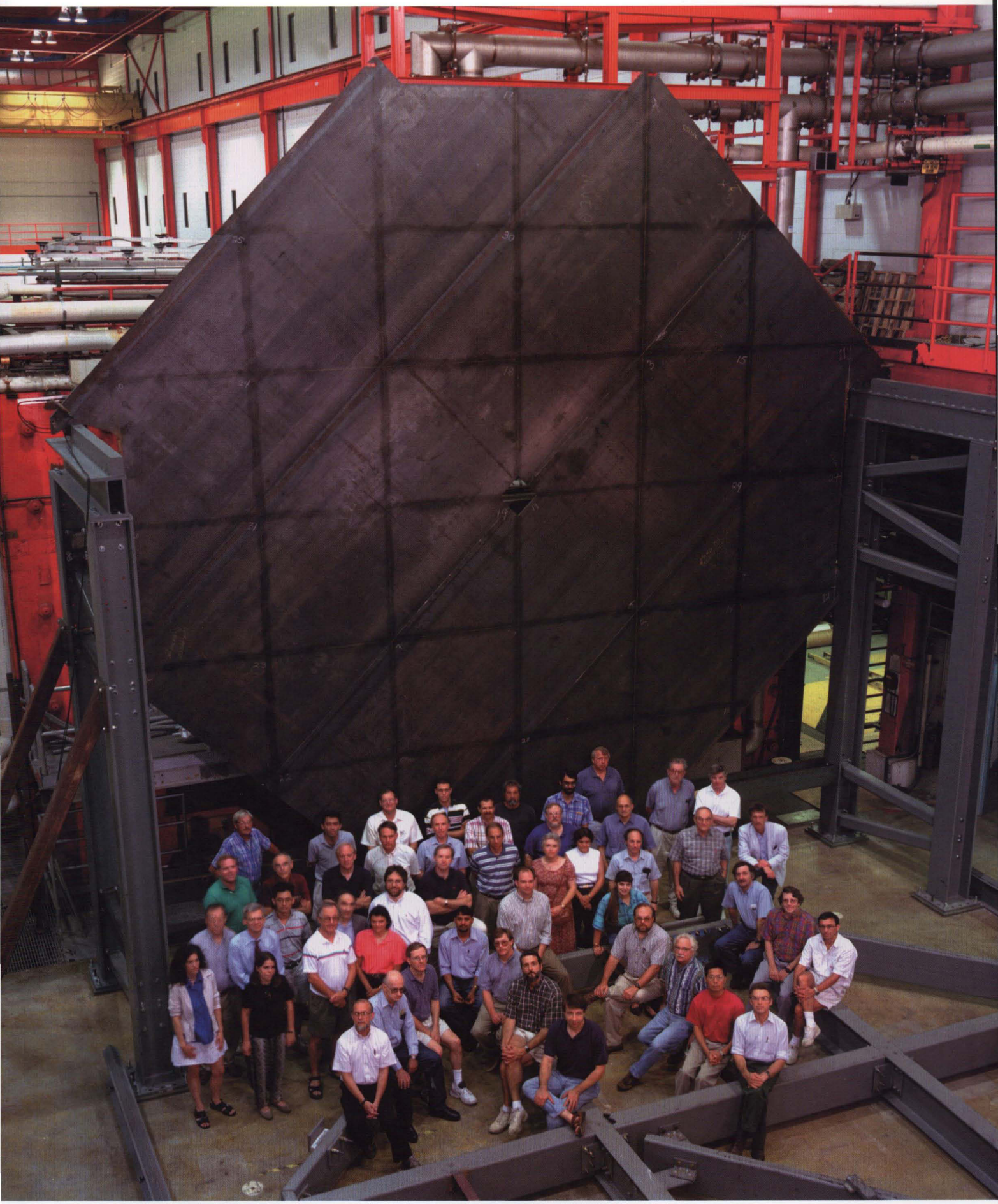
U.S. participation in the LHC has important consequences for Fermilab. The Technical Division's Jim Strait is the project manager for the U.S. contribution to the accelerator, leading a collaboration that includes Brookhaven and Lawrence Berkeley National Laboratories and Fermilab. Most of the R&D for the advanced superconducting quadrupole magnets for the LHC's interaction regions has been done at Fermilab, and most of the fabrication of these magnets will also take place at Fermilab.

In 1997, DOE and NSF 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 as its host laboratory, and Fermilab and URA agreed. During 1998, memoranda of understanding between Fermilab and the U.S. collaborating institutions were drafted and the first of the annual statements of work were circulated. Fermilab has also been investigating how to provide management of the major U.S. CMS regional computing center.

NUMI AND MINIBOONE

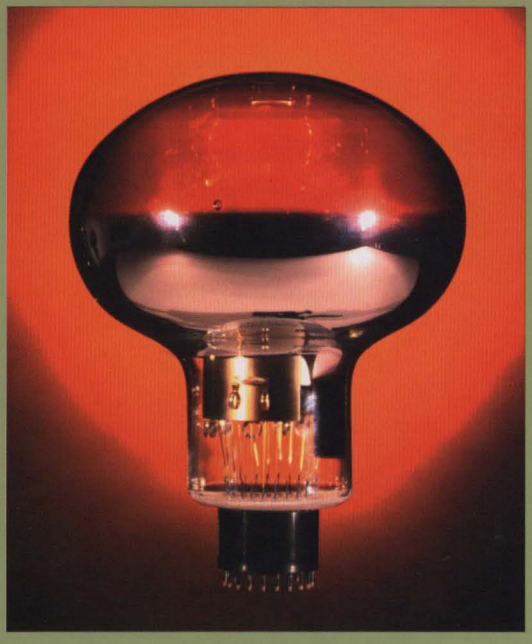
In project NuMI (Neutrinos at the Main Injector), Fermilab will provide a high-intensity neutrino beam for experiments that will explore the question of whether neutrinos are, in fact, massless or actually have a small mass. Fermilab will use the Main Injector to create a beam of muon neutrinos aimed through the earth to the MINOS experiment, a detector deep underground in the former Soudan iron mine in northern Minnesota. If MINOS should reveal that some of the muon neutrinos have changed "flavor" to become tau neutrinos during their 730-kilometer journey from Fermilab to Minnesota, that change would show that neutrinos do indeed have mass. If they do, the implications of such a discovery will be profound. Design and engineering work for the beamline began in late 1997. In Fall 1998, DOE reviewed favorably the status of the NuMI project and the MINOS experiment. A strong project team is in place, funding for the MINOS detector is starting to flow

The MINOS collaboration before a prototype slice of the neutrino detector.



to the collaborating institutions, and civil construction is scheduled to start in 1999, both on the Fermilab site and at Soudan. The Laboratory expects that the NuMI experiment will begin operating in late 2002, or early 2003.

