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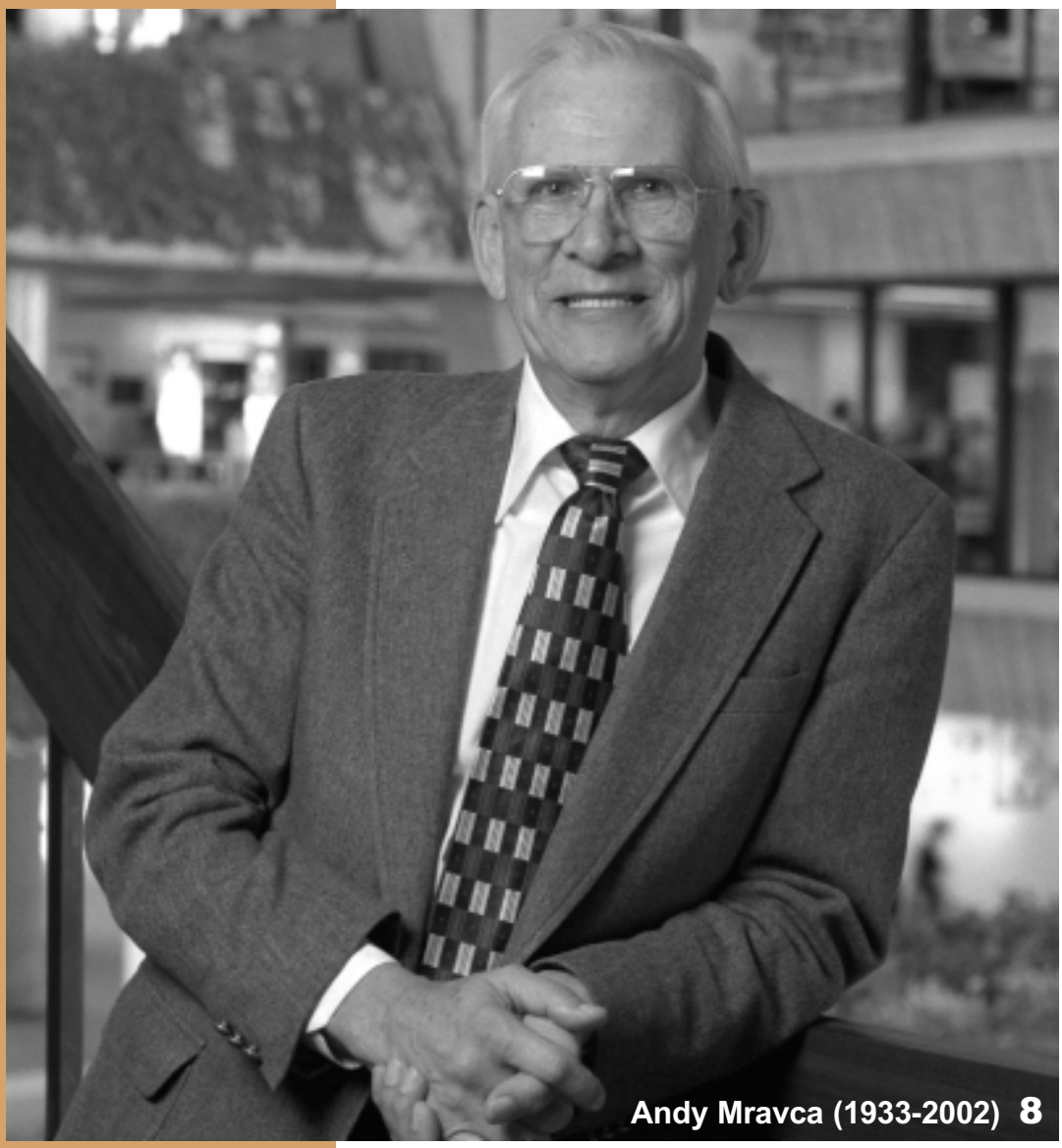

Andy Mravca (1933-2002) 8

Photo by Fred Ullrich

Volume 25
Friday, November 22, 2002
Number 19

INSIDE:

INTERACTIONS
Communicating particle physics in the 21st century

Photo by Reidar Hahn

Joseph Lykken is a member of the theoretical physics department at Fermi National Accelerator Laboratory, and is a professor at the Enrico Fermi Institute and in the physics department at the University of Chicago.

This article first appeared in the November issue of PHYSICS TODAY.

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CRISIS IN PHYSICS?

by Joseph Lykken

Physics has a lot in common with the U.S. economy: Both have flourished during the past century beyond the wildest dreams of even the most sanguine prognosticators. But even in good times, we worry about the future. Indeed, in physics, we are as often discouraged by discovery as we are by failure. Looking back at the glorious achievements of past decades, we are nervous that our success is a tough act to follow. Looking to the future, our drive to answer increasingly ambitious questions continually ups the ante needed to move ahead, increases the competitive pressures within our field, and stresses everybody out.

Is it fair to assert that physics is in crisis? Certainly physicists in the U.S. do face a crisis of funding; many years of flat research budgets and even flat-flat (that is, constant-dollar) budgets, have slowed and discouraged the new initiatives that constitute the future of U.S. physics. Another decade of stagnant or declining funding would eliminate any pretense of the U.S. as a world leader in physics research. That loss would be a terrible outcome both for physics and for the long-term prosperity and security of the U.S.

SELF-FULFILLING PROPHECIES

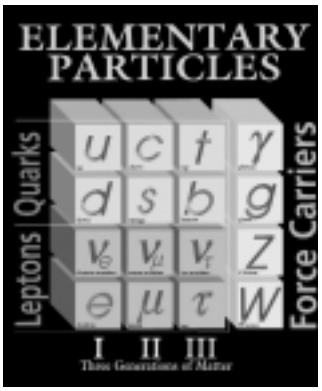
A good first step is to splash a little cold water in our faces and examine our own attitudes and rhetoric about our field. Ironically, one of the main reasons for stagnant research funding in U.S. physics is a lack of confidence among physicists themselves, despite the fact that worldwide, physics research on all fronts is as exciting as it has ever been. Too many physicists have accepted and even promulgated the notion that our field is in an intellectual crisis—that we have somehow lost momentum or motivation. That notion is demonstrably false, but if we don't stop bandying it about, we are likely to find it a self-fulfilling prophecy.

In my own field, particle physics, we are guilty of especially sloppy thinking. When we speak about a so-called crisis in particle physics, we are actually invoking a state of affairs that has existed for 20 years. It began when key experiments led to general acceptance of the standard model of strong and electroweak particle interactions. Suddenly, we had a powerful theory that could explain any high-energy experiment we threw at it, a theory so rich and dense that we are still puzzling out its physical implications. That watershed was itself the resolution of a previous two-decade period, when particle physics had been plagued by a plethora of new particles and particle

BUDGET PROBLEMS, lack of confidence —and RESEARCH that is *as exciting as ever*

properties, with only a patchwork of theoretical concepts to account for them. Instead of too many surprises, we graduated to having too few surprises. Of course, the problem of the standard model is, in reality, the triumph of the standard model. Any group of scientists should be so lucky as to develop a framework so powerful that it takes decades to assimilate it.

