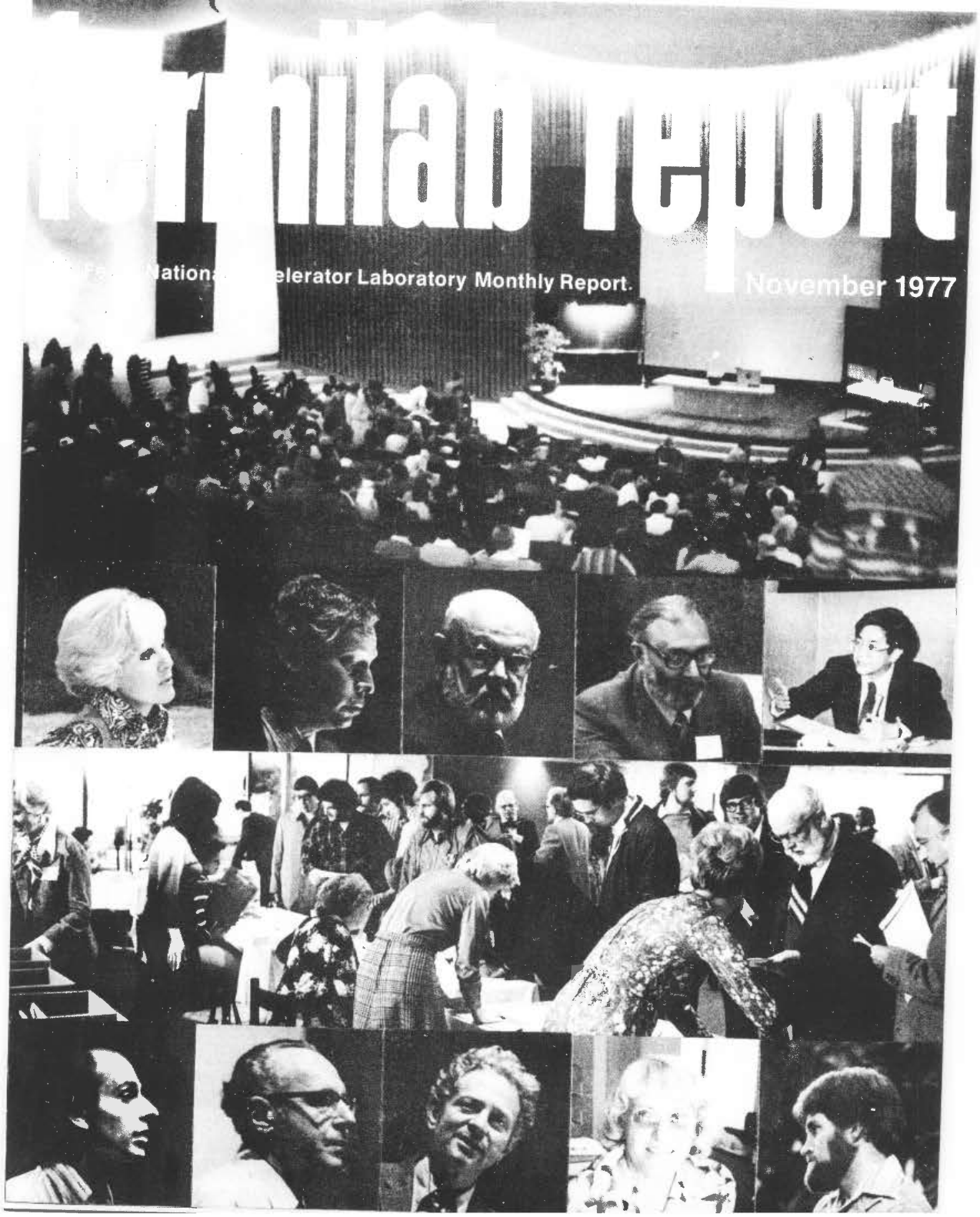
Fermilab Report

Fermi National Accelerator Laboratory Monthly Report. November 1977



fermilab report is published monthly by the Fermi National Accelerator Laboratory, P. O. Box 500, Batavia, Illinois 60510.

F. T. Cole, Editor R. Donaldson, Assistant Editor

The presentation of material in fermilab report is not intended to substitute for or preclude its publication in a professional journal, and reference to articles herein should not be cited in such journals.

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

FERMILAB-77/11 Fermi National Accelerator Laboratory 0090.01

THE COVER: Scenes from the Ben Lee Memorial International Conference, October 20-22. A collage done by Angela Gonzales; photographs by the Fermilab Photo Unit.

Operated by Universities Research Association, Inc., under contract with the United States Energy Research and Development Administration

CONTENTS NOVEMBER 1977

Booster Produces 10-GeV Beam 1
C. Ankenbrandt

Deep-Inelastic Muon-Scattering Experiments 3
K. W. Chen

Report on the Muon Workshop 9
T. B. Kirk

Notes and Announcements

1977-1978 Procedures Available. . . 15

Appointments. . . 15

PAC Subcommittee Meeting to Review 15-Ft Bubble Chamber Neutrino Program. . . 16

Research Activities During October 1977 17
James MacLachlan and Edward Stout

Facility Utilization Summary--October 1977 20

Monthly Operations History--October 1977 21

Beam Utilization by Experiment--October 1977 22

Manuscripts and Notes Prepared During October and November 1977 25

Dates to Remember

BOOSTER PRODUCES 10-GeV BEAM

C. Ankenbrandt

The Booster accelerated beam to a record 10 GeV during accelerator studies on November 9. The successful test gives the necessary confidence to proceed with further improvements. Routine operation at 10 GeV awaits the completion of projects to upgrade the Booster rf cavities and the 8-GeV line.

