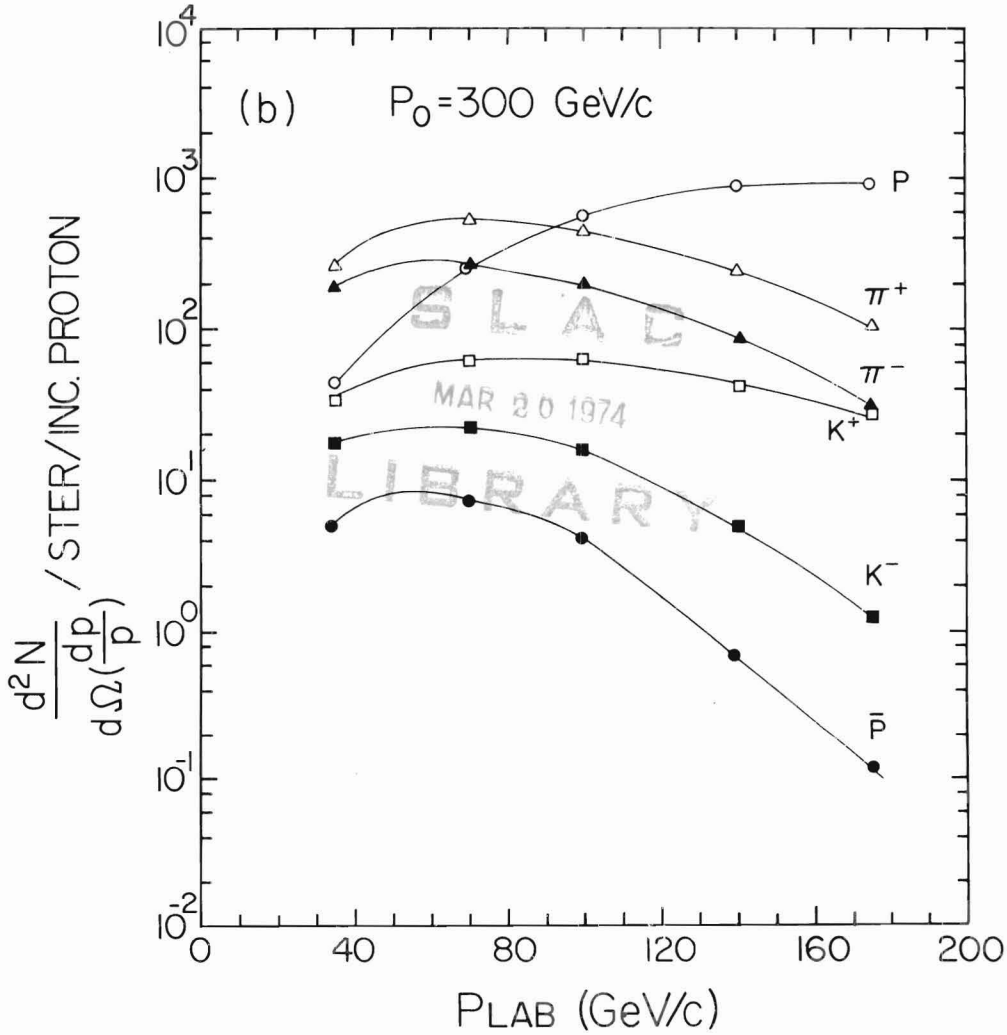
NALREP



SLAC
MAR 20 1974
LIBRARY

Monthly Report of the National Accelerator Laboratory February 1974

National Accelerator Laboratory

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

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

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

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

NAL-74/3 0090.01

THE COVER: Yields of pions (π^+ and π^-), kaons (K^+ and K^-), and protons (p and $\bar{p}$), at 3.6 mrad produced in a beryllium target by 300-GeV protons. Curves are shown to guide the eye. Studies of particle production are often made when beam lines are tuned for the first time, such as these data from the experimenters preparing for Total Cross Section #104.

Operated by Universities Research Association Inc. Under Contract with the United States Atomic Energy Commission

CONTENTS FEBRUARY 1974

Particle Survey in the M1 Beam Line 1

205 GeV/c π^-p Interactions--An Exploratory Experiment 9

Multipulsing of the 30-In. Bubble Chamber 15

Notes and Announcements 17

Laboratory Operations Center Moved. . .

Two-Body Kinematics. . .

Please Note. . .

Bus Service Resumed. . .

Facility Utilization Summary--January 1974 21

Proposals Received During January 1974 26

PARTICLE SURVEY IN THE M1 BEAM LINE

As part of the tune-up of the M1 beam line in the Meson Experimental Area in preparation for Total Cross Section #104, we have performed a survey of the yields of secondary particles produced by protons with laboratory momentum (P_0) of 200 and 300 GeV/c striking a beryllium target. The incident proton beam, typically 5×10^{11} per pulse, was focused to a spot about 1/16 in. in diameter on a beryllium bar 1/8-in. high by 1/8-in. wide and 12-in. long.

The M1 beam, which has a production angle of 3.6 mrad, was tuned to select the charge and momentum (between 23 and 197 GeV/c) of the secondary particles, and to transport them to our detectors. The final counter was located 1353 ft from the target.

A secondary emission monitor in the incident proton beam, together with a counter telescope focused on the production target and an ionization chamber, were used as monitors. Absolute calibrations were obtained using radiochemical means and a toroid current monitor. The fraction of the proton beam hitting the target was determined by sweeping the beam vertically across the target, and by moving the target horizontally through the beam. Effects of any beam halo were studied by comparing the yields from two targets with different cross-sectional areas. In order to minimize changes in the fraction of the beam hitting the target, absolute secondary fluxes were measured over as short a time period as possible.

