EXPERIMENT	:	Performance of closed Orbit Observation System as Function of Beam Intensity.
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1. Introduction

At high intensity and short bunch length, i.e. high peak voltage at pick-up output, the performance will be limited through saturation of the head amplifiers.

At low intensity, independent of bunch length, the normalizers will cease to work properly. The normalizers produce a voltage proportional to Δ/Σ. To avoid the mathematical indeterminacy of this ratio for $(\Delta, \Sigma) \rightarrow 0$, the electronics is designed to deliver zero output voltage for $\Sigma = 0$.

The determination of these two limits was the purpose of the experiment.

2. Method (normal polarity, p-test beam via loop)

- PS RF voltage adjusted for 60 nsec bunch length at ejection.
- AA RF voltage 14 kV, phase lock on, manual frequency control.
- Inject single pulse of about $3 \cdot 10^{10}$ p.
- * Deceleration to 1850.37 kHz (central orbit).
- Kill beam at injection (first time only, to kill untrapped protons).
- Measure central orbit, twice.
- Accelerate to 1846.07 kHz (injection orbit).
- Measure injection orbit, twice.
- Accelerate to aperture limit (ejection kicker).
- Scrape off part of beam.
- Return to step *, until orbit measurement very wrong.

This sequence was repeated for PS bunch lengths of 50, 40,30, 25 and 20 nsec.

3. Results

The buckets created by the maximum AA RF voltage of 14 kV are too small to match the PS bunches. After filamentation one always winds up in the AA with bunches of 120 to 140 nsec length. The upper limit, i.e. saturation of the head amplifiers, could therefore not be sensed.

The intensity reduction, by scraping on the ejection kicker ($\alpha_p \doteq 10$ m), was accompanied by a reduction in bunch length, typically only 80 nsec by the time the intensity was down to $4 \cdot 10^9$ p. No influence of this parameter is detectable in the results.

The measured injection orbit positions at the 8 QFW-PUs are plotted as a function of intensity in the 2 attached figures. As the intensity dependence shows up clearly only for beam positions far from the electrode centre, the positions at the 4 BLG-PUs are not shown, nor are the positions of the central orbit.

Over the flat part of the curves, the values scatter within ± 0.5 mm. At 10^{10} p the reading is nowhere more than 1 mm below the average high-intensity reading. Below 10^{10} p there is an increasingly rapid fall-off.

4. Conclusions

At a beam intensity of 10^{10} p, but no less, the closed orbit observation system delivers results within the specified accuracy of ± 0.5 mm ± 3 %o of reading.

Over the usual range of intensity and bunch length of reverse injected p-test beam there is no sign of saturation of the head-amplifiers, nor any other influence of these two parameters.

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