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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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COMMENTS ON A PREVIOUS NOTE (RHIC-1)
ABOUT INTRABEAM SCATTERING CALCULATION
FOR BUNCHED BEAMS IN COLLIDNG 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 , number of particles / bunch = 5×10^{10}

σ_c , 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 -

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

$$\gamma = 100$$

δ_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 δ_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

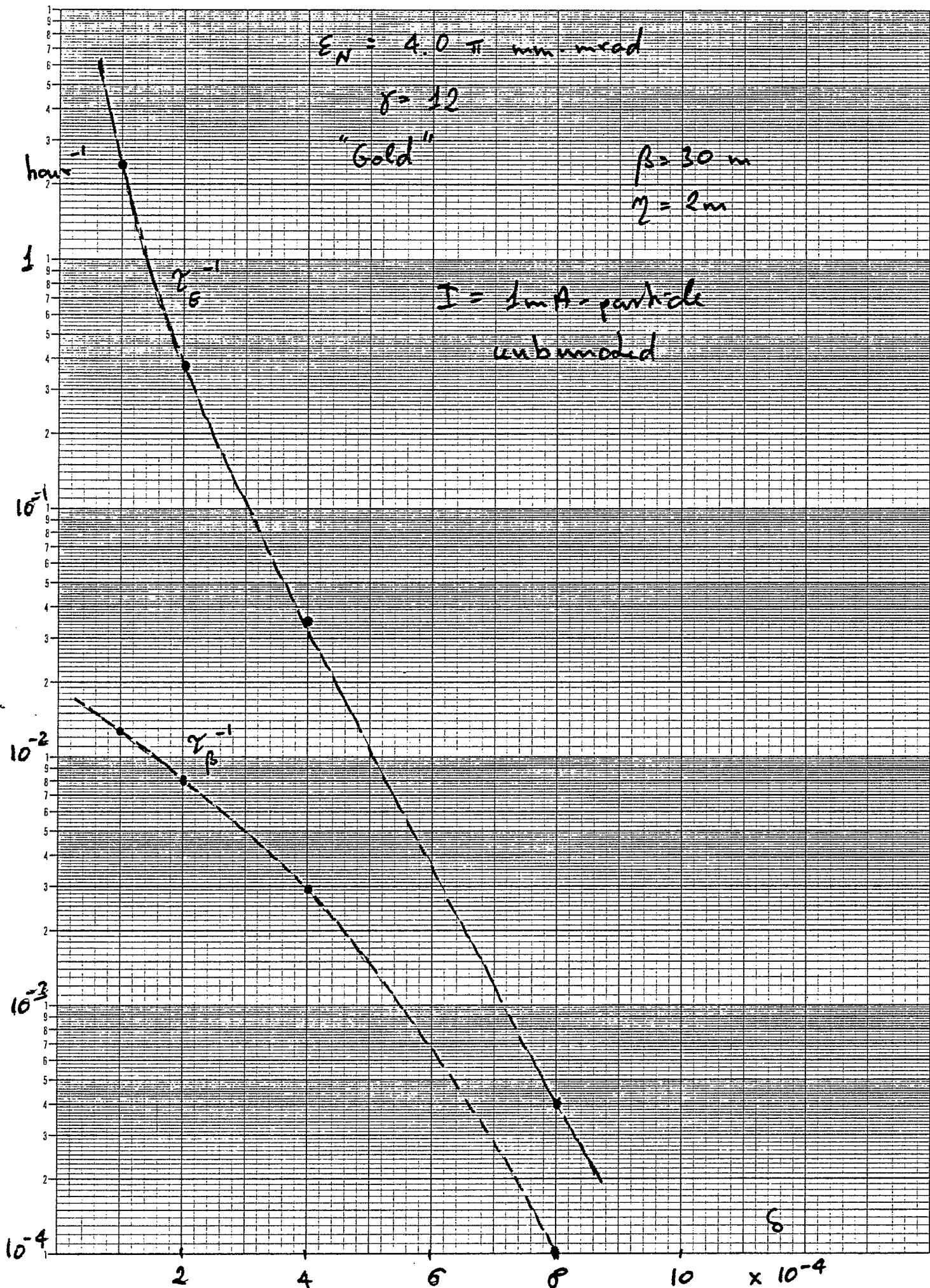
$\gamma = 12$

"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"