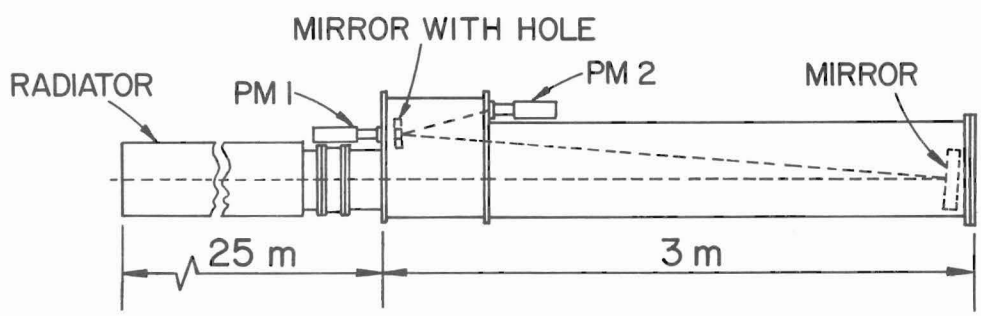
The secondary beam line was operated in two modes: nonfocusing and focusing. In the nonfocusing mode, only dipole magnets were energized in

order to measure the absolute total fluxes with well known defining apertures. Typically, these total flux measurements were made at eight secondary particle momenta for each beam polarity and each primary proton momentum. Four scintillation counters placed along the beam line were used in coincidence for these studies. The total acceptance was

$$\Delta\Omega\Delta\ p/p = 3.8 \times 10^{-11}\ \text{sr.}\%$$

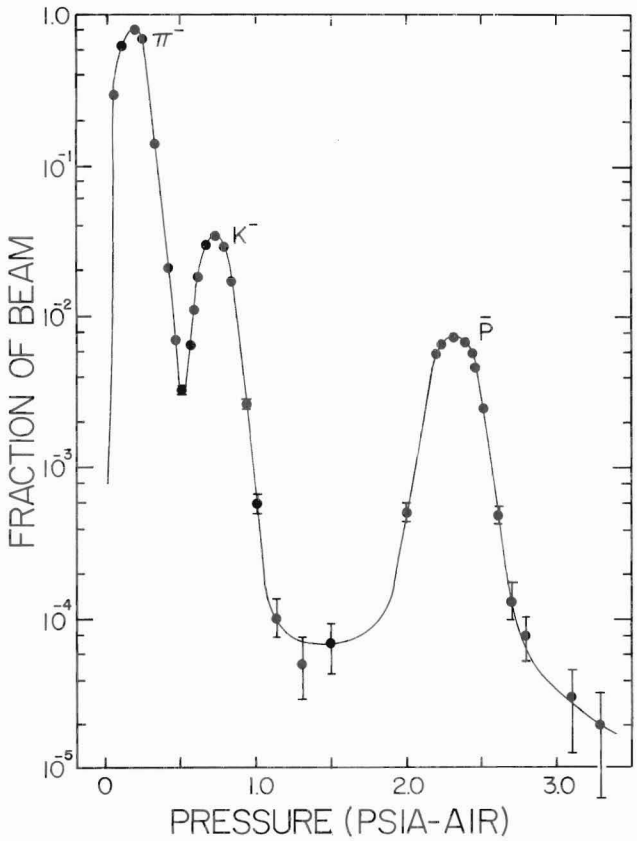
In the focusing mode, quadrupole magnets were also energized in order to increase the flux and to obtain an approximately parallel beam through two simple differential Cerenkov counters. One counter was used to measure relative abundances of pions, kaons, and protons, while the second was used to determine the efficiency of the first. The arrangement of the counters is shown below, and a typical pressure curve is shown on page 3.

The calculated solid angle for the M1 beam line in the focusing mode is 500 times larger than it is in the nonfocusing mode. However, the flux observed with the quadrupoles turned on did not correspond to this predicted increase. We believe that this discrepancy can be essentially eliminated by more carefully tuning the beam-line magnets.



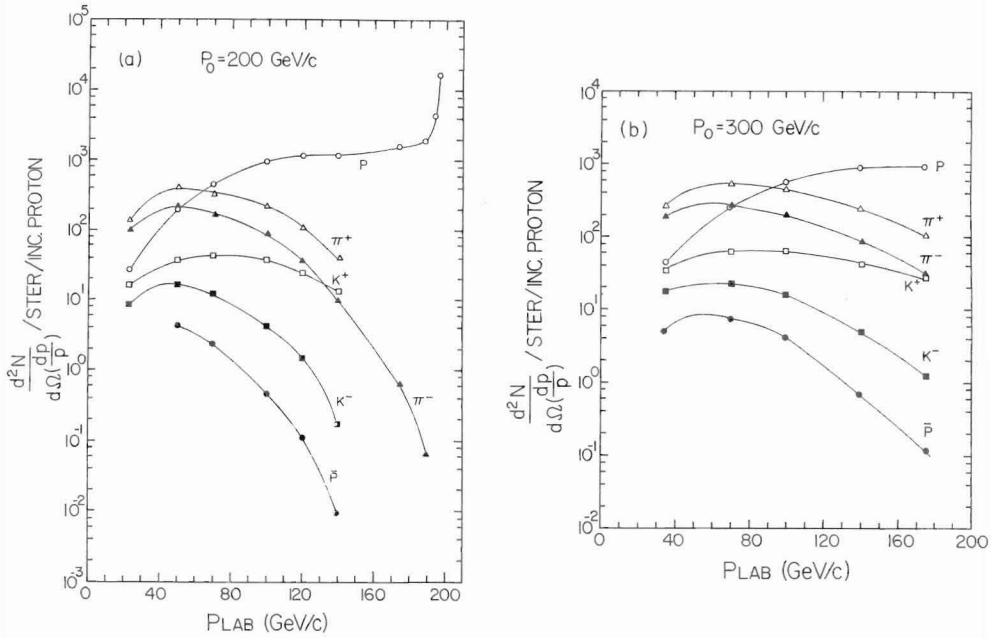
Arrangement of mirrors and photomultiplier tubes in the simple differential Cerenkov counters used for particle identification.