Not only are we in particle physics guilty of mislabeling triumph as crisis, we have also managed to confuse and conflate those healthy developments with a genuine failure: the cancellation of the Superconducting Super Collider project, which indeed was a mighty blow to the aspirations of U.S. high-energy physics. But now that a decade has passed, we see quite clearly that the failure has been overcome. A supercollider is in fact being built: the Large Hadron Collider at CERN. The supercollider is not a mistake; it is a great idea. The European high-energy physics community seized the opportunity to build this collider and has happily bet its future on it. The LHC project involves an unprecedented U.S.-Europe collaboration, the success of which has accelerated the internationalization of physics. Meanwhile, the U.S.-based high-energy physics program has diversified and exploited new opportunities in the physics of neutrinos and of heavy quarks. U.S. physicists have become the world's innovators for exploring the connections between particle physics and astrophysics, and we have revamped the Tevatron collider complex to provide another decade of exploration at the energy frontier. In terms of the questions we can ask and expect to answer, particle physics has never been richer.



THE UNITY AND DIVERSITY OF PHYSICS

Physics as an intellectual pursuit is simply defined as the study of the structure and forms of matter and of the attendant interactions. All physicists share a common set of problem-solving tools and a common base of knowledge. We also share what Gerald Holton of Harvard University calls the Ionian Enchantment, a conviction—passed down from Ionian philosopher Thales of Miletus—that the world is orderly and that it can be explained by a small number of natural laws.[1] In physics, we also have a common language, mathematics, that has been responsible in large part for the spectacular pace of theoretical advances in our field. As Eugene Wigner wrote, "The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve."[2] There is, in physics, an intellectual unity that we should all recognize and cherish.

Yet, because of the staggering exponential growth in our knowledge, research in physics has become an extraordinarily complex and diverse activity. Thus, physics as a human activity is not unified, nor can it ever be. The day is long gone when a single person could keep up with all of the advances in all branches of physics. Indeed, I can cheerfully assert that neither I nor any of my colleagues can hope to adequately understand all of the technical developments in particle physics alone. Want to know what is happening in my field? You can catch up by downloading the top-cited papers from the SPIRES HEP archive,[3] that is, only those papers important enough to be cited 50 or more times in other papers. There are 17,084 such papers; 1,644 of them are not even five years old.

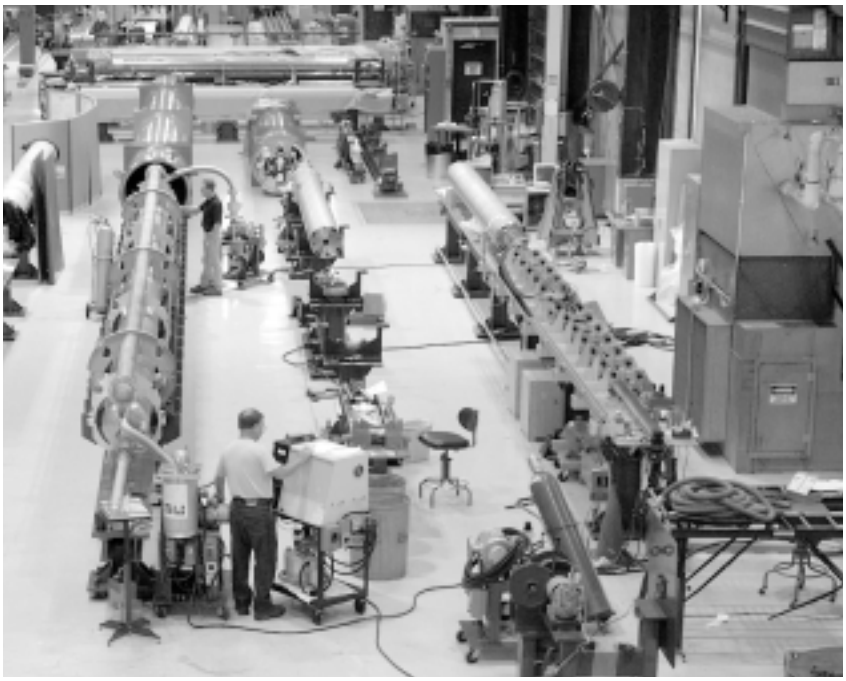


Photo by Jenny Mullins

Large Hadron Collider magnet production at Fermilab's Industrial Center Building. "The European high-energy physics community seized the opportunity to build this collider and has happily bet its future on it. The LHC project involves an unprecedented U.S.-Europe collaboration, the success of which has accelerated the internationalization of physics."

As we have extended the radius of our knowledge, so too have we increased the circumference of our ignorance. That is a good thing. Civilizations are vastly smarter than any individual within them, and get smarter through the cumulative efforts of thousands of talented people. That lever truly moves mountains.

Celebrating success

The danger, naturally, is that physicists feel—and are—increasingly detached from anything beyond their own research. Because it would be neither practical nor wise to subdivide every university physics department into five or six components, we had better try harder to maintain good intellectual connections with our colleagues in other areas of physics. But that is a practical problem, not a reason or excuse for ideological wrangling. Poor attendance, a distressingly common phenomenon at departmental colloquia, is best addressed by recognizing that physicists are busy people. A little prodding and peer pressure—and better colloquia—can solve this problem.

While we are improving our relations across subfields, let's refrain from indulging in debates about whose research is more attractive or is more in sync with postmodern mores. In some quarters, for example, it may be fashionable to attack reductionism, but it makes little sense for physicists to do so. Reductionism in physics is not a cult dogma; it is a tool, and we need it. As the great biologist Edward O. Wilson pointed out, reductionism "is the search strategy employed to find points of entry into otherwise impenetrably complex systems." [4] Take it apart, break it down, simplify, model. As such, says Wilson, "reductionism is the primary and essential activity of science." There are, of course, other essential approaches. Consider the reply of physicist Maria Spiropulu to a question asked about reductionism at the 2001 Arthur H. Compton lecture series: "Research in science is like food. Sometimes you want a nice reduction with lots of cooking, and sometimes you just want sushi." By the same token, physicists should avoid denigrating the wondrous features of other subfields. We celebrate that particle physics is addressing an amazingly ambitious slate of fundamental questions. We celebrate condensed matter physics for combining unsurpassed intellectual challenges with unlimited possibilities for technological application. We celebrate that astrophysics and cosmology have entered a golden age of data and discovery. We celebrate and nurture new subfields, and the connections and overlaps across existing disciplines.