During 1998, Fermilab, DOE and NSF approved a separate, complementary neutrino experiment, MiniBooNE, which will use beam from Fermilab's 8-GeV



Prototype phototube for the MiniBooNE detector.

Booster. The MiniBooNE collaboration will search for the flavor change of muon antineutrinos to electron antineutrinos, and will provide a definitive answer to evidence for such neutrino oscillations claimed by an experiment based at Los Alamos National Laboratory.

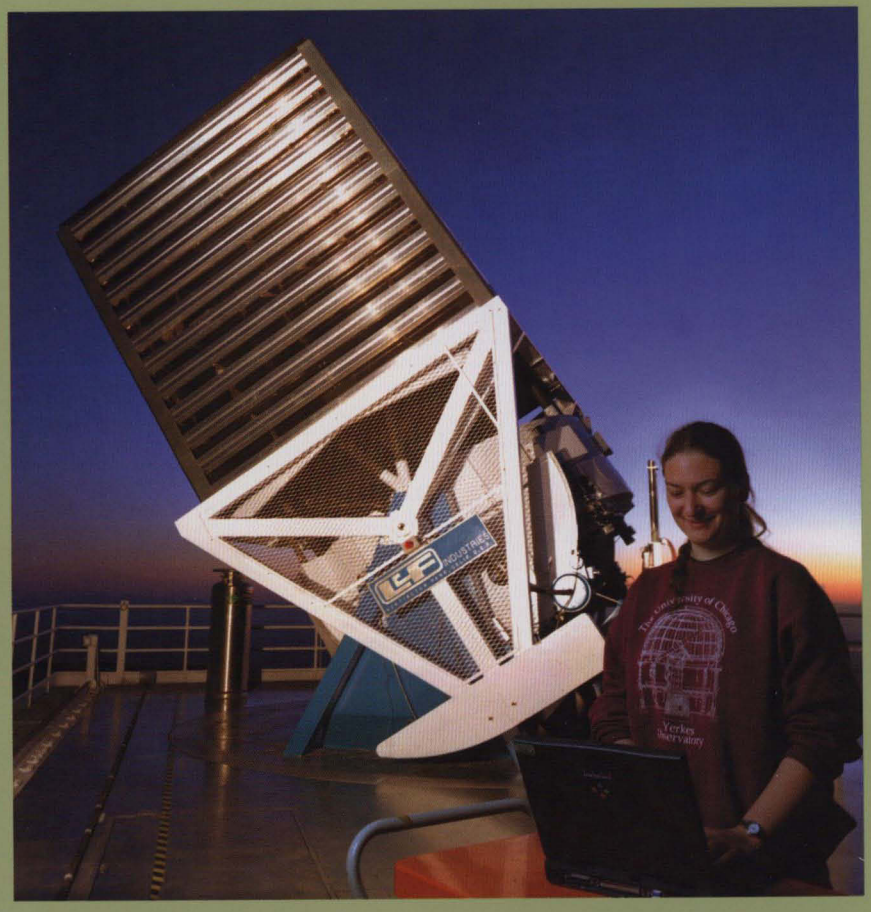
ASTROPHYSICS

The late David Schramm helped to bring astrophysics to Fermilab. He provided the inspiration that led to the creation of the Theoretical Astrophysics group at Fermilab in 1983. Together with astrophysicists Rocky Kolb and Mike Turner, he defined its scientific focus to be the early universe, and then he gave it energy and imagination to make it successful. He urged the creation of an Experimental Astrophysics Group to complement the theoretical work. Such a group emerged at Fermilab in 1986, and is now working in close partnership with the University of Chicago's Astrophysics Department on the Sloan Digital Sky Survey. While a member of the Fermilab Board of Overseers, Dave urged that the Laboratory's scientific program be expanded to include particle physics in the early universe, the exciting boundary between the traditional realm of particle physics and the field of 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 these massive particles are underway. Fermilab has joined the Cold Dark Matter Search of the University of California-Berkeley, Stanford and Case

Fermilab is also engaged in a project that aims

Western Reserve collaboration. 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. Because the performance of the detectors has met expectations, the collaborators are planning a much larger experiment, deep underground in the same Soudan Mine in northern Minnesota where the NuMI project will locate its detector.



University of Chicago graduate student Connie Rockosi at the Sky Survey telescope in Apache Point, NM.

to find out how matter, both dark and luminous, is distributed.

