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BEVATRON OPERATION AND DEVELOPMENT. 46 April through June 1965

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BEVATRON OPERATION AND DEVELOPMENT. 46

April through June 1965

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ABSTRACT

The Bevatron provided beam for physics research 85% of the scheduled operating time. The first extraction magnet in the external proton beam system was replaced because of a short to ground. Two primary experiments were ended this quarter, one primary experiment was continued through this quarter, and one new primary experiment was started.

I. OPERATION

The Bevatron operation record is shown in Fig. 1. The beam was on for 85% of the scheduled operating time. The beam was off for 8% of the time because of equipment failure and 7% of the time for experimental setup, tuning, and routine checks.

The external-proton-beam-extraction magnets have a ground current protection device that turns the power supplies off if any shorts to ground develop and ground current starts to flow. This protects the vacuum seals and vacuum skin of the Bevatron from carrying high currents. Early in April our first extraction magnet, M 1, developed a short to ground. Investigation of this short indicated it to be at the vacuum feed-through or inside the Bevatron vacuum system, most likely associated with the M 1 magnet itself. The ground protection circuit was modified to allow operation with the existing short but to still provide protection if a larger ground current flowed. The resistance of the short seemed to vary as the magnet (M 1) was pulsed. We decided to operate the magnet dc rather than pulsed. The maximum current was reduced to 1300 amperes dc from 1500 to 1600 amperes peak pulsed. At maximum energy of extraction (6.2 BeV) we compensated for this reduction in current by reducing the radial separation of the two extraction magnets M 1 and M 2. As the first quadrupole (Q 1) also affects the radial displacement of the extracted beam, additional radial deflection was gained by increasing the current in Q 1. We were able to run the external proton beam in this manner with only a slight reduction in extraction efficiency until the shutdown on May 30.

