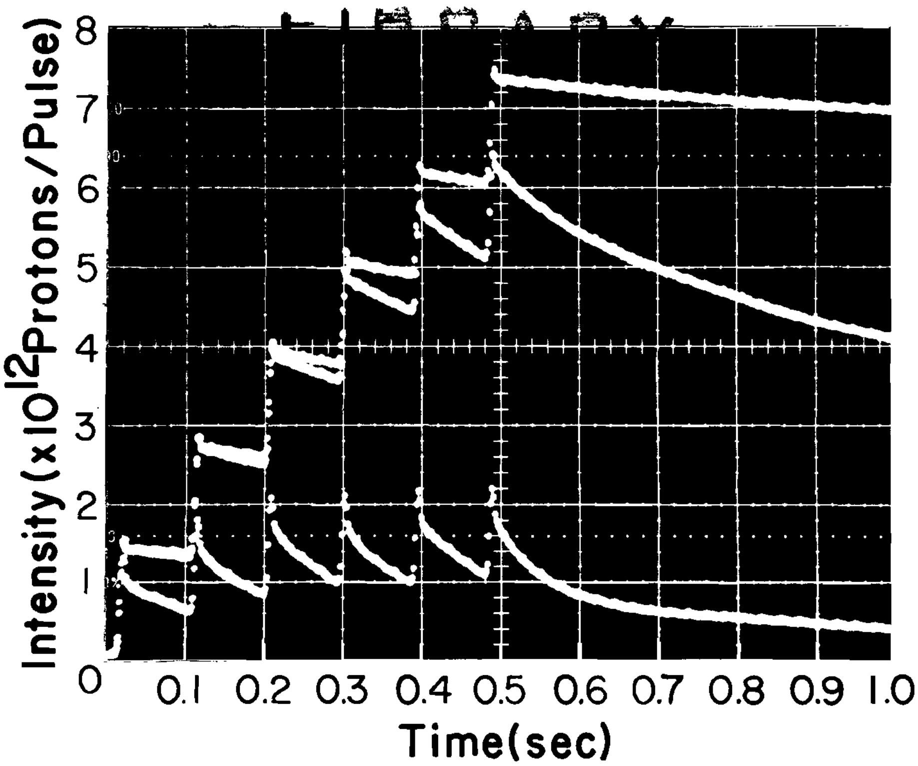
NALREP



Monthly Report of the Fermi National Accelerator Laboratory

January 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

FERMILAB-76/1 0090.01

THE COVER: This photograph of an oscilloscope trace shows the intensity of six pulses of 8-GeV protons from the booster circulating in the main ring for three correction sextupole magnet current settings. Small beam decay is seen when full correction is applied, but more beam loss is seen for 80% of full correction and total beam loss for 50% current settings.

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

BEAM STABILITY IN THE MAIN RING

Recent experience has shown that the main ring can store and accelerate to 400 GeV more than 80% of the 8-GeV protons injected into it. This level of performance leading to intensities of nearly 2×10^{13} protons per pulse has been made possible by the incorporation into the main accelerator system of many correction devices which stabilize the circulating beam. Although such devices have been used in earlier accelerators, they are particularly important to the Fermilab main ring. It is difficult to accelerate even 10^{11} protons with the correction devices turned off!

Many parameters are necessary to describe the motion of particles in an accelerator. Some of them are:

Momentum = p
Phase = ϕ
Distance along the structure = s
Vertical position = y
Vertical angle y' = dy/ds
Horizontal position = x
Horizontal angle x' = dx/ds

The parameters x, x', y, and y' are measured in transverse coordinates, while longitudinal coordinates are used for p, ϕ, and s. Particles execute betatron oscillations in the transverse coordinates and synchrotron oscillations in the longitudinal coordinates. Transverse motion is kept within bounds by alternating magnetic field gradients in quadrupole lenses, while longitudinal motion is controlled by time-varying electric fields in RF cavities. When there is an intensity limitation because the beam has died away, it is because something has interfered with the particle confinement in one of the coordinates just described.

The fields which disturb particle confinement are divided into two classes, those which are externally generated--such as a magnetic field caused by the improper shape of a magnet pole face, and those which are generated by the current in the beam itself. An instability caused by external forces is intensity-independent. An effect of this type is called a single-particle instability. Instability caused by the fields of the beam itself is intensity-dependent. Such an instability becomes noticeable in the main ring in the transverse coordinates at an intensity of 1×10^{12} protons per pulse. In the longitudinal coordinates it is observed above an intensity of 3×10^{12} protons per pulse. These instabilities are called space-charge effects.

When the main ring was first operated it was found that even very weak beams decayed away rapidly at 8 GeV. Although this was due in part to a variety of obstacles in the vacuum chamber, the decay remained after the obstacles had been removed. The machine behaved as if only a very small portion of the magnet aperture could contain a stable beam. This beam decay has been found to be caused by errors in the fields of the magnets which interfere with the transverse particle confinement.

In the course of a 4-sec acceleration cycle a particle travels 1.2×10^{6} km, going around the main accelerator nearly 200,000 times. During this process, the transverse oscillations of the protons are kept within the vacuum chamber by means of quadrupole lenses, alternating in sign, spaced at intervals of 30 m. In practice the lenses are not identical, and may contain imperfections. Imagine that the accelerator is not circular, but extends in a straight line for 1.2×10^6 km. As a particle passes through successive lenses, it receives a series of small extra deflections due to the magnet imperfections, the direction and magnitude of which are distributed randomly. Because of these slight random deflections, the amplitude of the transverse oscillations will grow in proportion to the square root of the distance traveled times some factor which depends upon the magnitude of the field errors. With magnets of the quality typical of those in the main ring, most of the particles would be lost against the vacuum chamber walls after traveling a distance of 1000 km, only 0.1% of their intended journey.

Fortunately, because the accelerator is circular, a particle passes through the same set of magnets every 6.28 km. If the phase of the transverse oscillations of the particles is advanced by a proper amount on every revolution, it is possible to cancel the effects of the random field errors. On the other hand, the phase advance can be adjusted to magnify the effect of the field errors. Under the most unfavorable conditions, the beam in the main ring will survive for only ten revolutions!

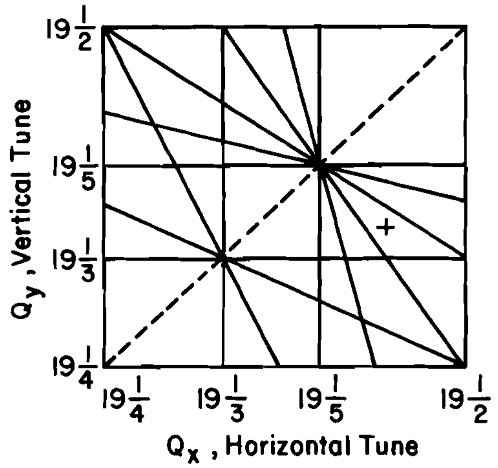
The number of transverse oscillations which a particle executes in one revolution is called the tune of the machine. Because the quadrupole magnets of opposite signs are connected to different power supplies, the tune of the horizontal and vertical oscillations can be controlled separately. If Q_y is the vertical tune and Q_x is the horizontal tune, whenever the relation

$$aQ_x + bQ_y = c$$

is satisfied, the transverse oscillations will grow and the beam will be unstable. In this relationship a, b, and c are integers. The instability decreases in importance with increasing values of c. For beams with the largest transverse size so far injected into the main ring, values of c as large as 97 are important. A diagram of the danger values for Q_x and Q_y for values of c up to 97 is shown opposite. The small cross is typical of the operating tune of the most stable particle in the accelerator. The various lines in the diagram differ in their power to destroy the beam, as they have their origins in different distributions of field errors in the accelerator magnet system. For this reason, the location of the best operating tune must be determined by experiment. It will be shown later that different protons within the accelerator can have different tunes. Therefore, it is important that the ensemble of all particles be confined within the boundaries set by the lines surrounding the cross if no beam loss is to occur.

The most important device used in keeping the tune away from a destructive value is the quadrupole power supply itself. Since the tune is nearly proportional to the current in the quadrupole magnets and since the distance from the cross to the nearest danger line is about 0.03, the quadrupole current must be held constant to at least $0.03/19.4 = 1.5 \times 10^{-3}$.

