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BEVATRON OPERATION AND DEVELOPMENT. XXXI
August through October 1961

Berkeley, California

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BEVATRON OPERATION AND DEVELOPMENT. XXXI

August through October 1961

Walter D. Hartsough

May 4, 1962

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ADDITIONAL INFORMATION
GENERAL INFORMATION
GENERAL INFORMATION
GENERAL INFORMATION

BEVATRON OPERATION AND DEVELOPMENT. XXXI .

August through October 1961.

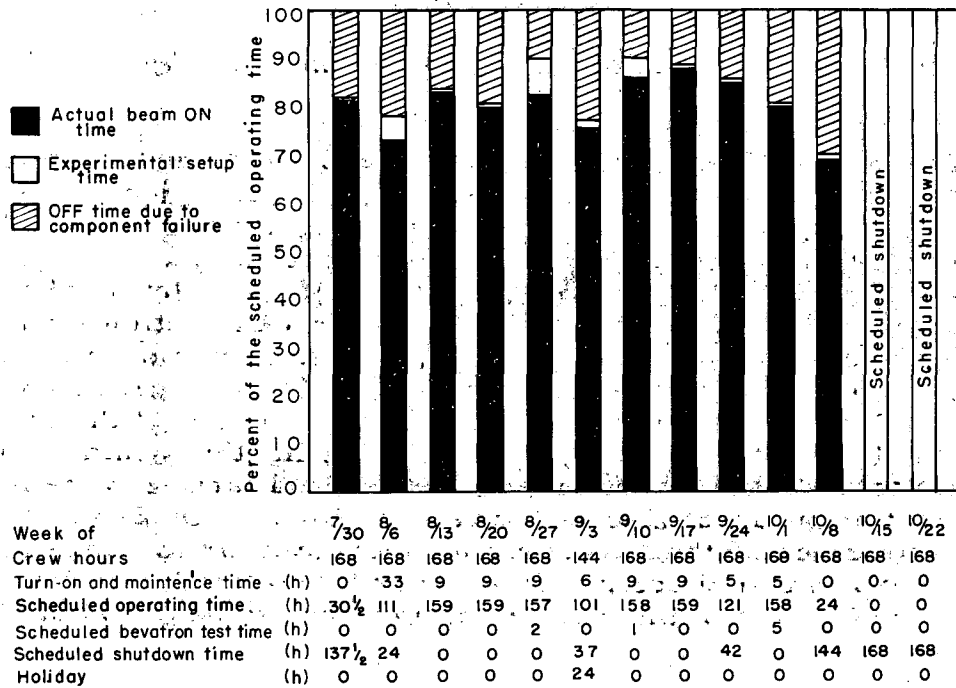
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Abstract

The Bevatron has been operating since August 1961. This report describes the operation and development of the Bevatron during the period August through October 1961. The Bevatron is a proton synchrotron which accelerates protons to a maximum energy of 6.2 GeV. The Bevatron is used for the production of secondary particles and for the study of high energy physics. The Bevatron is a large and complex machine and its operation is a major task of the Lawrence Berkeley Laboratory. This report describes the operation of the Bevatron during the period August through October 1961. The Bevatron is a proton synchrotron which accelerates protons to a maximum energy of 6.2 GeV. The Bevatron is used for the production of secondary particles and for the study of high energy physics. The Bevatron is a large and complex machine and its operation is a major task of the Lawrence Berkeley Laboratory. This report describes the operation of the Bevatron during the period August through October 1961.

* Preceding Quarterly Reports: UCRL-9981, UCRL-9721.



