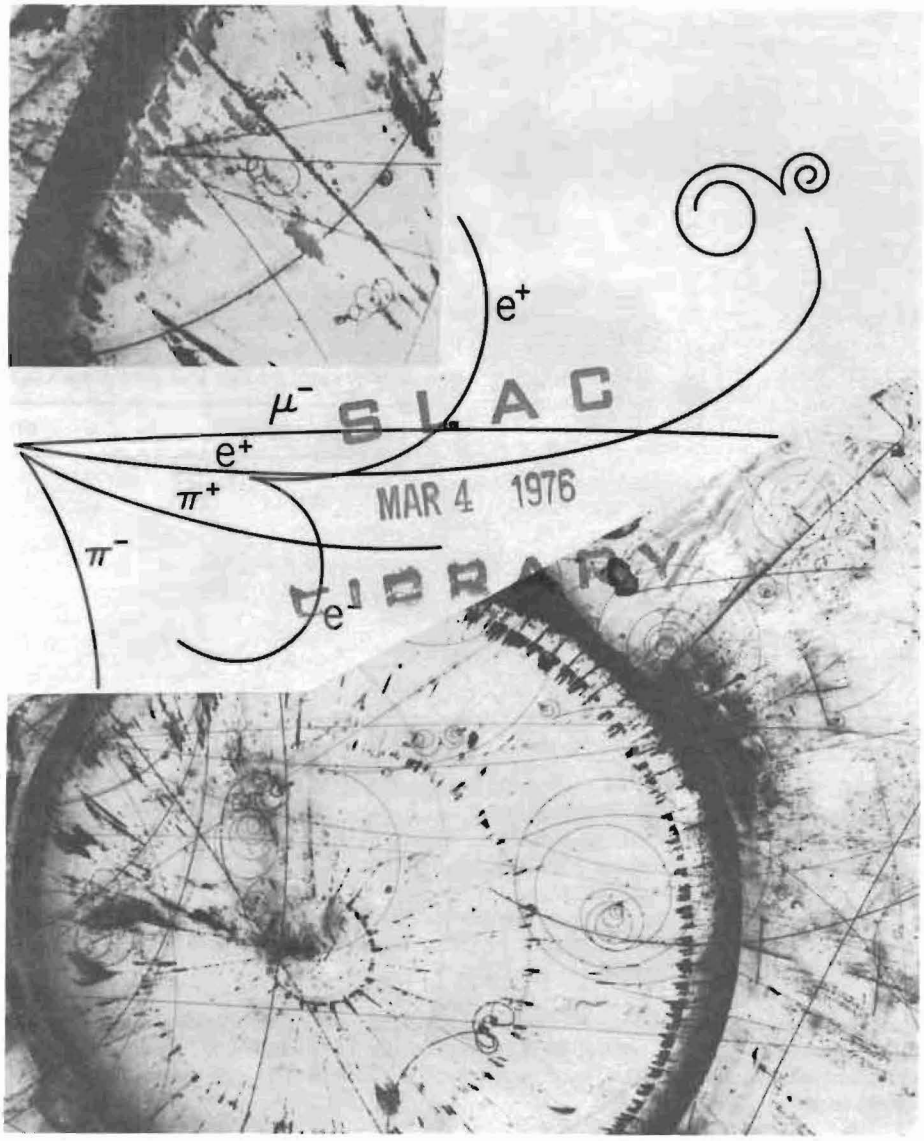
NALREP



Monthly Report of the Fermi National Accelerator Laboratory

February 1976

Fermi National Accelerator Laboratory

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

J. R. Sanford, Editor
N. Stiening, Assistant Editor

Contributions and comments should be addressed to the Program Planning Office. Requests for copies should be addressed to the Publications Office.

FERMILAB-76/2 0090.01

THE COVER: Photograph of a neutrino interaction in the 15-foot hydrogen bubble chamber filled with a 22% mixture of neon. The insert in the upper left is an enlargement of the interaction vertex as seen in the lower picture. The diagram helps in locating and identifying the outgoing tracks.

The existence of an e^+ from the interaction vertex along with the expected μ^- makes this event unique. Another interesting feature is a K_S^0 decaying into the $\pi^+\pi^-$ shown.

The photograph was taken during a running period in April and June 1975. Physicists participating in this particular research are from CERN, the University of Hawaii, Lawrence Berkeley Laboratory, and the University of Wisconsin.

