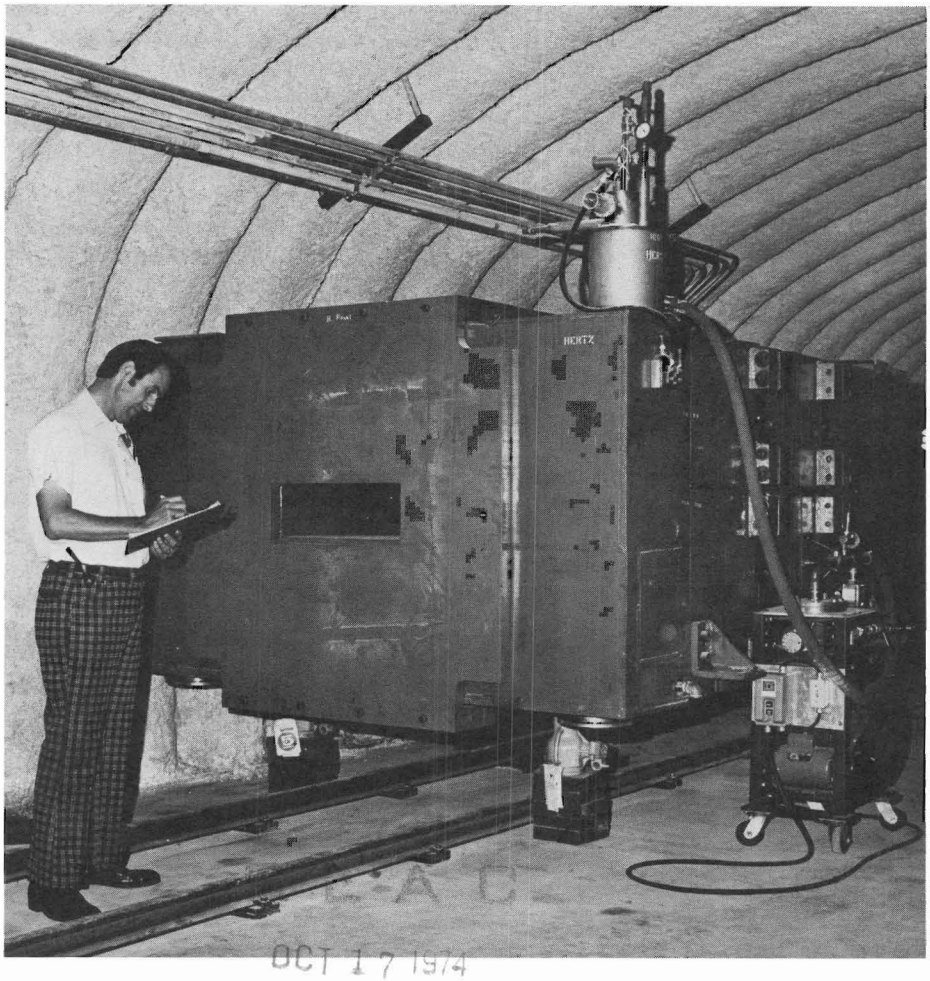
NALREP



Monthly Report of the Fermi National Accelerator Laboratory

September 1974

Fermi National Accelerator Laboratory

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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.

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THE COVER: "Hertz," one of Fermilab's two superconducting analysis magnets. The 6-ft long magnet, which has an 8 by 24-inch aperture, is installed in the M1 beam line in the Meson Area for use by Form Factor #216. H. L. Hart, of the Research Services Department, is shown here monitoring the cool-down.

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CONTENTS September 1974

"AVIS" AND "HERTZ": THE SUPERCONDUCTING ANALYSIS MAGNETS

The realization that the cost of electrical energy is a substantial fraction of the annual Laboratory budget has led various groups at Fermilab to consider using superconducting magnets as replacements for power-hungry "conventional" magnets. The potential now exists to build reliable superconducting magnets which are equivalent in capital cost to conventional magnets, and require 10 per cent or less electrical power.

The phenomenon of superconductivity, first discovered by H. Kamerlingh Onnes in 1911, is at the heart of all such power-saving devices. Superconductivity is the loss of all electrical resistivity of certain metals, compounds, and alloys at low temperatures and magnetic fields. The temperature is below 22°K for all known superconducting materials, and approximately 11°K for the niobium-titanium alloy which is most commonly used. Magnets, which are only one of a number of practical applications of superconductivity, are usually cooled by immersing the coil in a bath of liquid helium at its normal boiling point of 4.2°K.

Two superconducting versions of a well known analysis magnet (BM 109, to use the ANL designation) have been designed and built by the Research Services Department, and are now installed in the Meson Area. They have nicknamed "Avis" and "Hertz." The basic difference between these magnets and conventional ones is that a superconducting coil has been substituted for the usual copper coils. The characteristics of these superconducting magnets are as follows:

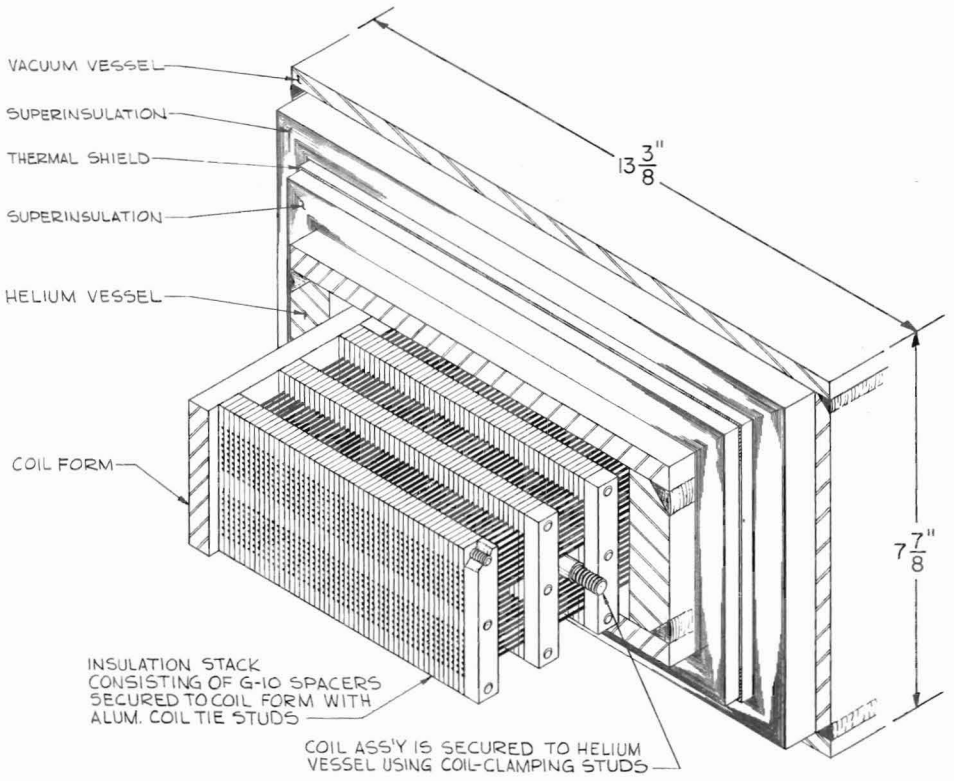
Aperture size: 24-in. wide by 8-in. high by 72-in. long
Magnetic field: 18 kG
Magnetic field volume: 8 ft^3
Stored energy at 18 kG: 600 kJ.

