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Verification Of The Magnet Enclosure Geometry And Of The Dispersion Killer For The RHIC-PG-12 Lattice

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VERIFICATION OF THE MAGNET ENCLOSURE GEOMETRY AND OF
THE DISPERSION KILLER FOR THE RHIC-PG-12 LATTICE

J. CLAUS

(BNL, December 7, 1983)

YLL
6 Dec '83

Geometry magnet enclosure:

$$R^* = 590.3298 \text{ m}$$

$$l_1 = 103.772 \text{ m}$$

$$l_2 = 38.0052 \text{ m}$$

$$\bar{\theta} = 0.057394454 \text{ rad}$$

$$r = 239.6523 \text{ m}$$

$$p_m^* = 381.2325 \text{ m}$$

$$R = r + p = 620.8848 \text{ m}$$

R.H.C. with 12.

Cells / super period $N_c = 16$
 Dipoles / half super period $N_D = N_c + 1 = 17$
 Deflection angle per dipole $\theta = \pi / 16 N_D = 0.030799928$
 Half cell length
 $LHQ = 0.95 \text{ m}$
 $D = 0.995 \text{ m}$
 $LD = 7.85 \text{ m}$
 $D = 0.995 \text{ m}$
 $LHQ = 0.95 \text{ m}$

$LHC = 11.74 \text{ m}$

Average radius $p_m = LHC / \theta = 381.1697225 \text{ m}$
 Half arc length $LHA = N_c * LHC = 16 * 11.74 = 187.84 \text{ m}$
 Dispersion correction $l_2 = 1/2 * LHC = 17.61$
 Distance from crossing point to bending point Disp. Corr:

$$l_1 = C/12 - l_2 - LHA = \frac{3833.845}{12} - 17.61 - 187.84$$

$$= 114.0370833$$

$$l_2 = 17.61$$

$$\bar{\theta} = \theta = 0.030799928$$

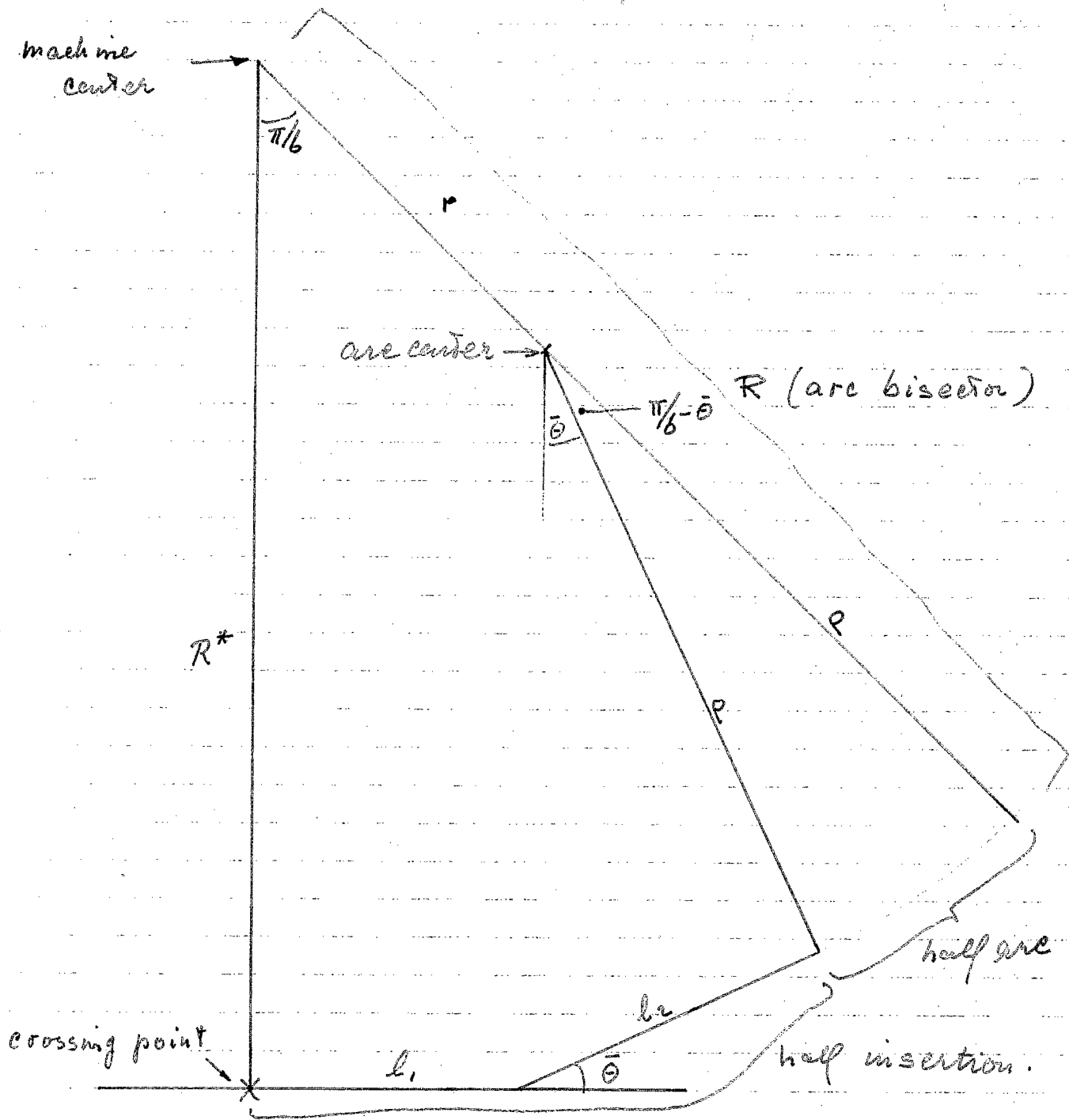
$$R_m^* = (l_1 + l_2 \cos \bar{\theta} - p_m \sin \bar{\theta}) / \tan \pi/6 + p_m \cos \bar{\theta} + l_2 \sin \bar{\theta}$$

$$= 589.2051513 \text{ m}$$

$$\Delta R^* = R_m^* - R_t^* = -1.1246487$$

$$r_m = (l_1 + l_2 \cos \bar{\theta} - p_m \sin \bar{\theta}) / \sin \pi/6 = 239.8011746$$

$$R_m = r_m + p_m = 620.9708971$$



Inspection shows: $r \sin \frac{\pi}{6} = l_1 + l_2 \cos \bar{\theta} - p \sin \bar{\theta}$