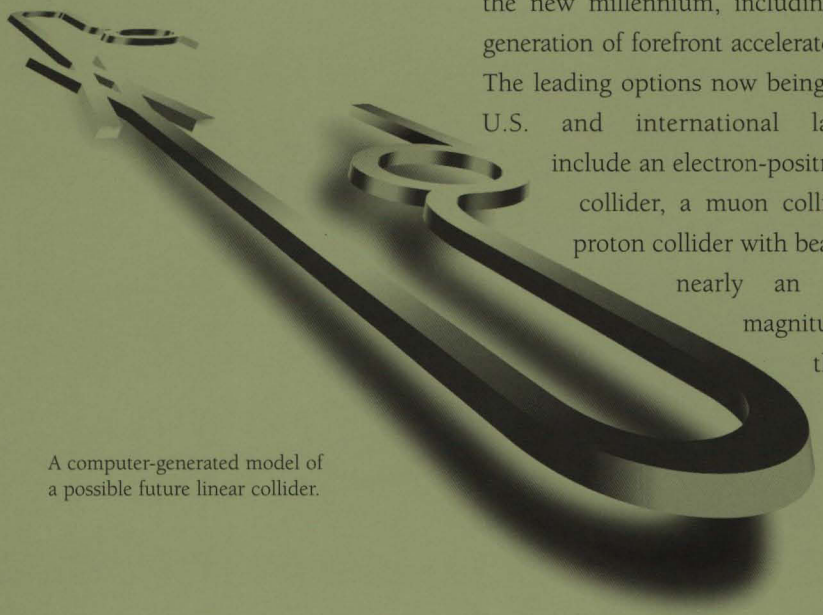
Fermilab is also engaged in a project that aims to find out how matter, both dark and luminous, is distributed. This project, the Sloan Digital Sky Survey, will measure the location and red shift of a million galaxies and a hundred thousand quasars in the northern galactic cap. Among Fermilab's many contributions to this project is 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 collaboration, comprising the University of Chicago, Fermilab, Johns Hopkins University, Princeton University, Japan Participation Group, the U.S. Naval Observatory and the University of Washington, has built a 2.5 meter telescope and the associated instruments located at Apache Point, New Mexico. First light in the telescope was recorded with the telescope and imaging camera in May 1998. First images are being recorded, and catalogs of multi-wavelength photometry are being assembled. Scientific results are already being produced from engineering data; 17 new high-redshift quasars have been discovered, and one of these has the largest redshift ever observed.

As a member of an international collaboration of 19 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.)

The U.S. high-energy physics community has been assessing the most promising directions for the new millennium.

PLANS FOR THE FUTURE

Although preparing for the exciting new science at Fermilab requires all the resources that the Laboratory can muster, planning has begun for the day when the Tevatron no longer represents the energy frontier. The U.S. high-energy physics community has been actively assessing the most promising directions for the field in the new millennium, including the next generation of forefront accelerator facilities. The leading options now being studied at U.S. and international laboratories include an electron-positron linear collider, a muon collider and a proton collider with beam energies nearly an order of magnitude greater than those available at the LHC. Fermilab is collaborating with a number of other laboratories and universities in investigations of these challenging options.



A computer-generated model of a possible future linear collider.

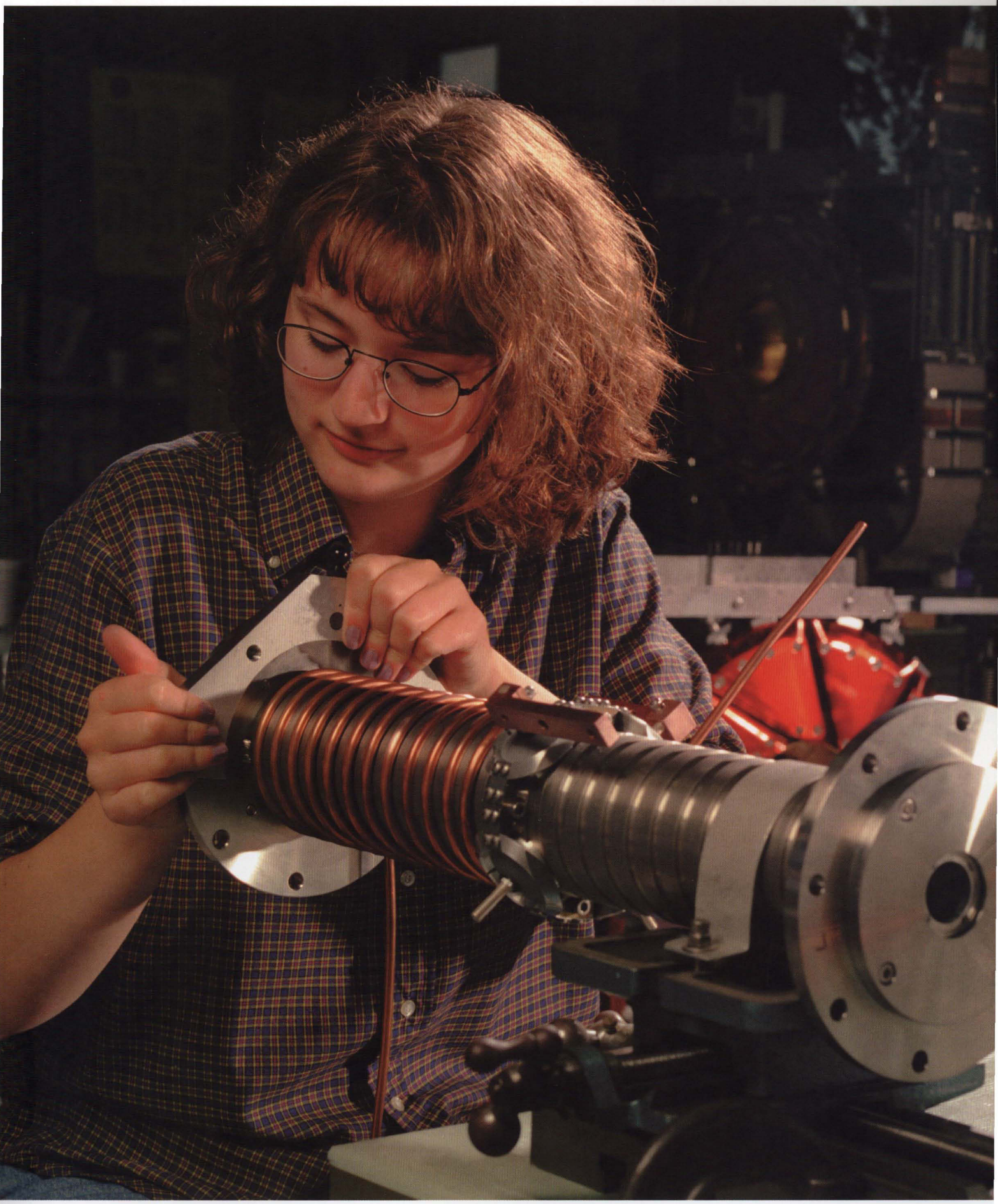
Up to now, groups at Fermilab have been focusing on two of the collider options: a very large proton-proton collider with a center-of-mass energy of 100 TeV and a 4 TeV center-of-mass muon-muon collider. Both approaches would take particle physics into the realm of discovery well beyond the LHC. Each offers distinct advantages and each presents great technical challenges. All three options will require significant R&D funds in the first few years of the next decade to establish their feasibility and affordability. Credible cost estimates are required for each of these approaches. Because the time horizon for particle accelerators is so long, the groups have already begun exploring conceptual designs and are identifying critical technical and cost issues.

