

## Intrabeam Scattering with Stochastic Cooling

G. Parzen

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Collider Accelerator Department  
**Brookhaven National Laboratory**

**U.S. Department of Energy**

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*G. Parzen*

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# Intra beam Scattering with Stochastic Cooling

$V_{RF}$  problem,  $V_{RF} \leq 4.5 \text{ MV}$

## $E_x$ blow up solution

Initial  $E_x = 10$  blown up to  $E_{x,0} = 60$  (Au,  $\gamma = 100$ )

This gives  $V_{RF} \leq 4.5 \text{ MV}$

$E_x = 60$  grows to  $E_x = 69$

Luminosity reduced by factor 3.

## Longitudinal Stochastic Cooling

Suggested by AG Ruggiero; cooling time  $\sim 10$  hrs  
to keep  $V_{RF} \leq 4.5 \text{ MV}$

## Solution with only longitudinal cooling

$$GRSCL = 1/9$$

$$V_{RF} \leq 4.5 \text{ MV} \text{ (reheat at } t = 5 \text{ hrs)}$$

$$\text{final } E_x = 37$$

32% less luminosity.

Au  $\rightarrow$   
 $\gamma = 100$

## Equations Used

$$\frac{1}{\sigma_p} \frac{d\sigma_p}{dt} = f_1(\sigma_x, \sigma_p) - \text{GRSCL}$$

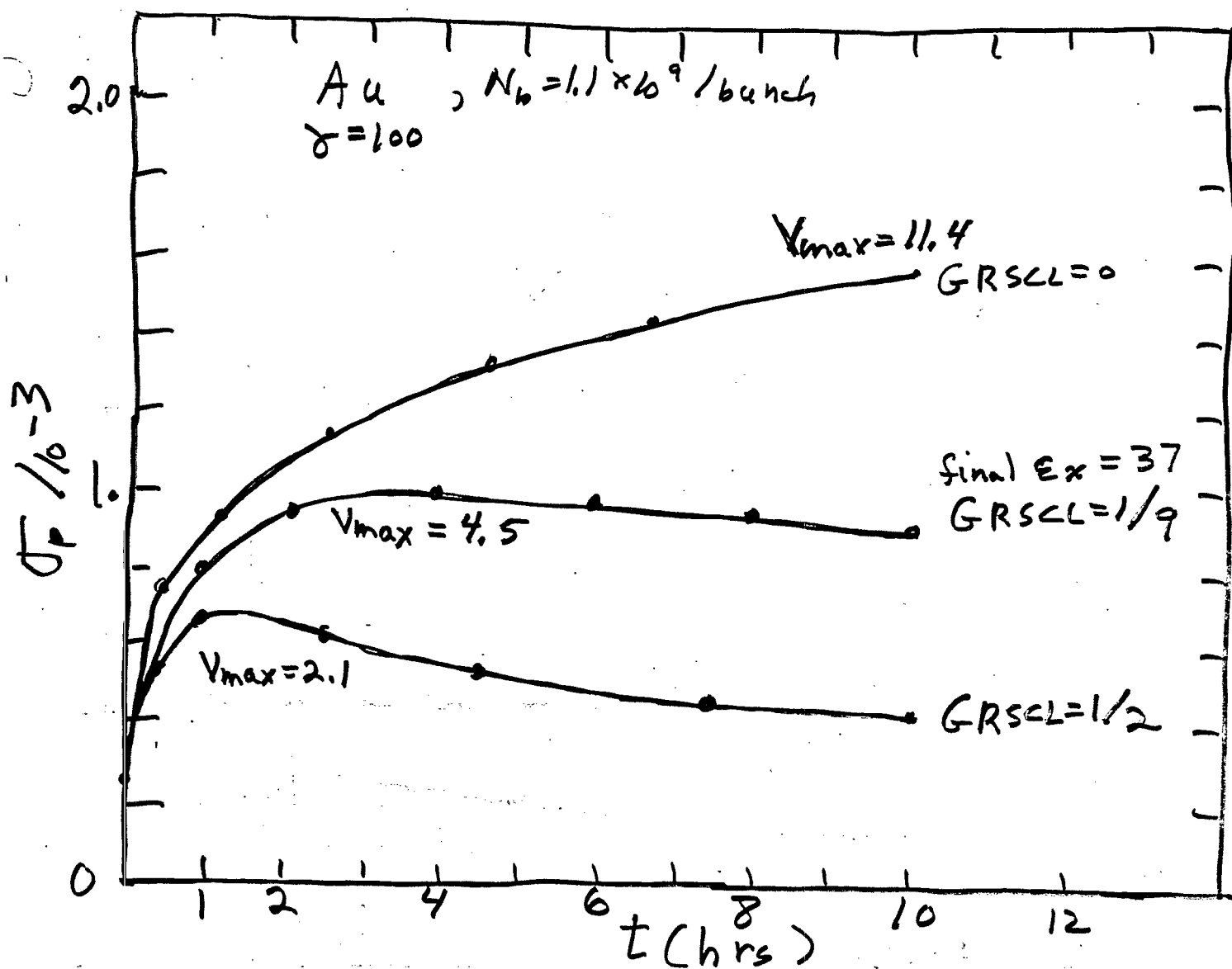
$$\frac{1}{\sigma_x} \frac{d\sigma_x}{dt} = f_2(\sigma_x, \sigma_p)$$

