ISR RUNNING-IN

Run 101, Ring 1, 15 GeV, 20 bunches, working line 15 FA
(with closed orbit corrections).

1. For normal operation, the coupling impedance of the scanning cavity (100-200 MHz) is kept low by two resistors connected to probes in the cavity walls. These can be attached directly, or over two low-loss cables in Al. In addition, four relais switches are provided to short-circuit the gap.

2. To achieve a high coupling impedance for this experiment, the relais switches had to be disconnected to avoid the parasitic capacity. The cables were adjusted in length to transform an open circuit in Al into an open circuit at the cavity, but the damping due to the cable losses was still considerable. It was thus decided to leave the resistors directly at the cavity for normal operation, and to remove them just before the experiment.

3. The coupling impedance of the cavity was measured by Mr. Frischholz by connecting the probe of an impedance meter directly to the gap. The Q-value could then be determined by measuring the bandwidth between 45° points. In addition, the Q-value was determined by measuring the decay of oscillations excited by a pulse generator. With the resistors, the Q-values were adjusted to about 200 by varying the depth of the probes. This corresponds to $Z = 4\Omega$, or $Z/\pi \approx 12\Omega$ at 100 MHz. With open cables, the impedance was about $10\Omega$ ($Z/\pi \approx 30\Omega$), and without cables $19\Omega$ ($Z/\pi \approx 60\Omega$). The cavity was then turned to the 316th harmonic (100.75MHz) to keep it low and to remain within the frequency response of the HP spectrum analyser (110 MHz).

4. A number of experiments was made with single shot injection, 10-20 pulse stacks, and one 5A stacks. The final RF-voltage was reduced in steps from 1.6 kV to 1 kV, 600, 400, and 300 V. The RF cavity was remotely turned to make sure that a harmonic would be within the resonant bandwidth (~100kHz). No signals have been seen about 100 MHz at the spectrum analyser.

5. Several scans of 10 and 20 pulse stacks were made to observe spill-out. At 600 V, a 0.67A stack (10 pulses) was quite clean and had a width of 8 mm. at the base, corresponding to

$$\left(\frac{\Delta r}{p}\right)_{\text{base}} \approx 5.4 \times 10^{-3}$$

The height of the scanning bucket is about 3 times the moving bucket height, and the height of the stack is also about 3 times ($\sim \sqrt{3}$) the single
bucket height. We should thus reduce the measured spread by $\sqrt{2}$ to get the actual spread.

Assuming $(\Delta p)_{\text{halfheight}} \approx \frac{1}{2} (\Delta p)_{\text{base}}$, the stability circuit becomes

$$\frac{Z}{n} < \frac{E_0}{e} \gamma \frac{n}{f_0} \left(\frac{\Delta p}{p}\right)^2,$$

halfheight = 100Ω

which is above the 60Ω of the scanning cavity. Assuming that $I_0 \sim (\Delta p)^2$ for the first few pulses (Symon's rule) the same value should be valid for a single shot. At higher currents $I_0 \sim \Delta p$, and the stability limit will be higher.

6. Conclusions

The maximum coupling impedance of the scanning cavity has not produced any observable longitudinal instabilities with present momentum spreads. This is in agreement with the stability criterion for those beams of which the momentum spread has been measured. Higher impedance will be required to reach the stability limit, and could be achieved with an RF-cavity.

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