SCIENCE EDUCATION

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 former Fermilab director 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 1998 of over 22,000 students and 6,500 teachers. The Center offers some 20 programs—teacher enhancement workshops and institutes, opportunities for research participation, development and distribution of instructional materials, a collection of teachers' resources, Laboratory tours, special events, class field trips, and science shows. Currently, 75 percent of the Center's funding is provided by Fermilab, and 25 percent comes from other federal, state and private sources.

Patricia Blankenberger, a summer co-op student from Bradley University, works on a piece of equipment in the Antiproton Source.



Volunteers at the annual Fermilab prairie harvest

URA also provides financial support for graduate courses at Fermilab. 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.

Fermilab sponsors fellowships, participates in a Joint University-Fermilab Doctoral Program in Accelerator Physics, and, in collaboration with other laboratories and U.S. universities, helps sponsor the U.S. Particle Accelerator School. The Laboratory also supports faculty members through a guest scientist program and as visitors to the Theory Group.

ENVIRONMENTAL ACTIVITIES

In addition to research in high-energy physics, Fermilab has been designated a National Environmental Research Park by DOE. The Laboratory maintains careful vigilance over restoration and preservation of the site's ecosystems. Over the years, the Laboratory has restored over 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 continued to improve its environmental monitoring program by adding six new ground-water monitoring wells, and conducting numerous hydrogeological studies. The goal of this work is to continually improve the Laboratory's ability to efficiently protect groundwater resources. The Fermilab environmental staff maintains a close partnership with state geologists to increase substantially the Laboratory's contribution to the knowledge of Illinois geology.

Fermilab is committed to using waste minimization and pollution prevention strategies to reduce environmental contam-

ination wherever possible. In 1998, Fermilab received a commendation award from DOE as the only laboratory to meet its affirmative procurement goals for the purchase of recycled products. The Laboratory also began a program to recycle fluorescent lightbulbs, and to replace existing bulbs, which contain high levels of mercury, with bulbs that use less energy and contain lower mercury levels.

As host of the second consecutive annual DOE-wide Environmental Monitoring Workshop in May 1998, Fermilab continues to establish itself as a leader among DOE laboratories in environmental protection policies and procedures.

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 Laboratory technologies. Symposia, tours, and exhibits at the Laboratory encourage the exchange of information between Laboratory staff and industry specialists. The ORTA also identifies and evaluates 15 to 20 technological innovations each year.

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 2500 patients have received treatment at Fermilab's Neutron Therapy Facility. About 25 percent of these patients reside outside Illinois, including individuals from Haiti, Greece, Pakistan, Canada, Mexico and the Philippines. Since 1995 the facility has been 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.

COMMUNITY PROGRAMS

Fermilab's role as a key element of Illinois's 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.

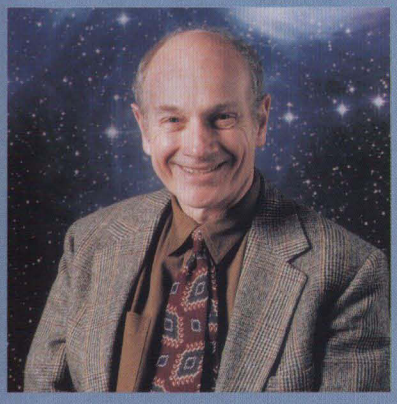
LABORATORY DIRECTORS

On March 5, 1999, URA announced the appointment of Michael Witherell as Fermilab's fourth director, effective July 1, 1999. Dr. Witherell succeeds John Peoples Jr., who led the Laboratory with distinction from 1989 to 1999. (See career profiles for Dr. Peoples and Dr. Witherell on pages 4 and 5.)

Fermilab's founding director, Robert R. Wilson, served from 1968 to 1978, and has been a member of URA's Fermilab Board of Overseers. Dr. Wilson has provided continuing guidance for the aesthetics of buildings and grounds, including sculpture that he created. Leon M. Lederman, a 1988 Nobel Laureate, directed the Laboratory from 1979 to 1989 and is a member of the URA Board of Trustees. His contributions to science education are known worldwide.

One of founding director Robert R. Wilson's many sculptures on the Fermilab site.

Pierre Auger Observatory Project



James W. Cronin, of the University of Chicago, Nobel-laureate and co-leader of the Pierre Auger Observatory Project