The basic design requirement was to reduce the overall power usage to as low a level as possible within the size constraints of an existing iron design. A secondary consideration was to provide a magnet with operating ease and reliability comparable to a similar conventional magnet, at approximately the same cost. A prototype magnet was built and operated in 1972. Further refinements based on fabrication and operating experience were incorporated into a subsequent design. The niobium-titanium coil used for Avis and Hertz is shown in cross section on page 3.

The helium cryostat or containment vessel itself conveys the horizontal electromagnetic forces, so only vertical and misalignment forces are supported to room temperature through insulating columns of low thermal conductance. A liquid nitrogen-cooled thermal shield and a high vacuum are used in the cryostat to reduce the heat flux into the 4.2°K region. A cut-away corner of the cryostat is shown on page 5.

The magnet iron is essentially identical with that used with copper coils. It is approximately 8 ft wide, 8 ft long, and 8 ft tall, and weighs nearly 50 tons.

Hertz and Avis were extensively tested before installation in the Meson Area. The electrical circuit used is shown on page 4. Avis ran continuously for over 2000 hours at full field, liquid helium and nitrogen being added as required while the magnet was energized. Hertz ran for over 1100 hours. The observed helium consumption for each magnet during this time was 2 liters per hour. In addition, 1 liter of liquid nitrogen was required per hour.

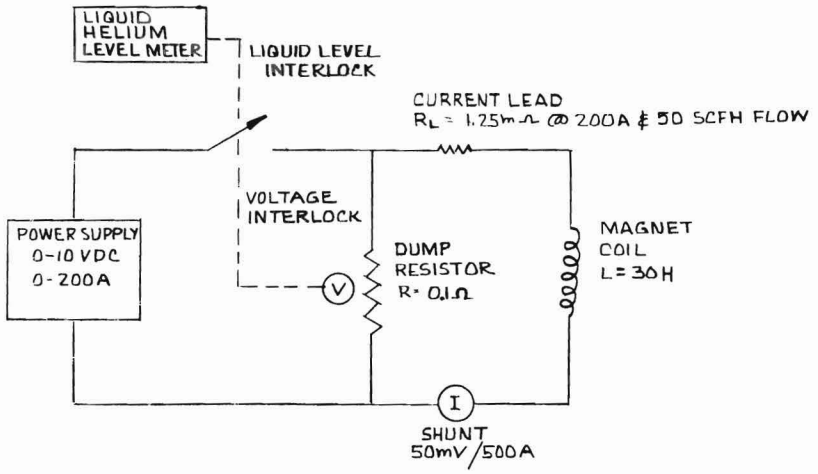


The superconducting coil, which is made of 0.04-inch diameter niobium-titanium/copper composite wire, with an operating current of 200 A. The G-10 spacers locate the wires, allow liquid helium penetration, and provide the load path for electromagnetic forces.

The ac power requirements for each magnet were as follows:

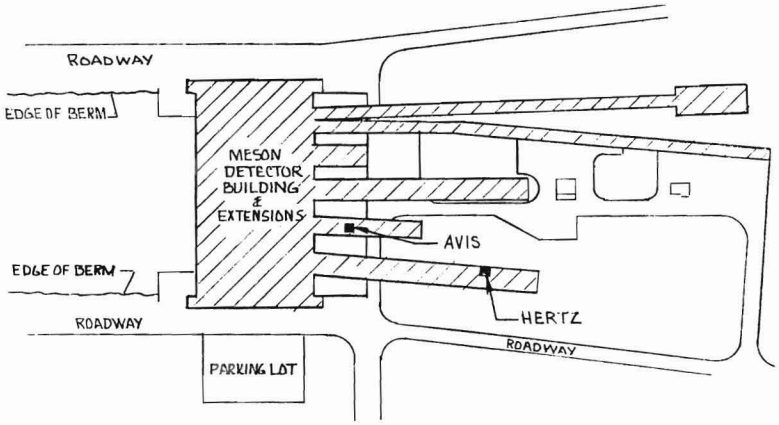
Power supply power consumption:	4 kW
Helium liquefier (to produce 2 liter per hr):	5 kW
Total power required:	9 kW

A BM 109 magnet with conventional copper coils required 250 to 300 kW of electrical power. Therefore, even allowing for the power for the helium liquefier, a superconducting magnet can be operated at full field for less than 5 per cent of the power of its conventional counterpart.

