RESEARCH ACTIVITIES DURING FEBRUARY 1977

James MacLachlan

The basic mode of accelerator operation for the entire month of February was a 400-GeV cycle with a one-second flattop. Both slow spill and a single-turn fast spill of about 10^{13} protons/pulse were provided. The first week continued the pattern of once-a-week Main-Ring feeder failure that prevailed in January and late December, but in mid-month two 2-day maintenance periods were taken to eliminate the routing of heavily loaded feeder cable through conduit at Main-Ring service buildings. All the recent faults have occurred where directly buried cable is brought up through conduit into an above-ground cubicle either to deliver load or simply for an access and tie point. The cables are within rating in the ground but substantially over rating in the conduit and cubicle and appear to have been significantly damaged during earlier running. The modification consisted of replacing non-load tie points by underground splices and delivering load to cubicles by an underground wye splice. This was a major project involving the reworking of 11 service buildings, the preparation of 45 in-line and 21 wye splices, the installation of 27 new terminations in the cubicles, and a total of 1682 man hours of electrical work in 5 shift sessions. It is believed that this effort has greatly reduced the likelihood of feeder failure. Several more service buildings will be given the same treatment during the April-May accelerator shutdown. The accelerator delivered beam for high-energy physics for 383 hours, which is 69% of the 557 hours scheduled. The repetition rate was generally about 11 seconds, and an intensity of about

1.8 to 2×10^{13} protons/pulse resulted in 2.1×10^{18} protons accelerated. In addition to the major interruptions several periods of accelerator instability and spill irregularity also disturbed the planned program. The week of February 7 was, practically speaking, a total loss with a two-day emergency feeder repair and a two-day feeder improvement maintenance period. Accelerator performance during the rest of the month was reasonably good.

The top priority in the experimental program was the antineutrino running in the 15-ft bubble chamber. The two-horn focusing system was used with a straight-ahead plug to reduce neutrino contamination. The chamber became operational on February 2. After about 4K pictures had been taken, it was discovered that one of the solenoid valves was being run at the wrong polarity for the experimenter's choice of field direction. Because of a coincidental failure of another solenoid valve, some chamber liquid was lost. The chamber was down because of this problem from February 4 to February 8. Thereafter, the chamber took pictures on about 90% of the available spills and ended the month with approximately 83K pictures with an average of approximately 10^{13} protons on target for each picture. The Neutrino Operations group devoted much effort to commissioning the bypass target for the N1 line to permit use of that beam by Particle Search #369 while the focusing horn is installed and to setting up of the N5 line to allow it to safely provide a diffracted proton beam to be used in Lab E by Particle Search #379.

The Proton Area started the month with the same experiments that have been running since mid December. Di-Hadron #494 was completed in

Proton-Central February 21, and Particle Search #325 was completed February 28, after having switched from dilepton production to a quark search at high p_T for the last 11 days of this run. The Princeton-Chicago group will now vacate the Proton-East Area, which they helped to bring into operation in June, 1973. Only p-p Elastic #177A remained at the month's end in P-West, struggling for statistics at their highest t-value while shutdowns were in progress in the Central and East branches; Photoproduction #401 was being installed in P-East and the changeover to the upgraded dimuon experiment, "Super 288," was underway in P-Central.

Highest priority in the Meson Area for most of the month was given to Polarized Scattering #61. The experimenters' top priority was to collect events for a 10% measurement of the scattering of 300-GeV protons from a polarized proton target in the dip region at $t \approx -1.4$ $(GeV/c)^2$. When their run ended February 24, they were close to their goal. The completion of Inclusive π^o #350 on February 24 marked the end of a series of experiments by the Cal Tech group that dates back to the earliest use of the M2 beam line in September, 1973. The M2 line was down at the end of the month for the installation of improved shielding in the tunnel and under the mezzanine in preparation for running with diffracted proton intensities as high as 10^{10} per pulse.