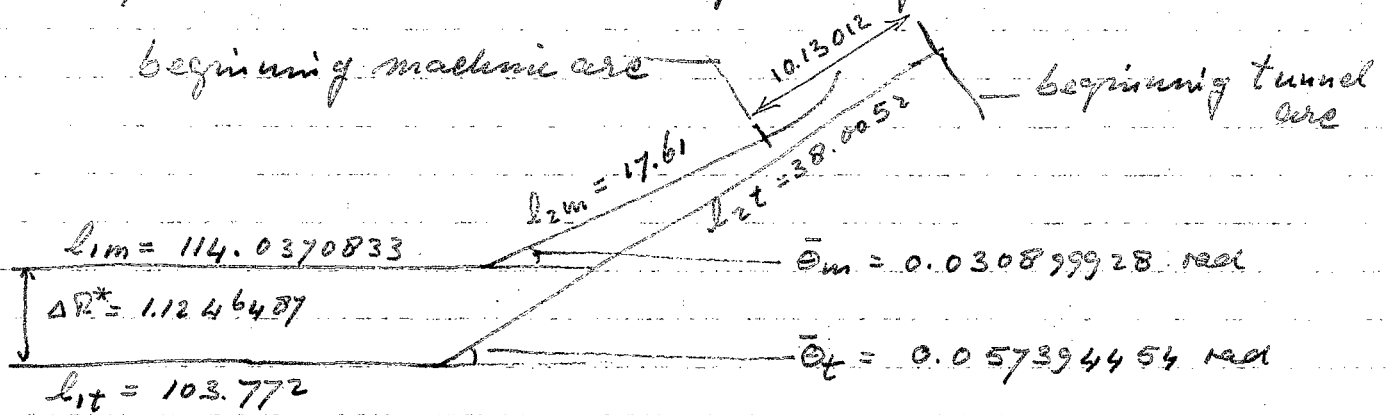
$$R = r + p$$

$$R^* = r \cos \left(\frac{\pi}{6} \right) + p \cos \bar{\theta} + l_2 \sin \bar{\theta}$$

$$C/12 = l_1 + l_2 + \left(\frac{\pi}{6} - \bar{\theta} \right) p$$

$$\Delta R = R_m - R_t = 0.0860971 \text{ m}$$

Consequences for insertion geometry.



Conclusions: tight in tunnel: $\Delta R^* = -1.125 \text{ m}$.

Short changing injection by $l_{1t} + l_{2t} - l_{1m} - l_{2m} = 10.1301167 \text{ m}$.

and by $\bar{\theta}_t - \bar{\theta}_m = 26.59 \text{ mrad}$.

Dispersion Corrector:

$$\ominus \cdot \frac{1}{2}l \left\| \begin{array}{c} l \\ g \end{array} \right\| \begin{array}{c} l \\ -g \end{array} \left\| \begin{array}{c} x_p \\ 0 \end{array} \right\|$$

$$\begin{pmatrix} x_p \\ x_p' \end{pmatrix}_2 = \begin{pmatrix} 1 & \frac{1}{2}l \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ g & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ g & 1 \end{pmatrix} \begin{pmatrix} 1 & l \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -g & 1 \end{pmatrix} \begin{pmatrix} x_p \\ 0 \end{pmatrix}_1 + \begin{pmatrix} 0 \\ \epsilon \end{pmatrix}$$

$$= \begin{pmatrix} 1 - \frac{1}{2}lg - (lg)^2 \\ g(1-2lg) \end{pmatrix} \begin{pmatrix} x_p \\ \end{pmatrix}_1 + \begin{pmatrix} 0 \\ \epsilon \end{pmatrix}$$

We want $x_{p2} = 0$, $x'_{p2} = 0$ \ominus

$$y = x_{p2} = 0 \rightarrow 1 - \frac{1}{2}lg - (lg)^2 = 0 \rightarrow lg = \frac{1}{4}(-1 + \sqrt{1+16})$$

$$= 0.780776407$$

$$lg = g \sin \frac{\Delta\psi}{2} \rightarrow \Delta\psi = 2g \sin lg$$

$$= 1.791814963 \text{ rad}$$

$$= 102.6634^\circ$$

$$y' = x'_{p2} = 0 \rightarrow \frac{\ominus l}{x_{p1}} = lg(2lg-1)$$

$$= 0.438447187$$

$$\frac{x_{p1}}{\ominus l} = 2.280776406$$

Dispersion for regular cell: $\frac{x_{p1}}{\ominus l} = \frac{1 + \frac{1}{2} \sin \frac{\Delta\psi}{2}}{\sin^2 \frac{\Delta\psi}{2}}$

$$= 2.280776407$$

Conclusion: Proposed dispersion corrector

models indeed proposed are structure, provided

that phase advance per cell $\Delta\psi = 1.7918 \text{ rad}$
 $= 102.6634^\circ$