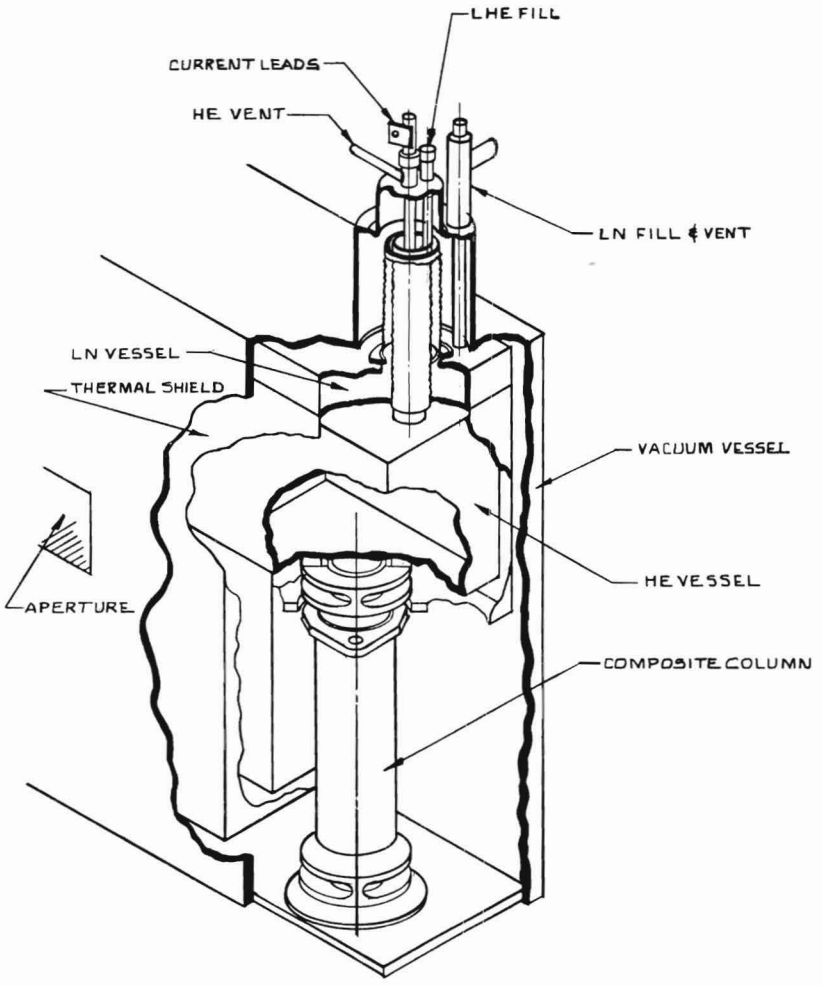


The electrical circuit for the magnets, having an L/R time constant of 300 sec. Therefore, the magnet requires about 30 minutes to reach 99.75% of the final field. The dc switch is interlocked by liquid helium level and by coil voltage, the magnet being shut down when unsatisfactory conditions occur.

Avis, located on the M2 beam line in the Meson Area, is being used by the Neutral Hyperon #8 experimental group, and Hertz is in the M1 beam line, ready for use by Form Factor #216. The locations of both magnets are shown below.



The locations of Avis and Hertz in the Meson Area beam lines.



The magnet cryostat, showing helium, nitrogen, and vacuum vessels. The composite columns use epoxy-fiberglass tubes with a thermal intercept for a load capability of about 30,000 lbs with a thermal conductance of 4.2°K of less than 0.1 W. Current leads are cooled by the returning helium gas.

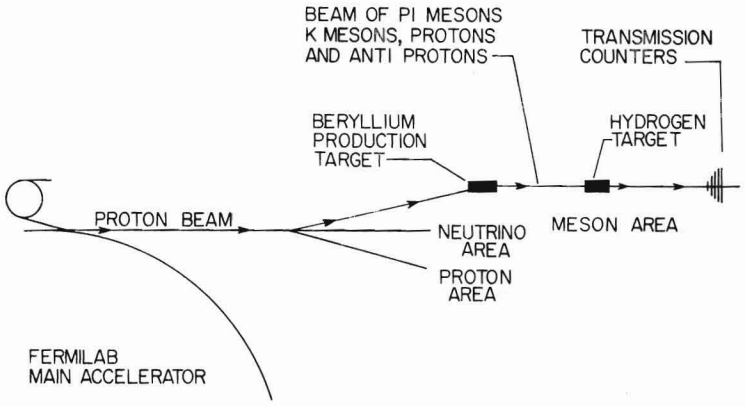
Other superconducting analysis magnets are presently under construction by the Research Services Department. They include a multiparticle spectrometer magnet for Multiparticle #110, and a recoil arm spectrometer magnet for Polarized Scattering #61. These magnets are scheduled for completion by the end of this year. Two additional superconducting magnets have been started for delivery in 1975.

Reported by R. W. Fast

TOTAL CROSS SECTIONS MEASURED IN THE MESON AREA

The first results from Total Cross Section #104 were presented at the XVII International Conference on High Energy Physics held in London this summer. These results show that the total cross sections for various incident particles systematically rise as the beam energy is raised from 50 to 200 GeV. This phenomenon was first suggested in 1971 by scientists working with a beam of positively charged K-mesons at energies up to 55 GeV at the Serpukhov accelerator. In 1973, western European scientists working at CERN announced an increase in proton-proton cross sections. Although the CERN scientists were limited to the study of proton-proton collisions by the nature of the Intersecting Storage Rings, in which two oppositely-directed beams of protons collide with each other, they were able to reach a record energy equivalent to that in a fixed-target accelerator of 2000 GeV.

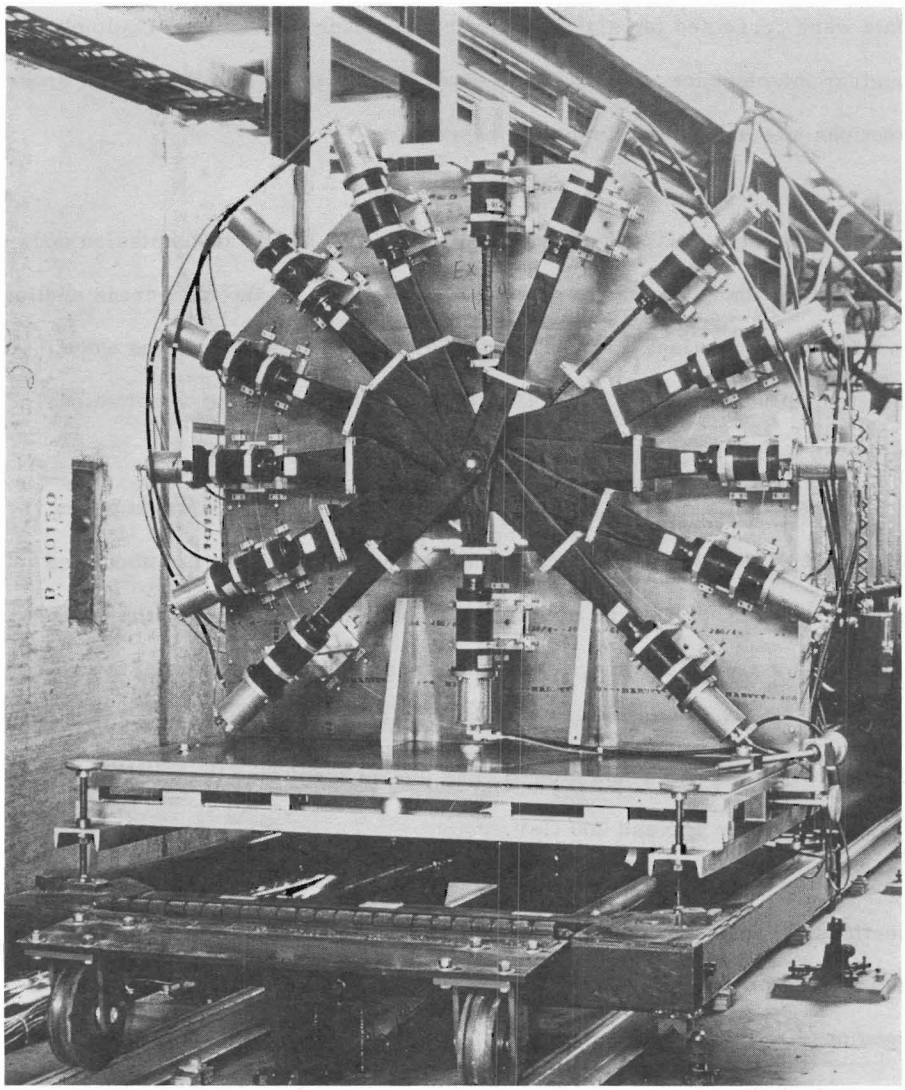
Experiment #104, which was done in the Meson Area, used a good geometry transmission technique to yield precise measurements for the many different particles available in the Fermilab secondary beams. Total cross sections were measured with beams of positive and negative pions, positive and negative K-mesons, protons and antiprotons, on both protons and deuterons. The layout of the apparatus is shown on page 8. The incident beam was defined by scintillation counters; the particles were identified by differential gas Cerenkov counters. The particles then passed through a target consisting of 3 meters of liquid hydrogen, or 3 meters of liquid deuterium, or 3 meters of vacuum. These targets were surrounded by a common outer jacket of liquid hydrogen for temperature stability. Hydrogen and deuterium densities