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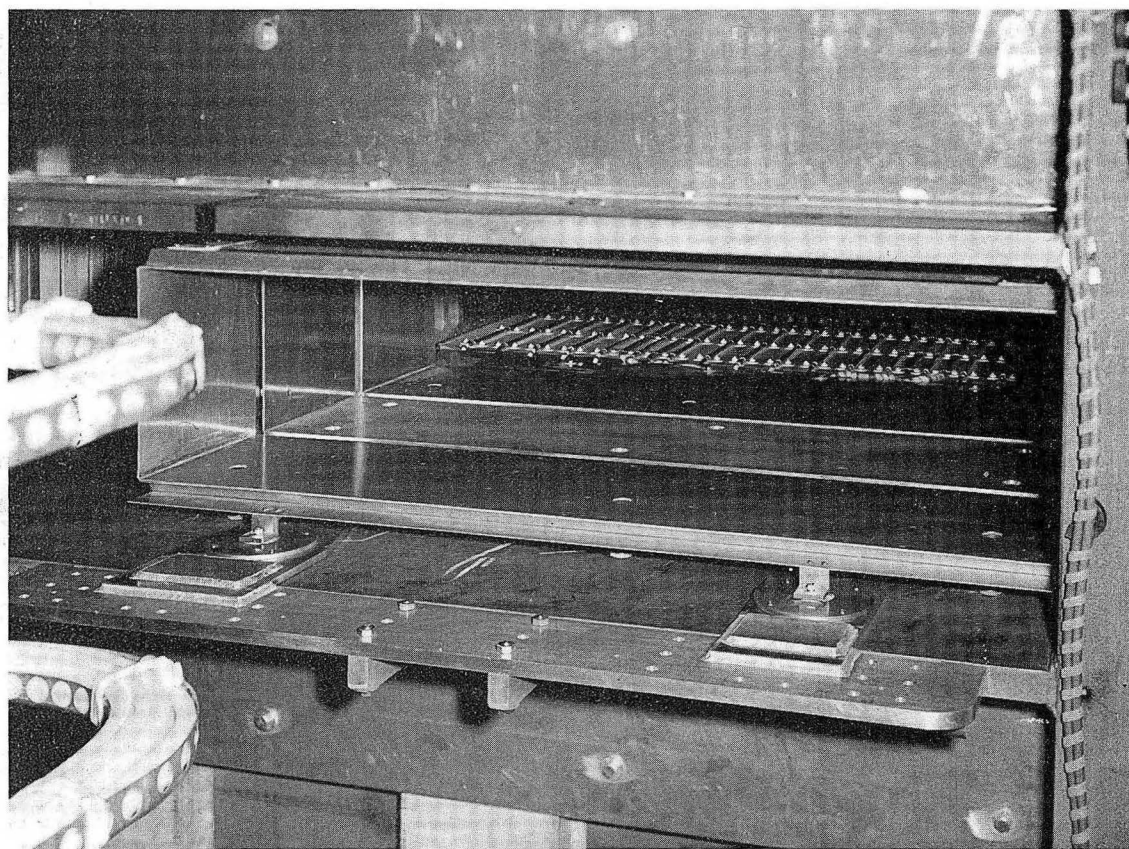
Fig. 1. Bevatron operating schedule, August through October 1961.

Table I. Beam record.

Week of (1961)	Number of 8-hour shifts	Total integrated beam (10^{15} protons)
July 30 - Aug. 5	4	3.7
Aug. 6 - 12	12	2.9
Aug. 13 - 19	21	9.6
Aug. 20 - 26	21	11.0
Aug. 27 - Sept. 2	21	10.0
Sept. 3 - 9	14	4.5
Sept. 10 - 16	21	14.3
Sept. 17 - 23	21	18.2
Sept. 24 - 30	15	9.5
Oct. 1 - 7	21	14.0
Oct. 8 - 14	3	1.1
Oct. 15 - 21	-----Shutdown-----	
Oct. 22 - 28	-----Shutdown-----	
Maximum beam amplitude at full energy = 4×10^{11} protons per pulse		
Maximum injected beam = 625 μ A		
Average beam per 8-hour shift = 5.7×10^{14} protons		