The installation of a second helium liquefier at the Internal Target Laboratory has permitted nearly continuous running of the superconducting spectrometer. Both p-p Polarization #313, which ran the first half of the month, and p-N Scattering #198A have had some solid running. During the

periods of marked accelerator instability early in the month, E-313 labored from time-to-time under restrictions on jet pressure, number of pulses, etc., because of possible effects on beam blowup. Despite the increased liquid-helium supply, there was seldom enough to permit useful running by p-N Scattering #381 which had made some effort to establish compatibility with the spectrometer experiments.

FACILITY UTILIZATION SUMMARY -- FEBRUARY 1977

I. Summary of Accelerator Operations

			Hours	
A.	Accelerator use for physics research			
	Accelerator physics research		31.7	
	High energy physics research		383.3	
	Research during other use		(37.4)	
		Subtotal		415.0
B.	Other activities			
	Accelerator setup and tuning to experimental areas		10.0	
	Program interruption — Scheduled 72.0, Adhoc 0.8		72.8	
	Unscheduled interruption		174.2	
		Subtotal		257.0
C.	Unmanned time			
		Total		672.0

II. Summaries of High Energy Physics Research Use

		# of Expts.	Hours	Results
A.	Counter experiments	14	2519.0	3 exp. completed
B.	Bubble chamber experiments	1	297.1	83,486 15-ft pictures
C.	Emulsion experiments	-	-	
D.	Special target experiments	2	-	2 target irradiations completed
E.	Test experiments	-	-	
F.	Engineering studies and tests	2	165.7	N5 & N1 beam tests
G.	Other beam use	-	-	
		19	2981.8	

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

A.	Beam accelerated in Main Ring @ 400 GeV		2.10
B.	Beam delivered to experimental areas		
	Meson Area		0.53
	Neutrino Area		1.00
	Slow Spill	0.03	
	Fast Spill	0.97	
	Proton Area		0.25
	Total		1.78

BEAM UTILIZATION BY

	Beam	Run Dates
MESON AREA		
Polarized Scattering #61	M1E	2/1-2/24
Nuclear Chemistry #81A	M0	
Multiparticle #110A	M6W	2/18-2/28
K^o Charge Radius #226/#486	M4	2/1-2/28
Backward Scattering #290	M6W	2/1-2/16
Inclusive π^o #350	M2	2/1-2/24
Form Factor #456	M1W	2/25-2/28
NEUTRINO AREA		
15' Antineutrino/H_2&Ne #180	N0	2/3-2/28
Particle Search #369	N1	2/20-2/28
Particle Search #379	N5	2/25-2/26
PROTON AREA		
p-p Elastic #177A	PW	2/1-2/28
Particle Search #325	P1	2/1-2/28
Nuclear Fragments #466	PE	2/1-2/28
Di-Hadron #494	PC	2/1-2/21
INTERNAL TARGET AREA		
p-N Scattering #198A	C0	2/18-2/28
p-p Polarization #313	C0	2/1-2/16
p-N Scattering #381	C0	2/1-2/28

EXPERIMENT -- FEBRUARY 1977

Activities

data: elastic scattering of protons @ 300 GeV from polarized proton target

data: one target exposed to 400-GeV protons

tests: setup and test of the multiparticle spectrometer

data: K_S^o regeneration from a lead regenerator

tests: continuation of checkout of the experiment, particularly PWC's

data: inclusive π^o production from 200 GeV π^-; experiment completed

tests: reestablish prior running conditions and work on rate dependence in PWC's

data: antineutrino events in 62% Ne/H_2 mixture from horn focused beam; beam; 83K pictures

tests: trigger studies and system tuneup

tests: trigger tests and system checkout

data: proton elastic scattering at 400 GeV in the range $12 \leq |\tau| \leq 18$

data: study of dilepton systems at high mass and a quark search at $t \approx 6$ $(GeV/c)^2$

data: completion of uranium foil exposure to 400-GeV protons started 1/21/77

data: high mass dihadron systems in various momentum and sign combinations

data: p-p elastic and inclusive scattering vs. s at $|t| \lesssim 2.4$ $(GeV/c)^2$

data: p polarization in p-p scattering by an analyzing scatter of the recoil proton

data: small-t elastic and inelastic scattering; parasitic running when adequate liquid helium is available

One of the Laboratory's Scottish Highland cattle models his winter coat.