Because other effects also cause the tune to vary, in practice the variation due to quadrupole current regulation alone must be held constant to within 5×10^{-4}. At injection time the quadrupole current is approximately 88 A. This is held constant to within ±0.04 A through the use of two transistor-bank power supplies recently added to the quadrupole system. It may seem odd that magnets which are eventually ramped to 7000 A at 500 GeV must be so carefully current-regulated at injection time, but experiments prove that this is so.



Instability diagram for the Fermilab main ring. Each line is identified by the value of c. Only those lines which $c \le 97$ are shown. The most stable tune for a particle is shown by the cross. The dotted line is the principal resonance, not described in the text, which couples vertical and horizontal oscillations. It must be avoided if the horizontal beam size is larger than the vertical magnet aperture.

Even if the quadrupole current is regulated to the required precision, the accelerator still will not work. This is because the beam ensemble at 8 GeV has a spread in momentum of about 2×10^{-3}. Since high-momentum particles travel at a larger radius than low-momentum particles, they explore a different region of the magnet aperture and are not necessarily subject to the same focusing field gradients. Indeed, measurements show that there are substantial radius-dependent field gradients in the bending magnets. Without correction these errors would cause an injected ensemble to be spread far beyond the boundaries shown in the diagram. In addition, synchrotron oscillations cause the momentum of each particle to oscillate, and it will wander across forbidden lines and eventually be lost. The repeated crossing of the forbidden lines at the synchrotron frequency causes a slow beam decay which in appearance is difficult to distinguish from that due to other effects such as a poor vacuum.

To cancel the effects of the bending magnet gradients, a system of about 400 correction magnets has been installed around the ring in spaces adjacent to every quadrupole. Yet another source of tune spreading is the field gradients caused by the currents which flow in the vacuum chamber during acceleration. The correction magnets are ramped to counter this effect.

Space-charge effects become important above an intensity of 1×10^{12} protons per pulse. The effect with the lowest threshold is the resistive-wall instability which disrupts the vertical transverse confinement. Qualitatively speaking, it can be described as follows. The oscillation of a particle leaves behind it a retarded or wake field due to currents of image charges in the vacuum chamber wall which may deflect a following particle. If that following particle in turn leaves behind a wake field which deflects the first particle, an instability can develop when the phases of the various oscillations are in an unfavorable relationship. Two sources of such instabilities are known to exist. In one the currents which are left behind survive the 20 μsec required for one revolution of the beam. This instability has the lowest threshold. It is characterized by a normal mode in which all particles in the machine participate in a coupled vertical motion. The lowest frequency of beam oscillation which a stationary observer detects is 18 kHz. Several devices detect this beam motion and suppress it through deflecting electrodes called beam dampers which buck out the oscillation.

The second source arises from particle motion within the individual RF bunches. The beam is segregated into 1113 bunches around the ring in which the protons are trapped by the RF electric fields. Synchrotron oscillations cause particles to circulate within the bunches. Thus, a particle at the head of a bunch can leave behind a wake field which deflects a particle at the tail of the bunch, only to be later deflected by that particle when their positions are reversed half a synchrotron period later. Naturally enough, this effect is called the head-to-tail instability. The normal mode with the lowest threshold is one in which the whole bunch oscillates vertically. Such motion can be detected and suppressed with a damping system which responds to the motion of individual bunches. The superdamper was built to control the vertical instability of a single bunch. Unfortunately, other modes of oscillation occur which have high frequency components that place them beyond control by beam dampers because of technological limitations. These instabilities have been known to cause the selective extraction of individual bunches and a resultant deterioration of the eventual spill structure. The threshold for such instabilities can be raised by making the individual bunches longer and thus diminishing the effect of short-range but strong wake fields. This is accomplished by a feedback system which has been incorporated into the main ring RF system. The penalty for using such a method of stabilization is the necessity for more RF voltage to confine the larger momentum spread characteristic of longer bunches.

One additional instability is important. Whenever there is an electrically insulated gap in the vacuum pipe, the possibility exists that the beam will induce a large voltage across the gap which induces a large momentum spread in the circulating beam. To cause this effect, the gap must be part of an electrically resonant circuit. Any resonant frequency which is a multiple of the 47-kHz revolution frequency is dangerous. Although an upper limit of about 250 MHz exists for this effect, there are over 5000 dangerous frequencies in between. The worst known structures containing such gaps are the RF cavities, which have high-Q resonances at frequencies other than the fundamental frequency of acceleration. A resonance at 128 MHz in an RF cavity once made it impossible to transport beam across a lower energy plateau, called the "front porch". Other resonances in the cavities have caused selective extraction of individual bunches. Work is presently underway on a damper for these spurious resonances in the RF cavities which will lower the gap impedence at all frequencies other than that of the accelerating fundamental.

It is impossible to predict what will happen when attempts are made to accelerate higher intensity beams. Some instabilities may actually go away, while others yet unseen may develop. A frequently heard comment among accelerator builders runs to the effect that, "had we known it would be that complicated, we might never have built the thing!"

Reported by R. Stiening

REPORT FROM THE USERS EXECUTIVE COMMITTEE

The Users Executive Committee has submitted the following report:

"The Users Executive Committee exists to serve as a channel of communication between the user community and both Fermilab and Universities Research Association, Inc. A number of subcommittees focus on areas of crucial interest to users (published in October 1975 NALREP), and user input is actively sought. In the past a wide variety of problems has been discussed by the UEC. Usually a recommendation is made either to Fermilab or to URA for action to produce a workable solution. The usefulness of the UEC depends very much upon the communications between the Users Organization membership and the Committee. We feel that this could be improved and that we need to hear more from the membership about potential or existing matters of concern.

"Three UEC meetings have been held in the latter half of 1975, and another is scheduled for January 10. This article is intended as a 'midyear' review of UEC activities and accomplishments.

"One of our major concerns is the supply of on-site housing. An extensive survey was conducted by J. Pine at the end of July to determine user housing needs in the peak summer period. From the results of this survey and further discussions with R. Carrigan and others, it was discovered that present dormitory space is adequate, but that a severe shortage exists in both family and bachelor group housing ('communes'). These facts were made known to the URA Trustees at their summer meeting, and several letters have been written to the Director with suggestions about how additional on-site housing might be obtained. Tangible results have been the release of funds for the completion of five more houses on Sauk Circle by this summer, plus two others which were already scheduled for renovation. At the present time we are continuing to press for funds to complete the remaining Circle houses, and when they become available, eight Village houses.

"Another possibility which has been suggested is an arrangement between an individual university and the Laboratory. For roughly $10,000, a Village house can be converted for group use. The money would be loaned to Fermilab by the university with the understanding that people from that university would then have prior claim to the use of that particular house. A portion of the rent would be allocated for repayment to the university of the loan. Users are encouraged to pursue this possibility with their home institutions. The UEC also helps set guidelines for housing priorities, and has made suggestions for the general improvement of the facilities.

"Another perennial issue which has received attention recently is the question of ERDA control of Soviet Bloc visitor access to the Laboratory. This has been an unpopular policy with the users for a long time. This year,

D. Caldwell raised the question with the High Energy Physics Advisory Panel, and L. Hand is writing a letter to R. Seamens, Head Administrator of ERDA, requesting that for single-purpose laboratories, the policy for high energy physics be the same as that for other sciences, i.e., that only State Department approval be required.

"In the field of computing, L. Stutte and D. Reeder worked with J. Sanford and A. Brenner to hold a workshop on the proposed BISON-NET system. About 75 people attended, and some useful input to this system was belatedly received. We are now investigating complaints about the Berkeley computer link.

"At the November UEC meeting, extensive reports were given by W. Fowler, A. Tollestrup, and J. Sanford on the progress of the Energy Doubler/Saver. We expect updated versions of these reports to be a significant part of the agenda for the Annual Meeting this May. At that time, plans for user participation in study groups considering the use of experimental areas with the Doubler/Saver will be described. Questions from persons interested in participating before that time should be directed to Sanford or to members of the UEC Doubler/Saver Subcommittee (L. Stevenson, G. Kalbfleisch, J. Peoples).

