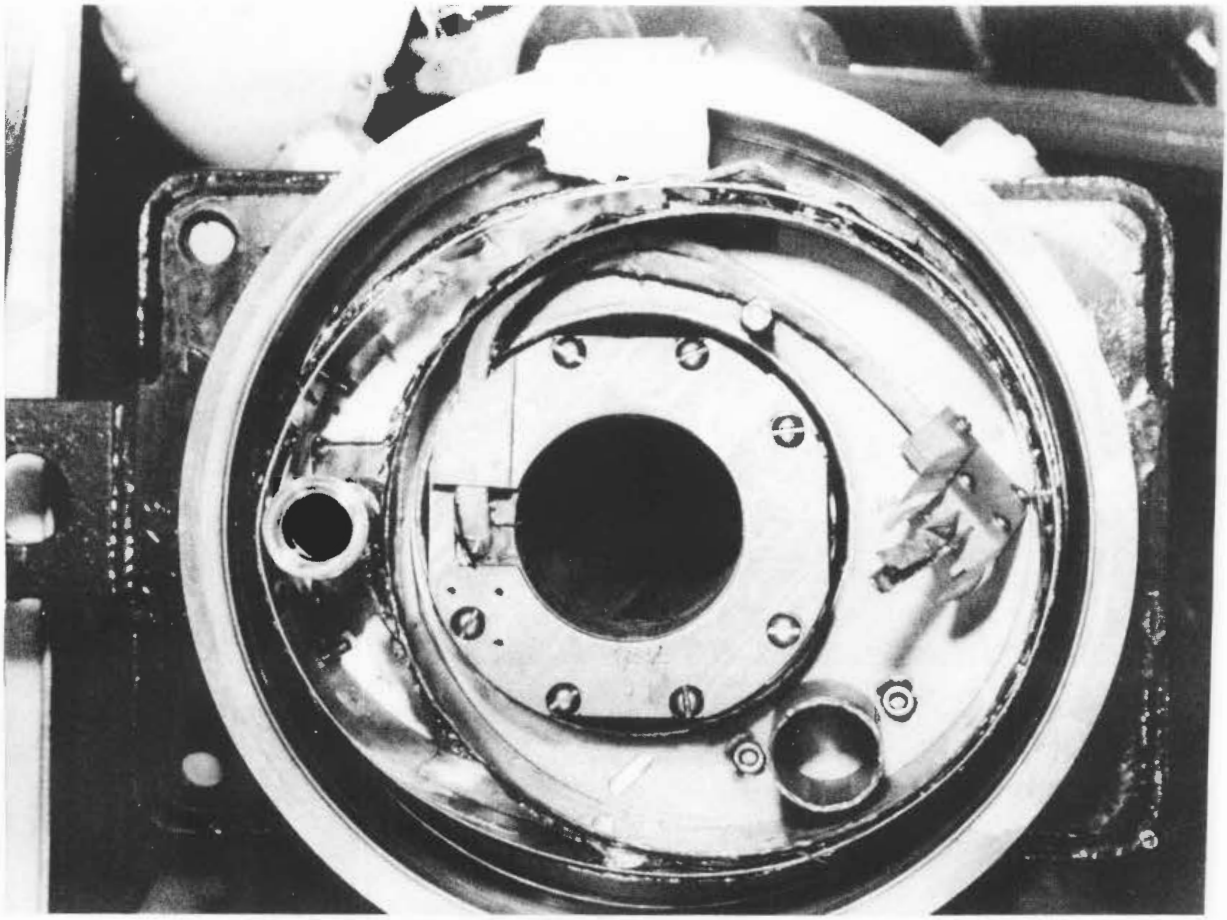
fermilab report

Fermi National Accelerator Laboratory Monthly Report

July August 1984



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F. T. Cole, R. Donaldson, and L. Voyvodic, Editors

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

FERMILAB-84/7 Fermi National Accelerator Laboratory 0090.01

THE COVER: The end of a damaged Energy Saver magnet (see inside story by Stan Pruss).

