BNL-101582-2014-TECH
RHIC/PG/39;BNL-101582-2013-IR

Intrabeam Scattering Results

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March 1984

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USDOE Office of Science (SC)

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March 11, 1984

RHIC Intra-beam Scattering Results

This note summarizes some results of a study of the effects of Intra-Beam Scattering on the beam for the RHIC-2 lattice ($\beta_x^* = 17$, $\beta_y^* = 3$). An output file for this lattice was provided by Jan Clouss

The effects of intra-beam scattering were studied as a function of γ. At each γ, the beam was allowed to grow for 2 hours.

The RHIC2 lattice has the following parameters. In the cells, $\chi_{p,max} = 1.39$ m, $\beta_{x,max} = 51.4$ m. $\gamma_t = 26.4$

The table on the following page lists the starting parameters δ_0, σ_{z0}, ε_0, and the various beam parameters after $t = 2$ hours. Below transition, $\gamma_t = 26.4$, the initial bunch area is $A = .2$ ev-sec, and above γ_t, the initial bunch area is $A = 1$ ev-sec. All results are for Au with $N = 1.2 \times 10^9$ ions/bunch. The RF parameters are $V = 1 \times 10^6$ volts, $h = 6 \times 5 = 7$.

RHIC Performance

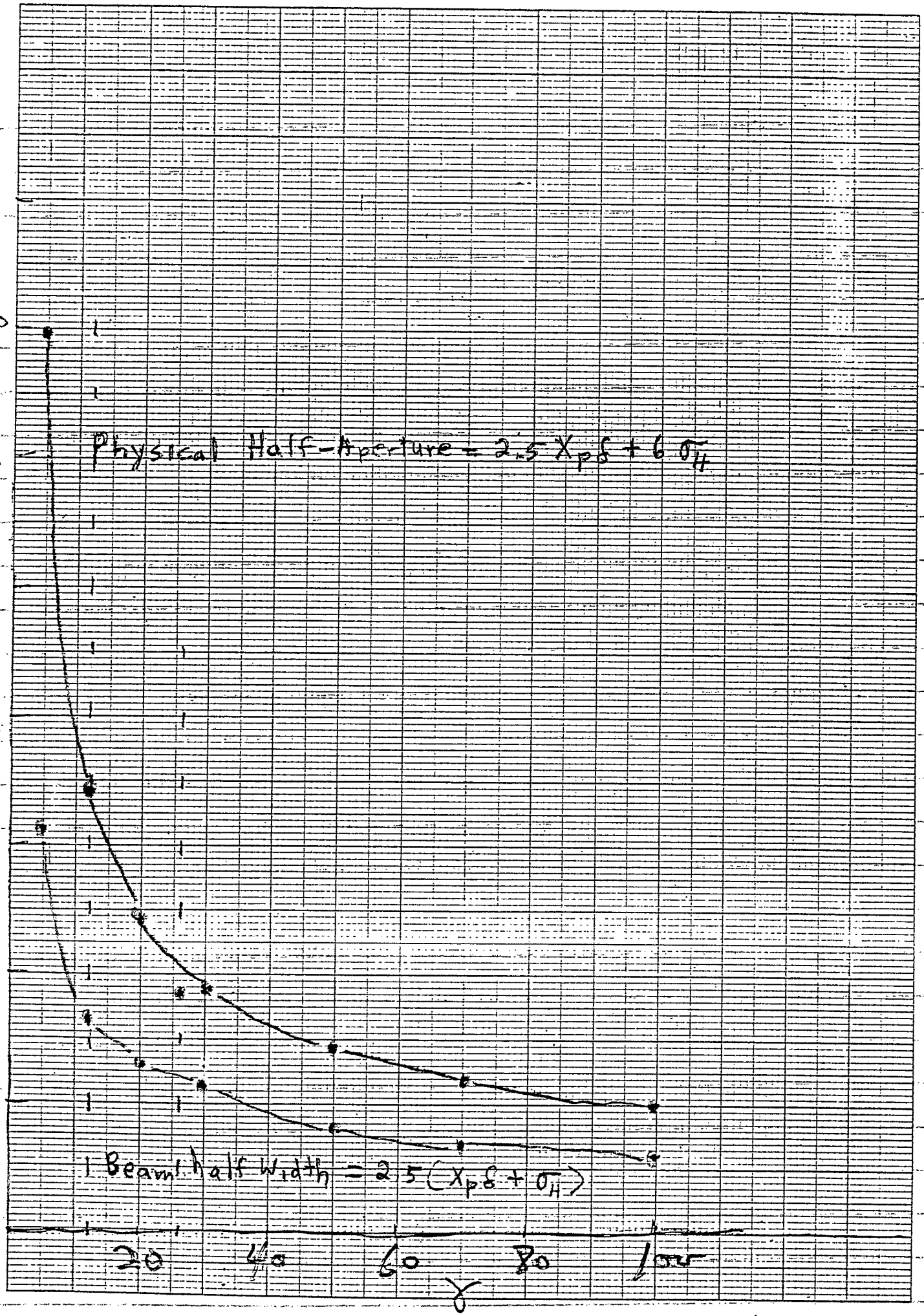
$\gamma_p = 1.39$, $\gamma = 1 \times 10^6$, $N = 1.2 \times 10^9$ /bunch — G. Parzen