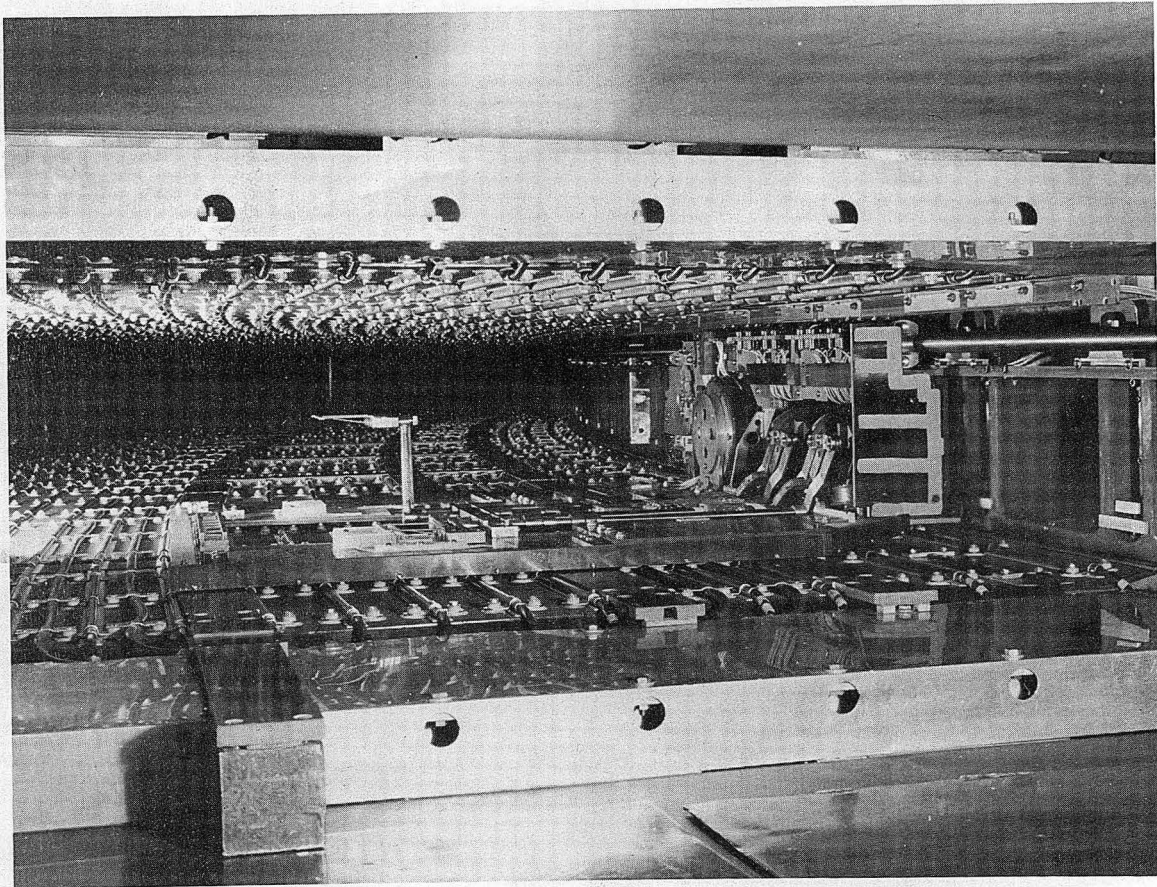
Table II. Analysis of the total lost beam time due to component failure (%)

Month (1961)	Injector	Magnet power supply	rf accelerating system	Other
August	40	6	17	37
September	45	18	13	24
October	85	6	2	7



ZN-3099

Fig. 2. New sum-signal induction electrode located in the transition section at the exit of Quadrant I.



ZN-3100

Fig. 3. Traveling flip target. Entrance of Quadrant III.

AUTOMATIC RADIAL POSITIONING OF THE BEVATRON BEAM

Fred H. G. Lothrop

A servo feedback system for radially centering the proton beam in the aperture of the Bevatron has been built in prototype form and was first tested on the machine on April 21, 1961. After some adjustments the system, dubbed "Autotrack," was put on long-term operational test. The gain of the Autotrack system is about ten and is presently being used to assist the open-loop tracking devices. The Bevatron has been operated to full energy using only Autotrack for frequency correction. This operation has only been on a test basis, but the indication is that in the future, automatic beam-controlled frequency correction may be used to achieve maximum acceleration efficiency.

RESEARCH

The experimental program accomplished during January through July 1961 is summarized in Table III. Table IV lists the experiments done this quarter.

MAGNET POWER SUPPLY

The record of magnet pulsing appears in Table V.

Table III. Summary of Bevatron experimental research program, January through July 1961.