All data have been corrected for particle decays and for absorption by material in the beam line to obtain the yields at the downstream end of the beryllium target.



Ratio (Beam · PM1 · PM2)/Beam as a function of the pressure of the gas in the Cerenkov counter.

Point-to-point errors in our results are typically ±5%. There is an uncertainty in the 300-GeV/c fluxes of -20 to +10%, relative to those taken at 200 GeV/c. In addition, there is an absolute scale error estimated to be

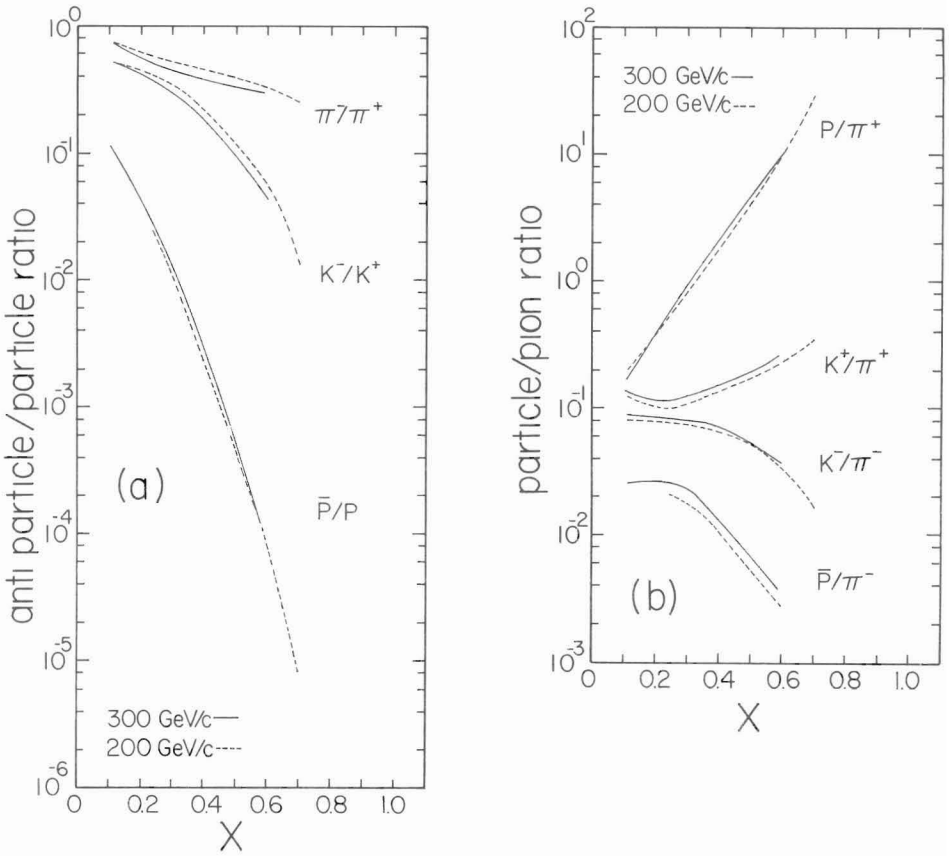


Particle yields at 3.6 mrad produced in a beryllium target by protons with primary momenta of (a) 200 GeV/c and (b) 300 GeV/c.

about ±30%. The uncertainty in the momentum of the secondary particles is approximately 1%.

Our results are summarized in the diagrams. We can compare our data (using a thick target) with the predictions of models for particle production. The Hagedorn-Ranft model (for a thin target) gives spectra in general agreement with the shapes of the curves above, but predicts absolute values in most cases too large by a factor of two to three.

The electron contamination in the secondary beam was measured using a 22-radiation length lead glass Cerenkov counter. The contamination varied from approximately 1% at 23 GeV/c to less than 0.1% above 100 GeV/c.



Ratios for various particle yields as functions of the variable X (P_{lab}/P_0). Particles were produced in the beryllium target by protons with primary momentum of either 200 or 300 GeV/c. The ratios show a strong dependence on X, but little P_0 dependence.

Muons were identified by their ability to penetrate a thick absorber (20 ft of iron); the muon contamination was between 1% and 5% of the total flux.

At P_0 = 300 GeV/c and P_{lab} = 70 GeV/c (positive), we used one Cerenkov counter to veto particles with masses up to and including that of the

proton while searching with the other counter for deuterons. We observed a deuteron signal at the level of d/total flux 4×10^{-5}. No attempt was made to observe antideuterons or higher mass particles.