(Photograph by Fermilab Photo Unit)

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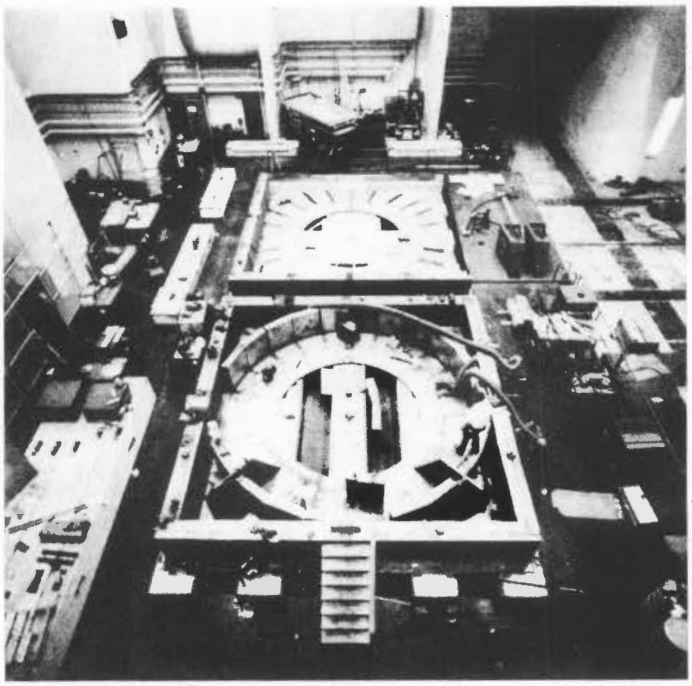
ENERGY SAVER NEWS

Stan Pruss

The 800-GeV run just ended saw many accomplishments and revealed some problems. Among the accomplishments were over 1000 hours of HEP, over 100,000 800-GeV ramps and nearly 2×10^{17} protons delivered for HEP. The best single week had 106 hours of HEP. The intensity record for 800 GeV exceeded 1×10^{13} protons per pulse. Multiple fast spills with $2\text{-}1/2\times10^{12}$ protons per spill were studied for the future neutrino program. The $\bar{p}p$ low-beta studies squeezed beam down to a β^* of 1 m. Considerable study was done on bunch coalescing and bunch rotation for the future $\bar{p}p$ colliding program. Beam storage studies indicated an intensity lifetime of many tens of hours. In fact, it was difficult to measure the intensity lifetime because the mean time between interruptions (e.g., aborts, ramp trips, etc.) was small compared to the lifetime.

The run also served to point up some design errors and construction weaknesses that will be fixed during the shutdown. Among the minor problems that cause small downtimes were misfiring of the abort and burning correction element fusible links because of loose connector bolts. Among the many things that happen in the spring is construction. Twice, earth-moving equipment caused serious problems by cutting buried cables (once a 13.8-kV power feeder and once the 19-heliax bundle carrying the control-system link).

The major problem revealed by the run was the ground-fault failure rate of Tevatron dipoles. There were five such failures, the first on March 10 and then June 2 and 18, July 6 and 9. These were all due to an apparently minor construction detail of the dipoles which was not properly specified. At the downstream end of one-half the Tevatron dipoles ("TC" type) there is a section of superconducting cable (about 10-m long) which is not restrained (see accompanying photo). When the ring is ramped, the current in the cable leads to a magnetic force of over 100 lbs. This causes the cable leads to move every ramp cycle. This repetitive motion causes damage to the conductor from mechanical fatigue and damage to the insulation wrapped around the cable from abrasion. Eventually a failure occurs. One of the major tasks that will now have to be done this summer is to modify approximately 380 "TC" style dipoles in the tunnel so the cable leads cannot move.



Partial assembly of the Collider Detector.
(Photograph by Fermilab Photo Unit)

PHYSICS ADVISORY COMMITTEE MEETING

June 15-22, 1984

Introduction

The construction of a cryogenic accelerator, its operation at 800 GeV, and the delivery of extracted beams for fixed-target experiments are supreme achievements of modern technology. The Committee congratulates the Laboratory on its splendid work. We note that the major construction projects for the Tevatron and its associated facilities have stayed within the budget and are on schedule.

Over the past five years, in anticipation of the commissioning of these facilities, this Committee has recommended a comprehensive program of experiments which utilize innovative electronic and visual detectors. This program directly confronts important issues at the forefront of elementary particle physics and provides unique opportunities for the discovery of new phenomena. The Laboratory Director has enthusiastically accepted our recommendations, and with the help of his staff, has developed plans to bring these experiments into operation in an efficient and timely fashion. A large number of physicists from all parts of the United States and from more than twenty other countries have committed their time and resources to these projects.

