SI/Mi DL/72-5
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Background information and notes on the meeting of 21 January on "Dealing with beam blow-up in the PSB"

Present : C. Bovet, I. Gumowski, H. Koziol (part-time), D. Möhl, G. Nassibian, K.H. Reich, F. Sacherer, K. Schindl, H. Schönauer.

Excused : J. Trickett.

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This meeting served to review the state of preparations for the PSB running in, last reviewed on 7th May 1971. The same order is adopted (cp SI/Mi DL/71-19).

A. TRANSVERSE PHASE SPACE

1. Stop band crossing

F. Guidici and K. Schindl have recalculated the multipole coefficients for 32 bending magnet units. The results correspond, within a factor of 2, to the values given in our Conference paper for 16 magnets.

G. Guignard has studied in more detail stop band crossing, both under the conditions of "small" amplitudes and of "lock on" (internal SI report now in the typing stage). This work, while indicating the limits of validity, confirms the earlier results given for the PSB.

2. Beam equipment interactions

In the case of an unbunched beam, the e-folding time for the growth of the (fastest) $n = 5$ mode due to the resistive wall is ~ 10 ms. The influence of the ceramic vacuum chambers, the ferrite kickers etc, on this growth, and the thresholds are being computed now (H. Schönauer).

For the bunched beam, the population spread required for independent bunch behaviour will be recalculated, including the extra coupling impedances listed above (H. Schönauer).

A. Brückner will start looking into the problems of an active feedback system.

3. Head-tail

F. Sacherer has included in his analysis the resistive wall fields resulting from preceeding turns, but not yet Landau damping. On this basis, he finds that PSB bunches would be unstable for $Q > 4.18$.

The existing orbit observation system would just allow to notice internal bunch oscillations with wavelength = bunch length, but no higher harmonics. These might be observed with an MPS 150-200 MHz pick-up station, to be mounted in one of the special vacuum manifolds when required.

Further progress in computing PSB numbers requires knowledge of the dispersion relation coefficients of PSB components other than the vacuum chamber. Some of these should be forthcoming from the work under point 2 above.

4. Beam injection

A film showing a computer simulation (in phase space) was projected at the International Accelerator Conference (see page 102 of the proceedings).

5. Filamentation

The formalism has been refined (see paper by R. Le Bail and P. Lapostolle contributed to the forthcoming conference on Computational Physics at CERN), but due to the departure from CERN of both authors no further work along these lines is in sight. (In the meantime we feel reassured about the PSB beam behaviour by observing the lifetime of the ISR beam).

6. Arnold-diffusion type phenomena (I. Gumowski)

On a relative scale, incoherent slow losses turn out (on paper) to increase rapidly as the fractional part of Q increases from zero to one. The absolute level of these losses for the PSB is not yet clear.

7. Neutralisation effects

From very rough estimates H. Koziol would not be surprised to find PSB neutralisation factors in the 10 to 20% region (long bunches).

H. Schönauer is considering the focussing of the electrons by the protons (using the AG focussing formalism) and finds that under certain conditions ~ 50% neutralisation may be stable. (A rough write-up of this work is being prepared).

While this point has a lower priority than point 2, existing theories (MPS-SI/Int. DL/68-4, CERN 71-15, CERN-ISR-TH/71-58) will be used to get a feeling for the PSB situation (H. Schönauer).

B. LONGITUDINAL PHASE SPACE

1. Dynamic effects

a) Numbers on unbunched beams

J. Trickett is using B. Zotter's computer program (made for a different geometry), to get a feeling for the influence of the fields penetrating the 0.4 mm vacuum chambers in the PSB bending magnets, and of the extra elements listed under points A2. First indications are that these effects do not change the situation significantly.

b) Counter measures

Further work is going on to reduce the coupling impedance of critical PSB components (G. Nassibian).

K.H. Reich

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