GP/iw

MPS/SR/Note 73-5

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REQUIREMENTS OF ISR AND SPS

(A note to the Beam Quality Working Party)

G. Plass

1. ISR

1.1 Luminosity

The outlook onto the future development of the ISR has been strongly influenced by the experience with the vacuum system : essentially the ISR are to be considered as current limited machine, the limit, in the region of 20 to 40 amps., set by the cleanliness of the vacuum chamber. (It is, may be, on very long term not excluded to get further, but this is pure speculation.) Improvements of luminosity can therefore be obtained by higher density or other techniques, but not by higher current.

* The design luminosity has been achieved with currents below the design goal by vertical shaving of the injected beam, such that only the denser core is stacked.

* The two-turn injection schemes Booster - PS and PS - ISR would

lead to higher currents for a given momentum spread. Since higher currents are not desirable, the only use of the scheme would be a reduction of the momentum width of the stack at the peak current. The profit does at the moment not appear to justify the investment required (particularly in the ISR).

* Use of the Booster should provide enhanced densities once the PS has been brought up to a state where it transmits the densities.

The interest of higher vertical density is obvious from the above remark on beam shaving in the ISR. A reasonable lower limit of the vertical beam dimension will be given by the precision with which the two stacks can be made parallel.

Increased longitudinal density will lead to a stack of reduced momentum width, hence better definition of the c.o.m. energy, and at the same time a smaller interaction volume which may be of some marginal value.

Increased radial density would lead to a slightly reduced interaction volume.

At the moment however, the ISR blow up the beam both longitudinally and radially and it is not clear whether higher densities will be accepted or whether the beam will be diluted down to the present density. Investigations of the reason of the blow-up are planned for 1973.

* Important luminosity increases are expected from low β region and/or zero crossing angle techniques (rather than from the PS).

1.2 Energy

The pressure for PS acceleration to 28 GeV/c may decrease since phase displacement acceleration appears at the moment to work better than expected.

There are difficulties to obtain a suitable working line (Q_R/Q_V) at 31 GeV/c.

1.3 Current Problems

There is a small number of problems of day-to-day life which are in the hands of Brouzet.

2. SPS

The SPS has been designed for the PS beam emittances estimated in 1971 for 10 Tp/p[1] and bunch-by-bunch transfer. With continuous transfer and the present emittance estimates there should be a substantial margin for any sort of beam the PS might produce up to and around the 10 Tp/p mark. A "danger" may come in certain cases from too dense beams, longitudinally or transversely, but it should not be difficult to dilute where necessary.

2.1 Parameters (extract from the SPS Parameter List)

Transfer momentum range	10.0 to 14.0 GeV/c
CPS cycle time + debunching	1.0 to 1.2 sec.
General parameters for 10 GeV/c	
CPS minimum acceleration time	250 msec.
CPS beam bunch frequency	9.5 MHz
CPS beam momentum spread (half)	$0.9 - 1.2 \cdot 10^{-3}$
CPS horizontal beam emittance	$3 - 6\ \pi \cdot 10^{-6}$ radm.
CPS vertical beam emittance	$1{,}5 - 3\ \pi \cdot 10^{-6}$ radm.
CPS beam intensity	10^{13} ppp.

Contrary to what has been stated up to now, a certain amount of prebunching at 200 MHz may still be requested in order to ease the beam position measurement problem. In contrast to a full-scale matched-bunch-into-bucket transfer system, only a small 200 MHz cavity (short s.s.) would be required.

Information on the envisaged cycle patterns has been circulated recently.

2.2 Pencil Beam

For the first phases of running-in the SPS and for machine investigations, the Parameter Section have specified a pencil beam as follows :

Momentum	10 to 14 GeV/c
Momentum spread	$\leqslant \pm 0{,}2$ o/oo
Emittance in each plane	$\leqslant 0{,}25\ \pi$ mm.mrad.
Intensity	$\geqslant 10^{11}$ ppp.

The numbers agree with the PS estimates[2], but the minimum transverse emittance will only be available in the horizontal or the vertical plane (with phase plane exchange in the transfer channel).

References

1. O. Barbalat - MPS/DL/Note 71-16
2. O. Barbalat - MPS/DL/Note 72-42

Distribution :

Beam Quality Working Party

E. Brouzet
A. Krusche
G.L. Munday
W. Schnell (ISR)