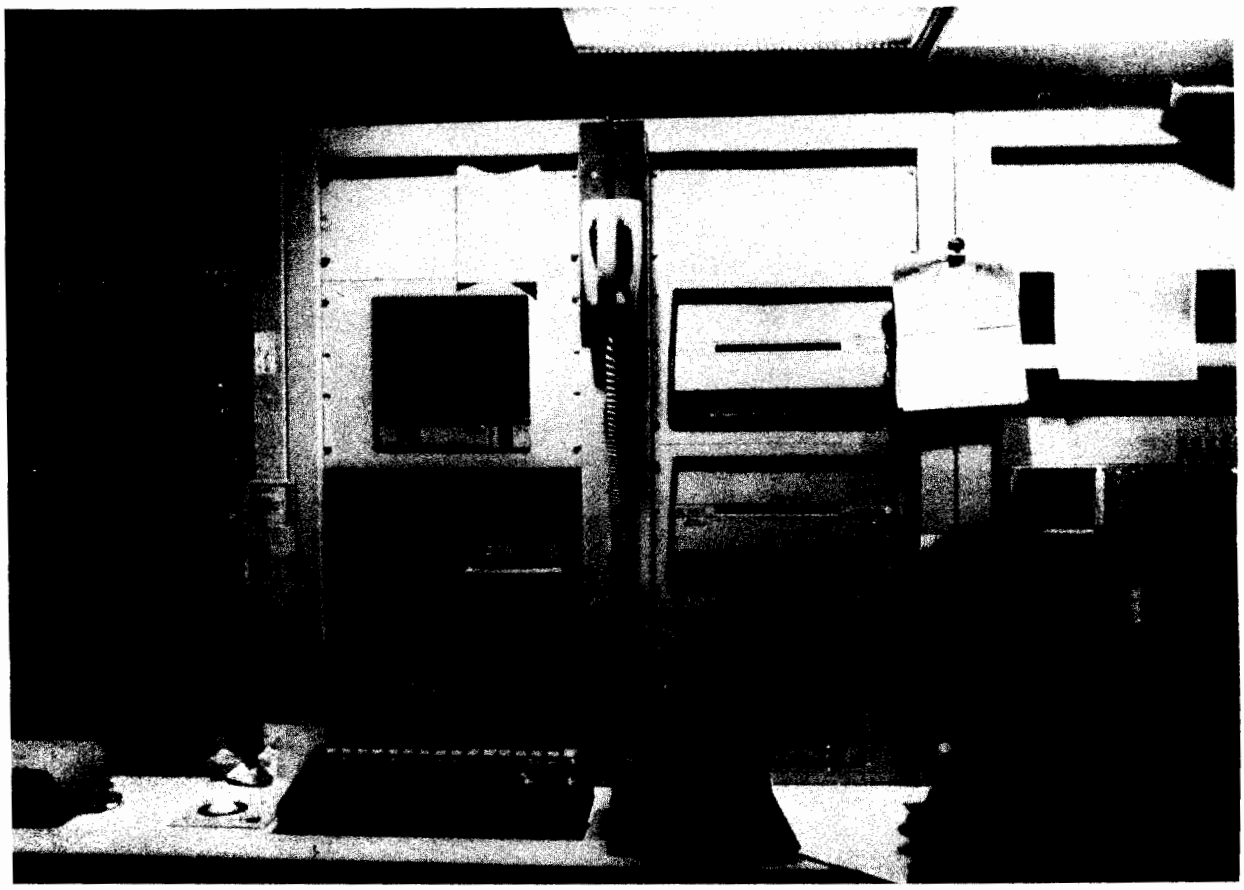
fermilab report

Fermi National Accelerator Laboratory Monthly Report

January 1983



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Contributions, comments, and requests for copies should be addressed to the Publications Office.

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THE COVER: The new Energy Saver control room takes shape in the former lobby of the control room.