It is in the context of these major commitments of construction funds, scientific personnel, and resources, that the Committee is compelled to express its dismay at the inadequate level of funding currently in prospect to equip and operate the experiments and beam lines. Adequate and properly phased funding for equipment and operation must accompany such a large construction project in order to realize the goals of the program.

The Committee has been asked to advise the Director on how the Laboratory should react to the current low level of funding and possible further cuts in the budget. After carefully evaluating the program, we cannot recommend that any part of the currently approved program be cancelled. We are deeply concerned about the chilling effects the current funding situation will have on physics opportunities we envision for the future. We therefore strongly urge the Laboratory to continue seeking adequate funds to carry out this program, and to emphasize forcefully to the Department of Energy and HEPAP the value of the physics opportunities which are in jeopardy, and the disproportion between the magnitude of the Tevatron construction projects and the level of funding available to exploit the opportunities they offer.

Tevatron I

The Committee reiterates its very strong support for the physics opportunites of the Tevatron I program and the desire to realize those opportunities as soon as possible. It is pleased with the rapid progress on the Antiproton Source and the CDF detector. It recognizes that implementation of a test run in June-July 1985 implies a very tight schedule for both the $\bar{p}$ source and CDF and that that goal may not be realized. However, it supports strongly the present schedule of a serious test run in the spring of 1986, followed by a physics run of several months duration in the fall of 1986. The Committee urges the Laboratory to adhere to that schedule if at all practical.

The Committee reaffirms its earlier commitment to the existence of a high quality second detector to exploit fully the physics of Tevatron I. It feels that the conceptual design of the DØ detector addresses well the physics opportunities, emphasizing those complementary to CDF. It is desirable to bring DØ into operation at an early date. It seems unlikely, given the current budget, that this detector will be ready to produce physics before 1988. The Committee notes that the physics output of Tevatron I will continue to be rich through the mid-1990's and considers it important to have a second detector in place for as much of this period as possible. It endorses the DØ Technical Review, and notes that the full capabilities of DØ are not really known until a cryogenic and mechanical design of the calorimeter is available. The Committee urges the Laboratory to provide manpower to help in this effort. It also notes the importance of finalizing the design of the DØ Hall as soon as possible so that its construction may begin during the 1985 shutdown.

The funding profile suggested by the Laboratory should enable construction of the DØ detector on a time scale nearly matched to the technical limitations, but it has little contingency. The Committee realizes that if the cost were to increase dramatically without a corresponding budget increase, it could only be accommodated by a stretch-out, staged implementation, or change in scope. The Committee feels that there may be opportunities for an optimization of the detector design leading to a reduction in the number of channels or a staged implementation.

Tevatron II

The Committee has reviewed in detail the entire Tevatron II experimental program. It is a vigorous and well-balanced program in a unique energy range which studies programmatically lepton, photon, and hadron interactions, conducts crucial tests of QCD and electro-weak theories, studies production and decay of heavy quark states, and searches for new phenomena in the higher energy range of Tevatron II. There is little overlap in the physics potential of individual experiments, and the Committee found that no major experiment could be eliminated without significant

reduction in the physics yield of Tevatron II. Thus, the present Committee reaffirms the scientific approval given by previous PACs to all of the approved Tevatron II experiments.

As mentioned above, the DOE guidelines on capital equipment funding communicated to the Laboratoy in March do not permit the timely utilization of Tevatron I and Tevatron II facilities. The Laboratory has submitted a plan (see page 7) that trims and stretches out the Tevatron II program (including the deferral of upgrades of the Proton-West and Meson-East beam lines). This scenario comes close to fitting within the guidelines, and, if there is no improvement in the budget, the Committee feels that this is a reasonable solution to an unfortunate problem.

In previous years the Committee assigned physics priorities within the Tevatron II program as follows: (1) Prompt Neutrino; (2) the Muon Beam and the Wide-Band Photon Beam; (3) the Meson-West Pion Beam; and (4) the Polarized Proton Beam. In reassessing this assignment of priorities the Committee has been unavoidably influenced by budget constraints and the cost to complete the Prompt Neutrino Beam and has separated that facility from the other major new beam lines. The Committee now ranks them in the following order: the Wide-Band Photon Beam, the Muon Beam, the Meson-West Pion Beam, and the Polarized Proton Beam. The Committee regards the Prompt Neutrino program as comparable in physics priority with the best of the programs ranked above.