"In discussing the status of the experimental areas, the Committee became particularly concerned about the shortage of skilled personnel in the Proton Area where a number of ambitious projects are underway. Since then, more personnel have been added by the Laboratory. More recently, unresolved issues include budgetary problems in the Internal Target Area and the use of overtime in the Meson Area, among others. Users are strongly urged to bring any new problems to the attention of the appropriate Laboratory Department Head or UEC Subcommittee member.

"The UEC welcomes comments from users on improvements to the recreational facilities (particularly during winter months), ways to popularize the Users Center (now rather lacking in patronage), and suggestions for improving the UEC itself. Items of general interest can be discussed at our March meeting and also at the Annual Meeting.

"In closing, the UEC would like to express its thanks on behalf of all users to the Users Office staff, C. Sazama and P. Hale, whose extremely competent work has been a major factor in making Fermilab a pleasant place for those who travel long distances to use it."

Submitted by L. Hand
Chairman, Users Executive
Committee

NOTES AND ANNOUNCEMENTS

MORE ON PLANS FOR THE SPRING PAC MEETING. . .

The next meeting of the Program Advisory Committee will be held at Fermilab on March 4 and 5, 1976. Proposals submitted prior to the January 23rd deadline will be discussed. Many of them will have been presented orally at the Proposal Presentation Meeting, February 5 and 6. (The Presentation Meeting is an open one, and all interested physicists are welcome to attend and to participate in the discussion to the extent time permits.) The PAC will also discuss the recommendations emanating from the January 15-16 meeting of the PAC Bubble Chamber Subcommittee. Questions about any of these meetings should be addressed to T. Groves in the Directors Office, Ext. 3211.

WORKSHOP ON ELASTIC SCATTERING AT LARGE P_t SCHEDULED. . .

A workshop on Elastic Scattering at large P_t is 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. Currently there are two proposals on hand which would be considered then: Elastic Scattering #301 and Elastic Scattering #347.

If it is held as planned, the deadline for submission of all written materials to be considered at the workshop will be March 12. The meeting will be open to all interested physicists. For further information, contact T. Groves in the Directors Office, Ext. 3211.

1976 ACADEMIC LECTURE SERIES UNDER WAY. . .

The 1976 Academic Lecture Series organized by the Fermilab Physics Department, started this month, and will continue through June. Aimed at persons at the postdoctoral level and above, the series is comprised of groups of lectures on specialized topics. In addition to some theory talks and some about the user of experimental systems at Fermilab such as spectrometers, some discussions of what kinds of physics can best be done at Fermilab, as opposed to CERN II for example, will also be held. Both Fermilab staff and visiting experimenters will participate.

The lectures are held on Mondays and Fridays at 9:30 a. m. in Curia II. Anyone wishing to attend is welcome to do so; for additional information and each week's topic consult NALCAL or call the Physics Department, Ext. 3203.

PROCEDURES FOR EXPERIMENTERS 1976 NOW AVAILABLE. . .

The Laboratory has just issued the 1976 edition of the PROCEDURES FOR EXPERIMENTERS booklet. As in the past, it has been carefully reviewed and revised, and it contains a rather complete statement of Fermilab policies and procedures as they pertain to experimenters. Particular attention is paid to matters of safety.

It is our intention that a copy of this booklet be available to each individual who works at Fermilab in the coming year. Copies have already been mailed to Spokespersons for experiments. We ask that all users, when first coming to the site, stop at the Users Office (atrium floor east, Central Laboratory) to pick up a 1976 PROCEDURES booklet, and make other necessary arrangements for working at the Laboratory.

NEW ASSIGNMENTS. . .

In accordance with the Fermilab policy of rotating administrative responsibilities, Frank Nezrick is now Head of the Physics Department. Peter Koehler will serve as Assistant Head of the Department.

J. Ritchie Orr has been appointed Business Manager of the Laboratory. He replaces James Finks, Jr., who has become Assistant Head of the Accelerator Division's Superconductor Group.

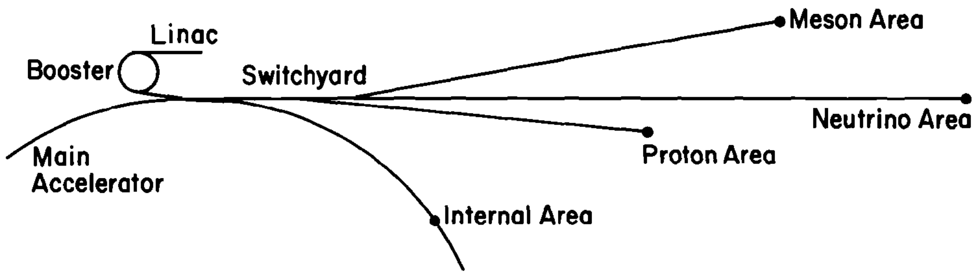
HOLIDAY SCHEDULE. . .

The following holidays will be observed at the Laboratory in 1976:

January 1	New Year's Day 1976
May 31	Memorial Day
July 5	Independence Day
September 6	Labor Day
November 25-26	Thanksgiving Holiday
December 23-24	Christmas Holiday
December 31	New Year's Day Holiday 1977

On these days, all offices at Fermilab will be closed. The operating schedule for the accelerator and experimental areas will be published in the Current Operations Schedule issued weekly by the Operations Center.

Fermi National Accelerator Laboratory



Experiments in the Research Areas

JANUARY - APRIL 1976

Internal Area	Proton Area	Neutrino Area	Meson Area
P-P INELASTIC #321	PROTON EAST:	HADRON BEAM:	PION DISSOC. #86A(M1)
	PARTICLE SEARCH #300/#325	15-FT. B.C.	INCLUSIVE SCATT. #324 (M1)
			NEUTRAL HYPERON #8 (M2)
PROTON-NUCLEON SCATT. #198A	PROTON-CENTER:	NEUTRINO BEAM:	INCLUSIVE PHOTON #268(M2)
	DI-LEPTON #288	15-FT. B.C.	PARTICLE SEARCH #357 (M2)
	MUON SEARCH #435	NEUTRINO #247	PARTICLE SEARCH #366 (M3)
			PARTICLE SEARCH #397 (M3)
P-P POLARIZATION #313	PROTON-WEST:	MUON/HADRON BEAM:	NEUTRON ELASTIC #248 (M3)
	PHOTON SEARCH #95A	DI-MUON #331	K^0 REGENERATION #425 (M4)
	P-P ELASTIC #177A		HADRON JETS #260 (M6)
	PARTICLE SEARCH #284		ELASTIC SCATT. #69A (M6)

SITUATION REPORT-JANUARY 1976

PAGE 1

FERMI NATIONAL ACCELERATOR LABORATORY

J. R. SANFORD

16 JAN 1976

EXPERIMENTAL PROGRAM SITUATION REPORT

THE EXPERIMENTAL PROGRAM SITUATION AT FERMILAB IS SUMMARIZED BELOW. THE EXPERIMENTS ARE LISTED SEPARATED BY EXPERIMENTAL AREA UNDER CATEGORIES THAT BEST DESCRIBE THEIR CIRCUMSTANCE AS OF JANUARY 1, 1976. FOR EXPERIMENTS WHICH HAVE BEEN COMPLETED OR HAVE RECEIVED BEAM THERE IS INDICATION OF THE AMOUNT OF RUNNING TIME OR EXPOSURE. THE EXPERIMENTAL AREA NAMES ARE ABBREVIATED AS FOLLOWS: INTERNAL TARGET AREA (ITA), MESON AREA (MA), NEUTRINO AREA (NA), PROTON AREA (PA).

