

RHIC Performance With Intrabeam Scattering

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U.S. Department of Energy

USDOE Office of Science (SC)

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RHIC-PG-49

RHIC PERFORMANCE
WITH INTRABEAM SCATTERING

G. Parzan

BNL - April 16, 1984

RHIC Performance

RHIC3

4/16/84

t = 10 hrs

$X_p = 1.39$

$N_b = 1.2 \times 10^9$

$\beta_x = 51.4$

$v = 1.2 \times 10^6$

γ	5	12	20	30	50	75	100	δt
$\delta_0 / 10^{-3}, t=0$	.818	.678	.696	1.261	.643	.452	.359	
$\sigma_{z0}, t=0$	128.	63.3	36.9	45.2	53.2	50.5	47.7	
$\epsilon / 10^{-6}, t=10$	89.0	44.5	35.8	33.2	27.7	27.8	27.8	
$\epsilon / 10^{-3}, t=10$	1.411	1.563	1.792	1.985	1.548	1.274	1.099	
$\sigma_{z0}, t=10$	221.	146.	95.0	71.7	128.	142.	146.	
Av. Lum./ L_0	.162	.319	.389	.422	.476	.471	.470	
RF								
$2.5 \epsilon / 10^{-3}$	3.53	3.91	4.48	4.96	3.87	3.18	2.74	
$\Delta P/P \text{ buckle} / 10^{-3}$	2.28	3.82	6.72	9.95	4.31	3.19	2.68	
Aperture								
$X_p \epsilon$ (mm)	1.96	2.17	2.49	2.76	2.15	1.77	1.53	
$\sigma_H = \sigma_V$ (mm)	12.4	5.64	3.92	3.08	2.18	1.78	1.54	
$2.5 X_p \epsilon$	4.90	5.42	6.22	6.90	5.38	4.42	3.82	
$2.5 \sigma_H$	31.0	14.1	9.80	7.70	5.45	4.45	3.83	
Beam Half Width								
$2.5 (\sigma_H + X_p \epsilon)$	35.1	19.1	15.7	14.3	10.6	8.70	7.52	
$2.5 \sigma_V$	31.0	14.1	9.80	7.70	5.45	4.45	3.83	
Physical Half-Aperture								
$2.5 X_p \epsilon + 6 \sigma_H$	78.9	39.1	29.6	25.2	18.3	15.0	13.0	
$6 \sigma_V$	74.4	33.8	23.5	18.5	13.1	10.7	9.24	
Av. Lum./ $L_0, t=7.5$	.150	.299	.368	.401	.457	.452	.452	
Luminosity/ 10^{26}	.100	.475	.965	1.57	2.95	4.38	5.83	
Luminosity = $12.4 \times 10^{26} \times \text{LUMAV} \times \delta / 100$								