Supplying the extra rf voltage necessary for high-intensity 10-GeV operation will involve raising the operating voltage of the cavities from 22 kV to 30 kV. This, in turn, will require replacing some of the ferrite in the tuners and using breakdown sensors to allow the cavities to be conditioned to 30 kV without damage. This is a continuing project, with pairs of cavities being replaced with upgraded ones during machine shutdowns. At present, more than half the 18 cavities have been upgraded.

It was not difficult to achieve the increased magnet current after it was realized that saturation of an inductance in the resonant circuit was causing the resonant frequency to change to 15.3 Hz at the 10-GeV level. Capacitance was added to each girder to retune the circuits to 15 Hz, making the available drive voltage adequate for 10-GeV operation.

Raising the energy should have several advantages. In the Main Ring, the beam size will be smaller at injection, space-charge and gas-scattering effects will be diminished, and remanent-field effects will be smaller. The Booster itself may also profit from more rapid acceleration, since the predominant losses are at low momentum.

A lively discussion during a break at the Ben Lee Memorial International Conference. (Photo by Fermilab Photo Unit)

DEEP-INELASTIC MUON-SCATTERING EXPERIMENTS

K. W. Chen*

The strikingly simple character of deep-inelastic electron scattering[1] led to a scaling hypothesis of the structure of the nucleon as a composite of structureless entities. The existence of structureless entities implies that the structure function νW_2 (W_1) must be a function of a single scaling variable,[2] say $\omega = 2M\nu/q^2$, where M is the mass of the nucleon, $\nu = E-E'$ is the energy transferred by the proton to the electron and $q^2 = 2EE'(1 - \cos\theta)$, where θ is the scattering angle. The structure function is related to the total cross section for a proton to absorb the virtual photon exchanged by the electron and proton. Without scaling, structure functions should, in general, depend on both ν and q^2. Before 1973, a series of electron-scattering experiments[3] performed at SLAC and DESY for q^2 from 1-15 GeV^2/c^2 and ν up to 20 GeV had confirmed the "scale-invariance" picture to a remarkable consistency. Data from low-energy muon-proton scattering experiments at BNL and SLAC were also consistent with this scale invariance. These observations led to an avalanche of theoretical work which, among other things, laid the basis for the "quark-parton" model.[4]

Beginning in 1973, tests of scale-invariance in muon scattering began at Fermilab with Experiment 26, a collaboration of Cornell, Michigan State, and the University of California. The experiment used an iron target to maximize the luminosity in order to reach high values of q^2 ($\sim 50\ GeV^2/c^2$).

---

*On leave from Michigan State University

available in 1978 at the CERN SPS. Two active muon-scattering experiments, NA2 and NA4, are currently under construction.

References

[1] W. K. H. Panofsky, 14th Intern. Conf. on High Energy Physics, Vienna, August, 1968.

[2] J. D. Bjorken, Phys. Rev. 179, 1547 (1969).

[3] For a review see, J. I. Friedman and H. W. Kendall, Ann. Rev. Nucl. Sci. 22, 203 (1972).

[4] R. Feynman, Phys. Rev. Lett. 23, 1415 (1969).

[5] Physics Today 27, 17 (1974); Y. Watanabe et al., Phys. Rev. Lett. 35, 898 (1975); C. Chang et al., Phys. Rev. Lett. 35, 901 (1975).

[6] H. Anderson et al., 18th Intern. Conf. on High Energy Physics, Tbilisi, August, 1976; Phys. Rev. Lett. 38, 1450 (1977).

[7] R. Ball et al., submitted to Intern. Symposium on Lepton and Photon Interactions, Hamburg, August, 1977.

[8] K. Schultze et al., submitted to the Intern. Symposium on Lepton and Photon Interactions, Hamburg, August, 1977.

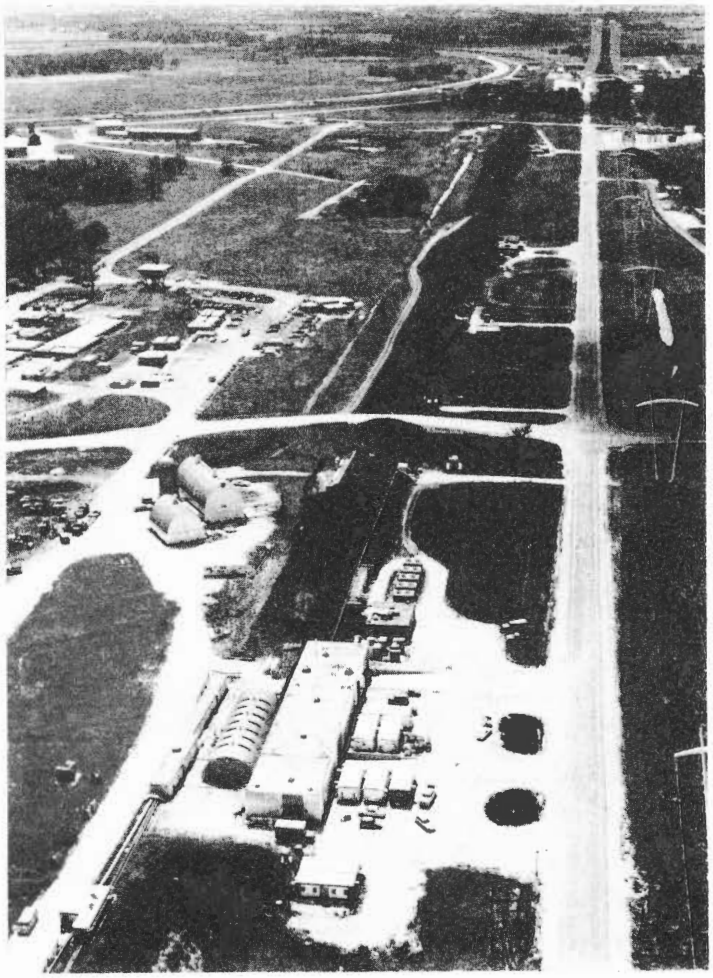
[9] H. D. Politzer, Phys. Reports C14, 129 (1974) and references therein.