TOTAL NUMBER OF APPROVED EXPERIMENTS – 234

A. EXPERIMENTS THAT HAVE COMPLETED DATA TAKING (139):

AREA-BEAM		SPOKESPERSON	EXTENT OF RUN TO DATE	DATE COMPLETED
MA -M1	ELASTIC SCATTERING #7	MEYER	2,350 HOURS	28 JAN 75
	FORM FACTOR #216	STORK	900 HOURS	1 OCT 75
	DETECTOR DEVELOPMENT #229	YUAN	300 HOURS	16 NOV 74
	DETECTOR DEVELOPMENT #261	WANG	600 HOURS	20 NOV 74
	MUON SEARCH #335	FACKLER	300 HOURS	6 JUN 75
	PARTICLE SEARCH #416	LUBATTI	400 HOURS	1 JUL 75
-M2	MULTIGAMMA #22	COLLINS	350 HOURS	26 JUN 74
	MISSING MASS #51A	VON GOELER	800 HOURS	23 OCT 74
	QUARK #75	YAMANOUCHI	1,050 HOURS	8 SEP 73
	BEAM DUMP #108	AMSCHALOM	350 HOURS	2 JUN 75
	PION CHARGE EXCHANGE #111	TOLLESTRUP	1,800 HOURS	19 SEP 74
	PARTICLE SEARCH #365	GARELICK	200 HOURS	5 FEB 75
-M3	NEUTRON CROSS SECTION #4	LONGO	1,450 HOURS	20 MAR 74
	NEUTRON BACKWARD SCATTERING #12	REAY	1,300 HOURS	2 DEC 74
	NEUTRON DISSOCIATION #27A	ROSEN	850 HOURS	24 APR 74
	MULTIGAMMA #230	LONGO	50 HOURS	24 APR 74
	NEUTRON DISSOCIATION #305	GOBBI	1,400 HOURS	14 APR 75
-M4	QUARK #72	LEIPUNER	500 HOURS	11 JUN 73
	K ZERO REGENERATION #82	TELEGDI	3,500 HOURS	5 JUL 75
	PARTICLE SEARCH #330	GUSTAFSON	150 HOURS	7 JUL 75
-M6	ELASTIC SCATTERING #96	RITSON	2,550 HOURS	17 FEB 75
	MULTIPLICITIES #178	BUSZA	800 HOURS	14 AUG 75
-OTHER	EMULSION/PROTONS @ 200 #90	WOLTER	4 STACKS	20 SEP 72
	EMULSION/PROTONS @ 200 #103	KING	1 STACK	20 SEP 72
	EMULSION/PROTONS @ 200 #105	MALHOTRA	1 STACK	20 SEP 72
	EMULSION/PROTONS @ 200 #114	JAIN	1 STACK	20 SEP 72
	EMULSION/PROTONS @ 200 #116	HEBERT	5 STACKS	20 SEP 72
	EMULSION/PROTONS @ 200 #117A	KUSUMOTO	11 STACKS	20 SEP 72
	EMULSION/PROTONS @ 200 #156	NIU	13 STACKS	20 SEP 72
	EMULSION/PROTONS @ 200 #171	LORD	6 STACKS	20 SEP 72
	EMULSION/PROTONS @ 200 #183	TRETJAKOVA	3 STACKS	20 SEP 72
	EMULSION/PROTONS @ 200 #189	RITSON	? PLATES FROM EXP #171	20 SEP 72
	SUPER-HEAVY ELEMENTS #147	DEBEAUVAIS	4 EXPOSURES	11 JUN 75
	DI-MUON #331	EARTLY	5 HOURS	7 FEB 75
	SUPER-HEAVY ELEMENTS #371	JURIC	2 STACKS	20 DEC 75
	FRAGMENTATION PARTICLES #426	FUKUI	8 STACKS	18 AUG 75
NA -NEUTRINO	NEUTRINO #1A	CLINE	2,850 HOURS	30 JUN 75
	15-FOOT NEUTRINO/H2&NE #28A	FRY	97K PIX	11 JUN 75
	15-FOOT ANTI-NEUTRINO/H2&NE #180	ERMOLOV	76K PIX	2 JUN 75
	NEUTRINO #21A	BARISH	2,450 HOURS	2 NOV 75
	15-FOOT EMI TEST #155	PETERSON	14K PIX	30 NOV 74
	NEUTRINO #254	KALBFLEISCH	550 HOURS	15 OCT 75
	NEUTRINO #262	BARISH	400 HOURS	20 MAR 74
	NEUTRINO #320	SCIULLI	500 HOURS	1 OCT 74
	NEUTRINO #370	CLINE	400 HOURS	19 MAR 75
-MUON/HADRON	MUON #26	HAND	900 HOURS	16 APR 74
	MUON #98	ANDERSON	1,800 HOURS	17 FEB 75
	PARTICLE SEARCH #382	HAND	200 HOURS	19 DEC 75
-15-FT	15-FOOT ENGINEERING RUN #234	HUSON	57K PIX	5 NOV 74
	15-FOOT P - P @ 400 #341	XO	34K PIX	21 DEC 75
-30-IN	30-INCH HYBRID #2B	SMITH	479K PIX	22 APR 74
	30-INCH P-P @ 300 #37A	MALAMUD	51K PIX	1 JUN 73
	30-INCH PI+ & P - P @ 100 #121A	LANDER	104K PIX	23 JAN 74
	30-INCH PI- - P @ 100 #125	MORRISON	53K PIX	28 AUG 73
	30-INCH PI- - P @ 200 #137	HUSON	48K PIX	10 MAR 73
	30-INCH P-P @ 400 #138	VANDER VELDE	52K PIX	26 AUG 75
	30-INCH P-P @ 200 #141A	FIELDS	67K PIX	27 NOV 72
	30-INCH PI- - P @ 300 #143A	KALBFLEISCH	51K PIX	10 APR 74
	30-INCH HYBRID #154	PLESS	105K PIX	13 MAR 74
	30-INCH P - PENE @ 300 #161	MAPP	51K PIX	25 JUN 74
	30-INCH PI- - PENE @ 200 #163A	WALKER	52K PIX	18 JUN 74
	30-INCH P - D @ 400 #196	ENGELMANN	109K PIX	20 OCT 75
	30-INCH P - D @ 300 #209	DAO	106K PIX	7 OCT 75
	30-INCH PI+ & P - P @ 200 #217	LANDER	85K PIX	15 MAY 74
	30-INCH PI- - D @ 200 #218	YAGER	72K PIX	18 SEP 74
	30-INCH PI+ & P - P @ 60 #228	FERBEL	37K PIX	15 APR 74
	30-INCH P-P @ 100 #252	FERBEL	33K PIX	6 DEC 72
	30-INCH P - D @ 200 #280	FIELDS	103K PIX	11 OCT 75
	30-INCH HYBRID #281	SMITH	301K PIX	28 SEP 75
	30-INCH PI+ & P - D @ 200 #295	YEKUTIELI	156K PIX	2 NOV 75
	30-INCH PBAR - P @ 100 #311	NEALE	98K PIX	27 JAN 75
-OTHER	MONOPOLE #3	EBERHARD	4 TARGETS EXPOSED	4 SEP 74
	PROTON-PROTON INELASTIC #14A	FRANZINI	140 HOURS	21 JUN 73
	MONOPOLE #76	CARRIGAN	5 TARGETS EXPOSED	1 DEC 74
	LONG-LIVED PARTICLES #115	STEVENSON	6 HOURS	23 NOV 74
	SUPER-HEAVY ELEMENTS #142	STOUGHTON	1 TARGET	4 JUN 75
	MASSIVE PARTICLE SEARCH #199	FRANKEL	2 TARGETS EXPOSED	22 AUG 73
	BEAM DUMP #211	GOEREL	2 HOURS	14 NOV 73
	LONG-LIVED PARTICLES #239	FRATI	350 HOURS	3 FEB 74
	QUARK #276	VAN GINNEKIN	3 TARGETS EXPOSED	2 NOV 75
	DETECTOR DEVELOPMENT #34	HUGGETT	50 HOURS	26 JUN 74
	QUARK #297	LEIPUNER	50 HOURS	10 JUL 74
	DETECTOR DEVELOPMENT #327	ALLISON	50 HOURS	7 FEB 75
	EMULSION/PROTONS @ 300 #181	CARY	3 STACKS	20 OCT 73
	EMULSION/PROTONS @ 300 #195	LIM	3 STACKS	10 JUN 75
	EMULSION/PROTONS @ 300 #232	KING	2 STACKS	20 OCT 73
	EMULSION/PROTONS @ 300 #233	HEBERT	8 STACKS	20 OCT 73
	EMULSION/PROTONS @ 300 #237	LORD	5 STACKS	10 JUN 75
	EMULSION/PROTONS @ 300 #242	NIU	? STACKS	20 OCT 73
	EMULSION/PROTONS @ 300 #244	JAIN	1 STACK	20 OCT 73
	EMULSION/PROTONS @ 300 #250	KUSUMOTO	1 STACK	20 OCT 73
	EMULSION/PROTONS @ 300 #275	ENGE	4 STACKS	20 OCT 73
	EMULSION/PROTONS @ 300 #329	TRETJAKOVA	2 STACKS	10 JUN 75
	EMULSION/PROTONS @ 300 #374	DAVIS	1 STACK	10 JUN 75
	EMULSION/PROTONS @ 300 #419	GIACOMELLI	1 STACK	10 JUN 75
	EMULSION/PROTONS @ 300 #421	DZHELEPOV	1 STACK	24 JUN 75
	EMULSION/PROTONS @ 200 #271	GOTTFRIED	10 STACKS	10 JUN 75
	EMULSION/MUONS @ 150 #255	JAIN	1 STACK	16 OCT 73
	EMULSION/MUONS @ 150 #205A	KUSUMOTO	2 STACKS	16 OCT 73
	EMULSION/PI- @ 200 #264	YOUNG	2 STACKS	7 OCT 74
	EMULSION/PI- @ 200 #328	TRETJAKOVA	5 STACKS	7 OCT 74
	EMULSION/PI- @ 200 #339	WOLTER	4 STACKS	9 JUN 75

