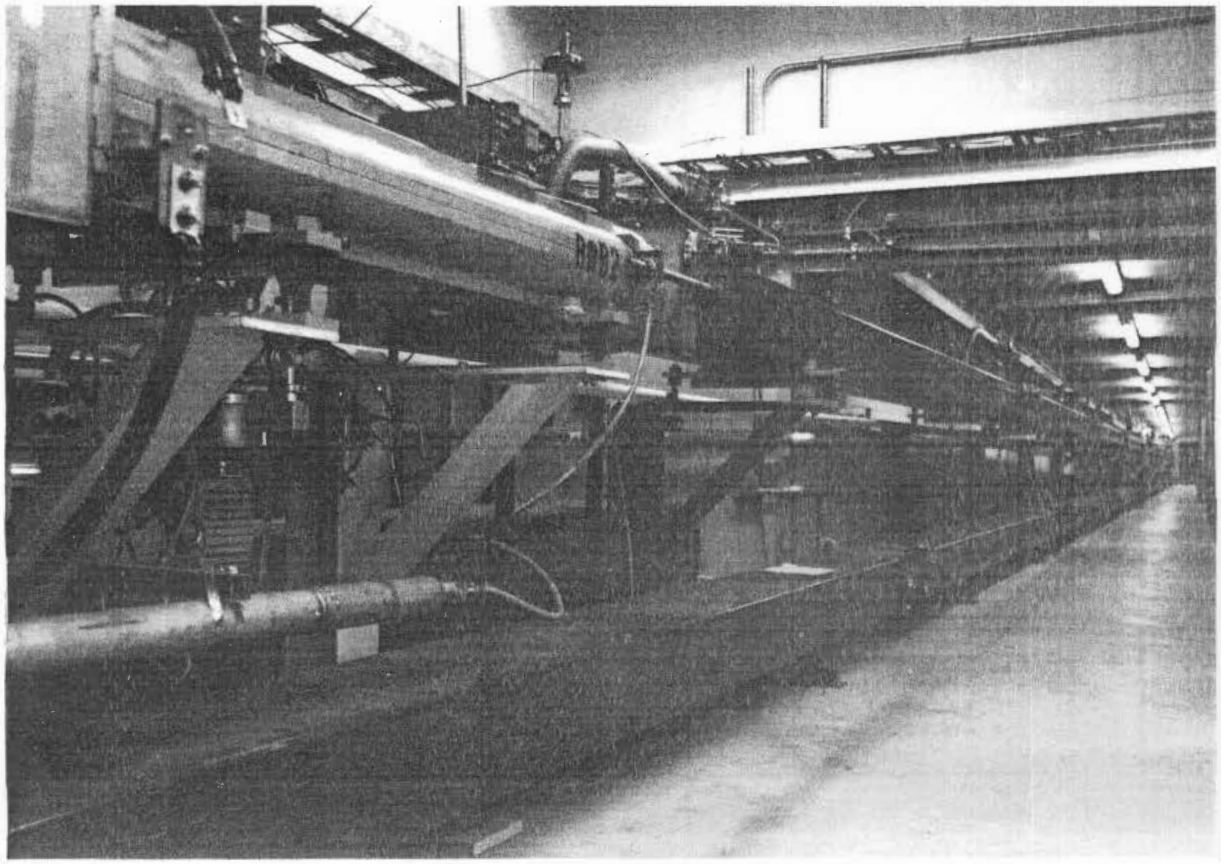
fermilab report

Fermi National Accelerator Laboratory Monthly Report

December 1979



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

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THE COVER: The superconducting magnet string in the systems test at B12. The string doubles back electrically and cryogenically at the far end. This magnet string has now been cooled down for tests.