Layout of Total Cross Section #104.

were determined by continuously monitoring the vapor pressure in the outer jacket. Variations in density were less than 0.07% throughout the experiment. The three targets were interchanged remotely at least once an hour, and a minimum of four cycles of the targets were taken at each momentum.

The transmission of particles through the targets was measured by a set of twelve scintillation counters of different diameters, with eleven independent channels being formed by coincidences between pairs of adjacent counters to minimize accidental counts. These counters were mounted on a movable cart, and were positioned such that for each momentum the counters accepted the same range of four momentum transfer squared, $|t|$, extending from 0.008 $(GeV/c)^2$ for the smallest channel up to 0.08 $(GeV/c)^2$ for the largest. For each momentum, the particle beam was tuned to focus at the transmission counters.



The detector for Total Cross Section #104, showing scintillation counters mounted on train in the Meson Area.

The experiment was monitored on-line by a PDP-15 computer. The data were corrected for single Coulomb scattering (< 0.1%) and Coulomb-nuclear interference (< 0.3%). The extrapolation to t = 0 of the partial cross sections was carried out using the expression

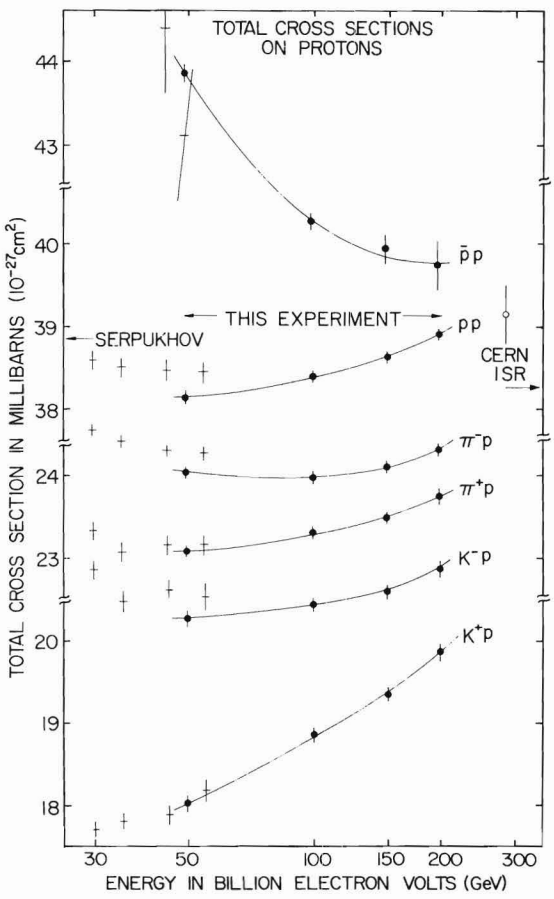
$$\sigma_i = \sigma_T \exp \{At_i + Bt_i^2 + Ct_i^3\},$$

where σ_i is the partial cross section measured by the i^{th} transmission counter combination subtending a maximum $|t_i|$, and σ_T is the total cross section. In some cases the last term was not required. The extrapolations were carried out using the 3rd through 10th transmission counter combinations, covering $0.012 \leq |t| \leq 0.062\ (\mathrm{GeV/c})^2$.

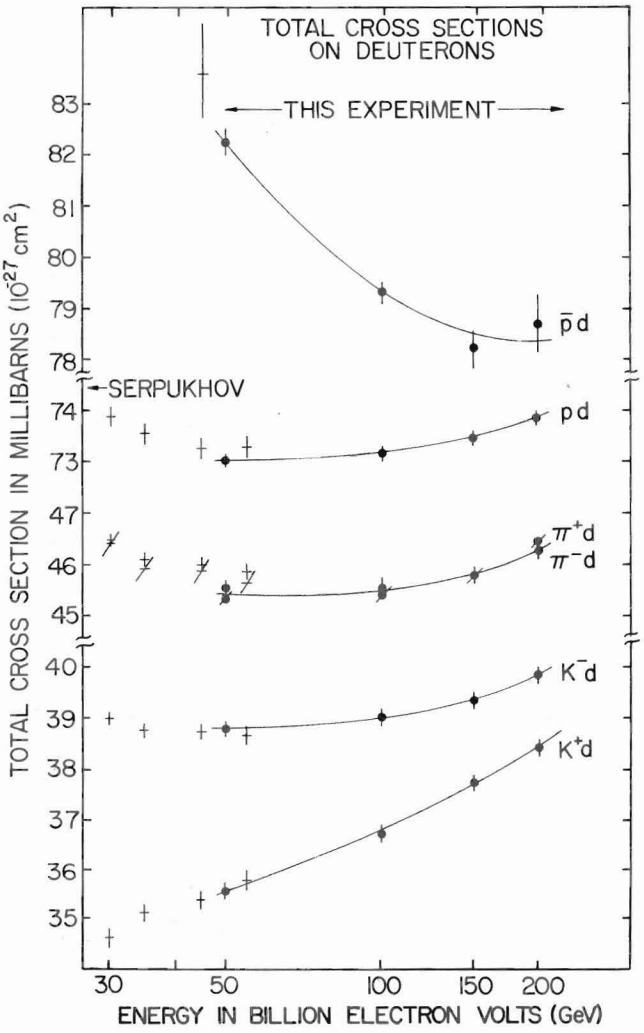
The results of the first part of this experiment are shown on pages 11, 12, and 13. These precise measurements, with an accuracy of about one part in 500, reveal that the effective size of both the proton and the neutron increase for five of the six probes when their energy is increased from 50 to 200 GeV. For the sixth, the antiproton, the rapid decrease in size previously observed below 50 GeV has slowed, and the apparent size becomes essentially constant between 150 and 200 GeV.

