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PHYSICS RUN ANALYSIS NO. 3 - 1979

Periods 4 and 5 - Run 1058 to Run 1071

(29 September to 31 October 1979)

1. INTRODUCTION

After the July/August shutdown, operation started without any major difficulty.

No important changes took place at the intersections. In I1, R110 has been completely installed. R807 is continuing their installation programme and some rearrangement in detectors took place for R416 and R806.

The physics demand for periods 4 and 5 was exclusively at 22 GeV/c and has been successfully satisfied. Continuous running at this energy made it possible to gradually increase the currents stacked and as a consequence, new luminosity records were attained with currents of up to 37 A and L = 27 10^{30} $cm^{-2}s^{-1}$ (run 1070) in normal intersections (in I1: L × 2.3). Due to the increase of initial luminosities, to machine reliability and to smaller dL/dt, physics runs lasted much longer (compared to previous 22 GeV/c runs), the average being 40 to 55 h stable beam physics.

The vacuum leak in sector 51, which perturbed the end of the running periods with limited current in Ring 1, has been successfully repaired, the cause being microscopic holes due to corrosion in a circular bellow. A similar case was found in sector 7.

At the beginning of period 4, some difficulties were experienced with a faulty valve giving insufficient water cooling to the main magnets and with closed orbit measurements due to new computer interfaces. Both were, however, cured rapidly.

Throughout these two periods, operation continued with an independent 18 kV transformer for the ISR power. In order to make a comparison, the ISR net was reconnected to the three CERN main transformers for run 1069. Consequent bad beam conditions made it necessary to come back to the single transformer configuration.

2. FILLING CONDITIONS (see Table 1)

The magnetic machine was continuously operating with SB22 working lines (ELSA type), including low-beta quadrupoles, the SC solenoid and the OAFM (except for run 1066).

It has been proven that the contribution of the OAFM on the closed orbit as well as the tilt produced at the intersections when the magnet is powered is negligible (see Performance Report by D. Swoboda, ISR-BOM/DS/ml dated 25.10.1979, Run 1069 - 22 GeV/c).

Great care has been taken to minimize the effects of large closed orbit distortions over the full aperture. In most cases, 10 mm in the H-plane and 6 mm in the V-plane were obtained after correction. For some runs, however, it was difficult to obtain good orbits at the top and at the bottom. Automatic space charge compensation during stacking has continuously been used, thus reducing by an appreciable amount the time needed for filling.

After the high current losses observed during previous periods, it has been decided to check and update the stack centering files for 22 GeV/c. Good results were obtained and as a consequence stacking over the maximum aperture was possible. Then, a centering of the beams by 10 mm after stacking was usually performed.

Interesting results have been obtained from beam transfer functions analyses with the FFT device. The coupling strength and beam stability have been measured which allowed to apply the necessary corrections (see Performance Report by J.P. Koutchouk, ISR-OP/JPK/svw dated 17.8.1979, Run 1055 - 22 GeV/c).

3. PHYSICS RUNNING CONDITIONS

A summary of the physics parameters is given in Table 2.a). 16 runs at 22 GeV/c, including the refills, gave a total stable beam time of 560 hours and provided a total integrated luminosity of 330 10^{35} $cm^{-2}s^{-1}$, as measured in I5 with the reference monitor.

Throughout the two periods, spurious spikes with current losses between 100 and 500 mA were the main perturbing events, especially in Ring 2 (runs 1058, 1059, 1061, 1062, 1064, 1067). After the consequent

background increase, considerable improvements were reached by relaxing the collimation system. In order to better correlate power supply spikes with beam perturbations, more than 300 spike detectors have been put into operation. Via fast computer monitoring programs, diagnostics could be improved and suspected power supplies repaired. As usual, the most perturbed intersection by spikes is I4 and to a lesser extent I2. I6 is generally not affected by spiky beam conditions which is probably due to its small acceptance.

At the end of run 1064, partial beam 2 losses with respectively 1.7 A, 1 A and 1.5 A over a few minutes could not be explained. An oscillating power supply could be localized, but there was no evidence of this being the cause for the disturbances. The mysterious Ring 2 background modulation appeared during run 1069, when the ISR net was connected to the three transformers, and perturbed most of the intersections. The structure disappeared for a while in I7, when outer scraping was performed, and in I4, when a vertical scraping was done. Nevertheless, modulations with irregular amplitudes were present during the whole run.

In order to better understand other problems in Ring 2 (higher background small and large current losses), "end of run" tests were performed, including closed orbit measurements in stack, Q-diagram meter scans and coupling measurements (runs 1061, 1067, 1068, 1071). These tests, however, did not reveal any evident faults.

4. BEAM LOSSES DURING STABLE BEAMS

During two runs, beam 1 was lost due to a spurious beam dump trigger. No real failure of the beam dump system could, however, be detected.