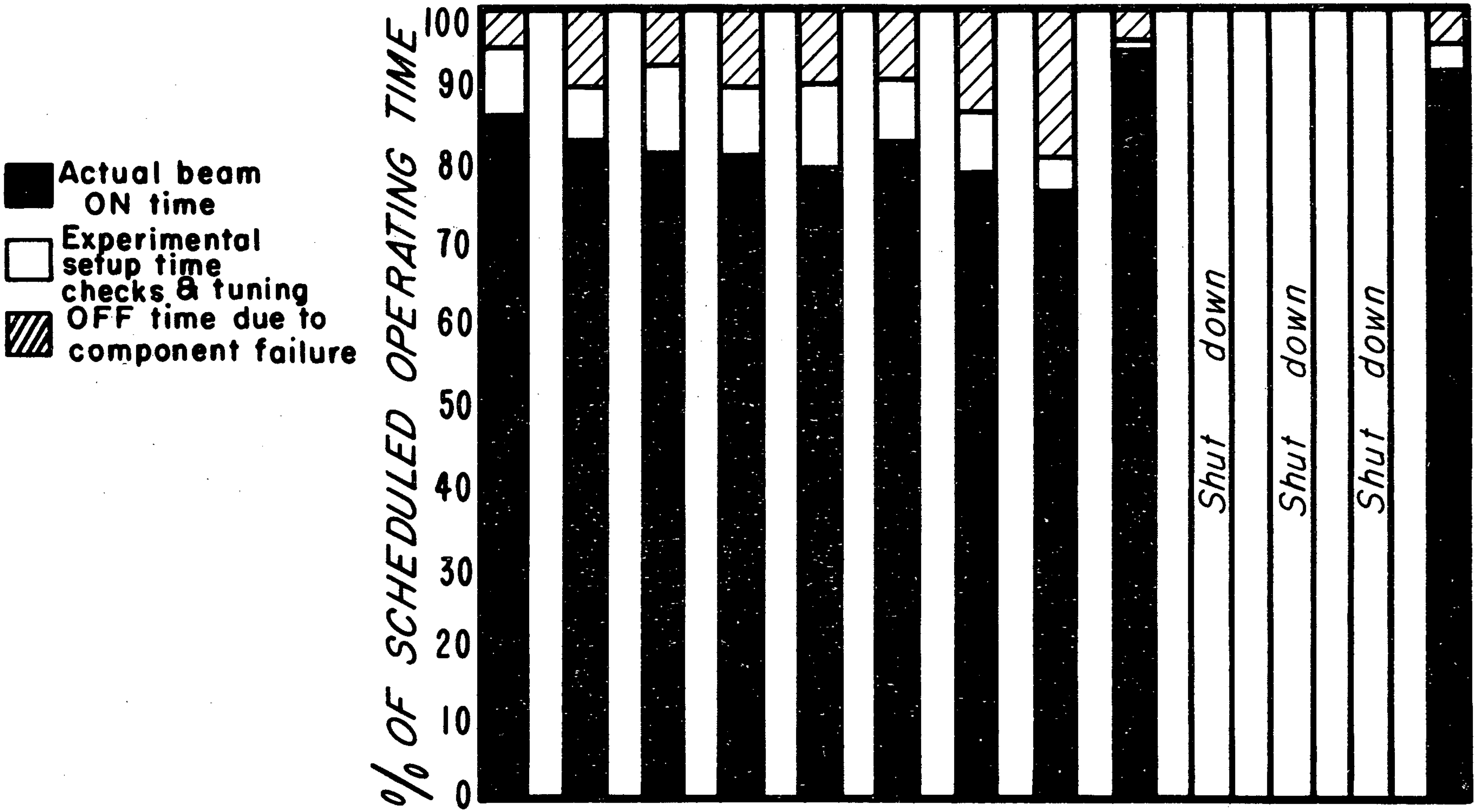
II. SHUTDOWN

The normal 8-hour maintenance-day on April 12 was extended into a 2-day shutdown to install the beam transport system for the SLAC - LRL experiment in the 72-inch hydrogen bubble chamber. The beam transport system was installed from the external-beam first focus area to the 72-inch bubble chamber. Other shutdown work was devoted to routine maintenance and installation jobs.

There was a scheduled 3-week shutdown from May 30 through June 19. During this 3- week period we operated on a three-shift Monday-through-Friday schedule. We returned to our normal three-shift seven-day-a-week schedule on June 20.

There were two major jobs during this shutdown. The first was the installation of the new motor control circuit for the main motor generators. The details of this new system will be covered in the next Bevatron Quarterly Report. [1]

The second major job was the repair of the short to ground in the M 1 magnet or feed-through of the external proton beam extraction system. At the start of the vacuum shutdown the M 1 magnet and feed-through were inspected to pinpoint the short. Pushing on the ground plane of the magnet caused the resistance of the short to change. Examination of the magnet disclosed many cracks in the epoxy insulation of the coil and a large quantity of metal chips in and about the magnet. These chips came from wear of the overhead support and guidance system. Vacuum cleaning in the region of the ground plane also changed the resistance of the ground short. We made the



Week of	4/4	4/11	4/18	4/25	5/2	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27
Crew hours	168	144	168	168	168	168	168	168	144	120	120	168	168
Turnon & maintenance time (h)	10	12	9	11	8	9	10	10	0	0	0	0	8
Scheduled operating time (h)	146	81	152	146	149	143	140	146	24	0	0	0	108
Scheduled Bevatron test time (h)	6	14	7	11	11	16	18	12	0	0	0	0	52
Scheduled shutdown time (h)	16	37	9	0	0	0	0	0	120	120	120	168	0
Holiday (h)	0	24	0	0	0	0	0	0	24	0	0	0	0

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Fig. 1. Summary of Bevatron operation for April through June, 1965.

decision to replace the M 1 magnet with a spare. Subsequent examination showed that the metal chips had gotten into cracks in the epoxy insulation on the magnet windings and shorted the windings to ground. It is possible that the cracks in the epoxy were caused by radiation damage, although there is no way to be certain.