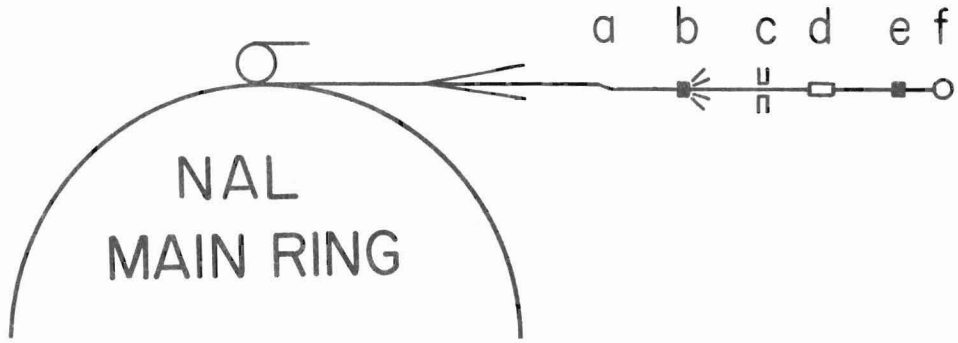
Those who participated in this work included W. F. Baker, A. S. Carroll, I.-H. Chiang, D. P. Eartley, O. Fackler, G. Giacomelli, P. Koehler, T. F. Kycia, K. K. Li, P. O. Mazur, P. M. Mockett, K. P. Pretzl, S. M. Pruss, D. C. Rahm, R. Rubinstein, and A. A. Wehmann.

205 GeV/c $\pi^- p$ INTERACTIONS--AN EXPLORATORY EXPERIMENT

Whenever a new accelerator begins operation at a higher energy than previously available, many exploratory experiments are done. Rather than studying one particular detail about a process, the process is looked at perhaps for the first time, and everything possible about it is studied. A bubble chamber is an ideal detection device for this type of work, as all events are recorded, and an enormous amount of information can be obtained. Some highlights of the first experiment using a pion beam in the bubble chamber, 30-in. Pion #137 (an NAL-Lawrence Berkeley Laboratory collaboration), are described in this article.

A 205-GeV/c π^- beam was sent to the 30-in. hydrogen bubble chamber via the hadron beam line in the Neutrino experimental area. Details of the experimental apparatus are given with the diagram on page 8. A total of 48,000 pictures were taken in two almost equal parts in January and March 1973.

The first step in the data analysis was the scanning of the film, largely done at the NAL Film Analysis Facility. Just about everything in the pictures was recorded: beam tracks, events on beam tracks, number of secondary prongs from an event, number of gamma conversions and neutral particle decays associated with an event, as well as several other phenomena. One exciting part of the scan was finding an event with 28 outgoing charged prongs. At the time, this was the highest multiplicity event ever found in a bubble chamber picture.

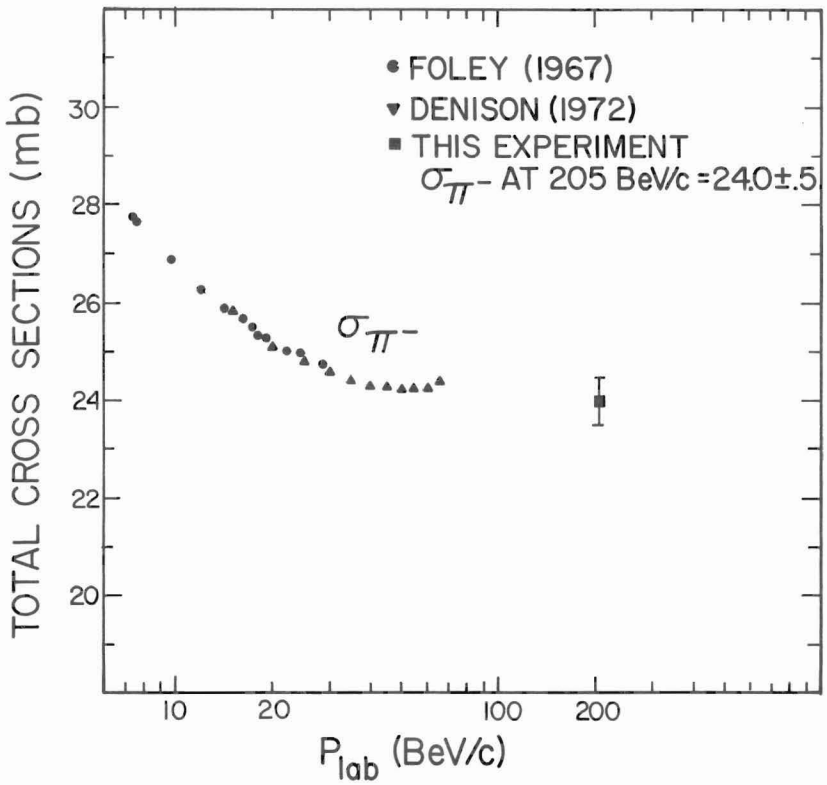


Locations of the beam elements for 30-in. Pion #137: At a, the start of the pulsed bypass line in Neuhall, the fast spill portion of the beam from the main accelerator was diverted to a separate line ending in the 30-in. hydrogen bubble chamber. Slow spill--flattop--had already been delivered to another experiment in the Neutrino Area; this switching was accomplished by three pulsed magnets obtained from CERN. Approximately 10^{11} protons/pulse at 303 GeV/c were focused on a target at b, in enclosure 100, producing a spray of secondary particles. After passing through a series of bending magnets, singly charged negative particles at 205 GeV/c were selected at a momentum slit located at c, in enclosure 103. A differential Cerenkov counter located at d, between enclosures 105 and 106, was used to determine the small percentages of K^- and $\bar{p}$ contamination in the beam (= 97% π^-). Muon contamination was measured by recording beam attenuation as the strongly interacting particles (π^-'s, K's, and $\bar{p}$'s) were absorbed in nine 1-ft blocks of aluminum, placed just upstream of the last bending magnet in enclosure 114, at e. At f, 2.7 km from the main ring, a beam of approximately 7 particles/pulse entered the bubble chamber, and a picture was taken.