The similarities and intercomparisons of the behavior of the cross sections with the six probing particle beams indicate that a new simplicity of nature may be revealing itself at very high energies--a situation which has been predicted by several physicists.

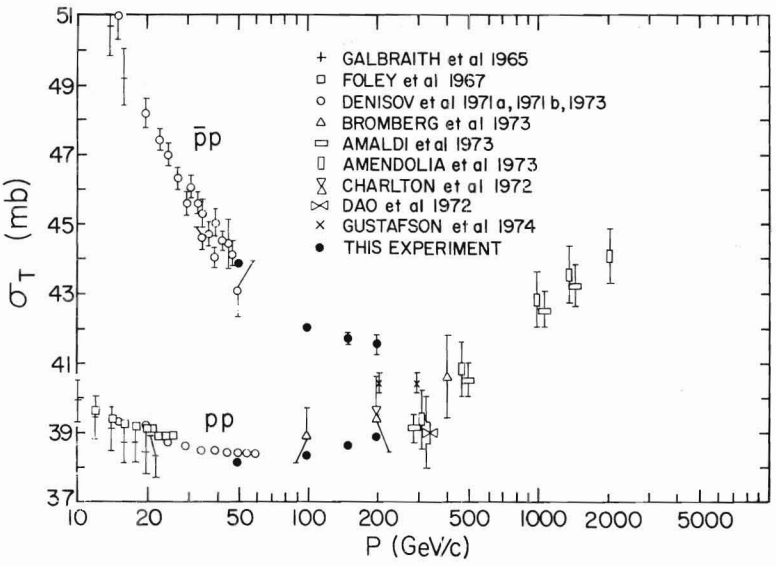
All of the particle-proton and antiparticle proton cross-section pairs uniformly approach each other in a way that is approximately proportional to the square root of their energy, as shown on page 13. The theorem that the



Total cross-section data from this experiment show a general rise with increasing energy for various incident particles on protons. Additional proton-proton cross-section measurements made at the CERN ISR lie off the figure to the right.



Total cross-section measurements on deuterons show the same general energy behavior as on protons. Only for incident antiprotons does the cross section fail to rise at this energy range; however, it does level off, perhaps in anticipation of rising at even higher energies. Since the deuteron consists of a proton and a neutron, the cross sections on free neutrons can be obtained by subtracting the cross sections on protons.



Total cross sections for pp and $\bar{p}p$. Momentum-dependent errors only are shown.

difference between a particle cross section and that of its antiparticle on the same target should approach zero at very high energies was first enunciated by the Russian theorist Isaak Ya. Pomeranchuk in 1958.

This experiment indicates that nuclear forces continue to be charge-symmetric at very high energies. The cross section for a charged pion on a proton is equal to that of the oppositely charged pion on a neutron. These data provide the "systematics" of the behavior of an entire class of interactions. The increase in the "size" of a proton or neutron with increasing energy appears to be a general and systematic property of strong interactions. The proton and neutron appear to have cross sections nearly equal to each

other for all of the probes. The differences between particle and antiparticle pairs seems to disappear at extremely high energies. Even the difference in cross sections between particles which do not have the same strangeness quantum number seems to disappear.

Those who participated in this work were: From Brookhaven National Laboratory - A. S. Carrol, I-H. Chiang, T. Kycia, K. K. Li, P. O. Mazur, P. M. Mockett, now at the University of Washington, D. C. Rahm.
From Fermi National Accelerator Laboratory - W. F. Baker, D. P. Eartly, G. Giacomelli, from the Institute of Physics, Padova, Italy; F. M. Koehler, K. P. Pretzl, now at the Max Planck Institute for Physics and Astrophysics in Munich, Germany; R. Rubinstein, A. A. Wehmann.
From The Rockefeller University - R. L. Cool, O. D. Fackler.

REPORT RECEIVED FROM THE USERS EXECUTIVE COMMITTEE

The Users Executive Committee acts as representatives of all Fermilab users. Such a broad mandate is exceedingly difficult to fulfill, and there is great concern among Committee members that we are not doing the job as well as it could be done. As a result, we hope to adopt a more activist role in the coming year. The basic problem, so it seems, is one of communication; we have pushed hard to improve matters by asking for NALREP, which is now viewed as the primary vehicle for the Committee to communicate to the users. While this channel is not perfect, we are striving constantly to improve it. The Laboratory has cooperated fully with our efforts. We will continue them, and invite all users to offer relevant suggestions or criticism.

Communication must be a two-way effort. In the coming year we hope to improve channels in the opposite direction; i.e., from the users to the Executive Committee (and thus to the Laboratory management). Precisely how to do so is now being explored. One suggestion is to divide the Executive Committee into subcommittees (perhaps only one person each) which specialize in a given area--computers, PREP, experimental areas, for example. Each subcommittee would collect, organize, and filter information for presentation to and action by the full Committee. Clearly, this role means more work for your Executive Committee, but we would hope it would lead to better physics for us all.

The Users Executive Committee considers a wide range of topics at each of its meetings. The following agenda was prepared for the September 19, 1974 meeting:

1. Report of the meeting with the URA Board of Trustees--D. Drickey
2. Proposed ballot and constitution change--L. Hand
3. Proposed changes in Procedures for Experimenters booklet--M. L. Stevenson
4. Report from the Recreation Committee--W. Lee
5. Report from the Users Office--C. M. Sazama
6. Panel discussion by young users (11:00 a.m.)
   - J. Yoh — Lepton #70
   - R. Imlay — Neutrino #1A
   - P. Shepard — Form Factor #216
7. Discussion with A. Brenner concerning 6600 behavior and Laboratory servicing of DEC computers
8. Discussion with J. R. Sanford (including report on NALREP)
9. Discussion of subcommittee structure of Users Executive Committee

Because of NALREP deadlines, action taken on these items cannot be reported until the next issue.

At the July 24 meeting, the Executive Committee took significant action on an important question by passing this resolution:

> The Fermilab Users Organization objects in the strongest possible terms to the AEC policy requiring prior approval of visits of Soviet bloc scientists to Fermilab. These scientists operate fully as members of a joint experimental team and as such must have the freedom to come to or to leave the Laboratory as the requirements of the experiment dictate. Any other policy is detrimental to the research carried on at the Laboratory. Furthermore, we find the spirit of this policy objectionable and contrary to the principles of science and to the stated national policy of scientific cooperation in high energy physics.
>
> We therefore propose that the contract with the AEC be changed so that Fermilab may adopt a policy of free access to the Laboratory for all scientists.

The resolution was given to both R. R. Wilson and the URA Board of Trustees with the request that they present it to the appropriate officials in Washington.