(Photograph by Fermilab Photo Unit)

NEUTRINO BUBBLE CHAMBER USERS PLAN FOR TEVATRON ERA

V. Z. Peterson
University of Hawaii

The first of two Workshops on Neutrino Bubble Chamber Physics at Tevatron Energies was held at Argonne National Laboratory on October 29-30. This meeting, organized by Vincent Peterson (Hawaii) and hosted by Malcolm Derrick (ANL), attracted over 60 physicists from 30 different institutions in the USA, Europe, and Japan. The purpose of this first workshop was to discuss the new physics that could be done with bubble chambers and Tevatron-era neutrino beams and to consider possible improvements to the 15-ft bubble chamber hybrid detector system.

On October 29, a preview of Fermilab planning for the Neutrino Area in the Tevatron era was provided by R. Huson (accelerator characteristics), T. Kirk (general plans for the Neutrino Area), S. Mori (neutrino beams), and J. Wolfson (EMI, IPF, and related external detectors). J. D. Bjorken and Chris Quigg then contributed theoretical comments on possible Tevatron neutrino experiments, with emphasis on tau-lepton physics. C. Baltay (Columbia) discussed expected yields and possible experiments using neon filling, while Douglas Morrison (CERN) presented the case for hydrogen/deuterium experiments.

On October 30, working groups were formed and met to consider improvements in (a) muon identification and momentum measurement (R. Plano, leader); (b) electron/photon detection and energy measurement (W. F. Fry); (c) external particle identification (H. Lubatti); (d) high resolution optics (L. Voyvodic); (e) wide-band beams and monitoring (H. Wachsmuth); and (f) new bubble-chamber systems (R. Huson). Co-leaders were chosen from non-USA institutions to coordinate participation in the Working Groups from across the Atlantic and Pacific. These groups are to consider carefully cost-effective improvements to the present 15-ft bubble chamber system for Tevatron experiments during the two months leading up to the January 9-12 Neutrino-Muon Workshop at Fermilab. Their leaders will present the results on January 9.

A "mid-course assessment" meeting of group leaders was held on December 3rd at Fermilab to discuss progress to date and plan a coordinated presentation on January 9th. A written summary of this meeting is being sent to all attendees at the October 29-30 Workshop. The principal highlights of this meeting were recognition of the importance of external particle identification, the need for wider discussion of wide-band beams and monitoring systems, and practical difficulties involved in modifying the 15-ft bubble chamber to accommodate ideal detection of the hadronic final states. Suggestions of the "new bubble chamber" group were expanded upon, and a further group leader meeting on this subject will be held prior to January 9.

In early December the Director's view on Tevatron bubble chamber physics was solicited and Leon Lederman responded that "It does seem obvious that at least for the first two years of 1000-GeV physics, the bubble chamber will be a necessary tool. Therefore I am looking forward to the results of the working groups and to the physics proposals that these may generate." Bubble chamber groups are urged to respond to this challenge.

THE FERMILAB CANCER THERAPY FACILITY: A MEDICAL PROGRESS REPORT

L. Cohen, M.D., F. Hendrickson, and J. Mansell, R.N., P.A.

The Fermilab Cancer Therapy Facility has now been treating patients for the past three years. More than 600 patients have now been evaluated, the great majority of whom were treated in the neutron facility. Evaluation of this clinical research project is continually in process, but an interim assessment would conclude the following:

1. Fermilab is a major contributor to the national neutron research effort, contributing more than half of the patient material to several of the national cooperative studies.

2. The Fermilab neutron beam has been highly reliable for delivering treatments on specific time schedules.

3. The Fermilab neutron beam is the most energetic and therefore the most penetrating neutron beam available in the world for patient treatment.

4. Fermilab facility personnel have been responsible for generation of the scientific justification and writing of the research proposals for nearly half the currently active clinical research studies using neutron beams with curative intent.

Specific evaluations have been completed in a number of areas. These include evaluations of specific types of cancers in specific locations, as well as evaluation of the effects of neutron treatment on normal tissues that are subjected to irradiation because of their proximity to the neoplasms. The national study of comparing neutron treatment with standard treatment for advanced cancers of the oral cavity and pharynx has now accrued over 200 patients. To date, neutron treatment has controlled cancer in more than half the patients, with the standard treatment having control rates of about 40%. This magnitude of improvement is encouraging, but further studies are being mounted to attempt even higher success rates. Patients referred for neutron treatment for tumors of the salivary glands have responded in a particularly gratifying way, with virtually 100% local control. The only patient who failed to achieve control was one with a very massive lesion.