(Photograph by Fermilab Photo Unit)

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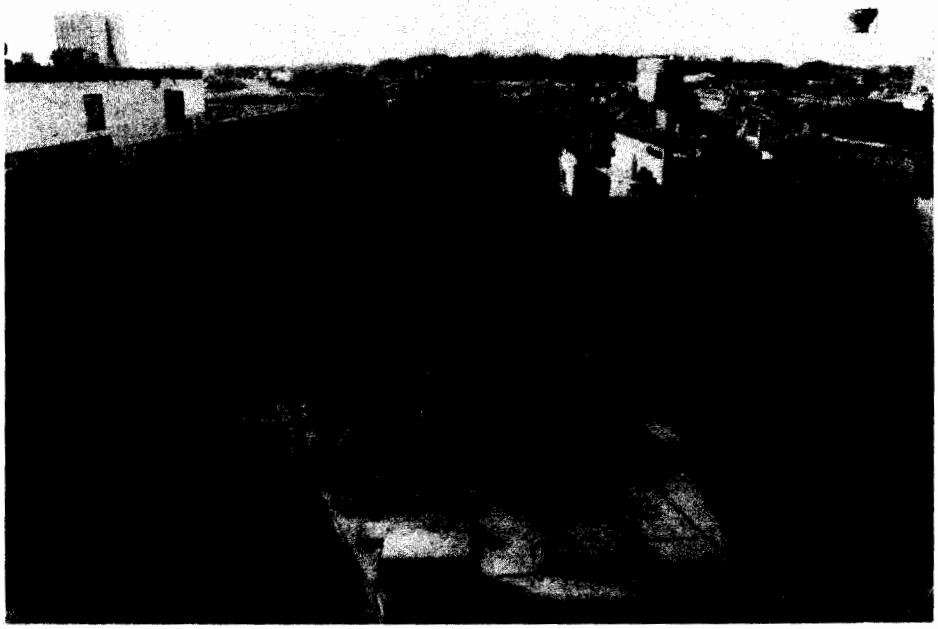
LEDERMAN, PERL RECIPIENTS OF WOLF PRIZE

Leon Lederman, director of Fermilab since 1979, and Martin Perl of SLAC have been awarded the prestigious Wolf Foundation prize for physics "for their experimental discovery of unexpected new particles establishing a third generation of quarks and leptons." Lederman was awarded the prize for the "discovery of the upsilon particle after a long and sophisticated experimental program devoted to the study of the production of muon pairs, which was of interest in its own right." "In addition, Prof. Lederman has participated in many other fundamental physics experiments, including the discoveries of the long-lived K0, the non-conservation of parity in muon decay, and the existence of two kinds of neutrinos."

Lederman and Perl share the $100,000 prize in physics. Lederman, as a professor of physics at Columbia University, together with collaborators from the State University of New York at Stony Brook, led Experiment #288 that discovered the upsilon particle here in 1977. Perl headed the experiment at SLAC that discovered the tau neutrino in 1975. "He single-handedly pushed, inspired, and directed the search for a new heavy lepton which was not wanted by any theory and was not expected by the vast majority of particle physicists." Both the Lederman and Perl experiments were pioneer studies into unique areas of particle research to understand the basic nature of the universe.

The Wolf Foundation was started in 1976 by the late chemist Ricardo Wolf, a Cuban envoy in Israel who remained in the country after his tenure until his death last year at the age of 93, who contributed $10 million for annual prizes in the fields of chemistry, medicine, agriculture, mathematics, physics, as well as in the arts. Recipients have typically been scientists globally recognized for achievements in their field. Of the 42 winners since the Wolf Foundation prize was created in 1978, four later received Nobel Prizes in physics and medicine. The prizes are also intended to promote "friendly relations among peoples without distinction of nationality, race, color, sex, or political outlook." The prize will be awarded May 8 at the Knesset Israel Parliament in Jerusalem.

In addition to teaching at Columbia University for thirty years, Lederman carried on research at Brookhaven National Laboratory and CERN, as well as at Fermilab.



The B0 Experimental Area is up to ground level. In this photograph, the accelerator ring is at the left.
(Photograph by Fermilab Photo Unit)

PROGRESS ON THE ENERGY SAVER

Installation and testing of components and systems have been moving rapidly in the two months since the Energy Saver was last covered in these pages. We give a short report to bring you up to date.