The radiation level at the surface of the M 1 magnet was about 18 R. This made the allowable work time per man in the area fairly short. Each step was carefully planned ahead to maximize the man effort in actually removing and replacing the magnets. If this had not been done, we would have run out of people before the job was completed. The deflection magnet, M 1, and quadrupole magnet, Q 1, were removed as a unit. Before the work began this unit and associated parts, as well as other high-level radiation sources in the tangent tanks, were shielded as well as we could manage, and as much work as possible was done outside the Bevatron tank. The new M 1 and new Q 1 were preassembled on their carriage prior to installation in the Bevatron.

In the past[2-4] we have had some misalignment problems with the support and guidance system of M 1 and Q 1. To help correct this problem a new, more rugged overhead support structure was built. In addition to providing a more rigid support, this assembly provides better position adjustments for the final magnet alignment in the Bevatron.

A rubber sheet was installed on top of the M 1 magnet to protect it from any falling chips that may come from wear caused by misalignment. The design of the Q 1 magnet provided adequate protection from this problem, so no additional protection was necessary.

III. BEVATRON DEVELOPMENT AND STUDIES

Most of the study periods this quarter were devoted to injector tuning, emittance tests, and Bevatron acceptance tests. The bulk of the effort was devoted to improving and expanding our diagnostic equipment. There are no details to report at this time. Some periods were used to study compatibility and beam-sharing problems, particularly problems having to do with beam sharing on two and three targets in the external proton beam channel. The findings in these tests were that it was possible to share beam between two or three targets under some operating conditions. At any given time the experimenters' beam requirements would determine what mode of beam sharing was possible.

IV. EXPERIMENTAL PROGRAM

The Crowe Group's K^+ decay-spectra experiment was continued through this quarter. The Lofgren Group's p-p scattering experiment was ended early in May, and the Trilling-Goldhaber Group's experiment studying the decays and strong interactions with K_2^0 mesons in the 25-inch hydrogen bubble chamber was ended with shutdown on May 30.

A new primary experiment was started at the EPB first focus. This was the SLAC-LRL experiment (No. 41). This new beam channel selects secondary particles at a mean production angle of 7-1/2 deg. This particular experiment is a study of inelastic nucleon-nucleon interactions in the 72-inch hydrogen bubble chamber over an energy range of 4.5 to 6.0 BeV.

A summary of the experimental program for this quarter is shown in Table I.

V. MAGNET POWER SUPPLY

The magnet pulsing record is shown in Table II.

STAFF

E. J. Lofgren	Bevatron Group Leader
Walter D. Hartsough	In charge of Bevatron operations
Kenneth C. Crebbin Fred H. G. Lothrop Wendell Olson	Operation supervision
William Everette	Radiation control
Duward S. Cagle Frank W. Correll Robert G. Gisser William H. Kendall	Operating crew supervisors
G. Stanley Boyle Robert W. Brokloff Ashton H. Brown Gary M. Byer Norris D. Cash Donald N. Cowles Ferdinand Dagenais James R. Guggemos Carles H. Hitchen Arthur K. Ikuma William J. Meserve Robert M. Miller Joseph F. Smith Harvey K. Syversrud Marsh M. Tekawa	Bevatron Operators
Robert W. Allison, Jr. Trancuilo Canton Warren W. Chupp Bruce Cork Kenneth C. Crebbin Tom Elioff Robert Force Leroy T. Kerth Fred H. G. Lothrop Donald Milberger Robert Richter Glenn White William A. Wenzel Emery Zajec	Development and support

Table I. Summary of Bevatron experimental research program, April through June 1965

