

Systematic Multipoles in the Dipoles and Their Effect on Dynamic Aperture and Δ -Spread

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Systematic Multipoles in the Dipoles
and
Their Effect on Dynamic Aperture and A ν -spread

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Introduction

Two effects of the systematic multipoles in the dipoles were studied:

- 1) the effect on the dynamic aperture
- 2) The γ -spread in the beam at $\gamma = 30$.

The γ -spread in the beam may be the more important effect, as it can be fairly large when compared with the available γ -space of $\Delta\gamma = 33 \times 10^{-3}$. The γ -spread appears to be largely due to the systematic b_4 . Thus, it can be reduced by about a factor ~~(2)~~ of 2 using the b_4 correction system. It may be desirable to further reduce b_4 below a certain tolerance level given below.

The γ -spread due to random multipoles is also large of the order of $\Delta\gamma_{\text{spread}} \approx 17 \times 10^{-3}$. This may be partially correctable. It still may be desirable to reduce the γ -spread due systematic multipoles as much as possible.

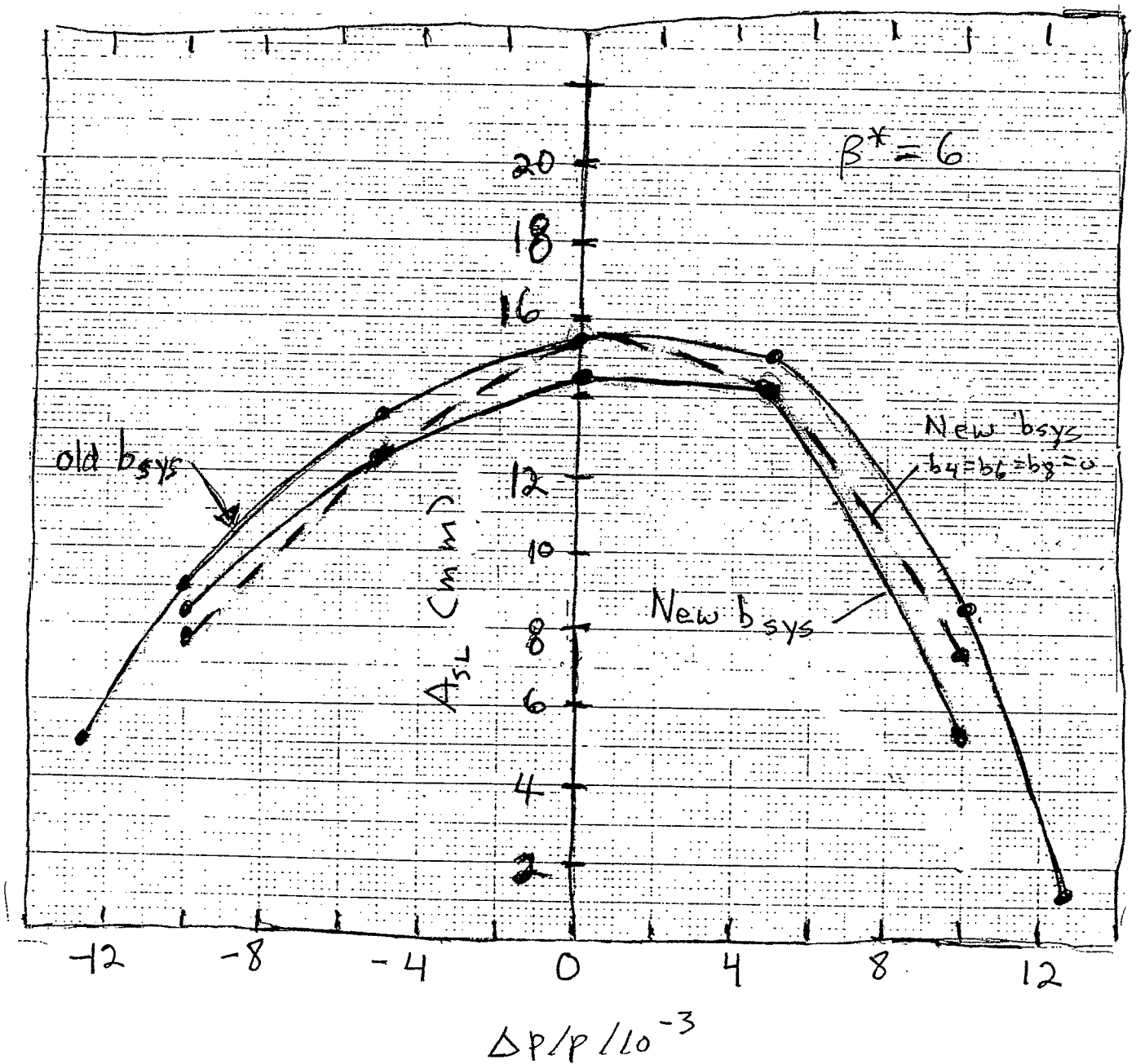
Data for Systematic b'_K

K	old	New								
		5/89								
2	.02	2.24								
4	.009	.75								
6	.003	.303								
8	.005	.181								