We admit that physics is expensive. Look at gravity physics, a field that, for decades, consisted of a few cheap tabletop experiments and a few theorists. Now, with the advent of the Laser Interferometer Gravitational-Wave Observatory, the gravity program is competing for the big dollars. As Kip Thorne of Caltech put it, "Do you think I'm happy that LIGO costs 300 million dollars? I'm not! But that's what it costs to do it." [5] We should be proud that basic research in physics is a major undertaking of our civilization. It's difficult, it's expensive, and it requires a huge cadre of brilliant minds.

Is it useful? Is it worth it? A century and a half ago, Michael Faraday was asked of what use was his discovery of electromagnetic induction. His reply: "Of what use is a child?" [6] Physics research continues to supply some of the great adventures of our time. We physicists can do a better job of communicating this simple message.

References

1. G. Holton, *Einstein, History, and Other Passions*, AIP Press, Woodbury, N. Y., (1995).
2. E. P. Wigner, *Commun. Pure Appl. Math.* 13, 1 (1960).
3. See the SPIRES archive at http://www.slac.stanford.edu/spires.
4. E. O. Wilson, *Consilience: The Unity of Knowledge*, Knopf, New York, (1998).
5. K. Thorne, *Los Angeles Times Magazine*, 11 August 2002, p. I.12.
6. M. Faraday, quoted in J. Barzun, *Science: The Glorious Entertainment*, Harper & Row, New York, (1964).

Potomac Parley Presents *Particle Physics Project Prioritization Panel*

Ray Orbach: "I want [the U.S. program] to be the best high-energy physics program in the world."

by Judy Jackson

Old Town Alexandria, Virginia, just south of Washington, DC, has seen its share of American history since its founding in 1669. As a 17-year-old surveyor's helper, George Washington helped lay out the city's pattern of streets and later drilled Revolutionary troops in Market Square. Earlier this month, at its meeting in Alexandria, the High Energy Physics Advisory Panel made history once again by laying out for the troops of U.S. high-energy physics the new Particle Physics Project Prioritization Panel. Dubbed P5, it represents the field's first formal organization to evaluate and rank "medium-sized" particle physics projects on a national scale.


Fred Gilman

Physicist Fred Gilman, of Carnegie-Mellon University, HEPAP's chair, presented the P5 charge to panel members on November 7, the first day of the panel's two-day Alexandria meeting. Gilman also announced the group's membership and its chair, Abe Seiden of the University of California at Santa Cruz. Gilman said P5 would be organized as a subpanel of HEPAP with a two-year lifetime. Following the traditional subpanel model, P5 will communicate its advice to HEPAP, which will in turn transmit its recommendations to the Department of Energy and the National Science Foundation, the federal agencies that fund U.S. particle physics. The recommendations would then be used to update the "roadmap" of projects constituting the national program of particle physics research.

Gilman defined the "medium-sized projects" within P5's purview as those costing between $50 million and $600 million.

The lively discussion among HEPAP members and others following Gilman's presentation centered on how and by whom projects would be presented to the P5 group for consideration, with most agreeing that proposals would come through the funding agencies to the subpanel.

An official of the Administration's Office of Management and Budget, listening to the discussion from the audience, said he hoped that P5 members would include all unfunded projects, even those previously approved, in the prioritization process. In contrast, some other scientific fields follow a practice of prioritizing only new proposals, rather than considering the entire slate of as-yet-unfunded projects.

ON THE WEB:

High Energy Physics Advisory Panel:
http://doe-hep.hep.net/hepap_general.html

Physicist Jonathan Bagger, co-chair of a recent HEPAP Subpanel on long-range planning for U.S. High-Energy Physics, presented the final, illustrated version of "The Science Ahead: The Way to Discovery," the plan presented by the subpanel earlier this year. It recommends that the United States "take steps to remain a world leader in the vital and exciting field of particle physics, through a broad program of research focused on the frontiers of matter, energy, space and time." It further recommends construction of a linear collider as the next large international accelerator. Bagger also distributed a brochure summarizing the opportunities for discovery in particle physics and the role of a linear collider. Readers can obtain copies of both publications from the Fermilab Office of Public Affairs.

Earlier in the day, HEPAP members heard from DOE Office of Science Director Raymond Orbach, who opened his remarks by acknowledging the budgetary difficulties confronting the field of particle physics.

"We have seen flat budgets for the Office of Science for the past ten years, resulting in a twenty percent decrease in effective funding." Orbach said. "No field feels that more than high-energy physics."

Nevertheless, Orbach said, he wants U.S. particle physics to be the best in the world.

"It is critical that we maintain scientific leadership," he said. "My immediate goal is to call attention to the scientific opportunities for high-energy physics in this century. I hope that these opportunities will change this funding picture."

Orbach encouraged HEPAP to produce a plan to ensure continued U.S. leadership in high energy physics research and called the formation of the P5 panel "terribly important." He also pointed to the special role of accelerators and accelerator research in DOE Office of Science research programs.

"Every program that we have, in one way or another, depends on accelerators," he said. "I want to call attention to the opportunities that accelerator science brings."

Orbach said he was pleased with the results of the recent DOE review of Tevatron luminosity, held at Fermilab October 28-31,

P5 Charge

A letter to HEPAP Chair Fred Gilman, signed by DOE Office of Science Director Raymond Orbach and NSF Acting Assistant Director for Mathematical and Physical Science John Hunt, presented the charge to P5.

In January 2002 the High Energy Physics Advisory Panel (HEPAP) unanimously endorsed the report of the Long-Range Planning Subpanel chaired by Jonathan Bagger and Barry Barish, which created a twenty-year vision for the field of particle physics. One of the central recommendations of the Subpanel was the creation of a Particle Physics Project Prioritization Panel (P5). The Subpanel felt that the U.S. particle physics program would greatly benefit from this new mechanism to assess and prioritize mid-scale initiatives. We agree that, given the significant number of such proposals for exciting new science now on the table, and the overall constraints on financial and human resources, P5 can perform an important function. Thus we are writing to ask you to implement this important function.

We request that HEPAP form a Subpanel that will be the Particle Physics Project Prioritization Panel. The membership should represent those communities in particle physics and related fields that can give independent advice on the relative merits of the various projects considered. P5 should evaluate for HEPAP the merits of specific proposals, and [make] recommendations concerning their priority standing in the context of the national high-energy physics program. In particular, this Subpanel should recommend priorities for mid-size (approximately $50M to $600M in total project cost) particle physics projects. These projects should have already received endorsement from their respective laboratories' Program Advisory Committee(s) (if based at a national lab), or an equivalent external peer-review process that can assess the merit of the proposals, such as the Scientific Assessment Group for Experiments in Non-Accelerator Physics.

The funding agencies will convey to you an initial set of proposals for P5 consideration in a separate communication. Projects that may require consideration during the timeframe of the Subpanel will be referred to P5 by the funding agencies as they arise.

and expressed confidence that both Fermilab and SLAC are "very well run," despite funding problems that put them "up against the wall." He encouraged HEPAP to work with Fermilab to maximize the Tevatron's performance in the period before Europe's Large Hadron Collider begins operating later in the decade.

