

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

A. G. Ruggiero

November 1983

Collider Accelerator Department  
**Brookhaven National Laboratory**

**U.S. Department of Energy**

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-AC02-76CH00016 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

## **DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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 -

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

$$\gamma = 100$$

$\delta_T$	$t_E$	$t_B$
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 times 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 -

$$\epsilon_N = 4.0 \pi \text{ mm-mrad}$$

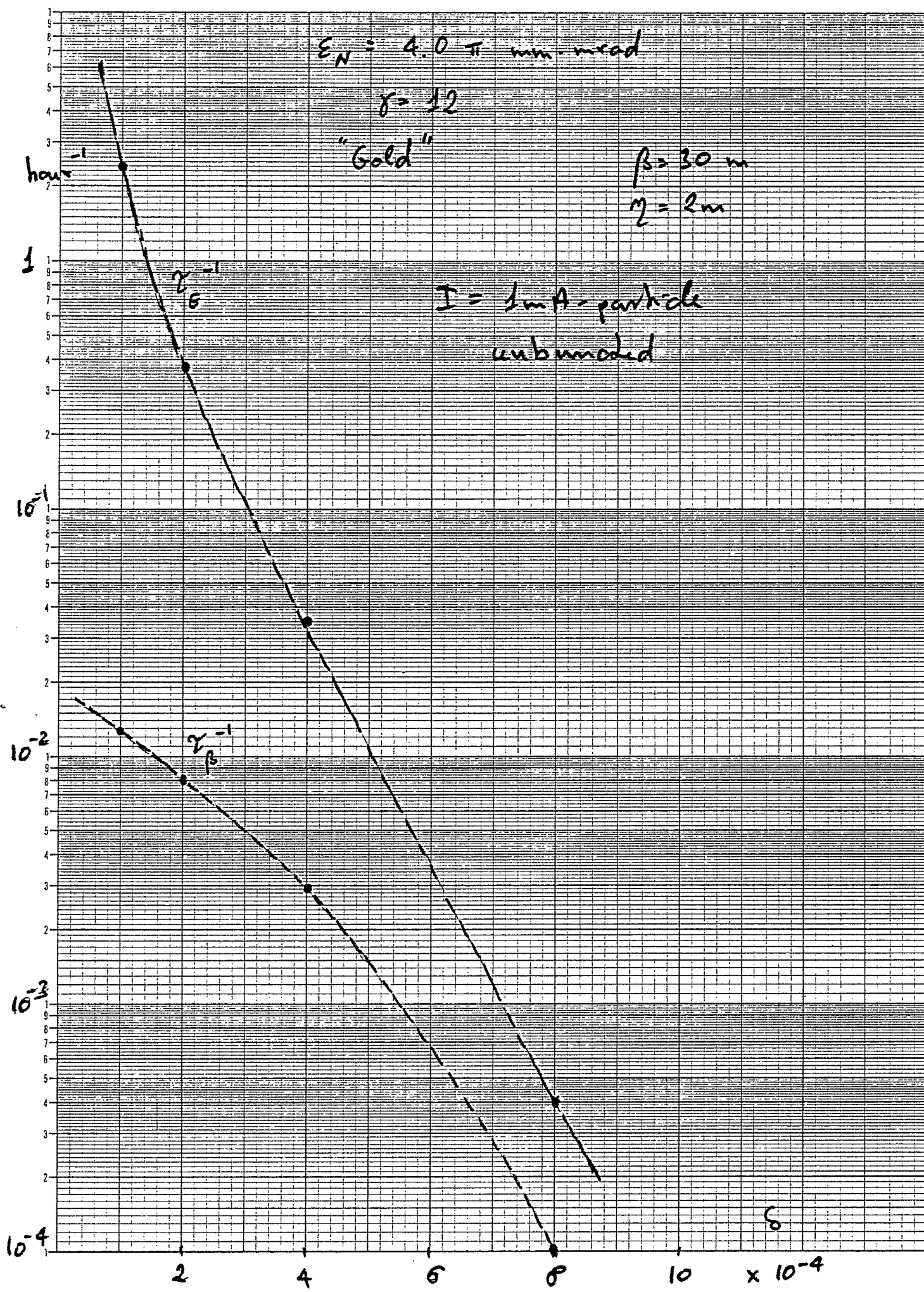
$$\gamma = 12$$

"Gold"