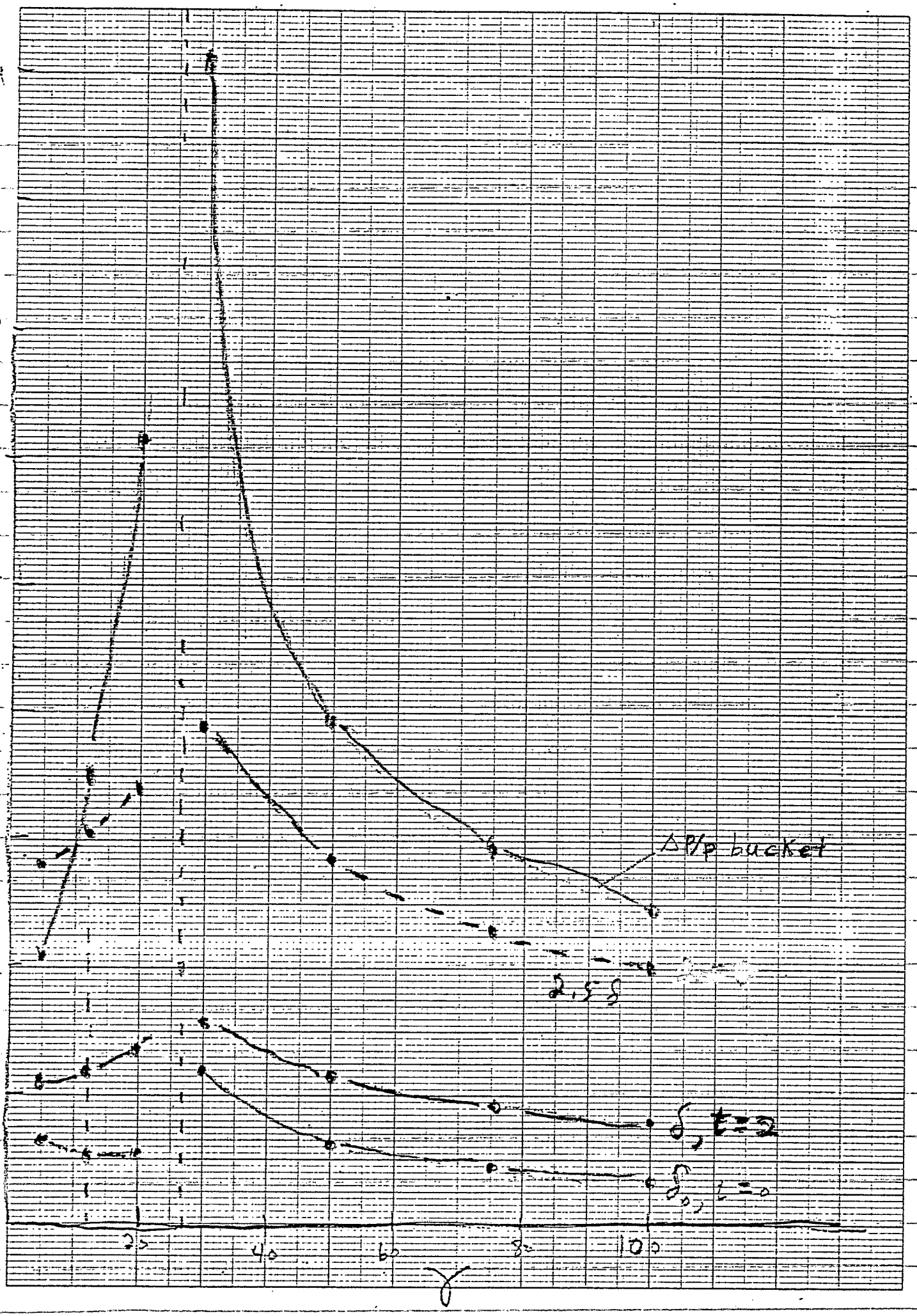
$F_x = 51.4$, $H = 5 \times 67$, $\varepsilon_0 = 10 \times 10^{-6}$, $\gamma_t = 26.4$

