Run 98 - 12 August 1971 - 10.00 to 13.00 h
Ring 2 - 22 GeV/c - 4 bunches

The influence of closed orbit corrections on resonances
(continued from Run 90)

This run was devoted to investigating the influence of
harmonics excited on the vertical closed orbit using the radial
field magnets. All machine parameters were made identical to
those of Run 90, so that it would be possible to compare directly
the results obtained in the two runs.

Machine status

The working line in file PS22 was applied to Ring 2. The
Q values on this working line and the corresponding Q values
measured in Run 90 are shown below. Both sets of values were
taken using the ramp generator and agree very closely.

<table>
<thead>
<tr>
<th>Position</th>
<th>Current Run</th>
<th>Run 90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$Q_H$</td>
<td>$Q_V$</td>
</tr>
<tr>
<td>inj.</td>
<td>8.579</td>
<td>8.554</td>
</tr>
<tr>
<td>+20 mm</td>
<td>8.599</td>
<td>3.579</td>
</tr>
<tr>
<td>+40 mm</td>
<td>--- *</td>
<td>8.600</td>
</tr>
<tr>
<td>+60 mm</td>
<td>--- *</td>
<td>8.626</td>
</tr>
<tr>
<td>+70 mm</td>
<td>--- *</td>
<td>8.640</td>
</tr>
</tbody>
</table>

*Q$_H$ not measurable as horizontal kicker for Q-meter
did not function correctly.

The resonance pattern in the aperture scan however was
very different to the one found in Run 90 (see Figure 1).
This scan was checked at different times during the run and
was found to be stable. The exact cause of this difference
was not found.
Effect of closed orbit harmonics (excited by H-magnets)

All aperture scans were made with a scan rate of 3 mm/sec. The zero phase point for the harmonics is in I5 and the phase increases in the beam direction. The harmonic amplitudes are expressed in normalised units (i.e., amplitude in meters/β²).

1st cosine harmonic

The amplitude of this harmonic was varied between the limits ± 0.0001. Larger amplitudes were not possible since distortions in the harmonic caused beam loss on the chamber walls. The variations in percentage loss when crossing the 5th order resonances in FATA are shown in Figure 2 (only the loss of beam when crossing the resonances in the outward direction is considered).

1st sine harmonic

Figure 3 shows the effect on the losses for amplitude variations between ± 0.0002.

9th cosine harmonic

It was possible to excite much larger amplitudes of ± 0.002 (± 8 mm approx.) with this harmonic. The losses however were approximately 10 times less for a given amplitude than for the 1st cosine harmonic (see Fig. 4).

9th sine harmonic

The effect of this harmonic is shown in Figure 5. This was the only harmonic found to have a non-symmetrical response curve. The non-symmetry is small however and may be caused by an error in one of the readings.
Conclusion

At PATA the losses in the 5th order resonances are increased by applying vertical closed orbit harmonics excited by the radial field magnets. The increase depends only on the amplitude of the harmonic. It may be that virtually any distortion of the vertical orbit will behave similarly and it would be interesting to verify, for example, the effect of the bumps used in luminosity measurements. The behaviour of these harmonics was clearly different to that of the horizontal closed orbit harmonics excited by the CR windings. Tentatively it may be possible to attribute the effects seen with the vertical orbit harmonics to the orbit position (distortion) and the effects seen with the horizontal orbit harmonics to both the orbit position and the residual multipoles in the correcting magnets.

F.J. Bryant

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FIGURE 1 - Aperture scans taken in Runs 90 and 98 of resonant losses at FATA.

Fata Straight
Ring 2 (RS22)
Run 98
(without closed orbit corrections)

Fata Straight
Ring 2 (RS22)
Run 90
(without closed orbit corrections)

Radial Position mm.