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E-6

ISR-MA/RP/PJB/JPG/JB/cd

9th August 1973

ISR PERFORMANCE REPORT

Run 334 - 30th July 1973

Rings 1 and 2 - 22 GeV/c - 20 bunches (1 in 3)

SFM Running-in (No. 1 - 22 GeV/c at 1.0 T)

Conclusions

During $2\frac{1}{2}$ hours, which was the only operational period for this whole run, most of the scheduled SFM tests were made, although not always in both rings. The first injected pulse in each ring went straight in to give a circulating beam of 90 mA approximately. The working lines and closed orbits showed no adverse effects due to the SFM. There was just enough time available to make a 9 A stack in Ring 2 and again no adverse effects of the SFM were apparent.

Measurements and Results

Using the 5C22 working line and the SFM at the 1.0 T field level, a circulating beam was obtained in each ring with the first pulses. After injection optimisation had been carried out and the protection scrapers had been positioned, checks on the closed orbit and working lines were made. The affect of the trim flap was measured in Ring 2 and after the security checks a stack was made. Finally the SFM was switched off and the unperturbed orbit position in Ring 1 was measured.

1) Closed Orbit

a) Pickups

Unfortunately only the Ring 2 pickup system was working. Table 1 compares the results obtained in Ring 2 with orbit measured in the previous run (on 22FP). The distortion (at injection) was in fact less with the SFM, which is probably due to the Q-shift between the lines or perhaps the fringe fields of experimental magnets. The increase in vertical distortion across the aperture with the SFM is not readily explainable (it may exist without the SFM).

Beam position mm α_p av.	Ring 2 distortion with SFM				Without SFM (Run 336F, 22FP)			
	Horizontal		Vertical		Horizontal		Vertical	
	pk.to pk.	r.r.s.	pk.to pk.	r.m.s.	pk.to pk.	r.m.s.	pk.to pk.	r.m.s.
- 42 (inj)	8.2	1.5	3.0	0.8	9.5	1.7	3.1	0.8
- 2.5	6.0	1.2	3.8	0.9	-	-	-	-
+ 44	6.4	1.3	6.0	1.5	-	-	-	-

Table 1 - Orbit Distortions in Ring 2 With and Without SFM

b) SFM Position Monitor

The position of a single pulse was measured in Ring 1, with and without the SFM switched on, using the magnetic detector. We found the following results :

		SFM off	SFM on
Acceleration to	$\bar{x}$ (from RF measurement)	0.0 mm	0.0 mm
		- 90.58 mm	
Without scraping 105 mA	x_{SFM} (pot. reading)	+ 47.15 mm	- 43.43 mm
	y_{SFM}	+ 3.40 mm	+ 3.45 mm
		+ 0.05 mm	
		- 90.60 mm	
After inner scraping 100 mA	x_{SFM}	+ 47.78 mm	- 42.83 mm
		- 90.58 mm	
After more scraping 94 mA	x_{SFM}	+ 48.36 mm	- 42.22 mm

In Ring 1, the horizontal position measurement is done 3.80 m downstream from the intersection point and 3.91 m for the vertical position measurement. The measured orbit displacements with the SFM on are : 90.6 mm in the horizontal plane against the theoretical value of 89.8 mm* and + 0.05 mm in the vertical plane**.

* The 0.8 mm horizontal displacement error indicates a mismatch of 64 Gm (approx.) in the compensators. It is not possible with this measurement alone to say which compensator.

** Theoretically there should be no vertical beam displacement. The 0.05 mm is probably due to a shift in the vertical closed orbit arising from the small changes in β and μ around the ISR.

The displacement of the center of gravity when progressively scraping the pulse from the inside is somewhat larger than expected and will have to be checked in the future.

2) Working lines

The working lines is both rings were measured and the results are shown in Figures 1 and 2. The working lines are virtually unchanged (a slight change at injection) but no correction is thought to be necessary. Towards the end of the run, the SFM was switched off but no new injection optimisation was needed to inject on the 5C22 working line.

3) Trim Flap

The trim flap can be used to change the integrated gradient through the SFM. This makes it possible to introduce corrective Q-shifts when necessary. Table 2 gives the Q-values measured on central orbit for various settings of the trim flap and Figure 3 gives a graphical representation of those same results.