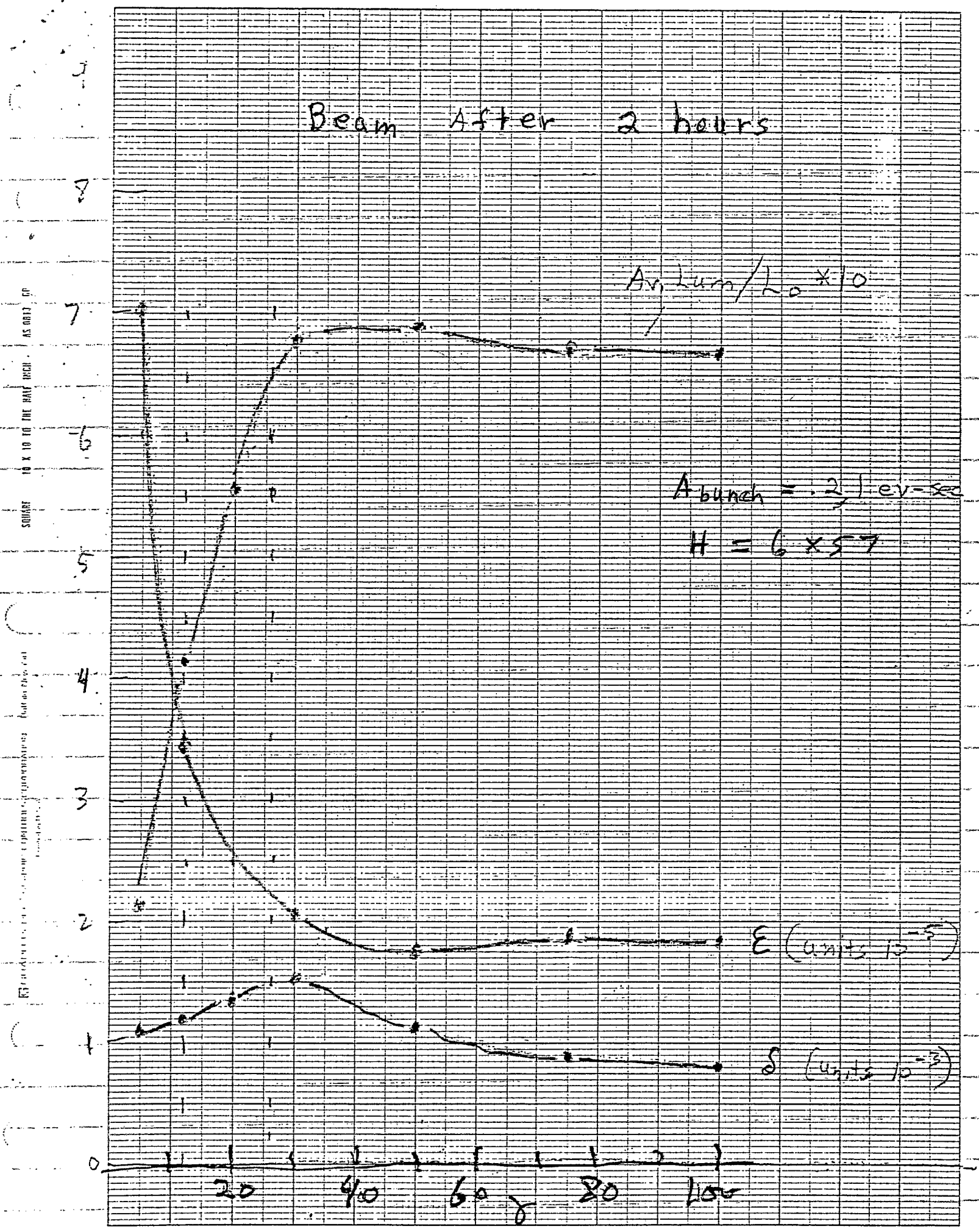
$\beta_x^* = 17$, $\beta_y^* = 3$

	A = .2 ev-sec			A = 1 ev-sec				
γ	5	12	20	30	50	75	100	26.4 γ_t
$\delta_0/10^{-3}$, $t=0$	.638	.529	.543	1.205	.614	.432	.343	
σ_{s_0} (cm) $t=0$	110.	54.1	31.6	41.3	55.7	52.9	49.9	
$\varepsilon/10^{-6}$, $t=2$	70.1	34.5	24.8	18.9	17.7	18.3	18.4	10
$\delta/10^{-3}$ $t=2$	1.11	1.22	1.57	1.57	1.14	.921	.789	4.12
σ_s (cm), $t=2$	191	125	80.	58	99	109	111	
Av. Lum $/L_0$	.212	.413	.554	.680	.690	.672	.669	
RF								
2.5 $\delta/10^{-3}$	2.78	3.05	3.42	3.92	2.85	2.30	1.97	
$\Delta p/p$ bucket $\#/10^{-3}$	2.08	3.49	6.13	9.08	3.93	2.91	2.45	
Aperture								
$X_p \delta$ (mm)	1.55	1.70	1.91	2.19	1.59	1.28	1.10	5.7
$\sigma_H = \sigma_V$ (mm)	11.0	4.96	3.26	2.32	1.74	1.44	1.26	1.8
$2.5 X_p \delta$	3.88	4.25	4.78	5.48	3.98	3.20	2.75	