"This may require massive contributions from the community," Orbach said. "I ask you to bring all the power you have to bear in the high-energy physics community. It may mean taking unusual steps, but I urge you to work with Fermilab to see a path forward. I just don't want us to be second. It would be awful if we didn't marshal our resources. I know it will be difficult, but I encourage you to do this."

Ray Orbach

"Every program that we have, in one way or another, depends on accelerators."

P5 membership

Abe Seiden (chair) University of California, Santa Cruz
William Marciano, Brookhaven
Pat Burchat, Stanford University
Marjorie Shapiro, LBNL, Berkeley
Eugene Beier, University of Pennsylvania
Boris Kayser, Fermilab
Dan Green, Fermilab
Ritchie Patterson, Cornell University
Melvin Shochet, University of Chicago
Elizabeth Simmons, Boston University
Gary Feldman, Harvard University
Marc Kamionkowski, California Institute of Technology
Jay Marx, LBNL, Berkeley
Charles Prescott, SLAC
Tor Raubenheimer, SLAC

HEPAP membership

Professor Frederick J. Gilman, Chair, Carnegie Mellon University
Professor Paul R. Avery, University of Florida
Professor Jonathan A. Bagger, The Johns Hopkins University
Professor Keith Baker, Hampton University
Dr. Joel Butler, Fermilab
Professor Ronald C. Davidson, Princeton University and Princeton Plasma Physics Laboratory
Professor David G. Hitlin, California Institute of Technology
Professor Young-Kee Kim, University of California at Berkeley
Professor Paul G. Langacker, University of Pennsylvania
Professor Angel M. Lopez, University of Puerto Rico
Dr. Vera G. Luth, SLAC
Professor Rene Ong, University of California at Los Angeles
Professor J. Ritchie Patterson, Cornell University
Dr. Stephen G. Peggs, Brookhaven
Dr. Natalie A. Roe, Berkeley Lab
Professor Randall Ruchti, University of Notre Dame
Dr. John T. Seeman, SLAC
Professor Stanley G. Wojcicki, Stanford University

The proposals referred to P5 will typically have already developed fairly detailed cost estimates. While we do not expect P5 to do an extensive review of costs, to be most helpful, in their report to HEPAP, P5 should comment on the appropriateness of existing cost estimates; indicate what funding levels are expected to be required by these new projects if they are approved (including R&D, engineering, design, pre-operations, operations, and possibly construction of new facilities); and evaluate what the scientific impacts would be if sufficient funding is not available during the timeframe of the projects under consideration. As part of its work, the Subpanel will naturally be gathering information about proposed and possible future opportunities. It will use this knowledge, together with its recommendations on projects, to update the project "roadmap" for the field created by the Long-Range Planning Subpanel. That roadmap identified decision points on a given project's path from research and development, to construction, and then to operation.

In assessing physics priorities, the Subpanel should weigh physics importance and the overall balance of the field within the context of available resources, including available funding and manpower, timescales, and other programmatic concerns. It will consider projects across particle physics, broadly defined, and across funding sources. Where relevant, the Subpanel should consider the international context of proposals, their relation to the programs of related fields such as nuclear physics and astrophysics, and their broader impacts on science and society. While understanding the broad physics program context in which these projects exist is vital for properly evaluating and prioritizing the individual projects, that context itself is outside the purview of P5. Advice on the general direction and overall priorities for the U.S. particle physics program is properly the responsibility of HEPAP itself, and any advice provided to the Department of Energy and the National Science Foundation should reflect HEPAP's views.

We look forward to the creation of the P5 Subpanel in the near future. We would like to have periodic status reports to HEPAP on the work of the Subpanel beginning in 2003, with a final report by the end of 2004.

We wish you success in this challenging and important endeavor.

Andy Mravca

(1933-2002)

Using the Rules to

by Pamela Zerbinos

If you're the founding director of a fledgling laboratory, and you've designed a spiral staircase that's modeled on the double helix, and you know that Illinois law requires all ornamental staircases to have a radius of at least 75 feet, what do you do?

You call Andy Mravca.

"Andy didn't bend the rules," said former Fermilab director John Peoples, "but he knew how to negotiate through them so that things were done, and done right."

Thanks in large part to Mravca, Robert Wilson got his staircase; it leads from the ground to the second floor of the Proton Laboratory.

Mravca's long relationship with Fermilab began in 1968, when he arrived as Chief of Engineering for the Atomic Energy Commission's Batavia Area Office. The AEC, predecessor agency to today's Department of Energy, sent Mravca to oversee the engineering aspects of the newly commissioned National Accelerator Laboratory. He worked closely with Wilson to establish the infrastructure and architecture that continue to shape the lab today.

"Other than Robert Wilson," said DOE Deputy Area Manager Jim Miller, "no person had more influence on the development of Fermilab than Andy Mravca."

Mravca, 69, passed away on Tuesday, Nov. 5, after a long battle with pancreatic cancer.

Photo by Reidar Hahn

Fermilab Director John Peoples (right) confers with Andy Mravca during the Lab's annual review in 1998.

Get the Science Done

His many contributions to the lab were honored in October by a joint Fermilab/DOE proclamation naming the lab's newest cooling pond "Andy's Pond" in Mravca's honor. The proclamation was presented to his wife, Joan, at the DOE Area Managers National Conference, held at Fermilab on Oct. 29.

"Andy was always very enthusiastic about science," said Peoples. "So enthusiastic, in fact, that his DOE colleagues would often jokingly accuse him of 'going native.' At the time, Fermilab wasn't always everyone's highest priority—it was just this funny basic science. But to Andy, it was very important."

Mravca's dedication and skill helped Wilson build the lab in five years, just as he had promised Congress, and with $6.5 million to spare. In 1973, with Fermilab's first accelerator up and running, Mravca was reassigned to the Clinch River nuclear reactor project in Tennessee.

He stayed away for only a few years, returning to Illinois to head the Reactor Engineering Division in the Chicago Area Office. In July of 1979 he returned to Batavia to serve as DOE Fermi Area Manager, a position he held until his retirement in January of 1999.

"Andy was always incredibly helpful," Peoples said. "I first met him in 1972, when I was here as an employee of Cornell. The AEC had rejected a proposal for the remote handling of neutrino trains, and I needed to come up with a new proposal that was acceptable. I didn't really have a sense of what Andy did or what his job was, but he always figured out ways to get things done. Whatever it was, Andy would find a way."

Mravca received his bachelor's degree in mechanical engineering from the Illinois Institute of Technology, and went straight to work for the Atomic Energy Commission. The AEC awarded him a fellowship to study nuclear engineering at Pennsylvania State University as part of President Eisenhower's Atoms for Peace Program. He was later awarded another fellowship to attend the Woodrow Wilson School of Public and International Affairs at Princeton. Mravca always applied his academic credits to the art of the possible at Fermilab.