MANUSCRIPTS AND NOTES PREPARED DURING FEBRUARY AND MARCH 1977

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

B. Y. Oh et al. Experiment #2B	Evidence for Double Pomeron Exchange at Fermilab Energies (Submitted to Phys. Rev. Lett.)
J. Whitmore Experiment #2B	Multiparticle Processes at Fermilab Energies (Submitted to the Division of Particles and Fields Meeting, American Physical Society, Brookhaven National Laboratory, October 6-8, 1976)
L. W. Mo Experiment #98	Review of Electron and Muon Scattering (Submitted to the Division of Particles and Fields Meeting, American Physical Society, Brookhaven National Laboratory, October 6-8, 1976)
J. Hébert et al. Experiment #233	Nuclear Interactions of 300 GeV Protons in Emulsion
J. Whitmore et al. Experiment #311	Properties of Inclusive $\pi^{\pm}$ Production in 100 GeV/c Antiproton-Proton Interactions (Submitted to Phys. Rev. Lett.)
M. D. Corcoran et al. Experiment #313	Preliminary Polarization Results at Fermilab Energies (Submitted to Coral Gables Orbis Scientiae, Coral Gables, Florida, January, 1977)
D. A. Garbutt et al. Experiment #418	Nuclear Size Dependence of Inclusive Particle Production (Submitted to Phys. Lett.)
W. Bozzoli et al. Experiments #419 and #462	Search for Short Lived Particles Produced By 300 and 400 GeV/c Protons in Nuclear Emulsions (Submitted to Nuovo Cimento Lett.)

Theoretical Physics

L. A. Balázs	Planar Bootstrap Without the Dual-Tree Approximation (FERMILAB-Pub-76/93-THY; submitted to Phys. Rev.)

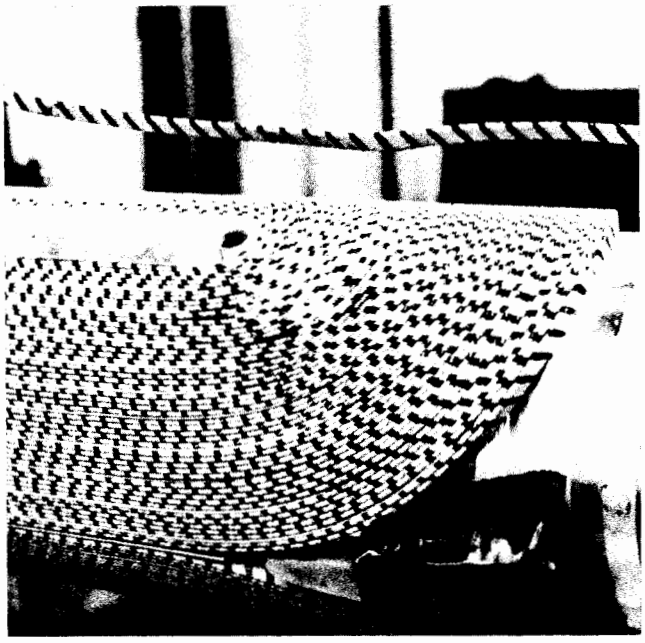
H. J. Lipkin	The Case Against the Pseudoscalar Nonet and SU(4) Symmetry in Meson Spectroscopy (FERMILAB-Pub-76/94-THY; submitted to Phys. Rev. Lett.)
V. A. Matveev	Cancellation of the Zero-Mode Singularities in Soliton Quantization Theory (FERMILAB-Pub-76/95-THY; submitted to Nucl. Phys. B)
D. W. Duke	Nucleon Exchange and Decay Angular Dependence in High Energy Nucleon Diffraction Dissociation (FERMILAB-Pub-76/96-THY; submitted to Phys. Lett.)
H. J. Lipkin	Can Pedestrians Understand the New Particles or Who Needs the Okubo-Zweig-Iizuka Rule (FERMILAB-Conf-76/98-THY; submitted to the Erice Conference, Italy, August, 1976)
K. Igi	Factorization of Regge Slopes for Ordinary and New Hadrons and their Spectroscopy (FERMILAB-Pub-76/100-THY; submitted to Phys. Rev. D)
B. W. Lee	Gauge Theories of Microweak CP Violation (FERMILAB-Pub-76/101-THY; submitted to Phys. Rev.)
K. M. Bitar	Instantons in Gauge Groups Larger Than SU(2) (FERMILAB-Pub-77/15-THY; submitted to Phys. Rev. D)
H. J. Lipkin	The Alexander. . . Zweig Rules and What Is Wrong with Pseudoscalar Mesons (FERMILAB-Conf-77/16-THY; submitted to Coral Gables Orbis Scientiae, Coral Gables, Florida, January, 1977)
B. W. Lee et al.	Muon and Electron Number Nonconservation in a V-A Six-Quark Model (FERMILAB-Pub-77/20-THY; submitted to Phys. Rev. Lett.)