10	.016	-.039								
12	.565	.754								
14	.182	.247								
16	-.19	-.232								
18	.036	.153								

Above data due to Pat Thompson.

This study uses ^{the} New data in the third Column

Effect of the Systematic b_k on the Dynamic Aperture



Dynamic Aperture Continued

Effect of Increasing Radius of BC2

Will increasing R_{BC2} from $R_{BC2}=4\text{ cm}$ to $R_{BC2}=5\text{ cm}$ still increase A_{SL} with the new $b_{k,sys}$? The answer is Yes.

With $R_{BC2}=5\text{ cm}$, $\Delta P/P=0$

$A_{SL} = 18.5\text{ mm}$, old $b_{k,sys}$

$A_{SL} = 18.5\text{ mm}$, new $b_{k,sys}$

Dynamic Aperture due $b_{k,sys}$ only (no random b_k, q_k)

$R_{BC2}=4$, $\Delta P/P=0$

$A_{SL} = 16.5\text{ mm}$, new $b_{k,sys}$

$A_{SL} = 17.5\text{ mm}$, old $b_{k,sys}$

$R_{BC2}=5$, $\Delta P/P=0$

$A_{SL} = 19.5\text{ mm}$, new $b_{k,sys}$

$A_{SL} = 19.5\text{ mm}$, old $b_{k,sys}$

ΔV - spread due to Systematic b/c (No random b/c, d/c)

At $\gamma = 30^\circ$, $\sigma_x = 3.1 \text{ mm}$, $\Delta p/p = 5 \times 10^{-3}$ after 10 hours

$\Sigma_t = \Sigma_x + \Sigma_y$ for 95% of beam is at

$$X = \sqrt{10} \sigma_x \quad (x' = y' = y = 0)$$

$$X = 9.8 \text{ mm}, \quad \Sigma_t = 1.92$$

ΔV -spread is found within $\Sigma_t = 1.92$,
within 95% beam, and not within
the Σ_t given by 6σ rule, $\Sigma_t = 6.5$.