Reported by D. Drickey
Chairman,
Users Executive Committee

NOTES AND ANNOUNCEMENTS

SINGLE-ARM SPECTROMETER WORKSHOP PLANS COMPLETED. . .

The future experimental program for the Single-Arm Spectrometer (SAS) facility will be discussed at a workshop scheduled for October 25, 1974. The meeting will be held in the Curia II conference room (second floor, west, Central Laboratory) beginning at 9 a.m. Representatives of groups having proposals or letters of intent involving the use of this facility and any other interested persons are invited to participate.

Although the agenda for the workshop is still tentative, plans are to begin with a discussion of the current SAS configuration and a review of future plans for the Meson Area as they relate to the SAS program. Pertinent results from Elastic Scattering #96 will be described. Representatives of each group which has submitted a proposal will then be asked to present their ideas (approximately one-half hour per proposal). Proposals which have been received include:

Short Title	Spokesman
Associated Production #99	R. Diebold
Form Factor #101	B. Gittelman
Inclusive Scattering #118	J. Friedman
Backward Scattering #165	D. Ritson

A panel, consisting of W. Lee, T. O'Halloran (Chairman), P. Piroué, J. Sandweiss, and S. Treiman, will formulate recommendations for presentation to the Program Advisory Committee at their November meeting.

BUBBLE CHAMBER SUBCOMMITTEE TO MEET . . .

The PAC Bubble Chamber Subcommittee will meet on Monday and Tuesday, November 4 and 5. The primary objectives of their meeting will be to provide guidance to the Laboratory on the future of hadron physics in the 30-inch bubble chamber including hybrid systems. Proposals for the 30-inch chamber which have been deferred or not yet considered will be reviewed, and recommendations formulated. The hadron physics program for the 15-foot bubble chamber will also be discussed. The Subcommittee's recommendations will be presented to the Program Advisory Committee at the November meeting.

PROGRAM ADVISORY COMMITTEE MEETING SCHEDULED . . .

The fall meeting of the Fermilab Program Advisory Committee will be held Thursday through Saturday, November 14-16, 1974. The principal focus of the meeting will be further consideration of the muon and neutrino experimental programs. In addition, consideration will be given to the reports from the Di-Lepton Workshop, the Single-Arm Spectrometer Workshop, and the Bubble Chamber Subcommittee meeting. The deadline for submitting written material to be considered at the full PAC meeting is October 14, 1974.

POPAE WORKSHOP II PLANNED . . .

The physics and experimental uses of POPAE will be considered at a workshop to be held at the Laboratory in November. It is tentatively scheduled for Thursday through Saturday, November 7 to 9, 1974.

Although the program is still being planned, certain subjects have already been suggested. These include an examination of the possible

experiments which can be done using a 1000-GeV-on-1000-GeV storage ring facility, the suitability of the proposed storage ring configuration, and possible refinements to the design. For guidance, the storage ring configuration studied will be the one developed at the September workshop. In addition, examples of the types of apparatus needed for experimental work using POPAE and some feeling for the cost of doing experiments at the facility will also be considered. It is hoped that a report on these topics will be available for distribution to the high energy physics community by the end of the year.

Professor M. Goldberger, of Princeton University, who has been asked to serve as Chairman of the POPAE Advisory Committee, is helping in the organization and planning of the workshop. Among those who have already indicated their willingness to participate are V. Barger, H. Frisch, G. Giacomelli, L. Hand, L. Lederman, D. Nygren, J. Sandweiss, F. Sciulli, F. Shoemaker, S. Smith, M. Strovink, L. Sulak, S. Wojcicki, and C. N. Yang. Members of the Fermilab staff and others interested in attending the meetings should contact D. Edwards, Ext. 3485.

EXPERIMENTAL AREAS DESCRIPTION AVAILABLE . . .

A Fermilab booklet, Design Description of the External Experimental Areas, has been prepared by the Research Division. It is intended as a general reference, as well as a guide for experimenters in planning for experiments at the Laboratory. An introductory chapter relates the experimental areas to the main accelerator, geographically and functionally. Separate chapters on the Meson, Neutrino and Proton Areas follow. The general characteristics of the areas are described, and information about

each beam line is included. The major facilities that currently exist in each area are also briefly noted.

The booklet was written by T. E. Toohig, with assistance from other members of the Research Division. In preparing it, the guiding consideration has been to provide a compendium which will be useful for experimenters. It is well documented with photographs and diagrams. Detailed references about the external experimental areas, as well as material concerning targeting, and shielding particle beams, are noted in an extensive bibliography. Anyone interested may examine these documents in the Research Division Office.

Copies of the booklet may be obtained from the Publications Office, Ext. 3278.

APPOINTMENTS . . .

Joyce L. Downs has joined the Laboratory as Manager of the Equal Employment Opportunity Office. She replaces Kennard Williams, who left Fermilab in June. Downs came to Illinois from Los Angeles, California, where she was a community labor relations specialist for the Economics Resources Corporation of Los Angeles. She is a graduate of Sacramento State College.

John A. McCook has joined the Laboratory as Associate Director for Administration. Among other duties in the Directors Office, he has assumed line responsibility for Business Administration, Personnel Services, and Site Services. McCook, who just retired from the Navy after 27 years of

service, was most recently assigned to the TRIDENT System Project for the Department of the Navy in Washington, D. C.

Roy Rubinstein, who has been serving as Associate Head of the Proton Department, formally took over as Head of that department on September 1. Rubinstein, who joined the Laboratory staff in October 1973, came to Fermilab from Brookhaven National Laboratory, where he was in the Experimental Planning and Support Division.

John Peoples, outgoing Department Head, will devote himself to his research commitments, namely Photoproduction #87A, Multigamma #192, and Hadron Dissociation #272. He has been assigned to the Physics Department, but will continue to assist the Research Division in coordination of construction projects.

FACILITY UTILIZATION SUMMARY -- AUGUST 1974

A major feature of the Fermilab research program for the month of August was a period of 200/300 GeV operation from the 9th through the 22nd. During this time, slow-spilled beam at both energies was delivered to the Proton Area, while the Meson Area received slow-spilled beam at 300 GeV. The Neutrino Area ran for the first week of the dichromatic operation, receiving slow-spilled beam followed by a fast spike for Neutrino #1A, also at 300 GeV. Although the operating efficiency during this run was only 57 per cent, considerable data were accumulated at both energies by Lepton #70 and Photoproduction #87A. Accelerator Operations personnel gained much valuable experience in operating with the dichromatic mode, which can be applied during future operation at 300/400 GeV. This run was sandwiched between two weeks of normal 300-GeV operation, during which beam was available for high energy physics research in all experimental areas.