Other tumors that have shown some response, but of considerably less magnitude, have been the primary tumors of the brain, cancer of the esophagus and of the pancreas. The esophageal and pancreatic tumors have been particularly suited for treatment at Fermilab because of their deep-seated location, requiring a penetrating neutron beam to deliver adequate dose.

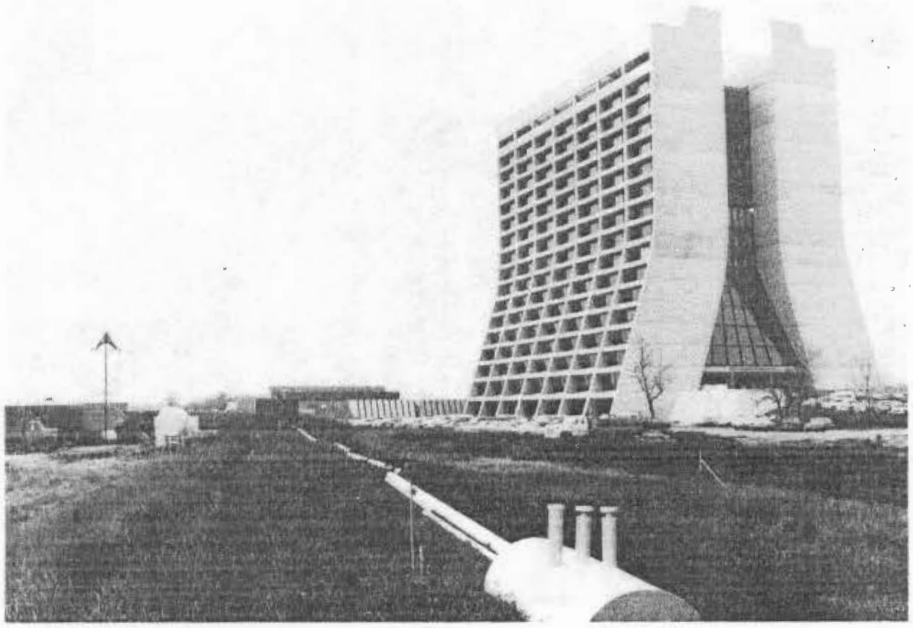
But the reactions and complications in the surrounding normal tissues have been sufficiently high and the control rate of the cancer sufficiently low that further evaluations of alternative treatment strategies are currently underway. These new research efforts will combine radiation-sensitizing agents in an effort to improve the therapeutic ratio of tumor injury to normal-tissue complications. Prostatic and uterine tumors have responded well and we hope to treat more patients who have these tumors.

Normal-tissue reactions were studied in 56 evaluable cases followed for at least one year after receiving neutron or "mixed beam" irradiation to total neutron doses of 20 Gy or more. Acute skin and mucosal reactions were classified as mild to moderate in all cases and all were considered clinically acceptable. The incidence of late reactions include severe subcutaneous fibrosis, trismus, and ulceration or necrosis of skin or gastrointestinal mucosa.

Eight out of 22 patients followed for a year or more after neutron doses in excess of 20 Gy showed significant late reactions. Late reactions were also observed in six out of twenty patients treated with a neutron boost of 7.5 Gy following 50 Gy of photons for intraoral cancer and 7 out of 11 "mixed-beam" cases receiving 9 to 11 neutron Gy with 45 to 50 photon Gy concurrently over a seven-week treatment period. Eight out of 17 patients treated with curative doses of neutrons following recurrence after radical photon therapy had excessively severe late effects.

