New Long 3 Layout

The best magnet placement
and bend center spacing

Angles are radians
Distances are in inchs

The spare dogleg measured strengths in T*M/A are:

The subscript on the Bl denotes the magnet serial number.

$Bl_7 := 415.826 \cdot 10^{-6}$

$Bl_8 := 412.294 \cdot 10^{-6}$

$Bl_3 := 414.349 \cdot 10^{-6}$

$Bl_6 := 413.226 \cdot 10^{-6}$

The injection momemtum is:

$p_{400} := 0.954$

The nominal magnet current is:

$I := 200$ amps

Bex2 current $I_t \equiv -0.0$

Choose to place the magnets initially in order a, b c d

where $a \equiv 3$ $b \equiv 6$ $c \equiv 7$ $d \equiv 8$

The angles are given by;

$$\theta_a := \frac{0.299 \cdot Bl_a \cdot I}{p_{400}} \qquad \theta_b := \frac{0.299 \cdot Bl_b \cdot I}{p_{400}} \qquad \theta_c := \frac{0.299 \cdot Bl_c \cdot I}{p_{400}} \qquad \theta_d := \frac{0.299 \cdot Bl_d \cdot I}{p_{400}}$$

These angles then add up as:

$\theta_1 := -\theta_a$ $\quad \theta_2 := \theta_1 + \theta_b + \theta_5$ $\quad \theta_3 := \theta_2 + \theta_c$ $\quad \theta_4 := \theta_3 - \theta_d + \theta_6$

$\theta_1 = -25.973 \times 10^{-3}$ $\quad \theta_2 = -70.394 \times 10^{-6}$ $\quad \theta_3 = 25.995 \times 10^{-3}$ $\quad \theta_4 = 151.004 \times 10^{-6}$

The angles due to the Bex2 magnets are θ_5 & θ_6. $\quad \theta_5 = 0$ $\quad \theta_6 = 0$

The nominal bend center spacings are

$z_1 := 0$ $\quad z_2 := 40.0$ $\quad z_3 := 107.98$ $\quad z_4 := 40$

The resultant beam positions at the bend center are:

$y_1 := 0$ $\quad y_2 := y_1 + z_2 \cdot \tan(\theta_1) + y_5$ $\quad y_3 := y_2 + z_3 \cdot \tan(\theta_2)$ $\quad y_4 := y_3 + z_4 \cdot \tan(\theta_3) + y_6$

$y_2 = -1.039$ $\quad y_3 = -1.047$ $\quad y_4 = -6.713 \times 10^{-3}$

If y_4 is required to be less than 1 mil $\quad y_4 := 0.0001$

z_4 has to be $\quad z_4 := \frac{y_4 - y_3}{\tan(\theta_3)}$ $\quad z_4 = 40.262$

Ordering of the Doglegs at Long3

J. Lackey 7/25/03

There are 4 magnets giving 24 possible combinations of ordering of the magnets. The position error can be minimized by adjusting the bend center spacing of magnets 1&2 or 3&4 or both. Adjusting the spacing between magnets 2 & 3 has virtually no effect on the result. A +/- 1.0 inch error gives less than 1 mil change in the position error for any combination. The table below shows the results of all the combinations. I have arbitrarily kept the 40 inch spacing between magnets 1&2 just to simplify the calculations. Note that there are only 6 possible angles, a +/- of three different magnitudes. The 1st two columns show the result of each of the possible orders with z_4 (distance between 3&4) adjusted to give a position (y_4) error of less than 1 mil while Bex2 current is zero. The last three columns show the result of adding an additional angle in the form of the Bex2 trims to essentially zero out both the position and angle. The position will be less than 1 mil and the angle less than 1 e-6 radians. This results in a new z_4. Only those combinations which work well are show. It is interesting to note the current values that Bex2 takes to achieve these results. It appears that order 6,8,7,3 gives the best result for both situations.