Nine experimental groups were in various stages of data taking in the Meson Area during August. These included Elastic Scattering #7, #69A, and #96; Charge Exchange #111; K^{O} Regeneration #82; Neutron Backward Scattering #12; Photon Inclusive #268, Total Cross Section #104; and Missing Mass #51A. In addition, the Detector Development #229 and #261 groups used the beam to test their apparatus. The research program was interrupted for some 20 hours on August 20 and 21 when a splice in electrical feeder #31 failed.

The primary users in the Neutrino Area were Neutrino #45A, using the 15-ft hydrogen bubble chamber, and counter experiment Neutrino #1A.

During the first week of August Neutrino #45A took approximately 13,000 pictures, while Neutrino #1A ran parasitically behind the chamber. This bubble-chamber run was terminated on August 11, when in addition to some minor problems, a small leak developed in the main piston shaft seal.

Neutrino #1A continued to run until mid-month, when the area was shut down for five days so that the narrow-band target train could be installed. During this time, Neutrino #21A completed a series of tests with their calorimeter, the N-7 and N-3 hadron beam to the 30-inch bubble chamber was realigned and retuned, and the N-1 muon beam was tested as a possible hadron beam. Initial tests were begun by Neutrino #320 in their study of neutrino-induced neutral currents, and Monopole #76 used an irradiated plug on the horn target. Earlier, Engineering Run #234 took about 1900 pictures in the 15-foot chamber, and External Muon Idnetifier #155 ran parasitically to the two bubble chamber runs. Following the train change, Neutrino #320 completed tuning the train and their apparatus, using first slow- and then fast-spilled beam. In parallel with this work, the N-3 hadron beam and the deuterium-filled 30-inch bubble chamber were tuned in preparation for Experiment #209 which began at the month's end.

In Proton Central, Lepton #70 collected electron-positron data using 200- and 300-GeV incident beam, and then continued at 300 GeV with studies on muon production at a laboratory angle of 100 mrad. Meanwhile, Photo-production #87A took data using the high energy photon beam which results from attenuating the neutrons in the neutral beam when the 35- and 70-foot long deuterium filters located downstream from the Proton East target box

are filled. Some data on neutron production were also collected during periods when there were operational difficulties with the filters. Several short periods of downtime were scheduled around the accelerator maintenance and development days in August to implement installation work in preparation for the move to the new Proton Area operations center and the commissioning of the tagged photon facility.

In the Internal Target area, Proton-Proton Inelastic #221 completed the data-taking phase of their experiment early in the month and then carried out several test runs using the hydrogen gas jet during the last week. During the interval between, Proton-Deuteron Scattering #186 made several tests with the gas jet in preparation for a proposed experiment.

The summary of accelerator utilization for August is as follows:

I. Summary of Accelerator Operations

	Hours	
A. Accelerator use for physics research		
Accelerator physics research	60	
High energy physics research	357	
Research during other use	(67)	
Subtotal		417
B. Other activities		
Accelerator setup and tuning to experimental areas	5	
Scheduled interruption	64	
Unscheduled interruption	258	
Subtotal		327
C. Unmanned time		0
Total		744

II. Summaries of High Energy Physics Research Use

	# of Expts.	Hours	Results
A. Counter expts.	15	2321	2,321 hours
B. Bubble chamber expts.	2	64	30,777 pictures
C. Emulsion expts.	0	-	-
D. Special target expts.	1	113	1 target
E. Test expts.	4	153	153 hours, 1880 pictures
F. Engineering studies and tests	2	188	188 hours
G. Other beam use	-	4	4 hours
	24	2843	

III. Number of Protons Accelerated and Delivered ($\times 10^{17}$)

	@ 200/300 GeV	@ 300 GeV	Totals
A. Beam accelerated in main ring	5.20	7.06	12.26
B. Beam delivered to experimental areas			
Meson Area	2.03	4.18	6.21
Neutrino Area			
Main beam	0.66	2.30	2.96
Bubble chamber beam (estimated)	0.01	0.07	0.08
Proton Area	1.51	0.43	1.94
Totals	4.21	6.98	11.19

IV. Beam Utilization by Experiment

	Hours	Results
A. Meson Area		
Elastic Scattering #7	41.5	
Neutron Backward #12	250.1	
Missing Mass #51A	263.7	
K^{O} Regeneration #82	320.0	
Elastic Scattering #96	265.4	
Total Cross Section #104	155.6	
Charge Exchange #111	44.0	
Photon Inclusive #268	202.7	
Detector Development #229	57.2	
Detector Development #261	57.2	
B. Neutrino Area		
Neutrino #1A	93.7	
Neutrino #21A	11.0	
Neutrino #320	106.5	$\int p = 0.8 \times 10^{17}$ protons
Neutrino #45A	32.7	12,665 pictures
30-In. p-d @ 300 GeV #209	31.6	18,112 pictures
Engineering Run #234	12.6	1880 pictures
EMI Test #155	25.9	
Monopole #76	112.6	1 target (partial)
N-1 Hadron Beam Tests	77.4	
N-3 Hadron Beam Tests	110.9	
C. Proton Area		
Lepton #70	271.0	
Photoproduction #87A	171.0	
D. Internal Target Area		
Proton-Deuteron #186	47.9	
Proton-Proton #221	76.7	

MANUSCRIPTS SUBMITTED FOR PUBLICATION DURING JULY AND AUGUST 1974

Experimental Physics

F. T. Dao et al. NAL-Pub-74/38-EXP (Experiment 37A)	Inclusive Production of Neutrons in 300-GeV pp Interactions (Submitted to Phys. Rev.)
L. Voyvodic NAL-Conf-74/68-EXP (General Bubble Chamber)	Recent Fermilab Bubble Chamber Experiments and Results (Submitted to the Vth International Conference on Multiparticle Hadrodynamics, Leipzig, June 2-10, 1974)
B. C. Brown et al. NAL-Pub-74/70-EXP (Experiment 70)	Hadron Production at Large Transverse Momentum (Submitted to Phys. Rev. Letters)
B. C. Brown et al. NAL-Pub-74/71-EXP (Experiment 70)	Observation of Direct Production of Leptons in p-Be Collisions at 300 GeV (Submitted to Phys. Rev. Letters)
M. B. Einhorn FERMILAB-Conf-74/73-THY/EXP	An Introduction to Fermilab (Presented at the IX Balaton Symposium on Particle Physics, Balatonfüred, Hungary, June 12-18, 1974)
W. F. Baker et al. NAL-Pub-74/75-EXP (Experiment 104)	Total Cross Sections of p and $\bar{p}$ on Protons and Deuterons Between 50 and 200 GeV/c (Submitted to Phys. Rev. Letters)
W. F. Baker et al. NAL-Pub-74/76-EXP (Experiment 104)	Total Cross Sections of $\pi^{\pm}$ and $K^{\pm}$ on Protons and Deuterons Between 50 and 200 GeV/c (Submitted to Phys. Rev. Letters)
Y. Akimov et al. FERMILAB-Conf-74/79-THY/EXP (Experiment 186)	An Analysis of Proton-Deuteron Interactions at Fermilab Energies (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
V. A. Tsarev FERMILAB-Pub-74/80-THY/EXP (Experiment 186)	Nucleon Diffractive Dissociation I. Peripheral Model with Absorption (Submitted to Phys. Rev. D)
B. Aubert et al. (Experiment 1A)	Scaling Variable Distributions in High Energy Inelastic Neutrino Interactions (Submitted to Phys. Rev. Letters)