Beam position (α_p.av.) mm	Trim Flap Setting mrad	Q_H	Q_V
.02	- 4.2	.541	.600
.09	18.0	.549	.597
.10	36.0	.555	.592

Table 2 - Variation of Q-values with Trim Flap Setting on the Central Orbit in Ring 2

From these results, the trim flaps can be calibrated for central orbit (Ring 2) :

$\Delta Q_H = 3.5 \times 10^{-4}\ \Delta\theta$ (theoretical value, $\Delta Q_H = 3.1 \times 10^{-4}\ \Delta\theta$)

$\Delta Q_V = -2.0 \times 10^{-4}\ \Delta\theta$ (theoretical value, $\Delta Q_V = -\ 2.2 \times 10^{-4}\ \Delta\theta$)

$\Delta Q_H = -\ 1.75\ \Delta Q_V$

where $\Delta\theta$ is in mrad.

Insufficient time was available to study the trim flap's effect across the chamber. However, it was noticed that a pulse circulating on the injection orbit would be lost if the trim flap was moved to its extreme value of - 4.2 mrad. Some further work is required to be sure of the reason for this.

4) <u>Security Tests</u>

These tests had the purpose of verifying that the ISR beams are dumped and that the SFM power supplies are switched off in the event of a fault in one of the elements of the system.

The first test took place at the very beginning of the run by turning the SFM key to "on"; the beams of the preceding physics run were dumped.

Before stacking the following tests were made with the interlock beam dump switch in "separate" operation position :

- simulated fault in SCM1 : beam in Ring 1 dumped, SCM1 power supply off.
- simulated fault in SCM2 : beam in Ring 2 dumped, SCM2 power supply off.
- simulated fault in LCM1 : beam in Ring 1 dumped, LCM1 and LCM2 power supplies off, beam lost in Ring 2.
- simulated fault in LCM2 : beam in Ring 2 dumped, LCM1 and LCM2 power supplies off, beam lost in Ring 1.

The interlock beam dump selector was then put on "parallel" operation position to allow safe stacking. In this position any fault will dump both beams.

At the end of the run, the system was stopped by pressing the SFM emergency off button : both beams were dumped and all SFM power supplies went off.

5) <u>Stacking</u>

Towards the end of the run, a stack of 9.25 A was made in Ring 2, with the following parameters :

Top : + 39 mm, Bottom : + 18 mm,
Step-back : 7.5 Hz (7.4 steps/mm),
90 mA/pulse (no shaving), final current : 9.25 A,
5C22 working line and SFM at 1.0 T.

Stacking would have continued but for lack of time. Figure 4 shows the Vosicki and Schottky scans of the final stack. As far as can be seen, the stack shows no adverse effects from the SFM.

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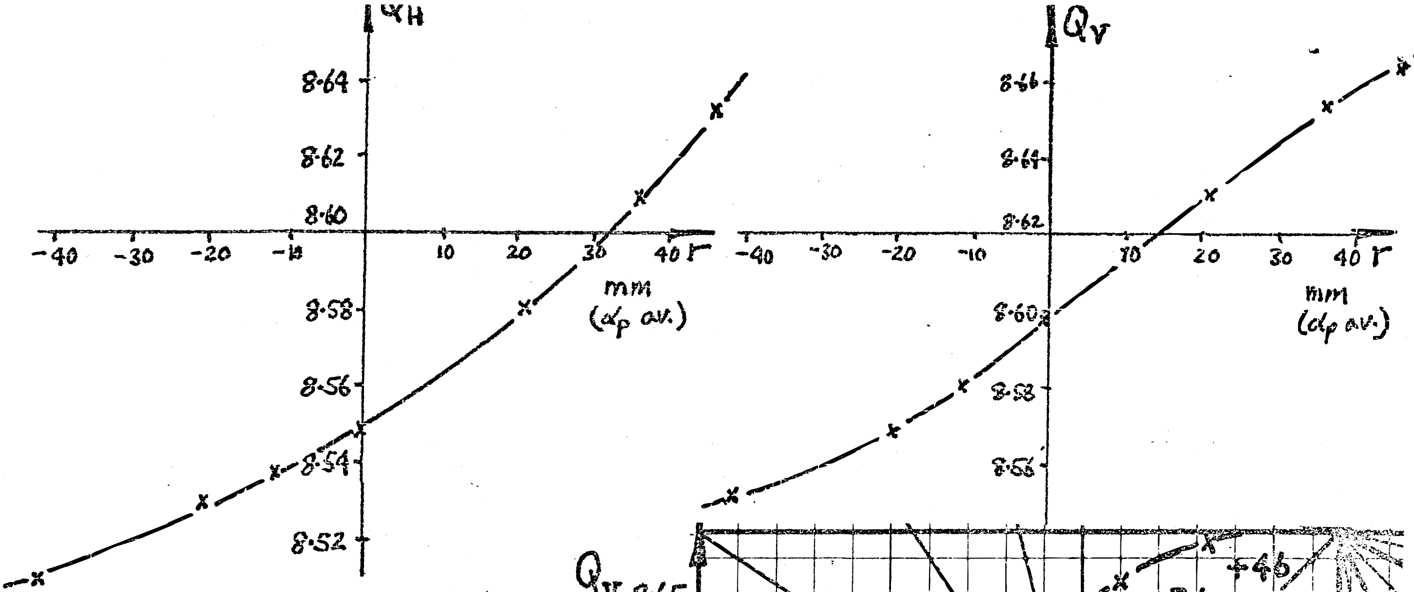