$2.5 \sigma_H$	27.5	12.4	8.15	5.80	4.35	3.60	3.15	
Beam Half Width								
$2.5(\sigma_H + X_p \delta)$	31.4	16.6	12.9	11.3	8.33	6.80	5.90	18.7
$2.5 \sigma_V$	27.5	12.4	8.15	5.80	4.35	3.60	3.15	4.5
Physical Half-Aprt.								
$2.5 X_p \delta + 6\sigma_H$	69.9	34.01	24.34	19.4	14.4	11.8	10.3	—
$6\sigma_V$	66.0	29.76	19.56	13.92	10.44	8.64	7.56	—
Luminosity $/10^{26}$	.011	.106	.331	.802	1.45	2.06	2.67	

Luminosity $/10^{26} = 4 *$ Av. Lum $/L_0 * (\sigma_{H,100}/\sigma_H)^2$


Physical Half-Aperture = 2.5 $X_p\delta + 6\sigma_H$
Beam half Width = 2.5 $(X_p\delta + \sigma_H)$
70
60
50
40
30
20
10
0
20
40
60
80
100
Y
(mm)


Δp/p bucket
2.5 δ
δ, t=2
δ, t=0
γ


Beam After 2 hours
Av. Lum/Lo *10
A bunch = .21 ev-sec
H = 6 x 57
ε (units 10⁻⁵)
δ (units 10⁻³)
0
2
4
6
7
20
40
60
80
100
γ