PAGE 2 EXPERIMENTAL PROGRAM SITUATION REPORT (CONT'D)

AREA-BEAM		SPOKESPERSON	EXTENT OF RUN TO DATE	DATE COMPLETED
	EMULSION/PI- @ 200 #362	JAIN	1 STACK	9 JUN 75
	EMULSION/PI- @ 200 #387	WILKES	4 STACKS	9 JUN 75
	EMULSION/PROTONS @ 400 #238	LORD	9 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #243	NIU	7 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #245	JAIN	1 STACK	9 DEC 75
	EMULSION/PROTONS @ 400 #249	WOLTER	3 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #251	KUSUMOTO	3 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #265	YOUNG	3 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #279	KING	3 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #292	GOTTFRIED	12 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #336	OGATA	2 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #346	EKSPONG	1 STACK	9 DEC 75
	EMULSION/PROTONS @ 400 #385	PRAKASH	1 STACK	9 DEC 75
	EMULSION/PROTONS @ 400 #423	SUGIMOTO	4 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #428	HEBERT	14 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #434	DAKE	3 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #461	LORD	6 STACKS	9 DEC 75
	EMULSION/PROTONS @ 400 #462	GIACOMELLI	1 STACK	9 DEC 75
	EMULSION/PROTONS @ 400 #463	TRETJAKOVA	2 STACKS	9 DEC 75
PA -PF	PHOTOPRODUCTION #87A	LEE	2,500 HOURS	21 DEC 75
	PARTICLE SEARCH #100A	PIROUE	1,150 HOURS	4 APR 74
	DI-MUON #358	LEE	400 HOURS	1 OCT 75
-PC	MUON SEARCH #48	ADAIR	500 HOURS	1 DEC 75
	LEPTON #70	LEDERMAN	2,800 HOURS	1 DEC 74
	PARTICLE SEARCH #187	LEDERMAN	200 HOURS	6 NOV 73
	DI-MUON #436	ADAIR	200 HOURS	29 OCT 75
ITA-C-0	PROTON-PROTON SCATTERING #36A	COOL	700 HOURS	24 JUN 73
	PHOTON SEARCH #63A	WALKER	2,600 HOURS	13 MAR 75
	PROTON-PROTON MISSING MASS #67A	SANNES	600 HOURS	8 AUG 73
	PHOTON SEARCH #120	CLINE	1,200 HOURS	29 MAY 73
	PARTICLE SEARCH #184	WANDERER	800 HOURS	29 MAY 74
	PROTON-DEUTERON SCATTERING #186	MELISSINOS	450 HOURS	19 AUG 74
	PROTON-NUCLEON INCLUSIVE #188	SANNES	1,050 HOURS	9 MAY 73
	PROTON-PROTON INELASTIC #221	FRANZINI	950 HOURS	5 SEP 74
	PROTON-NUCLEON INELASTIC #317	MUKHIN	1,400 HOURS	1 NOV 75
	PARTICLE SEARCH #363	OLSEN	650 HOURS	9 APR 75
	PARTICLE PRODUCTION #418	SANNES	900 HOURS	22 OCT 75

B. EXPERIMENTS THAT ARE IN PROGRESS (21):

MA -M1	TOTAL CROSS SECTION #104	KYCIA	1,400 HOURS
-M2	NEUTRAL HYPERON #8	PONDROM	2,500 HOURS
	PARTICLE SEARCH #357	MEYER	950 HOURS
	INCLUSIVE PHOTON #268	MELLEMA	1,450 HOURS
-M3	NEUTRON ELASTIC SCATTERING #248	LONGO	1,000 HOURS
-M6	ELASTIC SCATTERING #69A	MARX	2,400 HOURS
-OTHER	NUCLEAR CHEMISTRY #81A	KAUFMAN	120 BOMBARDMENTS
NA -NEUTRINO	15-FOOT NEUTRINO/H2 #45A	ROE	138K PIX
	15-FOOT ANTI-NEUTRINO/H2 #31A	DERRICK	26K PIX
-MUON/HADRON	DI-MUON #331	PILCHER	650 HOURS
-15-FT	15-FOOT P̄ - P @ 300 #343	ENGELMANN	7K PIX
	15-FOOT PI- - P @ 100 #83A	KITAGAKI	11K PIX
	15-FOOT PI- - P&NE @ 200 #89	FRETTER	4K PIX
-30-IN	30-INCH P - D @ 100 #194	MURPHY	41K PIX
	30-INCH HYBRID #299	PLESS	158K PIX
-OTHER	SUPER-HEAVY ELEMENTS #285	LEDERMAN	3 TARGETS EXPOSED
	TACHYON MONOPOLE #202	BARTLETT	COSMIC RAY RUNNING
PA -PE	PHOTON TOTAL CROSS SECTION #25A	CALDWELL	400 HOURS
-PC	DI-LEPTON #288	LEDERMAN	1,350 HOURS
-PW	PHOTON SEARCH #95A	COX	850 HOURS
	PARTICLE PRODUCTION #284	WALKER	350 HOURS

C. EXPERIMENTS THAT ARE IN TEST STAGE (11):

MA -M1	HADRON JETS #236A	HOCKETT	750 HOURS
	POLARIZED SCATTERING #61	CHAMBERLAIN	250 HOURS
-M3	PARTICLE SEARCH #397	ROSEN	200 HOURS
-M4	K ZERO REGENERATION #425	TELEGDI	350 HOURS
-M6	HADRON JETS #260	MCLEOD	1,150 HOURS
	INCLUSIVE SCATTERING #118A	FRIEDMAN	350 HOURS
NA -NEUTRINO	PARTICLE SEARCH #247	BURHOP	
PA -PW	PROTON-PROTON ELASTIC #177A	OREAR	150 HOURS
ITA-C-0	PROTON-PROTON INELASTIC #321	LEE-FRANZINI	200 HOURS
	PROTON-NUCLEON SCATTERING #198A	OLSEN	200 HOURS
	PROTON-PROTON POLARIZATION #313	NEAL	200 HOURS

D. EXPERIMENTS BEING INSTALLED (10):

			EXTENT OF APPROVAL
MA -M1	INCLUSIVE SCATTERING #324	WEISBERG	500 HOURS
	PION DISSOCIATION #85A	LUBATTI	500 HOURS
	FORM FACTOR #456	STORK	500 HOURS
-M3	PARTICLE SEARCH #366	ABOLINS	1,200 HOURS
-M6	MULTIPARTICLE #110A	MCLEOD	750 HOURS
NA -NEUTRINO	NEUTRINO #310	CLINE	1,000 HOURS
-15-FT	PARTICLE SEARCH #379	WOJCICKI	200 HOURS
PA -PE	PARTICLE SEARCH #300	CRONIN	600 HOURS
	PARTICLE SEARCH #325	CRONIN	300 HOURS
ITA-C-0	PROTON-NUCLEON SCATTERING #381	MALAMUD	300 HOURS