[10] For example, I. Karliner and J. D. Sullivan, Urbana Preprint, 1977.

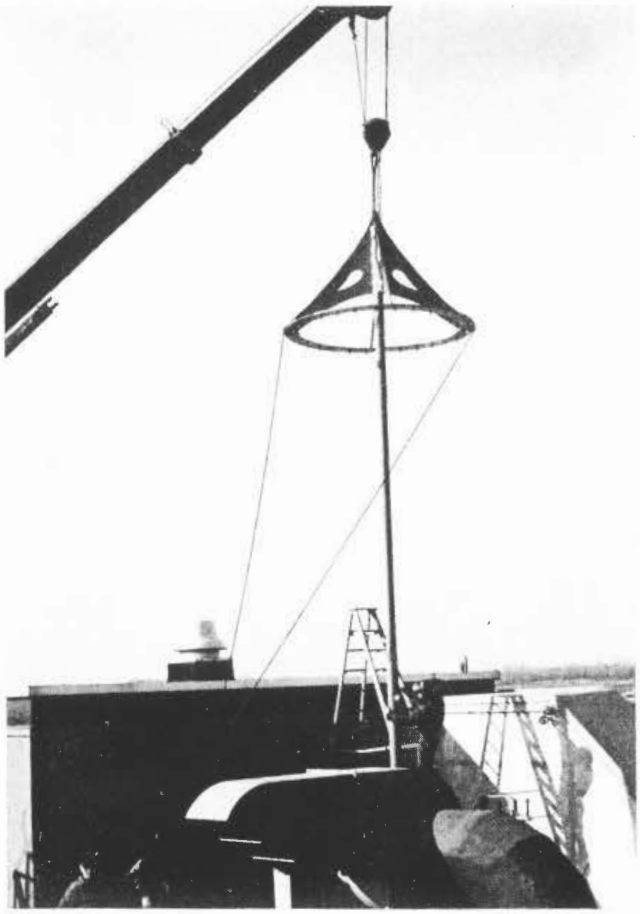
[11] For example, D. Schildknecht and F. Steiner, Phys. Lett. 56B, 36 (1975).

[12] W. A. Loomis et al., Phys. Rev. Lett. 35, 1483 (1976); W. R. Francis et al., Phys. Rev. Lett. 38, 633 (1977).

[13] C. Chang et al., Phys. Rev. Lett. 39, 519 (1977).



The Muon Laboratory. Since 1973 a series of deep inelastic muon-scattering experiments has been performed here. Scaling tests, hadron final states, and multimuon studies have been conducted. The neutrino detector building is shown on the left. The Main Ring is shown in the background. (Photo by Fermilab Photo Unit)



Installation of the first of six "energy fountains" at Service Building B1. This device will be ringed with hanging wires when complete. Its purpose is to dissipate the energy stored in the superconducting magnet ring in the event of a quench. (Photo by Fermilab Photo Unit)

REPORT ON THE MUON WORKSHOP

T. B. Kirk

A Muon Workshop was held on September 23 and 24 to discuss plans for a new muon beam. One of the important new facilities planned to be constructed for the advent of 1-TeV protons is a new muon beam with energy up to 800 GeV and intensities up to several times 10^8 per pulse. The workshop program was divided into three parts: first, design of the new beam; second, theoretical expectations for new physics associated with high-energy muons; and third, new or improved experimental facilities for use with muon beams. There was also a general discussion in which various questions not fitting neatly into the above categories were covered.

Taken as a whole, the workshop was designed to answer the vague but important question of whether there would be a challenging and exciting experimental program of muon physics to pursue at the time we could reasonably expect the new beam and experimental facilities to appear. There was a general consensus that there would be such a program.

1. Design of the New Beam

Anthony Malensek of Fermilab presented the results of a muon-beam design study made by Fermilab and Argonne physicists. The design includes proton splitting and transport for 400- and 1000-GeV primary protons from the accelerator to a production target located between the existing Neutrino and Proton Laboratory facilities, almost 1 mile (1460 m) from the extraction point. The new production target will receive beam independently of all other experimental areas in the Laboratory and be coupled only through the overall number of accelerated

protons. The muon beam itself is laid out to eliminate the penetration of nonbeam muons (halo) into other experimental areas. These two design principles alone will remove the most serious constraints on the present muon-physics program at Fermilab.