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

CONTENTS FEBRUARY 1976

HIGHLIGHTS OF FERMILAB EXPERIMENTS IN 1975

It has been over three years since experiments were first started at Fermilab. Each year the research has uncovered many new phenomena. However, in 1975 there was an abundance of striking results from the research which appears to overshadow those of all previous years. During 1975 the Main Accelerator took on the challenge of 400-GeV operation; since August experiments have benefitted from this higher energy. This is seen most directly in the increased fluxes of particles in the charged secondary and neutrino beams.

The highlights of the research program during 1975 are briefly described in the Historical Calendar on page 2 and in the table on page 3. In the calendar very concise notations are used for most of the experiments taking data during the year. Many of these experiments are also mentioned in the table, in which they are separated by the type of physics to which their contributions are expected to be most significant. This past year there has been success in completing a large number of experiments. These completions can be recognized by the upturn of the lower curve in the diagram on page 5. However, the upper line on the same diagram shows that a rise in the number of completed experiments leads only to a mountain of new proposals!

In the paragraphs following, some of the highlights of the research going on in each experimental area during 1975 are reviewed. Experimental groups were able to use the particle beams for physics research about 350 hours per month on the average. This represents about one-half of the total

FERMI NATIONAL ACCELERATOR LABORATORY

1975 HISTORICAL CALENDAR OF PRINCIPAL RESEARCH ACCOMPLISHMENTS

Month	Accel. Energy (GeV)	Internal Target Area	Proton Area	Neutrino Area	Meson Area
Jan., 1975	300	particle search	particle search in photoprod. and in neutron production	μ scattering @ 100,150 GeV 30" B.C. (H_2)	elastic scatt. particle searches hyperon prod.
Feb.					
Mar.	380			search for ν events with two μ's	
Apr.	300	p-N inelastic scattering	e/γ beam tests	ν's for 15' B.C. (H_2&Ne)	elastic scatt. particle searches K^o regen. $pp\to\pi^o$
May	300	p-N inelastic scattering	pA→ee e/γ beam tests	ν's for 15' B.C. (H_2&Ne) and electronic exp. π(or p)p→$\mu\mu$	particle searches π(or p)p→π^o K^o regen. elastic scatt. hyperon prod. pp→μ
June					
July					
Aug.	400	p-N inelastic scattering particle production	pA→ee test exp. in P-West particle search in neutron production photoproduction pA→$\mu\mu$	ν&$\bar{\nu}$ total cross sections 30" B.C. (H_2) 30" B.C. (D_2)	multiplicity studies π(or p)p→π^o π form factor hyperon σ_T neutral & charged particle elastic scatt.
Sept.					
Oct.					
Nov.					
Dec.	400	p-p inelastic scattering tests spectrometer tests	pA→μ(↑) photoproduction pA→ee particle production	ν's & hadrons for 15' B.C. (H_2) π(or p)p→$\mu\mu$	particle search neutron elastic scatt.

Description of Principal Research Accomplishments During 1975

A. Hadron Interactions Using Electronic Detectors

Charged hadron elastic scattering at 50 to 200 GeV/c (3 experiments).

Measurement of neutral hyperon production and total cross sections.

K^o regeneration from carbon at 30 to 120 GeV/c.

π^o production at large p_t from π-p and p-p interactions at 100 and 200 GeV/c.

Measurement of pion form factor at 100 GeV/c.

Neutron elastic scattering at 100 to 350 GeV/c.

Proton-nucleon inelastic scattering at 50 to 400 GeV/c.

B. Hadron Interactions in Bubble Chambers

Total of 890,000 pictures in 30-inch chamber with hydrogen and deuterium.

Total of 50,000 pictures in 15-foot chamber with hydrogen and a neon/hydrogen mixture.

C. Electromagnetic Interactions Using Electronic Detectors

Inelastic muon scattering from hydrogen at 100 and 150 GeV/c.

Photoproduction from heavy targets at 25 to 330 GeV/c.

D. Weak Interactions

Study of neutrino interactions in electronic detectors producing two muons.

Measurement of neutrino and antineutrino total cross sections at 30 to 250 GeV/c.

Total of 175,000 pictures of neutrino and antineutrino interactions in 15-foot chamber with a neon/hydrogen mixture.

Total of 70,000 pictures of neutrino interactions in 15-foot chamber with hydrogen.

E. Particle Searches

Photoproduction of heavy particles decaying to hadrons and leptons.

Neutron production of heavy particles decaying to hadrons and muons (3 experiments).

Dilepton and hadron pair production from proton interactions at 400 GeV/c (3 experiments).

Production of muon pairs by pions and protons at 150 and 230 GeV/c.