Next the film was sent to Berkeley, where all of the two-, four-, six-, and eight-prong events, as well as some of the higher multiplicity events, were measured. All events with an identified outgoing proton were measured separately. Gamma conversions and neutral particle decays were then measured at NAL. Finally, six months after it was taken, the film was turned over to another experimental group, 30-in. Hybrid #2B, for further analysis.

Preliminary results on much of this analysis have been reported at conferences, and some final papers have been published. Work will continue for several months before all the data are analyzed and published. The first results usually reported from these exploratory experiments are the total cross section and the average charged particle multiplicity. Total cross-section data for $\pi^- p$ interactions up to 205 GeV/c are shown on page 10. Note that the data point at 205 GeV/c is about the same as the values recorded at Serpukhov energies (30 to 65 GeV/c). Although the errors are large enough that a rise in the total cross section, such as that reported for proton-proton cross sections, cannot be ruled out, thus far there is no such indication.

Theoretically, both the average charged particle multiplicity and higher momenta of the prong distribution are important in helping to differentiate among various production models. Experimentally, several corrections must be applied to the raw scanning data before these numbers can be calculated. Very accurate measurements of the two-prong sample were made to separate elastic and inelastic events. Another class of corrections involved accurately determining the prong count for each event. Occasionally the count



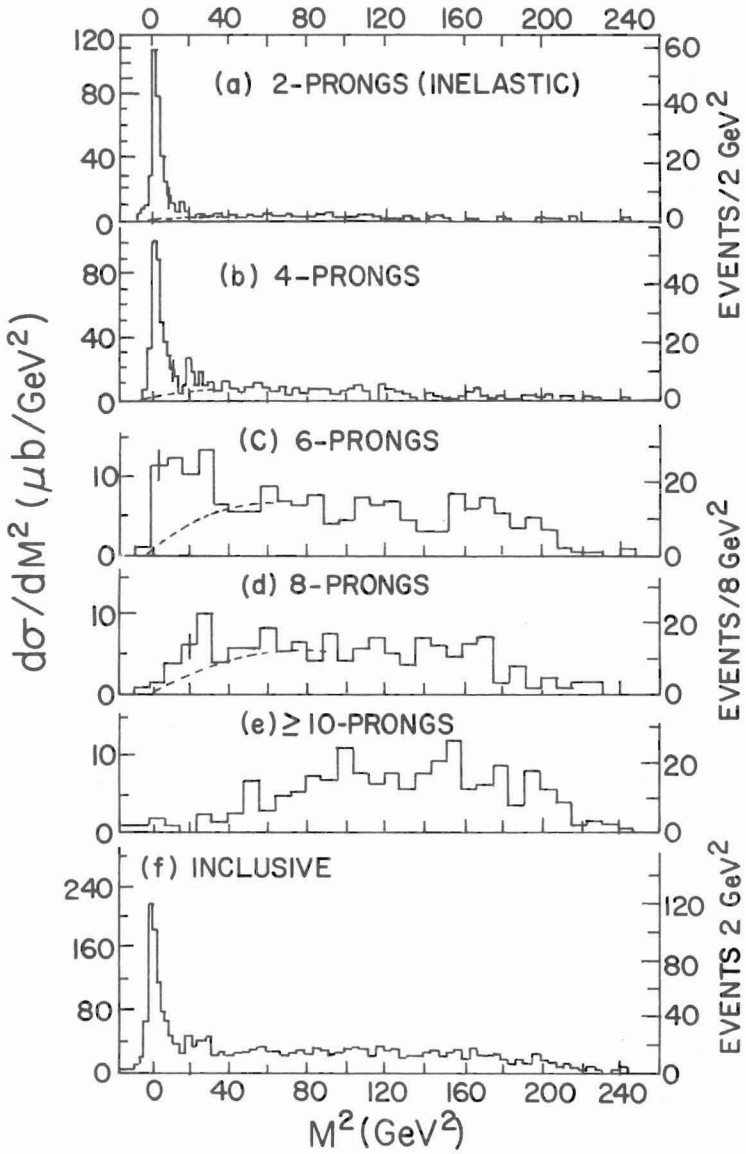
Total cross-section measurements for $\pi^- p$ interactions as a function of beam momentum.

obtained on the scan table would be wrong because the event vertex was "cluttered" up. For example, if a neutral particle decayed very close to the vertex, the decay products might be indistinguishable from the outgoing tracks. Corrections for these problems were generally made by studying the phenomena involved (like neutral-particle decays) far from the production vertex where they could be easily seen, and then extrapolating the results back to the production vertex. After all corrections, the average charged-particle multiplicity for this experiment was 8.02±0.12.

Earlier exploratory pp experiments had suggested that not one but at least two production mechanisms. [J. Lach and E. Malamud, Phys. Letters 44B, 474 (1973)] were responsible for the events produced at high energies. In order to study one of these mechanisms (diffraction), all events with an identified proton were measured, and the missing mass recoiling off the proton was calculated. The results as a function of the number of charged outgoing tracks in the event are shown on page 12. Note the excess of events (the diffractive peak) at low-missing mass squared above those expected from a shapeless background. Particularly in the lower multiplicity events, one sees evidence for diffractively produced events.