E. EXPERIMENTS TO BE SET UP WITHIN A YEAR (28):

MA -M1	PARTICLE SEARCH #354	BAKER	200 HOURS
-M2	INCLUSIVE NEUTRAL MESON #350	KENNEY	400 HOURS
	PARTICLE PRODUCTION #415	PONDROM	100 HOURS
	LAMBDA MAGNETIC MOMENT #440	BUNCE	160 HOURS
	PARTICLE SEARCH #411	GARELICK	250 HOURS
	PARTICLE SEARCH #413	GARELICK	150 HOURS
	PARTICLE SEARCH #439	GARELICK	400 HOURS
	HADRON JETS #395	SELOVE	450 HOURS
-M3	NEUTRON-NUCLEUS INELASTIC #438	JONES	200 HOURS
-M4	TEST K ZERO REGENERATION #226	TELEGDI	500 HOURS

AREA-BEAM		SPOKESPERSON	EXTENT OF APPROVAL
-M6	HADRON DISSOCIATION #396	GOULIANOS	600 HOURS
	BACKWARD SCATTERING #290	BAKER	900 HOURS
	ASSOCIATED PRODUCTION #99	DIEBOLD	500 HOURS
NA -NEUTRINO	15-FOOT NEUTRINO/H2 & NE #53A	BALTAY	100K PIX
	15-FOOT ANTI-NEUTRINO/H2&NE#172	BINGHAM	50K PIX
-MUON/HADRON	MUON #319	CHEN	500 HOURS
	MUON #398	ANDERSON	800 HOURS
-15-FT	15-FOOT PI- - P @ 350 #384	HUSON	50K PIX
	15-FOOT PI- - P @ 100 #429	MORRISON	50K PIX
-30-IN	30-INCH PI- - D @ 400 #338	MORIYASU	50K PIX
	30-INCH PBAR - P @ 30-60 #344	GUTAY	100K PIX
	30-INCH PBAR - D @ 100 #345	EKSPONG	100K PIX
	30-INCH PI+ & P - P @ 300 #277	BARNES	100K PIX
-OTHER	EMULSION/NEW PARTICLES #386	LORD	EMULSION EXPOSURE
PA -PE	PARTICLE SEARCH #400	PEOPLES	400 HOURS
-PC	MUON SEARCH #435	ADAIR	250 HOURS
ITA-C-O	PROTON-HELIUM SCATTERING #289	MALAMUD	700 HOURS
	NUCLEAR FRAGMENTS #442	TURKOT	400 HOURS

F. OTHER APPROVED EXPERIMENTS (25):

MA -M1	HADRON DISSOCIATION #272	FERBEL	600 HOURS
-M2	LAMBDA POLARIZATION #441	PONDROM	150 HOURS
	CHARGED HYPERON #97	LACH	400 HOURS
-M6	FORM FACTOR #446	ANKENBRANDT	500 HOURS
NA -NEUTRINO	15-FOOT NEUTRINO/D2 #151A	SNOW	100K PIX
	15-FOOT NEUTRINO/D2 #227	ENGELMANN	100K PIX
	15-FOOT ANTI-NEUTRINO/D2 #390	GARFINKEL	300K PIX
	NEUTRINO #356	BARISH	1,000 HOURS
	NEUTRINO #253	MO	1,000 HOURS
	15-FOOT NEUTRINO/H2 & NE #380	BALTAY	200K PIX
	15-FOOT ANTI-NEUTRINO/H2&NE#388	STEVENSON	700K PIX
-MUON/HADRON	DI-MUON #444	SMITH	400 HOURS
	MUON #203A	KERTH	500 HOURS
	MUON #391	KERTH	250 HOURS
-30-IN	30-INCH P - P @ 500 #207	ENGELMANN	50K PIX
-OTHER	DETECTOR DEVELOPMENT #206	PETERSON	200 HOURS
PA -PE	PHOTOPRODUCTION #401	GORMLEY	300 HOURS
	PHOTOPRODUCTION #152B	HEUSCH	350 HOURS
	PHI PHOTOPRODUCTION #263	CHEN	600 HOURS
	EMULSION/ELECTRONS @ HI E #340	DAKE	EMULSION EXPOSURE
	EMULSION/ELECTRONS @ >100 #399	GOLDEN	5 STACKS
-PC	PARTICLE SEARCH #312	BECKER	1,400 HOURS
-PW	PION INCLUSIVE #258	PIROUE	800 HOURS
	C-TEST #302	CESTER-REGGE	400 HOURS
	MULTIGAMMA #192	GUIRAGOSSIAN	400 HOURS

PROPOSALS BEING CONSIDERED (64):			EXTENT OF REQUEST
MA -M1	DETECTOR DEVELOPMENT #427	YUAN	50 HOURS
	PSI PRODUCTION #452	LUBATTI	400 HOURS
	MUON SEARCH #453	FRISCH	600 HOURS
-M2	K-SHORT REGENERATION #351	ARONSON	3,000 HOURS
	LAMBDA BETA DECAY #361	MARCH	300 HOURS
-M3	K+ PRODUCTION #449	ABOLINS	600 HOURS
-M4	INCLUSIVE K-SHORT #383	KOBRAK	500 HOURS
-M6	INELASTIC SCATTERING #165	RITSON	475 HOURS
	HADRON DISSOCIATION #317	EDELSTEIN	1,000 HOURS
	INCLUSIVE SCATTERING #451	BARTON	600 HOURS
NA -NEUTRINO	NEUTRINO #355	BARISH	1,400 HOURS
	15-FOOT NEUTRINO/H2&NE #389	TENNER	100K PIX
	15-FOOT NEUTRINO/H2 & NE #455	PETERSON	200K PIX
	15-FOOT NEUTRINO/H2 & NE #459	FRY	1,000K PIX
	15-FOOT NEUTRINO/H2 & NE #460	HUSON	200K PIX
-MUON/HADRON	PION DISSOCIATION #318	ASCOLI	400 HOURS
	MUON #348	WILSON	400 HOURS
	PARTICLE SEARCH #369	KIRK	700 HOURS
	DI-MUON #443	PILCHER	400 HOURS
	MUON #448	WILSON	300 HOURS
	TEST PARTICLE SEARCH #457	BRANDENBURG	100 HOURS
-15-FT	15-FOOT KO-P @ 20-60 #65	ALBRIGHT	250K PIX
	15-FOOT PI+ - D @ 40 #85	GUTAY	600K PIX
	15-FOOT K+ - P @ HI E #179	ERWIN	300K PIX
	15-FOOT P - P @ > OR = 300 #208	TAKIBAEV	75K PIX
	15-FOOT SIGMA- - P @ 50-200#214	RUSHBROOKE	275K PIX
	15-FOOT P - P&NE @ 100&400 #291	MANN	50K PIX
	15-FOOT NEUTRON - P@50-250 #303	SEIDL	100K PIX
	15-FOOT PI- - P/NE @ 485 #309	ERWIN	250K PIX
	15-FOOT K- - P @ 200 #333	RUSHBROOKE	100K PIX
	15-FOOT K+ - P @ 200 #334	RUSHBROOKE	100K PIX
	15-FOOT PI- -P/NE @ 200 #342	KENNEY	210K PIX
	15-FOOT SIGMA- - D @ 240 #432	FRIDMAN	60K PIX
-30-IN	30-INCH P&PI- - HI Z @ 200 #224	JONES	100K PIX
	30-INCH P - P&NE @100-500 #273	DREN	50K PIX
	30-INCH P&PI- -P&NE@100&400#298	MALHOTRA	15K PIX
	30-INCH PI- - HI Z @ 300 #304	WALKER	200K PIX
	30-INCH K+ - P @ 150 #375	RUBIN	400K PIX
	30-INCH K- - P @ 150 #376	LUDLAM	500K PIX
	30-INCH PI- - P @ 300 #377	HAFEN	200K PIX
	30-INCH PI- - P @ 75 #378	YAMAMOTO	200K PIX
	30-INCH PBAR - P@160 OR 200#392	NEALE	100K PIX
	30-INCH PI- - P @ 150 #393	PLESS	1,000K PIX
	30-INCH PBAR - P @ 100 #394	WHITMORE	2,000K PIX
	30-INCH PI+ - P @ 250 #407	BUGG	300K PIX
	30-INCH PBAR - P @ 75 #408	PLANO	300K PIX
	30-INCH PI+ - P @ 75 #409	WATTS	200K PIX
	30-INCH K+&K- - P @ 75 #410	PEVSNER	1,000K PIX
	30-INCH PBAR - P&D @ 50&80 #422	FRIDMAN	450K PIX
	30-INCH PBAR - P @ 150 #447	HULSIZER	100K PIX
	30-INCH K+ - P @ 150 #464	GPARD	400K PIX
-OTHER	EMULSION/MUONS @ 50-100 #373	JAIN	EMULSION EXPOSURE
	EMULSION/MUONS @ 200 #424	WADA	EMULSION EXPOSURE
PA -PE	PHOTOPRODUCTION #450	CALDWELL	600 HOURS
	PHOTOPRODUCTION #458	LEE	700 HOURS
-PC	CHARGED HYPERON #353	ECKLUND	600 HOURS