RHIC Performance

RHIC3

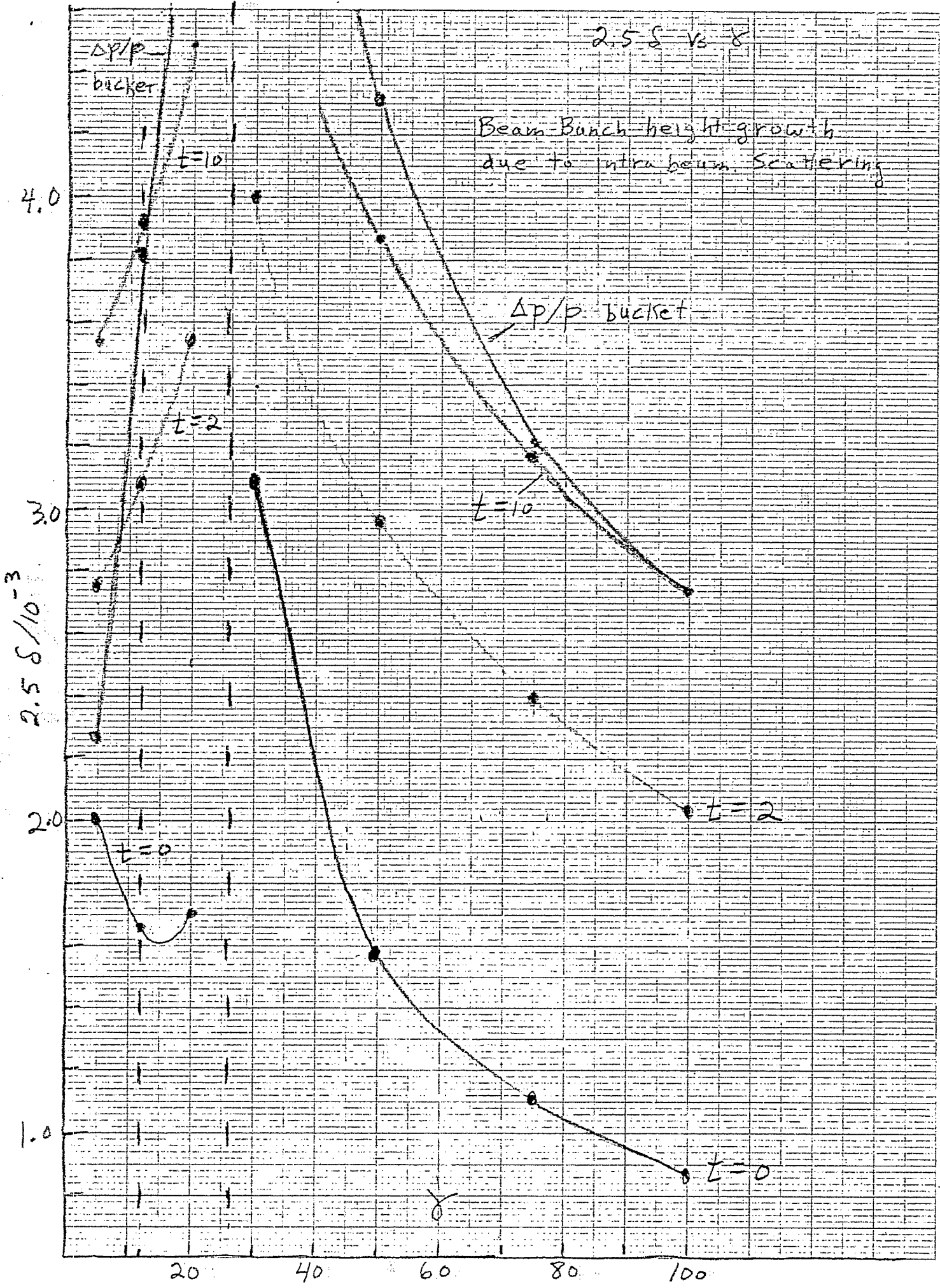
4/17/84

t=2 hrs

$X_p =$

$P_x =$

γ	5	12	20	30	50	75	100	δt
$\delta_0 / 10^{-3}, t=0$	.818	.678	.696	1.261	.643	.452	.359	
$\sigma_{z0}, t=0$	128.	63.3	36.9	45.2	53.2	50.5	47.7	
$\epsilon / 10^{-6}, t=2$	54.2	27.4	22.4	20.4	18.3	18.5	18.7	
$\delta / 10^{-3}, t=2$	1.104	1.230	1.414	1.604	1.180	.951	.817	
$\sigma_z, t=2$	173.	115.	75.0	57.5	97.7	106.	109.	
Av. Lum./ L_0	.267	.506	.596	.645	.677	.665	.663	
RF								
$2.5 \delta / 10^{-3}$	2.76	3.08	3.54	4.01	2.95	2.38	2.04	
$\Delta P/P \text{ bucke} / 10^{-3}$	2.28	3.82	6.72	9.95	4.31	3.19	2.68	
Aperture								
$X_p \delta$ (mm)	1.53	1.71	1.97	2.23	1.64	1.32	1.14	
$\sigma_H = \sigma_V$ (mm)	9.64	4.42	3.09	2.91	1.77	1.45	1.26	
$2.5 X_p \delta$	3.82	4.28	4.92	5.58	4.10	3.30	2.85	
$2.5 \sigma_H$	24.1	11.0	7.72	6.02	4.42	3.62	3.15	
Beam Half Width								
$2.5 (\sigma_H + X_p \delta)$	27.4	15.0	12.4	11.4	8.36	6.80	5.88	
$2.5 \sigma_V$	24.1	11.0	7.72	6.02	4.42	3.62	3.15	
Physical Half-Aperture								
$2.5 X_p \delta + 6 \sigma_H$	61.6	30.7	23.4	19.9	14.6	12.0	10.4	
$6 \sigma_V$	57.8	26.5	18.5	14.5	10.6	8.70	7.57	
Av. Lum/ $L_0, t=7.5$.224	.442	.534	.588	.623	.611	.612	
Luminosity/ 10^2	.165	.753	1.48	2.40	4.20	6.18	8.22	