Superconducting Systems

Sectors E and F are complete, including their local control systems. Six of the eight subsectors in E and F have been cooled to liquid-helium temperature. It is gratifying that this was done without the Central Helium Liquefier. We had had a difficult time trying to cool A sector without CHL, because one refrigerator, a prototype model, had smaller capacity than the production models in E and F. The A sector prototype refrigerator is now in the process of being replaced by a standard production model, as are the old quadrupoles in A sector. The work in E and F sectors is now in testing voltage to ground prior to bringing on power supplies for ramping.

All of the magnets in D Sector have been installed and leak-checked except for one spool piece at D12. All dipoles and quadrupoles are installed in C Sector, but some spool pieces are missing. In B Sector, B3 and B4 are being installed, so what is left to be done is the area including B2, B1 and A4.

There has also been much progress on other superconducting systems. All compressors are operational around the ring, although some building modifications are being made on the B0 system that has already been in operation. Satellite refrigerators are operational in E and F Sectors, and almost at this point in D. All heat exchangers, valve boxes, and refrigerator controls are operational. The transfer line is complete all the way around the ring. The helium tank farm is operational. The Central Helium Liquefier has been undergoing some modifications; the third (backup) compressor is installed, and liquid-helium storage capability is coming along.

Conventional Systems

Considerable work has been done in installation of injection, extraction, and abort hardware. The extraction system in the D0 area is in the tunnel.

Three rf cavities are in place in the tunnel. The new anode power supply is installed and being hooked up. The initial part of the rf system will be operational early in February.

The B0 bypass (not the overpass for Main Ring beam) has been occupied and hardware is being installed. It is expected that Main Ring tests will begin early in the spring.

The control system has come a long way. The system is now on the central VAX computers and operating reasonably well, although much work remains to be done.

With all this activity, there are no overwhelming problems.

THE MAGNET TEST FACILITY

Frank Turkot

An important part of the design and production of Energy Saver magnets has been the Magnet Test Facility located in Industrial Buildings 1 and 3. Every Energy Saver dipole and quadrupole must pass an exacting series of tests in the Magnet Test Facility before it can be installed in the ring.

It is not unusual to test accelerator magnets before they are installed, but superconducting magnets have features that make the testing more necessary but at the same time more laborious. In conventional magnets, the variation of the magnetic field with distance is almost completely determined by the shape of the steel magnet poles. In superconducting magnets like those of the Energy Saver, the steel has only secondary effects on the field, which is largely determined by the placement of the superconducting coils. This gives a field rich in harmonics higher than the desired dipole or quadrupole, so careful measurements are necessary to determine whether these harmonics are within acceptable limits. In the case of the Energy Saver, these limits on field quality are made more stringent by the fact that the ring will be used as a storage ring. Protons and antiprotons will stay in the ring for times much longer than in a mere accelerator, and this places tighter requirements on the field.

In addition, the time scale of testing is much longer for superconducting magnets, because some hours are needed for hooking up the complex cryogenic leads and cooling the magnet down to its operating temperature, 4.6°K above absolute zero. The total of the cooling, measurement, and warmup times means that every one of the 1150 production Energy Saver magnets and approximately 150 magnets built during the earlier design and development phase has spent at least 24 hours on a test stand at the Magnet Test Facility. (Some have spent much longer. During the course of the measurements of cryostat motion that led to the smart bolts, one magnet spent more than 4 weeks in continuous testing.)

Even before the completed magnets undergo their cold tests, the field of the collared coils is measured at room temperature with low current in IB3. This first look at the harmonics has the purpose of finding any defects in coil winding and fixing them before the coil is installed in a cryostat and yoke, a process not easily reversed.

There are six test stands in MTF, four for dipoles and two for quadrupoles. A 1500 W helium refrigerator with a 10,000 ℓ helium storage tank provides the cooling capability. A test stand holds only one magnet at a time and the helium flow must be

turned around in an "end box" similar to the "turn-around box" at the end of a magnet string in the tunnel.

A magnet is placed on the stand, connected cryogenically and electrically, vacuum pumped, and cooled down in approximately 6 hours. The Energy Saver is a cold-bore design, so an insulated pipe must be installed in the bore of the beam pipe to make it accessible for measurements. The magnet is then "trained" by ramping it up to a field at which it "quenches," that is, it stops being superconducting. The energy in the field must be dissipated at this point. It boils the helium, which is recovered and recooled. Energy Saver dipoles require at most one or two training ramps to reach the design field, quadrupoles typically exceed the design field before quenching.