In the neutron-only group, all patients were treated over a nominal six-week period, but the number of fractions ranged from 8 (once weekly) to 28 (four times weekly). A tentative isoeffect line (dose versus fractions) for cutaneous fibrosis could be drawn with an origin at 20 Gy and a slope of 0.04. A time-dose fractionation (TDF) analysis of the whole series suggested a median value, assuming an equivalency factor of 3.00 for our beam, of TDF = 120 ($\pm$10) for severe stromal fibrosis and associated complications.

The clinical research program has just recently undergone review by a group of peers for the National Cancer Institute. This group recommended for continued funding at a high priority level. New patients are being referred at a rate of 5 to 6 per week but the facility could handle a modest increase in patient referral without excessive strain. The continued clinical evaluation of neutron treatment in research laboratory settings is necessary as the nationally supported clinical neutron facilities will not be completed and available for patient accrual for at least 3 or 4 years.



Helium transfer line for the superconducting accelerator being installed above A sector.

(Photograph by Fermilab Photo Unit)

Drasko Jovanovic, new head of the Physics Department.
(Photograph by Fermilab Photo Unit)

NORMAN RAMSEY. . .

Norman Ramsey has returned to the presidency of Universities Research Association. He was elected by the URA board to succeed Prof. Milton White, who died in October.

T. B. W. KIRK. . .

T. B. W. Kirk has taken leave of the Neutrino Department to work on an experiment and Shigeki Mori will be head of the Neutrino Department until next April.

SUMMARY OF OPERATIONS - NOVEMBER 1979

Program Planning Office

The high-energy physics research program continued throughout November with the accelerator in operation at 400 GeV with a 1-second flattop. Emphasis on eliminating the rf power amplifier tube supply problem continued and by the end of the month both the Booster and Main-Ring rf stations had regained their full complement of amplifier tubes. The most significant cause of down time during November was the result of a loss of cooling water (LCW) pressure for the Booster which caused an unexpected shut down of all Booster and Switchyard devices.

Data taking for both Particle Search #567 (P-West) and Photoproduction #401 (P-East Broad Band beam) was completed during the month in the Proton Laboratory. After approximately one week of transition activities between Particle Search #567 and Dimuon #326 in the P-West High Intensity Laboratory, startup activities (primarily beam studies) for the latter experiment got underway. Photoproduction #516 (Tagged Photon Laboratory) will follow Photoproduction #401 in P-East and is scheduled to be in operation for the remainder of the current running period.

Routine data taking continued throughout the month for Neutrino #616 in the N0 beam line. The dichromatic beam train load was tuned for neutrino operation and data were acquired at 140, 165, 200, and 250 GeV.

In the Meson Laboratory data taking was completed late in the month for $\pi\mu$ Atoms #533 operating in the M3 neutral beam line. At the end of the month the transition to the follow-on experiment Particle Search #584 by the same group was in progress. Data taking for Hadron Dissociation #272 in M1 continued throughout the month. That experiment was assigned priority for determining the horizontal targeting angle for the M-Center target for much of the month and was progressing towards conclusion early in December. The transition from Lambda Beta Decay #361 (completed at the end of October) to Charged Hyperon Magnetic Moment #620 was completed early in the month and the latter experiment began startup operations. The initial data taking is expected to be directed towards a measurement of the Ξ^- magnetic moment. The startup run for Elastic Scattering #577 in the M6 east branch ended early in the month and startup activities with the M6 west branch and the Multiparticle Spectrometer got underway for Hadron Jets #557 and Particle Search #580. Those activities are scheduled to continue until the end of the current running period.