3 points on Σ_t surface ^{were} studied

$$\Sigma_x = \Sigma_t, \quad \Sigma_y = 0$$

$$\Sigma_x = \Sigma_t/2, \quad \Sigma_y = \Sigma_t/2$$

$$\Sigma_x = 0, \quad \Sigma_y = \Sigma_t$$

Largest ΔV found for $\Sigma_x = \Sigma_t, \Sigma_y = 0$

$$\Delta V_x, \Delta V_y = -8.5 \times 10^{-3} \quad \Delta p/p = 7.005$$

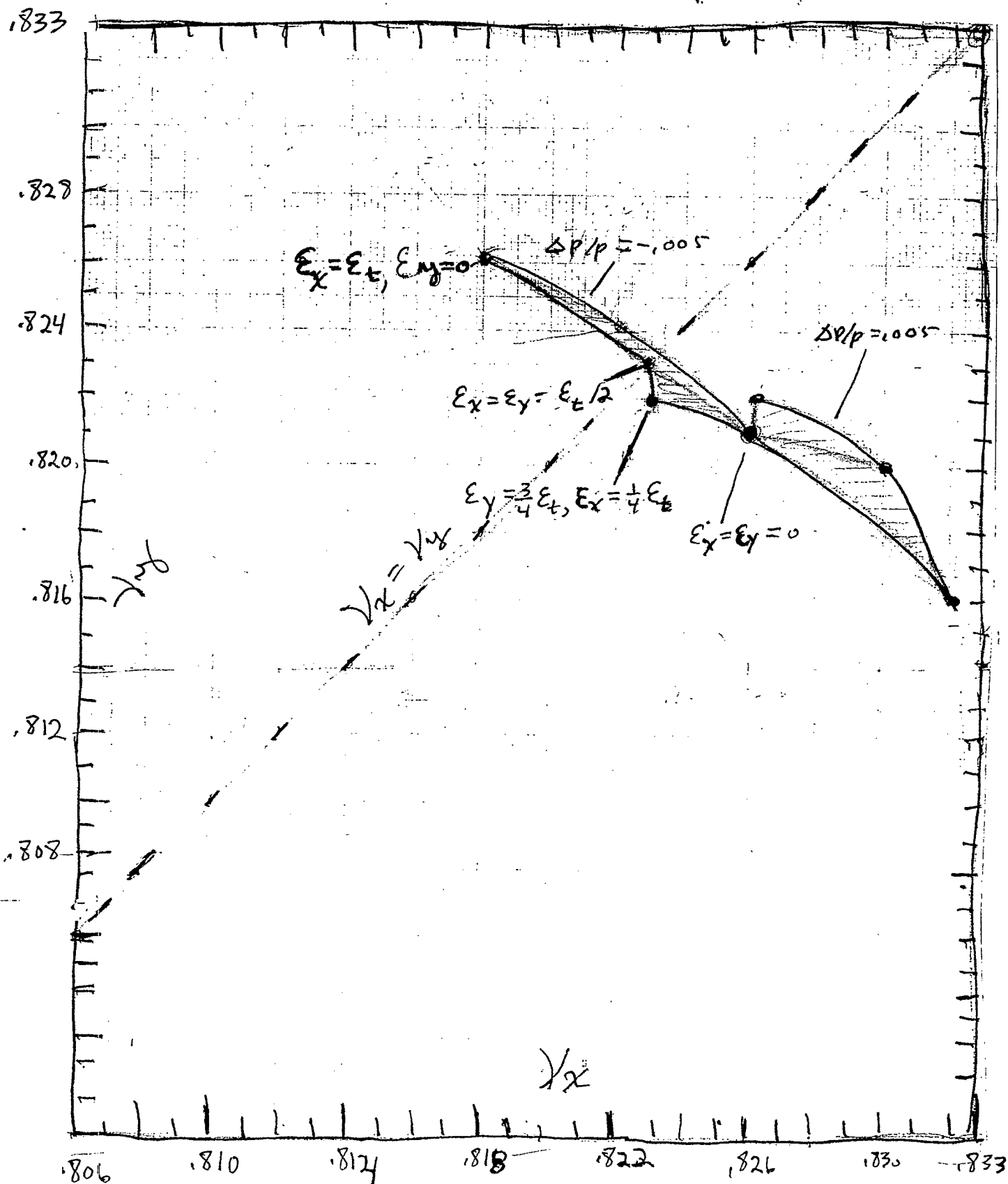
$$\Delta V_x, \Delta V_y = 6.5 \times 10^{-3} \quad \Delta p/p = 1.005$$

$$\text{Total } V\text{-spread} = 14 \times 10^{-3}$$

(note $b_4' = .75 \text{ hae}$)

γ -spread in 95% of Beam
due to bk, sys

6



Multiple Breakdown of D-Spread

	$\Delta p/p = -0.005$ $\Delta v_x, \Delta v_y / 10^{-3}$	$\Delta p/p = +0.005$ $\Delta v_x, \Delta v_y / 10^{-3}$	$r = 30$ $x_0 = 9.8 \text{ mm}$ $y_0 = 0$ $E_t = 1.92$
b_2 only	0, 0		
b_4 "	-6, 5	5, -4	
b_6 "	-1, 1		
b_8 "	0, 0		
b_{10} "	0, 0		
b_{12} "	0, 0		
b_{14} "	0, 0		
b_{16} "	0, 0		
b_{18} "	0, 0		
Total	-7, 5		

Tolerance on b'_4 to give $\Delta v_{\text{spread}} = 3 \times 10^{-3}$

$$b'_4 = .23 \times 10^{-4}$$

at $r = 30$, for $E_t = 1.92$, $\Delta p/p = \pm 0.005$

Assuming by correction gives a factor 2 improvement
the tolerance becomes

$$b'_4 = .46 \times 10^{-4}$$