The muon-beam design is of the FODO type, with quadrupoles forming a channel to capture and hold charged particles, pions, and kaons as parent hadrons and muons as desired daughter particles. In some running configurations, the noninteracting portion of the primary proton beam is also transmitted. Quadrupoles and dipoles early in the transport capture the secondary hadrons from the production target and direct them into the FODO channel. Three-fourths of the way along the beam, the FODO is interrupted by a 30-ft beryllium metal absorber and bending magnet that combine to rid the beam of all hadrons and to select the desired band of muon momenta. At this point, the beam becomes a muon beam. Downstream, spoiler magnets and magnetized-iron pipe are used to sweep all off-momentum and wide-angle muons (halo) away from the beam itself. The final beam enters the new Muon Laboratory nearly 2 miles (3100 m) from the extraction point. The yields for three characteristic beam energies are shown in Table I. The halo quoted is for an area 200 in. × 200 in. centered on the beam at the Muon Laboratory. At the end of the muon beam line, there will be a new Muon Laboratory. For present discussion purposes, it is thought of as being about 200 ft long and 30 ft wide with the beam center line 10 ft below local ground level. It could accommodate two of the present muon experiments in tandem. Obviously, the evolution of thinking on the detector designs will have a strong impact on the actual building design and dimensions.

Table I. Estimated Muon Yields.

Central Parent Momentum (GeV/c)	800	600	305
Central Muon Momentum (GeV/c)	750	550	275
Mu±/Interacting Proton (Wang)	$(1.35 \pm 0.2)\ 10^{-5}$	$(7.86 \pm 0.9)\ 10^{-5}$	$(3.28 \pm 0.3)\ 10^{-4}$
$\Delta p/p$ (rms)	±9%	±11%	±13%
Halo/Beam	3%	3%	4%

The Fermilab Neutrino Department is continuing to work on the beam design. An interim report will be issued by December 1, 1977, and made available to persons interested in the details of the beam. Questions associated with the beam design should be referred to T. B. Kirk in the Neutrino Department.

2. Theoretical Expectations

Two theoretical physicists, J. D. Bjorken (SLAC), and J. D. Sullivan (University of Illinois), who have been active in this field, presented their expectations for the physics that could be investigated with the new facility.

Sullivan gave an outline of the physics associated with muon scattering in nuclear matter. Although many physicists are familiar with the general idea of photon vector dominance, VMD, (the real photon acting partly like a vector meson in nuclear matter) and the parton picture of deeply inelastic scattering of leptons (virtual photon absorption by pointlike nucleon constituents), the recent progress in connecting these very different physical notions with a smooth and continuous mathematical formalism is less familiar. Sullivan outlined the

essentials of the theory that connects the one regime to the other. The experimental work to date has barely scratched the surface, particularly in exploring the so-called anti-shadowing region, which occurs when the Q^2 of the photon is moderate [1-2 $(GeV/c)^2$] but the energy is sufficiently high (hundreds of GeV) that the virtual photons are still in the diffractive regime. The entire transition can be mapped out by a scattering program. The increase in beam energy to 750 GeV or more will enable the scaling properties of the fully shadowed regime to be explored.

Bjorken talked on the fundamental parton physics that can be uncovered by measuring not only the muon inclusive scattering, but also the hadrons that emerge from collisions of virtual photons with partons in nuclear matter. He emphasized that the common view that "heavy-element target experiments study only messy nuclear physics " is wrong and that muon experiments with nuclear targets, particularly at very high energies and with moderate to high Q^2, uncover basic physics of considerable interest and importance. He also discussed the physics that can be learned by studying the systematics of recoil hadrons both in the forward direction and at large angles. This talk helped many to see a future for heavy-target physics that they had not previously considered. In addition to the physics of parton propagation in heavy nucleii, Bjorken outlined a number of other areas of physics that could benefit significantly from the proposed increase in muon energy.

Among these were:

i) Charm production by virtual photons

ii) EM-weak interference measurements

iii) Systematics of scaling violations in deeply inelastic scattering.

Although he did not mention it explicitly, the large increase in muon intensity and strong halo reduction will make some experiments possible which are impractical under present conditions.

3. Experimental Talks

The remainder of the workshop program was given over to talks by experimenters on various aspects of muon scattering, under present conditions and projected to the new facility. J. J. Aubert of the University of Annecy presented a stimulating and useful talk on the CERN European Muon Collaboration (EMC) program for muon scattering with the new 300-GeV beam at CERN. This program is modeled on the work of the CHIO Group (Experiment # 98) at Fermilab, but features an improved spectrometer with essentially 100% hadron acceptance in its final form, a large sophisticated multi-cell Cerenkov counter, and a beam of much better intensity and greatly reduced halo. They will be able to extend the CHIO scale-violation measurements on hydrogen and deuterium to the kinematic limits with precision and expand the recoil-hadron data to the target hemisphere. They also expect to make measurements on a polarized target at a later date.

Talks on existing lepton and neutrino data were given by K. W. Chen (Michigan State), L. Osborne (MIT), and J. Vander Velde (U. of Mich.). Chen

showed inclusive muon-scattering data, while both Osborne and Vander Velde concentrated on properties of recoil hadrons. All presented comments and views on likely directions to pursue in a new set of muon experiments. W. A. Loomis (Harvard) and M. Strovink (UCB) presented ideas and methods for detecting and identifying final-state hadrons from hydrogen and deuterium targets in new types of spectrometers. P. J. Limon (Fermilab) discussed the EM-weak interference experiments using ep colliding rings and μp scattering. He concluded that both types of experiments are in principle able to be done, but that ep collisions are in a better position to succeed since they gain by a factor of about 20 in c. m. energy and benefit by growth with energy of the relative strength of the weak interaction.