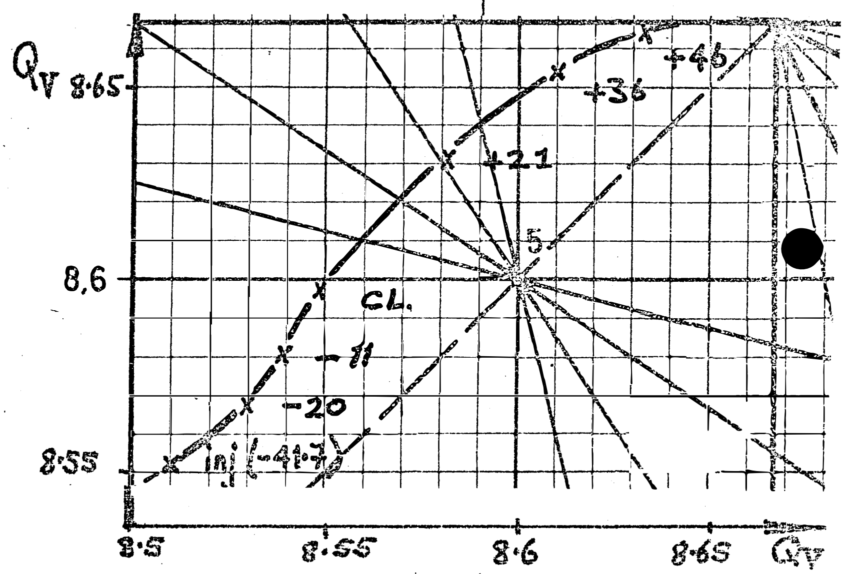
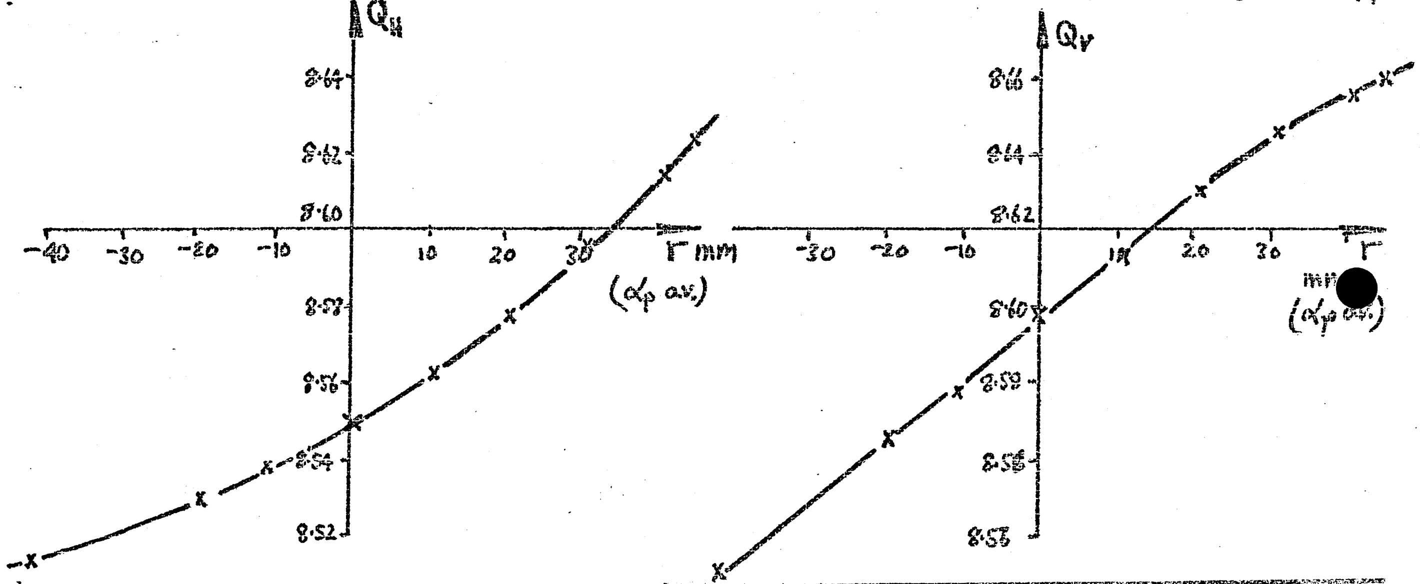


