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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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USDOE Office of Science (SC)

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

A.G. Ruggiero

(BNL, November 19, 1983)

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

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

where

$$N_c, \text{ number of particles / bunch} = 5 \times 10^{10}$$

$$\sigma_c, \text{ rms bunch length} = 50 \text{ m}$$

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 -

$$\epsilon_N = 4\pi \text{ mm} \cdot \text{mrad}$$

$$\gamma = 100$$

$\delta_T$	$t_E$	$t_B$
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  $\delta_T$  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 initial 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  $\Delta\delta/p$  of the RF stacking requirements -

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$E_N = 4.0 \pi$  mm-meas

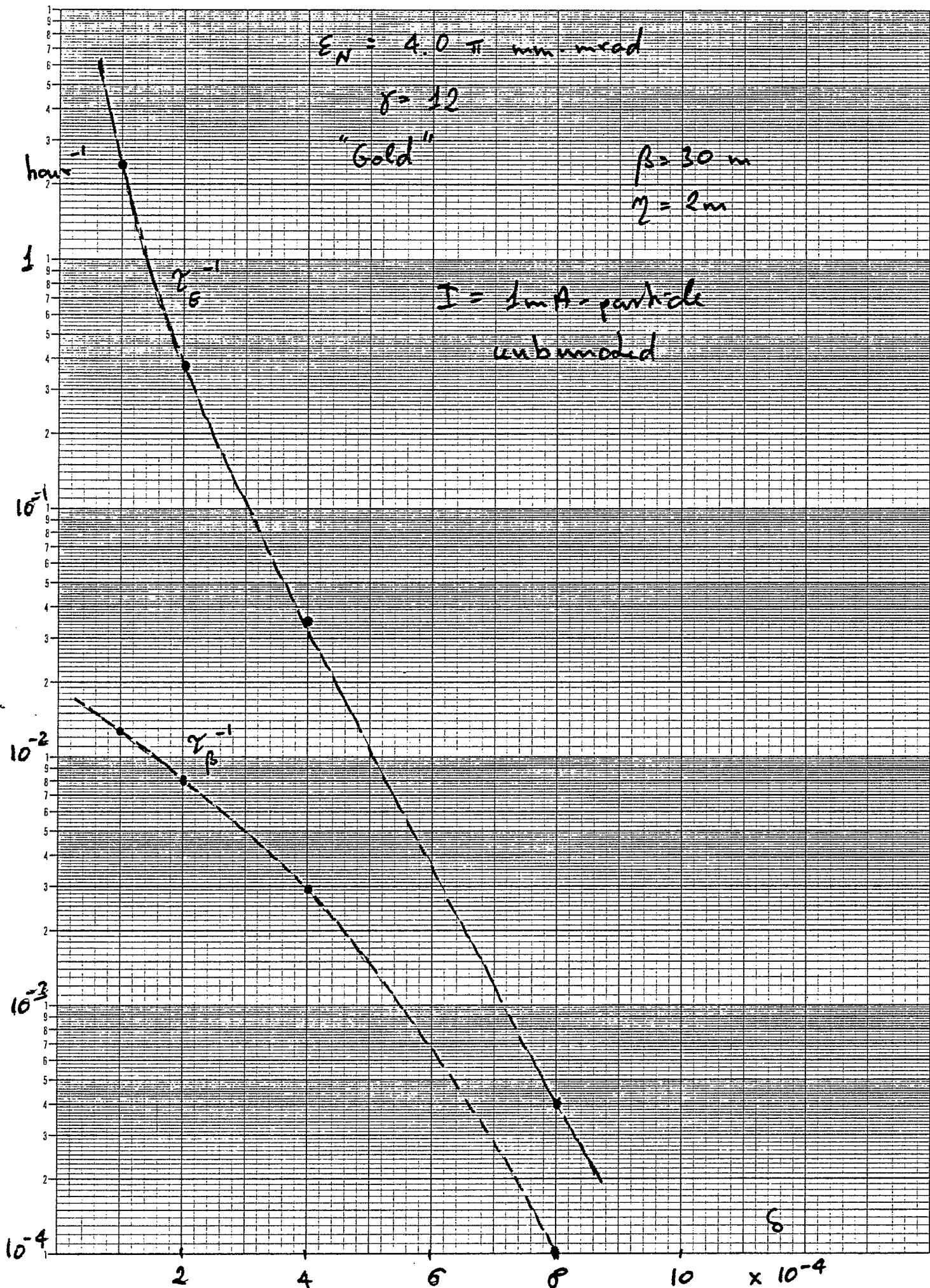
$\gamma = 12$

"Gold"