When training is done, the magnetic field is measured in a number of detailed ways. The integral field and its vertical plane are measured with a long loop. The centerline field is measured along the magnet in detail by a nuclear magnetic resonance probe. The field harmonics are measured in a series of three measurements, because the rotating coil probe is not long enough to do a 20 ft dipole in one shot. For a quadrupole, an additional measurement must be made to determine the field center. Following a successful cold test, a magnet undergoes extensive mechanical measurements to ensure that adjacent magnets will fit together in the ring.

These data are summarized and reviewed by Energy Saver people. The data are used partly to determine the optimum location for the magnet in the ring, because undesirable harmonics can be partly cancelled in neighboring magnets. This lengthy measurement and acceptance process has now been done on over 90% of the Energy Saver magnets. The production measurement accomplishment represents an intensive around-the-clock operation by some 65 technicians and physicists for the past two years.

Many people have contributed to the design and development of MTF. It was conceived and begun by Ryuji Yamada in 1977. Technical work of great importance was done by Dan Gross. Masyochi Wake of KEK made important contributions during his sabbatical year here. Frank Cole led the department through the completion of all six stands and of the measurements leading to an acceptable dipole. Frank Nezrick led through a large part of making MTF into a mass-production facility. Over the past several years, Ray Hanft, Bill Cooper, and Marvin Johnson have played major roles in running the MTF operation. Many other people, too numerous to mention, have worked to carry through this exacting task. All these people can feel pride in their participation in a vital part of the building of the Energy Saver.

12TH INTERNATIONAL HIGH-ENERGY ACCELERATOR CONFERENCE

Russ Huson

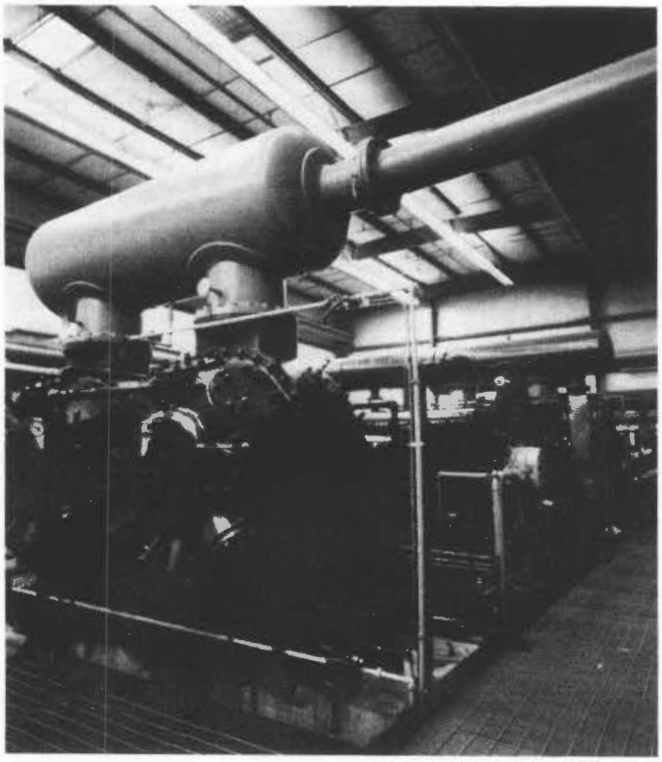
The 12th International Conference on High-Energy Accelerators will be held at Fermilab from August 11 through August 16 of 1983. A committee of Fermilab people, together with people from other institutions working in the field, has been busy organizing the conference. The organizing committee includes J. D. Bjorken, T. Collins, D. Edwards, R. Johnson, P. Livdahl, E. Malamud, F. Mills, and L. Teng.

