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Comments On A Previous Note (RHIC-1) About Intrabeam Scattering Calculation For Bunched Beams In Colliding Mode

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DISCLAIMER

COMMENTS ON A PREVIOUS NOTE (RHIC-1) ABOUT INTRABEAM SCATTERING CALCULATION FOR BUNCHED BEAMS IN COLLIDNG MODE

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There is a mistake in RHIC-1 note. For the long bunches colliding mode the peak current is

$$I = \frac{N_c e \beta c}{\sqrt{2\pi}\ \sigma_\ell}$$

where

N_c, number of particles / bunch = 6×10^{10}
σ_ℓ, rms bunch length = 50 m

As correctly stated in page 7 of the note

$$I = 0.023 \text{ Amp-particle}$$

and this number was used throughout all the rest of the calculation except when we come to the intra beam scattering effects. At page 9 we erroneously state that the peak current at $\gamma = 100$ is also the same than the average current at injection. By doing this we have underestimated the peak current by exactly a factor of 10. Therefore the diffusion rates

for intrabeam scattering at top energy should all be modified as shown in the following table.

$\varepsilon_N = 4\pi$ mm·mrad $\qquad\qquad \gamma = 100$

γ_T	t_E	t_β
10	0.15 hours	1.1
20	0.56	1.5
30	0.8	2.0
50	0.6	3.0
80	20.	5.

Unless γ_T is very large the energy diffusion time are too short to be accepted.

Nevertheless the following points are worth of consideration.

(i) There is a strong dependence of the diffusion rates with the inial energy spread. A time integration is required to check how much actually the beam will grow over a period of time long enough (10-20 hours).

(ii) Diffusion rates are quickly reduced by increasing the initial energy spread. The spreads we have assumed here are those at the limit of longitudinal stability. But it is possible to manipulate the bunches to larger bunch area, and therefore to larger spreads. How large can be the initial energy spreads. I see three possible limitations:

(a) the AGS bucket area and I have already estimated this requirement.

(b) the transition energy crossing (if any) implications

(c) the size in $\Delta p/p$ of the RF stacking requirements.