Figure 1 - 5C22 Working Line in Ring 1, with SFM at 1.0 Tesla



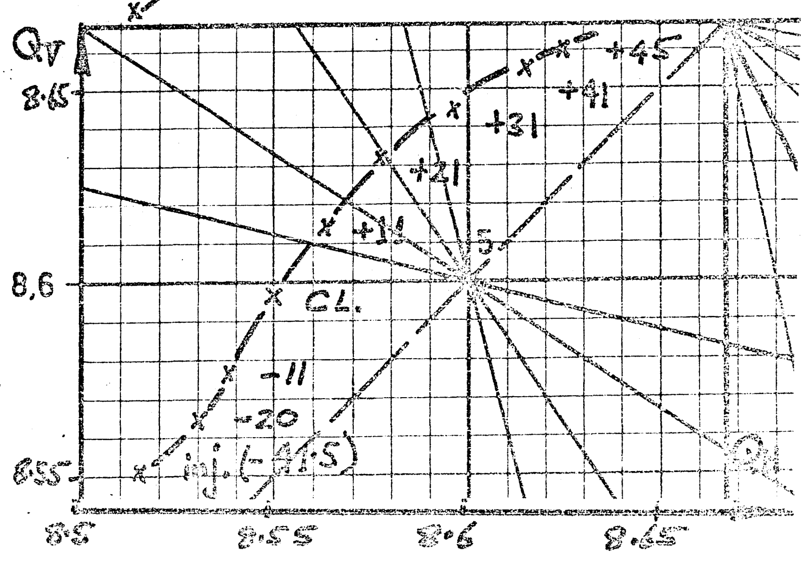


Figure 2 - 5C22 Working Line in Ring 2, with SFM at 1.0 Tesla

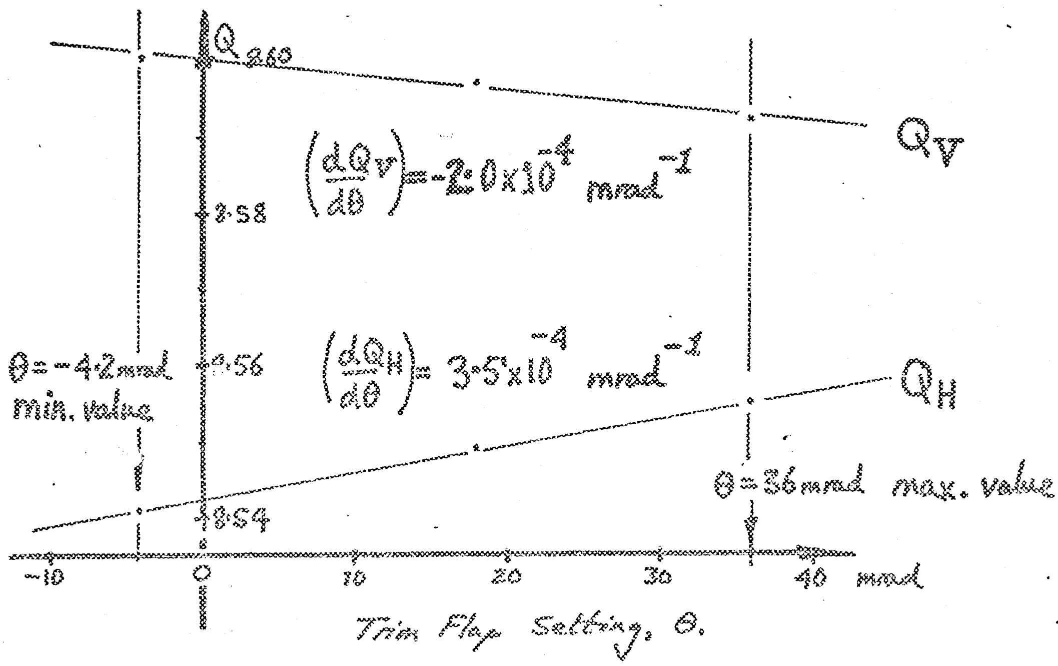
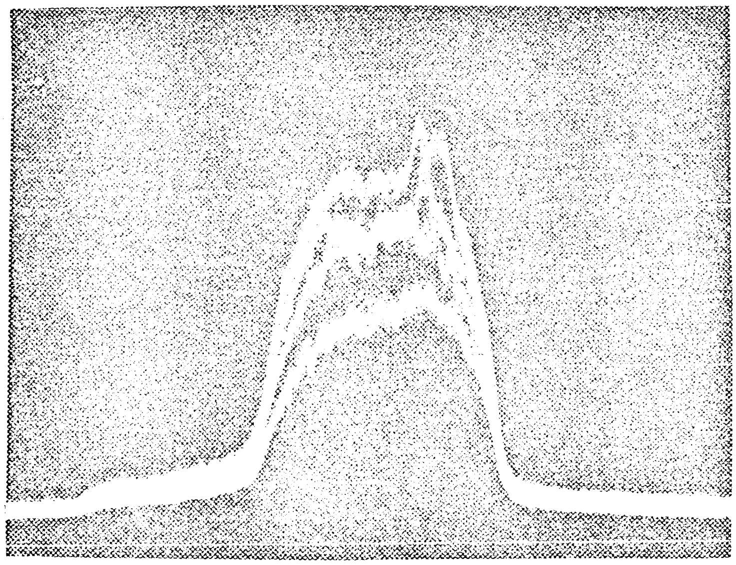