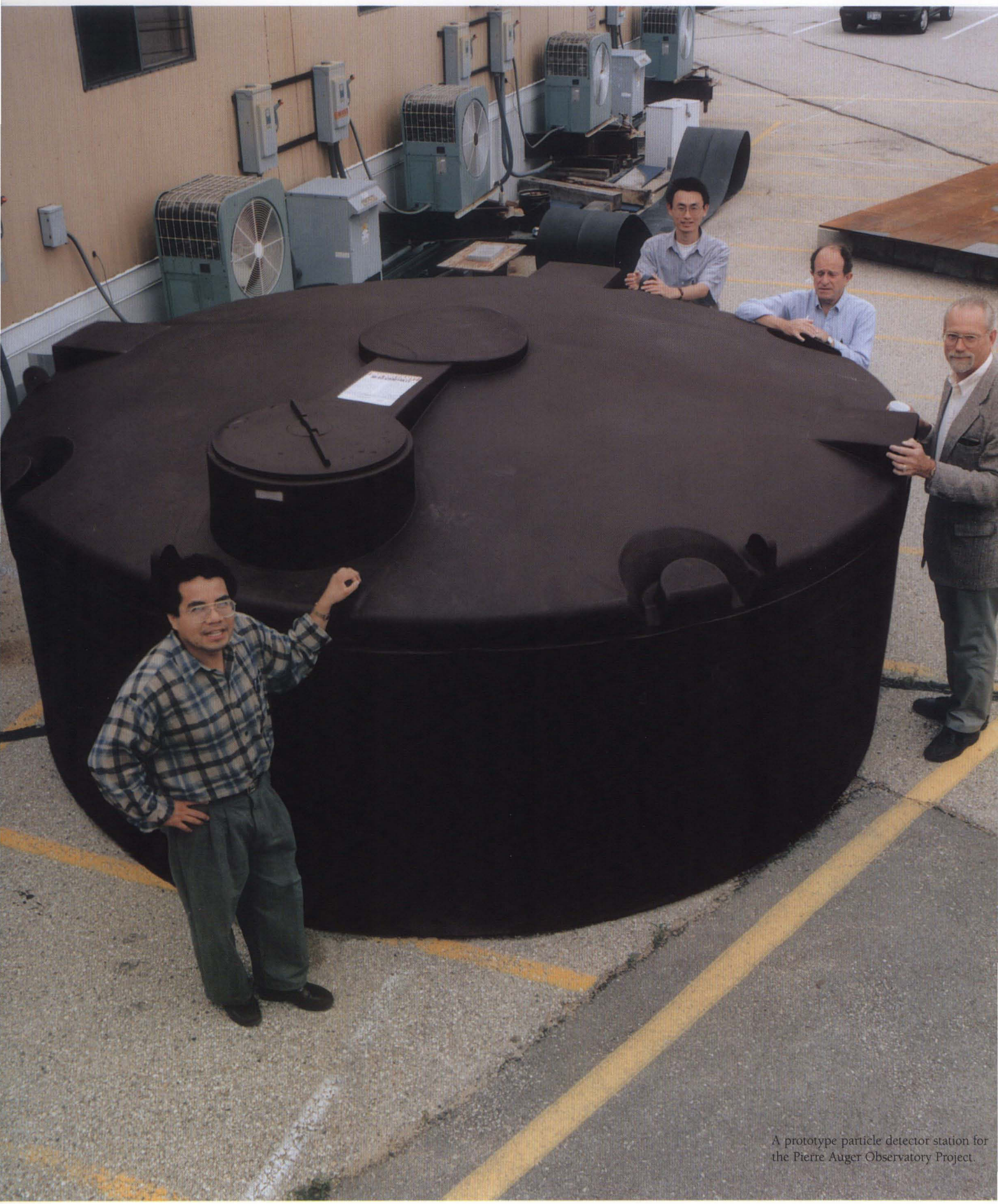
COSMIC RAYS ARE FAST-MOVING PARTICLES from space that constantly bombard the earth from all directions. Most of the particles are either electrons or the nuclei of atoms. Of the nuclei, the majority are single protons—the nuclei of hydrogen atoms—but a few are much heavier, ranging up to the nuclei of lead atoms. Cosmic ray particles travel at nearly the speed of light, which means they have very high energy. Some of them, in fact, are the most energetic particles ever observed in nature. To discover the source of cosmic ray particles, scientists measure their energy and their direction as they arrive from space. To measure cosmic ray particles directly requires sending detectors to heights above most of the earth's atmosphere, using high-flying balloons and satellites. However, scientists can also detect cosmic rays indirectly on the surface of the earth by observing the showers of particles they produce in the air, as discovered by Pierre Auger about 60 years ago.

The Pierre Auger Observatory Project is a broad-based international effort to make a detailed study of the highest 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's co-leaders are Dr. James W. Cronin, professor of physics, University of Chicago and Dr. Alan A. Watson, professor of physics, University of Leeds in the United Kingdom. Thus far, the Pierre Auger collaboration includes over 250 scientists from Argentina, Armenia, Australia, Bolivia, Brazil, China, France, Germany, Greece, Japan, Italy, 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.

Because the highest-energy cosmic rays are so rare, scientists must cast a huge net to capture even a few. The Pierre Auger Observatory would consist of two giant 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 would 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.

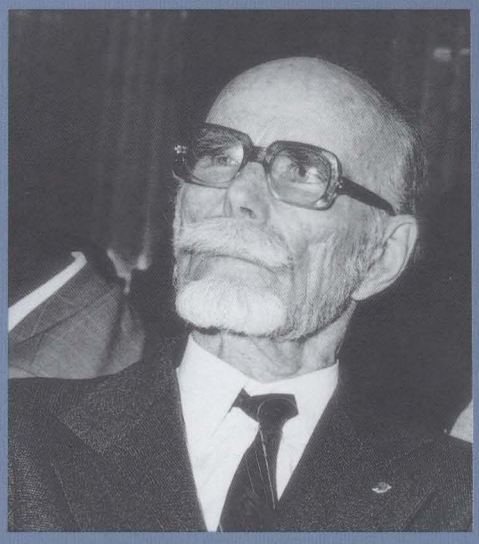
On behalf of the U.S. Project participants under Dr. Cronin's leadership, URA in March 1998 submitted a revised proposal to the National Science Foundation and the Department of Energy, in response to an interagency advisory committee and other reviewers. The two agencies have agreed to provide $7.5 million over four years toward the U.S. share for the construction of the southern hemisphere site. This is to be followed by construction of the northern hemisphere site.

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 the future, URA would also



A prototype particle detector station for the Pierre Auger Observatory Project.

oversee site preparation, construction, and operations at the Utah site. To implement these responsibilities, URA awards subgrants or subcontracts, based on memoranda of understanding with participating institutions. In addition, DOE and NSF have designated URA to be the agent representing the two U.S. agencies on the project's international Finance Board.



French physicist Pierre Auger, who first studied cosmic rays by observing the showers of particles they produce in air.