Photo by Reidar Hahn

Jane Monhart (left), U.S. Department of Energy Area Manager for Fermilab presents the Proclamation naming Andy's Pond to Joan Mravca, at the October 29 DOE Area Managers National Conference at Fermilab.

"When we were trying to build the Lederman Center," Peoples said, "I think we must have had to redesign the building two or three times before it complied with DOE regulations. Andy was there the whole time, trying to make it work."

Mravca is survived by his wife, Joan; daughters, Andrea and Susan; son, Jim; brother, Robert; sister, Mary Ann Segvich, and five grandchildren. The legacy of his work is a laboratory that worked from its very beginnings.

"He understood the rules, he understood how to build things, and he was very enthusiastic about science," Peoples said. "He liked to get things done."

Helen Edwards Receives 2003 Robert R. Wilson Prize from the American Physical Society

by Mike Perricone

Helen Edwards, whose work in the early days of Fermilab is a foundation of past, present and future scientific achievements, and whose current work is helping shape the next generation of particle accelerators, has been awarded the 2003 Robert R. Wilson Prize by the American Physical Society.

The award is named for Fermilab's founding director, Robert Rathbun Wilson (1914-2000), and was established in 1986 by friends of Wilson, and by the Division of Particles and Fields and the Division of Physics of Beams of the American Physical Society. Previous winners include Cornell University's Maury Tigner (2000) and Fermilab's Alvin Tollestrup (1989).

"It is a great honor to receive the Wilson Prize," said Edwards, who with her husband, Don, worked with Wilson first at Cornell University and then at the National Accelerator Laboratory, later renamed Fermilab.

Photo by Reidar Hahn

Helen Edwards

The 2003 award cites Edwards "for her pivotal achievement and critical contribution as the leader in the design, construction, commissioning and operation of the Tevatron, and for her continued contributions to the development of high gradient superconducting linear accelerators as well as bright and intense electron sources." The award will be presented in April 2003 at the APS annual meeting.

"I was delighted to learn that Helen Edwards had been awarded the Wilson Prize," said Fermilab Director Michael Witherell. "Bob Wilson brought Helen to work at Fermilab, and both of them made essential contributions to the remarkable success of Fermilab and its accelerators. I'm very pleased that Helen's work has been recognized in this way."

In a distinguished and much-heralded career, Edwards has been the recipient of a MacArthur Fellowship, the National Medal of Technology, and the Department of Energy's E. O. Lawrence Award. She is a member of the American Academy of Arts and Sciences and of the National Academy of Engineering, and is a Fellow of the American Physical Society.

Edwards said she regards herself as part of a permanent team with her husband, Fermilab physicist Don Edwards, with Wilson holding a special place as their team leader.

"My husband, Don, and I worked under Bob Wilson's direction for over 20 years and we benefited greatly from his example," Edwards said. "I believe this award is for my husband as much as for myself, as we have worked effectively as a team over the years. I have grown to appreciate Wilson's leadership and convictions more and more over the years. Not only was he a great technical leader but he communicated his beliefs with great clarity. He lauded international collaboration and decried 'creeping bureaucracy.'"

She continued: "I can do no better than to excerpt some of his thoughts from his 1969 testimony before Congress, on building the Fermilab accelerator: '…(T)his new knowledge has all to do with honor and country but it has nothing to do directly with defending our country except to make it worth defending.'"

ON THE WEB:

Robert R. Wilson Prize:
www.aps.org/praw/03winners.html/.

Fermilab's Accelerator Chain:
www-bd.fnal.gov/public/index.html/

Northern Illinois Center for Accelerator and Detector Development:
http://nicadd.niu.edu/

Deutsches Elektronen Synchrotron:
www.desy.de/html/home/index.html

Fermilab Photo

In 1983, Helen Edwards signed the document commemorating the installation of the last magnet and the completion of the Tevatron. She was also an early head of the lab's Accelerator (now Beams) Division.

The Tevatron accelerated its first beam in 1983, recorded its first proton-antiproton collisions in 1985, and provided the pathway for discovering the top quark in 1995. It has been named a national landmark by the American Society of Mechanical Engineers, for its pioneering use of more than 1,000 superconducting magnets. Still the world's highest-energy particle collider, the Tevatron has the Higgs boson among its targets for Collider Run II.

"To begin with, there was indeed a good bit of skepticism over whether [the Tevatron] would work," she recalled. "By the time we were ready to turn it on, I was pretty confident that it would work, and work well. I think that had to do with the many iterations of testing things, installing, re-installing and getting all the engineering to work. It began as a fixed-target machine, of course, then two years later joined up with the Pbar Source to run as a collider. So there were two major steps involved."

Edwards is conducting research in superconducting technology for one of the possible designs of an electron-positron linear collider, proposed as the next machine for the field of high-energy physics. She has been the leader of the Photoinjector Project, which used a superconducting radio-frequency cavity for the first time at Fermilab to accelerate an electron beam. The photoinjector is now the key element in the NICADD (Northern Illinois Center for Accelerator and Detector Development) collaboration between Fermilab and Northern Illinois University.

Photo by Reidar Hahn

Edwards has an abiding interest in education, using the funds of the MacArthur Fellowship to support science education efforts. She also works with students at the lab, including this group of 2001 summer students on the Photoinjector project. "The reward is in seeing young people come along," she said. "Initially, you might see them groping. Then there's a point where something connects and they begin functioning smoothly. That's nice to see."

Edwards also shuttles between Fermilab and *Deutsches Elektronen Synchrotron* (DESY) in Hamburg, Germany working on research and development for the TESLA superconducting linear collider. Don Edwards, who also works on the photoinjector project, edited the technical design report for DESY's TESLA Test Facility in 1994. Helen Edwards is adamant about the goal of building a linear collider as an international laboratory.

"Either we'll build it as an international laboratory," she said, "or we'll have nothing."

A Delicate Balance

DOE review gives high marks to Tevatron improvements, but cites challenges ahead

by Mike Perricone

A Department of Energy review of Fermilab's Accelerator Run II produced high grades and several remarks of "excellent progress," but also made clear that results are the ultimate benchmark.

The charge to the review committee from John O'Fallon, Director of the High-Energy Physics Division at DOE, clearly stated that "it is vital to the U.S. program in high-energy physics to maximize the performance of the Tevatron, and therefore, the scientific output of the collider experiments in this critical period before LHC turn-on."

"We are the flagship program for high-energy physics worldwide right now," said Fermilab Director Michael Witherell, "and we're expected to deliver on that."

From that starting point, and with a focus on Tevatron luminosity, the review committee findings included references to excellent progress in pursuit of luminosity goals; especially notable progress on stochastic cooling; confidence in the Recycler's success; impressive combined availability of the Linac and Booster, and very good availability for the Main Injector; and the judgment that the laboratory's technical approach for increasing luminosity is "sound and well-motivated."

To Witherell, that last characterization was critical because of the nature of the investigation.

"The biggest question for the committee was, 'do we have a good plan for the future, and are we going to make as much as we can of the scientific opportunity ahead of us?'" Witherell said. "This was a good review for us because it made the case that we are doing the right things on a very hard problem."