Scenarios and Relative Priorities

If the DOE is unable to supply even the inadequate capital equipment funds specified in its March guidelines, it will not be possible to realize the physics opportunities of Tevatron I and Tevatron II without a substantial delay in one or more of the programs. How the Laboratory should react to such a cut depends on its magnitude. If the shortage in FY 85 is at the level of $1-2M the Lab could delay the Polarized Proton Beam. In the event of a more drastic shortfall in FY 85, the Committee reluctantly concludes it may be necessary to delay or reduce in scope the Prompt Neutrino program. The Committee makes this recommendation only because other attempts to save an equivalent amount of capital equipment funds would require substantial delay in the entire TeV I program or in at least three other TeV II experimental programs. The Committee feels that it is important that the TeV II programs in the existing beams and in the new Neutrino, Muon, Photon, and Meson-West Pion beams and the TeV I program, as realized by CDF, proceed on schedule. It thus reluctantly accepts some delay in the Polarized Proton or Beam Dump programs, if necessary, to allow this.

The Committee believes that the Beam Dump does offer unique physics opportunities, that it is important to make a start on DO and that one cannot sacrifice opportunities for future fixed target experiments. Their relative priority in future years must

depend on a reevaluation of the Beam Dump program, on the technical progress of DØ, and on proposals received for new TeV II experiments. It encourages the Laboratory to hold a workshop on the opportunities for experiments using the Beam Dump.

Future Fixed Target Opportunities

Tevatron II, as the highest energy fixed-target machine in existence, presents unique experimental opportunities in hadron, photon, and lepton phyiscs. The program in place exploits these opportunities with a combination of revised older experiments and new experiments and facilities. Results from the initial round of experiments as well as other concurrent measurements will certainly point the way to a new generation of TeV II experiments.

The diversity and flexibility inherent in fixed-target work will continue to provide important windows into interesting and perhaps unforeseen phenomena. Given the long time scale in the design and construction of modern experiments, the Committee recommends that the Laboratory encourage initiatives by holding workshops to explore future fixed-target experimentation. At the same time, it is important that long-range planning of the Laboratory take into account the financial impact of the construction of possible major new fixed target facilities.

Physics Advisory Committee

Vera Luth, Chairperson, Stanford Linear Accelerator Center
Stanley Brodsky, Stanford Linear Accelerator Center
John Cumalat, University of Colorado
Thomas Devlin, Rutgers University
Gary Feldman, Stanford Linear Accelerator Center
Howard Gordon, Brookhaven National Laboratory
David Hitlin, California Institute of Technology
Alfred Mueller, Columbia University
Melvyn Shochet, University of Chicago
Ken Stanfield, Fermi National Accelerator Laboratory
Martinus Veltman, University of Michigan
Hugh Williams, University of Pennsylvania