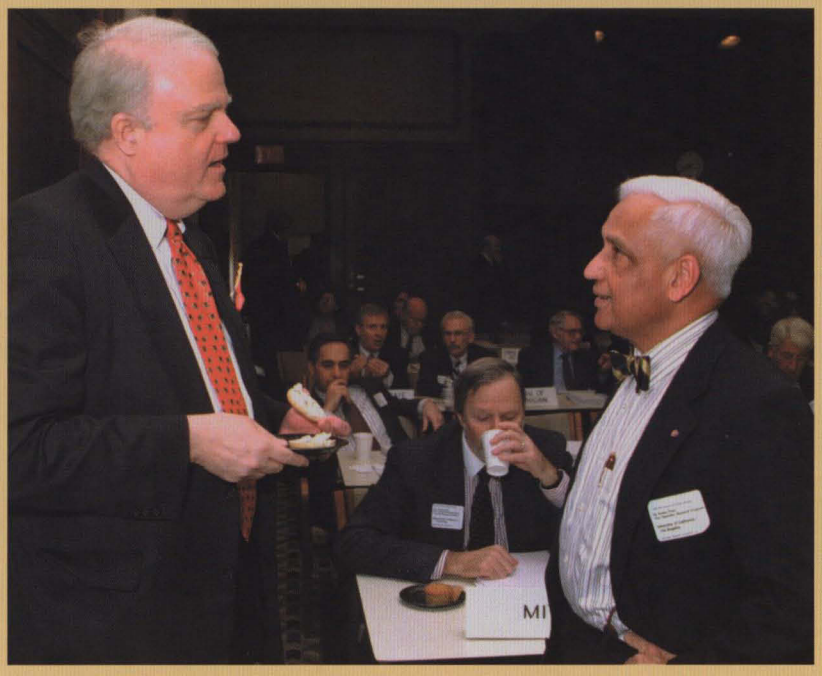
Two giant observatories—each containing 1,600 detectors spaced 1.5 kilometers apart over an area of 3,000 square kilometers—will track the unknown source of very-high-energy cosmic rays.

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 - 1998

Congressman James Sensenbrenner (R-WI), chairman of the House Science Committee, talks with Kumar Patel, UCLA vice chancellor for research programs, at the 1998 URA Council of Presidents meeting.



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.

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.