AREA-BEAM		SPOKESPERSON	EXTENT OF REQUEST
	PARTICLE SEARCH #465	BECKER	500 HOURS
-PW	HADRON JETS #246	SELOVE	600 HOURS
	ELASTIC SCATTERING #301	GETTNER	1,000 HOURS
	DI-MUON #326	PIROUE	400 HOURS
	ELASTIC SCATTERING #347	WALKER	1,200 HOURS
	HADRON-NUCLEON SCATTERING #420	GUIRAGOSSIAN	1,100 HOURS
	ELECTROPRODUCTION #454	GUIRAGOSSIAN	1,500 HOURS
	NUCLEAR FRAGMENTS #466	KAUFMAN	500 HOURS

RESEARCH ACTIVITIES DURING DECEMBER 1975

Operation of the accelerator and progress on the high energy physics research program throughout December can best be described as erratic. A beam instability developed in the main ring early in the month, causing high beam losses during acceleration and particularly during extraction. This problem was not understood, eluded extensive investigation and careful studies, and still plagued operations at month's end. Changes were eventually made in the magnet ramp which improved the losses, but necessitated a 15% reduction in pulse repetition rate. In response to a Proton Area research program requirement, the normal 400-GeV cycle was changed about mid-December to provide both 200- and 400-GeV beam spill using a front porch; operation with this cycle was unstable and was changed several times in attempts to resolve the poor operation. The Sunday before Christmas one of the main-ring feeder cables faulted, requiring excavation and extensive splicing, thereby suspending further running until the 26th, following a scheduled 55-hour Christmas holiday standby period.

Following a difficult startup period, which lasted over three days, the high energy physics research program was resumed without the front porch, and continued into the New Year. In addition to its erratic operation, the overall reliability of the accelerator during December was below that achieved during any month since the inauguration of 400-GeV operation last July, namely 322 hours of beam delivered during the 588 hours scheduled, 55%. On the other hand, most operation during this period was at intensities above 1.3×10^{13} protons per pulse, and in fact a 400-GeV pulse of over

1.84×10^{13} protons was achieved on December 20. This is the highest intensity ever observed in the main ring at any energy.

In the Neutrino Area, the hydrogen-filled 15-foot bubble chamber was expanded twice each accelerator cycle for work on both the neutrino and hadron physics research programs. Fast spill was made available on the horn target for picture taking by Neutrino #45A, while pinged beam was targeted in the bypass for hadron pictures by 15' p-p@400-GeV #341. Running primarily in this double-pulse mode, a total of 46,722 neutrino and 33,774 hadron pictures were taken at the chamber during December, completing the commitment to Experiment #341. By the end of the month the bypass beam was being retuned for 300-GeV protons for use by Experiment #343. Simultaneously with horn and chamber operation, slow-spilled beam was used to produce a secondary hadron beam in the N1 line, tuned for 230 GeV/c for data collection by Di-Muon #331 at the Muon Laboratory. This work was interrupted on December 9 for about $2\frac{1}{2}$ shifts to expose a total of 75 emulsion stacks at Lab E for 17 experimental groups. The N5 bypass beam, tuned for 400-GeV protons, was used for this exposure. Operation for Neutrino #45A and Di-Muon #331 experiments was again suspended at mid-month to permit a one-week run in the Muon Laboratory to complete Particle Search #382. High-intensity slow-spill beam was directed onto the horn target to produce muons in the N1 beam for the exposure of 24 emulsion stacks. At the same time, two pinged-beam pulses were set up to permit the taking of two hadron pictures per accelerator cycle in the 15-foot chamber. Throughout the month Tachyon Monopole #202 collected cosmic ray data in their apparatus using the 15-foot chamber fringe magnetic field.

The Proton Area research program involved beam use by three experimental groups. Photoproduction #87A, running in Proton-East, completed the data collection phase of their experiment just prior to the Christmas holiday break. The P-East line has been off since then for the installation of equipment for Particle Search #300/#325. The installation of Di-Lepton #288 in Proton-Central was essentially completed the first week in December. After another week of equipment tests and tuneup activity the group began and has continued with serious data taking work using both the 200 and 400 GeV beam spill when available. Equipment installation for Particle Production #284 was also completed during the first few days of the month and after several days of checkout and tuneup they too collected data using the beam at both 200 and 400 GeV.

Eleven experimenter groups participated in the research program at the Meson Area. Particle Search #357 ran in a solid data-taking mode through the entire month, with Neutral Hyperon #8 set up behind them also collecting data during the first three weeks. Particle Search #397 ran two days in the M3 beam to complete a short preliminary run after which Neutron Elastic Scattering #248 assumed control and started tuneup of the beam and their apparatus. This group took data using available beam during the last three weeks of December. In the M6 beam, Inclusive Scattering #118A completed a successful tuneup and preliminary data run using the single-arm spectrometer. Polarized Scattering #61 used the M1 beam for one shift to complete a set up and preliminary data run before turning the beam over to Hadron Jets #260. The latter group used the multiparticle spectrometer branch of the beam for about three weeks of setup and equipment testing work in preparation for data taking. Hadron Jets #236A also used beam for three weeks of setup and testing but was forced to suspend further running before Christmas because of electronics trouble in their proportional wire chamber system. Similarly, K^o Regeneration #425 spent the month doing apparatus tuneup but refrigerator and cold leak trouble prevented full operation of the experiment. The Hadron Jets #395 group continued to perform tests on their calorimeter modules and phototubes using both the M5 test beam and the M1 beamline, while Emulsion #371 exposed two Lexan stacks in the M2 proton beam.

The Internal Target Area program was once again mainly one of equipment installation and engineering tests. Proton-Proton Inelastic #321 installed additional pumping capability on the vacuum system to reduce backgrounds and conducted further experiments with their warm gas jets to refine the gas envelope. Proton-Nucleon Scattering #198A and Polarized Scattering #313 continued to work on the installation of cryogenics equipment and transfer lines for connecting the superconducting magnets on their spectrometer when the accelerator was not running. When beam was available, the upstream rotating target was used in the day and evening shifts to check out the operation of their detectors.

Reported by H. Allen

FACILITY UTILIZATION SUMMARY--DECEMBER 1975

I. Summary of Accelerator Operations

		Hours	
A.	Accelerator use for physics research		
	Accelerator physics research	48.7	
	High energy physics research	321.8	
	Research during other use	(50.4)	
	Subtotal		370.5
B.	Other activities		
	Accelerator setup and tuning to experimental areas	18.1	
	Programmed interruption	44.7	
	Unscheduled interruption	255.7	
	Subtotal		318.5
C.	Unmanned time (Christmas holiday)	55.0	55.0
	Total		744.0

II. Summaries of High Energy Physics Research Use

		# of Expts.	Hours	Results
A.	Counter experiments	20	2356.0	+24 tagged emulsion stacks
B.	Bubble chamber experiments	3	293.8	80,496 pictures
C.	Emulsion experiments	18	10.4	77 stacks
D.	Special target experiments	-	-	-
E.	Test experiments	1	61.5	Calorimeter tests
F.	Engineering studies and tests	1	4.0	15' bkgnd. tests
G.	Other beam use	-	30.4	-
		43	2756.1	22 expts. completed

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

A.	Beam accelerated in main ring	Total		1.219
B.	Beam delivered to experimental areas			
	Proton Area			
	@200 GeV	0.005		
	@400 GeV	0.110		
			0.115	
	Neutrino Area			
	Slow spill	0.273		
	Fast spill	0.474		
			0.747	
	Meson Area		0.206	
		Total		1.068