This is a time of ferment and thinking about future projects in high-energy accelerators. The 400-GeV era, which has been enormously productive for physics results, has run its course, and there is a need for experiments at higher energy. The CERN SPS $\bar{p}p$ Collider has already begun work in a new energy range suitable for searches for intermediate vector bosons. The Fermilab $\bar{p}p$ Collider, LEP, the SLAC SLC, and perhaps the Brookhaven CBA will all come into being in the next several years in this same range. In fact, the Energy Saver, the base for the Fermilab Collider and an important technical step in accelerators, may be in operation by the time of the conference. Many people have begun to discuss a step beyond the "vector boson" range, and in August there will be work to report on possible 20-TeV synchrotrons, single-pass colliders, and laser and collective accelerators. The mood is in some ways reminiscent of the first conference in 1956, when the invention of strong focusing had begun an explosion in accelerator technology and many results of critical importance were reported. That conference also covered pion physics. Our conference will include some discussion of detectors because they are now so intimately connected with accelerator design.

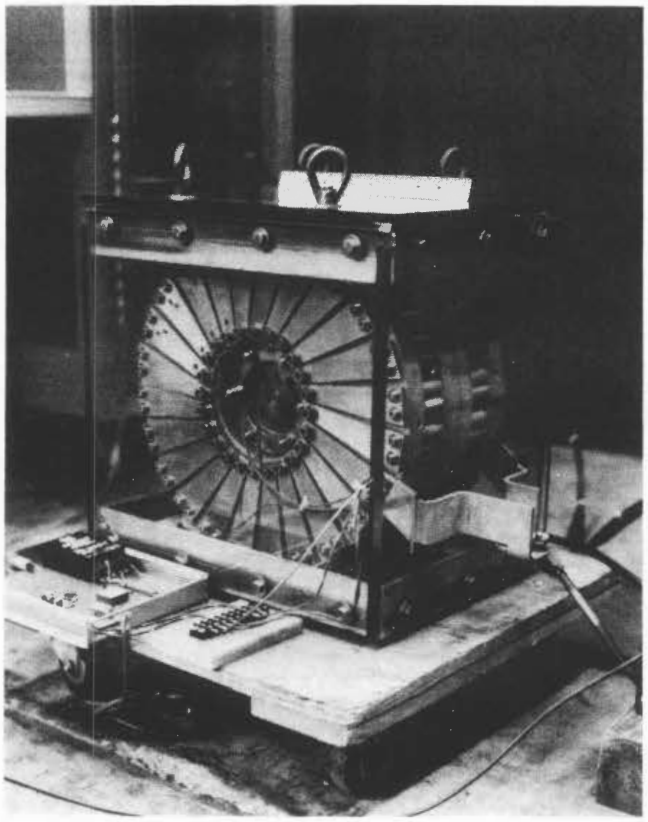
To cope with these large numbers of interesting papers on many different aspects, the Program Committee has arranged plenary sessions with invited speakers and poster sessions for contributed papers. The posters will be emphasized over the weekend, when there will also be tours of Fermilab facilities. A number of people have been invited to speak to summarize the state of various parts of the accelerator art. Some of the principal speakers are J. D. Bjorken, H. T. Edwards, A. M. Sessler, A. N. Skrinsky, and R. R. Wilson.

The time of the conference was chosen in coordination with the Photon-Lepton Conference, to be held at Cornell the preceding week. Having the conference continue through the weekend will allow for informal meetings and discussions, as well as for planned social events. There will be a concert Friday night, a buffalo roast Sunday, and a conference banquet on Monday evening.

People interested in attending should write to Rene Donaldson, the Conference Secretary.



New compressors in the Central Helium Liquefier.
(Photograph by Fermilab Photo Unit)



The transformer of the lithium lens of the Tevatron I project. The powerful pulsed lens focuses antiprotons produced in the target just upstream.

(Photograph by Fermilab Photo Unit)

SUMMER HOUSING INFORMATION

The Fermilab Housing Office is now making plans and accepting reservations for summer accommodations. Since there is always an influx of experimenters during the summer months, the office has established March 24 as the deadline for receipt of reservations for on-site housing.

An attempt will be made again this year to satisfy the annual summer housing crisis by a procedure on decision making based upon individual needs and optimization of the Laboratory program. A lottery will be used only as a last resort.

All requests, which can be for any period during the summer and need not necessarily commence June 1, should be in by March 24 and responses will be mailed by April 14. Although the present schedule does not call for experimental physics during the summer, the Housing Office expects more requests than can be accommodated. People currently in Fermilab housing may request extensions into the summer but are reminded that current occupancy does not guarantee placement.