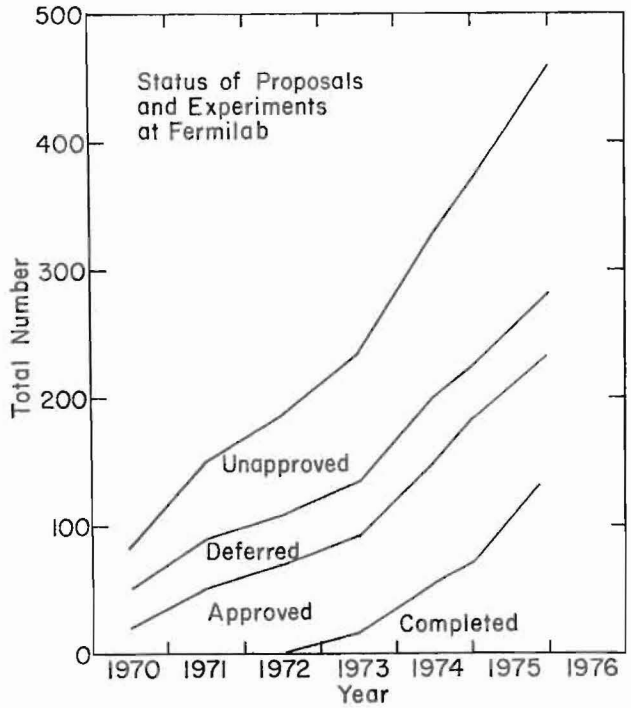
Study of muon polarization from proton interactions at 400 GeV/c.

number of hours available. Accelerator research, beam tuning, scheduled shutdowns, and repairs account for the remaining time.

Neutrino Area Research

Experiments with neutrino and antineutrino beams played a dominant role in the activities of the Laboratory and were most hungry for beam during 1975. The Neutrino Area received about 9×10^{18} protons for experiments, or about 60% of the total available flux.

A striking result from two electronic experiments is the observation of neutrino events producing two outgoing muons (a μ^+ and a μ^-), rather than one μ^- as is usually the case. Most of these events were obtained during February and March, with the accelerator operating at 380 GeV. While the interpretation of this result was providing a challenge to many physicists at Fermilab, observations in the 15-foot bubble chamber produced even more excitement and much speculation on the existence of charmed particles. In the analysis of pictures from an exposure of neutrinos interacting in a light neon/hydrogen mixture in the chamber, a number of interactions were observed with the single outgoing μ^- accompanied by an unexpected e^+. These events appear to reinforce the earlier results from counter experiments. Also intriguing is the observation of a single neutral kaon in many of these events. The 15-foot chamber pictures with light neon/hydrogen were taken last spring. Again this fall the chamber was operated, but with a hydrogen fill.



Growth of the Fermilab experimental program. During 1975 a total of 95 proposals were submitted, 51 approved, and 69 experiments were completed.

During the summer and fall, one of the electronic neutrino detectors used beams of neutrinos and antineutrinos for measurements of total cross sections. Results are expected to an accuracy of 5 to 10% at energies from about 30 to 250 GeV. A by-product of these measurements will be an examination of possible differences in neutrinos produced from decays of pions compared with those arising from kaon decay. The large spectrometer in the Muon Laboratory received a large exposure of muons last winter, and is expected to operate again this spring and summer. The analysis of this

experiment is dominated by the ability to measure the hadrons produced in muon interactions. During running for neutrino experiments (while there is insufficient intensity for producing a muon beam), the spectrometer has also been useful for a study of hadron interactions, producing pairs of muons. By these measurements the differential cross sections for producing the ψ (or J) with a mass of 3.1 GeV has been carefully measured with beams of incident pions and protons. The two bubble chambers have also contributed to the study of hadron interactions in the past year. During December the 15-foot chamber was first tested in a mode in which one neutrino picture and one hadron picture were taken during each accelerator cycle.

Proton Area Research

Recent results from the Proton-Center experimental area suggest the production of a new particle at Fermilab. The experimenters have measured its mass to be 5.97 GeV/c^2 and have named it Upsilon (Υ). It is produced in the interaction of a proton beam with a beryllium target and is observed through its decay into an e^+e^- pair. During the year there were two experiments studying the direct production of single muons from proton interactions. (One of these experiments was completed in the Meson Area.) The Proton Area experiment also looked for polarization of the produced muons, of interest if the muon were from the decay of a parent particle. From these experiments it was found that positive and negative muons are produced unpolarized in almost equal numbers. So far it is not easy to account for the relatively large numbers of produced muons from known processes.