The Oct. 28-31 review endorsed the lab's "fully resource loaded plan" for FY03. But in another sense, the review was a more intense restatement of the laboratory's ongoing challenge: marshalling resources for immediate needs without sacrificing important longer-term goals. The funding picture is sufficiently clouded that the review specifically stated: "Adequate funding throughout the luminosity upgrade period is not assured and so constitutes a substantial risk to reaching the goals."

ON THE WEB:

Fermilab's Accelerator Chain:
www-bd.fnal.gov/public/index.html

Photo by Reidar Hahn

On the question of Tevatron luminosity, the DOE review panel stated: "There has been excellent progress in the past year that serves as a solid platform for future progress, and the increased focus of the Laboratory on this effort is a crucial factor."

"What that's saying," Witherell explained, "is that we're giving extra priority to the accelerator effort, but the budget is not a good one. So we are supporting well the things that are going to get us additional luminosity this year. We're supporting a little less well the things we need to do to get added luminosity for the next year, and probably a little less well the things that are going to get us to the last step. I think that's the right priority, but I think what did come to everyone's mind was that, to do as much as we can for luminosity in 2003, '04, '05 and beyond, it will take somewhat more resources and somewhat more funding than we're seeing in FY03. That's part of the larger problem in high-energy physics now. I hope it will help make the case that a little bit of additional money will have a big return in the science we're able to do."

The lab's plan is divided into "base" goals, with a high degree of confidence, and "stretch goals," relying on everything developing as planned, and assuming a higher payoff in luminosity from improvements in 2003. The base goal for total integrated luminosity is 6.5 inverse femtobarns (fb^{-1}) by 2008; the stretch goal is 11 fb^{-1} by 2008. For FY03, the base integrated luminosity goal is 200 inverse picobarns (pb^{-1}); the stretch goal is 320 pb^{-1}. The Tevatron's initial luminosity has improved by a factor of four since January 2002 (from below 1E31 to 3.7E31), which tangibly improved the tone of the DOE review. The Tevatron is now delivering 5 pb^{-1} of integrated luminosity in a typical week, or nearly 2.5 times the normal weekly level of Run I.

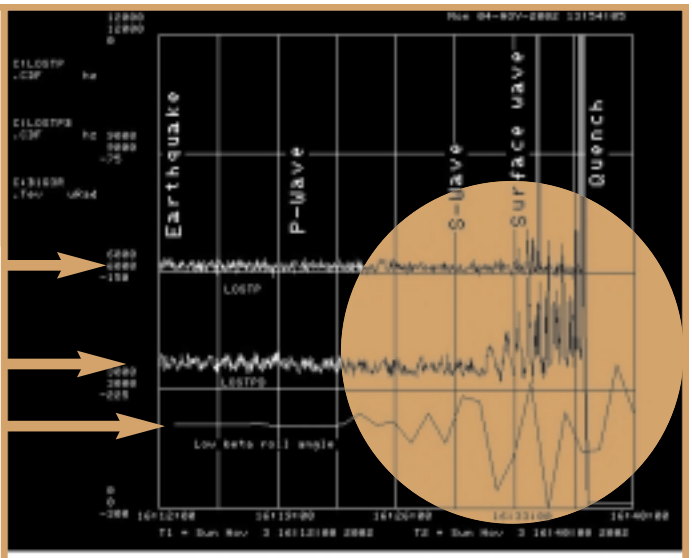
"If we just ran for the year at the level we have for the last month, we'd make our goal for FY03," said Steve Holmes, Associate Director for Accelerators and interim head of the Beams Division. "But if we did that, we'd be in no position to double that performance in FY04. So we have to find the correct balance between sustaining operations and implementing improvements, and continue to make investments during FY03 for '04, '05 and '06. We've got a reasonable plan for the coming year, we're organizing overall activity on Run II in a project mode, and I think we got an endorsement of that approach."

The perception by experimenters represents another important endorsement. DZero cospokesperson John Womersley, in producing a presentation of the plan for experimenters, described the changes as a delay, resulting from the additional time it took to reach current luminosity levels, and as the difference between a realistic outlook and a "wish list." The key factor, he said, is an improvement in planning.

Alaska earthquake shakes up Tevatron

The Tevatron, the world's highest-energy particle accelerator, is so sensitive to its environment that it felt the effects of the Nov. 3 earthquake in Alaska—some 6,000 miles away.

The earthquake, whose maximum magnitude registered at 7.9 in the vicinity of Denali National Park, caused the Tevatron to vibrate and lose its particle beam at around 4:30 p.m. (Central time) that Sunday afternoon. But it took an alert troubleshooter, checking the machine logs from his home computer while watching CNN on TV Sunday night, to finger the earthquake as the cause. Duane Plant, of Beams Division/Engineering and Support, noticed beam loss over a long interval before the machine quenched, or warmed above superconducting temperatures.



P-Wave, S-Wave, and Surface wave are shown at the time they were detected at Northern Illinois University by their seismometers.

"It was similar to a loss we saw back in June, when there was a smaller earthquake down in Indiana," Plant said. "That earthquake didn't quench the machine but it made a small loss pattern. This looked similar to me, so I went to some web sites of the U.S. Geological Survey, got the earthquake times in Alaska, and did a 'back-of-the-envelope' guess on the time it would take to get here. That guess was within two minutes of when the logbook showed the quench."

Plant got on the phone with Beams Division Tevatron specialist Todd Johnson. The two spent about an hour on plots and figures, and decided it was time to call the crew chief in the Main Control Room with the earthquake scenario.

"Since the crews couldn't find any other cause for the quench," Plant explained, "we thought maybe it was best to just go ahead with the next step in reestablishing the beam, instead of spending another four or five hours looking for the cause. We thought we understood the cause—as absurd as it sounded."

On Monday morning Plant, Johnson and MCR Operators checked with the seismology center at Northern Illinois University in DeKalb, and confirmed that the wave arrival times from the earthquake coincided with the effects felt at the Tevatron. Instrumentation in the Beams Division had recorded position shifts of 30 microns in the Tevatron and other accelerator components—about three times the width of a human hair. And just down the road, Argonne National Laboratory reported beam loss in its Advanced Photon Source at virtually the same time as the Tevatron.

"So much can affect the beam here at the lab, you have to keep your eyes open 'way outside the box, all the time," Plant said. "Then again, with a machine like this, operating out at the edge, there is no box."

He compared the lab to a sports team that was always able to win on talent and intuition, but now realizes that the game has changed and requires a more systematic strategy.

"One thing that's come out of the last year has been learning how to improve the accelerator operations," Womersley said. "But another thing to come out is an understanding that we need to plan better, and a sense of realism of what we can promise. We have a better understanding of how many people it takes, and how long it takes, and how complicated a job it is, to get physics out of a new accelerator and new detectors."

Schedules, Womersley said, are more important to physicists than they are to physics.