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

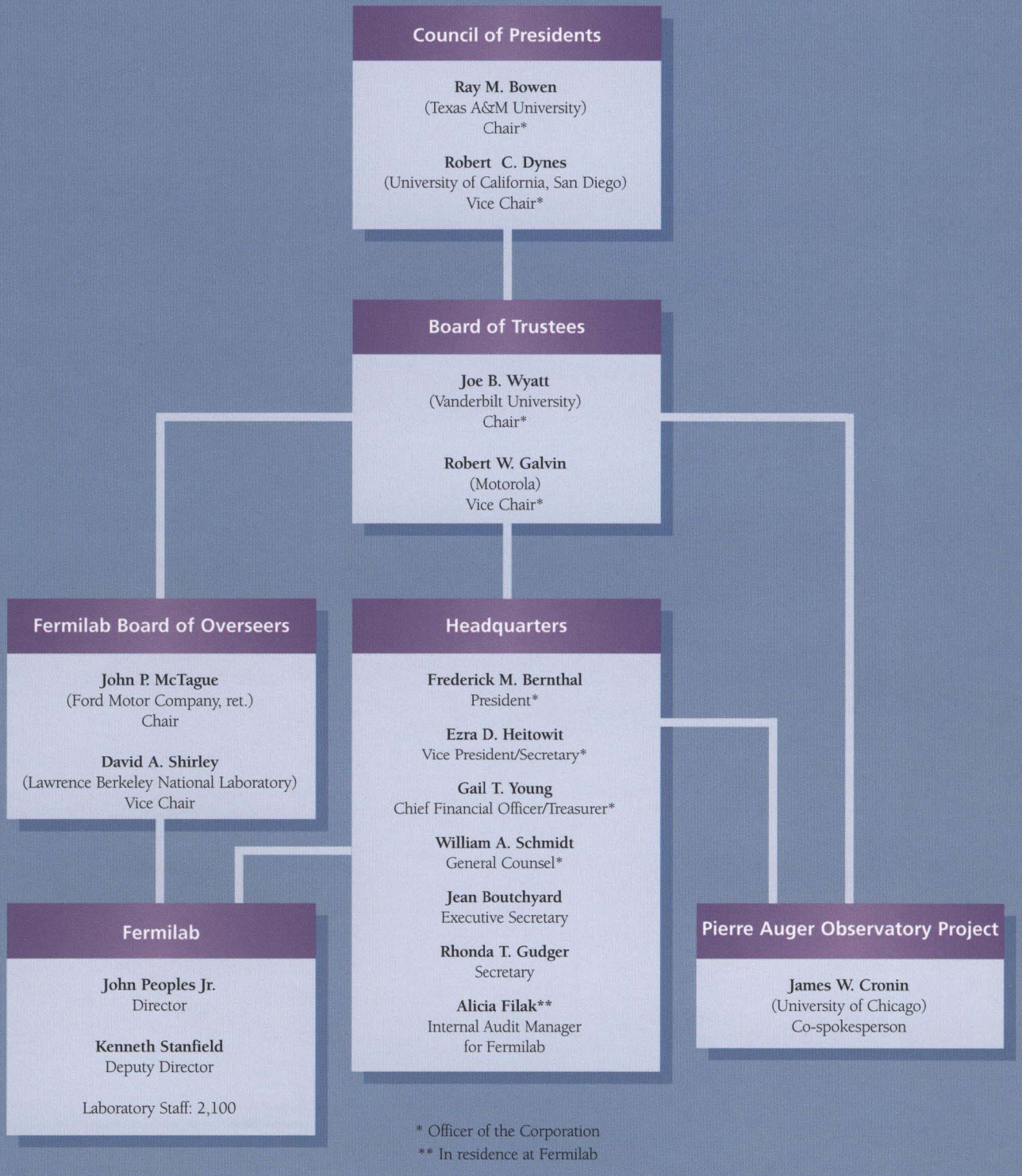
Council of Presidents

University of Alabama-Tuscaloosa	Andrew Sorensen
Arizona State University	Lattie F. Coor
University of Arizona	Peter Likens
Boston University	Jon Westling
Brown University	E. Gordon Gee
California Institute of Technology	David Baltimore
University of California-Berkeley	Robert M. Berdahl
University of California-Davis	Larry N. Vanderhoef
University of California-Irvine	Ralph J. Cicerone
University of California-Los Angeles	Albert Carnesale
University of California-Riverside	Raymond L. Orbach
University of California-San Diego	Robert C. Dynes
University of California-Santa Barbara	Henry T. Yang
Carnegie Mellon University	Jared Cohon
Case Western Reserve University	David H. Auston
University of Chicago	Hugo F. Sonnenschein
University of Colorado-Boulder	Richard L. Byyny
Columbia University	George Rupp
Cornell University	Hunter R. Rawlings, III
Duke University	Nannerl Overholser Keohane
Florida State University	H. Talbot D'Alemberte
University of Florida	John Lombardi
Harvard University	Neil Rudenstine
University of Hawaii-Manoa	Kenneth P. Mortimer
University of Houston	Arthur K. Smith
University of Illinois-Champ./Urbana	Michael Aiken
Indiana University	Myles Brand
Iowa State University	Martin Jischke
University of Iowa	Mary Sue Coleman
Johns Hopkins University	William R. Brody
Kansas State University	Jon Wefald
Louisiana State University	Mark A. Emmert
McGill University	Bernard Shapiro
University of Massachusetts-Amherst	David K. Scott
University of Maryland-College Park	C. D. Mote, Jr.
Massachusetts Institute of Technology	Charles M. Vest
Michigan State University	M. Peter McPherson
University of Michigan	Lee C. Bollinger
University of Minnesota	Mark G. Yudof
University of Nebraska-Lincoln	James C. Moeser
University of New Mexico	William C. Gordon
New Mexico State University	William B. Conroy
SUNY - Buffalo	William R. Greiner
SUNY - Stony Brook	Shirley Strum Kenny
University of North Carolina-Chapel Hill	William O. McCoy
University of North Texas	Alfred F. Hurley
Northeastern University	Richard M. Freeland
Northwestern University	Henry S. Bienen
University of Notre Dame	Edward A. Malloy, C.S.C.
Ohio State University	William E. Kirwan
University of Oklahoma	David L. Boren
University of Oregon	Dave Frohnmayer
Pennsylvania State University	Graham B. Spanier
University of Pennsylvania	Judith Rodin
University of Pisa	Luciano Modica
University of Pittsburgh	Mark Nordenberg
Princeton University	Harold T. Shapiro
Purdue University	Steven C. Beering
Rice University	Malcolm Gillis
University of Rochester	Thomas Jackson
Rockefeller University	Arnold J. Levine
Rutgers, The State University of New Jersey	Francis L. Lawrence
University of South Carolina	John M. Palms
Stanford University	Gerhard Casper
Syracuse University	Kenneth A. Shaw
University of Tennessee-Knoxville	William T. Snyder
University of Texas-Arlington	Robert E. Witt
University of Texas-Austin	Larry R. Faulkner
University of Texas-Dallas	Franklyn G. Jenifer
Texas A&M University	Ray M. Bowen
Texas Tech University	Donald R. Haragan
University of Toronto	J. Robert S. Prichard
Tufts University	John DiBiaggio
Tulane University	Scott S. Cowen
University of Utah	J. Bernard Machen
Vanderbilt University	Joe B. Wyatt
Virginia Polytechnic Institute	Paul E. Torgersen
University of Virginia	John T. Casteen, III
Waseda University	Takayasu Okushima
Washington University	Mark S. Wrighton
University of Washington	Richard L. McCormick
Wayne State University	Irvin D. Reid
College of William and Mary	Timothy J. Sullivan
University of Wisconsin-Madison	David Ward
Yale University	Richard C. Levin

Associate Members

Northern Illinois University	John LaTourette
Prairie View University	Charles A. Hines
San Francisco State University	Robert A. Corrigan
Southern Methodist University	R. Gerald Turner

Universities Research Association, Inc.
1998 Organization Chart



* Officer of the Corporation
** In residence at Fermilab

Corporate Structure

Membership and Governance

As a non-profit corporation, URA acts under the direction of its governing body, the Council of Presidents of its 89 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 currently responsible for oversight and governance of Fermilab and for corporate relations with the Federal government, industry, academe, and the general public.

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 2,100.

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 eight 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 chief executive officers of major industrial corporations, corporate vice-presidents, and university presidents and vice-presidents. Boards have also included winners of major science prizes, including Nobel laureates, as well as 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.

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 headquarters in Washington, D.C. Headquarters officers are the president, vice-president/secretary, chief financial officer/treasurer, and general counsel.

Regional Group Secretaries

1 **Barry Barish**
California Institute of Technology

2 **Lee Pondrom**
University of Wisconsin

3 **Austin M. Gleeson**
University of Texas-Austin

4 **Randy Ruchti**
University of Notre Dame

5 **William D. Walker**
Duke University

6 **Thomas Ferbel**
University of Rochester

7 **Michael Tuts**
Columbia University

1998 URA Board of Trustees

REGIONAL TRUSTEES

Region		Term Expires
1	Raymond L. Orbach, Chancellor University of California, Riverside	2000
2	Mary Sue Coleman, President University of Iowa	1999
3	Franklyn G. Jenifer, President University of Texas at Dallas	2001
4	Steven C. Beering, President Purdue University	2000
5	Joe B. Wyatt, Chancellor Vanderbilt University	1999
6	Harold T. Shapiro, President Princeton University	2001
7	Richard C. Levin, President Yale University	2000

TRUSTEES AT-LARGE

	Term Expires
Thomas E. Everhart, President Emeritus California Institute of Technology	1999
Emanuel J. Fthenakis, CEO (ret.) Fairchild Industries	2001
Robert W. Galvin, Chair, Exec. Comm. Motorola, Inc.	1999
William H. Joyce, Chairman, President & CEO Union Carbide Corporation	2000
Donald N. Langenberg, Chancellor University System of Maryland	1999
Leon M. Lederman, Professor Illinois Institute of Technology and Director Emeritus, Fermi National Accelerator Laboratory	2001
John P. McTague (ex officio), VP Technical Affairs (ret.) Ford Motor Company Chair, Fermilab Board of Overseers	
H. Guyford Stever, President Emeritus Carnegie Mellon University	2001
Jacqueline F. Woods, President Ameritech Ohio	2000

BOARD OF TRUSTEES ORGANIZATION

CHAIR

Joe B. Wyatt
Vanderbilt University

VICE CHAIR

Robert W. Galvin
Motorola, Inc.