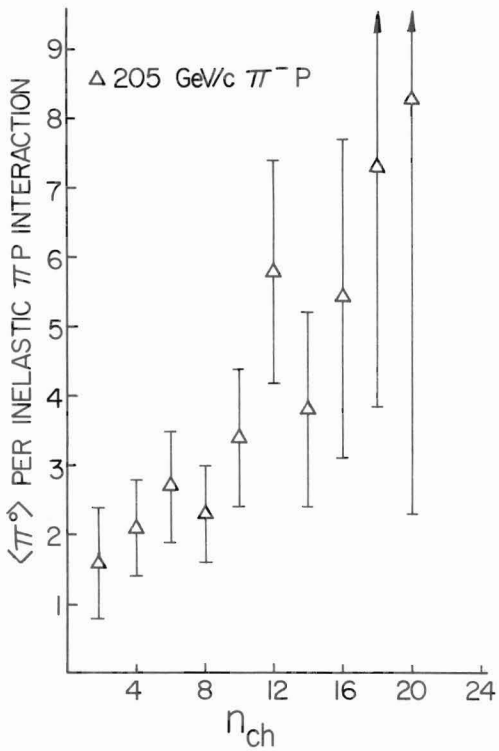
The study of four-prong events has been very interesting. These events were measured and kinematically fit in an attempt to separate events with missing neutral particles from those with no neutral particles produced. Despite the problems involved in accurately measuring very high energy tracks, this separation was done with only about 10% background. The events having four charged outgoing particles and no neutral particles were found to be almost entirely diffractively produced. Evidence that a very small number of events were produced by double Pomeron exchange was also found in this sample. (Diffractive processes are usually thought of as involving the exchange of a single pomeron.)

Measurement of gamma conversions reveals something about the production of neutral pions (π^0). The average number of neutral pions produced as a function of the number of charged particles produced is shown on page 13. Neutral pion production appears to depend linearly upon charged-particle



Distributions in M^2 for $\pi^- + p \rightarrow p + X$ for inelastic, two-, four-, six-, eight-, and ten-prong events. Dashed curves give estimates of the non-diffractive background. Sum of (a) through (e) is given in (f), as inclusive M^2 distribution.

production, a correlation which has not been observed at lower energies (where the two-production mechanisms appear to be independent).



Average number of neutral pions produced per inelastic $\pi^- p$ interaction.

In conclusion, we have explored and continue to explore many aspects of the production of particles at very high energies. This experiment, along with the others in this set, has started to clarify the production mechanisms involved. Less than two years ago, high energy physicists were wondering whether a multiperipheral, a diffractive fragmentation, or perhaps a statistical thermodynamical model would best explain the data about to come from NAL. Now we know that diffractive models best explain low-multiplicity events, although perhaps the multiperipheral model better explains higher multiplicity ones.

Those involved in this work included D. Bogert, R. Hanft, F. R. Huson, D. Ljung, C. Pascaud, S. Pruss, and W. M. Smart of NAL; G. S. Abrams, H. H. Bingham, D. M. Chew, B. Y. Daugeras, W. B. Fretter, C. E. Friedberg, G. Goldhaber, W. R. Graves, A. D. Johnson, J. A. Kadyk, L. Stutte, G. H. Trilling, F. C. Winkelmann, and G. P. Yost of Lawrence Berkeley Laboratory and the University of California at Berkeley.

Reported by D. Ljung

MULTIPULSING OF THE 30-IN. BUBBLE CHAMBER

Preparations have been in progress for the past year for multipulsing the 30-in. bubble chamber. During the month of January we were able to bring this quadripulsing system to fruition; and since then have taken 178,000 pictures in the 30-in. bubble chamber for five different experiments.

The multipulsing of the 30-in. bubble-chamber beam is achieved with a fast pulsing magnet (with a duration of 0.3 msec), an electrostatic septum, and a Lambertson septum magnet. Thus each pulse of this fast magnet takes ~1/3000 of the slow spill beam. For example, if the slow spill beam to the Neutrino Area is 3×10^{11} protons per main-accelerator cycle, each pulse of the fast magnet will give 1×10^{8} protons in the 30-in. beam line. This is sufficient intensity for proton and π^{+} experiments, but not enough for π^{-} or other more difficult experiments. Therefore, a fast-pulsing quadrupole magnet (~1 msec) in the accelerator is used to enhance the extracted beam simultaneously with the pulsing of the above-mentioned fast magnet. This gives an additional factor of 5 to 20 times the intensity in the 30-in. beam (in the above example up to $\sim2\times10^{9}$ protons per pulse). Work is being done to guide the quadrupole-induced pulse to only the 30-in. beam (at present this pulse is also seen in the Proton and Meson Areas).

The 30-in. bubble chamber had been quintuple-pulsed at ANL and thus quadripulsing was achieved with very little difficulty. The spark chambers behind the 30-in. bubble chamber worked at 250 msec intervals. Tests are underway to operate the spark chambers faster.

The success of this operation was due to the cooperation and extra efforts put forth by the Extraction and Switchyard Groups; the Accelerator Operations; the experimenters, particularly 30-in. Hybrid #2B and 30-in. Hybrid #154; and Neutrino Area personnel.

Reported by F. R. Huson

NOTES AND ANNOUNCEMENTS

LABORATORY OPERATIONS CENTER MOVED. . .

