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DAMPING OF THE 938 MHz RF CAVITY RESONANCE

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INTRODUCTION

In SPS Improvement Report No. 186 we described a transverse instability affecting the slow extracted beam spill structure and having as its driving element the RF accelerating cavities resonant on a higher order mode at ~ 938 MHz. At that time a measurement of the growth rate of the instability on an unbunched beam indicated a transverse impedance Z ~ 50 MΩ/m.

During the shutdown, Summer 1983, resonant damping loops, Ref. 1, were installed in the cavities, each section of the cavity receiving two loops.

We have repeated the measurement to determine the resulting transverse impedance and although unable to give a precise value we can give an upper limit.

THE EXPERIMENT

We used the operational cycle with the 450 GeV/c flat top. All extraction elements were switched off and the q_H extraction trim removed to provide high intensity circulating beam at 450 GeV/c. The octupoles were off. The RF gymnastics were switched off and the RF kept on along the flat top in order to measure q and the closed orbit in the middle of the flat top. Following the procedure described before, the horizontal chromaticity was carefully adjusted to -1.5 to reduce the frequency spread in the beam and render it potentially unstable when debunched. The RF was then switched off at the beginning of the flat top and the signal from the horizontal wideband pick-up was observed.

In the previous experiment at 250 GeV/c the beam was unstable at 938 MHz with an e-folding time of 40 msecs for an intensity of 2×10^{13} implying a transverse impedance $Z_\perp$ of 50 MΩ/m. Here no instability was observed at 450 GeV/c during the 2 second flat-top at a maximum available intensity of 2.3×10^{13}. From the formula

$$Z_\perp = - \frac{2 Q \omega_0 \gamma m_0 2\pi R}{e \beta I \tau} \ \Omega/m$$

we conclude that $Z_\perp \leq 1.6$ MΩ/m and hence that the reduction in impedance is $\geq 31x$.

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