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180
160
140
120
100
80
60
40
20

σ_e vs. δ

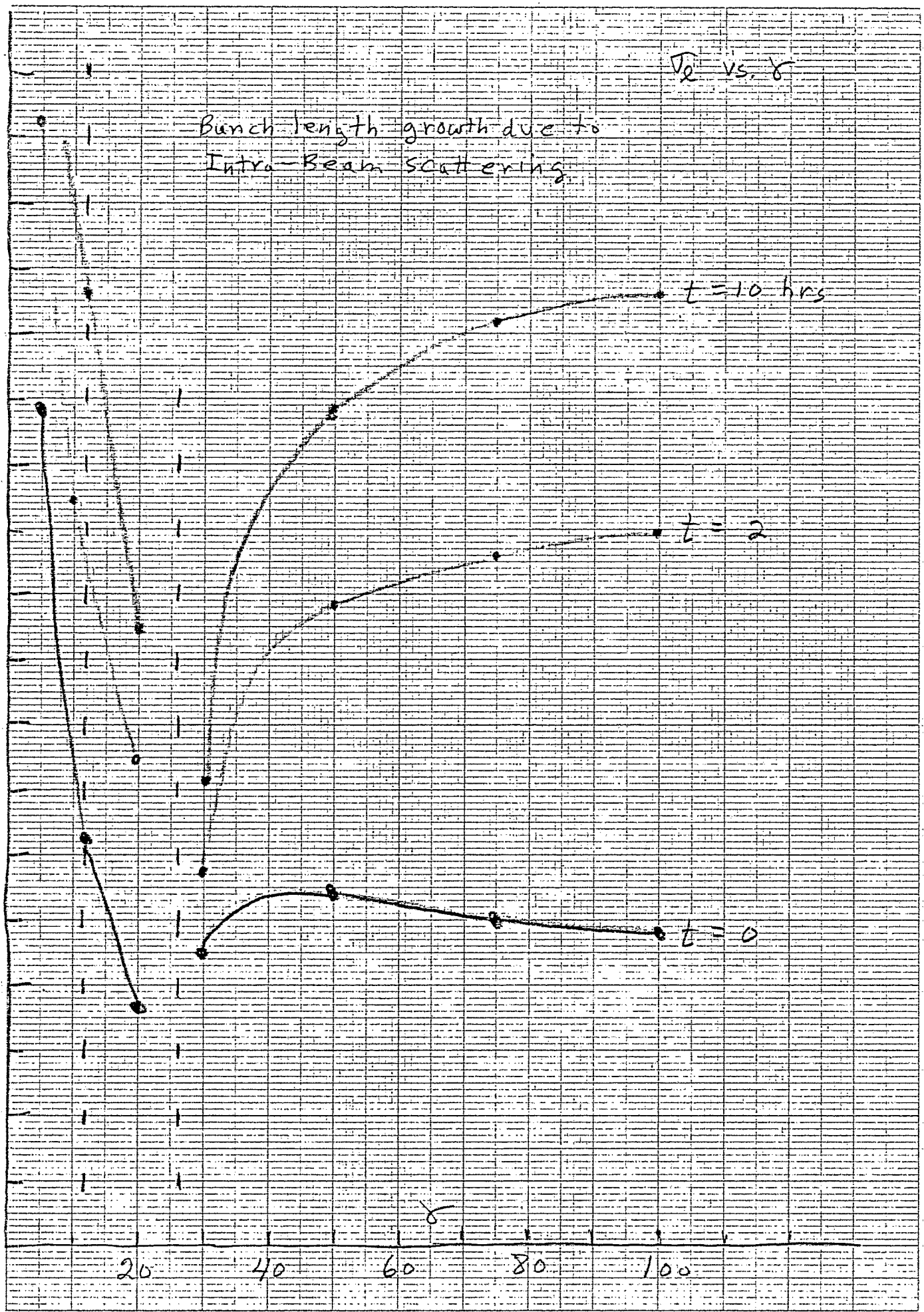
Bunch length growth due to
Intra-Beam scattering.