The personnel of the Operations Section recently moved from their quarters adjacent to the Main Control Room in the Cross Gallery to offices on the Atrium floor, east side, of the Central Laboratory building. The Operations Desk itself will remain for some weeks in the Main Control Room Lobby, while cabling and equipment installation proceeds and provisions are made for an orderly move to the permanent quarters. Although this change in the base of operations will require special effort to preserve the present close working relationship with accelerator operations personnel, it does reflect the equal importance of close communication with users and user groups.

The responsibility of the Operations Section is to maximize the usefulness of the accelerator, by continually evaluating the planned high energy physics research program in terms of current operating capabilities, and then making any necessary adjustments in the program or negotiating optimum resolutions to conflicts in schedule or resources. The Operations Assistant is the experimenter's source for schedule information, accelerator operating conditions and parameters, etc., as well as his contact for program changes. When such a request for change involves a significant departure from the priorities and schedule established at the weekly Experimental Planning Meeting, the Operations Assistant contacts the Operations Officer on call to gauge the merits of the request and to communicate with all affected parties.

The Section is led by H. Allen, who also shares the task of Operations Officer with J. MacLachlan and A. Greene, of the Program Planning Office.

One of the three is on call or on duty at all times. R. Evans, J. Liebau, W. Light, B. Kramper, and A. Malensek are the five Operations Assistants who man the Operations Desk round-the-clock during accelerator running periods and sixteen hours per day during shutdowns. C. Sazama and D. Ray handle administrative and secretarial details in the Operations Office.

As the Central Laboratory building has become more and more established as the center of Laboratory activities, the desirability of relocating the Operations Group has greatly increased. The group plans to maintain its present level of service during the transition from the Cross Gallery. The Center will then be able to provide more in the way of information and assistance to the Laboratory and its users and visitors.

TWO-BODY KINEMATICS . . .

The book, Two-Body Kinematics 10-1000 GeV, prepared for the Laboratory by Professor R. M. Kalback of the University of Arizona, is now being distributed. In addition to extending the energy range for such tables to 1000 GeV, the kinematic variables s, t, and u are included, as are graphs relating some of the variables for the reactions covered. These should be useful, for example in visualizing the geometry of possible experiments. Copies of the book have been mailed to spokesmen for some experiments; a limited number is still available and may be obtained from the NAL Publications Office, Ext. 3278. Two copies are available in the Library, one on the Reference Shelf and one which may be borrowed.

PLEASE NOTE. . .

Janice Adams has taken on Janice Roberts' responsibilities in the Visitors Office for the coming year, and Dorothy Carlson has joined the Housing Office staff.

BUS SERVICE RESUMED. . .

In response to an AEC request to reduce government vehicle mileage by 20 per cent, on-site bus service has been resumed on a trial basis. Two routes are served continuously on weekdays, from 8:30 a.m. to 5 p.m.

Route #1, Cross Gallery to Curia, with intermediate stops at the Central Laboratory (west side, by Auditorium foyer), Magnet Facility, Support Services, Personnel, Village Cafeteria, and Purchasing and the Village Stockroom, is scheduled to take about 20 minutes one way.

Route #2, Cross Gallery to Bubble Chamber, with intermediate stops at the Central Laboratory, Meson Detector Building, and the Proton Experimental Area, is scheduled to take about 14 minutes one way. This bus will begin its first trip in the morning from the NAL Village, leaving the Curia at 8:10 a.m. and going directly to the Cross Gallery.

Signs indicating regular stops are being prepared; in addition, drivers on both routes have been asked to pick up anyone along the road who indicates the desire for a ride. Schedules may be obtained at the Operations Desk on the Atrium Floor of the Central Laboratory, and at the Guard Desk in the Curia. Questions regarding the service and suggestions for improvements should be directed to J. Colson, Ext. 3470.

Three members of NAL's Chinese ring-necked pheasant population. Successfully imported to Portland, Oregon, from Shanghai, China, in March 1882, the species has become naturalized. The birds can withstand wide variations in climate, so long as they have good ground cover for nesting and protection from wind. Between 3000 and 4000 reside on site, according to one estimate. They appear plump during cold weather because they fluff their feathers for warmth. (Photo by Tim Fielding, NAL)

FACILITY UTILIZATION SUMMARY - JANUARY 1974

The long awaited stable 400-GeV accelerator operation was achieved during the first week of January after over two weeks of hard work by the Accelerator Division staff and patient waiting by experimenters. This activity ended on Sunday, January 6, when the accelerator operation was changed to 300 GeV to provide a few hours of normalization data for Particle Search #100A in the Proton Area. Maintenance and development work was done during the week following. The main-ring tune was changed from approximately $20\frac{1}{4}$ to $19\frac{1}{4}$, a mode in which there is less interference from beam-destroying resonances. Due to the tune change, it was necessary to move many of the extraction devices to new locations in the main ring. Other changes during this period included the installation of a two-way splitting station in the Proton Area and an exchange of train loads in the Neutrino Area, from the horn to the narrow-band train system.

Normal 300-GeV operation was then resumed. However, due to an unusual set of circumstance, i.e., the failure of the bus-bar to a quadrupole magnet on the narrow-band train, and the desire to do some accelerator research at higher energy after the tune change, operation at 400 GeV was resumed for a weekend. Internal Target experimenters eagerly returned to taking data, and the beam in the Neutrino Area was used in a new multi-pulse mode for the 30-in. bubble chamber. Since that weekend, the accelerator has been operated routinely at 300 GeV.