z_4	θ_4	Order	Bex2 Current	$\{\theta_4\}$	$\{z_4\}$
41.420	-151.0044×10^{-6}	7,8,3,6			
41.534	-291.791×10^{-6}	7,8,6,3			
41.082	-34.162×10^{-6}	7,6,3,8	0.125	-0.3e-6	40.975
41.288	-291.791×10^{-6}	7,6,8,3			
40.787	-34.162×10^{-6}	7,3,6,8	0.125	-0.3e-6	40.68
40.880	-151.004×10^{-6}	7,3,8,6			
38.556	291.791×10^{-6}	8,7,3,6			
38.660	151.004×10^{-6}	8,7,6,3			
39.474	-34.162×10^{-6}	8,6,3,7	0.125	0.3e-6	39.368
39.334	151.004×10^{-6}	8,6,7,3			
39.182	34.162×10^{-6}	8,3,6,7	0.125	-0.3e-6	39.077
38.938	291.791×10^{-6}	8,3,7,6			
40.229	151.004×10^{-6}	6,8,3,7			
40.085	34.162×10^{-6}	6,8,7,3	-0.125	0.3e-6	40.191
38.973	291.791×10^{-6}	6,7,3,8			
39.166	34.162×10^{-6}	6,7,8,3	-0.125	0.3e-6	39.272
39.356	291.791×10^{-6}	6,3,7,8			
39.692	-151.004×10^{-6}	6,3,8,7			
40.853	-291.791×10^{-6}	3,8,6,7			
40.596	34.162×10^{-6}	3,8,7,6			
39.585	151.004×10^{-6}	3,7,6,8			
39.674	34.162×10^{-6}	3,7,8,6			
40.262	151.004×10^{-6}	3,6,7,8			
40.608	-291.791×10^{-6}	3,6,8,7			

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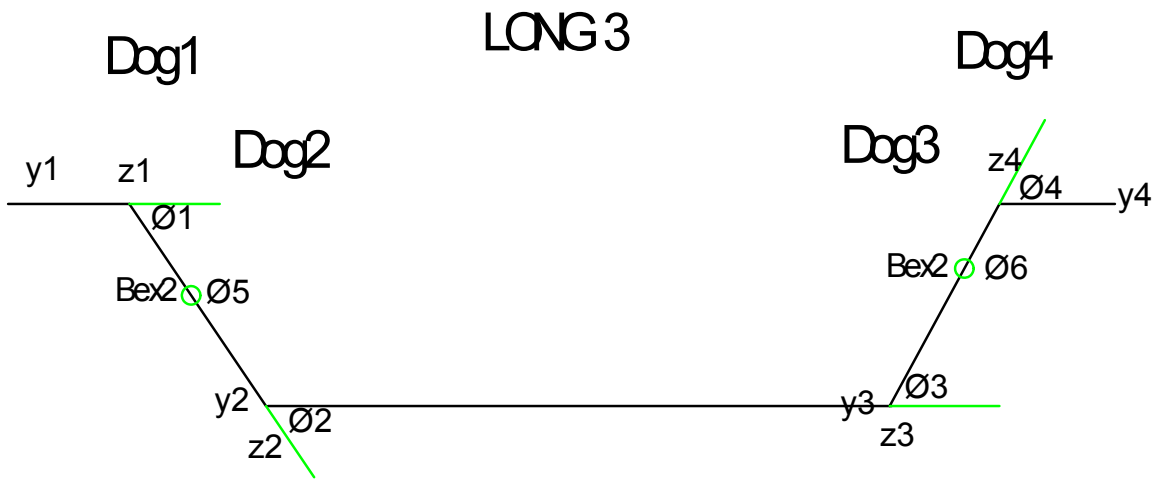

The angles due to the Bex2 magnets are θ_5 & θ_6.
The plan is to use two 200 Mev outer packages powered in series. Their placement with respect to magnets # 2 and #4 are defined as z_5 & z_6. The resulting displacement and angles will change as I_t is changed

$z_5 := 14.51$ $z_6 := 15.17$

$V_{trim} := 0.864 \cdot 10^{-3}$ $\theta_5 := \dfrac{.299 \cdot 0.5 V_{trim} \cdot I_t}{p_{400}}$

$\theta_5 = 0$ $\theta_6 := \theta_5$

$y_5 := z_5 \cdot \tan(\theta_5)$ $y_6 := z_6 \cdot \tan(\theta_6)$

$y_5 = 0$ $y_6 = 0$