In the Proton-East experimental area the dominant activity was a study of photoproduction. While the primary reason for this research was a search for new particles, results on the general features of photoproduction reactions will soon be available. The apparatus permits a study of many charged particles from these reactions. The scheme used for producing the photon beam also makes it possible to provide neutrons to the same apparatus, and the neutron beam was also used in a particle search. This experiment complemented several others using a neutron beam in the Meson Area.

The first experiments in the Proton-West area began operation during the fall. This was possible after construction of an improved beam transport system resulting in a reduction of the beam halo. An electron/tagged photon beam in Proton-East was also made operational and used briefly for an experiment. It is expected that the primary use of that beam will begin this spring or summer with measurement of the photon total cross section.

Meson Area Research

The most general prominant activity in the Meson Area was the search for new particles. The individual experiments are too numerous to discuss, but all types of incident particles and experimental techniques have been used. At present there are interesting features in mass plots from some experiments. However, careful cross-checks and remeasurements are in progress. Four elastic scattering experiments have produced substantial results in the last year. These measurements have included beams of neutrons and the long-lived charged hadrons. The kinematic region for one experiment has been primarily associated with very small angles and for

others, larger angle scattering. During the past year careful studies were made of the yields and kinematics of producing neutral hyperons. Also, measurements are now complete on neutral hyperon total cross sections. A surprise in the study of Λ^0 production is the observation of their polarization. This information will be used in other experiments.

There has been considerable effort in studying the production of π^0's at large transverse momenta by incident pions, kaons, and protons. Since these collisions are very penetrating, there is the possibility of studying properties of the constituent quarks comprising the incident beam particles. Last spring a measurement of the regeneration of K_S^0 by the interaction of a K_L^0 beam with a carbon target was completed. Presumably this reaction can be described by the exchange of the ω-Regge-trajectory. Studies of regeneration in liquid hydrogen are now in progress. The effective charge radius of the pion was measured to an accuracy of a few percent by an experiment run during the fall. This work will soon be continued with a higher energy measurement of the kaon radius.

Internal Target Area Research

Due to the intense interest in searches for charmed particles, a study looking for a variation in the ratio K^-/π^- over a wide range of energies available within the Main Accelerator was completed. It was motivated by the suggestion that charmed particles would frequently decay into strange particles. Later in the year an inelastic scattering experiment was completed using the latest version of the cryogenic gas jet target. A new warm gas target is now being used for another experiment of the same type.

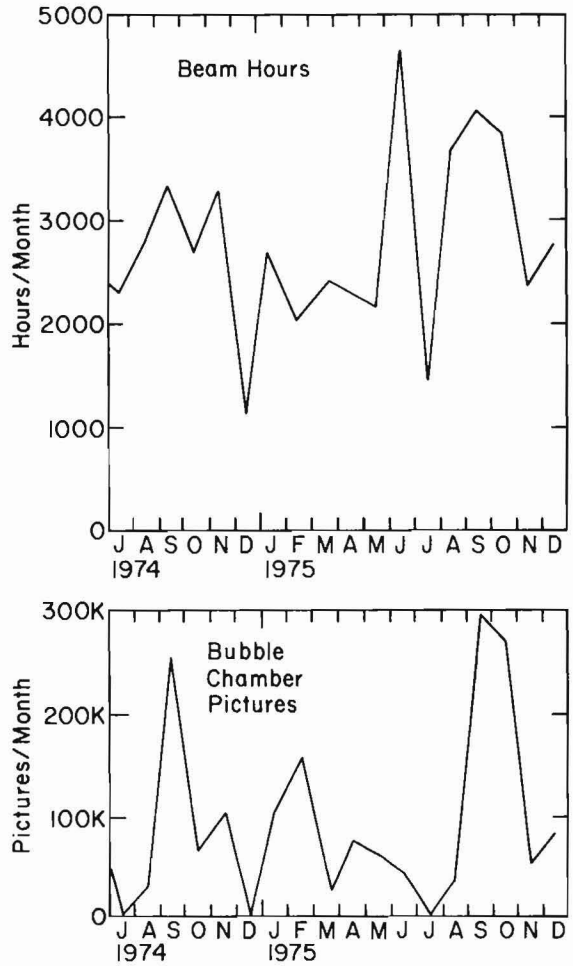
A simplified view of the achievements, requirements, and requests of the experiments and proposals measured in beam hours and bubble chamber pictures, is given in the table on page 10. This information is obtained from the Experimental Program Situation Report published in the January 1976 issue of NALREP. From this table and the diagram on page 11, we can estimate what our capabilities are for completing experiments. We are able to provide about 2000 beam hours per month for electronic experiments. The large number of beam lines at Fermilab contributes greatly to this capability. The productivity of the bubble chambers during the past one and one-half years is evident from the lower portion of the diagram on page 11. The larger peaks are from the 4 to 6 multiple pulses of the 30-inch chamber and the smaller peaks are from the operating periods of the slower 15-foot chamber. During the past year the experiments listed as "Other" in the table have been dominated by emulsion exposures to pion beams and to 400-GeV protons. Many of the experiments are motivated by the ability to see with microscopes the decay of short-lived particles in emulsions. The emulsion experiments contribute to the peaks in June and December 1975 shown in the upper diagram on page 12. Also to be noted on this figure is the very large average number of experiments always in operation at Fermilab.