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

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

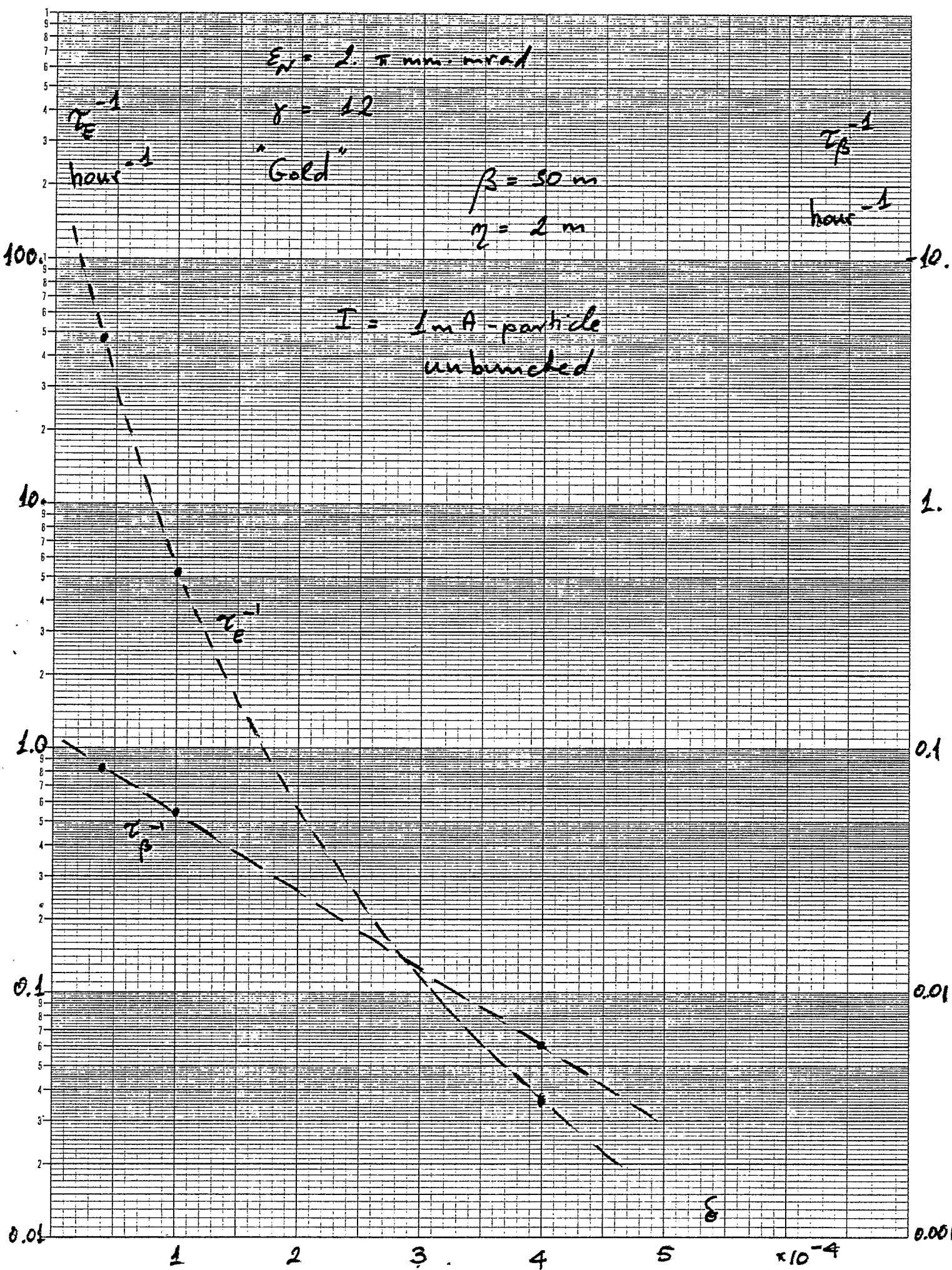
$I = 1 \text{ mA}$  - particle  
unbunched



AD 0845 -60  
5 CYCLES X 70 DIVISIONS  
SEMI-LOGARITHMIC  
GRAPHIC CONTROLS CORPORATION  
Buffalo, New York  
Printed in U.S.A.

$E_N = 2. \pi \text{ mm-mrad}$   
 $\gamma = 12$   
"Gold"  
 $\beta = 50 \text{ m}$   
 $\eta = 2 \text{ m}$

$I = 1 \text{ mA} - \text{particle un-bunched}$





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

"  $\gamma = 100$   
Gold "

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

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

$I = \text{d mA - particle}$   
bunched