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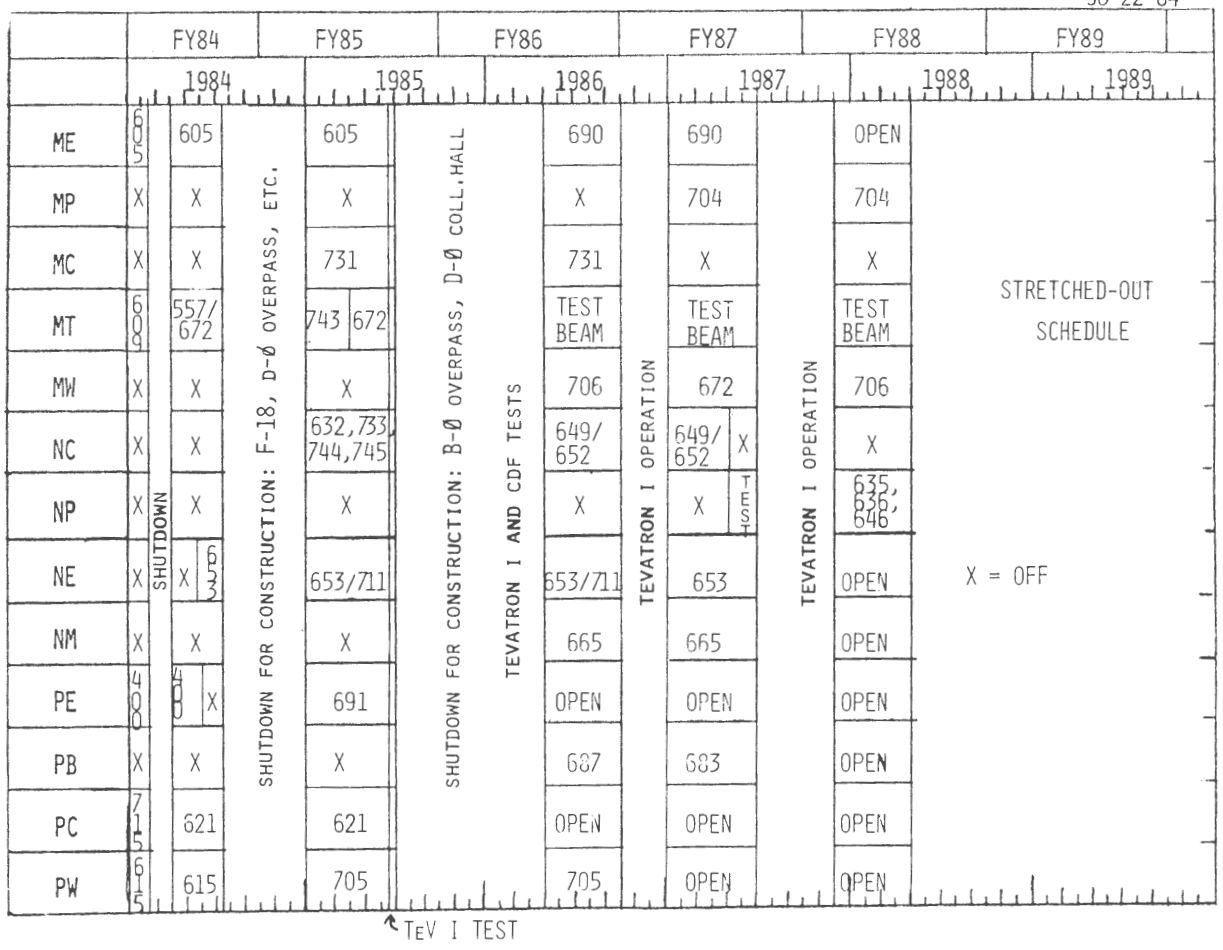
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STRETCHED-OUT SCHEDULE
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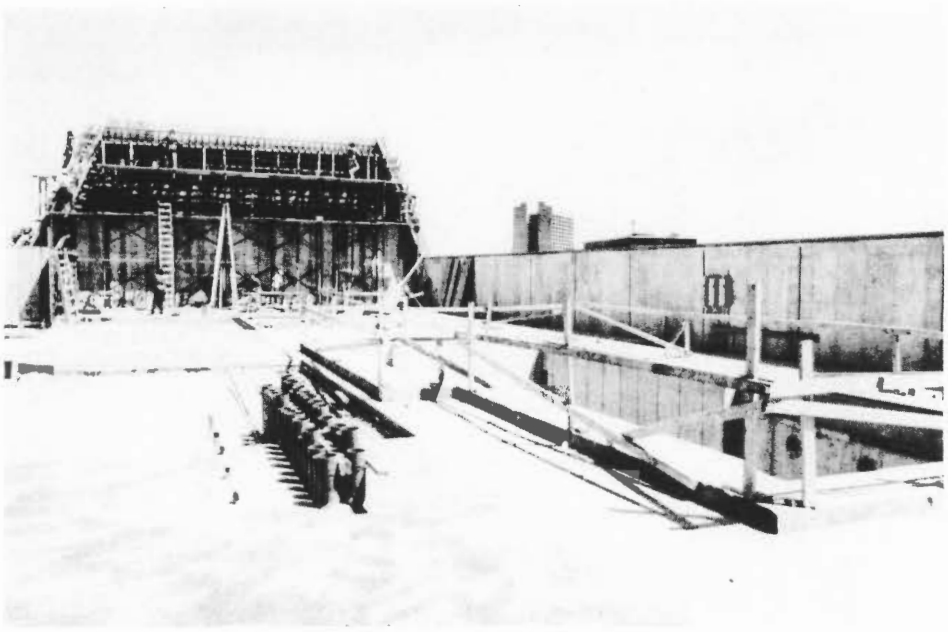