An indication of our progress in accelerating protons is shown in the lower diagram on page 12. Factors influencing this are the per pulse main ring intensity and the cycle period of the accelerator. Although there has been recent success in achieving intensities in excess of 2×10^{13} protons/pulse, the 400-GeV operating energy and associated power costs have restricted

Extent of the Research Program (as of January 1, 1976)

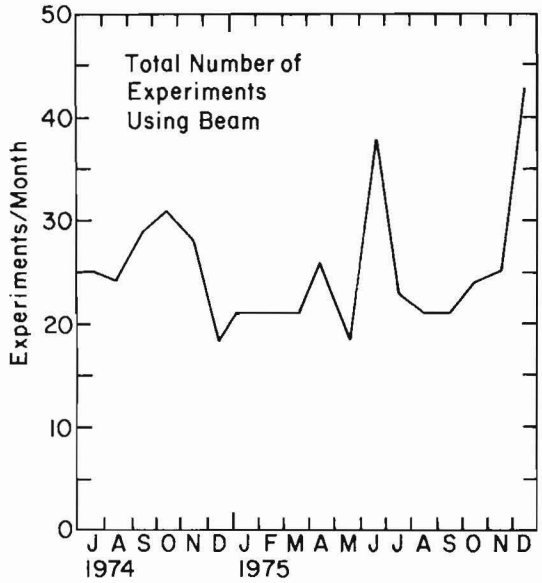
	Number of Exp. /Proposals		
Electronic Experiments			
Complete and In Progress	60	-	64,000 hours
Accomplished During 1975	(35	-	27,000)
Planned Within a Year	40	-	21,000
Unscheduled	16	-	9,000
Pending Proposals	28	-	20,000
Bubble Chamber Experiments			
Complete and In Progress	33	-	2,900K pictures
Accomplished During 1975	(14	-	1,185K)
Planned Within a Year and Remainder for 7 In Progress	8	-	1,600K
Unscheduled	6	-	950K
Pending Proposals	34	-	11,400K
Other Experiments			
Complete and In Progress	67		
Accomplished During 1975	(37)		
Planned Within a Year	1		
Unscheduled	3		
Pending Proposals	2		

Total Approved Experiments - 234
Total Pending Proposals - 64

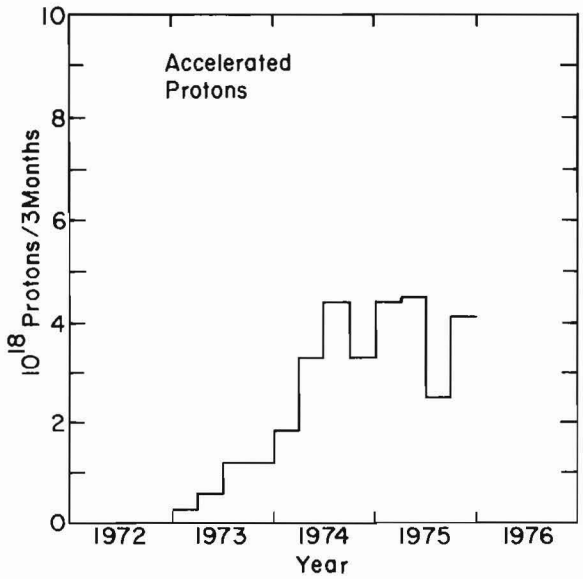


Beam hours and bubble chamber pictures accomplished for Fermilab experiments. A total of 34,000 beam hours were used by all types of experiments during 1975 and a total of 1,185,000 bubble chamber pictures were taken as follows:

neutrinos in the 15-foot chamber	- 245,000,
hadrons in the 15-foot chamber	- 50,000,
hadrons in the 30-inch chamber	- 890,000.



Number of experiments per month using beam at Fermilab.