## Dependence of GRSCL on $\sigma_p$

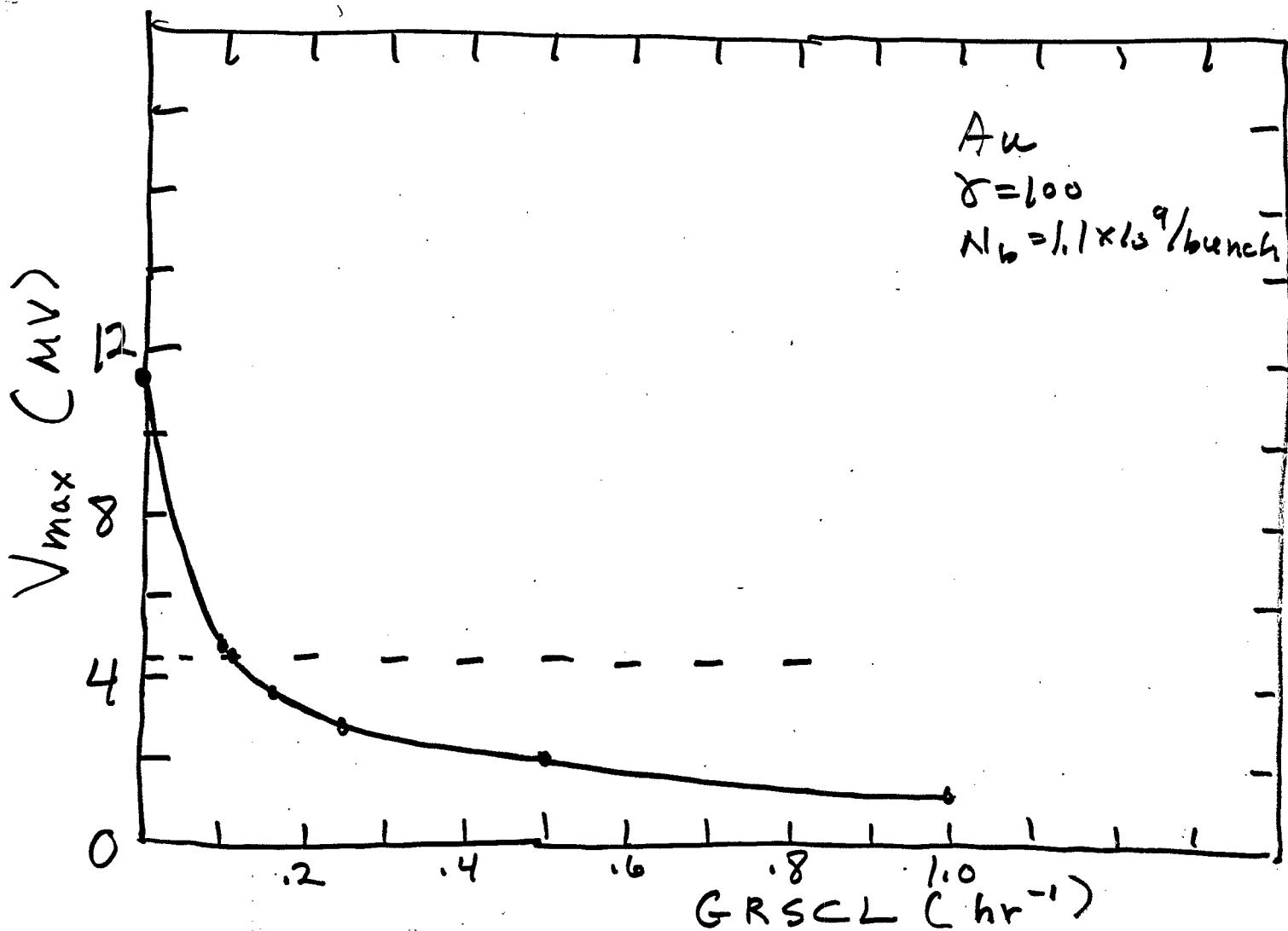
At the beginning, when  $\sigma_p$  is small -  
Cooling plays little role - I.B.S. dominates.

One needs to have the desired  
value of GRSCL when  $\sigma_p \sim 1 \times 10^{-3} \Rightarrow V_{RF} = 4.5 \text{ MV}$ ,  
that is,  $\text{GRSCL} \sim f_1(\sigma_x, \sigma_p)$  when  $\sigma_p \sim 1 \times 10^{-3}$

Growth in energy spread with time  
with  
longitudinal cooling only.



Maximum RF Voltage Required  
Versus  
the Longitudinal Cooling Rate, GR SCL



## Transverse Stochastic Cooling, GRSC

GRSC  $\neq$  requires more longitudinal cooling to keep  $V_{RF} \leq 4.5 \text{ MV}$

Transverse Cooling will give a higher and more constant luminosity

With both transverse and longitudinal cooling, there is an equilibrium value of  $\sigma_x, \sigma_p$ . The beam stops growing after 1 to 2 hours

A ~~small~~ reasonable compromise may be

$$GRSCL = 1/6$$

$$GRSCT = 1/10$$

$$f_{\text{final}} \epsilon_x = 17$$

about 50% more average luminosity

$$V_{RF} \leq 4.5 \text{ MV}$$

40% drop in luminosity with time



# Beam Growth with Transverse Cooling and Longitudinal Cooling