Figure 3 - Q-Shifts for Various Trim Flap Settings in Ring 2

Vosicki Scan



Schottky Scan

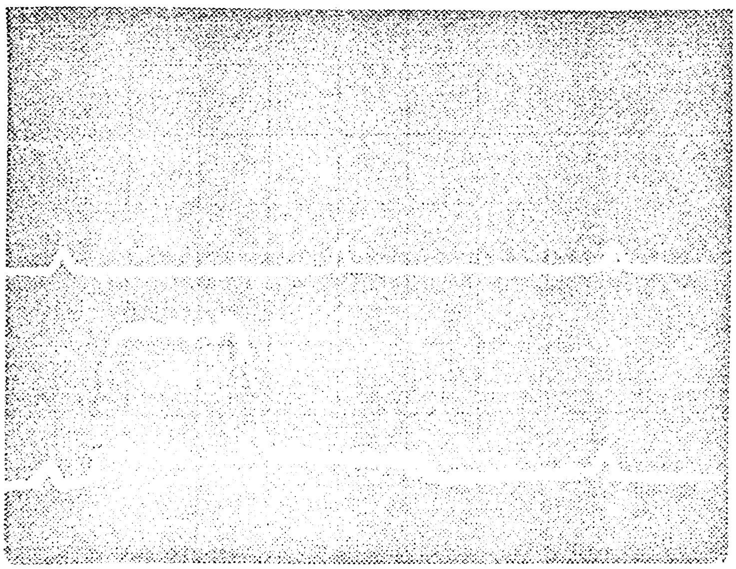


Figure 4 - Vosicki and Schottky Scans of a 9.25 A stack
in Ring 2 on 5022 with the OEM at 1.0 Tesla.