Target Building for Tevatron I.
(Photograph by Fermilab Photo Unit)

ILLINOIS RESEARCH CORRIDOR SCIENCE AND MATH TEACHERS SUMMER PROJECT

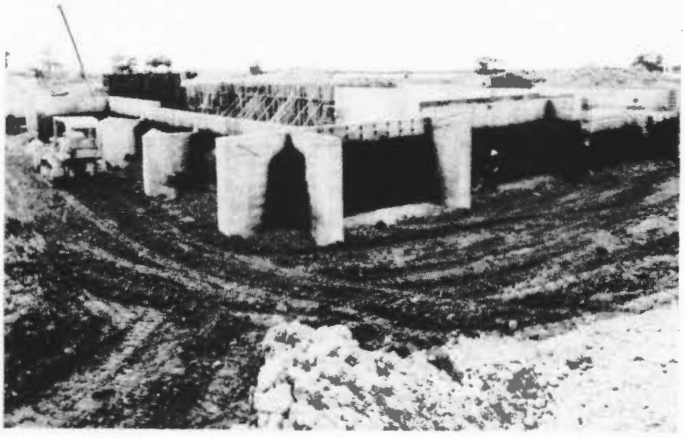
Six laboratories of the Illinois Research Corridor are continuing a program to help local schools develop and retain superior science and math teachers. Amoco Research Center, Argonne National Laboratory, Fermi National Accelerator Laboratory, AT&T Bell Laboratories, Nalco Chemical Company, and Northern Illinois Gas have joined in an effort to take a concrete step toward recognizing superior science teachers and improving science education. The program is in its second year.

Technical summer job opportunities have been made available at the participating institutions for the twenty-six educators selected. For these positions, seventy-one teachers were nominated as candidates by their DuPage and Kane County superintendents and principals. The finalists were selected on the basis of superior classroom teaching and their efforts toward enrichment programs for their students.

Participation in the program is beneficial to both the teachers and the laboratories. Involvement in research activities gives the teachers up-to-date background for selecting course materials and guiding students. The work done by the teachers contributes to the advancement of the laboratories' research programs.

Fermilab Participants

James William Carvell, Hinsdale South High School
Raymond John Dagenais, Waubonsie Valley High School
George Leon Eblin, Downers Grove North High School
Robert L. Hare, Wheaton North High School
Richard Anthony Lapetina, Streamwood High School
Paul Erik Madsen, Hinsdale South High School
Yvonne Pshea Richter, Batavia High School
James Alan Ruebush, St. Charles High School
Charlene Hubbard Ryan, Franklin Middle School



Construction of the Wideband Lab in Proton.
(Photograph by Fermilab Photo Unit)

NOTES AND ANNOUNCEMENTS

APPOINTMENTS. . .

Bruce Chrisman is rejoining Fermilab as Associate Director for Administration. He will be here part time for the summer and full time in the fall.

Ken Stanfield has been appointed Deputy Head/Operations of the Research Division. He will be responsible for operations, the fixed-target program, and for agreements with experimenters. **Tom Kirk** will continue as Deputy Head/Tevatron II.

PROMPT NEUTRINO FACILITY WORKSHOP. . .

A one-day workshop on the Prompt Neutrino Facility will be held on Friday, October 12, 1984. The workshop will review the physics goals of existing proposals for experiments and discuss new ideas for physics opportunities. The present plans and unsolved problems concerning the technical design for the primary proton beam and beam dump will be presented and discussed. An open discussion of possible cost-saving ideas and criticism of the existing design will be major purposes of the workshop. Further details and a tentative agenda will be announced in a mailing to all users at the end of August.

MANUSCRIPTS, NOTES, LECTURES, AND COLLOQUIA PREPARED
OR PRESENTED FROM FROM JUNE 18, 1984 TO JULY 29, 1984

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

Experimental Physics

J. L. Thron et al. Experiment #497	Search for Heavy Charged Particles and Light Nuclei and Antinuclei Produced by 400 GeV Protons (FERMILAB-Pub-84/53-E; submitted to Phys. Rev.)
R. Rubinstein et al. Experiment #577	Large Momentum Transfer Elastic Scattering of $\pi^{\pm}$, K^{+}, and p^{+} on Protons at 100 and 200 GeV/c (FERMILAB-Pub-84/54-E; submitted to to Phys. Rev.)
E. G. H. Williams et al. Experiment #580	Forward $K^0_S K^0_S$ Production in 200 GeV/c N Interactions (FERMILAB-Pub-84/51-E; submitted to Phys. Rev.)
M. W. Arenton et al. Experiment #609	Measurement of the Di-Jet Cross Section in 400 GeV/c pp Interactions (Submitted to Phys. Rev.)