The workshop was concluded with a general discussion led by T. B. Kirk (Fermilab) on the prospects for physics and the likely time scale for the new muon facility. An optimistic timetable might show initial experiments in mid-1981. To this end, the beam-design work will continue at Fermilab with a gradual transition to working engineering and architectural plans. At some point in the near future, Fermilab will issue a call for experimental proposals and letters of intent so that experiments and detectors can be designed and constructed on a time scale appropriate for keeping pace with the beam-line construction. All in all, the workshop generated a feeling of enthusiasm and challenge and reinforced the view that the proposed new beam will open up unique and exciting experiments which cannot be investigated as well by any other existing or planned facility.

NOTES AND ANNOUNCEMENTS

1977-1978 PROCEDURES AVAILABLE. . .

Copies of the 1977-1978 edition of "Procedures for Experimenters" are available at the Users Office (first floor east, Central Laboratory). This is a recently revised version of the booklet that was last distributed in early 1976.

Since the Procedures booklet contains a description of the safety requirements at Fermilab, it is considered an important reference for all users. Copies have been distributed to the Spokespersons of Fermilab experiments. Other users or interested individuals may obtain copies from the Users Office. New participants in experiments at Fermilab should visit the Users Office to make other arrangements necessary for working at the Laboratory, as well as obtaining a visitors identification card.

APPOINTMENTS. . .

Larry Coulson has been appointed head of the Radiation Physics Group and Laboratory Radiation Safety Officer. He succeeds Peter Gollon.

A. Lincoln Read has been appointed Patent Administrator, effective December 1. He succeeds Timothy Toohig.

PAC SUBCOMMITTEE MEETING TO REVIEW 15-FT BUBBLE CHAMBER NEUTRINO PROGRAM. . .

A subcommittee of the Program Advisory Committee is scheduled to meet at Fermilab on Thursday and Friday, January 12-13, 1978, to review and evaluate the accomplishments of the 15-ft bubble chamber neutrino program. Presentations of results from experiments which have been completed and presentations of preliminary results of experiments in progress will be made in an open session. Interested physicists are welcome to attend and to participate in the discussion. Proposals for experiments utilizing the planned arrangement of plates in the chamber will be considered at this meeting.

RESEARCH ACTIVITIES DURING OCTOBER 1977

James MacLachlan and Edward Stout

The first three weeks of October were a continuation of the run started in mid-September, during which the accelerator ran with about a 10.5-sec cycle, providing 2-sec spill at 200 and at 300 GeV and a 300-GeV 2-msec spill. Even after the switchover to 400 GeV on October 21, the accelerator continued to perform very reliably. As a result, 2.1×10^{18} protons were accelerated during 200/300 GeV operation and 10^{18} were accelerated at 400 GeV. The total exceeds the previous monthly record of 2.8×10^{18}, which was first set at 300 GeV, but tied at 400 GeV in June of this year. Even more encouraging to most experimenters is the new record of 547 hours of beam available for experimental use, which represents a healthy 82% of the scheduled time and 73% of the calendar month. This establishes a significant advance in beam availability over the 493 hour peak reached in July. The 400-GeV running was with a 1.25-sec flattop and a 2-msec fast spill with about a 10.25-sec cycle.

Because of the spectrometer-magnet problems of Di-Lepton #288, which was the prime user for the 200/300 GeV beam, this running was extended two weeks beyond the initial plan. By virtue of this extension and the success of the very difficult repairs described in last month's report, E-288 completed a test of the energy dependence of the production of the Υ states and the high-mass dimuon continuum. After the switchover to 400 GeV, the experiment began a period of tests and modifications including the addition of another magnetized-iron spoiler immediately downstream of the

target box. Installation work has been carried out during the days when the entire Proton Area activity has been constrained by radiation limits in the hyperon extension to P-Central, where conventional construction is in progress. The experiment is now in a test stage to establish what gains they can make in rate and mass resolution with the improved sweeping. Another development in the Proton Area was the completion of Photon Search #95A in Proton-West on October 17. Proton-West is now seeing use primarily as test beam.

Although not initially very high on the list of priorities, Neutrino #253 began taking data almost as soon as the fast spill at 300 GeV was available in the Neutrino Area in late September. The experimenters were well prepared and received almost 10^{18} primary protons on target. The appearance of the data online gave them great confidence in their ability to trigger on electromagnetic showers in their calorimeter and high hopes that they would be able to winnow out the ν_μ-e scatters. The 400-GeV running, however, confirmed their expectations of unmanageable muon punch-through at their location in the Wonder Building. Although their trigger remains effective, there are simply too many accidental muons in the chambers because of the $6 \times 10^4/m^2$ background on each spill.

Polarized Scattering #61 in the Meson Area's M1E beam line also made very good use of the extended 300-GeV running and finished their intended program of measuring the proton polarization in scattering from a polarized target near the region of the dip in the elastic cross section at $|t| \sim 1.4\ (GeV/c)^2$. They also got a few days to look at π polarization with 200 GeV π's during the

400-GeV running before the experiment was completed on October 26. Hadron Dissociation #396 replaced Backward Scattering #290 in the M6W beam line on October 13. They had several difficulties with the beam that slowed down their startup including alignment, magnet power-supply failures, radiation trips, and a radioactive quadrupole that swamped their recoil detector. By the end of the month, however, they had finished taking data at -100 GeV. A changeover to 200-GeV operation at the very end of the month brought on some further M6 power-supply problems which were not finally eliminated until early November.