"The point of delivering luminosity is to do the physics, and physics doesn't sit around waiting for a certain amount of data to come in," he said. "The physics is a continuous process. There isn't a single magic number that defines success or failure for the Tevatron in terms of the physics. There isn't a time that starts and ends when you have enough to do something. You always have enough to do something interesting, and as more data comes in you do more."

Witherell suggested the process of improving luminosity was an example of producing results under what might not be the best of circumstances. He noted that the team leading the accelerator efforts was concurrently formulating the luminosity plan while preparing for first, a director's review, and second, the DOE review.

"These two reviews were very important," Witherell said. "Yet while all that preparation was going on, we've also had some of the fastest improvements in accelerator performance, all at the same time. That's impressive to me."

The reviewers apparently felt the same way.

CALENDAR/LAB NOTES

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

NOVEMBER 25
NALWO invites laboratory women to a Spanish Sampler! Learn about preparation and ingredients for tapas; tastes, too! Music Room of the Users' Center, 1pm - 3pm. For more information, contact Sue, x5059 or mendel@fnal.gov.

DECEMBER 4
Fermi Singers Concert on Dec. 4, 12 Noon in the Auditorium.

DECEMBER 6
The Education Office invites parents (especially scientists!) to a unique Parent Science Fair Seminar on December 6, 2002 from noon to 1pm in WH1W. Find out how much AND how little help and guidance you should provide for your student's project! Bring your lunch. Call x8258 for more info.

WHAT'S NEW?
Find out what's happening at Fermilab. Sign up and receive the weekly "At Work" email every Friday, with news and events from around the lab. Visit www.fnal.gov/faw/atwork/atwork_digest.html to read the latest issue and to subscribe to the newsletter.

ASK-A-SCIENTIST AT WILSON HALL
The popular Ask-A-Scientist program has returned to the 15th floor of Wilson Hall, every Sunday from 1:30 p.m. to 3:30 p.m. Scientists will meet visitors to answer questions ranging from "What is dark matter?" to "How do you accelerate a particle close to the speed of light?" Visitors must use the Pine Street entrance on the west side of the lab, and obtain the special "Ask-A-Scientist" pass to proceed to Wilson Hall.

FILM SERIES

NOVEMBER 22
After Life (Wandafuru Raifu)

Japan (1998), 118 min., Dir: Hirokazu Koreeda
What happens after we die? In this beautiful film from Hirokazo Koreeda (MABOROSI), the recently deceased spend a week at a spiritual way-station where, assisted by counselors, they must select a single memory to take on to the afterlife. Interweaving the stories of those passing through with those of the counselors, AFTER LIFE is an enticing and intellectually titillating treat.

DECEMBER 6
Spike and Mike's 2001 Animation Classic

USA (2001), 85 min. For 23 years, Spike and Mike's Festivals of Animation have dazzled audiences with works by John Lasseter of Pixar, Tim Burton's first films, Nick Park of the Wallace and Gromit, the boys of South Park, Beavis and Butt-Head, The Powerpuff Girls, The Rugrats, Ren and Stimpy, and more. The 2001 Classic is a collection of 16 different cell, computer graphic, and clay animation shorts that range from the beautiful to the bizarre. It includes 10 international award winners, an Oscar nominee, and two Academy Award winners for best animated short, including the latest from Pixar Studios.

All shows are on Friday nights at 8 p.m. (promptly) in Ramsey Auditorium, in Wilson Hall at Fermilab. Tickets are sold at the door: Adults - $4 , Children (under 12) - $1, Fermilab students - $2.

MILESTONES

ELECTED
■ As Fellows of the American Physical Society, these Fermilab scientists and Users:
Marcela Carena, "for her outstanding contributions to the physics of Higgs bosons and Supersymmetry;" **Janet Marie Conrad,** Columbia University, "for her leadership in experimental neutrino physics, particularly for initiating and leading the NuTeV decay channel experiment and the Mini-BooNe neutrino oscillations experiment;" **Andreas S. Kronfeld,** "for his contributions to lattice quantum chromodynamics and its application to the phenomenology of the standard model;" **Peter Daniel Meyers,** Princeton University, "for contributions to rare kaon decay experiments, service and leadership in the particle physics community, and for communicating the excitement of the field to expert and non-expert alike;" **Nikolai V. Mokhov,** "for critical contributions to the understanding of the interaction of high energy particle beams with materials;" **Harrison Bertrand Prosper,** Florida State University, "for leadership in developing Bayesian and other analysis techniques in particle physics, especially as applied to measurements of the mass and cross section of the top quark, and particle searches;" **Elizabeth H. Simmons,** Boston University, "for contributions to the study of electroweak and flavor symmetry breaking, especially the origin of the top-quark mass, and for suggesting incisive tests of physics beyond the standard model;" **Thomas Joseph Weiler,** Vanderbilt University, "for important calculations that helped establish QCD and the Electroweak interaction as the Standard model, and for pioneering contributions to neutrino physics and particle astrophysics;" **William John Womersley,** "for his leadership of the DZero experiment."

Chez Léon MENU

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

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

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

Lunch	Dinner	Lunch	Dinner
Wednesday, November 27	Thursday, November 28	Wednesday, December 4	Thursday, December 5
Cheese Fondue	*Closed*	*Vol-au-vent filled with Chicken and Pimento in a Cream Sherry Sauce*	*French Onion Soup*
Salad of Field Greens with Tomato and Onion		*Steamed Broccoli with Lemon Zest*	*Fillet Mignon with Cabernet Sauce*
Cranberry Poached Pears		*Pecan Rum Cake*	*Potato Anna*
			Vegetable of the Season
			Peach Crepes with Cajeta Sauce

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Ferminews is published by Fermilab's Office of Public Affairs.
Phone: 630-840-3351
Design and Illustration:
Performance Graphics
Photography:
Fermilab's Visual Media Services
Ferminews Archive at:
http://www.fnal.gov/pub/ferminews/

The deadline for the Friday, December 6, issue is Monday, November 25, 2002.
Please send classified ads and story ideas by mail to the Public Affairs Office, MS 206, Fermilab, P.O. Box 500, Batavia, IL 60510, or by e-mail to ferminews@fnal.gov.
Letters from readers are welcome.
Please include your name and daytime phone number.

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CLASSIFIEDS

FOR SALE

■ '98 Ford Escort SE sedan, 51k, Quality Check Ford Certified, exc. cond., Met. Mocha Frost exterior, auto., A/C, ABS, loaded. Must sell immediately, moving out of country. $8,200 o.b.o., Contact Naeem at 630-840-4250, 898-7936, 788-6940 or naeema@fnal.gov.

■ '95 VW Jetta GLS, green, 101K miles, 5 speed manual, A/C, ABS, 6CD, premium audio, moonroof, $3,500 o.b.o. Contact Lukas at x8595 or lphaf@fnal.gov.