$\beta = 30 \text{ m}$

$\eta = 2 \text{ m}$

$I = 1 \text{ mA}$  - particle  
unbunched



$E_N = 2.5 \text{ mm-mrad}$

$\gamma = 12$

"Gold"

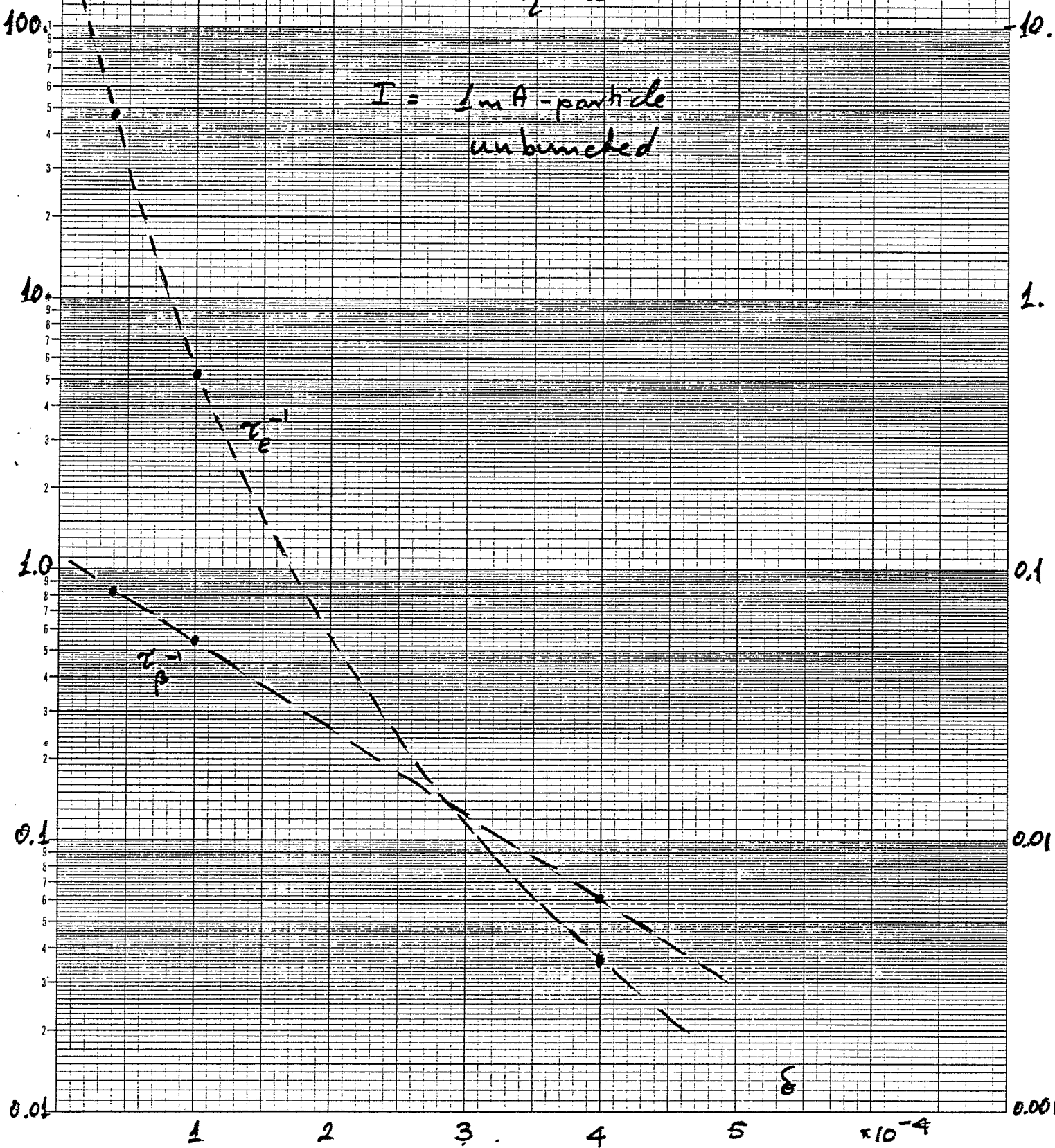
$\beta = 50 \text{ m}$

$\eta = 2 \text{ m}$

$\tau_E^{-1}$   
hour<sup>-1</sup>

$\tau_B^{-1}$   
hour<sup>-1</sup>

$I = 1 \text{ mA}$  - particle  
unbunched





$E_N = 4 \pi \text{ mm-mrad}$   
 $\gamma = 100$   
 "Gold"

$\beta = 30 \text{ m}$   
 $\eta = 2 \text{ m}$

$I = d \cdot m \cdot A$  - particle  
 bunched