Group	Experiment dates: Start	Experiment dates: End	Experiment	Beam time: This quarter (Apr.-June) 12-h periods	Beam time: This quarter (Apr.-June) Hours	Beam time: From start through June 1965 12-h periods	Beam time: From start through June 1965 Hours	Pulse schedule	Primary or secondary experiment
Internal groups									
Lofgren (No. 20a)[a]	1-13-65	5-6-65	p-p Scattering	5	48	79	792	1:1	P
	12-13-64	3-13-65		0	0	20	240	1:1	S
Crowe (No. 22)	12-11-64	In progress	K^+ Decay spectra	67	725	90	979	1:1	P
		In progress		0	0	39	424	1:1	S
Trilling-Goldhaber (No. 27)	3-3-65	5-30-65	K_2^0 in 25 inch bubble chamber	82	839	97	988	1:1	P
				0	0	21	209	1:1	S
Murray (No. 39)	2-11-65	5-28-65	Septum separator tests	0	0	0	4	1:1	P
				5	73	11	143	1:1	S
Alvarez (No. 45)	5-7-65	5-7-65	Tuneup for future scheduled experiments	0	0	0	0	1:1	P
				1	5	1	5	1:1	S
Segre-Chamberlain (No. 41)	4-27-65	In progress	Scatter p^+ in 72-inch H_2 bubble chamber	44	476	44	476	1:1	P
				7	67	7	67	1:1	S
External groups									
U. of Carolina (Childs)	5-27-65	5-27-65	Crystal exposure	1/2	-	1/2	-	1:1	P
SLAC (No. 41) (Perl)	4-27-65	In progress	Scatter p^+ in 72-inch H_2 bubble chamber	44	476	44	476	1:1	P
				7	67	7	67	1:1	S

a. Numbers in parentheses are experiment numbers.

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

Month (1965)	4 to 6 pulses per minute						7 to 9 pulses per minute						10 to 17 pulses per minute						Totals					Comments
	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				
	Pulses	Faults[a] 14	26	Pulses	Faults[a] 14	26	Pulses	Faults[a] 14	26	Pulses	Faults[a] 14	26	Pulses	Faults[a] 14	26	Pulses	Faults[a] 14	26	Pulses (P)	Arc-backs	Arc-through	Total (F)	P/F	
Jan.	1,566			1,732						2,397	2		26,909			246,571	19	42	279,175	21	42	63	4431	
Feb.	4,501			1,358						10,422			89,963	4	4	168,801	14	31	275,045	18	35	53	5189	
March							454						246,308	10	10	145,517	22	30	392,279	32	40	72	5448	
April							245			49,942	2	2	160,776	12	28	11,422		2	222,385	14	32	46	4834	
May	2,539						4,039			2,071	1		310,039	16	35	34,413	4	6	353,155	21	41	62	5696	
June	10,095			272			945			1,496			68,818	2	5	3,317			84,943	2	5	7	12,135	
July																								
Aug.																								
Sept.																								
Oct.																								
Nov.																								
Dec.																								

[a] 14 indicates an arc-back, 26 indicates an arc-through.

Edward Hartwig Robert Force	In charge of Electrical Engineering Group
Marion Jones	In charge of Electrical Coordination Group
Harold Vogel	In charge of Motor Generator Group
Donald Milberger	In charge of Electrical Maintenance Group
Kenow Lou Cedric Larson Abraham Glicksman	In charge of Mechanical Engineering Group

REFERENCES

1. Kenneth C. Crebbin and Robert Frias, Bevatron Operation and Development. 47, July through September 1965, UCRL-16554.

2. Kenneth C. Crebbin, Robert Frias, William L. Everette, and Walter D. Hartsough, Bevatron Operation and Development. 41, January through March 1964, UCRL-11560, July 1964.

3. Kenneth C. Crebbin, William L. Everette, and Walter D. Hartsough, Bevatron Operation and Development. 40, October through December 1963, UCRL-11383, July 1964.

4. Kenneth C. Crebbin, William L. Everette, Calvin F. Hansen, and Harold W. Vogel, Bevatron Operation and Development. 39, July through September 1963, UCRL-11279, April 1964.