■ '94 Mazda 323m, auto., p/s, A/C, Pioneer CD AM/FM stereo radio. Very reliable car, never had any problems, and it's in overall good condition. Asking $2,500, o.b.o. Contact 630-840-3151 or cardoso@fnal.gov.

■ '92 Saturn SL1 Sedan 4D 4-Cyl., 1.9 L, 16V, auto., A/C, cruise, sun roof, AM/FM cassette, 153K miles, adult driven, excellent condition, records available, asking $2,000. More details at: http://www.geocities.com/alessia_ghisellini/Saturn Flyer.doc. Contact 630-357-6524, 217-637-2232 or maltoni@uiuc.edu.

■ '89 Chevy Caprice station wagon, blue, 133K miles, p/s, p/b, p/locks, p/windows, AM/FM/cassette. Seats 9! rear seat faces back. $1,200 o.b.o. Contact Bill at x2689 or barker@fnal.gov.

■ '86 T-Bird, gold, 80K original miles! New tires, runs well, $1,000 Firm. Contact Doug at x3699 or wkelley@fnal.gov.

■ WARN light bar for '99-'02 Chevy Silverado & GMC Sierra, $120. Also: set of OEM wheels and tires 265/75/16, 2K miles on them, from '00 GMC Sierra truck, $350. Contact Roberto at 840-6771.

■ Tires: Four 215/75 R14 steel belted radial snow tires, less than 5K miles, $60 for all 4. Contact Jim at x3374 or mulvey@fnal.gov.

■ Snowthrower, Snowflite MTD 3/21; 21″, two cycle w/directional chute and auto stop level, 15 plus years old; not used in last 2 years; stored in insulated garage. Make Offer. Contact Anne at x8506 or lucietto@fnal.gov.

■ Olympic weight set, chrome plated, 550 lbs., $300. Contact Bert at x3825.

■ Washer and dryer. Tappan brand. Very good condition. $200 for both o.b.o. Located in Glendale Hts. Contact x6342 or 708-645-1168.

■ Vintage 1970's Ludwig drum set, green sparkle, 5pcs., including hi-hat. Great for a collector, or beginner. Excellent Condition, asking $800. Contact Jeremy at 630-557-2166 or cudzewicz@fnal.gov.

■ Frigidaire gas stove, white with black trim, $100 o.b.o. Beige leather couch, 86″ long, 4 years old, $300 o.b.o. 4-14″ tires and wheels from 1990 Ford Mustang, good condition, $80. Pfalzgraff dinnerware, $20 a place setting, 12 to sell. Coca Cola ceiling fan, very good condition, $75. Contact Randy at 630-964-2311 or RLW58@yahoo.com.

■ Solid wood bunk bed, $75. +5 drawer chest, $15. Dishwasher on wheels adaptable to faucet, does not require installation, $180. G&E 26″ TV with remote, $80. Basketball hoop, almost new, adjustable height, $60. 3 bicycles, 2 adult and 1 child, $50 for all. Must sell. Contact Sandra x5527 or x4240 off-hours, or padula@fnal.gov.

■ 1960's model "Rowe AMI 200" juke box, (w\o coin changer) good condition and works fine, 45 rpm records included. $1,200 o.b.o. Full size 8ft. pool table (1″ thick slate) with accessories, good shape, $1,000 o.b.o. Contact Gerry Davis at x3103 or 554-0589.

■ Pair of Gemini 1532 speakers, 15″ woofer, 7″x 4″ midrange, 3 Motorola Piezo tweeters per speaker. Great condition, still has 2 years of warranty left, $150. Contact Brad at 630-505-0276.

■ Cinnamon brown leather recliner; custom-made lined drapes for patio door; large modern painting; antique crystal chandelier and matching sconces; 4 padded dinette chairs; track lights. All in excellent condition. Contact x3817 or 630-584-1429.

■ Burgundy couch and chair $175, twin bed set with frame $100, dresser/TV stand $75, Two bookcases $100, handmade trestle dining room set $175, two end tables $25, black TV stand $10, 6 drawer waterbed platform $100, 50″ projection TV $600, Computer desk $100. Contact 896-6196 after 5 p.m. weekdays to view.

FOR RENT

■ Two bedroom villa at the Orange Lake Country Club in Orlando, Florida, next to Disney World. Room enough for 8 people. Available Feb. 8-15 2003, $1,000. Check the website orangelake.com. Contact 630-840-3499.

■ Three bedroom home in Marywood, near I-88 and Butterfield Rd., five minutes from Fermilab. On one acre, located on cul-de-sac, overlooks the Illinois Prairie Path System, with immediate access. $925/mo. plus utilities. Available December 1, 2002. Contact Robert at 630-416-9640.

■ Warrenville on Continental Drive (walking distance to gate). 2 story SFH. 3 BR, 1.5 bath, 1-car garage, tool shed. All major appliances incl. washer/dryer. Fireplace, clubhouse amenities (pool, recreation room, etc.) $1,200 per mo. Contact 630-674-8847 day or 630-898-5035 evening.

■ Furnished house for rent in Geneva, Switzerland. 10 minutes drive from CERN. Available Dec. 18, 2002 to Sept. 30, 2003. 3 bedrooms, 3-1/2 baths, fully equipped eat-in kitchen. Spacious living-room/dining room. Fenced-in garden. Contact Leslie.Camilleri@cern.ch.

WANTED

■ Sublease for apartment, duplex, or small house from Jan. 2003 to Aug. 2003. Contact Bob at 219-617-4300 or rdysert@fnal.gov.

■ Used lap top computer in good condition and reasonable price. Contact Bud 630-584-1263.

CUT YOUR OWN CHRISTMAS TREE

■ Beginning November 23, until December 23, daily from 9:00 a.m. to dusk, Marmion's fields will be open for those tree hunters who enjoy the fun and challenge of cutting down their own Christmas trees. Marmion Abbey is located at 850 Butterfield Road, Aurora, IL. Contact Rev. Bede Stocker, 630-897-6936, x344.

FERMILAB ARTS SERIES 2002-2003 SEASON

Battlefield Band
November 23, 2002
Tickets - $19 ($10 ages 18 and under)

Windham Hill's Winter Solstice
Liz Story, Will Ackerman, and Samite of Uganda
December 7, 2002
Tickets - $25 ($13 ages 18 and under)

Libana
February 8, 2003
Tickets - $17 ($9 ages 18 and under)

Dragon's Tale: Nai-Ni Chen Dance
March 8, 2003
Tickets- $19 ($10 ages 18 and under)

Quartetto Gelato
April 5, 2003
Tickets - $21 ($11 ages 18 and under)

Orquesta Aragon
May 10, 2003
Tickets - $26 ($13 ages 18 and under)

Gallery Chamber Series
Sunday afternoons at 2:30 p.m.
Three Concert Series - $36

Tickets for all Fermilab Events are available now. For further information or telephone reservations, call 630/840-ARTS weekdays from 9 a.m. to 4 p.m. Additional information is available at www.fnal.gov/culture.

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