Theoretical Physics

E. Eichten et al.	Supercollider Physics (FERMILAB-Pub-84/17-T; submitted to Rev. Mod. Phys.)
C. T. Hill	Possible Cosmological Origin of the Ultra High Energy Cosmic Rays (FERMILAB-Conf-84/40-T; invited talk 4th Moriond Workshop on Massive Neutrinos in Particle and Astrophysics, LaPlagne, France, January 15-21, 1984)
A. Sen	Monopole Induced Baryon Number Violation Due to Weak Anomaly (FERMILAB-Pub-84/42-T; submitted to Nucl. Phys.)

P. B. MacKenzie — Monte Carlo Renormalization Group Calculations for SU(2) Lattice Gauge Theory (FERMILAB-Conf-84/48-T; talk presented at the Workshop on Gauge Theory on a Lattice, Argonne National Laboratory, April 1984)

R. K. Ellis — Transverse Momentum Distributions of Jets and Weak Bosons (FERMILAB-Conf-84/49-T; talk presented at the 4th Topical Workshop on $p\bar{p}$ Collider Physics, Bern, Switzerland, March 5-8, 1984)

General

D. Eartly et al. — Semi-Remote Handling of Radioactive Devices in the Fermilab Target Stations (TM-1271; presented at the 1984 Annual American Nuclear Society Meeting, New Orleans, June 4, 1984)

O. Fackler et al. — The Calculation of Molecular Final States and Tneir Effect on a Precision Neutrino Mass Experiment (Presented at tne 4th Moriond Workshop on Massive Neutrinos in Particle and Astrophysics, LaPlagne, France, January 15-21, 1984)

O. Fackler et al. — An Experiment for a Precision Neutrino Mass Measurement (Presented at the Fourth Moriond Workshop on Massive Neutrinos in Particle and Astrophysics, LaPlagne, France, January 15-21, 1984)

R. L. Gluckstern and R. K. Cooper — Beam Cavity Interaction (Presented at the 1984 Linear Accelerator Conference, Darmstadt, Germany, May 7-11, 1984)

P. Hale and B. Winstein, Eds. — PSSC - Physics at the Superconducting Super Collider Summary Report

M. Harrison — The Fermilab pp Collider (Submitted to the 4th Topical Workshop on $p\bar{p}$ Collider Physics, Bern, Switzerland, March 5-8, 1984)

H. E. Montgomery	Nuclear Effects in Muon Scattering (FERMILAB-Conf-84/58; submitted to the Conference on the Intersections Between Particle and Nuclear Physics, Steamboat Springs, Colorado, May 23-30, 1984)
L. C. Teng	High Intensity Hadron Accelerators (TM-1262; presented at the Conference on the Intersections Between Particle and Nuclear Physics, Steamboat Springs, Colorado, May 23-30, 1984)
D. Theriot	The Collider Detector (CDF) at Fermilab - An Overview (Invited talk at the 4th Topical Workshop on $p\bar{p}$ Collider Physics, Bern, Switzerland, March 5-8, 1984)
A. V. Tollestrup	Status of the FNAL Tevatron Program (Submitted to the ICFA Seminar on Future Perspective in High Energy Physics, May 14-19, 1984, KEK, Japan)