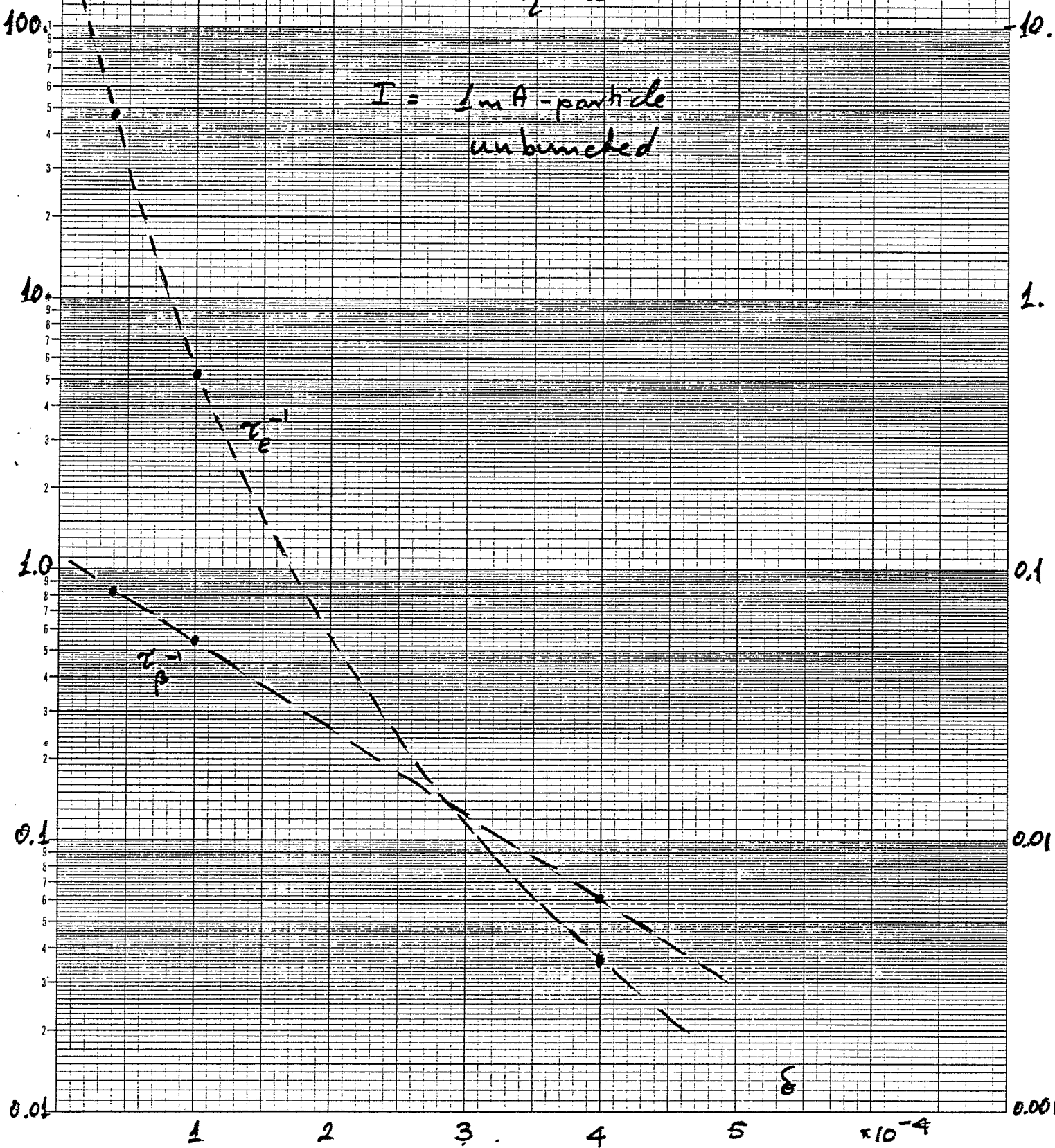
$\beta = 50 \text{ m}$

$\eta = 2 \text{ m}$

τ_E^{-1}
hour⁻¹

τ_β^{-1}
hour⁻¹

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



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

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

$I = d m A$ - particle
 bunched