IV. Beam Utilization by Experiment

	Hours	
A. Meson Area		
Neutral Hyperon # 8	111.3	Data (parasitic running)
Polarized Scattering # 61	9.0	Setup & tuning
Inclusive Scattering # 118A	127.8	Testing & tuning
Hadron Jets # 236A	202.3	Testing & tuning
Neutron Elastic Scattering # 248	197.5	Data
Hadron Jets # 260	173.7	Tests & tuning
Particle Search # 357	254.7	Data
Emulsions/Protons @300 GeV # 371	0.8	2 stacks Lexan (complete)
Hadron Jets # 395 Tests	61.5	Tests
Particle Search # 397	43.6	Setup & tests
K^o Regeneration # 425 Tests	226.6	Tests
B. Neutrino Area		
15' Neutrino/H_2 # 45A	181.3	46,722 pictures
Tachyon Monopole # 202	-	Cosmic ray data
Di-Muon # 331	97.5	Tests & data
15' p-p @400 GeV # 341	106.9	33,774 pictures (complete)
15' p-p @300 GeV # 343	5.6	Setup
Particle Search # 382	76.0	24 tagged stacks (complete)
Emulsions/Protons @400 GeV(17 expts) #238(9), #243(7), #245(1), #249(3), #251(3), #265(3), #279(3), #292(12), #336(2), #346(1), #385(1), #423(4), #428(14), #434(3), #461(6), #462(1), #463(2).	9.6	75 stacks (complete)
C. Proton Area		
Muon Search # 48	7.8	Data (complete)
Photoproduction # 87A	221.8	Data (complete)
Particle Production # 284	203.7	Tests & data
Di-Lepton # 288	170.9	Data
Particle Production # 300	2.0	Tests
D. Internal Target Area		
p-N Scattering # 198A	89.6	Setup & tests
Polarized Scattering # 313	84.6	Setup & tests
p-p Inelastic # 321	55.6	Tests
Total	2721.7	

MANUSCRIPTS AND NOTES PREPARED DURING NOVEMBER AND DECEMBER 1975

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

J. Whitmore et al. Experiment #2B	Study of the Approach to Scaling and Factorization in Proton Fragmentation into $\pi^{\pm}$ (Submitted to Phys. Lett. B)
G. Bunce et al. Experiment #8	Λ^0 Hyperon Polarization in Inclusive Production by 300 GeV Protons on Beryllium (Submitted to Phys. Rev. Lett.)
F. J. Sciulli Experiment #'s 21, 262, and 320	Highlights of Neutrino Physics: An Experimental Review (Invited talk presented at the APS Division of Particles and Fields Meeting, Seattle, August 27-29, 1975)
B. C. Barish Experiment #'s 21, 262, and 320	Search for New Interactions in High Energy Neutrino Collisions (Invited talk presented at the International Symposium on Lepton and Photon Interactions at High Energies, Stanford University, August 21-27, 1975)
V. Bartenev et al. Experiment #36	Measurement of the Real Part of the Proton-Proton Forward Scattering Amplitude from 80 to 280 GeV By Means of Silicon Position Sensitive Detectors (Submitted to Sov. J. Nucl. Phys.)
A. Sheng et al. Experiment #37A	Study of ρ^0 Production in High Multiplicity pp Interactions at 300 GeV/c (Submitted to Phys. Lett.)
J. P. Berge et al. Experiment #45	An Experimental Study of Inclusive Hadron Production in Deep Inelastic Neutrino Proton Scattering (FERMILAB-Pub-75/84-EXP; submitted to Phys. Rev. Lett.)
J. P. Berge et al. Experiment #45	Multiplicity Distributions in High Energy Neutrino Interactions (FERMILAB-Pub-75/85-EXP; submitted to Phys. Rev. Lett.)

J. P. Berge et al. Experiment #45	An Experimental Study of Inclusive Deep Inelastic Neutrino Proton Scattering (FERMILAB-Pub-75/86-EXP; submitted to Phys. Rev. Lett.)
J. P. Berge et al. Experiment #45	Inclusive Strange Particle Production by νp Interactions in the 10-200 GeV Region (FERMILAB-Pub-75/87-EXP; submitted to Phys. Rev. Lett.)
L. B. Leipuner et al. Experiment #48	Production of Prompt Muons in the Forward Direction by 400 GeV Proton Interactions (Submitted to Phys. Rev. Lett.)
F. E. Taylor et al. Experiment #63	An Analysis of Radial Scaling in Single Particle Inclusive Reactions (FERMILAB-Pub-75/90-EXP; submitted to Phys. Rev.)
R. A. Carrigan, Jr. et al. Experiment #76 (in part)	Search for Misplaced Magnetic Monopoles (FERMILAB-Pub-75/83-EXP)
J. H. Klems et al. Experiment #218	A Search for Charmed Particle Production in $\pi^- d$ Interactions at 200 GeV/c
K. Dziunikowska et al. Experiment #218	Multiplicity Distributions and Double Scattering Effects in $\pi^- d$ Interactions at 205 GeV
J. Biel et al. Experiment #305	Neutron-Nuclear Total Cross Sections Between 30 and 300 GeV/c (FERMILAB-Pub-75/89-EXP; submitted to Phys. Rev. Lett. Comments and Addenda)
J. Whitmore Experiment #311	Multiplicities and Inclusive and Exclusive Reactions at Fermilab Energies (Presented at the APS Division of Particles and Fields Meeting, Seattle, August 27-29, 1975)
J. H. Cobb et al. Experiment #327	The Ionisation Loss of Relativistic Charged Particles in Thin Gas Samples and Its Use for Particle Identification: I Theoretical Predictions (Submitted to Nucl. Instr. and Methods)
W. W. M. Allison Experiment #327	The Ionisation Loss of Relativistic Charged Particles in Thin Gas Samples and Its Use for Particle Identification: II Experimental Results (Submitted to Nucl. Instr. and Methods)

J. G. Branson et al. Experiment #331	Dimuon Production by 150 GeV/c π^+ and Protons with a Large-Acceptance Detector (Presented at the APS Division of Particles and Fields Meeting, Seattle, August 27-29, 1975)
K. J. Anderson et al. Experiment #331	Production of Muon Pairs by 150 GeV/c π^+ and Protons
D. Buchholz et al. Experiment #335	A Measurement of Direct Muon Production in the Forward Direction (FERMILAB-Pub-75/88-EXP; submitted to Phys. Rev. Lett.)
G. J. Blanar et al. Experiment #365	$\psi(3.1)$ Production by Pions and Protons at Fermilab (Presented by M. T. Ronan at the 1975 SLAC Summer Institute on Particle Physics)
G. J. Blanar et al. Experiment #365	Dimuon Production by Pions and Protons (Presented by R. Weinstein at the 1975 International Sympoisum on Lepton and Photon Interactions, Stanford University, August 21-27, 1975)
G. J. Blanar et al. Experiment #365	Dimuon Production by Pions and Protons at Fermilab (Presented by D. A. Garelick at the APS Division of Particles and Fields Meeting, Seattle, August 27-29, 1975)

Theoretical Physics

C. Quigg et al.	Rapidity Gap Distributions and Clustering in Multiparticle Production (FERMILAB-Pub-75/40-THY; submitted to Phys. Lett. B)
M. K. Gaillard et al.	Comment on Calculations of the $K_L \rightarrow \mu\bar{\mu}$ Decay Rate and the $K_L K_S$ Mass Difference in Gauge Theories (FERMILAB-Pub-75/68-THY; submitted to Phys. Rev. D)

General

E. Barsotti	Auxiliary/Master Microprocessor CAMAC Crate Controller Applications (Submitted to IEEE Nucl. Sci. Symposium, San Francisco, November 19-21, 1975)

Physics Note

S. C. Snowdon FN-284	Mechanical and Thermal Stresses in Doubler Dipole Magnets

DATES TO REMEMBER

February 5-6, 1976	Proposal Presentation Meeting.
February 20, 1976	Fermilab Bicentennial Lecture Series: William A. Powers, M. D., Division of Radiation Oncology, Washington University of St. Louis. No charge, but tickets are required and may be obtained in the Guest Office.
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).
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.
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).