Total number of protons accelerated in the Main Accelerator for each three-month period since start-up in 1972. A total of 16×10^{18} protons were accelerated during 1975.

the cycle period to about 10 sec. This latter fact contributed to the dip seen at the start of 400-GeV operation in mid-1975. One can also see that an increase followed soon afterward.

Due to the hard work of the experimenters and the strong support of the Fermilab staff, this past year has been most rewarding.

Reported by A. Greene

NOTES AND ANNOUNCEMENTS

WORKSHOP ON ELASTIC SCATTERING AT LARGE P_t STILL PLANNED . . .

The workshop on Elastic Scattering at large P_t is still tentatively scheduled to be held at Fermilab on April 15 and 16, 1976. It will be held if sufficient progress has been recorded in the acquisition of data for Proton-Proton Elastic #177, and if there is evidence of substantial user interest in experiments of this kind at this time. The situation has not changed in this regard since one month ago, i. e., there remain two proposals on hand which would be considered: Elastic Scattering #301 and Elastic Scattering #347.

The deadline for submission of all written materials for the workshop will be March 12. A final decision on whether to hold the workship will be made immediately following that date. The meeting would be open to all interested physicists. For further information, contact T. Groves in the Directors Office, Ext. 3211.

ANNUAL MEETING OF THE USERS ORGANIZATION SCHEDULED . . .

The Annual Meeting of the Users Organization is scheduled to be held at Fermilab on May 14 and 15, 1976. A program of talks of interest to users will be planned. The agenda and other details of the meeting will be sent to all members of the Users Organization within the next month. Please note that this year the date of the meeting does not coincide with the Washington APS meeting. This was necessary to avoid conflicts with other conferences that users will be attending. Suggestions for the agenda should be forwarded to the Chairman, L. Hand, in care of the Users Office at Fermilab as soon as possible.

APPOINTMENTS . . .

Quentin Kerns, who has been serving as Acting Head of the Research Services Department in the Research Division, has now been appointed Head of the Department. Paul Mantsch has been appointed Associate Department Head of Research Services for Cryogenic Services, effective January 1. Effective March 1, Bradley Cox will become Head of the Proton Department.

RESEARCH ACTIVITIES--JANUARY 1976

After a night of concentrated tuning, at 6:20 a. m. on January 20 the main accelerator intensity exceeded 2×10^{13} protons/pulse for the first time and within minutes a peak intensity of 2.016×10^{13} protons/pulse at 400 GeV was attained. The accelerator ran well at intensities close to 2×10^{13} protons/pulse for several hours, until an interruption in the operation of the 15-foot bubble chamber necessitated a reduction in extracted beam intensity. Clearly, the new intensity record was the high-water mark in accelerator performance for January, as a series of component and system failures frequently plagued operation. There were two separate failures and subsequent repairs on an electrostatic septum in the Proton Area beam splitting station during the first 12 hours of 1976, a harbinger of things to come. During the following four and one-half weeks, over 200 hours of downtime were accumulated in addition to the normal maintenance periods. These unscheduled interruptions cut up the running time for high energy physics research. Major accelerator system failures included two underground shorts in one of the main-ring pulsed power feeder cables, leaks in the 55° and 95° low-conductivity water systems, problems with the linac and main-ring rf systems, and a fault in a main-ring power transformer.

The cause of the instability which produced high beam losses during December (reported last month) was found in the rf system early in January. Once corrected, it was possible to use the short parabola magnet-ramp program and still maintain operation at intensities above 1.5×10^{13} protons per pulse. Front porch operation at 200 GeV was then resumed for about a week

to complete a requirement for Particle Production #284 in the Proton Area. For the remainder of the month, a standard 400-GeV cycle with a 1-sec flattop and a 10.5-sec period was the running mode. On each accelerator cycle three types of spill were delivered: first, "pinged" beam for a hadron beam pulse to the 15-foot bubble chamber, then slow-spilled beam to all areas for counter experiments, and then a one-turn high intensity fast extracted beam spike for neutrino physics in the 15-foot chamber. A total of 416 hours of beam time was available for the high energy physics research program during January, delivered at an efficiency of 66.6%.

Di-Lepton #288, running steadily in Proton-Central, was the top priority experiment at Fermilab during much of January, when it became apparent that some interesting results were being observed in their study of electron-positron pair production in the high mass region. In Proton-West, Particle Production #284 completed their first data taking run by mid-month using both 200- and 400-GeV slow-spilled beam on their liquid hydrogen target. That area was then turned off for about two weeks for installation of equipment for p-p Elastic Scattering #177A. During the last few days of the month this group began to use beam, when available, to check equipment. In Proton West, the Particle Search #300/#325 group installed apparatus and a liquid hydrogen target during the first half of January, and then spent two weeks starting up, tuning, and testing in preparation for data taking.