EXECUTIVE COMMITTEE

Fred Bernthal, Chair
URA President

Steven C. Beering
Purdue University

Emanuel J. Fthenakis
Fairchild Industries (ret.)

Robert W. Galvin
Motorola, Inc.

Leon M. Lederman
Illinois Institute of Technology

Harold T. Shapiro
Princeton University

H. Guyford Stever
Carnegie Mellon University

Joe B. Wyatt
Vanderbilt University

AUDIT COMMITTEE

Emanuel J. Fthenakis, Chair
Fairchild Industries (ret.)

Donald N. Langenberg
University System of Maryland

Percy Pierre (ex officio)
Michigan State University,
Fermilab Board of Overseers

H. Guyford Stever
Carnegie Mellon University

NOMINATING COMMITTEE

Steven C. Beering, Chair
Purdue University

Fred Bernthal
URA President

Thomas E. Everhart
California Institute of Technology

Robert W. Galvin
Motorola, Inc.

1998-99 Fermilab Board of Overseers

REGIONAL OVERSEERS

Region		Term Expires
1	Benjamin Shen, Professor University of California, Riverside	2000
2	John Kozak, Professor Iowa State University	2001
3	Marjorie Corcoran, Professor Rice University	2001
4	Percy Pierre, Professor Michigan State University	1999
5	Alexander Abashian, Professor Virginia Polytechnic Institute	2001
6	Donald Hartill, Professor Cornell University	2001
7	Jerome Friedman, Professor Massachusetts Institute of Technology	1999

OVERSEERS AT-LARGE

	Term Expires
Jonathan Bagger, Professor Johns Hopkins University	1999
John Boright, Exec. Dir., Office of Int'l Affairs National Academy of Sciences	2000
France Cordova, Vice Chancellor, Research University of California, Santa Barbara	2000
Harold Forsen, Foreign Secretary National Academy of Engineering	1999
John Gage, Director, Science Office Sun Microsystems, Inc.	1999
Maurice Glicksman, Prof. and Provost Emeritus Brown University	1999
Paul Grannis, Professor State University of New York-Stony Brook	2001
Peter Koehler, Professor University of Pittsburgh	2000
John McTague, Vice Pres., Technical Affairs (ret.) Ford Motor Company	2001
David Shirley, Director Emeritus Lawrence Berkeley National Laboratory	2000
Jill Wittels, President Lockheed-Martin IR Imaging Systems	1999

FERMILAB BOARD OF OVERSEERS ORGANIZATION

CHAIR
John McTague

VICE CHAIR
David Shirley

EXECUTIVE COMMITTEE
John McTague, Chair
Marjorie Corcoran
Donald Hartill
Peter Koehler
John Kozak
Percy Pierre
David Shirley

ADMINISTRATIVE COMMITTEE
Peter Koehler, Chair
John Gage
Maurice Glicksman
John McTague
Percy Pierre

AUDIT COMMITTEE
Percy Pierre, Chair
Peter Koehler
Jill Wittels

ENVIRONMENTAL, SAFETY AND HEALTH COMMITTEE
John Kozak, Chair
John Boright
Harold Forsen
David Shirley
Jill Wittels

NOMINATING COMMITTEE
Marjorie Corcoran, Chair
John Boright
Peter Koehler

PHYSICS COMMITTEE
Donald Hartill, Chair
Alexander Abashian
Jonathan Bagger
Marjorie Corcoran
France Cordova
Jerome Friedman
Paul Grannis
Benjamin Shen

External Committees

FERMILAB PHYSICS ADVISORY COMMITTEE

	Term Expires
Andreas Kronfeld, Chair Fermilab	2000
Giorgio Bellettini University of Pisa	2001
Martin Breidenbach SLAC	1999
Leslie Camilleri CERN	2000
Adam Falk Johns Hopkins University	2002
Nicholas Hadley University of Maryland, College Park	2001
Kenneth Lane Boston University	1999
Frank Merritt University of Chicago	2001
Peter Meyers Princeton University	2002
Shoji Nagamiya KEK	2002
Ritchie Patterson Cornell University	1999
Jeffrey Richman University of California, Santa Barbara	2001
Taiji Yamanouchi Secretary (Fermilab)	

URA VISITING COMMITTEE FOR FERMILAB

	Term Expires
Frank Sciulli, Chair Columbia University	1999
David Burke SLAC	2001
Peter Fisher Massachusetts Inst. of Technology	2001
Lorenzo Foa CERN	2001
Lawrence J. Hall University of California, Berkeley	2000
William Marciano Brookhaven National Laboratory	2001
Dan McCammon University of Wisconsin-Madison	2001
Robert B. Palmer Brookhaven National Laboratory	1999
J. Anthony Tyson Lucent Technologies	1999

FROM THE FERMILAB BOARD OF OVERSEERS

Marjorie D.B. Corcoran Rice University	2000
Donald L. Hartill Cornell University	1999

Finances

UNIVERSITIES RESEARCH ASSOCIATION, INC.
OPERATING STATEMENT
YEAR ENDED SEPTEMBER 30, 1998

Total Revenue	$ 278,176,434
EXPENSES:	
Salaries, wages and benefits	$ 118,768,190
Subcontracts and other purchased services	32,574,500
Materials and supplies	20,393,268
Travel, relocation and other employee allowances	7,589,361
Electric power	6,931,005
Inventory usage	5,084,836
Fermi National Accelerator Laboratory support	376,311
Scholarships	135,684
Other	3,558,301
Portion of expenses redirected to property, plant and equipment	($11,897,335)
Total Operating Expenses	$ 183,514,121
Cost of property, plant and equipment for DOE	$ 94,349,689
Excess of net transfers from U.S. DOE and other federal agencies over cost	($773,623)
Total Expenses	$ 277,090,187
Excess of revenue over expenses	$1,086,247

Universities Research Association, Inc.

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Washington, DC 20036

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E-mail: info@ura.nw.dc.us