RHIC-PG-49

RHIC PERFORMANCE WITH INTRABEAM SCATTERING

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BNL - April 16, 1984

RHIC Performance

RHIC3
4/16/84

$X_p = 1.39$ $N_b = 1.2 \times 10^9$ $t = 10$ hrs

$P_x = 51.4$ $\gamma = 1.2 \times 10^6$

γ	5	12	20	30	50	75	100	γ_t
$\delta_0/10^{-3}$, $t=0$	.818	.678	.696	1.261	.643	.452	.359	
σ_{ℓ_0} $t=0$	128.	63.3	36.9	45.2	53.2	50.5	47.7	
$\varepsilon/10^{-6}$, $t=10$	89.0	44.5	35.8	33.2	27.7	27.8	27.8	
$\delta/10^{-3}$, $t=10$	1.411	1.563	1.792	1.985	1.548	1.274	1.099	
σ_ℓ $t=10$	221.	146.	95.0	71.2	128.	142.	146.	
Av. Lum./L_0	.162	.319	.389	.422	.476	.471	.470	
RF								
$2.5\,\delta/10^{-3}$	3.53	3.91	4.48	4.96	3.87	3.18	2.74	
$\Delta p/p$ bucket$/10^{-3}$	2.28	3.82	6.72	9.95	4.31	3.19	2.68	
Aperture								
$X_p\,\delta$ (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	
$2.5\,X_p\,\delta$	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	3.85	
Beam Half Width								
$2.5(\sigma_H + X_p\,\delta)$	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	3.85	
Physical Half-Aprtr								
$2.5\,X_p\,\delta + 6\,\sigma_H$	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 = $12.4 \times 10^{26} \times$ LumAV $\times \gamma/100$