FERMI NATIONAL ACCELERATOR LABORATORY
MONTHLY OPERATIONS HISTORY
NOVEMBER 1979

Date		Accelerator	Internal Target Area	Proton Area	Neutrino Area	Meson Area
Thu.	11/1	Accelerator Research & Maintenance				
Fri.	11/2	Accelerator Startup				
Sat.	11/3	~1.7x10^{13}ppp @400 GeV 1.0 sec flattop	OFF	567 (PW) 401 (PE)	616 (NO)	533 (M3) 272 (M1) 577 (M6) OFF (M2)
Sun.	11/4					
Mon.	11/5	~~Necessary Repairs~~				
Tue.	11/6					
Wed.	11/7	Reprs:Linac vac;Booster rupture disk;MR quad.F-27		(End 567)		
Thu.	11/8	Accelerator Studies & Necessary Repairs				
Fri.	11/9	~1.8x10^{13}ppp @400 GeV 1.0 sec flattop	OFF	401 (PE) OFF (PW)	616 (NO)	533 (M3) 272 (M1) 620 (M2) MPS Tests (M6)
Sat.	11/10					
Sun.	11/11					
Mon.	11/12	~~Necessary Repairs~~				
Tue.	11/13	~~Reprs:Booster Vac.~~				
Wed.	11/14	Accelerator Research & Maintenance				
Thu.	11/15					
Fri.	11/16	~1.7x10^{13}ppp @400 GeV 1.0 sec flattop	OFF	401 (PE) P-West beam tsts.	616 (NO)	272 (M1) 533 (M3) 620 (M2) MPS Tests (M6)
Sat.	11/17					
Sun.	11/18					
Mon.	11/19					
Tue.	11/20	Accelerator Research & Maintenance				
Wed.	11/21	~1.9x10^{13}ppp @400 GeV 1.0 sec flattop	OFF	401 (PE) P-West beam tsts.	616 (NO)	272 (M1) 620 (M2) 533 (M3) MPS Tests (M6)
Thu. (H)	11/22					
Fri. (H)	11/23					
Sat.	11/24					
Sun.	11/25			(End 401)		
Mon.	11/26	~~Necessary Repairs~~		326 (PW)	616 (NO)	
Tue.	11/27	~1.8x10^{13}ppp @400 GeV		OFF (PE)		(End 533)
Wed.	11/28	Accelerator Research & Maintenance				
Thu.	11/29					
Fri.	11/30					

BEAM UTILIZATION BY

	Beam	Hours
PROTON AREA		
Photoproduction #401	PE	260
Particle Search #567	PW	80
P-West Beam Tests	PW	80
NEUTRINO AREA		
Neutrino 616	NO	400
MESON AREA		
Hadron Dissociation #272	M1	340
$\pi-\mu$ Atoms 533	M3	400
Elastic Scattering 557	M6	80
Charged Hyperon Mag. Mom. 620	M2	280
MPS TESTS	M6	190
TOTAL HOURS FOR HIGH ENERGY PHYSICS		2110

Activities
completed; study of photoproduction of high-mass two-body final states
completed; search for charm production in 200-GeV hadron interactions
test and studies to improve the beam in the P-West High Intensity Area
data to measure neutrino structure functions
data to study the coherent dissociation of π, K, and p into strange particles
completed study to measure the rate of formation of π-μ atoms in $K^0_L \rightarrow \pi\mu\nu$ decay
setup and tuneup of experimental apparatus to measure large angle angle elastic scattering of $\pi^{\pm}$ on protons at 200 GeV
setup, tuneup, and data to measure the magnetic moments of Σ^+, $\bar{\Xi}^-$, $\bar{\Sigma}^-$, and $\bar{\Omega}^-$ hyperons
beam studies and installation of experimental apparatus at the MPS facility