Run 1059	:	R1 lost	:	beam dump trigger ?
Run 1059 Refill	:	R1 + R2 lost	:	18 kV fluctuation
Run 1061	:	R1 lost	:	beam dump trigger ?
Run 1068	:	R1 lost	:	spike on 18 kV
Run 1069	:	R2 lost	:	power supply fluctuation
Run 1070	:	R2 lost	:	during Q-shift

5. CONCLUSIONS

- Higher luminosities have been achieved by gradually increasing the stacked currents.
- I6 main user of 22.5 GeV/c achieved very stable conditions, while I2 for beam 1 and I4 for beam 2 needed collimator adjustments and clean-ups.
- To connect the ISR to a single independent transformer gives much more stable conditions with lower backgrounds, particularly in I4.
- Large and small current losses, mainly in Ring 2, are still unexplained.

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FILLING PARAMETERS
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RUN	P1 P2 GEV/C	WL1	WL2	SHAVING		DENSITY A/MM		STACK TOP		STACK BOTTOM		I.INITIAL AMP.		HEFF MM		DH/DT :/H INIT.	L.INIT 10E30
				R1	R2	R1	R2	R1	R2	R1	R2	R1	R2	IN.	IN.		
1058	22/22	SB	SB	30	30	.53	.54	33	31	-26	-27	31.20	31.86	5.3	7.1	1.3	18.9
1059	22/22	SB	SB	30	30	.49	.47	32	33	-31	-30	30.97	30.04	5.6	5.7	.4	16.5
1059	22/22	SB	SB	30	30	.48	.47	32	34	-29	-31	29.46	29.76	5.4	7.3	.6	16.2
1061	22/22	SB	SB	30	30	.52	.52	35	33	-26	-31	31.68	33.21	4.5	6.2	1.5	23.4
1061	22/22	SB	SB	25	25	.62	.52	35	32	-28	-31	35.25	31.65	5.7	6.7	1.2	19.4
1062	22/22	SB	SB	30	30	.44	.49	34	32	-35	-30	30.90	30.12	4.9	7.4	1.7	18.9
1064	22/22	SB	SB	30	30	.55	.55	34	33	-29	-30	31.63	32.69	5.0	8.5	.6	20.0
1066	22/22	SB	SB	30	30	.53	.53	30	34	-31	-28	32.30	32.38	4.8	6.8	1.1	21.9
1067	22/22	SB	SB	30	30	.60	.55	33	32	-30	-31	33.65	31.49	5.2	7.0	1.3	20.5
1067	22/22	SB	SB	30	30	.48	.50	33	38	-34	-30	29.19	31.35	4.9	6.7	1.0	18.8
1068	22/22	SB	SB	30	30	.49	.53	30	33	-32	-28	30.07	31.92	5.0	7.9	.9	19.2
1069	22/22	SB	SB	30	30	.58	.56	33	34	-28	-27	35.35	33.52	5.1	6.5	1.1	23.0
1070	22/22	SB	SB	30	30	.62	.61	34	31	-26	-30	36.95	36.66	5.0	5.8	.7	26.7
1070	22/22	SB	SB	30	30	.55	.48	34	34	-30	-29	32.83	29.95	4.9	6.8	1.2	20.2
1071	22/22	SB	SB	30	30	.40	.54	37	33	-31	-30	27.58	34.42	4.8	6.9	1.6	19.6
1071	22/22	SB	SB	30	30	.54	.55	34	30	-28	-30	33.42	33.21	4.6	6.6	.9	24.3