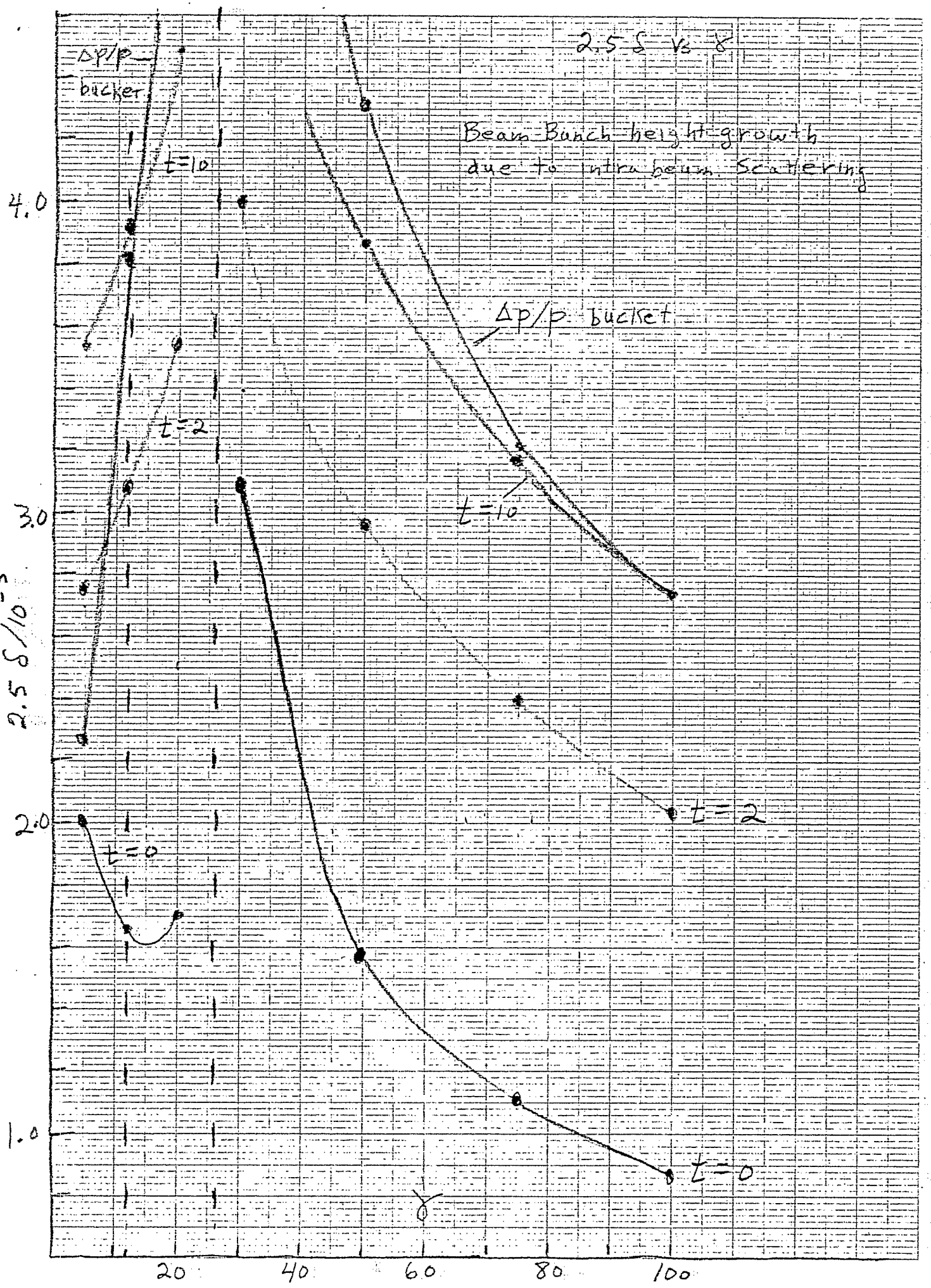
RHIC Performance

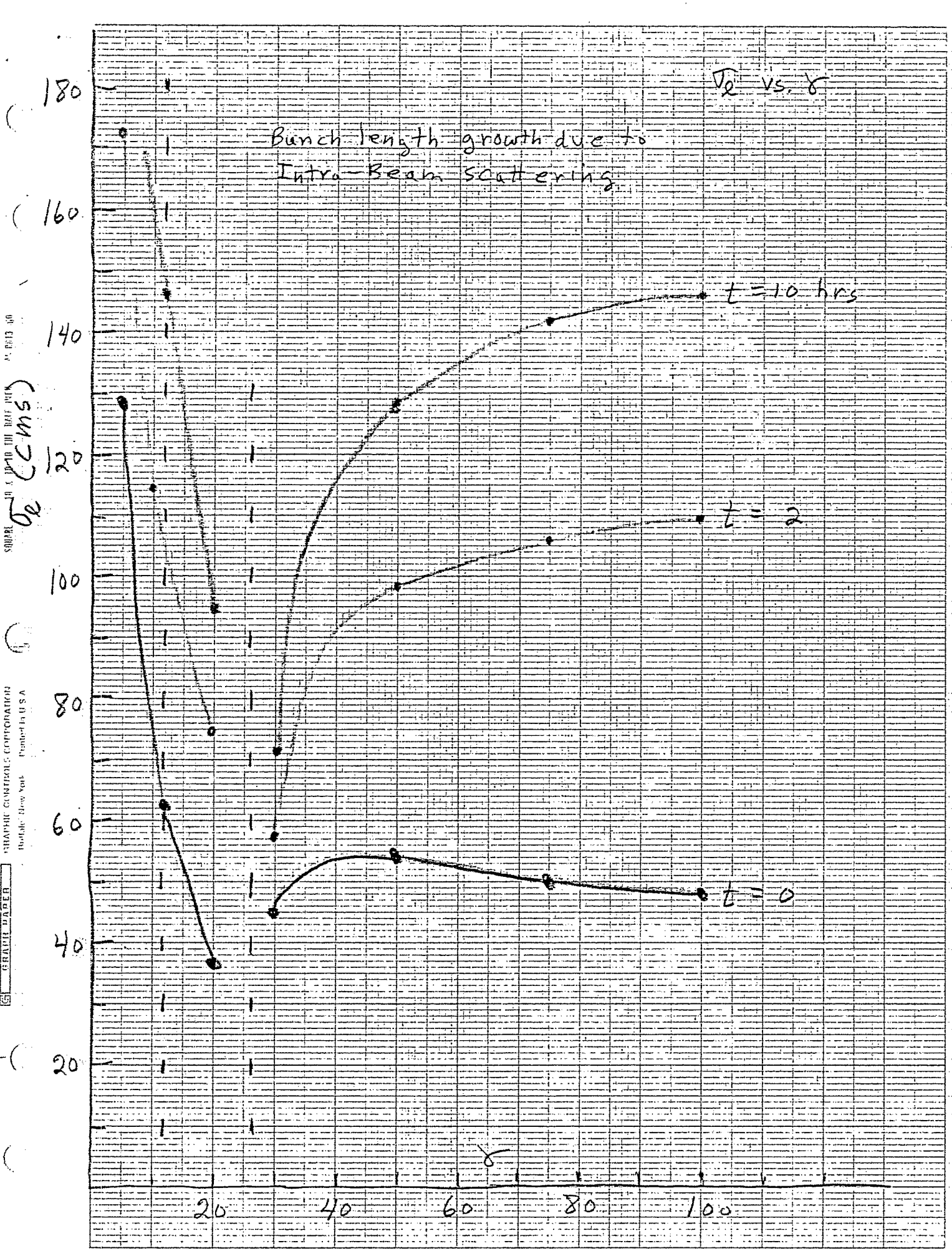
RHICS
4/17/84
t = 2 hrs

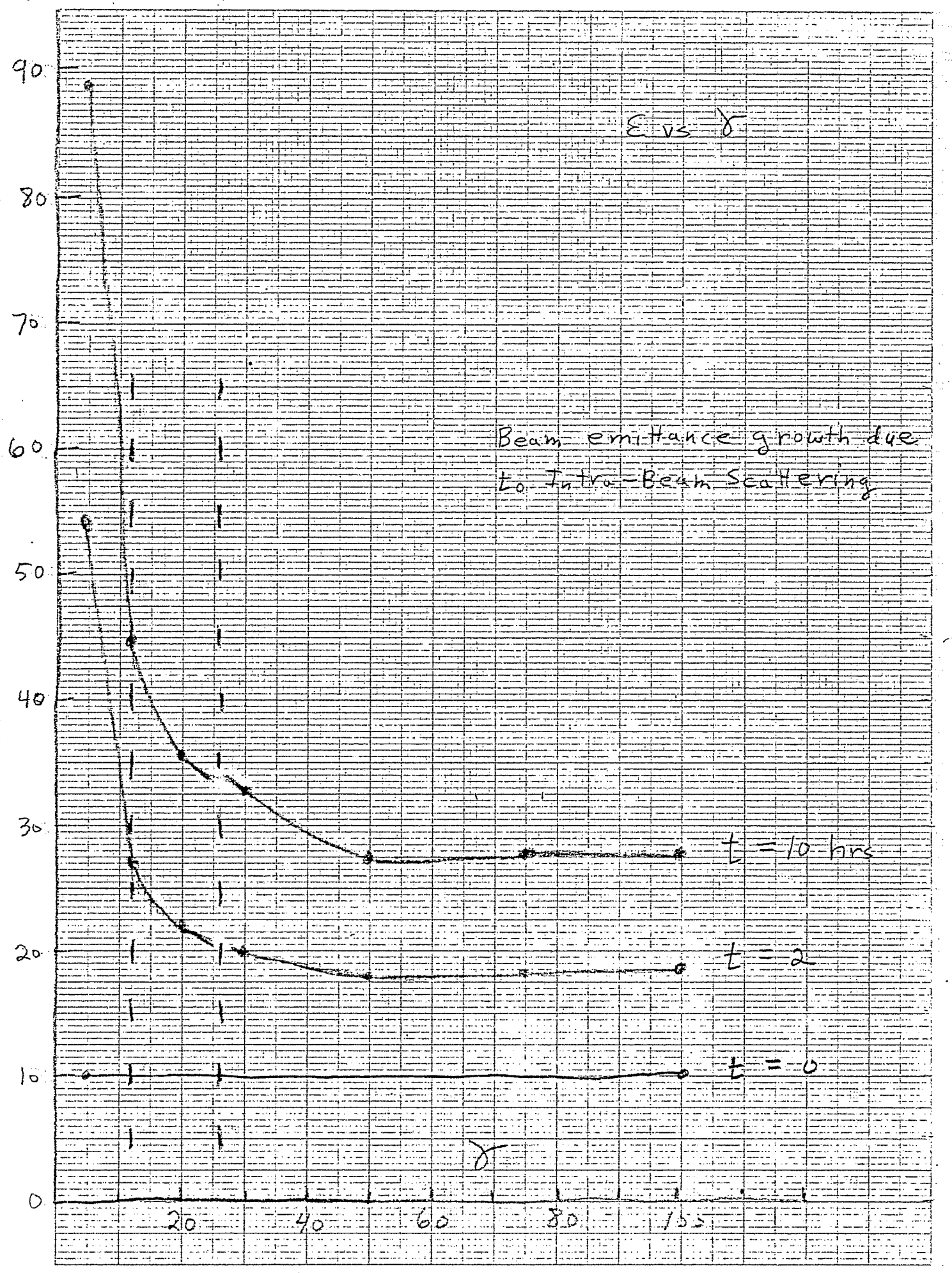
X_p =

P_x =

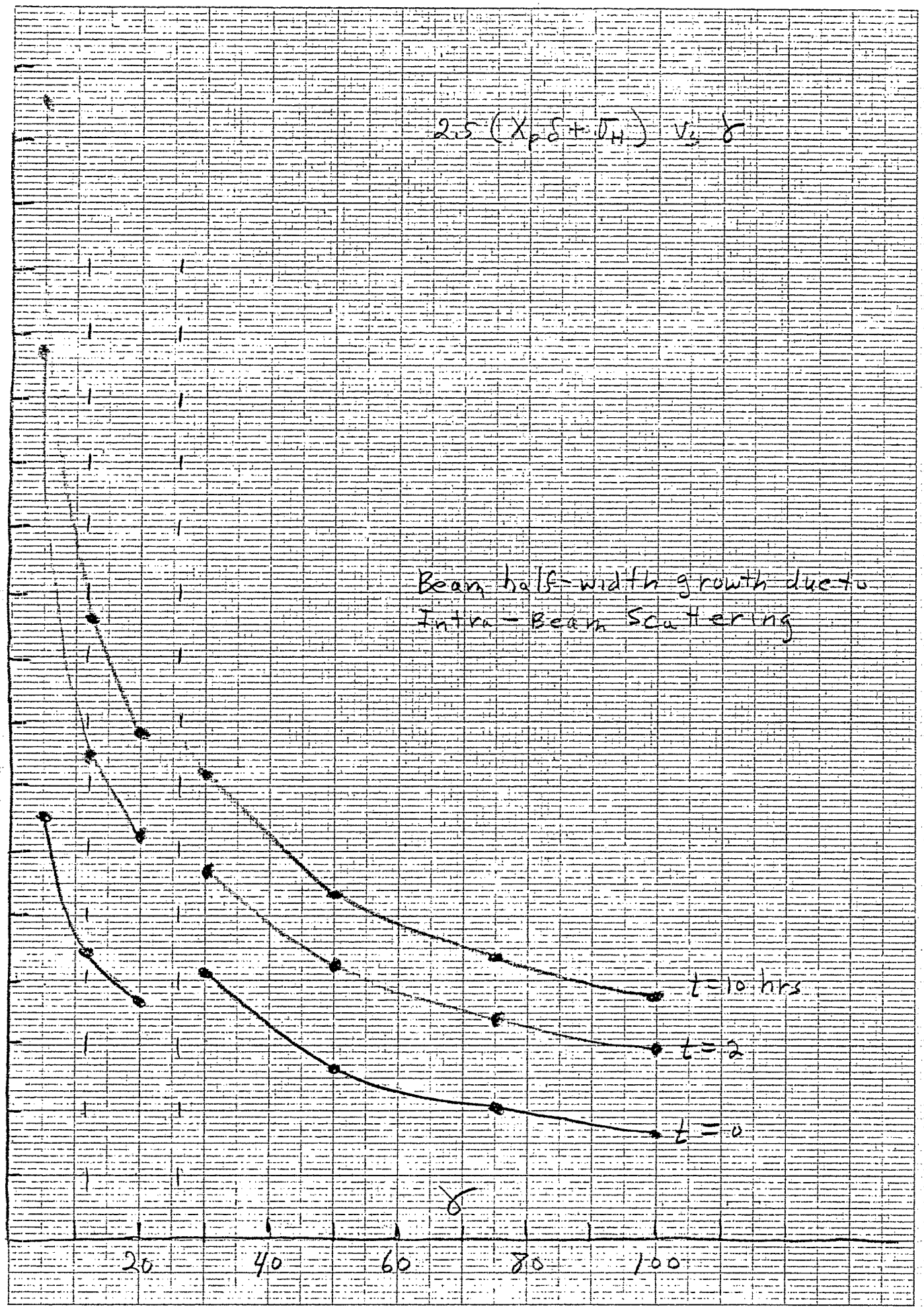
γ	5	12	20	30	50	75	100	γ_t