FACILITY UTILIZATION SUMMARY - NOVEMBER 1979

I. Summary of Accelerator Operations

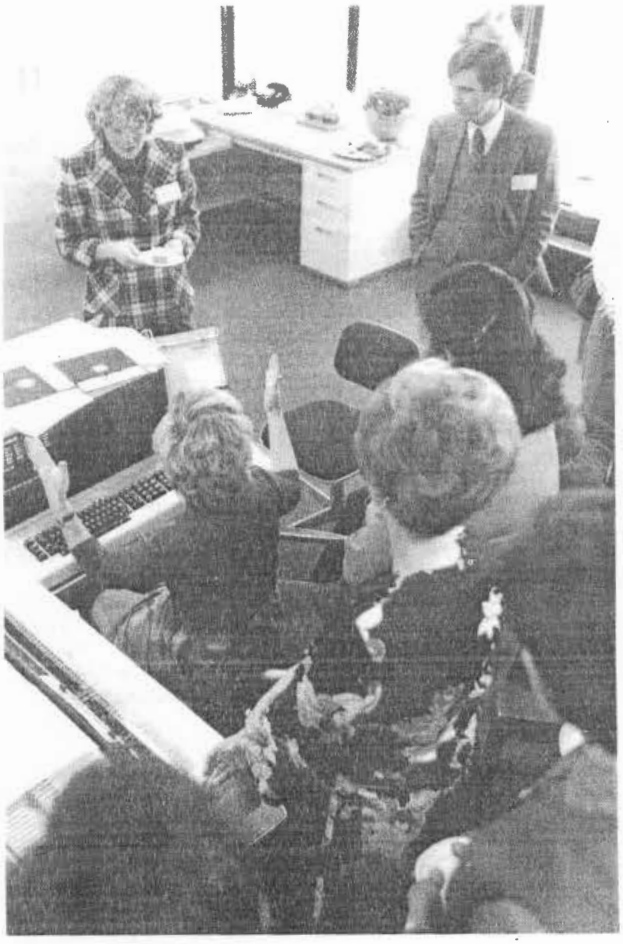
		Hours	
A. Accelerator use for physics research			
High energy physics research		448.9	
Accelerator physics research		60.8	
	Subtotal		509.7
B. Other Activities			
Program interruption		69.5	
Accelerator setup and tuning to experimental areas		33.5	
	Subtotal		103.0
C. Unscheduled interruption			107.3
D. Unmanned time			0
Total			720.0

II. Summaries of High Energy Physics Research Use

	# of Expts.	Hours	Results
A. Counter experiments	7	1840	
B. Bubble chamber experiments	-	-	
C. Emulsion experiments	-	-	
D. Special target experiments	-	-	
E. Test experiments	-	-	
F. Engineering studies and tests	2	270	P-West & M6 beam studies
G. Other Beam Use	-	-	
Totals	9	2110	

III. Number of Protons Accelerated and Delivered ($\times 10^{18}$ p) at 400 GeV

A. Beam accelerated in Main Ring	2.86
B. Beam delivered to experimental areas	2.69
Proton Area	0.16
Neutrino Area	
Slow Spill	0.90
Fast Spill	0.93
Meson Area	0.70



Claire Gorman (seated) explaining operation of a new word-processing system to Rene Donaldson during a Publications Office open house. **Fermilab Report** is now prepared using this new machine.

(Photograph by Fermilab Photo Unit)

MANUSCRIPTS AND NOTES PREPARED
FROM NOVEMBER 13 TO DECEMBER 12, 1979

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

L. Voyvodic General Review	A Review of Recent Measurements of Charmed Particle Lifetimes Using Emulsions (FERMILAB-Conf-79/80-EXP; presented at the International Symposium on Lepton and Photon Interactions at High Energies, Fermilab, August 23-29, 1979)
A. Schiz et al. Experiment #69	Hadron-Nucleus Elastic Scattering at 70, 125, and 175 GeV/c (FERMILAB-Pub-79/78-EXP; submitted to Phys. Rev. D)
A. Schiz et al. Experiment #69	A High Statistics Study of π^+p, π^-p, and pp Elastic Scattering at 200 GeV/c (FERMILAB-Pub-79/81-EXP; submitted to Phys. Rev. D)
B. Cox Experiment #95	A Search for Direct Photon Production at Fermilab Energies and Comparison with Direct Photon Measurements (FERMILAB-Conf-79/85-EXP; presented at the International Symposium on Lepton and Photon Interactions at High Energies, Fermilab, August 23-29, 1979)
R. G. Kennett Experiment #260	Experimental Tests of Triple Regge Theory (Ph.D. Thesis, California Institute of Technology, September 1979)
K. W. Yung Experiment #260	Study of Hadronic Jets Produced by Charged Pion and Proton Beams Incident on Hydrogen and Aluminum Targets (Ph.D. Thesis, California Institute of Technology, September 1979)