Neutrino physics, using the double horn and 15-foot bubble chamber, also received strong emphasis during January. The chamber operating mode of two expansions per accelerator cycle was continued whenever possible,

using the fast spill for neutrino exposures and pinged beam for hadron pictures. For the first two weeks of the month, 15' Neutrino H_2 # 45A and 15' p-p @ 300 GeV # 343 were paired; they accumulated 24,176 and 20,245 pictures, respectively. The # 45A experiment was continuing a run begun last November. At mid-month the horn and bypass beam polarities were reversed and picture-taking commenced for 15' Antineutrino H_2 # 31A and 15' π^--p @ 360 GeV # 384. Progress on these experiments was hampered by failures of hydraulic piping in the chamber expansion system and by trouble with both the expansion engine and the refrigerator for the liquid helium system which cools the superconducting magnet. Nevertheless, a total of 18,768 antineutrino and 9,400 hadron pictures had been accumulated for these experiments by the end of the month. Running concurrently with the bubble chamber program, Di-Muon # 331 continued to take data using +230 GeV/c hadrons in the N1 beam line, produced by slow-spilled protons on the target. Tachyon Monopole # 202 also continued to collect cosmic ray data throughout January.

In the Meson Area, eight experimental groups were active. Particle Search # 357 completed a data-taking run at the end of the first week. Since then, Inclusive Photon # 268 has been running in the M2 beam, first to set up, tune, and calibrate their apparatus, and then to collect data for two weeks. In the M3 beam line, Neutron Elastic Scattering # 248 collected data for two weeks, after which Particle Search # 397 began a week of equipment testing and beam studies. This was followed by a week of preliminary data taking; serious data acquisition was begun during the last weekend of the month. In

the M6-West beam line, Hadron Jets # 260 spent about one week on beam tuning, equipment checking, and calibration work, and three weeks taking data before turning the line over to Elastic Scattering # 69A. This group tuned the beam and their apparatus rather quickly, and were solidly engaged in their final data-taking run by the last weekend in January. Inclusive Scattering # 324 spent most of the month testing and calibrating equipment and beam tuning in the M1-West line, while in the M4 line K^0 Regeneration # 82 was off to make repairs and some necessary design modifications to their liquid hydrogen target. Both experiments were able to take data during the last week of the month. Nuclear Chemistry # 81A was unable to expose additional targets to the proton beam in Meshall because of trouble with the remotely operated electric train used to move them into position; repairs should be completed shortly.

In the Internal Target Area, Proton-Proton Inelastic # 321 further refined the vacuum pumping system for their warm gas jet. They used running time on the day and evening shifts, when beam was available, to calibrate their equipment; by the end of January they were taking data, pulsing the 3-mil jet for 50 msec once per accelerator cycle. Work on installing and connecting the cryogenic magnets on the spectrometer arm in the recoil room continues whenever accelerator downtime permits. Polarized Scattering # 313 is ready to begin data taking when the spectrometer is completed. Proton-Nucleon Scattering # 198A also continued installing equipment during access periods, and made some use of the main-ring beam and upstream rotating target to check their apparatus.

Reported by H. Allen

FACILITY UTILIZATION SUMMARY--JANUARY 1976

I. Summary of Accelerator Operations

		Hours	
A. Accelerator use for physics research			
Accelerator physics research		52.6	
High energy physics research		415.5	
Research during other use		(41.3)	
	Subtotal		468.1
B. Other activities			
Accelerator setup and tuning to experimental areas		7.0	
Programmed interruption		48.5	
Unscheduled interruption		220.4	
	Subtotal		275.9
C. Unmanned time			-
	Total		744.0

II. Summaries of High Energy Physics Research Use

	# of Expts.	Hours	Results
A. Counter experiments	18	3001.2	
B. Bubble chamber experiments	4	305.0	72,589 pictures
C. Emulsion experiments	-		
D. Special target experiments	-		
E. Test experiments	1	11.4	Phototube tests
F. Engineering studies and tests	-		
G. Other beam use	-	66.4	
	23	3384.0	1 expt. completed

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

A. Beam accelerated in Main Ring	Total		1.929
B. Beam delivered to experimental areas			
Proton Area			
@ 200 GeV		0.005	
@ 400 GeV		0.033	
		0.038	
Neutrino Area			
Slow Spill		0.629	
Fast Spill		0.777	
		1.406	
Meson Area		0.200	
	Total		1.644