$\delta_0/10^{-3}$, $t=0$	.818	.678	.696	1.261	.643	.452	.359	
σ_{z_0} $t=0$	128.	63.3	36.9	45.2	53.2	50.5	47.7	
$\varepsilon/10^{-6}$, $t=2$	54.2	27.4	22.4	20.4	18.3	18.5	18.7	
$\delta/10^{-3}$, $t=2$	1.104	1.230	1.414	1.604	1.180	.951	.817	
σ_z $t=2$	173.	115.	75.0	57.5	97.7	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	
$\Delta p/p$ 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	2.41	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-Aprt.								
$2.5\,X_p\,\delta + 6\,\sigma_H$	61.6	30.7	23.4	19.9	14.6	12.0	10.4	
$6\,\sigma_V$	51.8	26.5	18.5	14.5	10.6	8.70	7.51	
Av. Lum/L_0, $t=2.5$	.224	.442	.534	.588	.623	.611	.612	
Luminosity$/10^2$	.165	.753	1.48	2.40	4.20	6.18	8.22	


2.5 δ vs γ
Beam Bunch height growth
due to intra beam Scattering
Δp/p bucket
Δp/p bucket
t=10
t=2
t=10
t=2
t=0
t=0
4.0
3.0
2.0
1.0
2.5 δ/10⁻³
20
40
60
80
100
γ