Group	Start of experiment	End of experiment	experiment	Beam time		Pulse schedule	Primary or secondary experiment
				(12-hour periods)	(hours)		
<u>Internal Groups</u>							
Alvarez	4-22-60	6-11-61	π^\pm interactions in hydrogen and deuterium, by using the 72-inch hydrogen bubble chamber (0.9 to 1.6 GeV/c).	304 50	3096 548	1:1 1:2	P
Alvarez	8-9-60	1-24-61	K^- interactions in hydrogen and deuterium, by using the 15-inch hydrogen bubble chamber (740 MeV/c).	119 34	1279 330	1:1 1:2	P
Lofgren	12-7-60	1-31-61	K^+ -p and K^+ -n total cross sections and elastic scattering (1 to 3 GeV/c).	22 10	248 106	1:1 1:1	P
Lofgren	1-27-61	1-31-61	π^+ -p scattering, measurement of angular distribution (1.5, 2.0, and 2.5 GeV/c).	3	25	1:1	S
Segrè	2-5-61	5-28-61	π - π scattering (280-MeV/c to 2.25 GeV/c π^-).	83	769	1:1	P
Barkas	3-9-61	3-15-61	Emulsion exposure (740-MeV/c K^-).	10	87	1:1	P
Lofgren	3-16-61	4-23-61	Spark chamber tests in a π -meson beam.	—	14	1:1	S
Lofgren	4-21-61	6-10-61	Study of Σ , Λ decay polarization, by using spark chambers (1-GeV/c π^+).	38 4	459	1:1	P S
Crowe	6-4-61	7-17-61	Ke_3 , $K\mu_3$ decay spectra (700-MeV/c K^+).	38	426 129	1:1 1:1	P S
Powell	6-10-61	In progress	Study of Λ^0 , Σ^+ , Σ^- leptonic decay, by using the 30-inch propane bubble chamber (700-MeV/c K^-).	33	345	1:1	P

Table III. (continued)

Group	Start of experiment	End of experiment	Experiment	Beam time		Pulse schedule	Primary or secondary experiment
				(12-hour periods)	(hours)		
<u>Internal Groups</u>							
Alvarez	6-11-61	In progress	Study of RBE spill on targets. Preliminary studies for a future experiment.	—	9	1:1	P
Lofgren	7-10-61	7-13-61	Test of a hydrogen Cerenkov counter.	—	30	1:1	S
Segre	7-21-61	In progress	π - π scattering (continuation of run listed above).	11	119	1:1	P
Perlman	Chemistry target bombardments (22) in the internal proton beam.						
<u>External Groups</u>							
	Institution and Experimenter						
Univ. Chicago Northwestern U. Levi-Setti	1-14-61	1-23-61	Emulsion exposure (800-MeV/c K^-). Study of production of hyperfragments.	9	106	1:1	P
Duke Univ. Block	1-27-61	4-10-61	K^- interactions in a helium bubble chamber (740 MeV/c).	65 ^a	636 ^a	1:1	P
U. Tennessee King	3-16-61	3-16-61	Emulsion exposure (740-MeV/c K^-).	—	1½	1:1	P
U. Stockholm Ekspong	4-12-61	4-13-61	Emulsion exposure (700-MeV/c K^-).	2	30	1:1	P
Univ. Miami Perlmutter	4-13-61	4-15-61	Emulsion exposure (700-MeV/c K^-).	1	14	1:1	P
Tufts Univ. Schneps	4-15-61	4-15-61	Emulsion exposure (700-MeV/c K^-).	2	18	1:1	P
Oxford Univ. Wilkinson	4-16-61	4-20-61	Emulsion exposure (700-MeV/c K^-).	9	88	1:1	P
Univ. Washington Masek	7-19-61	7-31-61	Test of a hydrogen Cerenkov counter.	5	50	1:1	S

^aThis experiment was done on a 1:1 and 1:2 pulse basis. The beam-time record, however, represents the equivalent of 1:1 pulse operation.

Table IV. Summary of Bevatron experimental research program, August through October 1961.