All persons using housing for the summer will be asked to state that they will make steady use of the housing for the period they request. If the space will not be used for some portion of the period requested, Housing should be notified. In accord with recommendations from the Users Executive Committee, a fee equal to two weeks' rent will be charged to an individual or group if two weeks notice of cancellation or postponement is not given prior to the scheduled arrival. Double occupancy will not be employed for dormitory rooms unless it is requested. The charge for the second person will be $4 per night.

Allocation Priority

1. Theorists - six houses or apartments and five dorm rooms
2. Long-term commitments (foreign experimenters at Fermilab under official exchange agreement).
3. Running experiments, experiments in test stage, and experiments setting up for the fall.
   (a) Families - at least one house or apartment per experiment in this category.
   (b) Individuals - at least one dormitory room per experiment in this category.
   (c) Remaining dormitory rooms, houses, and apartments will be assigned until as many requests as possible from persons in this category can be met.

The starting dates for summer occupancy will be staggered over the week of May 31 through June 6, 1983. In the event that on-site housing facilities are filled, the Housing Office will assist in finding off-site accommodations. For further information, please contact the Housing Office, 840-3777.

MANUSCRIPTS, NOTES, LECTURES, AND COLLOQUIA PREPARED
OR PRESENTED FROM DECEMBER 20, 1982 TO JANUARY 21, 1983

Copies of preprints with Fermilab publication numbers can be obtained from the Publications Office or Theoretical Physics Department, 3rd floor east, Central Laboratory. Copies of some articles listed are on the reference shelf in the Fermilab Library.

Experimental Physics

L. J. Teig et al. Experiment #497	Charged Hyperon Production by 400 GeV/c Protons (FERMILAB-Conf-82/97-EXP; submitted to the 5th International Symposium on High Energy Spin Physics, BNL, September 16-22, 1982)
B. Cox and P. K. Malhotra Experiment #537	Comparison of Energy Dependence of Transverse Momentum of Dimuons Produced in pN and π^-n Interactions with QCD Predictions (FERMILAB-Pub-82/99-EXP; submitted to Phys. Lett.)
B. Cox Experiment #537	A Comparison of Dimuon Production by 125 GeV/c $\bar{p}$ and π^- with Predictions of the Drell-Yan Model (FERMILAB-Conf-83/13-EXP; invited talk presented at the Drell-Yan Workshop, Fermilab, October 1982)
S. Katsanevas et al. Experiment #537	A Fast Processor for Dilepton Triggers (FERMILAB-Conf-83/14-EXP; submitted to the Topical Conference on Application of Microprocessors to High-Energy Physics Experiments, CERN, May 4-6, 1981)
R. C. Ball et al. Experiment #613	Prompt Neutrino Results from Fermilab (Invited talk at the 1982 Meeting of the Division of Particles and Fields, College Park, Maryland)

Theoretical Physics

D. Campbell et al.	Resonance Structure in Kink-Antikink Interactions in ϕ^4 Theory (FERMILAB-Pub-82/51-THY; submitted to Physica D)

W. A. Bardeen et al.	Fractional Charges: Global and Local Aspects (FERMILAB-Pub-82/54-THY; submitted to Nucl. Phys.)
J. D. Bjorken	Energy Loss of Energetic Partons in Quark-Gluon Plasma: Possible Extinction of High p_T Jets in Hadron-Hadron Collisions (FERMILAB-Pub-82/59-THY; submitted to Phys. Rev. D)
A. Sen	Asymptotic Behavior of the Wide Angle On-Shell Quark Scattering Amplitudes in Non-Abelian Gauge Theories (FERMILAB-Pub-82/66-THY; submitted to Phys. Rev. D)
H. Aratyn and M. Moshe	Inverted Hierarchy and Asymptotic Freedom in Grand Unified Supersymmetric Theories (FERMILAB-Pub-82/73-THY; submitted to Phys. Lett.)
J. D. Bjorken	Remarks on Future Accelerators and Future Physics (FERMILAB-Conf-82/77-THY; "Concluding Remarks" given at the ECFA-RAL Meeting on "The Challenge of Ultra-High Energies," Oxford, September 27-30, 1982)
H. J. Lipkin	The Successes and Failures of the Constituent Quark Model (FERMILAB-Pub-82/82-THY; submitted to Phys. Rev. D)
C. Quigg	Hadron Jets in Perspective (FERMILAB-Conf-82/91-THY; summary remarks at the Europhysics Study Conference on Multibody Phenomena in Strong, Electromagnetic, and Weak Interactions, Erice, September 11-18, 1982)
K. M. Bitar and R. Raja	Four Dimensional CP^2 on a Lattice (FERMILAB-Pub-82/98-THY; submitted to Phys. Rev. D)