D. Brick et al. Experiment #299	Leading Particles and Diffraction Dissociation in 150 GeV/c π^-p Interactions (Submitted to Phys. Rev. D)
D. Theriot Experiment #365	Recent Experimental Measurements of the Neutrino Charged Current Cross Sections (FERMILAB-Conf-79/79-EXP; presented at the International Symposium on Lepton and Photon Interactions at High Energies, Fermilab, August 23-29, 1979)
H. Fuchi et al. Experiment #531	Detection Method of Neutrino Interaction in the Vertical Emulsion Target of Hybrid Apparatus [J. Phys. Soc. Jpn. **47**, 687 (1979)]
F. E. Taylor et al. Experiment #594	The Construction and Performance of Large Flash Chambers (FERMILAB-Conf-79/86-EXP; presented at the IEEE Nuclear Science Symposium, San Francisco, October 17-19, 1979)

Physics Notes

S. Mori	Neutrino Beams in the Energy Range of 20 TeV (FN-318)

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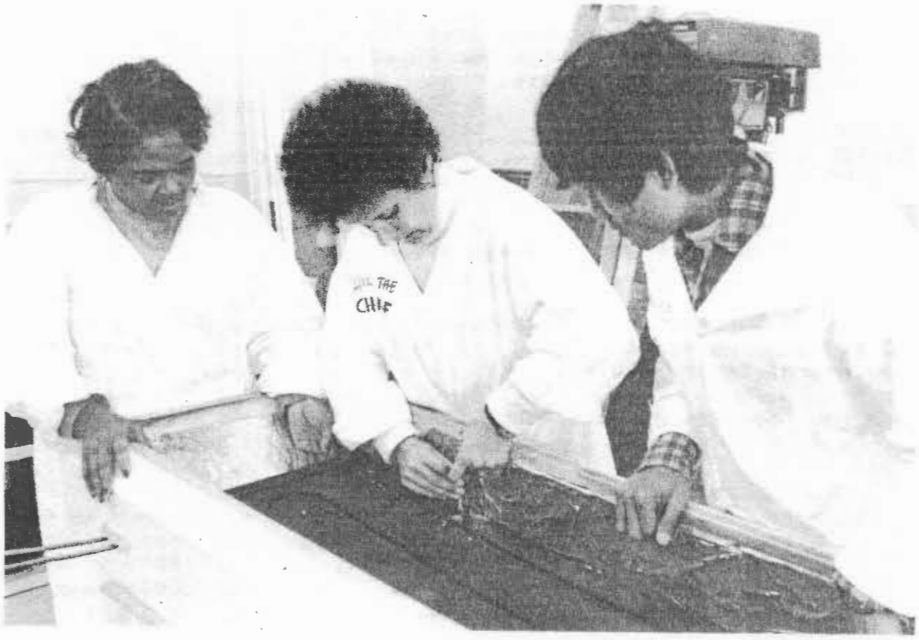

Estelle Lesure (left), Penny Horak, and Inpeng Samayavong (right) working on a solar collector for the Industrial Building. (Photograph by Fermilab Photo Unit)

DATES TO REMEMBER

January 9-12, 1980	Workshop on Tevatron Neutrino and Muon Facilities.
January 25, 1980	Deadline for receipt of all new proposals and other written materials to be considered at the spring meeting of the Physics Advisory Committee.
February 14-15, 1980	Proposal Presentation Meeting.
March 13-14, 1980	Spring meeting of the Physics Advisory Committee.
March 28, 1980	Deadline for requests for summer housing. Please register as soon as possible. More detailed information will be given in next month's **Fermilab Report.**
April 25, 1980	Deadline for receipt of all new proposals and other written materials to be considered at the summer meeting of the Physics Advisory Committee. This will also be the deadline for receipt of the first set of Tevatron proposals (those dealing with experiments in the Neutrino and Muon areas).
May 15-16, 1980	Proposal Presentation Meeting.
June 21-27, 1980	Summer meeting of the Physics Advisory Committee (Aspen).