Physics Notes

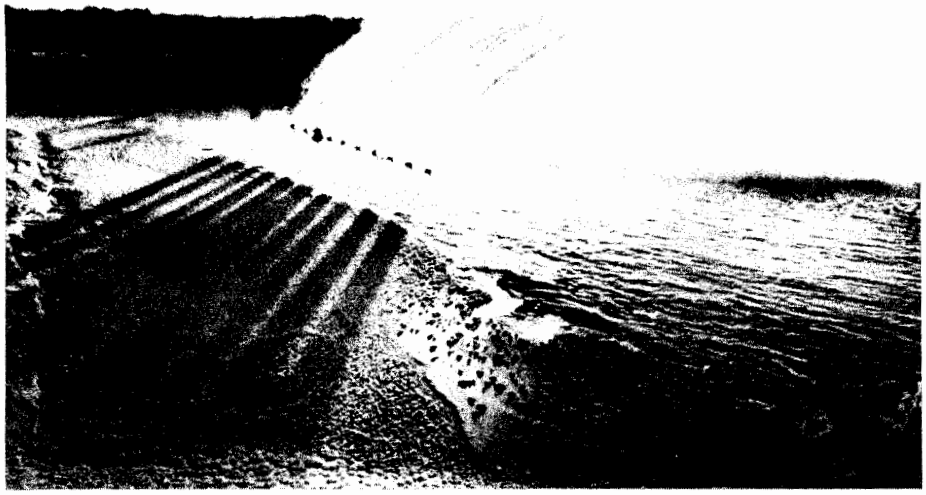
L. C. Teng	A "Conventional" Accelerator System for Inertial Fusion Using Heavy Ion Beams (FN-302)

DATES TO REMEMBER

March 31, 1977	Deadline for request for Fermilab Summer Housing. Please register as soon as possible.
April 21-22, 1977	Future Neutrino Experiments Workshop
May 6, 1977	Deadline for receipt of all new proposals and other written materials to be considered at the Summer meeting of the Program Advisory Committee
May 13-14, 1977	Users Annual Meeting
May 19-20, 1977	Proposal Presentation Meeting
June 18-24, 1977	Summer meeting of the Fermilab Program Advisory Committee



A close-up view of the winding of a superconducting dipole.



Main-Ring fountain casts haunting shadows across an ice-encrusted landscape.
(Photograph by Anthony R. Donaldson)