FACILITY UTILIZATION SUMMARY--OCTOBER 1977

I. Summary of Accelerator Operations

			Hours	
A.	Accelerator use for physics research			
	Accelerator physics research		52.0	
	High energy physics research		546.8	
	Research during other use		(8.8)	
		Subtotal		598.8
B.	Other activities			
	Accelerator setup and tuning to experimental areas		8.3	
	Program interruption Scheduled 18.2, Ad hoc 1.0		19.2	
	Unscheduled interruption		118.7	
		Subtotal		146.2
C.	Unmanned time	Total		745.0

II. Summaries of High Energy Physics Research Use

		# of Expts.	Hours	Results
A.	Counter experiments	18	4433.3	2 expts. completed
B.	Bubble chamber expts.	1	161.1	46,245 15 ft pictures
C.	Emulsion expts.	0	-	-
D.	Special target expts.	1	80.3	1 target irradiated
E.	Test experiments	1	14.0	DPI tests in N3
F.	Engineering studies and tests	-	-	-
G.	Other beam use	(1)	31.1	N3 tune
		21	4719.9	

III. Number of Protons Accelerated and Delivered ($\times 10^{18}$)

		200/300 GeV	400 GeV	
A.	Beam accelerated in Main Ring	2.07	0.99	3.06

B. Beam delivered to experimental areas	@200 GeV	@300 GeV	@400 GeV	
Meson Area	-	0.72	0.14	
Neutrino Area				
Slow Spill	-	0.13	0.16	
Fast Spill	-	1.00	0.57	
Proton Area	0.06	0.07	0.06	
Totals	0.06	1.92	0.93	2.91

FERMI NATIONAL ACCELERATOR LABORATORY
MONTHLY OPERATIONS HISTORY
OCTOBER 1977

Date		Accelerator	Int. Target Area	Proton Area	Neutrino Area	Meson Area
Sat.	10/1	~1.6x10^{13}ppp @200/300 GeV	p-He Scattering 289	Photon Search 95A (PW) Photoproduction 152B (PE) OFF for repairs (PC)	Di-Muon 444(N1) Neutrino 310(N0) Neutrino 482(N5) Neutrino 253(N0)	Pol.Scatt.61(M1E) Bkwd.Scatt. 290 (M6W) Had. Jets 395(M2) Part.Search 540 (M3) Tests for Incl. K_s^o 383(M4)
Sun.	10/2					
Mon.	10/3					
Tues.	10/4					
Wed.	10/5	Accel. Studies ~1.7x10^{13}ppp @200/300 GeV				
Thurs.	10/6					
Fri.	10/7					
Sat.	10/8					
Sun.	10/9			Di-Lepton 288 (PC) Photon Search 95A (PW) Photoproduction 152B (PE)		
Mon.	10/10					
Tues.	10/11					
Wed.	10/12	Accel. Studies & Startup				
Thurs.	10/13					Polariz.Scatt.61 (M1E) Had.Dissoc. 396 (M6W) Had.Jets 395(M2) Part.Search 540 (M3) 383 Tests (M4)
Fri.	10/14					
Sat.	10/15	Repairs:2 magnets ~1.9x10^{13}ppp @200/300 GeV				
Sun.	10/16					
Mon.	10/17					
Tues.	10/18			Di-Lepton 288(PC) Photoprod.152B (PE)		
Wed.	10/19			OFF (PW)		
Thurs.	10/20	Accelerator Studies and Maintenance & Development & 400 GeV Startup				
Fri.	10/21	1.7x10^{13}ppp @400 GeV (1.25 sec flattop)	p-He Scattering 289	OFF Di-Lepton 288 (PC) Photoproduction 152B (PE) E-369 Calib. (PW)	Di-Muon 444(N1) Neutrino 310, 482 (N0) 15' #546 (N0) DPI Tests (N3) Nucl.Frag. 466 (N0)	
Sat.	10/22					
Sun.	10/23					
Mon.	10/24					
Tues.	10/25					
Wed.	10/26	Accel. Studies ~1.9x10^{13}ppp @400 GeV				Same as above but OFF (M1)
Thurs.	10/27					
Fri.	10/28					
Sat.	10/29					396, 395, 104, 540, 383
Sun.	10/30					
Mon.	10/31					

BEAM UTILIZATION

	Beam	Hours
MESON AREA		
Polarized Scattering #61	M1E	367.2
Total Cross Section #104	M1W	36.6
Hadron Dissociation #272	M1W	10.8
Backward Scattering #290	M6W	201.5
Inclusive K_s^o #383	M4	-
Hadron Jets #395	M2	442.6
Hadron Dissociation #396	M6W	190.2
Particle Search #540	M3	143.6
NEUTRINO AREA		
Neutrino #253	N0	321.5
Neutrino #310	N0	494.2
Di-Muon #444	N1	339.8
Neutrino #482	N5	386.1
15' ν/H_2 & Ne #546	N0	161.1
DPI tests	N3	14.0
Nuclear Fragments #466	N0	80.3
PROTON AREA		
Photon Search #95A	PW	238.0
Photoproduction #152B	P2	370.0
Di-Lepton #288	PC	297.3
E-369 Calibration	PW	94.8
INTERNAL TARGET AREA		
p-He Scattering #289	C0	485.5
p Polarization #522	C0	13.7
Hours for Experiments		4688.8
Hours for Tests and Beam Tuning		31.1
TOTAL HOURS FOR HIGH-ENERGY PHYSICS		4719.9