Group	Start of experiment	End of experiment	Experiment	Beam time		Pulse schedule	Primary or secondary experiment
				(12-hour periods)	(hours)		
<u>Internal Groups</u>							
Powell	6-10-61	9-19-61	Study of Λ^0 , Σ^+ , Σ^- leptonic decay, by using the 30-inch propane bubble chamber (700-MeV/c K^-).	42 19	455 290	1:1 1:1	P S
Segrè	7-21-61	9-7-61	π - π scattering (280-MeV/c to 2.25-GeV/c π^-).	41	448	1:1	P
Moyer	8-11-61		Test counters for a future experiment.	--	15	1:1	S
Alvarez	8-16-61	8-25-61	Test counters for a future experiment.	--	6	1:1	S
Alvarez	8-29-61	In progress	K^- interactions in hydrogen, by using the 72-inch hydrogen bubble chamber (1.2 to 1.95 GeV/c).	27 5	291 56	1:1 1:1	P S
Moyer	8-28-61	In progress	π^\pm -p differential scattering. Measurement of angular distributions and polarization (0.5 to 1.5 GeV/c).	8 7	81 74	1:1 1:1	P S
Alvarez	9-1-61	In progress	Study the reaction $\pi^-p \rightarrow \pi^+\pi^-n$, using the 72-inch hydrogen bubble chamber (700 MeV/c).	Time is included with the K-meson experiment.			S
Perlman	Chemistry target bombardments (4) in the internal proton beam.						
<u>External Groups</u>							
Institution and Experimenter							
U. Chicago	8-18-61	8-20-61	Emulsion exposure (700-MeV/c K^-).	3	41	1:1	P
U. Michigan Jones, Perl	9-10-61	9-24-61	Study of π^\pm -p elastic scattering (3 to 5 GeV/c).	16 2	213 20	1:1 1:1	P S

Table V. Bevatron motor-generator set monthly fault report.

MONTH	4 to 6 pulses per minute				7 to 9 pulses per minute				10 to 17 pulses per minute				Totals					
	1500 to 6900 A		7000 to 9000 A		1500 to 6900 A		7000 to 9000 A		1500 to 6900 A		7000 to 9000 A		Faults			P/F	Ignitrons replaced	
	Pulses	Faults	Pulses	Faults	Pulses	Faults	Pulses	Faults	Pulses	Faults	Pulses	Faults	Pulses (P)	Arc-backs	Arc-throughs			Total (F)
(1961)																		
Jan.	2001	--	1200	--	5099	--	--	--	6671	--	277091	59	292062	24	35	59	4951	--
Feb.	--	--	--	--	--	--	--	--	4431	--	345853	45	350284	9	36	45	7784	--
Mar.	--	--	--	--	--	--	--	--	3941	--	396827	51	400768	10	41	51	7857	--
April	--	--	--	--	--	--	--	--	4364	--	398449	55	402813	20	35	55	7323	--
May	--	--	--	--	--	--	--	--	2752	--	416350	61	419102	16	45	61	6870	--
June	--	--	--	--	--	--	--	--	9781	--	343112	38	352893	7	31	38	9287	--
July	--	--	--	--	--	--	--	--	3891	--	373182	41	377073	11	30	41	9197	--
Aug.	--	--	--	--	--	--	--	--	10235	--	322324	53	332559	15	38	53	6275	--
Sept.	--	--	--	--	--	--	--	--	5010	--	351237	44	356247	7	37	44	8097	--
Oct.	--	--	--	--	--	--	--	--	1308	--	110165	11	11473	11	--	11	1044	--

ACKNOWLEDGMENTS

Edward J. Lofgren is the Bevatron Group Leader; William A. Wenzel is the Alternate Group Leader. Walter D. Hartsough, with Glen R. Lambertson and Wendell Olson assisting, is in charge of Bevatron Operation. Members of the Operating Crew are: Robert W. Allison, G. Stanley Boyle, Robert W. Brokloff, Ashton H. Brown, Duward Cagle, Norris D. Cash, Frank W. Correll, Ferdinand Dagenais, John R. Ellisen, Robert Gisser, William Kendall, William Lee, Wayne Logan, David Loucks, Kenneth Morgan, and Martin E. Scelnick. The following members of the Operating Group are carrying out support and development projects: Robert Anderson, Perry Arana, Trancuilo Canton, Warren Chupp, Bruce Cork, Kenneth Crebbin, Walter Hartsough, Rudin Johnson, Leroy Kerth, Glen Lambertson, Fred Lothrop, Ross Nemetz, Douglas Pounds, Robert Richter, Joseph Smith, William Wenzel, Glenn White, Emery Zajec, and Theodore Zipf. Engineering Groups were headed by Edward Hartwig, Electrical Engineering; Clarence Harris, Electrical Coordination; Harold Vogel and Gordon Harding, the Motor-Generator Group; and William Salsig, Mechanical Engineering. Donald Milberger was in charge of the Electrical Maintenance Group.

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