ANL-Iowa State-U. of Maryland-Michigan State U. -NAL Collaboration (Experiment 2B)	Charged Particle Correlations in 200 and 300 GeV/c pp Interactions (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
ANL-Iowa State-U. of Maryland-Michigan State U. -NAL Collaboration (Experiment 2B)	Gamma-Ray Multiplicity and Gamma-Charged Particle Correlations in 200 GeV/c pp Interactions (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
ANL-Iowa State-U. of Maryland-Michigan State U. -NAL Collaboration (Experiment 2B)	The NAL 30-Inch Bubble Chamber-Wide Gap Spark Chamber Hybrid System (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
W. T. Ko (Experiment 2B)	Summary of Particle Correlation Study Results (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
M. J. Longo et al. (Experiment 4)	Neutron-Proton Total Cross Sections from 40 to 280 GeV/c
K. Abe et al. (Experiment 67)	Missing Mass Spectra for $p + p \rightarrow p + X$ from 9 to 300 GeV/c (Submitted to Phys. Rev. Letters)
G. English et al. (Experiment 81)	Nuclear Reactions of Silver with 300-GeV Protons (Submitted to Phys. Rev. C)
J. W. Cronin et al. (Experiment 100)	Production of Hadrons with Large Transverse Momentum at 200, 300, and 400 GeV (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
J. W. Cronin et al. (Experiment 100)	Atomic Number Dependence of Hadron Production at Large Transverse Momentum in 300 GeV Proton-Nucleus Collisions (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
A. Gurtu et al. (Experiment 105)	Multiplicity in Proton-Nucleus Collisions at 200 GeV/c and Models of Multiparticle Production (Submitted to Pramana, Bangalore, India)

A. V. Barnes et al. (Experiment 111)	The Reaction $\pi^- p \rightarrow \pi^0 n$ Between 20 GeV/c and 100 GeV/c (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
O. L. Dahl et al. (Experiment 111)	The Reaction $\pi^- p \rightarrow \eta n$ Between 20 GeV/c and 100 GeV/c (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
J. Erwin et al. (Experiment 121A)	Single Pion Production in $\pi^+ p$ and pp Collisions at 100 GeV/c - A Detailed Test of Factorization
E. L. Berger et al. (Experiment 125)	Multiplicity Cross Sections for 100 GeV/c $\pi^- p$ Interactions (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
E. L. Berger et al. (Experiment 125)	The Reaction $\pi^- p \rightarrow \pi^- \pi^+ \pi^-$ at 100 GeV/c (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
E. L. Berger et al. (Experiment 125)	Production of K_s^0, Λ, and γ in 100 GeV/c $\pi^- p$ Interactions (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)
D. Bogert et al. (Experiment 137)	Pion and Nucleon Dissociation in $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ at 205 GeV/c (Submitted to Phys. Rev. Letters)
T. Ferbel et al. (Experiment 138)	Upper Limits on the Production of Particles with Charm Quantum Numbers in pp Collisions at 400 GeV/c (Presented as a comment at the Conf. on Experimental Meson Spectroscopy, Northeastern University, 1974)
D. Bintinger et al. (Experiment 184)	The Observation of Prompt Muons from Nucleon-Nucleon Interactions and a New Limit on the Production Cross Section for Massive Leptons (Submitted to the XVII International Conf. on High Energy Physics, London, July 1-10, 1974)

T. Ferbel et al. (Experiment 252)	Laboratory Angular Distributions for the Production of Charged Secondaries in Inelastic Proton-Proton Collisions at 102 GeV/c (Submitted to Nucl. Phys. B)
F. T. Dao et al.	Inclusive Single-Particle Distributions in $\bar{p}p$ Interactions at 14.75 GeV/c (Submitted to the International Conf. on Antinucleon-Nucleon Interactions, Liblice, Czechoslovakia, June 23-28, 1974)

Theoretical Physics

S. A. Jackson NAL-Pub-74/44-THY	A Multiperipheral Model with Continued Cross Channel Unitarity (Submitted to Annals of Physics)
B. W. Lee NAL-Conf-74/50-THY	Neutrino Physics - Theoretical Considerations (Presented at the IV International Conf. on Neutrino Physics and Astrophysics, Philadelphia, April 26-28, 1974)
J. B. Bronzan and J. W. Dash NAL-Pub-74/53-THY	Higher Order ϵ-Terms in the Renormalization Group Approach to Reggeon Field Theory (Submitted to Phys. Rev. Letters)
R. L. Sugar and A. R. White NAL-Pub-74/58-THY	Renormalization Group Sum Rules and the Construction of Massless Field Theories in 4-ϵ Dimensions (Submitted to Phys. Rev. D)
R. L. Sugar and A. R. White FERMILAB-Pub-74/59-THY	Construction of the Reggeon Calculus in 4-ϵ Dimensions (Submitted to Phys. Rev. D)
J. Bartels and R. Savit NAL-Pub-74/60-THY	Why We Don't See Fermion Parity Doublets (Submitted to Phys. Rev. Letters)
S. Meshkov and S. Peter Rosen FERMILAB-Pub-74/62-THY	Gauge Theories and M-Spin Conservation (Submitted to Phys. Rev. D)
S. L. Adler et al. FERMILAB-Pub-74/64-THY	Comments on Proposed Explanations for the μ-Mesic Atom X-Ray Discrepancy (Submitted to Phys. Rev. D)

DATES TO REMEMBER

October 1, 1974	Deadline for submission of material to be considered for inclusion in Procedures for Experimenters 1974. Users should direct their comments to M. L. Stevenson, c/o Users Office.
October 4, 1974	Deadline for receipt of material to be considered by PAC Bubble Chamber Subcommittee.
October 14, 1974	Deadline for receipt of material to be considered at the fall meeting of the Program Advisory Committee.
October 25, 1974	Single-Arm Spectrometer Workshop at Fermilab.
November 4-5, 1974	PAC Bubble Chamber Subcommittee Meeting.
November 14-16, 1974	Fall meeting of the Fermilab Program Advisory Committee.

For additional information about any of these meetings or deadlines, please contact T. H. Groves, Secretary of the Program Advisory Committee, (telephone 840-3211).