Examining the 400-GeV operating period in more detail, approximately 200 hours of beam were available for high-energy physics, with half of that during the very successful last week. The spill for experiments was in the slow/fast mode, with approximately 300 msec of slow-extracted beam followed by a fast spike of approximately 150 μsec duration.

The slow-spill beam was used primarily in the Proton Area for Particle Search #100A, which accumulated data from nearly 0.2×10^{17} protons on target. These data were of pion, kaon, and proton production (of both charges) at high transverse momenta. Reasonably complete data now exist on such production for incident proton energies of 200, 300, and 400 GeV. The fast-extracted beam was directed to the Neutrino Area and targeted on the single-horn train load for Neutrino #1A. Approximately 0.5×10^{17} protons on target were used for data on neutrino interactions at high energy, including a continued search for neutral currents.

A small portion (<10%) of the slow extracted beam was also sent to the Neutrino Area for 30-in. bubble chamber operation. A "pinger" in the manhole upstream of the Neutrino Target Hall then deflected a small portion of this beam into the hadron line to the 30-in. bubble chamber. In this way, it was possible to provide for bubble-chamber operation without interfering with neutrino running. This mode of operation has subsequently been improved to four-pulse operation of the pinger and the bubble chamber (see page 15).

During the 400-GeV operating period three experiments were working in the Internal Target Area using the gas jet and rotating targets. At times they were able to run simultaneously.

During the first weeks of the more recent 300-GeV operation there was only slow spill beam of 1 sec duration each pulse. In the Neutrino Area Muon #98 used a total of 0.9×10^{17} protons for production of muons and subsequent study of their interactions. Record intensities of 370,000 muons per pulse were obtained with a secondary muon per incident proton ratio of 10^{-7} Following completion of this run there has been neutrino running with fast spill onto the narrow-band train. This beam is used in Neutrino #262, a search for neutral current events, although the last week of January was used primarily for testing and background measurements. The 30-in. bubble chamber has steadily taken four pictures per accelerator cycle with 56,000 pictures of π^--p interactions at 100 GeV and 11,000 pictures of π^+-p interactions at 100 GeV for Hybrid #2B. 30-in. Pion #121A was completed with the taking of 46,000 pictures without the hybrid system, also of π^+-p interactions at 100 GeV.

During the 300-GeV operating period the Proton Area splitting station was commissioned and used extensively for two experiments, Lepton #70 (studying direct electron production at 50 mrad) and Particle Search #100A (now measuring direct muon production at large transverse momenta). However, along with the increased capability in the experimental areas has come a strong demand for increased accelerated proton intensity.

In the Internal Target Area data have been taken for three experiments, including Particle Search #184 (looking for direct muon production), Proton-Deuteron Scattering #186 (with a study of the slope parameter for proton-deuteron elastic scattering and nucleon isobar production at small momentum

transfer), and Photon Search #63A (studying data from direct photon production).

The Meson Area has been off throughout January for cleanup following the fire in the M6-West construction area. Operation in the Meson Area is expected to resume in mid-February.

The facility utilization summary follows.

I. Summary of Accelerator Operations	
A. Accelerator hours for physics research	
Accelerator physics research	41
High energy physics research	352
Subtotal:	393
B. Nonphysics hours	
Accelerator setup and tuning to experimental areas	34
Scheduled interruption	92
Unscheduled interruption	224
Subtotal:	350
C. Unmanned hours	0
Total:	743*
II. Summaries of Experimental Use	
A. Integrated number of hours in external beams	
For approved experiments	1062
Other (for beam tuning and studies)	129
Total:	1191
B. Total hours charged to approved experiments	1209**
C. Total bubble-chamber pictures for approved experiments	133,000
D. Total number of experiments to which time of pictures were charged	15

*Change to Daylight Savings Time

**These tabulations to not include 485 hours of parasitic time run for the above approved experiments.

III. Total Number of Protons Accelerated

Main Ring	Total:	44.62×10^{16}
Experimental Areas		
Meson Area		0.00×10^{16}
Neutrino Area		22.66×10^{16}*
Proton Area		9.64×10^{16}
	Total:	32.30×10^{16}

*This does not include fast spilled beam for bubble-chamber operation.

PROPOSALS RECEIVED DURING JANUARY 1974

Exp. #	Title	Spokesman
274	Study of ~500 GeV $\pi^- p$ Interactions in the 30-In. Hydrogen Bubble Chamber	H. H. Bingham W. B. Fretter
275	Exposure of Plastic Detector Stacks to a 300 GeV Proton Beam at NAL	W. Enge
276	A Search for Stable Integrally Charged Massive Particles (Han-Nambu Quarks)	A. Van Ginneken
277	Proposal to Study π^+ and K^+ Interactions at 300 GeV in the NAL 30-In. Hydrogen Bubble Chamber	V. E. Barnes
278	Proposal to Study π^+ Interactions at 400 GeV in the 30-In. Hydrogen Bubble Chamber	V. E. Barnes
279	The Interaction $pA \rightarrow pAe^+e^-$ at 400 GeV	D. T. King
280	Proposal to Study pd Interactions at 205 GeV/c in the 30-In. Bubble Chamber	T. Fields
281	Proposal to Study High Energy Proton-Proton and Pi-Minus Proton Interactions with the NAL 30-In. Bubble Chamber-Wide Gap Spark Chamber Hybrid System	G. A. Smith

Correction: Proposal No. 272, "Proposal to Measure Coherent Dissociation of Pi, K, and p in Strange Particles at NAL Energies," was submitted by both T. Ferbel and J. Rosen.