IV. Beam Utilization by Experiment

	Hours	
A. Meson Area		
Elastic Scattering # 69A	22.6	Data
n Elastic Scattering # 248	160.6	Data
Hadron Jets # 260	309.9	Tests and preliminary data
Inclusive Photon # 268	249.4	Data
Inclusive Scattering # 324	254.0	Tests and data
Particle Search # 357	96.9	Data
Hadron Jets # 395 tests	11.4	Calorimeter tests
Particle Search # 397	203.6	Data
K^0 Regeneration # 425	112.1	Data
B. Neutrino Area		
15' Antineutrino/H_2 # 31A	73.4	18,768 pictures
15' Neutrino/H_2 # 45A	103.5	24,176 pictures
Tachyon Monopole # 202	-	Cosmic ray data
Di-Muon # 331	378.9	Data
15' p-p @ 300 GeV # 343	93.8	20,245 pictures (complete)
15' π^--p @ 360 GeV # 384	34.3	9,400 pictures
C. Proton Area		
p-p Elastic Scattering # 177A	53.6	Testing and setup
Particle Production # 284	187.2	Data
Di-Lepton # 288	363.4	Data
Particle Search # 300	132.7	Setup and data
Di-Muon # 325	56.9	Background tests
D. Internal Target Area		
p-p Inelastic # 321	199.0	Tests and preliminary data
Polarized Scattering # 313	110.2	Tests
p-N Scattering # 198A	110.2	Tests
Total	3317.6	

PROPOSALS RECEIVED DURING DECEMBER 1975 AND JANUARY 1976

No.	Title	Submitted by
465	Proposed Charm Search with Muon Trigger	U. Becker
466	A Proposal for the Study of High-Energy Reaction Mechanisms by the Measurement of the Angular and Energy Distributions of Nuclear Recoiling from Targets Bombarded with 200 to 300 GeV Protons	S. Kaufman
467	Proposal for Parasitic Dual Target Irradiation with Muon Spill Beam Behind Exp. # 319	M. Freedman
468	Search for Penetrating Massive Neutral Particles Produced in High Energy Proton Collisions	P. Steinberg
469	Search for Heavy Long-Lived Particles	D. Cutts
470	A Measurement of the A-Dependence of Hadron Production at Large $X_{\parallel}$ and P_t	J. Trischuk
471	Proposal to Investigate the Nature of ψ Production by Pions and Protons	D. Potter
472	Search for Heavy Particles Produced in Association with Prompt Muons	K. Stanfield
473	Search for Monopoles above the 15-Foot Bubble Chamber	D. Bartlett
474	A Detailed Study of Extra Muon Production in Deep Inelastic Muon Interactions	K. W. Chen
475	Search for Multi-Photon Events Produced in Photon-Beryllium Interactions	J. Ficenic
476	Proposal for Studying Antineutrino Interactions in Neon with a Narrow Band Beam in the 15-Foot Bubble Chamber	A. Kernan
477	Study of π, K and $\bar{p}$ Production of High Mass Multi-Muon States	R. Weinstein
478	Proposal to Search for Intermediate Boson Production in Proton-Proton Collisions at 200 GeV in the Center of Mass	J. K. Walker

DATES TO REMEMBER

March 4-5, 1976	Spring Meeting of the Fermilab Program Advisory Committee.
March 31, 1976	Requests for summer accommodations should be received in the Housing Office.
April 3, 1976	Fermilab Auditorium Arts Series: Chicago Brass Ensemble. Admission $3.00; tickets available in Guest Office.
April 15-16, 1976	Workshop on Elastic Scattering at Large P_t (tentative).
April 30, 1976	Fermilab Auditorium Arts Series: "The Adventures of Huckleberry Finn--Part I" performed by the Organic Theater. Admission $3.00; tickets available in Guest Office.
May 6-7, 1976	Workshop on Multiparticle Final State Experiments (tentative).
May 7, 1976	Deadline for receipt of new proposals and other written materials to be considered at the Extended Summer Meeting of the Program Advisory Committee.
May 14-15, 1976	Annual Meeting of the Fermilab Users Organization.
May 20-21, 1976	Proposal Presentation Meeting.
May 21, 1976	Fermilab Bicentennial Lecture Series: "The Carbon Isotopes and the Rise of American Biochemistry." Dr. Martin Kamen, University of Southern California. No charge; tickets are required and may be obtained in the Guest Office.
June 19-25, 1976	Extended Summer Meeting of the Fermilab Program Advisory Committee (Aspen, Colorado).
June 28 - July 9, 1976	Aspen Summer Study on the Use of the Energy Doubler/Saver (tentative).