TABLE 1

PHYSICS PARAMETERS
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RUN	P1 P2 GEV/C	WL	WL	STACK MM				I.INIT AMP		I.FIN AMP		DI/DT PPH/MN		L.AVE 10E30	TIME HOURS	WORKING CONDITIONS FOR EXPERIMENTERS RING 1 INTERSECTIONS							RING 2 INTERSECTIONS						
				TOP		BOTTOM										I1	I2	I4	I5	I6	I7	I8	I1	I2	I4	I5	I6	I7	I8
		R1	P2	R1	R2	P1	P2	R1	R2	R1	R2	R1	R2																
1058	22/22	SB	SB	33	31	-26	-27	31.20	31.86	29.47	31.02	13	5	15.8	38	2	2	2	2	2	0	2	2	2	2	2	2	0	2
1059	22/22	SB	SB	32	33	-31	-30	30.97	30.04	0.00	30.01	10	1	16.4	3	0	2	2	2	2	0	2	0	2	3	2	2	0	2
1059	22/22	SB	SB	32	31	-29	-31	29.46	29.76	0.00	0.00	7	17	13.1	49	0	3	2	2	2	0	2	0	2	3	2	2	0	2
1061	22/22	SB	SB	35	33	-26	-31	31.68	33.21	0.00	32.77	6	2	19.8	27	0	2	2	2	2	0	2	0	2	2	2	2	0	2
1061	22/22	SB	SB	35	32	-28	-31	35.25	31.65	34.18	30.61	8	8	17.7	24	2	2	2	2	2	0	2	2	2	2	2	2	0	2
1062	22/22	SB	SB	34	32	-35	-30	30.90	30.12	28.99	29.07	11	5	15.2	54	2	2	2	2	2	0	2	2	2	2	2	2	0	2
1064	22/22	SB	SB	34	33	-29	-30	31.63	32.69	28.70	26.27	16	11	14.4	52	0	3	2	2	2	0	2	0	3	3	2	2	0	2
1066	22/22	SB	SB	30	34	-31	-28	32.30	32.38	30.88	31.39	10	2	18.1	37	0	2	2	2	1	0	1	0	2	2	2	1	0	1
1067	22/22	SB	SB	33	32	-30	-31	33.65	31.49	31.12	29.26	12	6	16.7	41	0	2	2	2	1	0	2	0	2	2	2	1	0	2
1067	22/22	SB	SB	33	33	-34	-30	29.19	31.35	27.79	30.89	11	3	15.6	38	2	2	2	2	2	0	2	2	2	2	2	2	0	2
1068	22/22	SB	SB	30	33	-32	-28	30.07	31.92	0.00	29.20	16	7	14.7	55	2	2	2	2	2	0	2	2	2	2	2	2	0	2
1069	22/22	SB	SB	33	34	-28	-27	35.35	33.52	34.65	0.00	10	13	20.2	16	3	3	3	3	2	0	3	3	4	4	3	3	0	4
1070	22/22	SB	SB	34	31	-26	-30	36.95	36.66	0.00	0.00	5	2	24.8	14	2	2	2	2	2	0	2	2	2	3	2	2	0	2
1070	22/22	SB	SB	34	34	-30	-29	32.83	29.95	30.49	29.04	15	6	16.6	40	0	2	2	2	2	0	2	0	2	2	2	2	0	2
1071	22/22	SB	SB	37	33	-31	-30	27.58	34.42	26.63	32.27	4	5	15.9	34	2	2	2	2	2	0	2	2	2	2	2	2	0	2
1071	22/22	SB	SB	34	30	-28	-30	33.42	33.21	31.97	32.20	10	2	19.9	38	2	2	2	2	2	0	2	2	2	2	2	2	0	2

NO DATA.....0

VERY GOOD....1

GOOD.....2

FAIR.....3

BAD.....4

TABLE 2.a)

SPECIAL COMMENTS
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RUN	
1058	LB+SOL+AFM QUIET COND.SMALL CURRENT LOSSES IN R2.
1059	LB+SOL+AFM.SPIKES PERTURBED COND.IN I4.R1 LOST DUE TO UNKNOWN FAULT
1059	REFILL.LB+SOL+AFM.FAST BLOW-UP IN R1.SOME SPIKES IN R1+R2.
1059	BOTH BEAMS LOST DUE TO 18KV.
1061	LB+SOL+AFM.STABLE AND QUIET COND.R1 LOST DUE TO UNKNOWN FAULT
1061	REFILL R1.LB+SOL+AFM.CLEAN-UP FOR I2.SOME SPIKES IN BOTH BEAMS
1062	LB+SOL+AFM.GOOD COND.DETERIORATING FOR I2.CLEAN-UPS MANILY FOR I2.
1062	SMALL CURRENT LOSSES IN R1.
1064	SOL+LB+AFM.GOOD COND.CLEAN-UPS FOR I2.SPIKES WITH HIGH BEAM LOSSES IN R1+R2
1066	LB+SOL+AFM.VERY GOOD AND STABLE WORKING COND.CLEAN-UPS FOR I4
1067	SOL+LB+AFM.GOOD COND WITH GROWNING-UP BACKGROUND FOR I2.SPIKES IN R1
1067	REFILL.LB+SOL+AFM.GOOD COND.CLEAN-UPS FOR I2.COLL VERY EFFECT IN BG REDUCT.
1068	SOL+LB+AFM.GOOD COND.LARGE SPIKES IN R2.R1 LOST DUE TO 18KV SPIKES
1069	SOL+LB+AFM.BACK STRUCTURE IN R2,SMALL AND LARGE CURRENT LOSSES IN R2
1069	BEAM 2 LOST DUE TO POWER SUPPLY FLUCTUATION
1070	SOL+LB+AFM.GOOD TO FAIR COND.IN I4.BOTH BEAMS LOST DURING Q-SHIFT IN R1
1070	REFILL.SOL+LB+AFM.GOOD COND.SMALL SPIKES IN R1+R2.CLEAN-UPS MAINLY FOR I2.
1071	LB+SOL+AFM.PRETTY GOOD CONDITIONS.
1071	LB+SOL+AFM.LOW BG.GOOD COND. SMALL SPIKES IN R2.

TABLE 2.b)