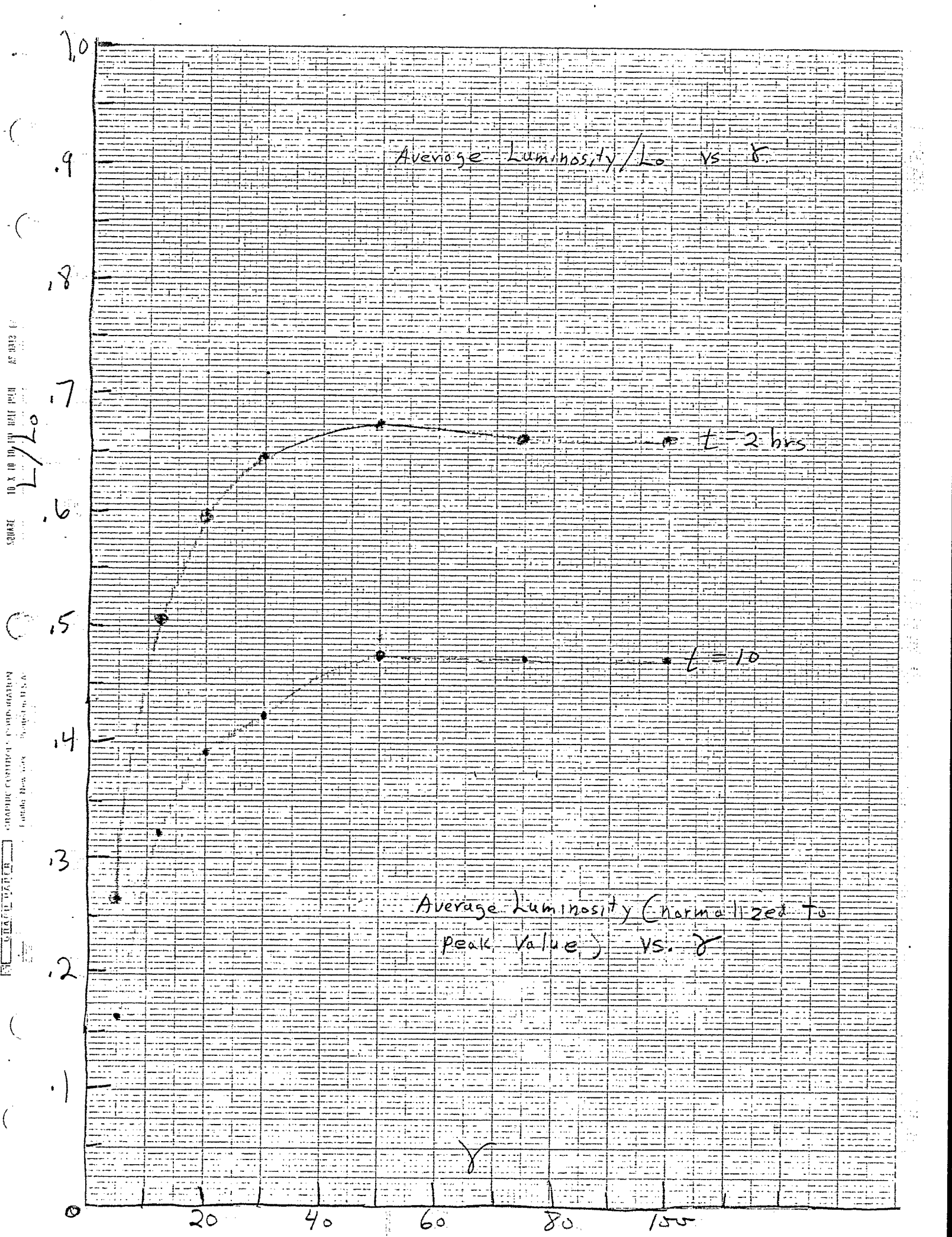

σ_ℓ vs. γ
Bunch length growth due to
Intra-Beam Scattering
$t = 10$ hrs
$t = 2$
$t = 0$
σ_ℓ (cms)
γ
180
160
140
120
100
80
60
40
20
20
40
60
80
100



ε vs γ
Beam emittance growth due to Intra-Beam Scattering
t = 10 hrs
t = 2
t = 0
ε/10^-6 (m)
γ
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100



2.5 (Xp δ + σH) vs γ
Beam half-width growth due to
Intra-Beam Scattering
30
20
10
(mm)
t=10 hrs
t=2
t=0
γ
20
40
60
80
100


Average Luminosity/Lo vs β
L/Lo
t = 2 hrs
t = 10
Average Luminosity (normalized to peak value) vs. β
β
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
20
40
60
80
100