BY EXPERIMENT -- OCTOBER 1977

Activities

data: complete elastic scattering of 300-GeV protons and 200-GeV π^+ on polarized proton target

setup & tuning: beam line tuning

tests: rate tests on drift chambers

data: $\pi^{\pm}p$ elastic backward scattering at 50 GeV/c

tests: chamber, beam line, and counter tuneup and checkout

setup & data: ±130- and +200-GeV beam onto a hydrogen target; apparatus consists of two segmented calorimeter arms for hadrons and photons

tuneup and data: -100-GeV beam into H_2 gas target using a recoil detector of track chambers and time-of-flight counters and downstream drift chambers and lead glass

tests: search for delayed energy release in a lead glass detector bombarded by neutrons

setup & data: ν-e scattering data using a calorimeter of 40 1-radiation length aluminum cells interspersed with MWPCs

tests & data: multi μ and prescaled single μ triggers in the Lab C calorimeter and μ spectrometer apparatus

tests & data: di-μ production by 225 π^+ analyzed by the cyclotron spectrometer

tests & data: di-μ production by ν in the Lab E target calorimeter with μ momentum measurement by iron toroids

data: 46 K pictures in the 15-ft chamber with a 47% Ne fill using a two-plane EMI

tests: setup N3 beam line and Cerenkov counters and test lead-glass γ detector

data: 1 target irradiated

data: single-arm inclusive and two-arm coincidence photon production by 200- and 300-GeV protons

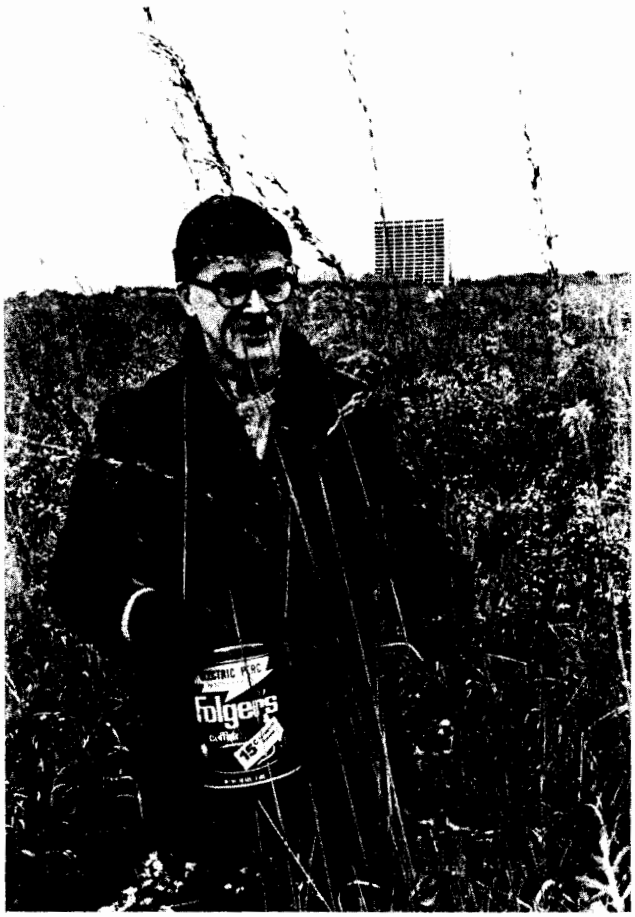
setup & tests: shower counter calibration, tagging studies, and recoil detector setup

data: high mass di-μ production by 200- and 300-GeV protons

tests: lead glass calibration with electron beam

data: p-He scattering at 40-400 GeV using a helium jet target

tests: checkout of superconducting spectrometer, polarimeter, etc.



Merrit Nicholls of Wheaton harvests seeds of Indian grass at the Fermilab Prairie Restoration in the Main Ring. Harvesters recently hand collected about 350 pounds of grass and flower seeds which will be planted in the Ring this fall. (Photo by Fermilab Photo Unit)

MANUSCRIPTS AND NOTES PREPARED DURING OCTOBER AND NOVEMBER 1977

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

B. C. Barish et al. Experiment #21A	Rate of Dimuon Production from Neutrinos and Antineutrinos at High Energy
A. Turkevich et al. Experiment #81	Search for the Production of Particle-Stable Nuclei at Multi-GeV Energies (Submitted to Phys. Lett. B)
W. A. Loomis et al. Experiment #98	Hadron Production in Muon-Proton and Muon-Deuteron Collisions (Submitted to Phys. Rev.)
G. A. Weitsch et al. Experiment #118	Inclusive Double Charge Exchange π^- Production at 100 GeV/c
T. H Burnett et al. Experiment #172	Study of Hadronic Systems Produced in $\nu_e(\bar{\nu}_e)$Ne Interactions (Paper presented by H. J. Lubatti at the ν77 Conf., Elbrus, USSR, June 1977)
G. C. Fox Experiment #260	Phenomenology of High p_T Scattering (Invited talk at the Brookhaven APS Meeting, October 1976)
J. R. Johnson et al. Experiment #284	Inclusive Charged Hadron Production in 100-400 p-p Collisions (FERMILAB-Pub-77/98-EXP; submitted to Phys. Rev.)
B. C. Brown et al. Experiment #288/ #494	A Swimming Pool Hadron Calorimeter (Submitted to the IEEE Nuclear Science Symposium, San Francisco, October 19-21, 1977)
W. R. Innes et al. Experiment #288	Observation of Structure in the Υ Region (FERMILAB-Pub-77/86-EXP; submitted to Phys. Rev. Lett.)
W. Mollet et al. Experiment #305	Coherent Dissociation of Neutrons on Nuclei at 100-300 GeV/c (Submitted to Phys. Rev. Lett.)
Y. Akimov et al. Experiment #317	Diffraction Dissociation of High Energy Protons on Hydrogen and Deuterium Targets (FERMILAB-Pub-77/88-EXP; submitted to Phys. Rev. Lett.)