Physics Notes

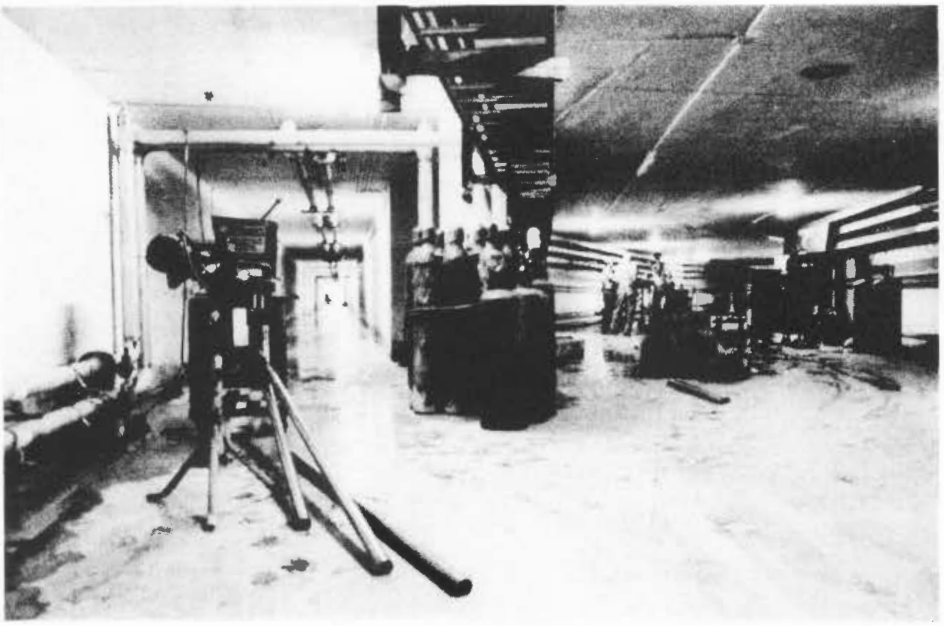
P. Kurup et al.	Response of the Epidermoid and Non-Epidermoid Cancers of the Head and Neck to Fast Neutron Irradiation: The Fermilab Experience (FN-400)
S. Ohnuma	Effects of Correction Sextupoles in Synchrotrons (FN-401; presented at the Conference on the Intersections between Particle and Nuclear Physics, Steamboat Springs, Colorado, May 23-30, 1984)
J. D. Cossairt and A. J. Elwyn	Shielding Considerations for Fixed Target Usage of the SSC (FN-404; submitted to the SSC Workshop on Fixed-Target Physics, The Woodlands, Texas, January 1984)

Colloquia, Lectures, and Seminars

F. Cole	"Particle Accelerators" (Fermilab, June 18, 1984)

P. Heinicke et al.	"DECUS Conference Highlights - PDP-11 and VAX News" (Fermilab, June 19, 1984)
R. Orr	"Accelerator Division Information Meeting" (Fermilab, June 19 and July 10, 1984)
H. B. White	"Particle Beam Transport" (Fermilab, June 20, 1984)
G. T. Mulholland	"Chapter 15.2 of the Lab Safety Manual - Cryogenics Safety Review Requirements and Chapter 15.3 - Cryogenics Occupational Training" (Fermilab, June 25, 1984)
E. Kolb	"Man's View of the Universe - The Inner Space/Outer Space Connection" (Fermilab, June 26, 1984)
M. Purohit	"Particle Interactions and Symmetry" (Fermilab, June 27, 1984)
D. Green	"Scattering and Spectroscopy" (Fermilab, July 2, 1984)
L. Lederman	"Everything You Want to Know About Elementary Particles" (Fermilab, July 10, 1984)
F. Mills	"More on Tevatron I Dipole Field Measurements" (Fermilab, July 12, 1984)
R. Oberholtzer	"Status of Tevatron I Installation - Electrical" (Fermilab, July 19, 1984)
A. Lennox	"Status of Tevatron I Installation - Survey" (Fermilab, July 19, 1984)
F. Krzich	"Status of Tevatron I Installation - Water System" (Fermilab, July 19, 1984)
D. Jovanovic	"Particle Detectors" (Fermilab, July 23, 1984)
D. Lindley	"The Distribution of Matter in the Universe" (Fermilab, July 27, 1984)

Beginning the new Muon Lab.
(Photograph by Fermilab Photo Unit)



Tevatron I tunnel.
(Photograph by Fermilab Photo Unit)

DATES TO REMEMBER

August 13-24, 1984	U. S. Summer School on Particle Accelerators, Fermilab
September 21-22, 1984	Vertex Detectors: Charm and Beauty I (for more information, contact Phyllis Hale, Users Office, 840-3111)
October 12, 1984	Prompt Neutrino Facility Workshop, Fermilab (for more information, contact Phyllis Hale, Users Office, 840-3111)