General

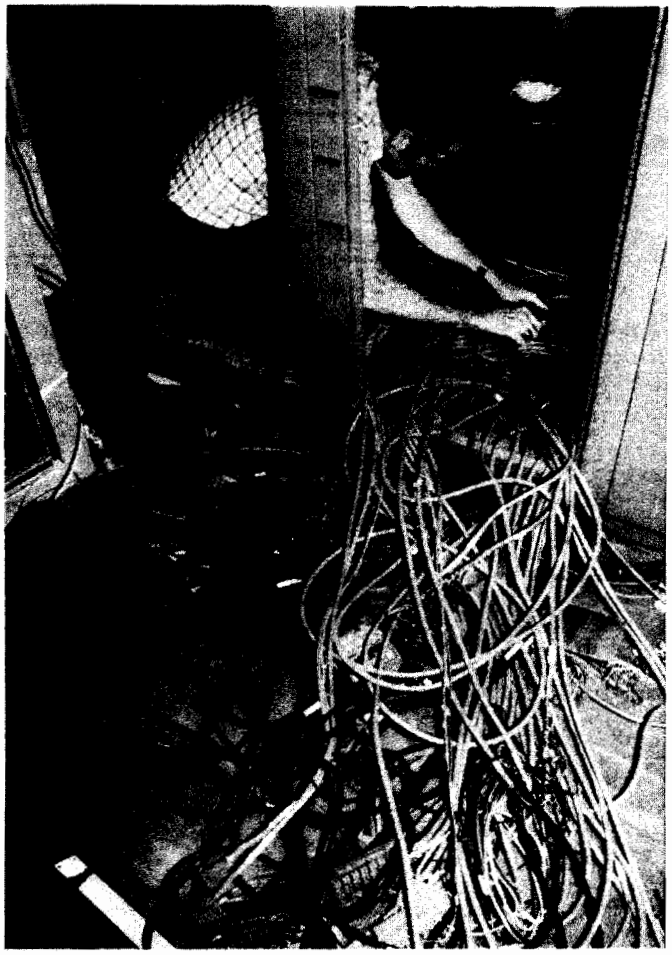
J. R. Orr	Status of the Energy Saver (Submitted to the 1982 Applied Superconductivity Conference, Knoxville, November 30-December 3, 1982)

Physics Notes

D. Neuffer et al.	An Exploration of the Frequency Dependence of Modulation Blowup in $\bar{p}p$ Colliding Beams (FN-373)
C. Brown et al.	Construction and Operation of a Large Ring-Imaging Cerenkov Detector (FN-375; talk presented at the IEEE Nuclear Science Symposium, Washington, D. C., October 20-22, 1982)
M. Atac	Breakdown Processes in Wire Chambers and Prevention (FN-376)
G. A. Chartrand and W. P. Trower Experiment #623	Development of a Remote Computer Work Station at Fermilab (FN-377)

Colloquia, Lectures, and Seminars

H. Thacker	"Solvable Quantum Field Theories" (Fermilab, January 4, 1983)
C. Owen	"Sojourns at KEK (Japan) and IHEP (Beijing)" (Fermilab, January 4, 1983)
R. Rubinstein	"The Two Small Experiments Already Approved for the Tevatron Collider" (Fermilab, January 11, 1983)



Michael Shea working on installation of the new microprocessor linac control system.

(Photograph by Fermilab Photo Unit)

DATES TO REMEMBER

February 1, 1983	Deadline for new DO proposals and other submissions for consideration of the Physics Advisory Committee
February 25, 1983	Users Executive Committee Meeting
March 24, 1983	Deadline for receipt of reservations for on-site summer housing
April 7-8, 1983	PAC Proposal Presentation Meeting
April 22-23, 1983	Annual Users Organization Meeting
June 18-24, 1983	PAC Extended Summer Meeting