$t = 10$ hrs

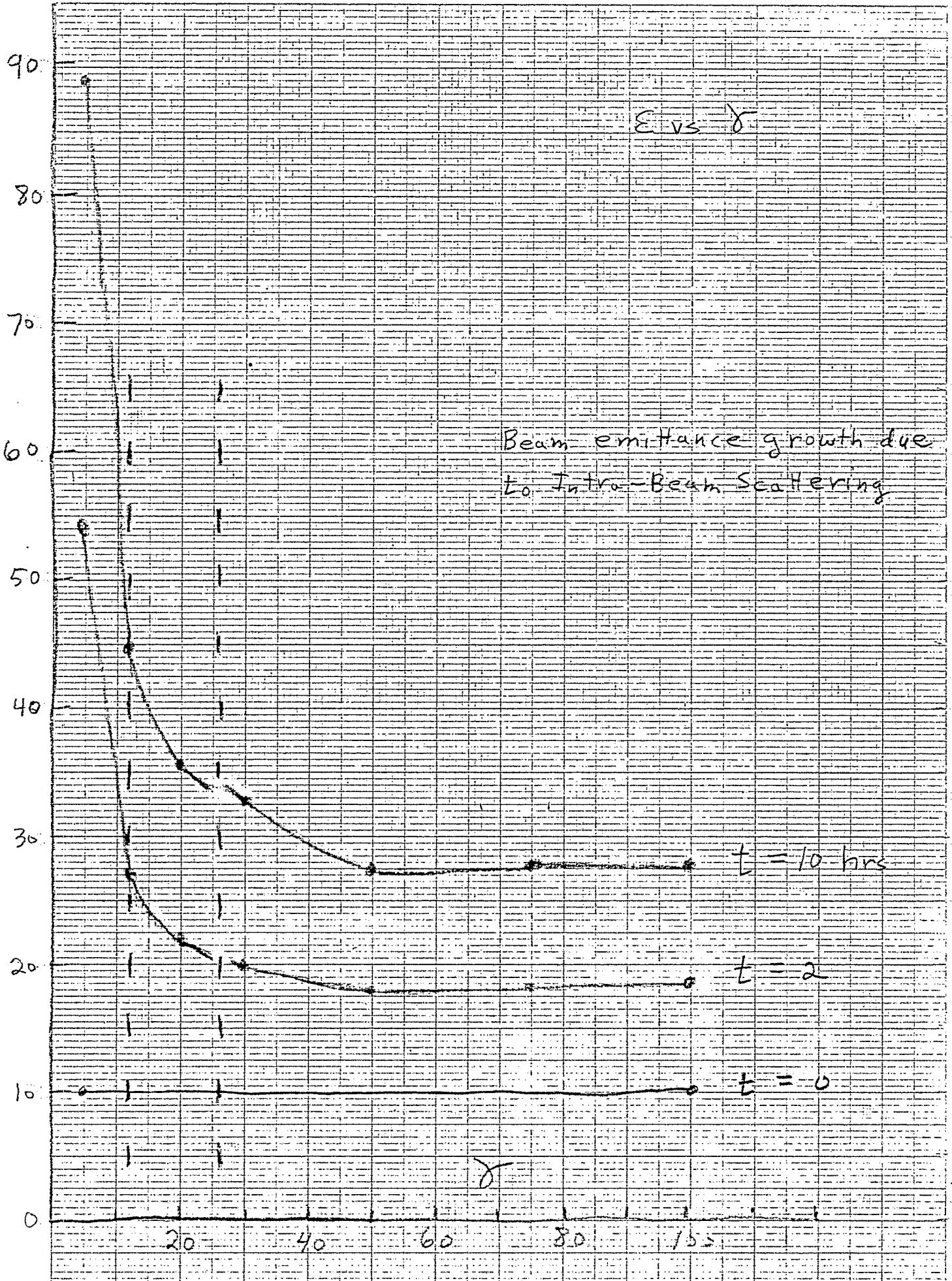
$t = 2$

$t = 0$

20 40 60 80 100



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$$2.5 (X_p \delta + \sqrt{H}) \sqrt{\delta}$$

30

20

10

(mm)

Beam half-width growth due to
Intra-Beam Scattering

t = 10 hrs

t = 2

t = 0

δ

20

40

60

80

100

30MM X 10 X 10 TO THE RIGHT SIDE

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