F. S. Merritt et al. Experiment #320	Determination of the V, A Structure of the Neutral Current Coupling
W. R. Ditzler et al. Experiment #472	New Limits on $D^{o}(1.865)$ Production in Proton-Nucleus Collisions at 400 GeV/c (FERMILAB-Pub-77/87-EXP; submitted to Phys. Lett.)
R. L. McCarthy et al. Experiment #494	Atomic Number Dependence of the Production Cross Sections for Massive Dihadron States (FERMILAB-Pub-77/102-EXP; submitted to Phys. Rev. Lett.)

Theoretical Physics

H. J. Lipkin	Theoretical Review of Strange and Nonstrange Mesons (FERMILAB-Conf-77/65-THY; presented at the Vth International Conference on Experimental Meson Spectroscopy, Northeastern University, April 29-30, 1977)
K. M. Bitar and S-J. Chang	Vacuum Tunneling of Gauge Theory in Minkowski Space (FERMILAB-Pub-77/67-THY; submitted to Phys. Rev. D)
I. M. Dremin and C. Quigg	Independent Emission of Groups of Hadrons Describes the Essential Features of High-Energy Scattering (FERMILAB-Pub-77/69-THY; submitted to Phys. Rev. D)
T. Hagiwara et al.	The Newly Found Resonance $\Upsilon(9.5)$ and the Charge of the Heavy Quark (FERMILAB-Pub-77/72-THY; submitted to Phys. Rev. Lett.)
K. O. Mikaelian	Photoproduction of Charged Intermediate Vector Bosons (FERMILAB-Pub-77/79-THY; submitted to Phys. Rev. D)
F. Wilczek	Decays of Heavy Vector Mesons into Higgs Particles (FERMILAB-Pub-77/80-THY; submitted to Phys. Rev. Lett.)
C. H. Albright, et al.	Implications of the $\Upsilon(9.5)$ for Gauge Theories of Weak Interactions (FERMILAB-Pub-77/81-THY; submitted to Phys. Rev. D)
C. Quigg and J. L. Rosner	Quarkonium Level Spacings (FERMILAB-Pub-77/82-THY; submitted to Phys. Lett.)

H. J. Lipkin	A Dynamical Model for Mixing of Axial Vector (Q) Mesons (FERMILAB-Pub-77/84-THY; submitted to Phys. Lett.)
H. B. Thacker	Polynomial Conservation Laws in (1 + 1)-Dimensional Classical and Quantum Field Theory (FERMILAB-Pub-77/85-THY; submitted to Phys. Rev. D)

General

A. R. Donaldson	An Electro-Optic Interface for Microprocessor Control of a 750-keV Accelerator (Presented at the Electro Optics/Laser 77 Conference, Anaheim, October 25-27, 1977)
T. F. Droege et al.	A High Rate Amplifier-Digitizer System for Liquid Argon Calorimeters (Submitted to the IEEE Nuclear Science Symposium, San Francisco, October 19-21, 1977)
T. F. Droege et al.	A High Speed Digital Processor for Second Level Trigger Selections (Submitted to the IEEE Nuclear Science Symposium, San Francisco, October 19-21, 1977)
R. W. Goodwin and M. F. Shea	The Microprocessor-Based Control System for the Fermilab Cancer Therapy Facility (Submitted to the IEEE Nuclear Science Symposium, San Francisco, October 19-21, 1977)
F. E. Taylor et al.	A Fine Grain Flash Chamber Calorimeter (FERMILAB-Conf-77/100-EXP; submitted to the IEEE Nuclear Science Symposium, San Francisco, October 19-21, 1977)

Physics Notes

L. C. Teng	Further Parametric Studies of the Accelerator System for Heavy Ion Fusion (FN-307)

DATES TO REMEMBER

January 12-13, 1978	PAC Subcommittee Meeting to review 15-ft bubble chamber neutrino program.
January 27, 1978	Deadline for receipt of all new proposals and other written materials to be considered at the spring meeting of the Program Advisory Committee and at the Bubble Chamber Subcommittee Meeting.
February 9-10, 1978	Proposal Presentation Meeting.
February 23-24, 1978	Meeting of the Bubble Chamber Subcommittee of the Program Advisory Committee.
March 9-10, 1978	Spring meeting of the Fermilab Program Advisory Committee.
May 5, 1978	Deadline for receipt of all new proposals and other written materials to be considered at the summer meeting of the Program Advisory Committee.
May 18-19, 1978	Proposal Presentation Meeting.
June 17-23, 1978	Summer meeting of the Fermilab Program Advisory Committee.

DR. ERNEST MALAMUD
RD/MESON
CL 10W
FERMILAB

☆ U.S. GOVERNMENT PRINTING OFFICE 750/141